

ADDENDUM TO THE FACT SHEET AND SUPPLEMENTAL INFORMATION FOR THE  
PROPOSED REISSUANCE OF THE NPDES GENERAL PERMIT FOR NEW AND  
EXISTING SOURCES IN THE OFFSHORE SUBCATEGORY OF THE OIL AND GAS  
EXTRACTION POINT SOURCE CATEGORY FOR THE WESTERN PORTION OF THE  
OUTER CONTINENTAL SHELF OF THE GULF OF MEXICO (GMG290000)

## Produced Water Critical Dilution Percent Effluent Values

The critical dilution percent effluent tables have been revised to reflect a more representative concentration derived from modeling the same parameters used in the previous general permit (GMG290000). For this permitting action, CORMIX 7.0.0.0 is employed to determine the critical dilutions used at the edge of the 100 meter regulatory mixing zone. The common parameters for all model runs are arranged by the appropriate input parameter pages.

### 1. *Effluent Characterization*

- a. The pollutant is assumed to function as a conserved pollutant which means that the pollutant does not undergo any decay or growth processes.
- b. The pollutant discharge concentration is set to 100% which is appropriate for the characterization of the discharge.
- c. Effluent density is the averaged value ( $1070 \text{ kg/m}^3$ ) based on previously obtained data used for the preceding issuance of the GMG290000 permit.

### 2. *Ambient Geometry*

- a. The average depth and the depth at discharge are presumed to be the same in the Gulf of Mexico. This assumption is representative for the vast majority of the seafloor in the Gulf. The depths are varied according to the modeled input parameters.
- b. Wind Speed ( $U_w$ ) parameter is set to 4 m/s which is representative of a light wind at the design conditions.
- c. The ambient velocity ( $U_a$ ) is set to 0.1 m/s which is conservative with respect to the dispersion of the pollutant and current speeds in the Gulf of Mexico.
- d. The water body is considered to be unbounded which is appropriate in an ocean setting.
- e. Bottom friction (Manning  $n$ ) is considered to be low based upon the character of the bottom of the OCS. A representative value for a smooth bottom and no weeds was used which is represented by a value of 0.020.
- f. In the ambient density data field, a non-fresh water density of  $1017 \text{ kg/m}^3$  is an appropriate salt water density at the surface. A linear density gradient of  $0.182 \text{ kg/m}^3/\text{m}$  is used which is appropriate given the maximum density (bottom density-  $\text{RHOAB}$ ) used in the modeling is  $1020.822 \text{ kg/m}^3$ .

### 3. *Discharge Geometry*

- a. The CORMIX1 Single Port model is utilized in this exercise.
- b. The nearest bank is set to 3000 m to the left which is the minimum distance which is appropriate to the OCS.
- c. Port diameter is varied with the representative diameters used in the modeling exercise.
- d. A submerged offshore discharge configuration is used with a submerged port height of 20 cm below the surface. The 20 cm above the port is not included in the density gradient portion of the calculation.
- e. The appropriate vertical angle ( $\theta$ ) and horizontal angle ( $\sigma$ ) for a topside downward oriented pipe are  $-90^\circ$  and  $0^\circ$  respectively.

### 4. *Mixing Zone Specifications*

- a. No water quality standard is specified in the modeled iterations

- b. A downstream mixing zone distance is set to 100 m.
- c. The region of interest is 3000 m.

The tables representing the appropriate critical dilution effluent percentages are as follows:

<b>Table 1-A: Critical Dilution (Percent Effluent) for Discharges with a Depth Difference Between the Discharge Pipe and the Sea Floor of Greater than 0 Meters to 4 Meters</b>						
<b>Discharge Rate</b>	<b>Pipe Diameter (inches)</b>					
<b>(bbl/day)</b>	<b>&gt;0" to 5"</b>	<b>&gt;5" to 7"</b>	<b>&gt;7" to 9"</b>	<b>&gt;9" to 11"</b>	<b>&gt;11" to 15"</b>	<b>&gt;15"</b>
0 to 500	0.07	0.20	0.16	0.13	0.10	0.08
501 to 1000	0.16	0.39	0.32	0.26	0.20	0.16
1001 to 2000	0.35	0.35	0.63	0.56	0.40	0.31
2001 to 3000	0.55	0.54	0.94	0.79	0.60	0.47
3001 to 4000	0.89	0.85	0.85	0.85	0.85	0.85
4001 to 5000	1.14	1.09	1.08	1.08	1.08	1.08
5001 to 6000	1.40	1.35	1.30	1.31	1.31	1.31
6001 to 7000	1.66	1.59	1.51	1.53	1.53	1.54
7001 to 8000	1.90	1.83	1.75	1.74	1.73	1.73
8001 to 9000	2.13	2.07	2.00	1.94	1.93	1.94
9001 to 10,000	2.38	2.30	2.21	2.13	2.13	2.14
10,001 to 15,000	3.15	3.39	3.28	3.18	3.04	3.04
15,001 to 20,000	4.34	4.39	4.25	4.15	3.83	3.92
20,001 to 25,000	5.14	5.43	5.20	5.17	4.77	4.46
25,001 to 35,000	6.36	7.18	7.18	6.86	6.56	5.96
35,001 to 50,000	7.29	8.91	9.44	9.20	8.62	8.03
50,001 to 75,000	8.33	10.52	11.72	12.22	11.34	10.90

<b>Table 1-B: Critical Dilution (Percent Effluent) for Discharges with a Depth Difference Between the Discharge Pipe and the Sea Floor of Greater than 4 Meters to 6 Meters</b>						
<b>Discharge Rate</b>	<b>Pipe Diameter (inches)</b>					
<b>(bbl/day)</b>	<b>&gt;0" to 5"</b>	<b>&gt;5" to 7"</b>	<b>&gt;7" to 9"</b>	<b>&gt;9" to 11"</b>	<b>&gt;11" to 15"</b>	<b>&gt;15"</b>
0 to 500	0.07	0.14	0.11	0.09	0.07	0.05
501 to 1000	0.10	0.27	0.22	0.18	0.14	0.11
1001 to 2000	0.18	0.18	0.44	0.37	0.28	0.22
2001 to 3000	0.29	0.29	0.66	0.55	0.42	0.33
3001 to 4000	0.40	0.39	0.39	0.74	0.56	0.43
4001 to 5000	0.51	0.50	0.49	0.92	0.70	0.54
5001 to 6000	0.75	0.73	0.70	0.71	0.70	0.70
6001 to 7000	0.90	0.87	0.83	0.82	0.83	0.83
7001 to 8000	1.05	1.01	0.97	0.96	0.96	0.96
8001 to 9000	1.18	1.15	1.10	1.08	1.08	1.08

9001 to 10,000	1.32	1.28	1.24	1.19	1.20	1.20
10,001 to 15,000	1.93	1.92	1.87	1.81	1.78	1.75
15,001 to 20,000	2.46	2.52	2.42	2.34	2.24	2.25
20,001 to 25,000	2.97	3.02	2.94	2.95	2.76	2.73
25,001 to 35,000	3.75	4.00	4.01	3.95	3.82	3.54
35,001 to 50,000	4.54	5.31	5.43	5.37	5.14	4.84
50,001 to 75,000	5.49	6.64	7.14	7.34	6.90	6.73

<b>Table 1-C: Critical Dilution (Percent Effluent) for Discharges with a Depth Difference Between the Discharge Pipe and the Sea Floor of Greater than 6 Meters to 9 Meters</b>						
<b>Discharge Rate</b> (bbl/day)	<b>Pipe Diameter (inches)</b>					
	<b>&gt;0" to 5"</b>	<b>&gt;5" to 7"</b>	<b>&gt;7" to 9"</b>	<b>&gt;9" to 11"</b>	<b>&gt;11" to 15"</b>	<b>&gt;15"</b>
0 to 500	0.08	0.10	0.08	0.06	0.05	0.04
501 to 1000	0.11	0.19	0.15	0.13	0.10	0.08
1001 to 2000	0.14	0.14	0.31	0.26	0.20	0.15
2001 to 3000	0.17	0.17	0.46	0.39	0.29	0.23
3001 to 4000	0.20	0.20	0.20	0.51	0.39	0.30
4001 to 5000	0.24	0.24	0.23	0.64	0.49	0.38
5001 to 6000	0.30	0.29	0.29	0.29	0.59	0.46
6001 to 7000	0.36	0.35	0.34	0.34	0.69	0.53
7001 to 8000	0.48	0.47	0.45	0.45	0.45	0.45
8001 to 9000	0.56	0.54	0.52	0.51	0.52	0.52
9001 to 10,000	0.63	0.62	0.60	0.58	0.58	0.58
10,001 to 15,000	0.99	0.98	0.95	0.92	0.90	0.91
15,001 to 20,000	1.29	1.34	1.30	1.26	1.19	1.20
20,001 to 25,000	1.58	1.61	1.58	1.57	1.50	1.49
25,001 to 35,000	2.11	2.15	2.15	2.09	2.07	1.95
35,001 to 50,000	2.69	2.88	2.91	2.91	2.85	2.71
50,001 to 75,000	3.37	3.90	4.12	4.15	4.01	3.94

<b>Table 1-D: Critical Dilution (Percent Effluent) for Discharges with a Depth Difference Between the Discharge Pipe and the Sea Floor of Greater than 9 Meters to 12 Meters</b>						
<b>Discharge Rate</b> (bbl/day)	<b>Pipe Diameter (inches)</b>					
	<b>&gt;0" to 5"</b>	<b>&gt;5" to 7"</b>	<b>&gt;7" to 9"</b>	<b>&gt;9" to 11"</b>	<b>&gt;11" to 15"</b>	<b>&gt;15"</b>
0 to 500	0.08	0.07	0.06	0.05	0.04	0.03
501 to 1000	0.11	0.15	0.12	0.10	0.08	0.06
1001 to 2000	0.14	0.14	0.24	0.20	0.15	0.12
2001 to 3000	0.17	0.17	0.36	0.30	0.23	0.18
3001 to 4000	0.19	0.19	0.19	0.40	0.31	0.24

4001 to 5000	0.21	0.21	0.21	0.50	0.38	0.30
5001 to 6000	0.23	0.23	0.23	0.23	0.46	0.36
6001 to 7000	0.24	0.24	0.24	0.24	0.53	0.41
7001 to 8000	0.19	0.19	0.19	0.19	0.61	0.47
8001 to 9000	0.20	0.20	0.20	0.20	0.69	0.53
9001 to 10,000	0.30	0.23	0.23	0.23	0.76	0.59
10,001 to 15,000	0.74	0.74	0.72	0.70	0.69	0.69
15,001 to 20,000	0.76	0.77	0.75	0.75	0.72	0.72
20,001 to 25,000	0.97	0.98	0.96	0.94	0.91	0.90
25,001 to 35,000	1.34	1.34	1.34	1.32	1.29	1.24
35,001 to 50,000	1.79	1.81	1.86	1.82	1.80	1.73
50,001 to 75,000	2.37	2.58	2.64	2.61	2.61	2.55

**Table 1-E: Critical Dilution (Percent Effluent) for Lower Volume Discharges with a Depth Difference Between the Discharge Pipe and the Sea Floor of Greater than 12 Meters**

Discharge Rate (bbl/day)	Pipe Diameter (inches)					
	>0" to 5"	>5" to 7"	>7" to 9"	>9" to 11"	>11" to 15"	>15"
0 to 500	0.08	0.07	0.05	0.04	0.03	0.03
501 to 1000	0.11	0.13	0.10	0.09	0.07	0.05
1001 to 2000	0.15	0.15	0.21	0.18	0.13	0.10
2001 to 3000	0.17	0.17	0.31	0.26	0.20	0.16
3001 to 4000	0.19	0.19	0.19	0.35	0.27	0.21
4001 to 5000	0.21	0.21	0.21	0.44	0.33	0.26
5001 to 6000	0.23	0.23	0.23	0.23	0.40	0.31
6001 to 7000	0.24	0.24	0.24	0.24	0.47	0.36
7001 to 8000	0.19	0.19	0.19	0.19	0.53	0.41

**Table 1-F: Critical Dilution (Percent Effluent) for Higher Volume Discharges with a Depth Difference Between the Discharge Pipe and the Sea Floor of Greater than 12 Meters**

Depth Difference Greater than 12 Meters to 14 Meters						
Discharge Rate (bbl/day)	Pipe Diameter (inches)					
	>0" to 5"	>5" to 7"	>7" to 9"	>9" to 11"	>11" to 15"	>15"
8001 to 9000	0.20	0.20	0.20	0.20	0.60	0.47
9001 to 10,000	0.21	0.21	0.21	0.21	0.67	0.52
10,001 to 15,000	0.39	0.39	0.39	0.39	0.39	0.39
15,001 to 20,000	0.73	0.74	0.71	0.71	0.68	0.68
20,001 to 25,000	0.94	0.95	0.93	0.92	0.89	0.88
25,001 to 35,000	1.06	1.04	1.21	1.02	0.99	0.96
35,001 to 50,000	1.47	1.48	1.42	1.45	1.43	1.38

50,001 to 75,000	1.90	2.06	2.04	2.06	2.02	1.98
<b>Depth Difference Greater than 14 Meters to 16 Meters</b>						
<b>Discharge Rate</b>	<b>Pipe Diameter (inches)</b>					
<b>(bbl/day)</b>	<b>&gt;0" to 5"</b>	<b>&gt;5" to 7"</b>	<b>&gt;7" to 9"</b>	<b>&gt;9" to 11"</b>	<b>&gt;11" to 15"</b>	<b>&gt;15"</b>
8001 to 9000	0.20	0.20	0.20	0.20	0.53	0.41
9001 to 10,000	0.21	0.21	0.21	0.21	0.59	0.46
10,001 to 15,000	0.39	0.39	0.39	0.39	0.39	0.39
15,001 to 20,000	0.43	0.44	0.44	0.44	0.44	0.44
20,001 to 25,000	0.68	0.69	0.67	0.67	0.64	0.48
25,001 to 35,000	1.05	1.03	1.02	1.01	0.99	0.95
35,001 to 50,000	1.48	1.48	1.45	1.44	1.42	1.39
50,001 to 75,000	1.62	1.69	1.70	1.69	1.68	1.63
<b>Depth Difference Greater than 16 Meters to 19 Meters</b>						
<b>Discharge Rate</b>	<b>Pipe Diameter (inches)</b>					
<b>(bbl/day)</b>	<b>&gt;0" to 5"</b>	<b>&gt;5" to 7"</b>	<b>&gt;7" to 9"</b>	<b>&gt;9" to 11"</b>	<b>&gt;11" to 15"</b>	<b>&gt;15"</b>
8001 to 9000	0.20	0.20	0.20	0.21	0.46	0.36
9001 to 10,000	0.21	0.21	0.21	0.21	0.51	0.40
10,001 to 15,000	0.39	0.39	0.39	0.40	0.40	0.40
15,001 to 20,000	0.44	0.44	0.44	0.45	0.45	0.45
20,001 to 25,000	0.48	0.48	0.48	0.49	0.49	0.49
25,001 to 35,000	0.55	0.55	0.55	0.57	0.57	0.57
35,001 to 50,000	1.07	1.06	1.04	1.02	1.00	0.96
50,001 to 75,000	1.58	1.61	1.60	1.59	1.54	1.53
<b>Depth Difference Greater than 19 Meters</b>						
<b>Discharge Rate</b>	<b>Pipe Diameter (inches)</b>					
<b>(bbl/day)</b>	<b>&gt;0" to 5"</b>	<b>&gt;5" to 7"</b>	<b>&gt;7" to 9"</b>	<b>&gt;9" to 11"</b>	<b>&gt;11" to 15"</b>	<b>&gt;15"</b>
8001 to 9000	0.20	0.20	0.20	0.20	0.42	0.33
9001 to 10,000	0.21	0.21	0.21	0.21	0.47	0.36
10,001 to 15,000	0.39	0.39	0.39	0.39	0.39	0.39
15,001 to 20,000	0.44	0.44	0.44	0.44	0.44	0.44
20,001 to 25,000	0.48	0.48	0.48	0.48	0.48	0.48
25,001 to 35,000	0.55	0.55	0.55	0.55	0.56	0.56
35,001 to 50,000	0.64	0.64	0.64	0.65	0.65	0.65
50,001 to 75,000	1.32	1.33	1.32	1.30	1.26	1.25

CORMIX 7.0.0.0 is the latest version of the CORMIX model available to the Agency at the time of revised effluent table development and represents the most robust version of the model used in the effort to describe the critical dilutions. Several significant updates are included in the latest

version when compared to the previous model versions used (CORMIX 3.2/4.0) in the critical dilution percent effluent tables. A list of features, updates, and bug fixes can be found at [http://www.mixzon.com/quality\\_assurance.php](http://www.mixzon.com/quality_assurance.php). In particular, the handling of negatively buoyant plumes and density gradients has been addressed.

In summary, Tables 1-A through 1-F hereby supersede all previous iterations of the critical dilution percent effluent tables and should be utilized in all instances associated with the general permit number GMG290000.