MATAGORDA BAY AND NEARBY COASTAL WATERS DISSOLVED OXYGEN AND pH TMDL ASSESSMENT REPORT

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Texas Commission On Environmental Quality

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Total Maximum Daily Load (TMDL) Assessment

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EXECUTIVE SUMMARY

This project provides technical support to the Texas Commission on Environmental Quality (TCEQ) for the development of a Total Maximum Daily Load (TMDL). The TCEQ will lead an effort to assess the causes and sources of the following water quality problems identified in the 2002 Texas Water Quality Inventory and 303(d) List for Matagorda Bay/Powderhorn Lake (Segment 2451), which only partially supports the aquatic life use due to exceedence of the dissolved oxygen (DO) standard on the east half of the main bay; Tres Palacios/Turtle Bay (Segment 2452),which only partially supports the aquatic life use due to exceedance of the dissolved oxygen standard in the Palacios area assessment unit and Carancahua Bay (Segment 2456); which only partially supports the general use due to high pH in 9.2 square miles at the north end of the bay; and Carancahua Creek and Conn Brown Harbor (Segment 2483A), which does not support the aquatic life use in the entire harbor due to depressed dissolved oxygen.

The goals of the current project were to develop a Quality Assurance Project Plan, to develop and implement a monitoring program to assess the DO conditions in Matagorda Bay, Tres Palacios Bay, and Conn Brown Harbor and the pH conditions in Carancahua Bay, and to assess the data collected from the monitoring plan and determine the cause of impairments that result in exceedence of the water quality criteria.

A review of historical TCEQ data (July 16, 1969 to September 9, 2005) showed that low DO (i.e., DO < 5 mg/L) appears to be isolated in West Carancahua Creek and in harbors. Only one station out of 19 stations (5%) in Matagorda Bay (segment 2451) had DO values below the 5 mg/L criteria. Only one out of 18 stations (6%) in Tres Palacios/Turtle Bay (segment 2451) was below the 5 mg/L criteria. Two out of 15 stations (13%) in Carancahua Bay were below the 5 mg/L criteria. Although they are designated in the dataset as being within the confines of segment 2456, both of these stations were not covered under the Carancahua Bay TMDL project because they are designated as tidal streams (i.e., tributaries to Carancahua Bay). One out of 13 stations (13%) in the Conn Brown Harbor (Segment 2483A) was below the 5 mg/L criteria.

A total of nine stations were sampled (13382, 13381, 14682, 14689, 17354, 13377, 13378, 13388, and 13287) as part of this project. A total of 79 24-hour continuous samples and 955 grab samples were taken between 15 June 2004 and 4 October 2005.

In Matagorda Bay (Segment 2451), DO exceedances occurred once at station 13378 for both the 24-hour minimum and 24-hour average DO. Station 13378 is off the Matagorda ship channel. Both of these exceedances occurred in July 2004. Theses samples were taken during a period of high freshwater inflow. There was strong stratification, and this is likely the cause of low DO concentrations. Overall, only 3% of samples in segment 2451 exceeded the average and minimum DO criteria.

Neither segment 2456 or 2483A exceeded the average and minimum DO criteria.

In Tres Palacios Bay (Segment 2452), DO exceedance at station 13382 occurred once in the 24-hour average and three times in the 24-hour minimum data. This station is located within Palacios Harbor. Salinities at this station are low and temperatures are high. The water is shallow, and relatively stagnant. The Harbor does not appear to be representative of the entire segment, therefore two additional stations were added to determine if the Harbor station is representative of the bay in general. Both of the additional stations had one exceedance of the 24-minimum. Overall, only 4% of samples in segment 2452 exceeded the average DO criteria and 18% of the samples exceeded the minimum DO criteria. Three out of the five exceedances (11% of the total) for the minimum DO criteria occurred at station 13382.

The primary factor that appears to be causing the depressed DO values in the Palacios area is lack of water circulation during summer and high temperatures. Station 13382 is located within Palacios Harbor, inside the jetties. The jetties minimize wave action and impede water circulation and mixing. The additional stations of 14682 and 14689 were only sampled a few times, which may not have been enough samples to provide an accurate spatial assessment of this area in general. A preliminary source assessment indicates that it is unlikely that the permitted discharges are large sources of nutrient loading in the area. The City of Palacios wastewater treatment plant discharges into Prices Slough (Figure 28) which ultimately drains into Tres Palacios/Turtle Bay. Station 14689 is directly south of this slough and this station had only one minimum 24-hour exceedance in August 2005, but no exceedances in the grab sample averages. Nonpoint source nutrient inputs are more likely to be an important factor in the depressed DO values in this area. Storm water discharges directly into the harbor. In addition, the Port of Palacios is the second largest commercial port for the shrimp fishery in Texas. Disposal of shrimp heads and other waste from shrimp cleaning is a potential nonpoint source nutrient input. The combination of low water circulation and nonpoint source nutrient inputs are likely the primary cause of low DO values in the Palacios harbor area.

Recommendations

Based on the historical data review and new 24-hour data presented in the current study it is concluded that Carancahua Bay segment 2456 does not currently appear to suffer from pH impairment. Segment 2456 supports exceptional aquatic life use. Based on the data presented in this report it is recommended that the segment be removed from the 303(d) list for pH.

Matagorda Bay segment 2451 and Conn Brown Harbor segment 2483A do not currently appear to suffer from dissolved oxygen impairment. Segment 2451 and 2483A supports the exceptional aquatic life use DO criteria. Tres Palacios / Turtle Bay segment 2452 currently appears to suffer from partial dissolved oxygen impairment. The Oliver Point to Coon Island Bay assessment area supports exceptional aquatic life use, but the Palacios area does not. Based on the data presented in this report it is recommended that the segment 2451, 2483A, and the Oliver Point to Coon Island Bay assessment area of segment 2452 be removed from the 303(d) list for dissolved oxygen.

Additional 24-hour monitoring is recommended for station13382, 14689, and 14682 in the Palacios area. Nutrient analyses and biological oxygen demand studies are also recommended to support a total maximum daily load assessment if additional data indicates that it is needed for this segment.

INTRODUCTION

This project provides technical support to the Texas Commission on Environmental Quality (TCEQ) for the development of a Total Maximum Daily Load (TMDL). The TCEQ will lead an effort to assess the causes and sources of the following water quality problems identified in the Texas 2000 Clean Water Act 303(d) list for Matagorda Bay / Powderhorn Lake (Segment 2451), Tres Palacios / Turtle Bay (Segment 2452), Carancahua Bay (Segment 2456), and Conn Brown Harbor (Segment 2483A).

Matagorda Bay only partially supports the aquatic life use due to exceedance of the dissolved oxygen (DO) standard on the east half of the main bay. Tres Palacios / Turtle Bay only partially supports the aquatic life use due to exceedance of the dissolved oxygen standard in the Palacios area assessment unit. Segment 2483A (Conn Brown Harbor) does not support the aquatic life use in the entire harbor due to depressed dissolved oxygen. Segment 2456 (Carancahua Bay) only partially supports the general use due to high pH in 9.2 square miles at the north end of the bay and Carancahua Creek.

Matagorda Bay, segment 2451, is located in Matagorda and Calhoun county in southeast Texas east of the city of Port O'Connor. Matagorda Bay is a primary bay, with Pass Cavallo as the outlet to the Gulf of Mexico. Tres Palacios/Turtle Bay, segment 2452, is located in Matagorda county and is adjacent to the City of Palacios. Palacios city has a population of 5,153 people (2000 Census).

The 2456 Carancahua Bay segment is in Jackson county and has no cities surrounding the bay. The 2483A Conn Brown Harbor segment is in the city of Aransas Pass. Aransas Pass has a population of 8,138 (2000 Census).

Their were several goals of the current project. The first goal was to develop a Quality Assurance Project Plan. The second goal was to develop and implement a monitoring program to assess the DO conditions in Matagorda Bay, Tres Palacios Bay, and Conn Brown Harbor and the pH conditions in Carancahua Bay. This monitoring plan adheres to the protocols specified in the developed Quality Assurance Project Plan and relies on recommendations from the historical data review. In addition to the historical review, three stations were monitored in the Matagorda Bay segment (2451), four stations were monitored in the Tres Palacios segment (2452), and one station was monitored in each Carancahua Bay (segment 2456) and Conn Brown Harbor (2483A).

The third goal was to assess the data collected from the monitoring plan and determine the causes of any impairments that do not meet water quality criteria. The assessment was conducted on all potential sources of pollution leading to the DO impairments including both point and nonpoint sources. The various land uses in the watersheds, permitted outfalls, demographics, rainfall runoff, nutrient inputs, and any additional sources are also considered.

HISTORICAL DATA REVIEW

A detailed and relevant historical data review for dissolved oxygen (DO) definitions and use as an indicator of aquatic ecosystem health has already been completed (Ritter et al., 2002; Montagna and Russell 2003).

The current data review was used to support the development of a TMDL for DO and pH. Segments 2451 and 2452 were listed on the 303(d) list because DO concentrations are lower than the criterion established to support the aquatic life in the east half of Matagorda Bay and in the Palacios area. Segment 2483A was listed because Conn Brown Harbor does not support aquatic life use in the entire harbor due to depressed oxygen concentrations. Segment 2456 was listed because Carancahua Bay only partially supports the general aquatic life use due to high pH levels in 9.2 square miles at the north end of the bay and in Carancahua Creek.

"Aquatic life use" is a term used in Texas water resource management to characterize water bodies and specify water quality criteria for those bodies. The Texas Commission on Environmental Quality (TCEQ) has identified four aquatic life use categories: exceptional, high, intermediate, and limited. For Texas estuaries fully supporting the exceptional aquatic life use, DO criteria are 24-hr mean $\geq$ 5.0 mg/L and 24-hr minimum $\geq$ 4.0 mg/L. Matagorda Bay, Tres Palacios Bay, and Carancahua Bays are designated for exceptional aquatic life use and Conn Brown Harbor is designated as intermediate aquatic life use.

Data Sets

Data from TCEQ for the historical review were obtained for the period 16 July 1969 to 9 September 2005. Stations for which data were available for segment 2451 are plotted in Figure 1. Stations for which data were available for segment 2452 are plotted in Figure 2. Stations for which data were available for segment 2456 are plotted in Figure 3. Stations for which data were available for segment 2483A are plotted in Figure 4. Data was available for five (5) parameters, which are listed in Table 1. Temperature, DO, salinity and total ammonia were averaged by month for each segment to determine seasonal variations. These parameters where also averaged by station for each segment to determine spatial variation. Most TCEQ hydrographic measurements were from grab samples. Grab samples are samples, or composite samples (i.e., depth profiles) taken at a single point in time. Depth profiles were averaged from surface to bottom for each parameter because samples were taken year round and were well mixed the majority of the time.

Table 1. Parameters reviewed for the Matagorda Bay and nearby waters.

Parameter	Units	Parameter Code
DO	mg/L	00300
Salinity	‰	00480
Temperature	°C	00010
Total Nitrogen Ammonia	mg/L	00610
pH	pH	00400

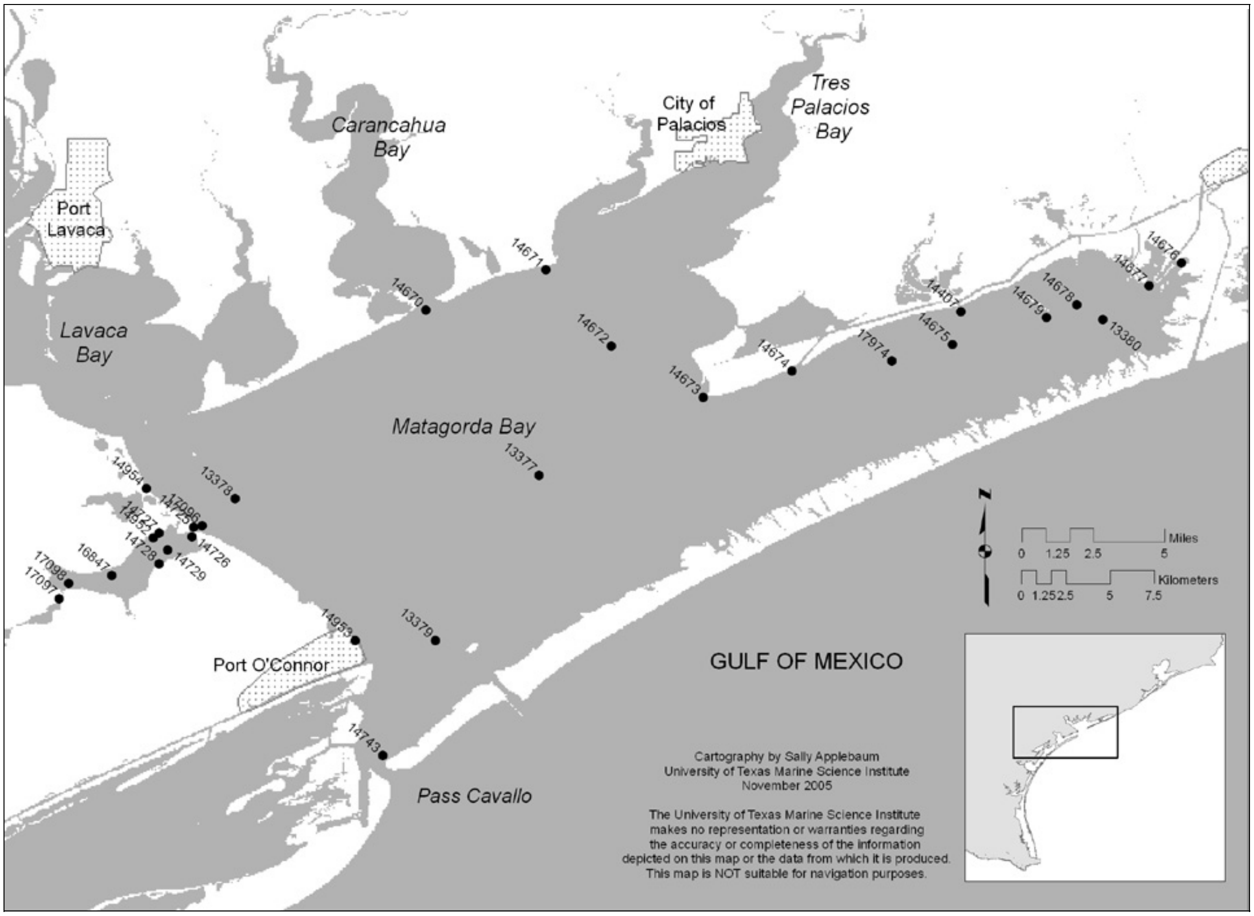


Figure 1. Map of TCEQ stations in Segment 2451 used for historical data review.

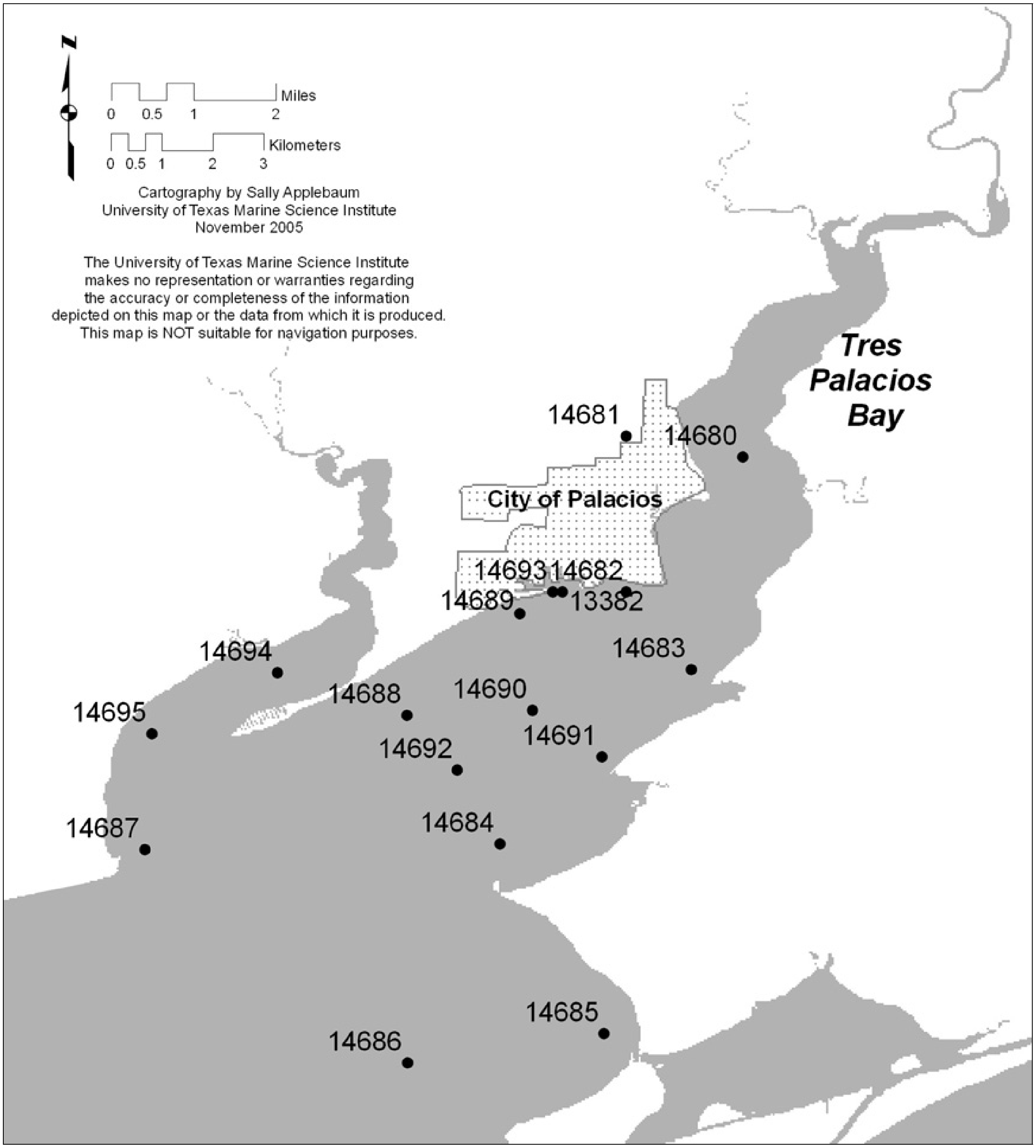


Figure 2. Map of TCEQ stations in Segment 2452 used for historical data review.

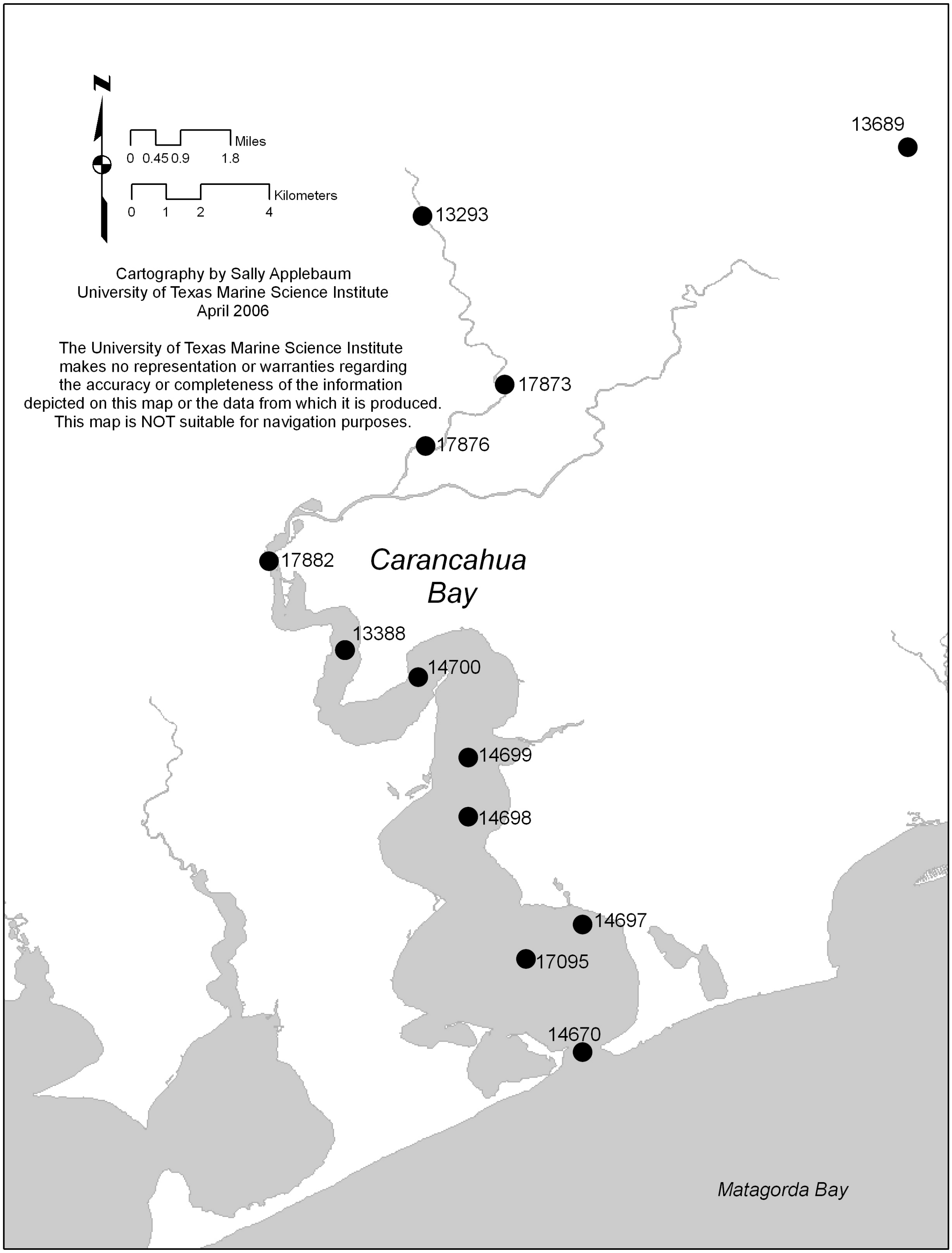


Figure 3. Map of TCEQ stations in Segment 2456 used for historical data review.

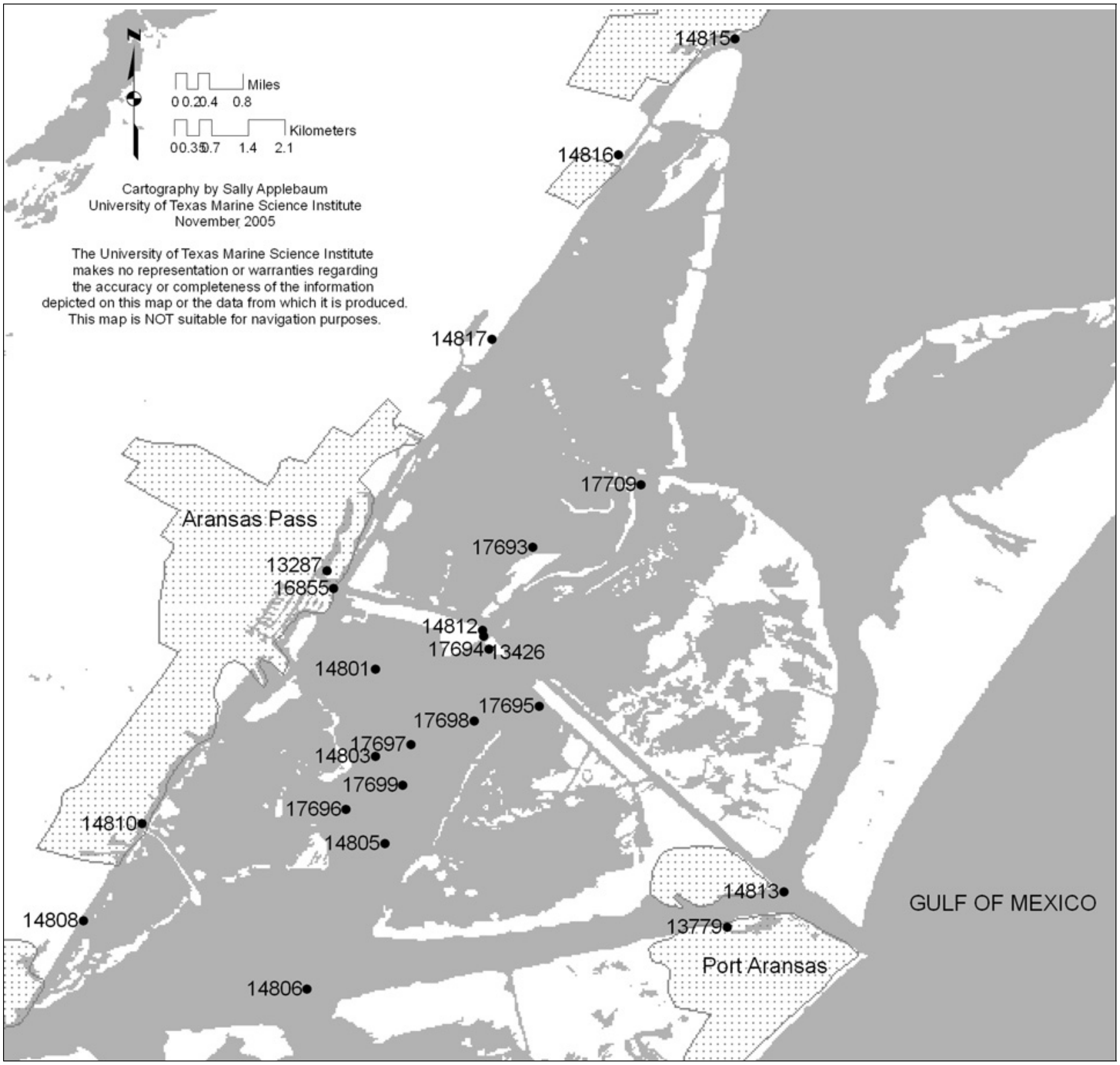


Figure 4. Map of TCEQ stations in Segment 2483A used for historical data review.

Seasonal Patterns

The entire TCEQ data set was averaged and plotted by month for each segment to determine seasonal patterns (Figure 6 - 9). Temperature peaked in the summer months of July and August for all four segments. Low DO concentrations were associated with high temperature in all segments, with DO reaching its monthly minimum in August. None of the monthly DO averages were below 5 mg/L. Salinity and total ammonia concentrations had no seasonal trend. Average total ammonia concentrations were all below 0.19 mg/L. These values are low in comparison to Lavaca Bay (Montagna and Russell 2003).

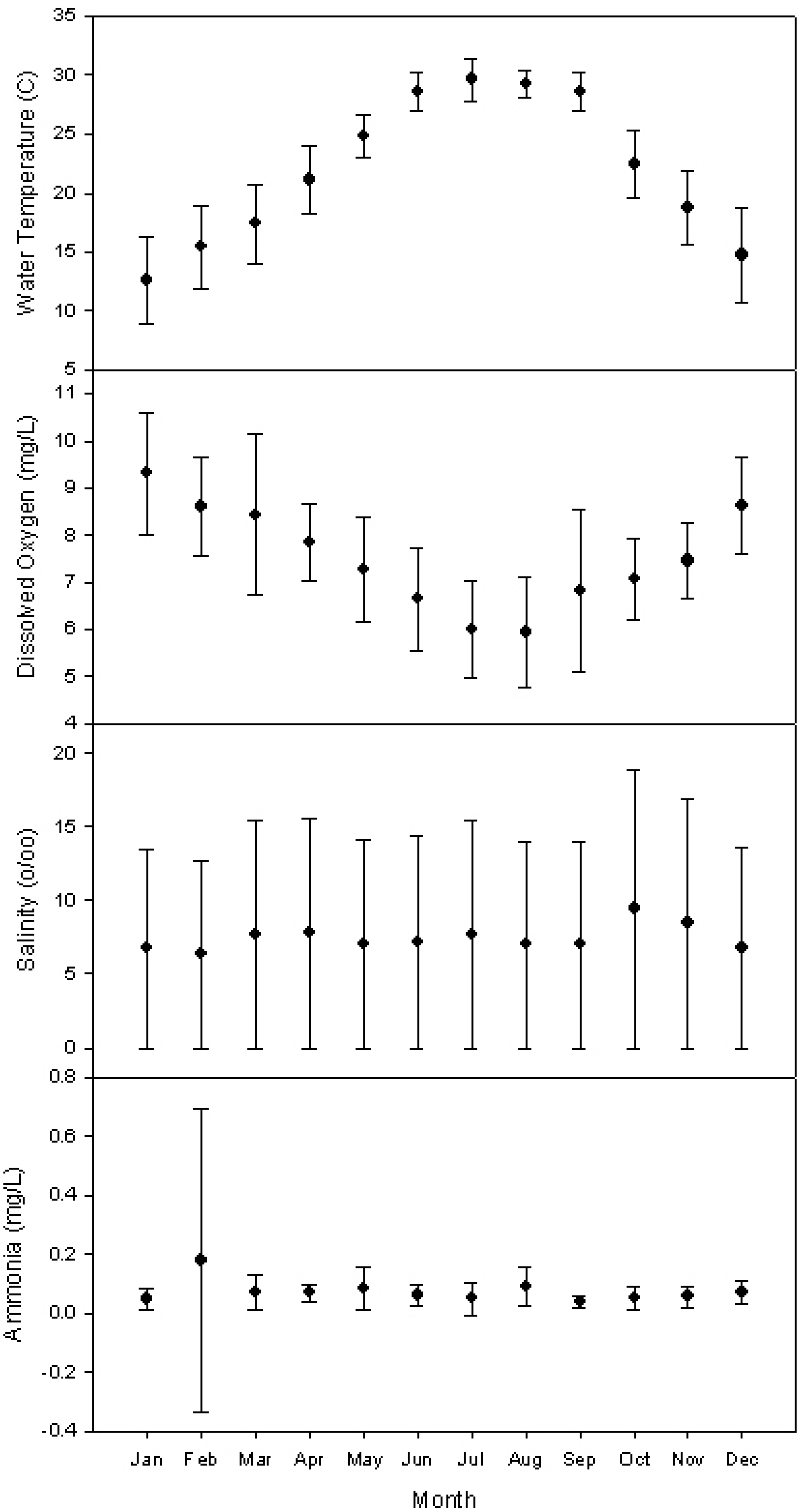


Figure 5. Seasonal patterns of temperature, dissolved oxygen, salinity, and ammonia for Matagorda Bay, segment 2451.

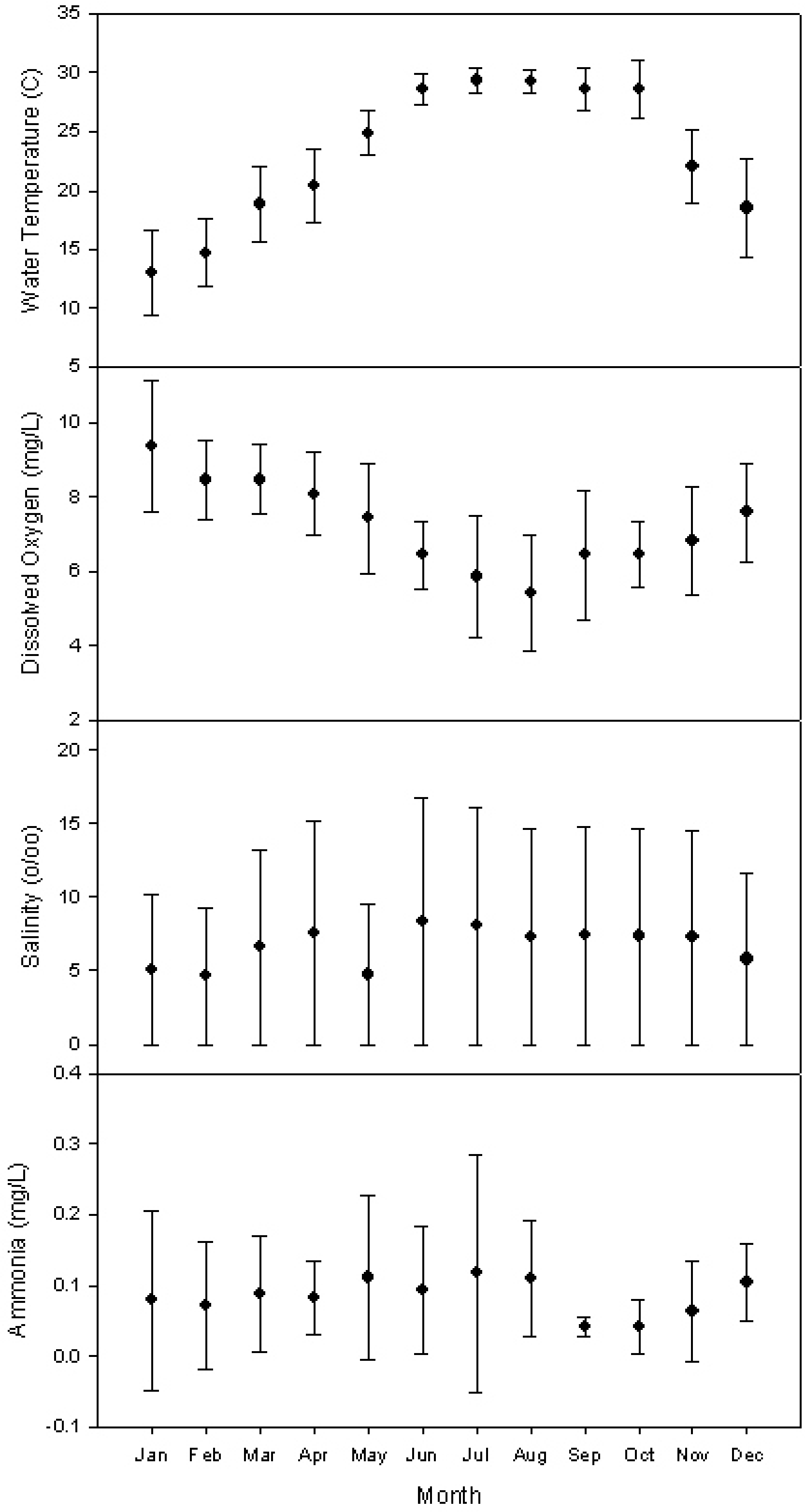


Figure 6. Seasonal patterns of temperature, dissolved oxygen, salinity, and ammonia for Tres Palacios Bay and Turtle Bay, segment 2452.

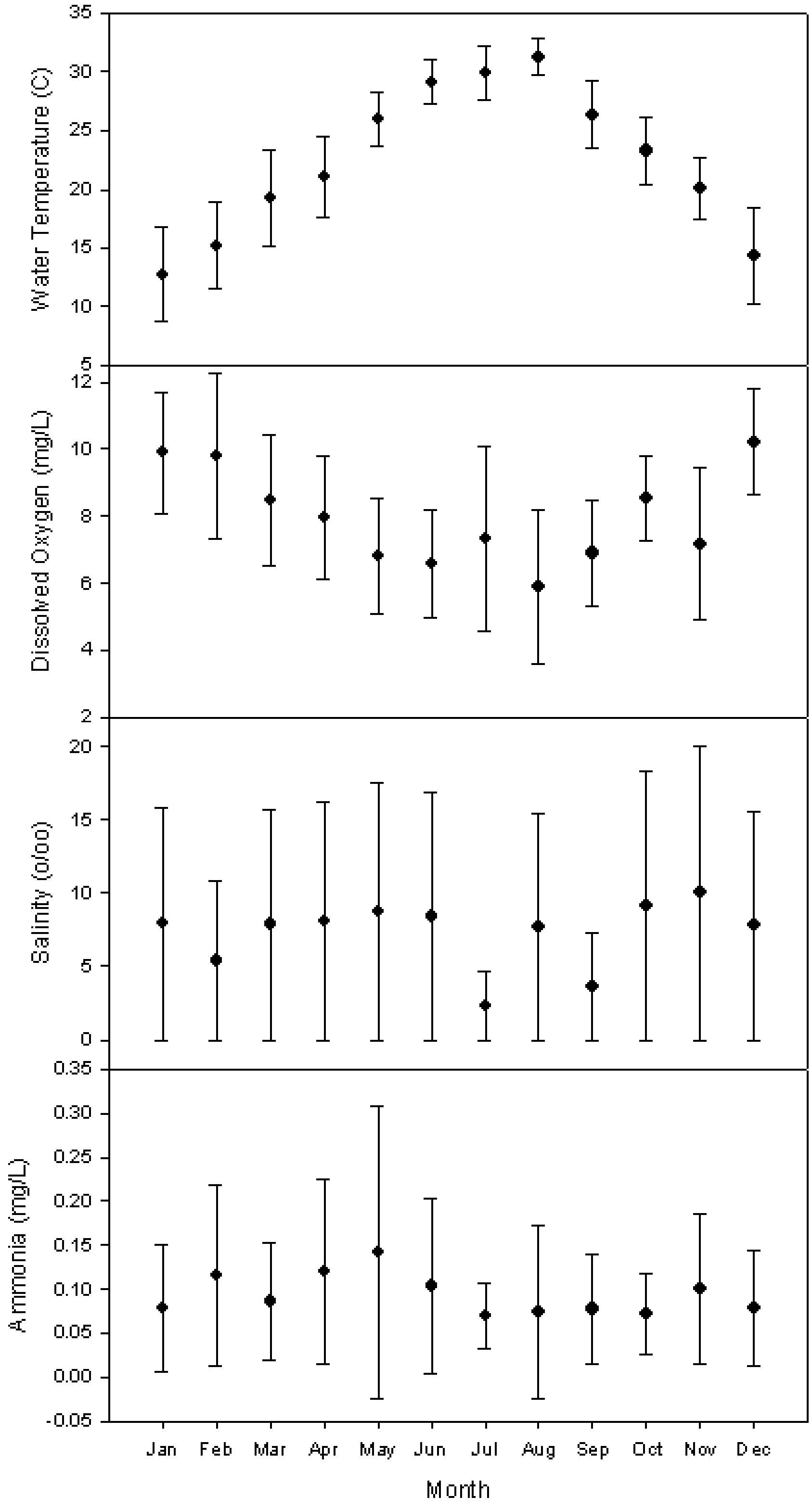


Figure 7. Seasonal patterns of temperature, dissolved oxygen, salinity, and ammonia for Carancahua Bay, segment 2456.

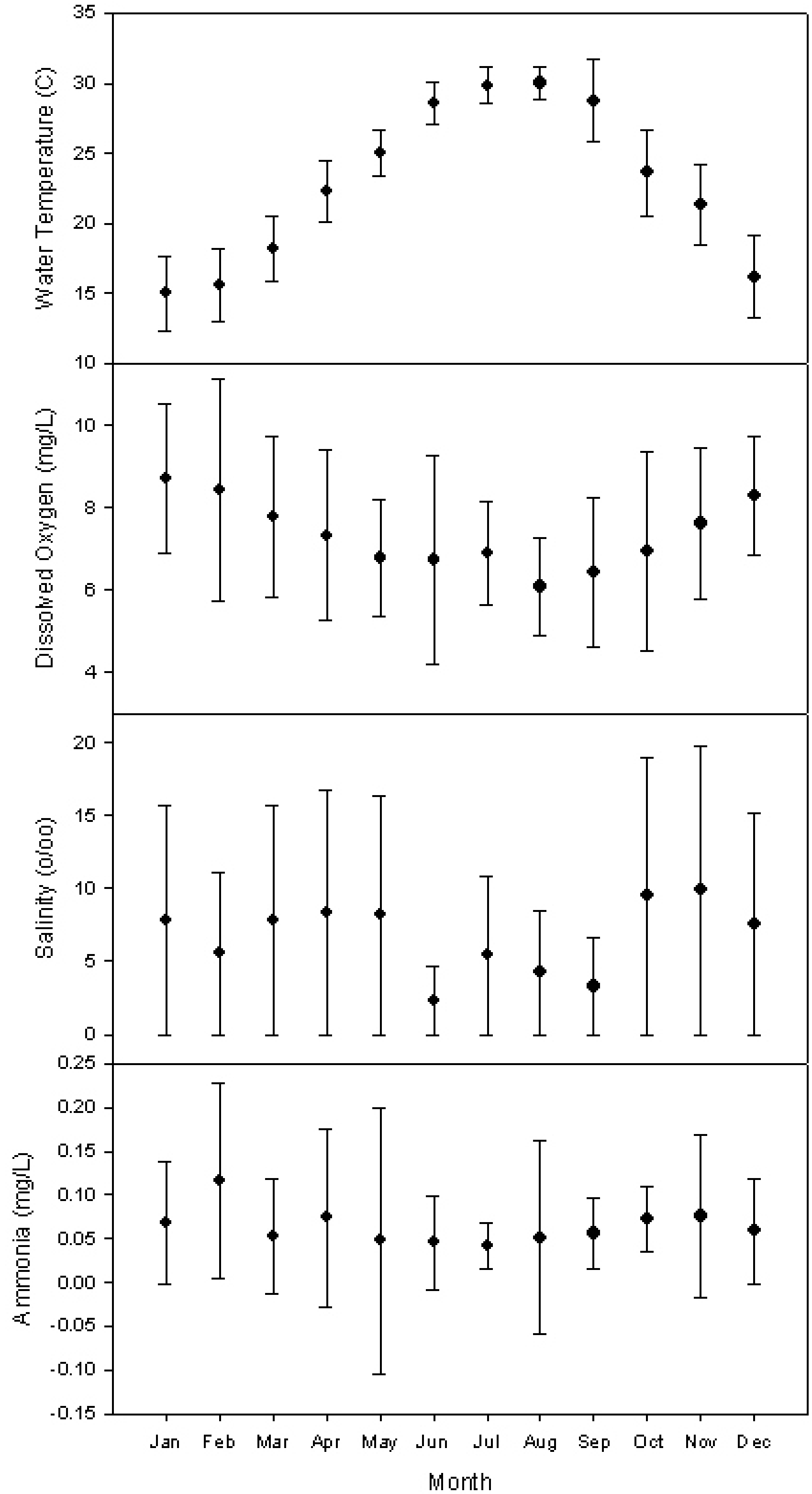


Figure 8. Seasonal patterns of temperature, dissolved oxygen, salinity, and ammonia for Conn Brown Harbor, segment 2483A.

Spatial Patterns

Averages of DO concentrations were all above 5 mg/L, with the exception of two stations in West Carancahua Creek (17873, 17876) (Figure 9 and Table 2). These two stations were each sampled 11 times and were below 5 mg/L 91% and 82% of the time. Stations in the Palacios area assessment area were lower than the rest of the segment. In addition, station 13382 in Palacios Harbor was below 5 mg/L 17% of the time. This station was also chosen as a sampling site in this TMDL monitoring plan. DO concentrations in Matagorda Bay had lower averages in the center of the bay. Only station 14952 in Powderhorn Lake within the Indianola Shrimp Fleet Harbor was below 5 mg/L more than 10% of the time. Only one station (13779) in the Conn Brown area had an average DO concentration less than 5 mg/L for more than 10% of the time. This station 13779 is located in the Port Aransas Municipal Harbor. Three of the five occurrence of DO averages that were below 5 mg/L occurred in harbors. Stations within harbors are subject to minimal mixing because of the jetties and breakwaters that inclose the harbors and are designed to minimize wave action. Low mixing rates can often lead to water column stratification and in turn low DO values.

In general, salinity ranges were correlated with fresh water and seawater sources (Figure 10). The eastern portion of Matagorda Bay had low salinity values due to its proximity to the Colorado River. The lower average value at Pass Cavallo (station 14743) is likely caused by insufficient data. A recent draft report to the Lower Colorado River Authority determined that salinity values at Pass Cavallo averaged 25-30 psu for the majority of the year (LCRA 2005). This report used bay-wide surface salinity data to determine the spatial and seasonal salinity characteristics in the Lavaca and Matagorda estuary.

Seems like a long way for the freshwater fro the Colorado River to travel. The salinity values in Aransas Pass area were high because of the exchange with the Gulf of Mexico. Average salinity values do not appear to be related to average DO concentrations.

Temperature values are variable, but could be attributed to water depth and freshwater inflow sources (Figure 11). Average temperature values do not appear to be related to average DO concentrations.

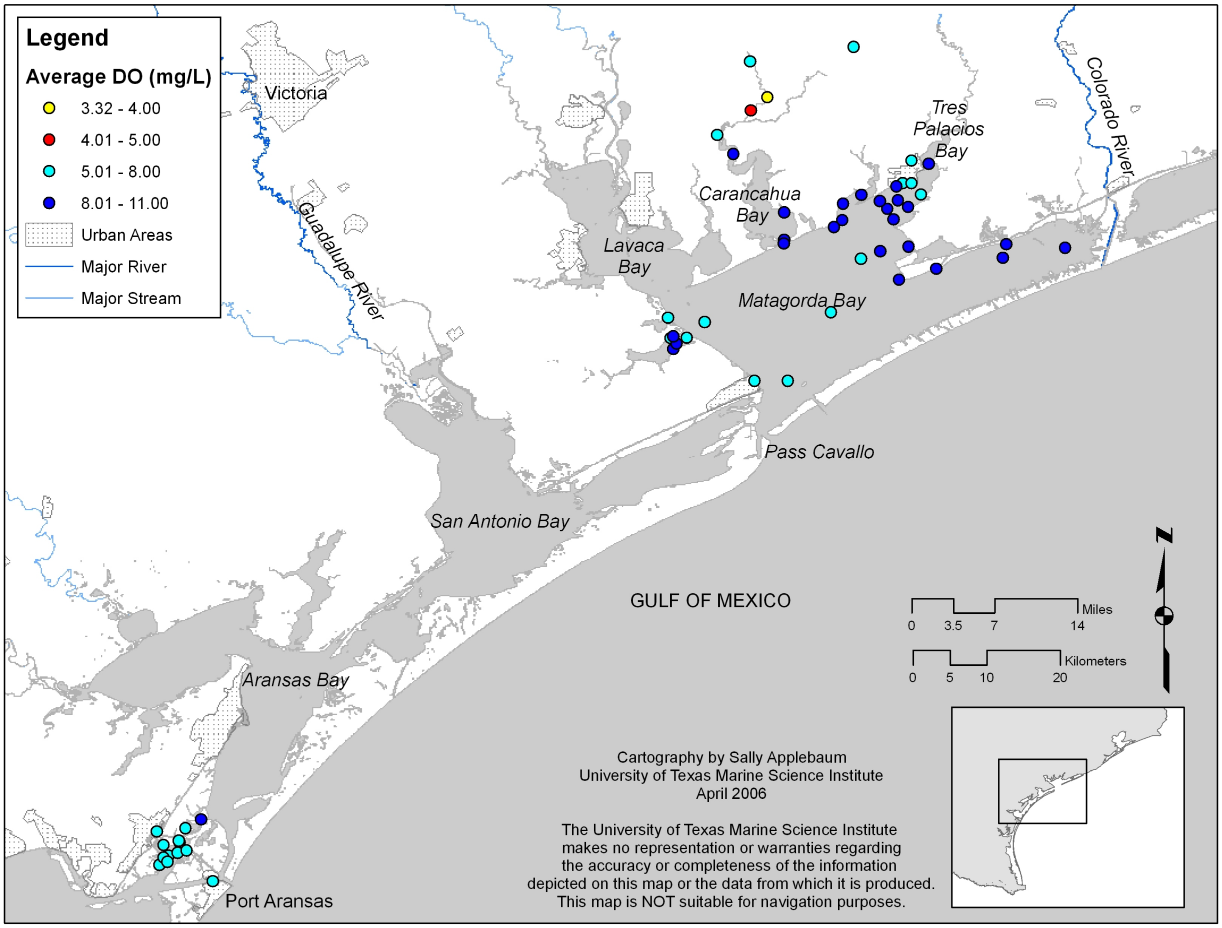


Figure 9. Spatial distribution of DO averages for segments 2451, 2452, 2456, and 2483A generated from TCEQ stations.

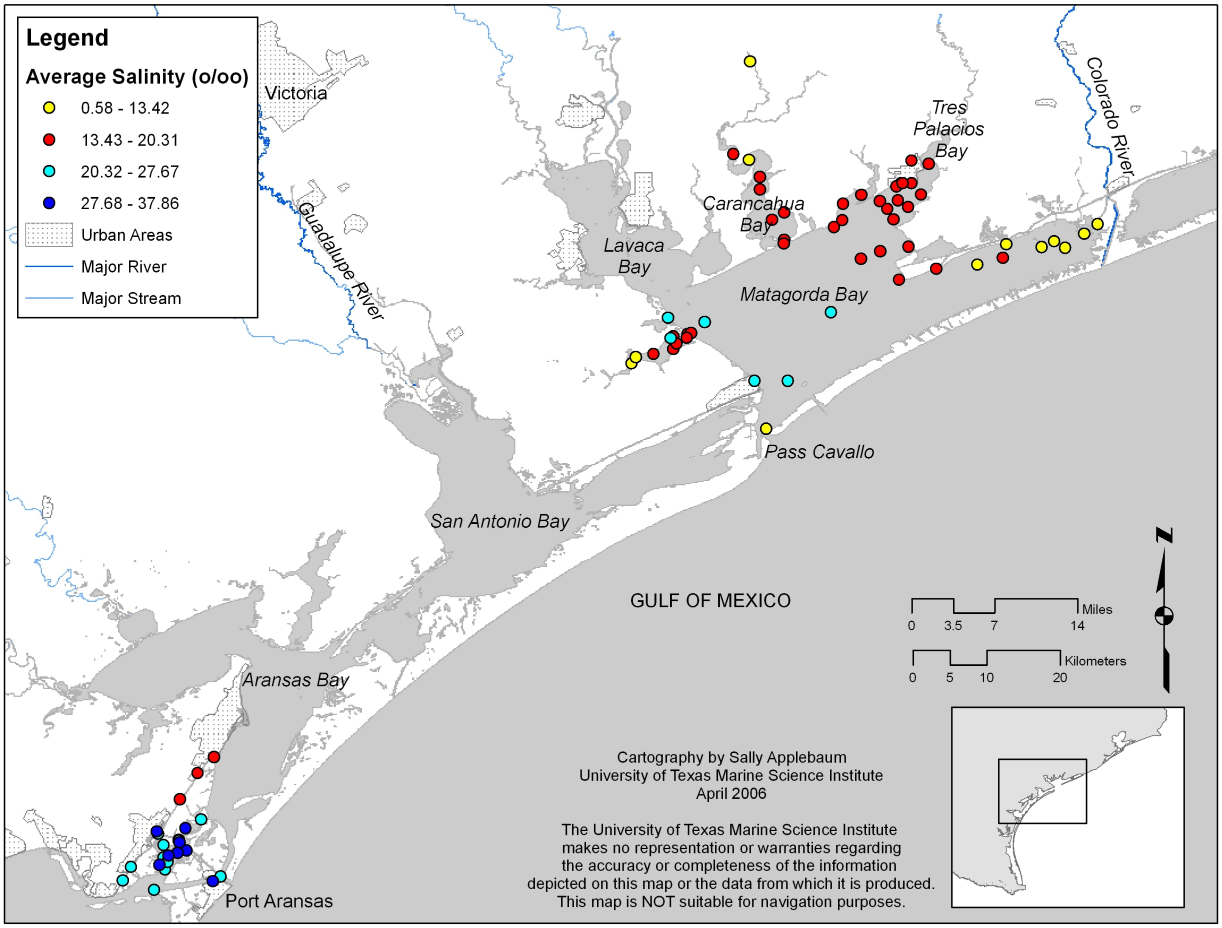


Figure 10. Spatial distribution of salinity averages for segments 2451, 2452, 2456, and 2483A generated from TCEQ stations.

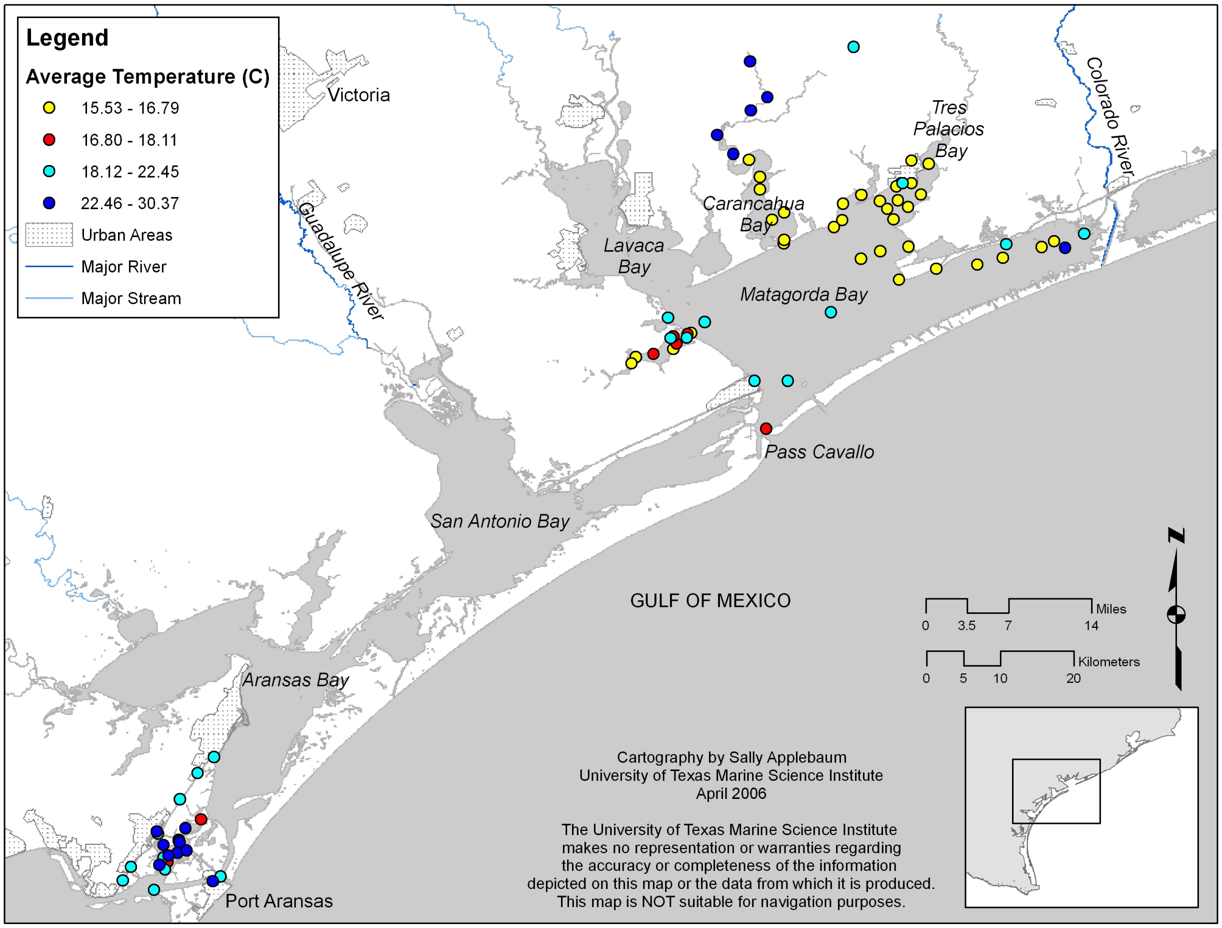


Figure 11. Spatial distribution of temperature averages for segments 2451, 2452, 2456, and 2483A generated from TCEQ stations.

Table 2. Number (and percent) of observations at each station indicative of low oxygen during the period 16 July 1969 to 9 September 2005. Stations with no dissolved oxygen (DO) data have been omitted. Station = TCEQ station ID. N = total number of DO observations. Observations based on grab-sample data. Observations that were < 5 mg/L for more than 10% of the time are in bold typeface.

Segment	Station	Average DO	N	Number of obs. where DO <5 mg/L	Number of obs. where DO <4 mg/L
2451	13377	7.40	131	6 (5%)	1
2451	13378	7.10	117	7 (6%)	0
2451	13379	7.31	99	3 (3%)	0
2451	13380	8.15	64	1 (2%)	0
2451	14407	9.30	4	0	0
2451	14670	8.87	3	0	0
2451	14671	8.25	4	0	0
2451	14672	7.20	1	0	0
2451	14673	8.40	4	0	0
2451	14674	8.34	5	0	0
2451	14675	10.30	5	0	0
2451	14726	7.70	31	0	0
2451	14727	9.20	1	0	0
2451	14728	9.20	1	0	0
2451	14729	9.20	1	0	0
2451	14952	7.44	7	**1 (14%)**	0
2451	14953	7.80	7	0	0
2451	14954	7.91	7	0	0
2451	18395	7.42	7	0	0
2452	13381	7.59	132	3 (2%)	1 (1%)
2452	13382	6.90	110	**19 (17%)**	5 (5%)
2452	14680	8.50	3	0	0
2452	14681	7.63	3	0	0
2452	14682	7.67	3	0	0
2452	14683	7.83	3	0	0
2452	14684	8.40	3	0	0
2452	14685	8.23	3	0	0
2452	14686	8.23	3	0	0
2452	14687	8.63	4	0	0
2452	14688	8.30	3	0	0
2452	14689	8.47	3	0	0
2452	14690	8.30	3	0	0
2452	14691	8.27	3	0	0
2452	14692	8.12	7	0	0
2452	14694	8.03	4	0	0
2452	14695	9.05	2	0	0
2452	18398	7.30	4	0	0

Segment	Station	Average DO	N	Number of obs. where DO <5 mg/L	Number of obs. where DO <4 mg/L
2456	13293	7.55	22	1 (5%)	1 (5%)
2456	13388	7.51	118	0	0
2456	13389	7.47	1	0	0
2456	13390	6.37	3	0	0
2456	13391	8.60	4	0	0
2456	13392	7.50	1	0	0
2456	13393	7.10	1	0	0
2456	13394	7.7	1	0	0
2456	13395	7.9	1	0	0
2456	13689	7.28	11	1 (9%)	0
2456	14696	8.27	3	0	0
2456	14697	8.67	3	0	0
2456	17873	3.32	11	**10 (91%)**	8 (73%)
2456	17876	4.51	11	**9 (82%)**	4 (36%)
2456	17882	6.93	11	0	0
2483	13287	6.92	93	7 (8%)	1 (1%)
2483	13426	7.60	220	6 (3%)	0
2483	13779	6.28	8	**2 (25%)**	0
2483	14801	6.97	25	0	0
2483	14803	7.44	4	0	0
2483	17693	7.69	1	0	0
2483	17694	5.41	1	0	0
2483	17695	7.33	1	0	0
2483	17696	6.42	1	0	0
2483	17697	5.87	1	0	0
2483	17698	6.77	1	0	0
2483	17699	7.51	1	0	0
2483	17709	8.48	1	0	0

Summary

Low DO (i.e., DO < 5 mg/L) appears to be isolated in West Carancahua Creek and in harbors. In the TCEQ data set, five stations, out of a total of 65 stations in Matagorda Bay (2451), Tres Palacios/Turtle Bay (2452), Carancahua Bay (2456) and Conn Brown Harbor (2483A) analyzed for DO, had low dissolved oxygen values (Table 2). Only 1 out of 19 stations (5%) in Matagorda Bay (segment 2451) was below the 5 mg/L criteria. Only 1 out of 18 stations (6%) in Tres Palacios/Turtle Bay (segment 2451) was below the 5 mg/L criteria. This station was chosen as one of the stations to be sampled in the TMDL monitoring plan. Two out of 15 stations (13%) in Carancahua Bay were below the 5 mg/L criteria. Although they are designated in the dataset as being within the confines of segment 2452, both of these stations are not covered under the Carancahua Bay TMDL project because they are designated as tidal streams (i.e., tributaries to Carancahua Bay). One out of 13 stations (13%) in the Conn Brown Harbor was below the 5 mg/L criteria.

Possible Causes of Dissolved Oxygen Depletion

Several natural factors may contribute to the depletion of DO in Matagorda Bay and nearby waters. The saturation concentration of DO varies inversely with temperature and salinity (Ritter et al., 2002; Montagna and Russell 2003). When temperature and/or salinity are high, the water will contain less DO than when temperature and/or salinity are low. In Matagorda Bay and nearby waters, DO averages were lowest during summer months when temperatures peaked (Figures 5 - 8).

Water column stratification is another natural factor that may contribute to the depletion of DO in Matagorda Bay and nearby waters. In estuaries, water column stratification can be induced by the influx of freshwater which overlies a layer of much saltier water. Water column stratification inhibits the mixing of oxygenated surface waters to deeper waters; the larger the surface to bottom salinity difference, the more mixing is inhibited. In shallow areas, low bottom DO may not be induced because of benthic photosynthesis (e.g., benthic diatoms), however, water turbidity may inhibit DO production by photosynthesis.

Inhibition of mixing processes that give rise to water column stratification may also be caused by anthropogenic alterations to the bay, such as the presence of a man-made channel, harbor, or island. Stations 13382, 14952 and 13779 are all located in harbors. These stations have had multiple incidences of low DO (Table 2).

Another factor that may contribute to DO depletion in Matagorda Bay and nearby waters is nutrient loading. Ammonia concentrations were relatively low, however these averages had a small sample size of 34 stations for all segments combined. It is therefore possible but unlikely that nutrient contributions are the primary cause of low DO values . Nutrients contribute to DO depletion via eutrophication processes (Ritter et al., 2002; Montagna and Russell 2003). Eutrophication can lead to increased phytoplankton production followed by increased consumer production. The wastes of this productivity (e.g., dead cells, excrement, exudates) can settle to the benthos where decomposition processes occur and microbial respiration depletes the surrounding water of DO. In some cases benthic DO can be replenished via mixing processes or benthic primary production, however, if mixing processes are inhibited by stratification or the presence of man-made structures (e.g., channels, harbors) DO depletion may be increased. Eutrophication is not in itself harmful to the ecosystem; it can boost production without causing DO depletion under some conditions. Where excess nutrients are associated with low DO, nutrient controls are needed to increase DO levels.

Source Assessment

The following information is a source assessment of all potential sources of pollution leading to the DO impairments including both point and nonpoint sources to Matagorda and Tres Palacios Bay (segments 2451, 2452) (Figure 12). The various land uses in the watersheds, permitted outfalls, demographics, rainfall runoff, nutrient inputs, and any additional sources are considered.

There are five permitted dischargers in the Tres Palacios Bay segment (Table 3). The Matagorda Co. Navigation District (04036) is located in the Port of Palacios and treats and disposes of wastes from a bilge water reclamation facility (SIC4499). The discharge goes to Turning Basin No. 3 of the Port of Palacios, thence to boat channel, thence to Tres Palacios Bay/Turtle Bay. This permit expires December 1, 2006. However, this permit was cancelled in August 2004 at the request of the permitted entity. The wastewater from this facility is now transported by truck away from the site and is no longer discharged into Palacios harbor.

Harold Wilbur Bowers (04005) is adjacent to Tres Palacios Bay at the end of Cockburn Road. This facility treats and disposes of wastes from the Bowers Shrimp Farm, an aquaculture shrimp and fish production facility (SIC 0273). The discharge goes to Matagorda County Drainage District #3 Ditch, thence to an unnamed natural tidal channel, thence to Little Redfish Lake, thence to Tres Palacios Bay/Turtle Bay. This permit expires December 1, 2004 (renewal requested 6/3/04).

Seaside Aquaculture (03660) (formerly Saroc Oil Co., DBA Redfish Unlimited) is located on the eastern side of FM3280 where FM3280 terminates at Matagorda Bay. This facility treats and disposes wastes from a mariculture facility (SIC 0273, 0921). Outfalls 001-008 discharge directly to Matagorda Bay and outfall 009 discharges to Tres Palacios Bay. This permit expires December 1, 2004 (renewal requested 7/1/04).

Matagorda County Water Control and Improvement District No. 5 (10217) is located immediately west of the intersection of Pecan Street and 6th Street. This facility treats and discharges wastes from the Blessing Wastewater Treatment Facility (SIC 4952). Discharge drains to an unnamed drainage ditch, thence to Cashs Creek, thence Tres Palacios Bay. This permit expires October 1, 2009.

The City of Palacios Wastewater Treatment (10593) facility is located approximately 1,800 feet west of the intersection of 12th Street and Mosier Drive. It treats and disposes of wastes from the Palacios Wastewater Treatment Plant (SIC 4952). Discharge drains into a ditch, thence to Prices Slough, thence to Tres Palacios Bay. This permit expires December 1, 2005. TCEQ station 14689 is located in Tres Palacios Bay at the end of Prices Slough.

Additional nonpoint sources that could be contributing factors to nutrient loading in Palacios Harbor include storm water runoff, failing septics, broken/leaking sewage mains, and disposal of shrimp carcasses from the shrimp vessels within the harbor.

Table 3. Permitted dischargers to Matagorda and Tres Palacios Bay.

Permit No.	Outfall No.	Permittee Name	Type of Discharge
04036-000	001	Matagorda Co. Nav. Dist.	Industrial - minor
04005-000	001-011	Harold Bowers	Industrial - minor
03660-000	001-009	Seaside Aquaculture	Industrial – minor
10593-001	001	City of Palacios	Municipal – minor

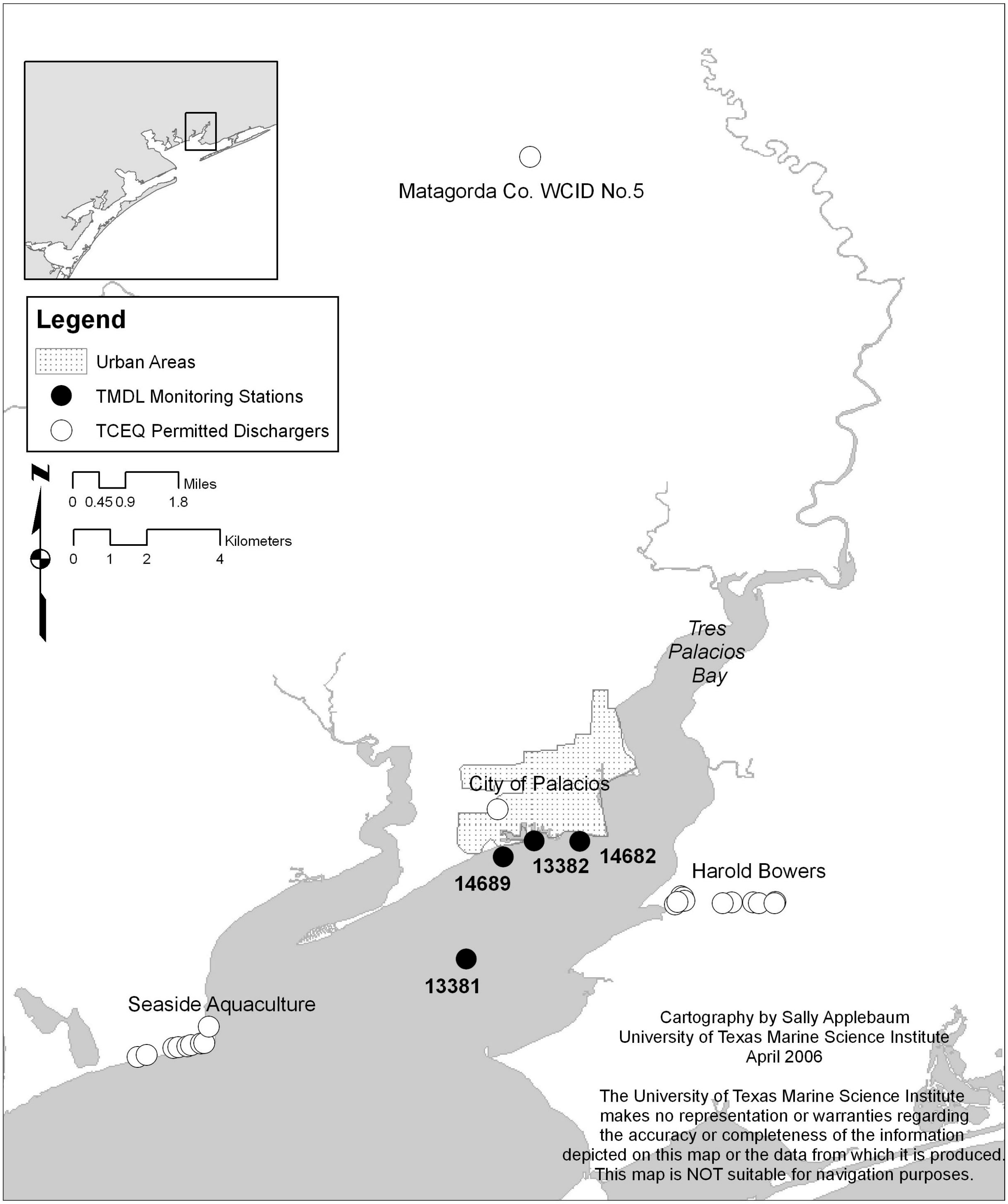


Figure 12. TCEQ permitted discharges and TMDL project monitoring stations in the Tres Palacios and Matagorda Bay area.

pH Historical Data Review

The historical data review for pH is limited to Carancahua Bay, Segment 2456, because that is the only segment of concern where pH values might be out of compliance range. Data is from the same set as the DO data, and variables are listed in Table 1, and the stations are shown in Figure 3. A total of 300 grab samples were taken in the Segment from 9/24/1973 to 9/8/2005. Much of the data was for a vertical profile, so the data were averaged by date and station, and this yielded 188 independent measurements. The pH criteria are segment specific. For all segments 2451, 2452, 2483A, and 2456, the standard is a minimum of 6.5 and a maximum of 9.0. There are criteria exceedances only for segment 2456 (Figure 13). The exceedance occurred only 5 out of 198 samples or 2.5% of the samples.

There was some variability of pH over time and space (Figure 14). Except for one date being out of compliance in 1977, the pH values were over 9.0 only three times in 1997 and once in 1998. Four of the five times that pH was over 9.0, it occurred at station 13388. The pH was out of compliance only once at station 13293. Since 1998, no pH values were out of compliance.

The pH value in estuarine and marine waters typically is affected by the carbonate cycle and photosynthesis. As photosynthesis occurs during the day, carbon dioxide is consumed by plants from the water, and the amount of bicarbonate decreases. Thus, with lowering buffering capacity, the pH decreases to more acidic conditions. In contrast, at night respiration consumes oxygen and produces carbon dioxide, bicarbonate levels increase, buffering increases, and the water becomes more basic. It is not known why the pH was high during the five incidents that occurred between 1975 and 2005. However, it is likely that very high respiration rates were coincident. This could be a result of degradations of organic matter, which could be natural or related to human activities. High nutrient levels caused by human activities could have increased plant biomass and therefore lead to high respiration rates.

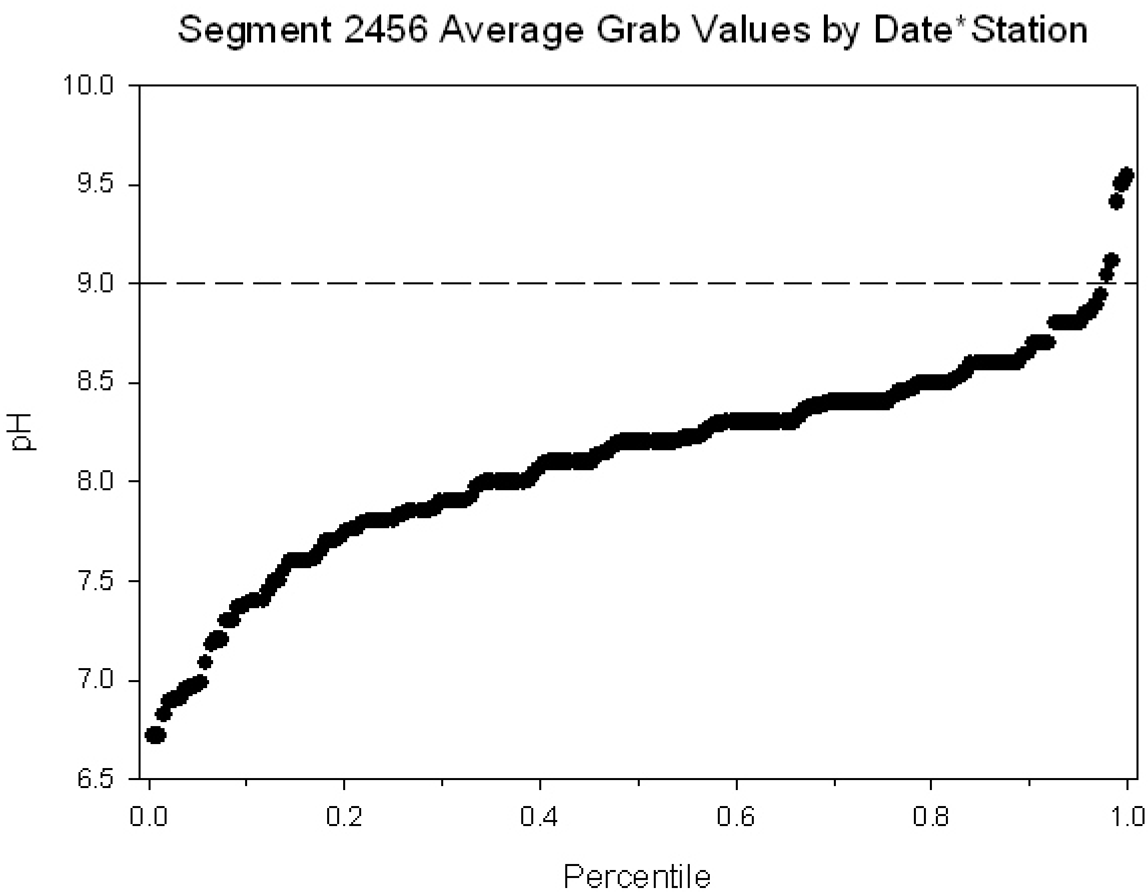
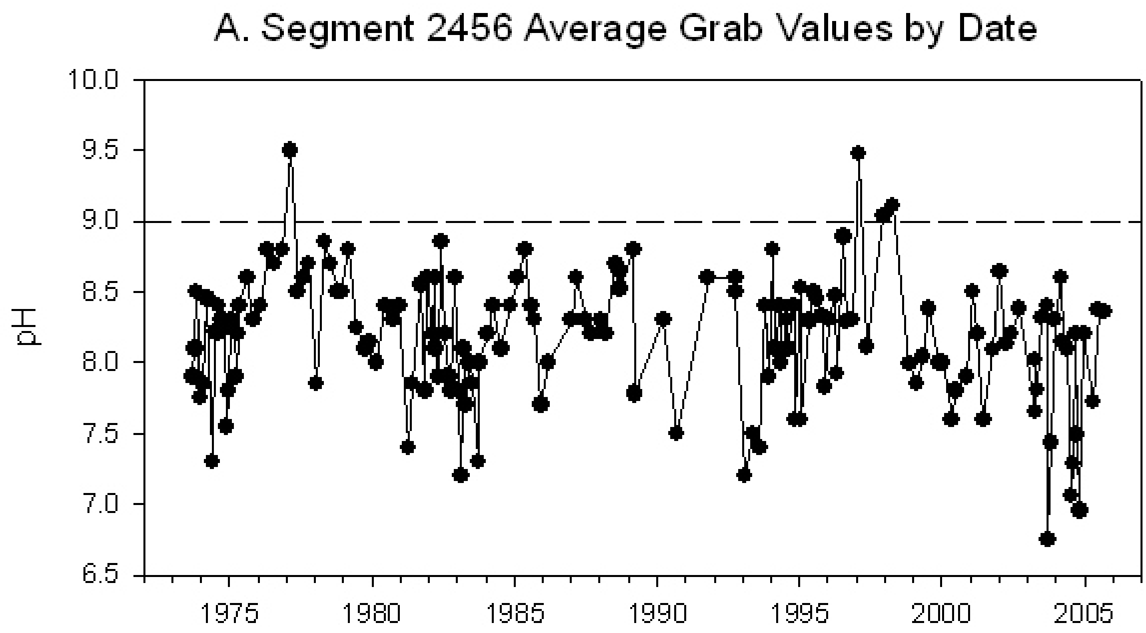


Figure 13. Caranchua Bay (Segment 2456) historical pH values averaged by date and station. Dotted line is the upper bound of acceptable pH values.



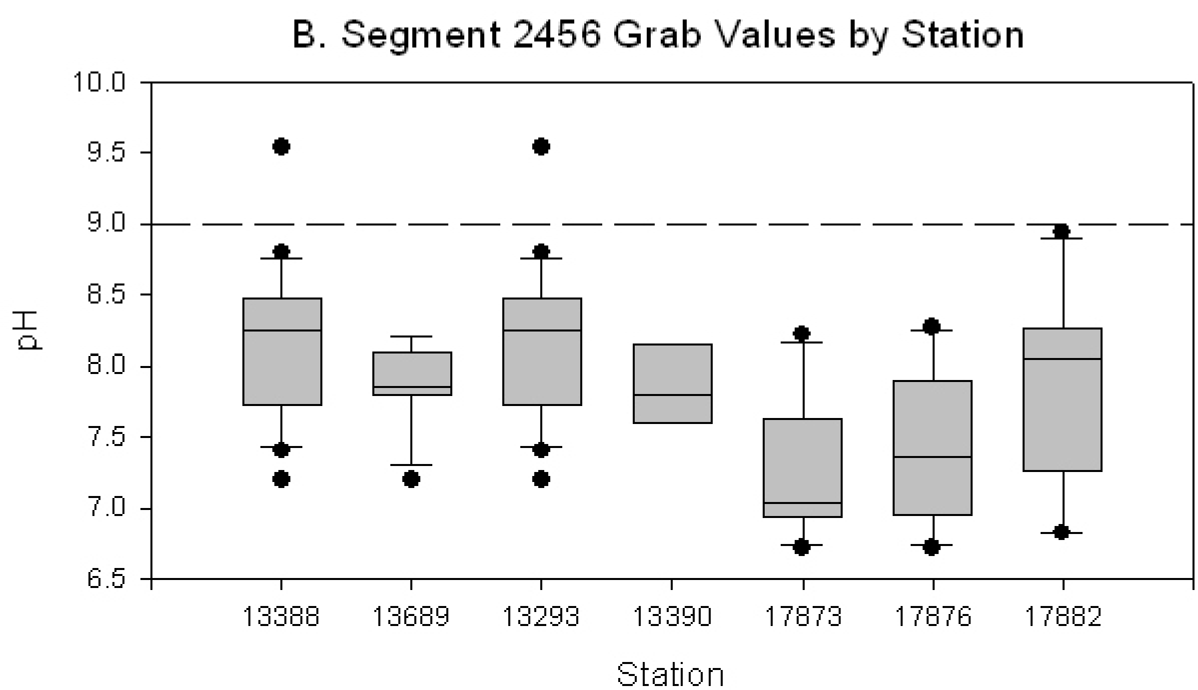


Figure 14. Variability of pH in Caranchua Bay (Segment 2456) historical values. A. By date. B. By Station. Dotted line is the upper bound of acceptable pH values.

DISSOLVED OXYGEN MONITORING AND ASSESSMENT

Methods

10 Measurement Requirement

The dissolved oxygen assessment for Matagorda Bay / Powderhorn Lake (Segment 2451), Tres Palacios / Turtle Bay (Segment 2452), Carancahua Bay (Segment 2456), and Conn Brown Harbor (Segment 2483A) was completed through a 24-hour dissolved oxygen monitoring plan. The monitoring plan was based on the requirements for a dissolved oxygen assessment as stated in the TCEQ 24-Hour DO Monitoring Fact Sheet (Appendix A), which requires 10 or more 24-hour samples over a two to five year period. All DO methods are described in detail in standard operating procedures in the 2004 Annual update of the Quality Assurance Project Plan (QAPP) submitted to TCEQ (Appendix B).

Twenty-four hour parameter measurements were taken using YSI6920 and YSI600XLM data sondes at nine stations (Figure 15). The parameters have the following accuracy and units: temperature (± 0.15 °C), pH (± 0.2 units), dissolved oxygen (mg/L ± 0.2), dissolved oxygen saturation (% ± 2%), specific conductivity (± 0.5% of reading depending on range), redox potential (± 20 mV), depth (± 0.2 m), and salinity (± 1% of reading or 0.1 ppt, whichever is greater). Salinity is automatically corrected to 25°C.

Spatial Requirement

Assessment occurs at each station that is representative of 25% of the total estuary square miles, but not more than 5,120 acres or 8 square miles. These areas are called assessment units. Based on the area of Matagorda Bay there are three assessment units (Table 4). The stations sampled are thus grouped into assessment units as follows: 13377 comprises the east half of main bay, 17354 comprise the northeast area of bay, and 13378 comprises the west half of main bay (Figure 16). Based on the area of Tres Palacios and Turtle Bay there are two assessment units (Table 4). The stations sampled are thus grouped into assessment units as follows: 13382, 14682, and 14689 comprise the Palacios area, and 13381 comprise the Oliver Point to Coon Island Bay assessment area (Figure 16). Two additional stations (14689 and 14682) were added in the 2005 sampling plan to get a more accurate spatial assessment of the segment because station 13382 is located in Palacios Harbor. Based on the area of Carancahua Bay there is one assessment unit that is represented by station 13388 (Table 4 and Figure 16). Based on the area of Conn Brown Harbor there is one assessment unit that is represented by station 113287 (Table 4 and Figure 17).

Critical Period Requirement

All samples were taken during the required index period of March 15 - October 15 (Table 5). The critical period sampling requirements, between half and two thirds of a year's samples within an assessment unit must be taken between July 1 - September 30, were met in 2004. In 2005, the critical period sampling requirements were met for the Palacios area and the Carancahua Creek assessment units by not in the other assessment units sampled.

Annual and Monthly Sampling Requirement

Samples were taken at seven stations in June through October in 2004 and April through August in 2005. The Carancahua Bay station was sampled for an additional month (September) in 2005. In order to get a more accurate assessment of Tres Palacios Bay, stations were sampled for a longer time period in 2005, and two additional stations were sampled in 2005. The DO Monitoring Fact Sheet states: "No more than 2/3 of the samples should be taken in the same year" and that "Sampling events should be more than one month apart." The first of these requirements was met for both years (Table 5). The second requirement was not met for 8 out of a total of 13 sampling dates but came within 2-3 days of meeting this requirement.

Sonde Depth Requirement

The DO Monitoring Fact Sheet states that sondes are to be deployed "...between a depth of 1 foot and a depth of ½ the mixed surface layer." Assuming that Matagorda Bay, Tres Palacios Bay, Turtle Bay, Carancahua Bay and Conn Brown Harbor are well mixed, because it is shallow and subjected to tidal and wind mixing forces, all samples were taken within a depth of 1 ft and ½ the total depth of the station. This requirement is met for all data. Sampling depths varied from month to month due to tide level and varying station depth.

Measurement Interval Requirement

The DO Monitoring Fact Sheet requires that sondes record data at least once per hour and no more frequently than every 15 minutes. This requirement is met for all data. Measurements were taken every 15 minutes for each 24-hour period for this project.

Duplicate Sonde Requirement

Following the 24-hr DO Monitoring Fact Sheet, two sondes were deployed in the same general area at least 20% of the time to check spatial variability at deployment sites. Thus, replicate samples were taken at sites 25 out of 79 deployments or 37% of the time.

Data Analysis

The complete data set was then analyzed to determine the percentage of 24-hour observations that were below minimum requirements for average and minimum dissolved oxygen measurements.

Table 4. Sampling stations for dissolved oxygen monitoring in Matagorda Bay and nearby coastal waters.

Assessment Unit	Segment	Station No. TCEQ	Station No. UTMSI	Description	Latitude (N)	Longitude (W)
Palacios Area	2452	13382	1	Tres Palacios Bay at Palacios Harbor	28.69583	96.22499
Oliver Point to Coon Island Bay	2452	13381	2	Tres Palacios Bay Palacios CM #38	28.66666	96.24166
Palacios Area	2452	14682	9	Tres Palacios Bay 300 yds. South of Baptist encampment	28.69572	96.21375
Palacios Area	2452	14689	8	Tres Palacios Bay 200 yds. Offshore from creek entrance of STP	28.69186	96.23255
Northeast area of bay	2451	17354	3	W. Matagorda Bay at ICWW CM #4	28.56203	96.21597
East half of main bay	2451	13377	4	Matagorda Bay at Palacios CM 16	28.53750	96.31250
West half of main bay	2451	13378	5	Matagorda Bay Matagorda Ship CM #43	28.52555	96.46667
9.2 square miles at the north end of the bay and Carancahua Creek	2456	13388	6	Carancahua Bay at SH 35	28.73167	96.43166
Entire harbor	2483A	13287	7	Conn Brown Harbor	27.90022	97.13660

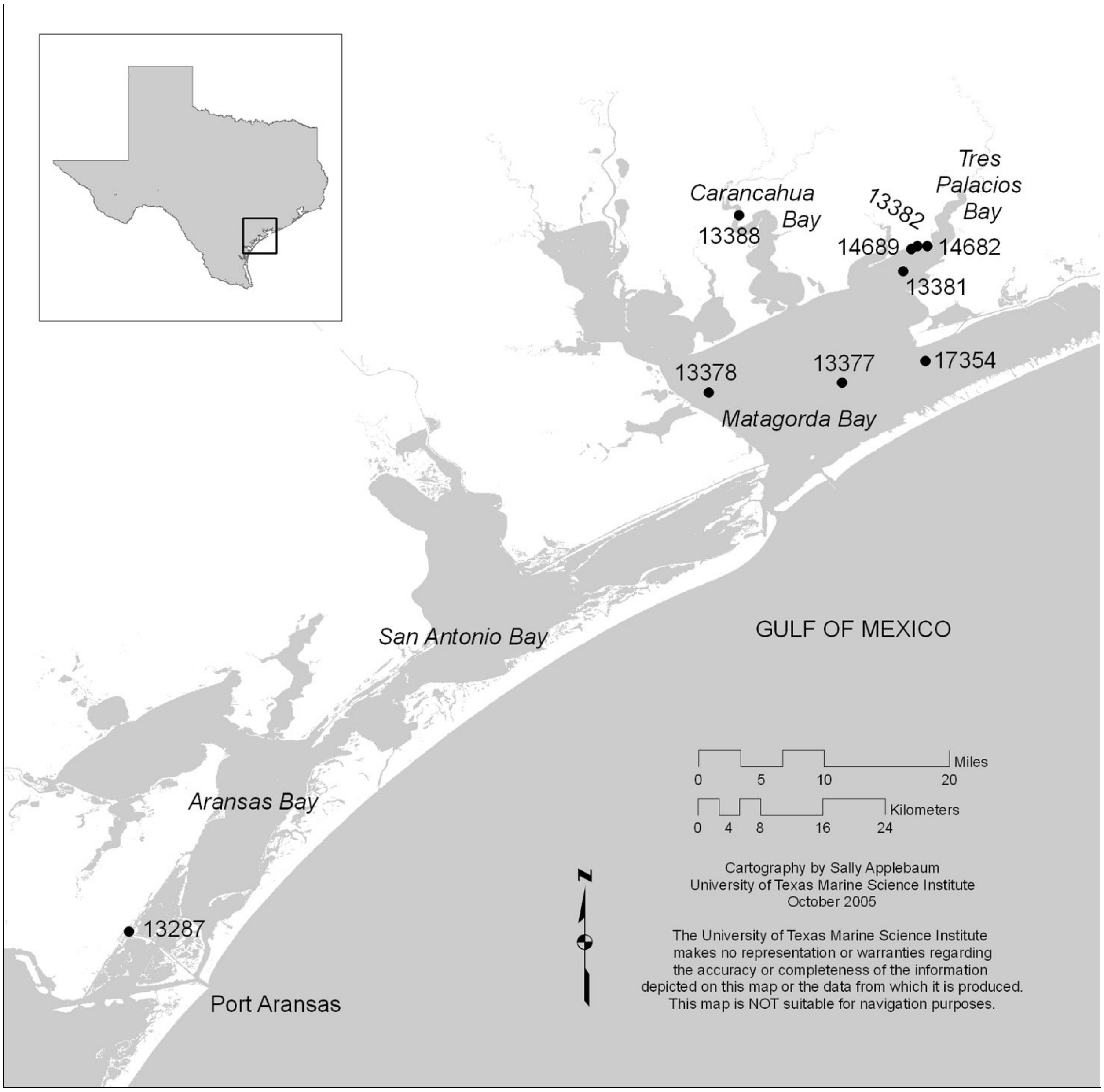


Figure 15. Map of stations used for the 24-hour data sonde deployment in Segment 2451, 2452, 2456, and 2483a. Stations numbers are assigned by TCEQ.

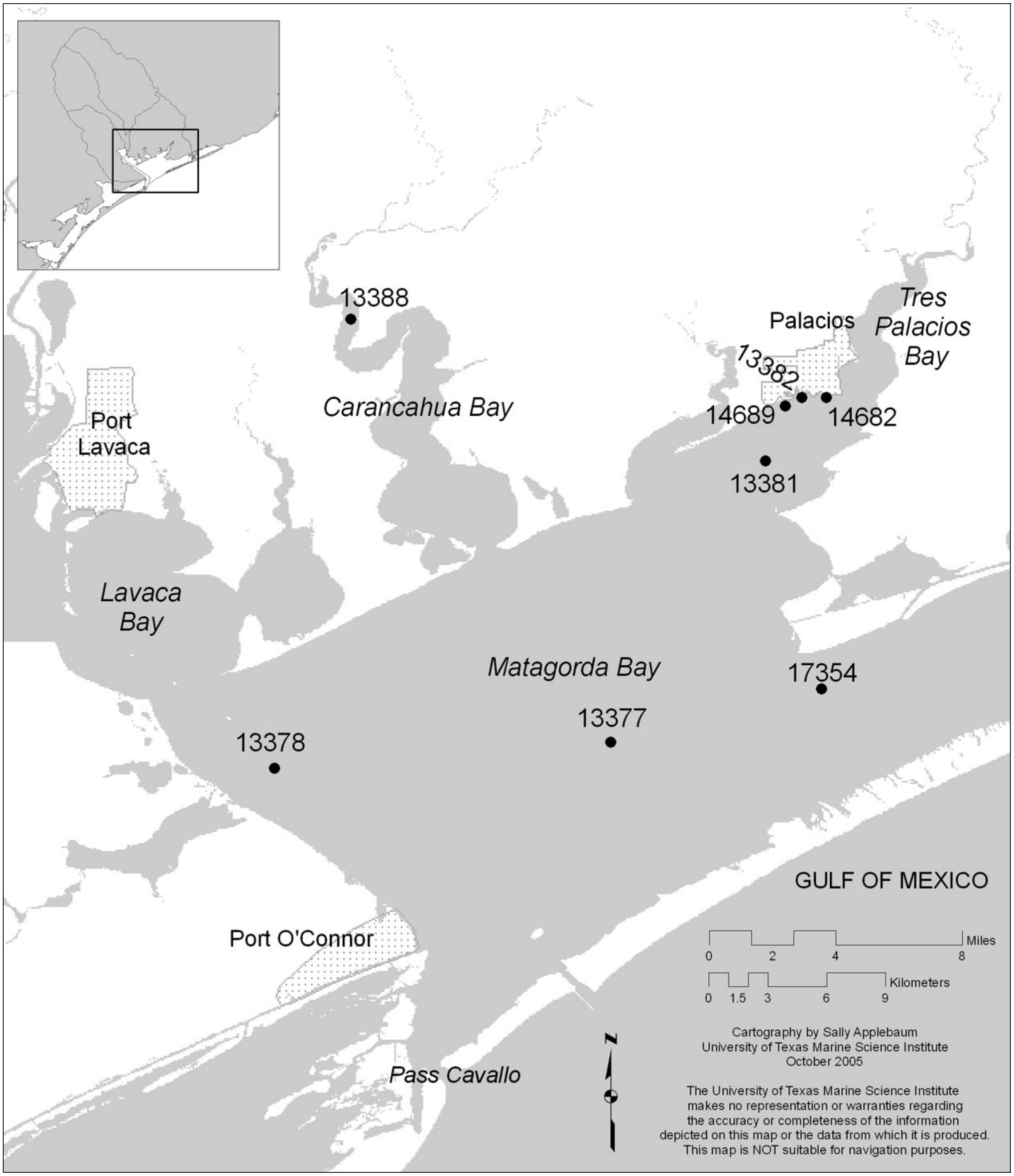


Figure 16. Map of stations used for the 24-hour data sonde deployment in Segment 2451, 2452, and 2456. Stations numbers are assigned by TCEQ.

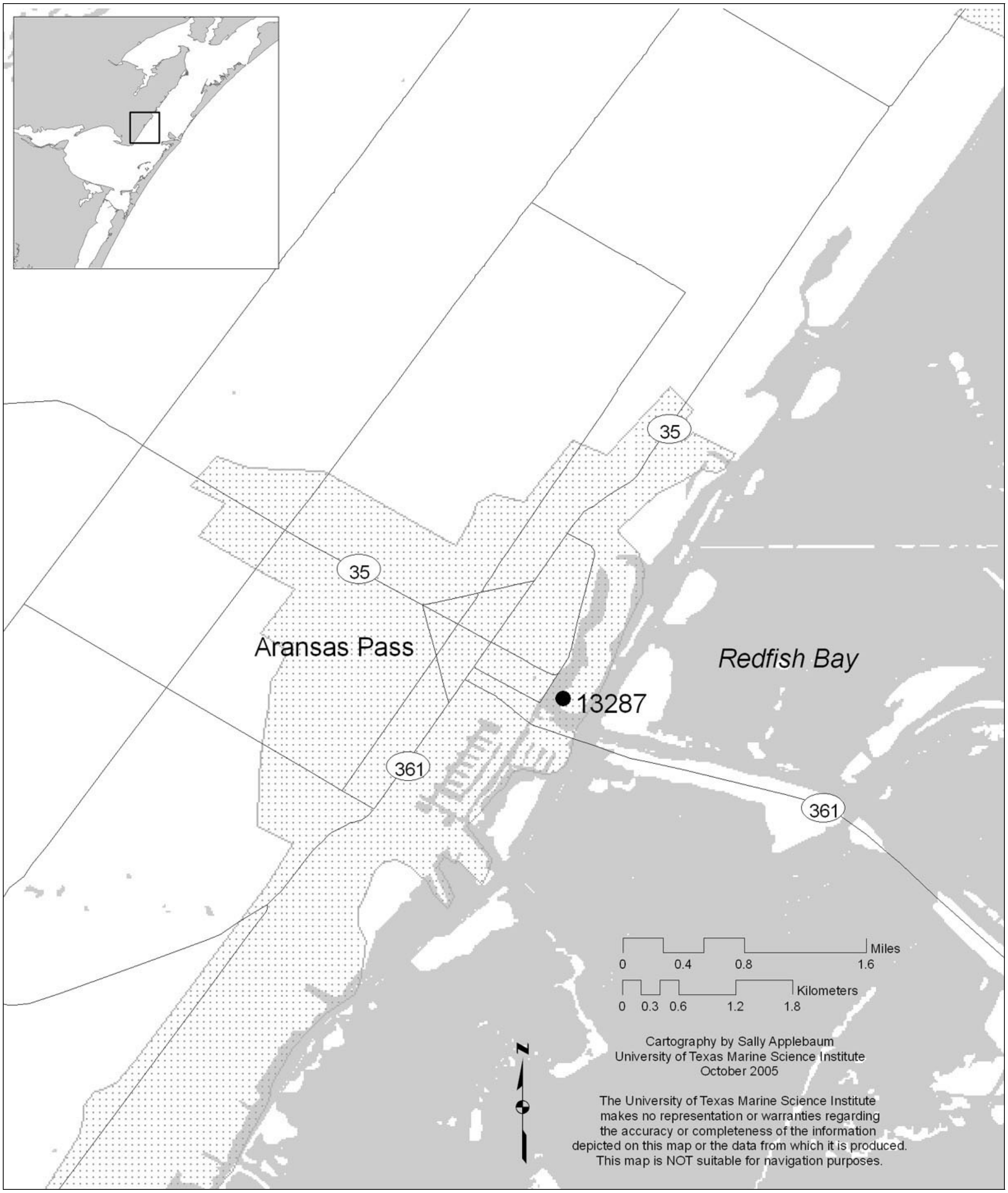


Figure 17. Station used for the 24-hour data sonde deployment in Segment 2483a. Stations number is assigned by TCEQ.

Table 5. Number and percent of samples taken per assessment in 2004 and 2005 within the index and critical periods.

Assessment Unit	Stations	2004 Index Period	2005 Index Period	2004 Critical Period	2005 Critical Period
Palacios Area	13382, 14682, 14689	5 (100%)	11 (100%)	3 (60%)	6 (55%)
Oliver Point to Coon Island Bay	13381	5 (100%)	6 (100%)	3 (60%)	2 (**33**%)
Northeast area of bay	17354	5 (100%)	5 (100%)	3 (60%)	2 (**40**%)
East half of main bay	13377	5 (100%)	5 (100%)	3 (60%)	2 (**40**%)
West half of main bay	13378	5 (100%)	5 (100%)	3 (60%)	2 (**40**%)
9.2 mi^2 at the north end of the bay and Carancahua Creek	13388	5 (100%)	6 (100%)	3 (60%)	3 (50%)
Entire harbor	13287	5 (100%)	5 (100%)	3 (60%)	2 (**40**%)

Results

Data for 24-hour average and minimum DO, and minimum and maximum pH are presented in Table 6. In 25 Station-Date combinations, there are duplicate samples and these should be averaged to yield the correct assessment sample unit. The duplicate samples also provide information to assess precision of the assessments. Other ancillary data (e.g., salinity, temperature and depth) needed to interpret the DO and pH trends is also presented.

Segment 2452

Stations in segment 2452, Tres Palacios Bay, are located in two assessment areas. Station 13382, 14689, and 14682 are in the Palacios areas assessment area, and station 13381 is in the Oliver Point to Coon Island Bay assessment area.

The Palacios area assessment unit had only one out of 17 sampling measurements (6%) that had average dissolved oxygen concentrations of less than the required 5 mg/L (Table 6, Figure 18), which occurred at station 13382. Five out of total 17 sampling measurements in this assessment area (29%) had minimum dissolved oxygen measurement of less than the required 4 mg/L (Table 6, Figure 19). Three of these five exceedances occurred at station 13382, which is located in Palacios Harbor. Concern was raised in the summer of 2005 that the harbor station 13382 may not be representative of the Palacios area assessment unit. To contrast the harbor and bay, two additional stations were added (station 14682 and 14689), which are both very near the harbor but in the open bay. Station 14682 was sampled in September and October 2005. Station 14689 was sampled in July, August and October 2005. It was found that the 24-h average DO was slightly less in the harbor than in the new bay stations, but neither station was below the level acceptable for exceptional aquatic life use in 2005. However, the station 14689 did have a minimum DO level below 4 mg/L for August 2005, in contrast, the minimum DO level in the harbor did not fall below 4 mg/L. Station 14682 also had a minimum DO level below 4 mg/L in October 2005, that was lower than the minimum DO level in the harbor. There were no pH exceedances at this stations.

Station 13381 in the Oliver Point to Coon Island Bay assessment area did not have any DO or pH exceedances in either 2004 or 2005 for either average or minimum.

Segment 2451

Stations in segment 2451, Matagorda Bay, are located in three assessment areas. Station 13377 is in the east half of the main bay assessment area. Station 13378 is in the west half of main bay assessment area, and station 17354 is in the northeast area of bay assessment area.

Station 13378 exceeded the 24-hour average and minimum DO criteria in one out of the ten samples (10%) (Table 6, Figure 20 and 21). Although there were two TAG ID samples in July 16, 2004 with exceedances, these are duplicate samples and should be averaged into one value. For this date, the average DO concentration for the 24-hour sample is 2.78 mg/L and the minimum is 1.4 mg/L. There are no DO exceedances for stations 13377 or 17354. Because only one sample in 30, i.e., only 3% of the samples exceeded the exceptional aquatic life standard, overall the segment does not appear to be impaired. There were no pH exceedances for any stations.

Segment 2456

The Carancahua Bay segment 2456 had one station, 13388, in the assessment area 9.2 square miles at the north end of the bay and Carancahua Creek. There were no DO or pH criteria exceedances in the 11 samples (Table 6, Figure 22). On September 16, 2005 there was one minimum DO exceedance, but this was a duplicate sample and the average from minimum DO on this date was 4.14 mg/L, which does not exceed the DO criteria.

Segment 2483A

The Conn Brown Harbor segment 2483A had one station, 13287, in the entire harbor assessment area. There were no DO or pH criteria exceedances in the 11 samples (Table 6, Figure 23).

Table 6. Analysis of 24 hour data for segments 2452, 2451, 2456, and 2483A: Depth (m), Temperature (°C), Salinity (ppt), Dissolved Oxygen (mg/L). Abbreviations: Dep=Depth, Temp=Temperature, Sal=Salinity, DO=Dissolved Oxygen. Parameter code in parentheses. The criteria for 24-hr average and 24-minimum DO are 5 mg/L and 4 mg/L, respectively, so values lower than these TCEQ criteria are in bold typeface.

					24 Hour Sample						
Tag ID	End Date	Station	Total Dep (82903)	Sample Dep (13850)	Avg Temp (00209)	Avg Sal (00218)	Avg DO (89857)	Min DO (89855)	Max DO (89856)	Min pH (00216)	Max pH (00215)
UM01601	6/15/2004	13381	2.5	1.21	29.62	11.85	9.13	7.72	11.27	8.48	8.71
UM01605	6/15/2004	13381	2.5	1.17	29.54	11.99	9.02	7.68	10.93	8.11	8.33
UM01712	7/16/2004	13381	2.4	0.72	30.08	3.27	6.89	6.14	7.91	8.54	8.70
UM01807	8/18/2004	13381	2.4	0.58	27.97	20.57	7.14	6.34	7.72	8.29	8.35
UM01808	8/18/2004	13381	2.4	0.76	27.90	20.74	7.29	6.55	7.85	8.13	8.23
UM01900	9/14/2004	13381	2.4	0.83	28.90	24.71	6.59	5.81	7.43	8.31	8.39
UM02006	10/12/2004	13381	2.5	0.76	25.08	23.64	8.43	7.39	9.22	8.42	8.53
UM02007	10/12/2004	13381	2.5	0.73	24.95	23.65	8.44	7.39	9.26	8.46	8.55
UM02104	4/6/2005	13381	1.8	0.88	21.68	13.88	8.30	7.67	9.04	8.26	8.39
UM02188	5/3/2005	13381	2.3	0.79	21.60	19.98	8.46	8.11	8.99	8.26	8.32
UM02281	6/2/2005	13381	2.4	0.62	27.99	20.18	8.03	6.03	10.65	8.22	8.43
UM02377	7/1/2005	13381	2.4	0.82	30.96	24.94	6.25	5.45	7.52	8.10	8.25
UM02477	8/2/2005	13381	2.4	0.67	31.48	23.72	6.53	5.89	7.56	8.12	8.26
UM02617	10/4/2005	13381	2.7	1.18	29.30	27.75	6.54	5.66	8.06	7.89	8.08
UM01600	6/15/2004	13382	1.6	0.64	29.87	8.16	6.75	5.15	8.12	7.98	8.60
UM01604	6/15/2004	13382	1.6	0.63	29.85	8.18	6.66	5.19	7.99	8.00	8.60
UM01714	7/16/2004	13382	1.3	0.49	31.30	2.52	5.21	**3.46**	8.15	8.01	8.75
UM01806	8/18/2004	13382	1.3	0.65	28.64	17.58	5.53	**2.99**	8.23	7.92	8.26
UM01812	8/18/2004	13382	1.3	0.63	28.55	17.79	5.54	**3.13**	8.33	7.93	8.28
UM01899	9/14/2004	13382	1.5	0.46	29.29	23.18	5.03	4.38	5.97	8.03	8.14
UM02005	10/12/2004	13382	1.4	0.41	25.54	23.81	5.99	4.28	7.62	8.00	8.37
UM02103	4/6/2005	13382	0.9	0.59	22.11	10.59	6.77	5.96	7.37	7.47	7.73
UM02111	4/6/2005	13382	0.9	0.68	22.07	10.65	6.71	5.82	7.35	7.74	8.00
UM02187	5/3/2005	13382	1.4	0.51	22.02	17.79	7.48	6.78	8.13	7.88	8.10
UM02280	6/2/2005	13382	1.6	0.29	28.44	14.23	7.72	5.31	11.30	7.68	8.39
UM02376	7/1/2005	13382	1.3	0.39	31.20	20.53	5.92	5.13	7.66	8.09	8.36
UM02476	8/2/2005	13382	1.3	0.27	31.84	20.80	6.34	4.71	9.02	8.01	8.44
UM02578	9/6/2005	13382	1.5	0.49	30.68	25.23	6.61	4.81	9.95	7.89	8.18
UM02579	9/6/2005	13382	1.5	0.49	30.76	25.31	6.45	4.56	9.68	8.01	8.33
UM02615	10/4/2005	13382	1.6	0.53	29.58	25.75	**4.89**	4.00	5.55	7.67	7.86
UM02616	10/4/2005	13382	1.6	0.55	29.62	25.83	**4.88**	**3.91**	5.59	7.67	7.86
UM02583	9/6/2005	14682	1.9	0.59	30.78	21.08	7.60	4.69	10.66	8.09	8.46
UM02584	9/6/2005	14682	1.9	0.66	30.22	23.31	7.66	4.57	10.86	8.03	8.41
UM02620	10/4/2005	14682	2.1	0.83	29.55	23.94	5.55	**3.48**	7.11	7.80	8.05

Tag ID	End Date	Station	Total Dep (82903)	Sample Dep (13850)	24 Hour Sample Avg Temp (00209)	Avg Sal (00218)	Avg DO (89857)	Min DO (89855)	Max DO (89856)	Min pH (00216)	Max pH (00215)
UM02621	10/4/2005	14682	2.1	0.82	29.54	23.85	5.68	**3.55**	7.27	7.78	8.02
UM02383	7/1/2005	14689	1.7	0.47	31.06	21.52	6.60	5.66	8.05	7.88	8.18
UM02483	8/2/2005	14689	1.6	0.32	31.66	21.26	6.48	**3.70**	8.56	7.81	8.18
UM02618	10/4/2005	14689	1.9	0.64	29.29	24.31	6.21	5.17	7.94	7.99	8.29
UM02619	10/4/2005	14689	1.9	0.68	28.73	24.81	6.25	5.36	8.06	7.68	7.97
UM01606	6/15/2004	13377	4.4	2.21	29.45	14.52	7.50	6.13	8.73	7.99	8.28
UM01716	7/16/2004	13377	4.2	1.57	29.95	11.64	6.97	6.29	7.83	8.35	8.55
UM01717	7/16/2004	13377	4.2	1.61	29.89	11.66	6.67	5.87	7.40	8.27	8.50
UM01810	8/18/2004	13377	4.2	1.65	27.77	25.69	6.93	6.47	7.49	8.20	8.25
UM01902	9/14/2004	13377	4.3	1.82	29.15	27.76	6.56	6.02	7.19	8.20	8.28
UM02010	10/12/2004	13377	4.3	1.76	25.50	25.94	7.76	7.23	8.28	8.35	8.41
UM02011	10/12/2004	13377	4.3	1.75	25.41	26.20	7.57	7.04	8.15	8.43	8.48
UM02106	4/6/2005	13377	3.8	1.75	21.11	18.96	8.20	7.75	8.71	8.42	8.48
UM02190	5/3/2005	13377	4.2	1.65	21.71	23.12	8.40	7.95	9.07	8.22	8.29
UM02283	6/2/2005	13377	4.5	1.49	28.22	27.47	7.15	6.54	8.05	8.07	8.15
UM02378	7/1/2005	13377	4.2	1.54	30.88	28.57	6.37	5.89	6.90	8.00	8.14
UM02479	8/2/2005	13377	4.2	1.26	31.45	29.29	6.78	6.35	7.36	7.89	8.05
UM01603	6/15/2004	13378	4.4	1.88	29.79	10.15	6.84	4.80	9.20	8.11	8.70
UM01713	7/16/2004	13378	4.4	1.89	29.96	21.05	**2.68**	**1.36**	5.65	7.86	8.29
UM01715	7/16/2004	13378	4.4	1.87	29.97	20.85	**2.87**	**1.43**	5.77	7.70	8.32
UM01813	8/18/2004	13378	4.5	2.01	27.77	25.70	6.54	5.62	7.51	8.20	8.30
UM01905	9/14/2004	13378	4.3	2.11	29.28	27.36	6.55	5.77	7.17	8.28	8.35
UM01907	9/14/2004	13378	4.3	2.16	29.27	26.65	6.28	5.59	6.82	8.14	8.27
UM02003	10/12/2004	13378	4.4	2.07	25.48	24.65	7.13	5.94	7.82	8.27	8.38
UM02107	4/6/2005	13378	3.7	2.02	21.00	24.85	7.73	7.30	8.25	8.26	8.32
UM02191	5/3/2005	13378	4.1	2.20	21.59	24.31	7.72	7.17	8.10	8.12	8.19
UM02284	6/2/2005	13378	4.7	2.19	28.50	23.51	6.88	5.52	7.84	8.06	8.20
UM02380	7/1/2005	13378	4.6	2.11	30.99	24.54	6.28	5.34	7.01	8.12	8.22
UM02480	8/2/2005	13378	4.4	1.72	31.70	25.37	6.31	5.43	7.53	8.00	8.13
UM01602	6/15/2004	17354	3.2	1.42	30.05	13.69	8.44	5.89	10.38	8.26	8.50
UM01718	7/16/2004	17354	3.0	1.06	29.80	8.86	6.89	5.43	8.68	8.34	8.60
UM01719	7/16/2004	17354	3.0	1.10	29.65	8.89	6.82	5.44	8.57	8.49	8.79
UM01809	8/18/2004	17354	3.0	1.16	27.72	24.85	6.69	6.01	7.49	8.12	8.21
UM01811	8/18/2004	17354	3.0	1.14	27.61	25.42	6.70	6.02	7.50	8.35	8.41
UM01901	9/14/2004	17354	3.0	1.48	28.92	26.86	6.55	5.97	7.13	8.18	8.28
UM02008	10/12/2004	17354	3.2	1.05	25.21	24.48	7.92	6.83	8.75	8.40	8.53
UM02009	10/12/2004	17354	3.2	1.14	25.16	24.54	7.52	6.54	8.26	8.25	8.40
UM02105	4/6/2005	17354	2.6	1.00	21.37	17.93	8.38	7.78	8.91	8.31	8.44
UM02189	5/3/2005	17354	3.0	1.11	21.29	21.87	8.28	7.48	9.16	8.14	8.34
UM02282	6/2/2005	17354	3.3	1.09	27.92	24.27	6.58	5.05	8.53	7.91	8.26

Tag ID	End Date	Station	Total Dep (82903)	Sample Dep (13850)	24 Hour Sample Avg Temp (00209)	Avg Sal (00218)	Avg DO (89857)	Min DO (89855)	Max DO (89856)	Min pH (00216)	Max pH (00215)
UM02379	7/1/2005	17354	3.0	1.14	30.79	27.75	5.85	4.91	7.56	7.70	8.05
UM02478	8/2/2005	17354	3.0	1.09	31.13	26.07	6.18	4.55	7.62	7.58	8.05
UM01681	6/24/2004	13388	1.5	0.78	25.74	0.03	5.34	4.91	6.27	6.81	7.17
UM01682	6/24/2004	13388	1.5	0.80	25.72	0.03	5.35	5.00	6.09	6.72	7.07
UM01720	7/16/2004	13388	0.3	0.28	30.59	0.41	6.30	5.17	8.07	7.68	8.61
UM01814	8/18/2004	13388	0.6	0.12	28.02	1.67	7.53	5.94	9.15	8.06	8.62
UM01903	9/14/2004	13388	0.7	0.12	28.76	4.64	6.98	5.63	8.34	8.25	8.49
UM01908	9/14/2004	13388	0.7	0.14	28.66	4.57	6.81	5.51	8.20	8.28	8.54
UM02004	10/12/2004	13388	0.6	0.20	25.31	1.36	9.30	7.51	11.75	8.28	8.82
UM02109	4/6/2005	13388	0.2	0.29	22.59	4.25	8.19	7.14	9.37	8.33	8.76
UM02112	4/6/2005	13388	0.2	0.30	22.51	4.25	8.15	7.03	9.32	8.34	8.77
UM02192	5/3/2005	13388	0.5	0.40	22.02	9.79	9.27	7.63	11.11	8.18	8.55
UM02285	6/2/2005	13388	0.9	0.12	28.30	0.50	7.61	5.81	11.60	7.81	8.57
UM02381	7/1/2005	13388	0.5	0.18	30.31	7.52	6.61	4.87	9.18	7.85	8.39
UM02481	8/2/2005	13388	0.5	0.04	29.76	1.74	7.35	4.79	10.20	7.50	8.49
UM02580	9/6/2005	13388	0.7	0.43	30.19	10.94	6.21	**3.92**	8.14	8.32	8.55
UM02581	9/6/2005	13388	0.7	0.42	30.20	10.87	6.65	4.35	8.69	8.32	8.51
UM01679	6/24/2004	13287	3.9	1.60	29.07	26.81	5.11	4.33	6.07	8.33	8.44
UM01680	6/24/2004	13287	3.9	1.62	29.11	26.95	5.38	4.51	6.35	8.28	8.40
UM01721	7/16/2004	13287	3.8	0.60	31.10	27.13	6.92	5.47	8.02	8.31	8.64
UM01815	8/18/2004	13287	3.9	1.73	28.29	24.41	6.57	4.46	8.12	8.60	8.75
UM01904	9/14/2004	13287	3.9	1.61	30.08	26.73	6.57	4.18	8.22	8.35	8.74
UM01906	9/14/2004	13287	3.9	1.62	30.17	26.30	6.75	4.54	8.10	8.35	8.70
UM02002	10/12/2004	13287	4.2	1.86	26.95	21.73	7.96	7.36	8.61	8.57	8.67
UM02108	4/6/2005	13287	3.5	1.94	22.03	25.44	7.15	5.77	8.65	8.28	8.51
UM02110	4/6/2005	13287	3.5	1.96	22.42	25.18	7.11	5.77	8.58	8.17	8.40
UM02193	5/3/2005	13287	4.0	1.93	21.94	25.28	7.72	7.32	8.22	8.45	8.57
UM02286	6/2/2005	13287	4.0	1.59	28.15	28.30	6.46	5.78	7.75	8.28	8.37
UM02382	7/1/2005	13287	3.9	1.50	31.30	27.91	5.82	4.62	7.27	8.43	8.53
UM02482	8/2/2005	13287	3.9	1.54	31.82	31.53	7.16	5.20	8.89	8.13	8.29

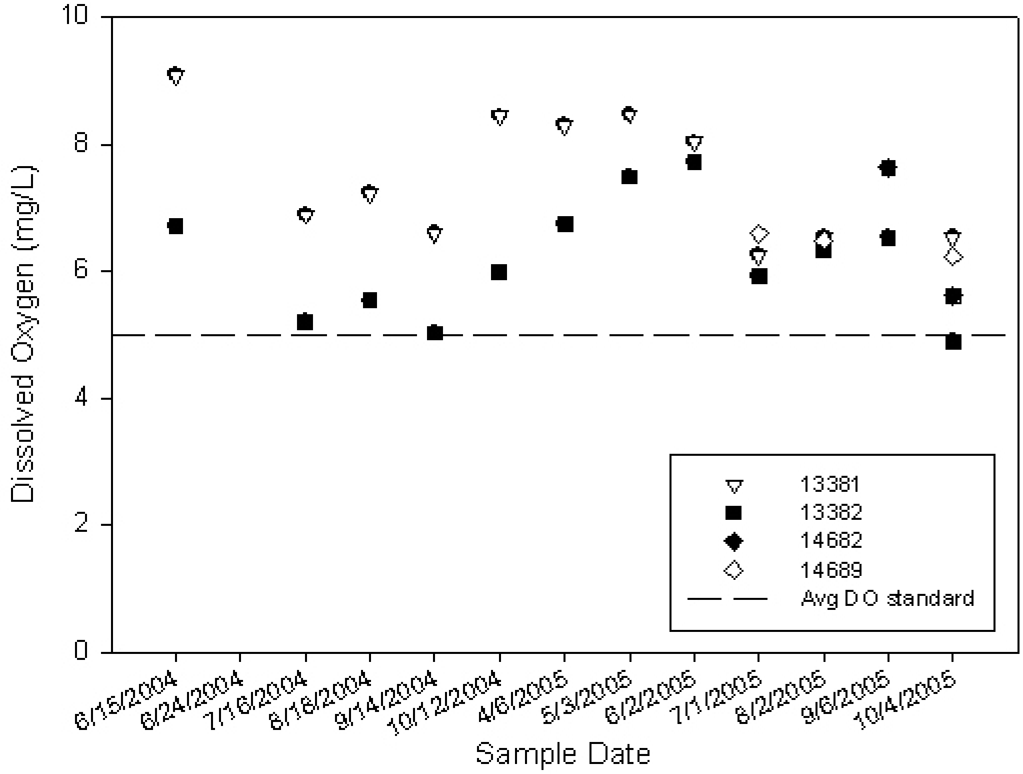


Figure 18. Average dissolved oxygen concentrations for segment 2452.

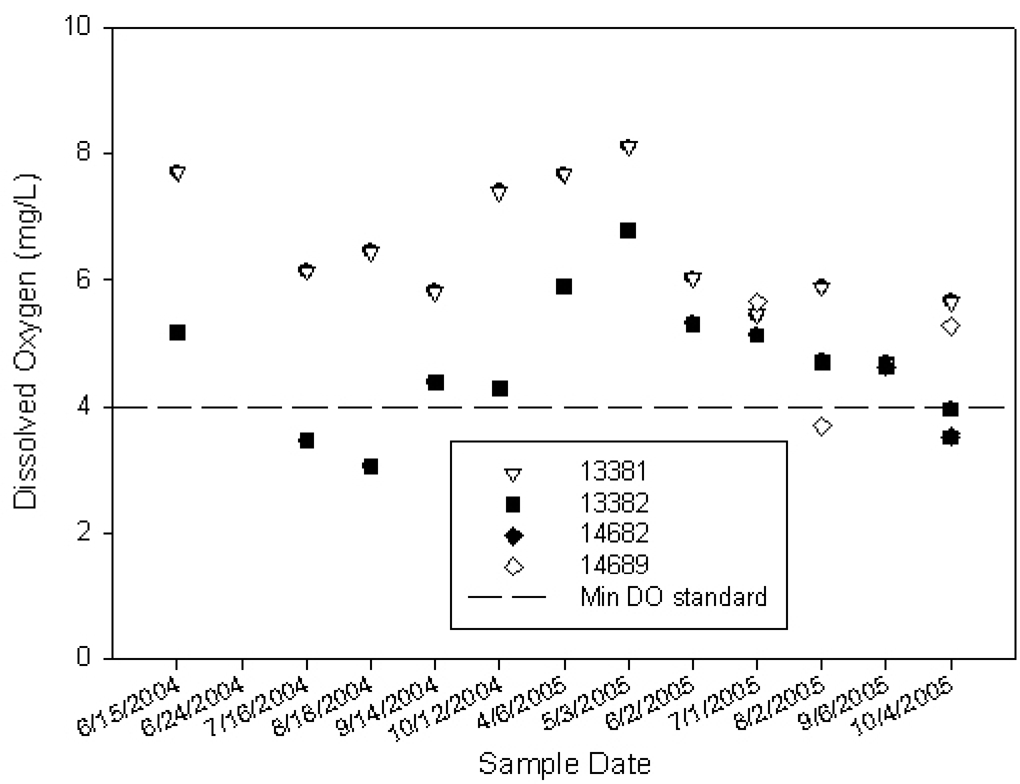


Figure 19. Minimum dissolved oxygen concentrations for segment 2452.

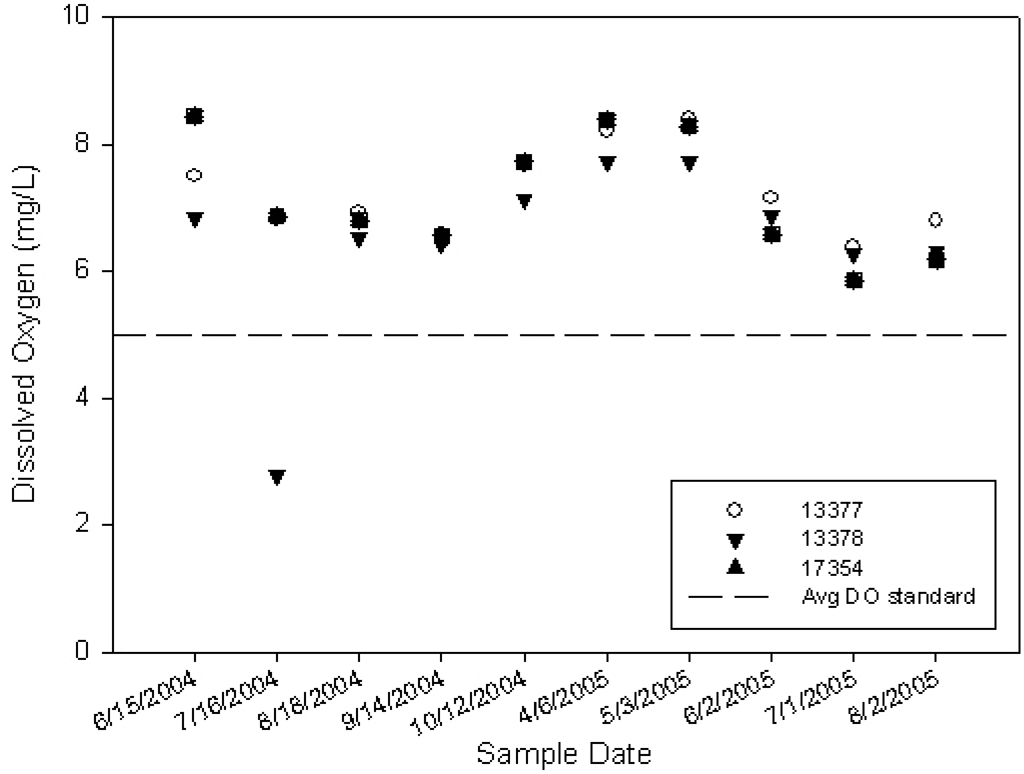


Figure 20. Average dissolved oxygen concentrations for segment 2451.

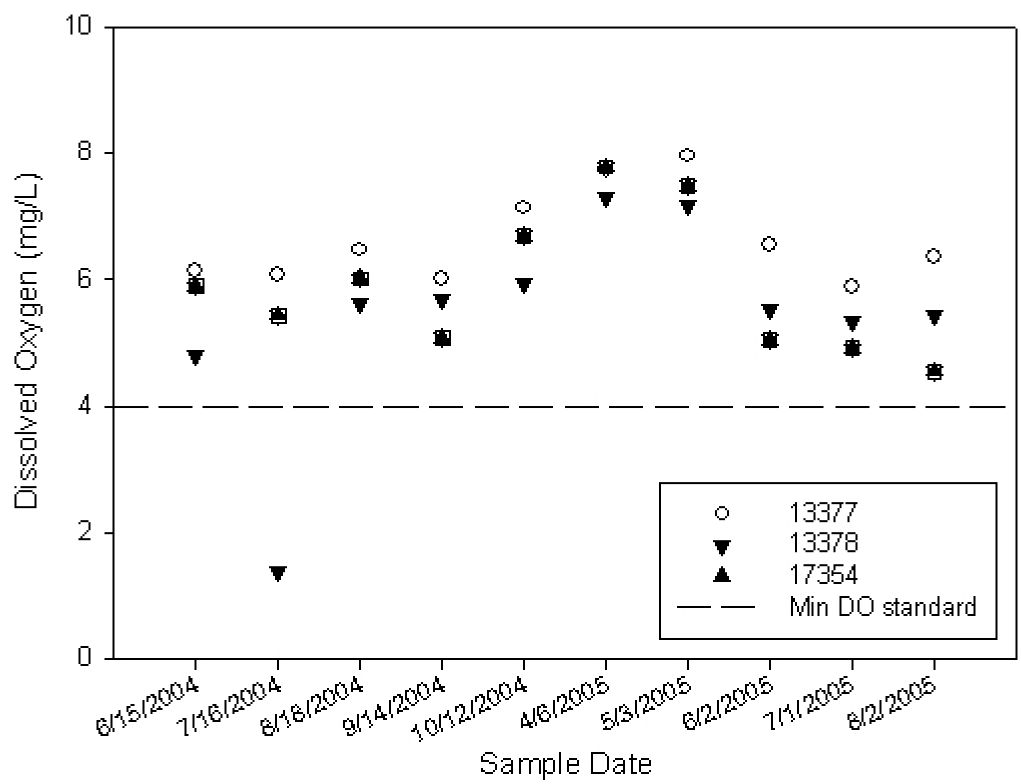


Figure 21. Minimum dissolved oxygen concentrations for segment 2451.

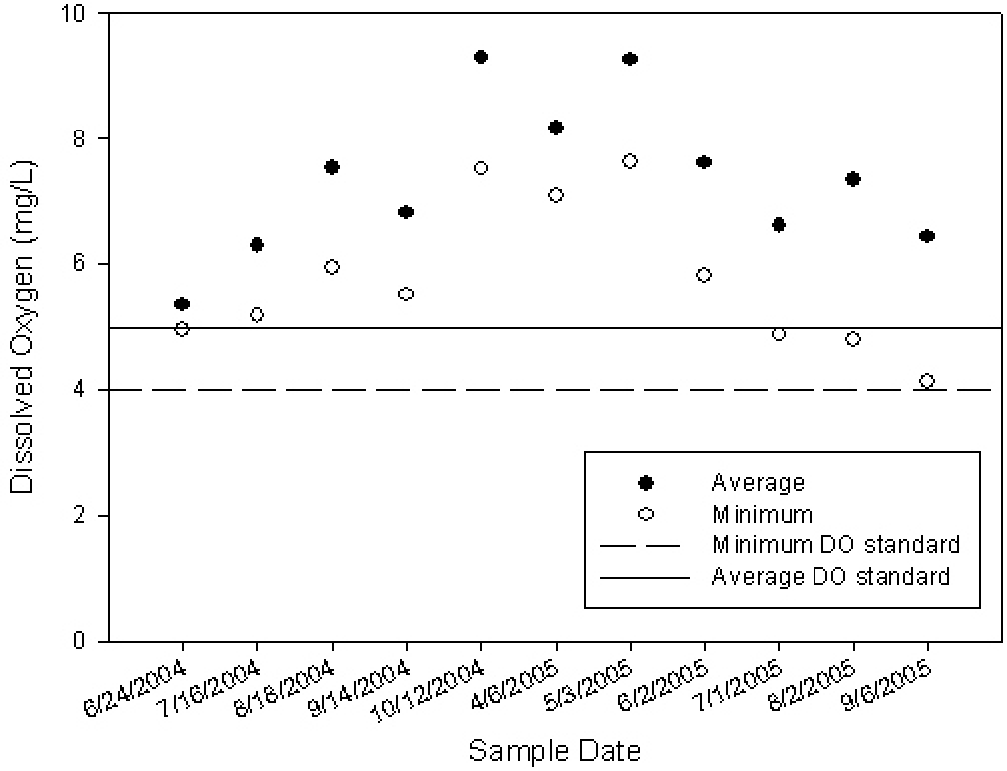


Figure 22. Average and minimum dissolved oxygen concentrations for segment 2456.

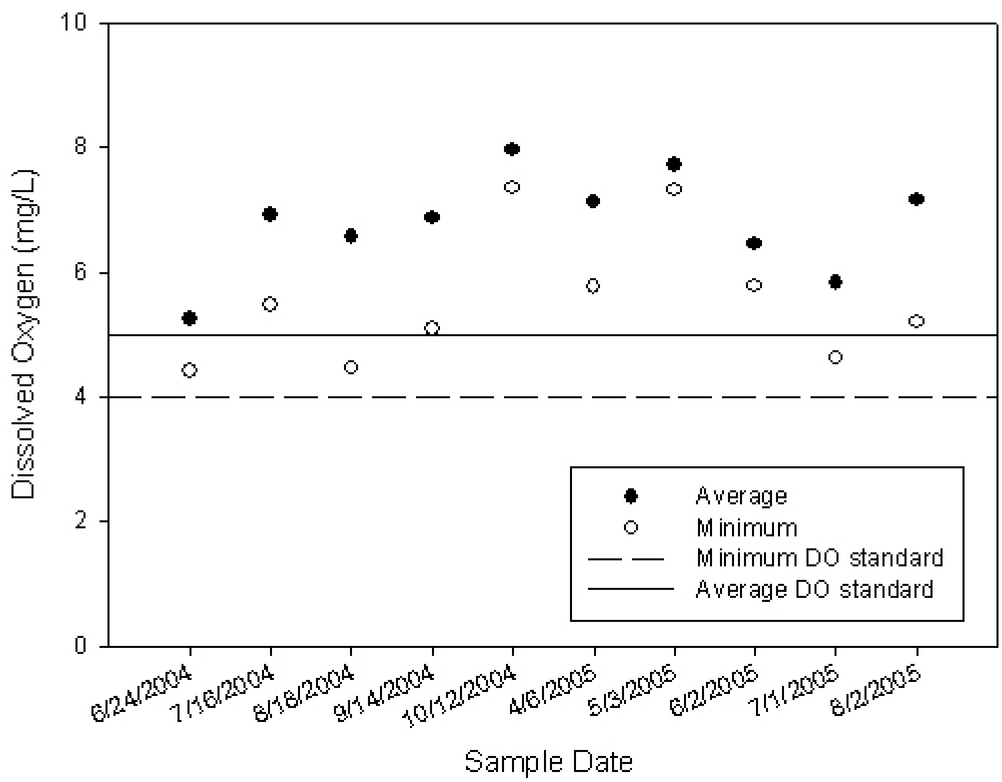


Figure 23. Minimum dissolved oxygen concentrations for segment 2483a.

Temporal Results

With the exception of October 2005, all exceedences of average and minimum requirements took place during the critical period from July 1 - September 30 (Figures 24 and 25). Out of 79 total measurements, only 2 (2.6%) were below the 24-hour average standard of 5 mg/L (Figure 24) and only 6 (7.6%) were below the 24-hour minimum standard of 4 mg/L (Figure 25). When averaged by station, the segment-wide average and minimum do not exceed the standard.

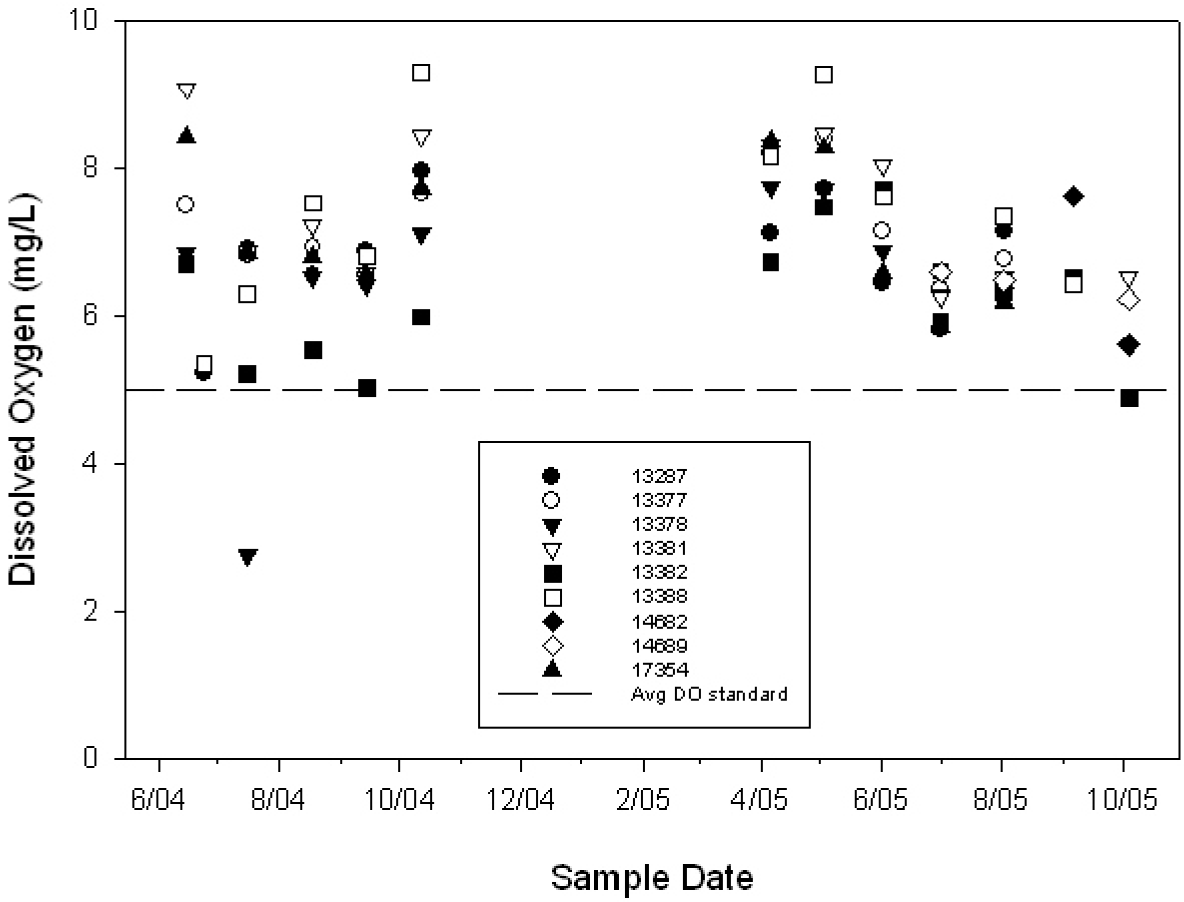


Figure 24. Average 24-hour dissolved oxygen concentrations for all samples taken from 2004 through 2005.

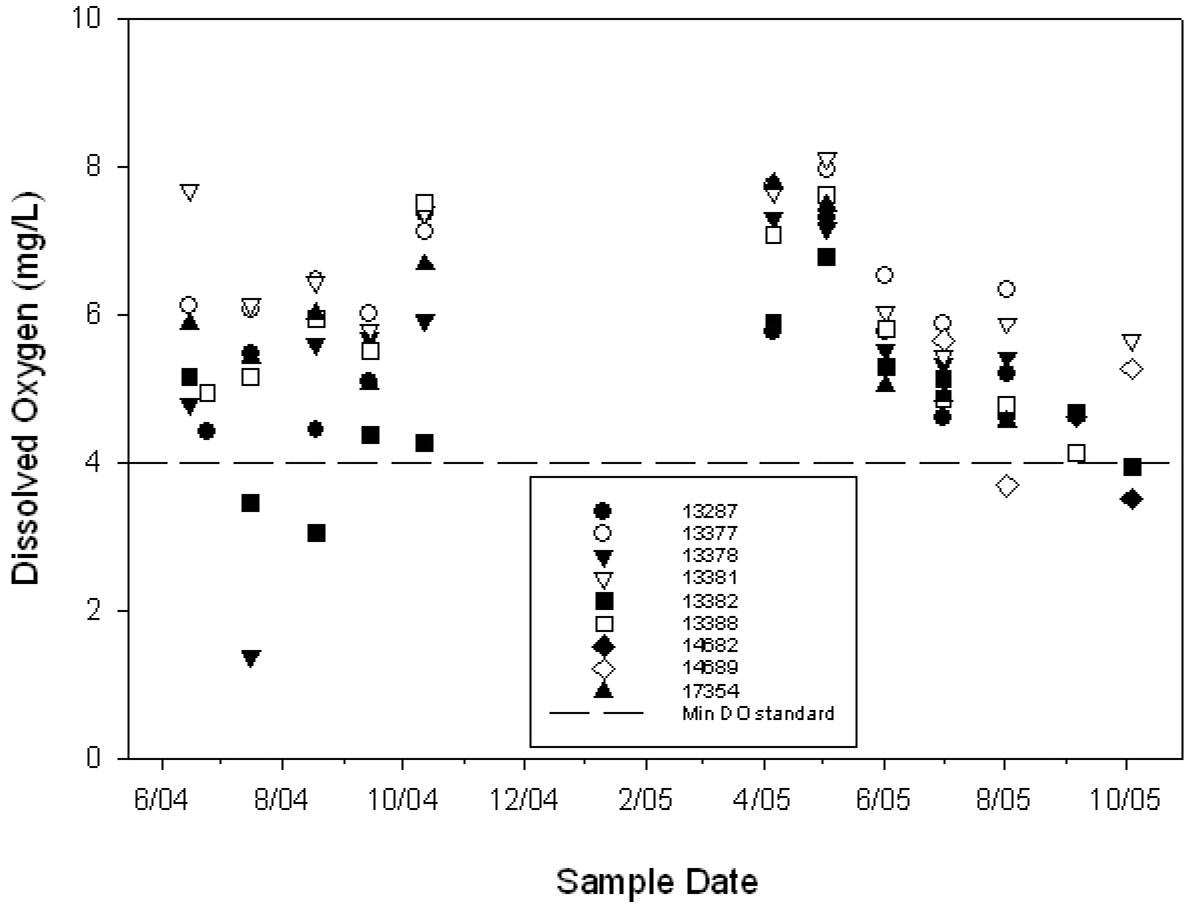


Figure 25. Minimum 24-hour dissolved oxygen concentrations for all samples during 2004 through 2005.

Fresh Water Inflow

With the exception of sampling on June 24, 2004 and June 1, 2005, fresh water inflow concentrations were low during sonde deployments (Figure 26). The exceedances on July 17, 2004 at station 13378 in Matagorda Bay may correspond to the large freshwater inflow events that occurred in late June.

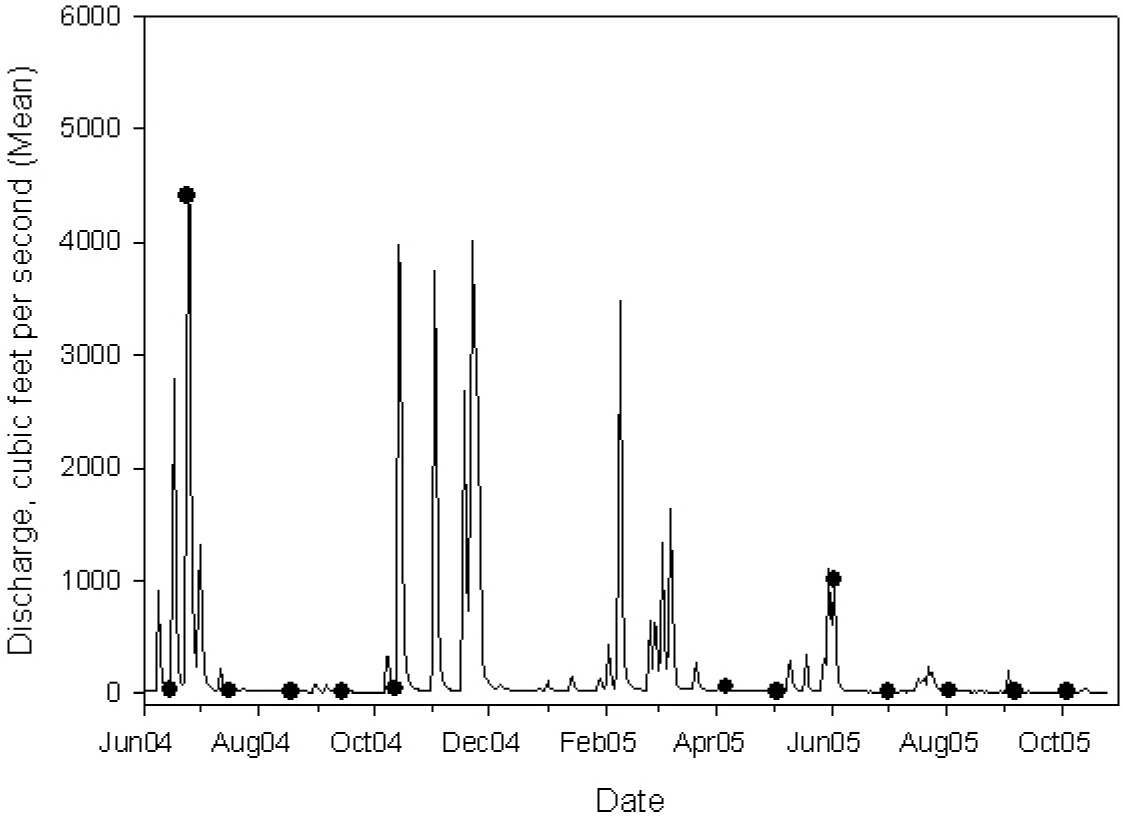


Figure 26. Fresh water inflow discharge from the Tres Palacios River collected from USGS gage 08162600. Circles indicate sampling dates.

Grab Sample Analysis

Grab samples are instantaneous measurements that are collected in a routine monitoring protocol. In this study, grab samples were taken during sonde deployment and sonde retrieval, resulting in two vertical profile data sets per 24-hour continuous measurement. A total of 955 grab samples were taken over the period of the current study.

In general, grab samples are used to identify surface waters of concern and if a 24-hour mean criterion is supported. In this study, grab samples were taken to verify the accuracy of the 24-hour measurements, and provide additional supporting data for the assessment. Measurements for each station and date were averaged into depth zones of upper mixed layer, intermediate layer, and bottom layer to determine if stratification is occurring and to locate the mixed surface layer. Exceedances of the DO standard in the upper mixed layer are reported because this is the mixed surface layer. To meet TCEQ standards, concentrations in this layer must be less than the average criterion of 5 mg/L 10% or less of the time.

There were no exceedances of DO averages from the upper mixed layer in all assessment areas of segments 2451, 2456, and 2483A (Table 7). The Oliver Point to Coon Island Bay assessment area in segment 2452 also had no exceedances of DO averages. The Palacios area, however, had five exceedances of DO average out of 36 samples (14%). Three of the five exceedances occurred in Palacios Harbor at station 13382, and two of the exceedances occurred at station 14682, which is located east of the harbor. There were no exceedances at station14689, which lies just south of Prices Slough and the City of Palacios wastewater treatment outfall.

When averaged by all sampling dates, only station 14682 had DO exceedances in the middle to bottom water layers of 1 - 2 meters in depth (Table 8).

Table 7. Analysis of grab samples DO concentration (mg/L) upper mixed layer averages for segments 2452, 2451, 2456, and 2483A. The criteria for average DO is 5 mg/L, respectively, so values lower than these TCEQ criteria are in bold typeface.

Sample Date	Segment (Station)								
	2451			2452				2456	2483A
	(13377)	(13378)	(17354)	(13381)	(13382)	(14682)	(14689)	(13388)	(13287)
6/14/2004	7.69	7.90	8.26	10.21	7.76	-	-	-	5.07
6/16/2004	7.15	7.17	7.87	7.39	7.35	-	-	-	6.36
6/23/2004	-	-	-	-	-	-	-	5.63	6.42
6/25/2004	-	-	-	-	-	-	-	5.72	7.24
7/15/2004	7.34	6.55	6.96	7.05	6.37	-	-	7.77	6.16
7/17/2004	6.49	5.25	6.80	6.88	7.27	-	-	5.83	6.61
8/17/2004	7.40	6.40	7.41	7.59	7.69	-	-	8.08	5.88
8/19/2004	6.52	6.87	6.71	6.73	5.94	-	-	7.55	7.45
9/13/2004	7.06	5.86	6.98	6.99	5.31	-	-	6.60	6.98
9/15/2004	7.16	5.87	7.33	7.24	**4.98**	-	-	5.77	7.16
10/11/2004	8.76	6.55	9.08	9.14	5.98	-	-	8.31	7.06
10/13/2004	8.50	6.40	9.52	9.20	8.33	-	-	7.72	8.17
4/4/2005	8.52	7.30	8.90	8.85	7.25	-	-	11.27	7.10
4/7/2005	8.11	7.43	8.27	8.37	6.11	-	-	9.27	8.11
5/2/2005	8.58	7.28	8.28	8.75	7.44	-	-	8.48	5.68
5/4/2005	7.91	7.24	8.30	7.73	7.47	-	-	8.79	6.82
6/1/2005	6.63	6.00	6.32	7.27	7.11	-	-	7.58	6.00
6/3/2005	6.61	6.05	6.67	6.99	6.93	-	-	7.25	6.12
6/30/2005	6.63	6.30	5.85	6.77	7.35	-	6.94	6.67	5.77
7/2/2005	6.34	5.82	7.05	5.85	5.48	-	5.98	5.86	7.32
8/1/2005	7.35	6.16	6.44	7.53	7.91	-	7.35	8.60	-
8/3/2005	6.32	5.55	5.74	6.48	6.16	-	6.64	5.76	-
9/5/2005	-	-	-	-	5.31	6.35	8.12	6.36	-
9/7/2005	-	-	-	-	**4.90**	**4.74**	6.27	6.54	-
10/3/2005	-	-	-	6.87	**4.65**	5.01	7.23	-	-
10/5/2005	-	-	-	6.47	5.15	**4.59**	5.63	-	-

Table 8. Summary statistics of grab samples by depth.

			Temperature			Salinity			D.O.		
Station	Depth	N	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
13287	0.1	21	28.13	20.35	32.83	25.84	21.09	32.41	6.77	5.03	8.28
13287	0.5	21	28.22	20.47	32.82	26.14	21.41	32.42	6.72	4.86	8.21
13287	1.0	21	28.28	20.44	32.79	26.45	21.62	32.43	6.67	4.78	8.17
13287	1.5	21	28.30	20.32	32.76	26.82	21.72	32.49	6.52	4.73	8.16
13287	2.0	21	28.22	20.28	31.82	27.29	21.78	33.23	6.31	4.60	8.19
13287	2.5	21	28.17	20.29	31.41	27.79	21.87	33.89	6.14	4.51	8.11
13287	3.0	21	28.12	20.66	31.32	28.34	24.57	33.99	5.87	4.18	7.85
13287	3.5	20	28.69	22.64	31.10	28.76	24.84	34.48	5.25	3.20	7.74
13377	0.1	20	27.86	20.88	32.43	23.62	9.04	30.09	7.38	6.31	8.74
13377	0.5	20	27.81	20.87	32.43	23.64	9.44	30.09	7.40	6.33	8.77
13377	1.0	20	27.74	20.85	32.32	23.74	10.27	30.10	7.38	6.34	8.74
13377	1.5	20	27.63	20.83	31.68	23.89	11.45	30.12	7.33	6.18	8.76
13377	2.0	20	27.55	20.79	31.44	24.21	14.25	30.12	7.29	5.76	8.97
13377	2.5	20	27.44	20.79	31.16	25.07	14.76	30.78	6.86	2.54	8.77
13377	3.0	20	27.37	20.70	31.16	26.01	15.59	31.74	6.32	1.55	8.73
13377	3.5	37	28.01	20.66	31.14	27.06	16.02	31.75	5.36	0.40	8.54
13378	0.1	20	27.34	20.17	31.86	21.43	5.87	26.96	6.76	5.25	9.25
13378	0.5	20	27.36	20.63	31.51	21.51	6.87	26.99	6.77	5.67	8.87
13378	1.0	20	27.31	20.64	31.06	22.04	7.67	27.46	6.65	5.54	7.80
13378	1.5	20	27.40	20.64	31.22	23.01	7.74	28.57	6.31	5.01	7.42
13378	2.0	20	27.29	20.67	31.28	23.96	7.86	28.85	6.01	2.16	7.39
13378	2.5	20	27.30	20.70	31.33	24.58	9.46	29.80	5.75	1.98	7.29
13378	3.0	20	27.29	20.70	31.37	26.31	18.20	31.16	5.53	2.78	7.23
13378	3.5	20	27.26	20.50	31.28	27.11	21.11	32.60	5.44	3.14	7.22
13378	4.0	23	27.78	20.48	31.30	27.51	21.74	32.96	5.10	3.43	7.00
13381	0.1	22	27.96	21.28	33.11	19.75	3.41	28.15	7.60	5.96	9.94
13381	0.5	22	27.75	21.32	31.44	19.80	3.56	28.16	7.58	5.87	10.26
13381	1.0	22	27.67	21.33	31.15	19.91	3.62	28.15	7.50	5.72	10.43
13381	1.5	22	27.58	21.32	31.01	20.09	3.62	28.18	7.25	5.52	9.02
13381	2.0	30	27.75	21.29	30.78	20.82	3.66	28.23	6.86	5.11	8.77
13382	0.1	24	28.29	21.74	32.12	17.83	2.58	27.01	6.52	4.69	8.38
13382	0.5	23	28.50	21.70	31.90	18.19	2.60	26.96	6.34	4.60	8.18
13382	1.0	39	28.01	21.68	31.84	19.17	2.60	26.88	5.82	3.70	7.48
13388	0.1	23	27.28	20.36	32.96	3.87	0.04	12.45	7.29	5.63	11.27
13388	0.5	17	27.34	23.03	31.09	4.65	0.04	12.50	6.77	5.05	8.87
14682	0.1	4	29.33	28.72	30.30	25.00	24.10	26.52	5.22	4.64	6.49
14682	0.5	4	29.27	28.77	30.04	25.10	24.36	26.52	5.12	4.53	6.21
14682	1.0	4	29.21	28.77	29.86	25.25	24.62	26.53	**4.83**	4.54	5.54
14682	1.5	4	29.23	28.87	29.85	25.84	25.17	26.60	**4.35**	3.18	5.47

			Temperature			Salinity			D.O.		
Station	Depth	N	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
14682	2.0	4	29.25	28.84	29.88	25.85	25.13	26.60	**4.19**	2.98	5.31
14689	0.1	8	30.46	28.68	32.21	23.70	20.53	27.82	6.77	5.63	8.08
14689	0.5	8	30.32	28.62	32.13	23.73	20.52	27.83	6.77	5.62	8.17
14689	1.0	8	30.22	28.65	31.88	23.67	20.51	27.83	6.52	5.43	7.16
14689	1.5	8	30.07	28.71	31.44	23.88	20.51	27.83	6.24	4.64	7.16
17354	0.1	20	27.90	21.22	32.38	21.54	7.25	27.82	7.76	5.90	10.04
17354	0.5	20	27.83	21.19	32.39	21.63	8.15	27.81	7.73	5.86	10.05
17354	1.0	20	27.73	21.22	32.14	21.80	8.97	27.81	7.59	5.79	9.77
17354	1.5	20	27.57	21.18	31.22	22.19	10.02	27.81	7.24	4.82	9.15
17354	2.0	20	27.49	21.16	31.21	22.74	10.67	27.82	6.85	3.75	8.90
17354	2.5	32	27.74	21.16	31.15	24.43	12.05	27.84	5.75	0.89	8.89

Conclusions

The 2002 Texas Water Quality Inventory and 303(d) List identifies Matagorda Bay / Powderhorn Lake (Segment 2451), Tres Palacios / Turtle Bay (Segment 2452), and Conn Brown Harbor (Segment 2483A) as having dissolved oxygen concentrations that occasionally exceed the criteria established to support the exceptional aquatic life designation. The 303(d) List also identifies Carancahua Bay (Segment 2456) as having pH concentrations that occasionally exceed the criteria established to support the exceptional aquatic life designation.

The historical data review identified that low DO conditions are primarily in and around harbors and occur primarily in summer. A monitoring plan was completed to assess the spatial and temporal occurrences of DO and pH exceedances in segments 2451, 2452, 2456, and 2483A.

DO exceedances for the Matagorda Bay segment (2451) only occurred once at station 13378 for both the 24-hour minimum and average. Station 13378 is off the Matagorda ship channel. Both of these exceedances occurred in July 2004. Theses samples were taken during a period of high freshwater inflow. There was strong stratification, and this is the likely cause of the low DO concentrations. Typically, there is good circulation in the area and this is the likely reason that upon completion of all samples, the number of exceedances was not greater than 10% of samples. Overall, only 3% of samples in segment 2451 exceeded the average and minimum DO criteria. Neither segment 2456 or 2483A exceeded the average and minimum DO criteria.

DO exceedances were strongest in the Tres Palacios Bay segment (2452). Exceedances at station 13382 occurred once in the 24-hour average and three times in the 24-hour minimum. This station is located at the entrance of Palacios Harbor. Salinities at this station are low and temperatures are high. The water is shallow, and relatively stagnant. The Harbor does not represent the entire segment. Two additional stations were added to allow for sufficient comparison to determine if the Harbor station is representative of the bay in general. Both of the additional stations had one exceedance of the 24-hour minimum criterion. Overall, only 4% of samples in segment 2452 exceeded the average DO criteria and 18% of the samples exceeded the minimum DO criteria. Three out of the five exceedances (11% of the total) for the minimum DO criteria occurred at station 13382.

Dissolved oxygen concentrations in Tres Palacios Bay were found to be a function of water circulation, temperature and biological factors that use or produce oxygen, such as organic carbon remineralization and primary production. The primary factor that appears to be causing the depressed DO values in the Palacios area is lack of water circulation during summer and high temperatures. Station13382 is located within Palacios Harbor on the inside of the jetties (Figure 27). The jetties minimize wave action and impede water circulation and mixing. The additional stations of 14682 and 14689 were only sampled a few times, which may not have been enough sample dates to provide an accurate spatial assessment of this area.

It is unlikely that the permitted discharges are large sources of nutrient loading in the area. The City of Palacios wastewater treatment plant discharges into Prices Slough (Figure 28). Station 14689 is directly south of this slough. This station had a minimum 24 hour exceedance in August 2005, but no exceedances in the grab sample averages, therefore it does not appear to be affecting DO values.

Nonpoint source nutrient inputs are more likely to be a factor in the DO depression in this area. Storm water discharges directly into the harbor. In addition, the Port of Palacios is the second largest commercial port for the shrimp fishery. Disposal of shrimp heads and other waste from shrimp cleaning is a potential nonpoint source nutrient input. The bait shrimping season is year round, but the commercial shrimping season for major bays occurs May 15th - July 15th and August 15th -

November 3rd. Although shrimp wastes could be a potential nutrient source, commercial shrimping in major bays does not occur from July16th - August 14th when DO exceedances often occur. During this time period, commercial shrimping in offshore waters is also closed.

The combination of low water circulation and nonpoint sources nutrient inputs are likely the primary cause of low DO values in the Palacios area.

Figure 27. The opening to the Palacios Harbor. Station 13382 is located on the inside of the jetties.

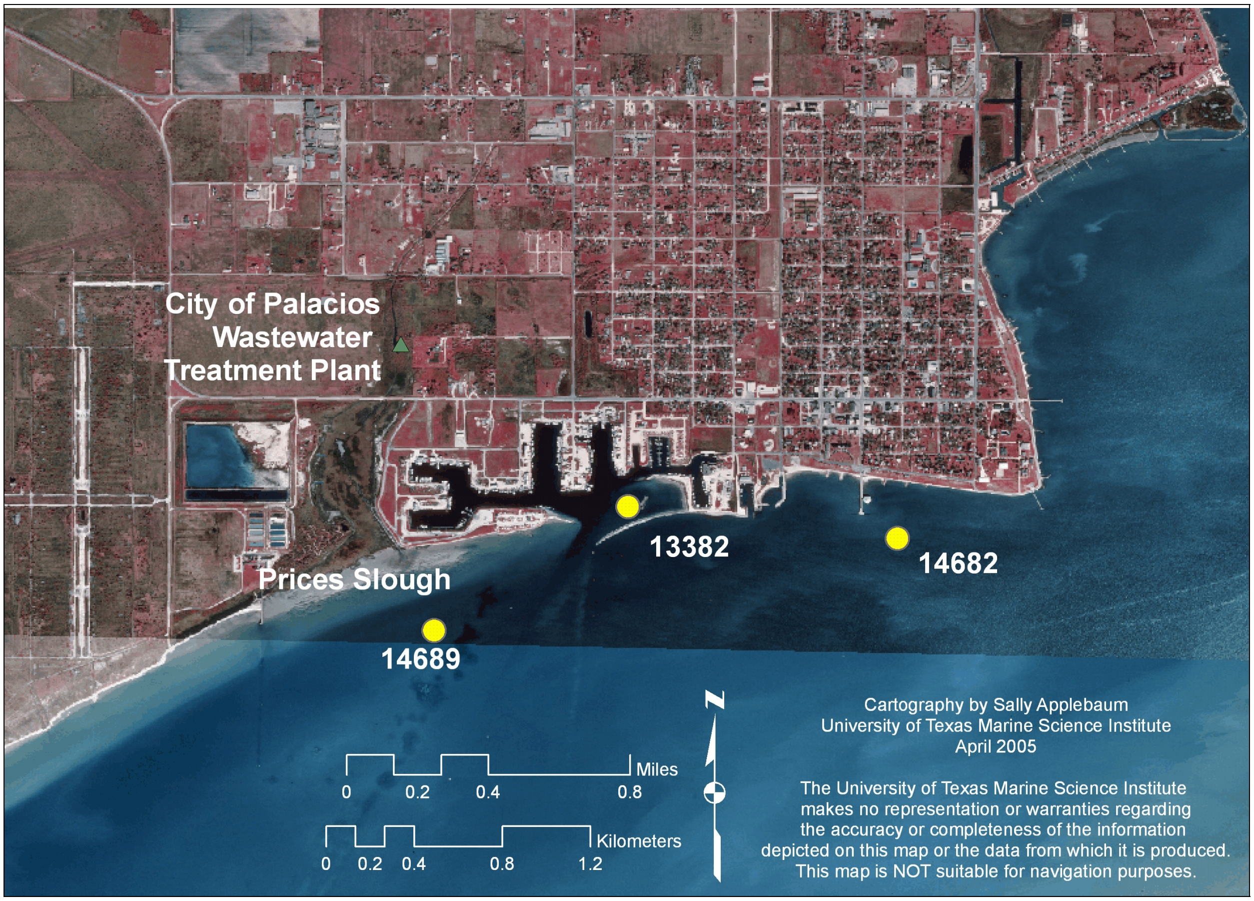


Figure 28. Permitted dischargers in the Palacios assessment area.

PUBLIC INPUT

A public hearing was held on November 1, 2005 in Palacios , Texas to present and discuss the results of the TMDL project for the Matagorda Bay (2451), Tres Palacios / Turtle Bay (2452), and Carancahua Bay (2456) segments. The hearing had an attendance of about 15 people that consisted of the local public, and local-based state agency representatives. The majority of the discussion was focused on the possible causes of the Palacios area impairment. Non-point source contaminants were indicated as the primary cause that would impair the Palacios Harbor and more specifically, station 13382. There is a storm water outfall that discharges directly into Palacios Harbor. Palacios Harbor is also the second largest port on the Texas coast for commercial shrimping. It was suggested that disposal of shrimp carcasses could be an additional source of contaminant to Palacios Harbor.

A second presentation was held to discuss the results of the Conn Brown Harbor TMDL. This presentation was held on November 8, 2005 in Corpus Christi, Texas at the Coastal Bend Bays and Estuaries Program (CBBEP) sediment and water quality implementation team meeting. The primary response from this meeting was a request for additional details in the station description. Presently, station 13287 is identified by the station description as Conn Brown Harbor. The following station description for station 13287 is more detailed and has been incorporated into the long description of the TCEQ database: “Conn Brown Harbor, at the end of the Harbor Shrimp Company Pier.” New and more precise coordinates were also submitted.

RECOMMENDATIONS

The Carancahua Bay segment 2456 does not currently appear to suffer from pH impairment. Segment 2456 supports exceptional aquatic life use. Based on the data presented in this report it is recommend that the segment be removed from the 303(d) list for pH.

The Matagorda Bay segment 2451 and the Conn Brown Harbor segment 2483A does not currently appear to suffer from dissolved oxygen impairment. Segment 2451 and 2483A supports exceptional aquatic life use. Tres Palacios / Turtle Bay segment 2452 currently appears to suffer from partial dissolved oxygen impairment. The Oliver Point to Coon Island Bay assessment area supports exceptional aquatic life use, but the Palacios area does not. Based on the data presented in this report it is recommend that the segment 2451, 2483A, and the Oliver Point to Coon Island Bay assessment area of segment 2452 be removed from the 303(d) list for dissolved oxygen. The Palacios area assessment unit should remain on the 303(d) List.

Additional 24 hour DO monitoring is recommended for stations in the Palacios area. Nutrient analysis and biological oxygen demand studies are also recommended.

REFERENCES

Montagna, P. and M. Russell, 2003. Lavaca Bay TMDL dissolved oxygen assessment report. Submitted to the Texas Commission on Environmental Quality, UTMSI technical report TR/03-002.

Ritter, C., P. A. Montagna, and M. Russell. 2002. Historical Data Review of Dissolved Oxygen and Related Parameters for the Lavaca Bay TMDL Project. Report for Texas Commission on Environmental Quality, Contract No. 582-1-30479. University of Texas at Austin, Marine Science Institute, Technical Report Number TR/02-001.

LCRA. 2005. Draft - Matagorda Bay Freshwater Inflow Needs Study. Report for Lower Colorado River Authority (LCRA). In conjunction with Texas Commission on Environmental Quality, Texas Parks and Wildlife Department, and Texas Water Development Board. Jordan, M. (Ed.), Anderson, R., Solis, R., Brown, R., Cook, B., Wedig, J., Kabir, N., Rodriguez, A., Dean, L., Trow, L. and B. Watson.

APPENDIX A: 24-Hour DO Monitoring Fact Sheet

Index period for sampling:	March 15 - October 15. All sampling events must occur within the index period. However, at least one sample and between half and two thirds of each year's samples must be taken during the critical period of July 1 - September 30. No more than 2/3 of the samples should be taken in the same year. Sampling events should be more than one month apart. A total of ten 24-hour measurements within a two to five year period is required to provide assessment of the aquatic life use. For perennial streams, in order to determine criteria support, all ten measurements must be at or above the 7Q2, so more than ten sample-collection events may be needed. The 7Q2 for classified segments is listed in Appendix B of the TSWQS. For unclassified waterbodies, contact Suzanne Vargas: svargas@TCEQ.state.tx.us; (512) 239-4619, of the Modeling and Assessment Team to determine 7Q2. To avoid collecting samples below the 7Q2, it is recommended that flow be determined before beginning a 24-hr sampling run.
Depth on streams, reservoirs, or estuaries:	Deploy sonde at a point between a depth of 1 foot and a depth of ½ the mixed surface layer.
How often to record:	Measurement interval should be no more frequently than once per 15 minutes and no less than once per hour. Four or more dissolved oxygen measurements may also be made manually at even intervals over one 24-hour period at a site, as long as one is made near sunrise to approximate the daily minimum.
Data reporting:	Parameter Codes • 24-hour averages DO: **89857**; temperature: **00209**; specific conductance: **00212**; pH n/a • # of measurements over a 24-hour period: **89858** • Minimum values DO: **89855**; temperature: **00211**; specific conductance: **00214**; pH: **00216** • Maximum values DO: **89856**; temperature: **00210**; specific conductance: **00213**; pH: **00215** Program Codes • Diel sampling (multiple field measurements conducted over a 24 hr period and/or summary 24 hr D.O. statistics), not conducted under the scope of a TMDL QAPP: **DI** • Diel sampling conducted under the scope of a TMDL QAPP: **TI**
QA requirements:	• If sampling is multiday, the measurement (average) used for the assessment will be the first 24-hour period recorded during the deployment. Following multiday deployments, evaluate and report only creditable data (free from drift). • During initial multiday sampling, drift must be checked each day with a recently calibrated separate instrument, until it is known how long the multiprobe can be deployed before significant drift occurs. • Reference checking of the multiprobe will generally be required at 3-7 day intervals. • When setting up a YSI, ensure that the warm up time is set at 90 seconds, rather than the instrument default. • Twenty percent of the time, deploy two sondes in the same general area as a test of how spatially variable conditions are at deployment sites. This QA check may be revised after we have gained some experience.
When to collect other routine field measurements and water samples:	Should collect at either the time of deployment, reference check, or retrieval of 24-hour monitoring multiprobe. Flow must be measured at site unless it is not possible to do so.

Priority for scheduling 24-hour sampling:	1. 303d listed waterbodies 2. Waterbodies with Concerns for DO problems (too few samples available for full use assessment). 3. Occurrence of low DO concentrations observed during the day 4. Waterbodies with trends indicating declining concentrations 5. Waterbodies which would contribute to Eco-region data set

APPENDIX B: Matagorda/Tres Palacios Bays Dissolved Oxygen
Total Maximum Daily Load (TMDL)
Quality Assurance Project Plan

2004

Work Order No. 582-1-30479-05

Principal Investigator, Project Manager:

Dr. Paul A. Montagna
The University of Texas at Austin
Marine Science Institute
Port Aransas, TX 78373
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TCEQ Project Manager:

Ms. Sandra Alvarado
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
P.O. Box 13087, MC - 150
Austin, Texas 78711-3087

Effective Period July 9, 2004 - August 30, 2005

A1 Approval Page
Matagorda/Tres Palacios Bays Dissolved Oxygen Total maximum Daily Load (TMDL)

Texas Commission on Environmental Quality
Office of Compliance and Enforcement
Compliance Support Division

____
Jose A. Franco, Director
Compliance Support Division

____
Stephen Stubbs, Quality Assurance Manager

____
Kyle Girten, TMDL Quality Assurance Specialist
Quality Assurance Program

Monitoring Operations Division

____
Dr. David Sullivan, Manager
Monitoring Data Management and Analysis Section

Office of Environmental Policy, Analysis, and Assessment
Environmental Planning and Implementation Division

____

Candice Garrett, Director
Environmental Planning and Implementation Division

____

Faith Hambleton, Water Quality Planning Program, Section and Grant Manager

____

Sandra Alvarado, TMDL Project Manager

University of Texas at Austin
Marine Science Institute

____
Dr. Paul A. Montagna, Project Manager, Principal Investigator

____
Mr. Larry Hyde, Quality Assurance Officer

Note: The UTMSI Quality Assurance Officer will secure written documentation (such as the letter in Appendix G) from each project participant stating the organization's awareness of and commitment to requirements contained in this quality assurance project plan and any amendments or revisions of this plan. The UTMSI Quality Assurance Officer will maintain the documentation as part of the project's quality assurance records, and will ensure that the document is available for review. Copies will also be submitted as deliverables to the TMDL Project Manager within 60 days of QAPP approval.

A2 Table of Contents

A3 Distribution List

Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Office of Compliance and Enforcement
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Kyle Girten, TMDL Quality Assurance Specialist
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Environmental Planning and Implementation Division

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University of Texas at Austin
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Mr. Larry Hyde, Quality Assurance Officer
(361) 749-6750, hyde@utmsi.utexas.edu

Mr. Richard D. Kalke, Laboratory Supervisor
(361) 749-6750, rkalke@utmsi.utexas.edu

Mr. Richard D. Kalke, Laboratory Quality Assurance Officer
(361) 749-6750, rkalke@utmsi.utexas.edu

Note: The UTMSI Quality Assurance Officer will provide copies of this project plan and any amendments or revisions of this plan to each project participant. The UTMSI Quality Assurance Officer will document receipt of the plan by sub-tier participants and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review and will also be submitted to the TMDL Project Manager within 60 days of QAPP approval.

Table A.1 - List of Acronyms.

ARAR	Applicable or Relevant and Appropriate Requirements
AWRL	Ambient Water Reporting Limits
CCC	Criteria Continuous Concentration
CHN	Carbon, Hydrogen, Nitrogen
CMC	Criteria Maximum Concentration
COC	Chain of Custody
COD	Chemical Oxygen Demand
CRM	Certified Reference Material
DMP	Data Management Plan
DO	Dissolved Oxygen
DQO	Data Quality Objective
EPA	Environmental Protection Agency
MDL	Method Detection Limit
NIST	National Institute of Science and Technology
PES	Performance Evaluation Sample
QA/QC	Quality Assurance/Quality Control
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QAS	Quality Assurance Specialist
QMP	Quality Management Plan
RPD	Relative Percent Deviation
SOP	Standard Operating Procedure
SRM	Standard Reference Material
SWQM	Surface Water Quality Monitoring
TBN	To Be Named
TCEQ	Texas Commission on Environmental Quality (ne TNRCC)
TMDL	Total Maximum Daily Load
TNRCC	Texas Natural Resource Conservation Commission
TOC	Total Organic Carbon

TRACS	Texas Regulatory Activities and Compliance System
TSWQS	Texas Surface Water Quality Standards
UTMSI	University of Texas at Austin, Marine Science Institute
WQMP	Water Quality Management Plan

A4 Project/Task Organization

TCEQ

Compliance Support Division

Kyle Girten
TMDL Quality Assurance Specialist

Assists the TCEQ Project Manager in QA related issues. Reviews and approves the QAPP and any amendments or revisions. Conveys quality related problems to an appropriate TCEQ manager. Coordinates or performs audits, as deemed necessary.

Monitoring Data Management and Analysis Section

MDMA Water Data Manager

Reviews QAPP for valid stream monitoring stations, checks validity of parameter, program and source codes, and ensures that data will be reported following the *Surface Water Quality Monitoring Data Management Reference Guide*, March 2003 procedures or most current version. Surveys the TRACS database to monitor submittal of scheduled sampling data and provides data completeness reports to Project Managers as data is received by the TMDL Data Manager. Analyzes TRACS database to identify level 1 data validation inconsistencies and report to appropriate Project Managers. Serves as Monitoring Operations data management customer service representative for TMDL Project Manager. Provides training to the TMDL Project Manager to ensure proper data submittal. Reviews and approves the QAPP.

Brenda Smith
TCEQ Surface Water Quality Program
Assists the TMDL team by coordinating efforts with SWQM basin assessors in the review of monitoring plans and QAPPs associated with TMDL projects. This review is to ensure that data collected in the project for assessment purposes follows the guidelines set forth in the current *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (September 2003).

Environmental Planning and Implementation Division

Faith Hambleton
Section and Grant Manager
Water Quality Planning Program

Responsible for oversight of the TCEQ TMDL Program. Oversees the development of QA guidance for the TMDL Team to be sure it is within pertinent frameworks of the TCEQ. Reviews and approves all TMDL Projects, QA audits, corrective actions, reports, work plans, and contracts. Enforces corrective action, as required, where QA protocols are not met. Ensures that all TCEQ TMDL personnel are fully trained, and TMDL projects are adequately staffed.

Kerry Niemann
TCEQ TMDL Data Manager

Tracks and verifies TMDL data. Responsible for receiving data (Event/Results Files) from TMDL Project Managers, converting the electronic files into Paradox tables, fixing parameter codes, dates, and times and running a Paradox Tools Program that summarizes invalid stations, invalid parameter codes, outliers, and orphans. Corresponds the deficiencies in data summary form to the Project Manager to ensure that data deficiencies are identified, verified, and/or corrected by the University of Texas Marine Science Institute (UTMSI). Provides quality assured data sets to TCEQ Information Resources in compatible formats to be uploaded into TRACS. Coordinates correction of data errors with TMDL Project Manager, UTMSI, and TCEQ Information Resources Staff.

Sandra Alvarado
TCEQ TMDL Project Manager

Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Provides the primary point of contact between the UTMSI and the TCEQ. Tracks deliverables to ensure that tasks in the work plan are completed as specified in the contract. Reviews and approves the QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPS to TCEQ participants. Responsible for verifying that the QAPP is followed by the UTMSI. Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TCEQ participants. Notifies the TCEQ QAS of particular circumstances which may adversely affect the quality of data derived from the collection and analysis of samples.

University of Texas Marine Science Institute

Dr. Paul A. Montagna
UTMSI Project Manager and Principal Investigator

The UTMSI Project Manager is responsible for ensuring that tasks and other requirements in the contract are executed on time and with the quality assurance/quality control requirements in the system as defined by the contract and in the QAPP; assessing the quality of subcontractor/participant work; approving/overseeing subcontractor work; submitting accurate and timely deliverables to the TCEQ Project Manager; and coordinating attendance at conference calls, training, meetings, and related project activities with the TCEQ. Responsible for verifying that the QAPP is distributed and followed by the UTMSI and that the project is producing data of known and acceptable quality. Responsible for ensuring adequate training and supervision of all activities involved in generating analytical data, corrective action taken as well as facilitating internal audits.

Mr. Larry Hyde
UTMSI Quality Assurance Officer

Responsible for coordinating development and implementation of the UTMSI QA program. Responsible for writing and maintaining QAPPs. Responsible for maintaining records of QAPP distribution, including appendices and amendments, and monitoring and their implementation. Responsible for maintaining written records of sub-tier commitment to requirements specified in this QAPP. Responsible for identifying, receiving, and maintaining project quality assurance records. Responsible for compiling and submitting the QA report. Responsible for coordinating with the TCEQ QAS to resolve QA related issues. Notifies the UTMSI Project Manager and TCEQ Project Manager of particular circumstances which may adversely affect the quality of data. Responsible for validation of data prior to the submission of data to the TCEQ. Coordinates the research and review of technical QA material and data related to water quality monitoring system design and analytical techniques. Conducts laboratory inspections. Develops, facilitates, and conducts monitoring systems audits. Implements or ensures implementation of corrective actions as needed to resolve nonconformances noted during assessments. Ensures data collected is of known and acceptable quality and adheres to QAPP specifications

Mr. Richard D. Kalke
UTMSI Laboratory Manager

Responsible for supervision of laboratory personnel involved in generating analytical data for this project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and a thorough knowledge of the QAPP and all SOPs specific to the analyses or task performed and/or supervised. Responsible for oversight of all UTMSI laboratory operations, ensuring that all QA/QC requirements are met and documentation related to laboratory analyses is completely and accurately reported. Responsible for ensuring that corrective actions are implemented, documented, reported, and verified.

Mr. Richard D. Kalke
UTMSI Laboratory Quality Assurance Officer

Monitor the implementation of the QAM/QAP within the laboratory to ensure complete compliance with QA objectives as defined by the contract and in the QAPP. Conduct in-house audits to identify potential problems and ensure compliance with written SOPs. Responsible for supervising and verifying all aspects of the QA/QC in the laboratory. Perform validation and verification of data before the report is sent to the UTMSI Quality Assurance Officer. Insures that all QA reviews are conducted in a timely manner from real-time review at the bench during analysis to final pass-off of data to the QA officer.

Ms. Carol Simanek
UTMSI Data Manager

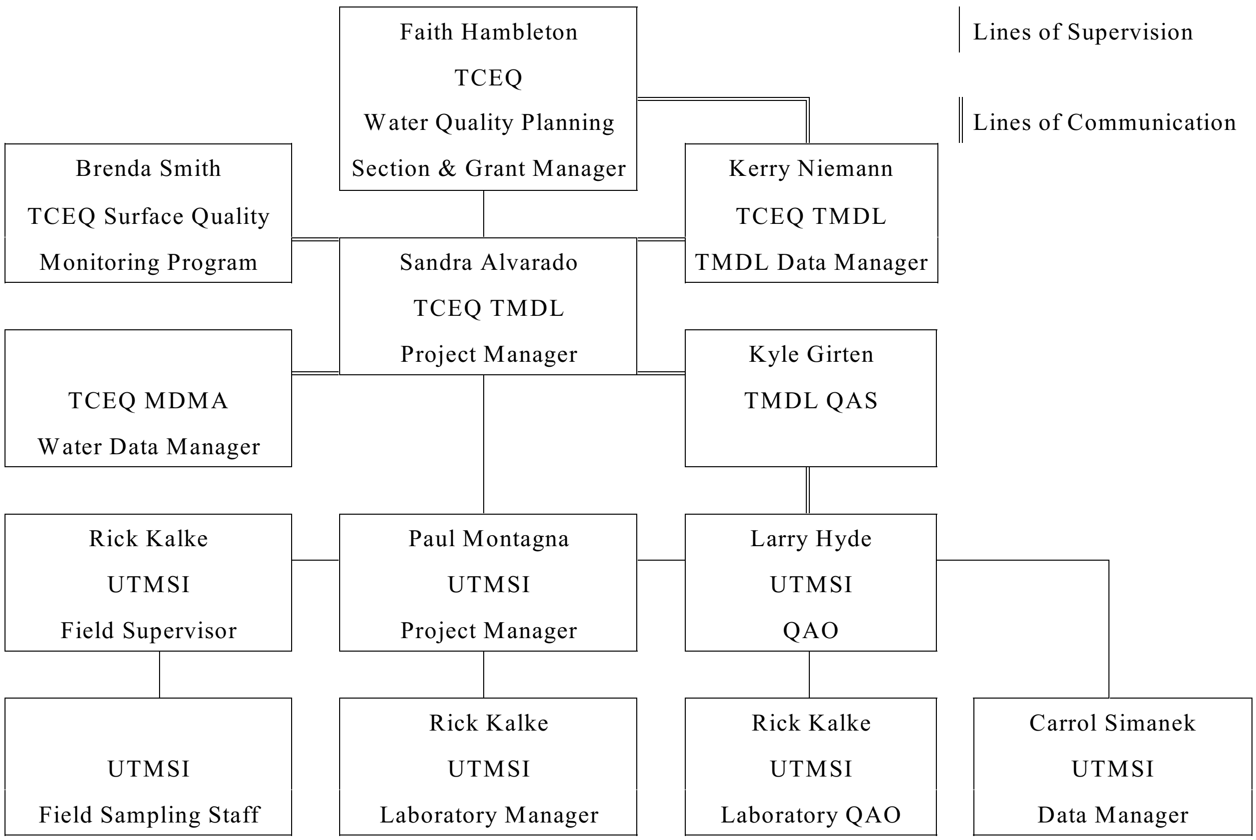
Responsible for the acquisition, verification, and transfer of data to the TCEQ. Oversees data management for the study. Implements the Data Management Plan prior to transfer of data to TCEQ. Responsible for transferring data to the TCEQ in the acceptable format. Ensures that the data management checklist is filled out and data submitted with appropriate codes. Provides the point of contact for the TMDL Project Manager to resolve issues related to the data and assumes responsibility for correction of any data errors.

Mr. Richard D. Kalke
UTMSI Field Supervisor

Responsible for supervising all aspects of the sampling and measurement of surface waters and other parameters in the field. Responsible for the acquisition of water samples and field data measurements in a timely manner that meet the quality objectives specified in Section A7 (Table A.2), as well as the requirements of Sections B1 through B8. Responsible for field scheduling, staffing, and ensuring that staff are appropriately trained as specified in Sections A6 and A8. Coordinates any joint monitoring with the TCEQ Project Manager. Reports status, problems, and progress to UTMSI Project Manager.

Figure A1. Organization Chart

The chart displays the “functional organization” of the TMDL Project, delimiting lines of supervision and lines of communication.



A5 Problem Definition

TMDL Process

The TCEQ implements the statewide approach for watershed management in Texas to improve the efficiency, effectiveness, and continuity of water quality management programs. The approach, which is summarized in *The Statewide Watershed Management Approach for Texas: The TCEQ's Framework for Implementing Water Quality Management* (TNRCC, 1997), establishes the state's process for managing water quality. It focuses on assessing watershed conditions for all waters of the state and implementing solutions where improvement is necessary. The primary goal of the approach is to ensure that management efforts provide a safe, clean, affordable water supply and healthy aquatic ecosystems for Texas.

The Total Maximum Daily Load (TMDL) Program, a major component of the approach, addresses impaired or threatened streams, lakes, and estuaries (water bodies). The primary objective of the TMDL Program is to restore and maintain the beneficial uses of impaired or threatened water bodies. The Federal Clean Water Act §303(d) list identifies "impaired" water bodies not meeting applicable water quality standards for their designated uses and requiring development of TMDLs for contaminants of concern. In general, a TMDL is the total amount of a pollutant that a water body can assimilate and still meet state water quality standards. The term also refers to the assessment necessary to establish an acceptable pollutant load for an impaired water body and to allocate the load between contributing point, nonpoint, and natural background sources of pollutants in the watershed. Thus, water quality monitoring and other assessment activities are an integral part of the TMDL.

This QAPP addresses the monitoring program developed between the UTMSI and the TCEQ to carry out the activities specified in the contract. The purpose of the QAPP is to clearly delineate the UTMSI QA policy, management structure, and processes which will be used to implement the QA requirements necessary to document the reliability and validity of environmental data. The QAPP is reviewed by the TCEQ to help ensure that data generated for the purposes described above are scientifically valid and legally defensible. This process will insure that all data submitted to the Surface Water Quality Monitoring (SWQM) portion of the Texas Regulatory and Compliance System (TRACS) database have been collected and analyzed in a way that helps to guarantee its reliability and therefore can be used in TMDL development, stream standards modifications, permit decisions, and water quality assessments.

The data generated in this project will support the development of TMDLs for dissolved oxygen (DO) in Matagorda Bay/Powderhorn Lake (Segment 2451), Tres Palacios Bay/Turtle Bay (Segment 2452), Conn Brown Harbor (Segment 2483A), and Carancahua Bay (Segment 2456). Segment 2451 (Matagorda Bay/Powderhorn Lake)only partially supports aquatic life use due to exceedence of the DO criterion in the east half of the main bay. Segment 2452 (Tres Palacios/Turtle Bay) only partially supports aquatic life use due to exceedence of the DO criterion in the Palacios area. Segment 2483A (Conn Brown Harbor) does not support the aquatic life use in the entire harbor due to depressed DO. Segment 2456 (Carancahua Bay) only partially supports the general use due to high pH in 9.2 square miles at the northern end of the bay and Carancahua Creek.

Segment 2451 (Matagorda Bay/Powderhorn Lake), Segment 2452 (Tres Palacios Bay/Turtle Bay), and Segment 2483A (Conn Brown Harbor) are listed as an impaired water body for DO because minimum DO concentrations in grab samples are occasionally lower than the criterion established to assure optimum conditions for aquatic life. Segment 2456 (Carancahua Bay) was listed as an impaired body of water for pH because minimum pH values in grab samples are occasionally lower than criterion established to assure optimum conditions for aquatic life. The appropriateness of these listings is in question. The conflict centers around whether the observed DO and pH values are caused by human impact, are a naturally occurring phenomenon, or there is simply insufficient sampling. The goal of this study is to generate a set of chemical water quality data, beginning in the summer of 2004, which will meet the objectives and tasks listed below.

A more comprehensive analysis of how DO and pH values vary throughout diurnal cycles and vertical profiles is necessary to understand the relative significance of these data. Specific insight into how DO and pH values vary with depth will also show whether there is a correlation between these values and effects of saline encroachment of estuaries.

The data will be subsequently analyzed and assessed by the TCEQ TMDL team to determine whether associated aquatic life use impairment exists and the relative source contributions to the impairment.

Study Objective:

Collect data to support modeling and assessment activities necessary for the development of TMDL for DO in Segment 2451 (Matagorda Bay/Powderhorn Lake), Segment 2452 (Tres Palacios Bay/Turtle Bay), and Segment 2483A (Conn Brown Harbor); and pH in Segment 2456 (Carancahua Bay).

Study Tasks:

1. Perform 24 hour - 72 hour continuous water quality measurements of field parameters (i.e., DO, pH, conductivity, salinity, and temperature) at several locations, at a depth determined following the SWQM manual protocol (i.e., between a depth of 1 ft, and ½ the depth of the mixed surface layer). Measurements will be performed during the index period of June 1, 2004 - October 15, 2004, and March 15, 2005 - August 30, 2005.

2. Perform field survey measurements of DO, pH, conductivity, salinity, and temperature during the index period (June 1, 2004 - October 15, 2004; and March 15, 2005 - October 15, 2005). Specific emphasis will be on DO characterization at several locations in Segment 2451 (Matagorda Bay/Powderhorn Lake) and Segment 2452 (Tres Palacios Bay/Turtle Bay). Only one stations will be sampled in Segment 2483A (Conn Brown Harbor) for DO and in

Segment 2456 (Carancahua Bay) for pH. The water quality parameters will include multiprobe sonde data. Ultimately, this information will be used to evaluate the water quality classification and use attainment for these segments in addition to comparing water quality differences within the system. UTMSI will be responsible for the collection and analysis of conventional water quality data.

A6 Project/Task Description and Schedule

See Appendix B for monitoring to be conducted under this QAPP.

See Appendix A for the approved work plan tasks and schedule of deliverables for this project. This QAPP covers the water quality monitoring tasks of the work plan. No decisions will be made by the project team based on the data collected. These data, and data collected by other organizations (e.g., USGS, TCEQ, etc.), will be subsequently analyzed and used by the TCEQ for TMDL development.

Revisions to the QAPP

Until the work described is completed, this QAPP shall be revised as necessary and reissued annually on the anniversary date, or revised and reissued within 120 days of significant changes, whichever is sooner. The last approved version of the QAPP shall remain in effect until revised versions have been approved. If the entire QAPP is current, valid, and accurately reflects the project goals and the organization's policy, the annual re-issuance may be done by a certification that the plan is current, to include a copy of new, signed approval pages for the QAPP.

Expedited Changes

Expedited Changes to the QAPP may be approved to reflect changes in project organization, tasks, schedules, objectives, and methods; address deficiencies and non-conformance, improve operational efficiency; and accommodate unique or unanticipated circumstances. Requests for expedited changes are directed from the UTMSI Project Manager to the TCEQ Project Manager in writing. They are effective immediately upon approval by the TCEQ Project Manager and Quality Assurance Specialist, or their designees. Expedited changes to the QAPP and the reasons for the changes shall be documented, and the revised pages shall be distributed by the UTMSI Project Manager to all persons on the QAPP distribution list.

Expedited changes shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

A7 Quality Objectives and Criteria

The project objective is to collect data that complies with TCEQ rules for surface water quality monitoring programs, to support decisions related to TMDL development, stream standards modifications, permit decisions, and water quality assessments. The measurement performance criteria to support the project objective are specified in Table A.2.

The QAPP is reviewed by the TCEQ to help ensure that data generated for the purposes described herein are scientifically valid and legally defensible. This review process will also help ensure that data submitted to the SWQM portion of the TRACS database have been collected and analyzed in a way that guarantees its reliability.

Only data collected which have a valid TCEQ parameter code assigned in Table A.2 will be submitted to the SWQM portion of the TRACS database. Any parameter listed in Table A.2 which does not have a valid TCEQ parameter code will not be submitted to the SWQM portion of the TRACS database.

Table A.2 - Data Quality Objectives for Field Parameter Measurement Data.

PARAMETER	UNITS	METHOD	METHOD DESCRIPTION	PARAMETER CODE
24-hr # DO obs.		SWQMPM	YSI datasonde	89858
24-hr avg. DO	mg/L	SWQMPM	YSI datasonde	89857
24-hr min. DO	mg/L	SWQMPM	YSI datasonde	89855
24-hr max DO	mg/L	SWQMPM	YSI datasonde	89856
24-hr min. pH	pH units	SWQMPM	YSI datasonde	00216
24-hr max. pH	pH units	SWQMPM	YSI datasonde	00215
24-hr # pH obs		SWQMPM	YSI datasonde	00223
24-hr avg. Salinity	‰	SWQMPM	YSI datasonde	00218
24-hr min. Salinity	‰	SWQMPM	YSI datasonde	00219
24-hr max. Salinity	‰	SWQMPM	YSI datasonde	00217
24-hr # Salinity obs.		SWQMPM	YSI datasonde	00220
24-hr avg. Cond.	uS/cm	SWQMPM	YSI datasonde	00212
24-hr min. Cond.	uS/cm	SWQMPM	YSI datasonde	00214
24-hr max. Cond.	uS/cm	SWQMPM	YSI datasonde	00213
24-hr #Cond obs.		SWQMPM	YSI datasonde	00222
24-hr avg. water temp.	°C	SWQMPM	YSI datasonde	00209
24-hr min. water temp.	°C	SWQMPM	YSI datasonde	00211
24-hr max. water temp.	°C	SWQMPM	YSI datasonde	00210
24-hr # temp obs.		SWQMPM	YSI datasonde	00221
Water Depth of Measurement	m	SWQMPM	YSI datasonde	13850
pH	pH units	EPA 150.1 Appendix H	YSI datasonde	00400
DO	mg/L	EPA 360.1 Appendix H	YSI datasonde	00300
Salinity	‰	Appendix H	YSI datasonde	00480
Conductivity	uS/cm	Appendix H	YSI datasonde	00094
Water Temperature	°C	Appendix H	YSI datasonde	00010
Total Water Depth	m	SWQMPM	YSI datasonde	82903
Secchi Depth	m	SWQMPM		00078
Days Since Last Significant Rainfall	days	SWQMPM		72053

SWQMPM =*Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue* (September 2003) or subsequent editions.

Ambient Water Reporting Limits

Ambient water reporting limits, or AWRLs, are the specifications at or below which data will be reported to the TCEQ. The laboratory reporting limit (RL) is the lowest concentration at which the laboratory will report quantitative data within a specified recovery range.

The laboratory is required to meet the following:
- The laboratory's reporting limit for each analyte will be at or below the AWRL.
- The laboratory will demonstrate and document on an ongoing basis the laboratory's ability to quantitate at its reporting limits.

Acceptance criteria are defined in Section B5.

Precision

The precision of laboratory data is a measure of the reproducibility of a result when an analysis is repeated. It is strictly defined as a measure of the closeness with which multiple analyses of a given sample agree with each other.

Duplicate deployments of multiparameter sondes in the field are used to assess the variability of sample handling, instrument performance, as well as the analytical process, and are prepared by splitting samples in the field. Performance limits for field duplicates are defined in Section B5.

Accuracy

Accuracy is a statistical measurement of correctness and includes components of systemic error. A measurement is considered accurate when the value reported does not differ from the true value. Accuracy is verified through the analysis of certified reference materials and blank samples. Performance limits for blank analyses are discussed in Section B5.

Representativeness

Most data collected under the TMDL Program will be considered representative of ambient water quality conditions. This data will be coded with Program Code TI or TQ in Appendix B, Table 2. TI reflects data collected over a 24-hour period under a TMDL QAPP that may be used to conduct an assessment on a body of water. TQ reflects grab data collected under a TMDL QAPP that may also be used to conduct an assessment on a body of water. Data not considered representative of ambient water quality conditions and collected under a TMDL QAPP will be coded TN (i.e. data collected under a TMDL Q APP but not to be used for the 305b/303d assessment).

Representativeness is a measure of how accurately a monitoring program reflects the actual water quality conditions. The representativeness of the data is dependent on 1) the sampling locations, 2) the number of samples collected, 3) the number of years and seasons when sampling is performed, 4) the number of depths sampled, and 5) the sampling procedures. Site selection and sampling of all pertinent media and use of only approved analytical methods will assure that the measurement data represents the conditions at the site.

The goal for meeting total representation of the water body is tempered by the availability of time and funding. Representativeness will be measured with the completion of samples collected in accordance with the approved QAPP

Comparability

The comparability of the data produced is predetermined by the commitment of the staff to use only approved procedures as described in this QAPP. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for rounding figures, and by reporting data in a standard format as specified in the Data Management Plan (Appendix E).

Completeness

The completeness of the data is basically a relationship of how much of the data is available for use compared to the total potential data. Ideally, 100% of the data should be available. However, the possibility of unavailable data due to accidents, insufficient sample volume, broken or lost samples, etc. is to be expected. Therefore, it will be a general goal of the project(s) that 90% data completion is achieved.

A8 Special Training/Certifications

Field personnel will receive training in proper sampling and field analysis. Before actual sampling or field analysis occurs, they will demonstrate to the UTMSI QA Officer their ability to properly calibrate field equipment and perform field sampling and analysis procedures. Training will be documented and retained in the UTMSI personnel file and be available during a monitoring systems audit.

UTMSI staff will attend relevant training pursuant to their role in this TMDL project. For example, the QAO could attend EPA workshops concerning Quality Assurance (i.e., Orientation to Quality Assurance Management, Data Quality Objectives, and QMP/QAPP Seminar). The Project Manager and QAO could attend the EPA workshop Watersheds 103: Training for TMDL Practitioners. All GIS and GPS work conducted as part of this project will comply with TCEQ requirements.

The Project Manager has developed and conducted an internal GPS training program that meets TCEQ policies and guidelines as outlined in sections 8.12.1 Global Positioning System: policy, and 8.12.2 Global positioning System: Guidelines and information as revised March 20, 2000 of the Texas Natural Resource Conservation Commission Operating Policies and Procedures. The GPS training course is described in the GPS SOP in Appendix I, and adheres to relevant TCEQ policies and guidelines. Once staff have completed the training, their names will be reported to the GPS coordinator who will assign a certificate number. Staff GPS skills will be assessed every two years to determine if a refesher course is necessary. The Field Supervisor and all relevant staff will attend this training prior to collecting data that will become part of the TCEQ's database.

A9 Documents and Records

The documents that describe, specify, report, or certify activities, requirements, procedures, or results for this project and the items and materials that furnish objective evidence of the quality of items or activities are listed in Table A.3. The Project PI will be responsible for assuring that all project personnel have the most recent version of the QAPP, any amendments to the the QAPP, and any updates. The TCEQ may elect to take possession of records at the conclusion of the specified retention period.

Table A.3 - Document and Record Retention Information.

Document/Record	Location	Retention	Form
QAPP, amendments, and appendices	TCEQ/UTMSI	5 years	Paper
QAPP distribution documentation	UTMSI	5 years	Paper
Field notebooks or field data sheets	TCEQ/UTMSI	5 years	Paper
Field equipment calibration/maintenance logs	UTMSI	5 years	Paper
Chain of custody records	UTMSI	5 years	Paper
Field SOPs	TCEQ/UTMSI	5 years	Paper
Field demonstration of capability	UTMSI	5 years	Paper
Field corrective action documentation	UTMSI	5 years	Paper
Field equipment internal/external standards	UTMSI	5 years	Paper
Laboratory instrument performance	UTMSI	5 years	Paper
Laboratory initial demonstration of capability	UTMSI	5 years	Paper
Field procedures	UTMSI	5 years	Paper
Field instrument raw data files	UTMSI	5 years	Electronic or Paper
Field instrument readings/printouts	UTMSI	5 years	Electronic or Paper
UTMSI data base verification	UTMSI	5 years	Paper
UTMSI data quality assurance	UTMSI	5 years	Paper
Quality control verification/validation	UTMSI	5 years	Paper
Final Report/data	TCEQ/UTMSI	5 years	Electronic

Special Reporting Formats

The UTMSI will use the same formats from the TCEQ SWQM Program. Special reporting formats are included in the SWQM *Data Management Reference Guide* (2003).

References

TCEQ, 2003. *Surface Water Quality Monitoring, Data Management Reference Guide*. http://www.tnrcc.state.tx.us/water/quality/data/wqm/wdma/dmrg/2003dmrg.html.

TCEQ, 2003. *Program Guidance & Reference Guide FY 2004-2005, Texas Clean Rivers Program*.

TCEQ, 2003. *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue*. Publication No. RG-415, December 2003, Austin, TX. www.tnrcc.state.tx.us/admin/topdoc/rg/415/415.html

TNRCC, 1997. *The Statewide Watershed Management Approach for Texas.*

MEASUREMENT/DATA ACQUISITION

B1 Sampling Process Design

Tables B1 provides descriptions and locations for stations to be sampled in the dissolved oxygen and pH study. Table B2 identifies the monitoring schedule, stations, parameters, and frequency of water quality data to be collected under this QAPP. A map of sampling sites is shown in Figure B1.

Sample Design and Rationale

The sampling design and rationale are based on the study's two-fold purpose: to characterize potential DO impairments in Matagorda Bay/Powderhorn Lake (Segment 2451), Tres Palacios/Turtle Bay (Segment 2452), and Conn Brown Harbor (Segment 2483A), and pH impairment in Carancahua Bay (Segment 2456). Limited access to multiparameter instruments will limit the total number of sampling locations. Additional water quality data (e.g., salinity, conductivity, temperature, and pH) will be collected durng the 24-hour deployment. This data, in addition to grab samples, will provide supplemental information regarding anthropogenic stresses on the estuarine system. The rationale for this sampling design are based on the requirements for the 305 (b) assessment as outlined in TCEQ's *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data, 2004.*

Site Selection Criteria

The data collection effort is to monitor water quality and hydrological parameters using procedures that are consistent with the TCEQ SWQM program. All monitoring activities will be developed with input from the TCEQ. To this end, some general guidelines will be followed when selecting sample sites, as identified below.

- Five sampling stations are identified for DO or pH assessment in the largest area, which is the Matagorda and Tres Palacios Bays complex (Fig. B1). One stations is chosen for Conn Brown Harbor (Fig. B2). At each station, samples for 24-hour composite monitoring and conventional data will be collected.
- Monitoring sites are representative of in-bay water quality and hydrology.
- Overall consideration is given to accessibility of sites and safety of the sampling crew.
- Monitoring sites are selected to ascertain the progressive water quality impacts within the segments studied. Sites are also selected to ensure that hydrologic effects from watershed tributaries are captured at a single location.
- At least one monitoring site in segment will correspond with an existing TCEQ SWQM site that has historically shown significant occurrences of low dissolved oxygen readings.
- Monitoring sites are chosen based on accessibility.

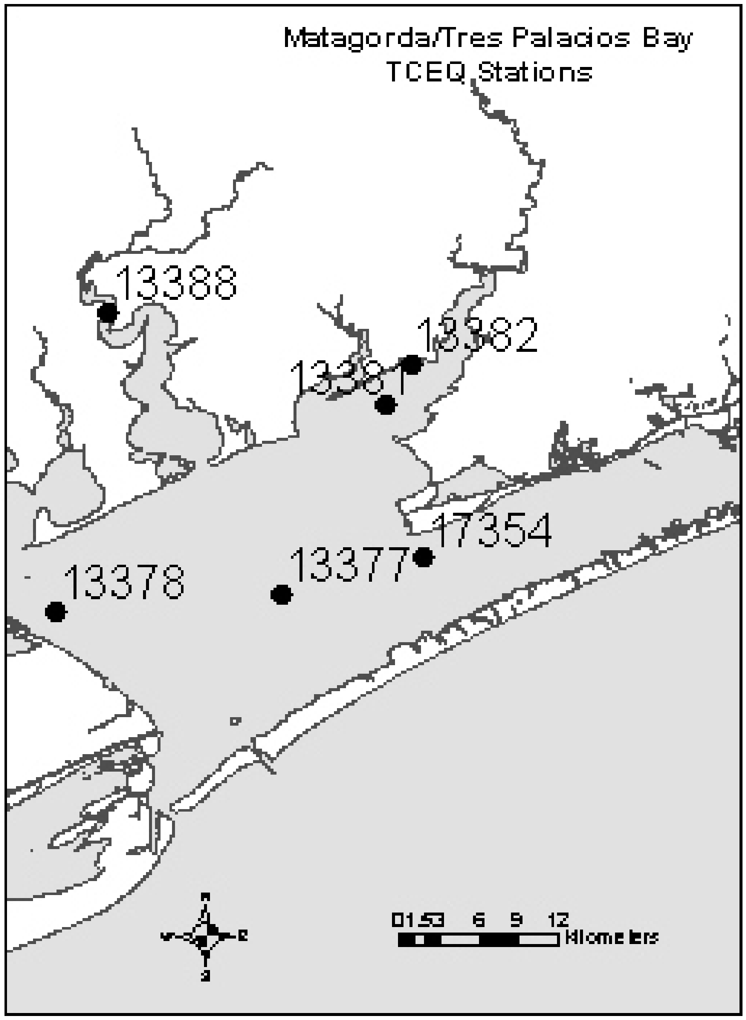


Figure B1. Map of Sample Stations for Dissolved Oxygen Study in Segments 2451, 2452, and 2456.

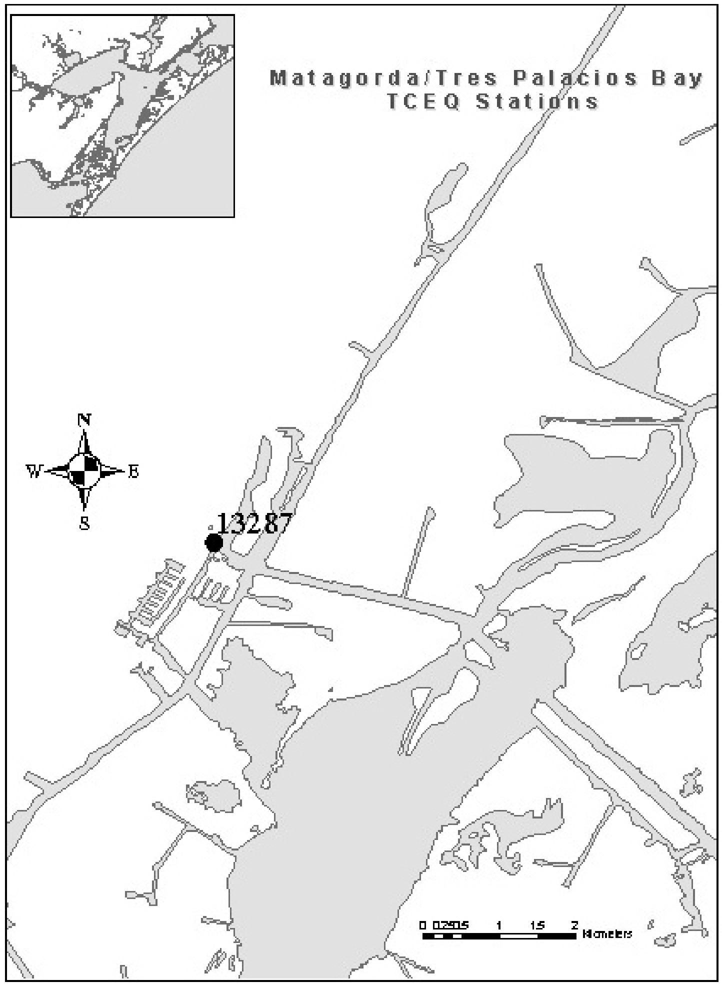


Figure B2. Map of Sample Stations for Dissolved Oxygen Study in Segment 2483A.

Table B.1 - Stations to Be Sampled for Dissolved Oxygen and pH with Descriptions and Locations.

Segment	**Station**	**Description**	**Latitude (N)**	**Longitude (W)**
2451	13377	Matagorda Bay at Palacios CM 16	28.53750	96.31250
2451	13378	Matagorda Bay Matagorda Ship CM #43	28.52555	96.46667
2451	17354	W. Matagorda Bay at ICWW CM #4	28.56203	96.21597
2452	13381	Tres Palacios Bay Palacios CM #38	28.66666	96.24166
2452	13382	Tres Palacios Bay at Palacios Harbor	28.69583	96.22499
2456	13388	Carancahua Bay at SH 35	28.73167	96.43166
2483A	13287	Conn Brown Harbor	27.90417	97.14450

Table B.2 - Number of Dissolved Oxygen and pH Study Samples to be Collected for Each Parameter During the Period 6/1/2004 - 8/30/2005.

TCEQ Station	**Start Date**	**End Date**	**24-hr Composite**	**Grab**
13377	6/1/2004	8/30/2005	10	10
13378	6/1/2004	8/30/2005	10	10
17354	6/1/2004	8/30/2005	10	10
13381	6/1/2004	8/30/2005	10	10
13382	6/1/2004	8/30/2005	10	10
13388	6/1/2004	8/30/2005	10	10
13287	6/1/2004	8/30/2005	10	10

24-hr Time Composite = pH, dissolved oxygen, salinity, conductivity, and temperature data to be sampled over a 24+ hr period.

Grab = pH, dissolved oxygen, salinity, conductivity, and temperature data to be instantaneously sampled.

B2 Sampling Methods

Field Sampling Procedures

The UTMSI will follow the field sampling procedures for field and conventional chemical parameters documented in the TCEQ *Surface Water Quality Monitoring Procedures Manual (2003)* as much as practicable. Additional procedures for field sampling outlined in this section reflect specific requirements for sampling under this TMDL Project and/or provide additional clarification.

<u>Dissolved Oxygen and pH Assessment</u>

All field parameters and 24-hr composite field parameters (i.e., pH, dissolved oxygen, salinity, conductivity, and temperature) will be sampled in accordance with the SWQM Procedures Manual. Instruments are deployed in the mixed surface layer. The depth at which sondes are deployed at are determined at the time of deployment based on SWQM requirements. The location of the mixed surface layer is determined by doing vertical profile measurements (i.e., grab samples). The multiprobe instrument will be deployed between a depth of 1 foot (from the surface) and one half the depth of the mixed surface layer. For example, if the mixed surface layer is 4 feet, the instrument would be deployed between 1 and 2 feet. This is only required when the water body is stratified. It is highly likely that the water body will be well mixed and not stratified. In this case, the multiprobe is deployed between 1 foot (from the surface) and one half the depth of the water column. In bays or estuaries, the central water mass is sampled, rather than side channels, backwater areas, or shallow areas near the bank.

The 24-hour DO monitoring events are performed during the index period representing warm weather seasons of the year, March 15-October 15 (Figure 3-1). One-half to two-thirds of the measurements will be taken during the critical period (July1- September 30). The critical period of the year is when minimum stream flows, maximum temperatures, and minimum dissolved oxygen concentrations typically occur in Texas aquatic systems. Approximately one month will separate each 24-hour sampling event.

The approach to obtaining high quality data from multiprobe sondes is to ensure that calibrated values are repeatable at the end of the measurement period (Appendix H). The steps are to: 1) calibrate the sondes before field measurements (pre-deployment calibration), 2) start data logging, 3) log for a latent period in 100% saturated environment with stable temperature and pressure, 4) make field measurements, 5) log for post-deployment period in 100% saturated environment with stable temperature and pressure, 6) stop logging, download data, and 7) calibrate probes. Data is of acceptable quality when: 1) the pre- and post-deployment latent period data equilibrate to the same levels, and 2) pre- and post-deployment calibration values are the same within acceptable ranges. The pre-calibration is done about three days before a deployment so that the latent period will be at least one day. The post-calibration is done within one day retrieval.

Documentation of Field Sampling Activities

Field sampling activities are documented on field data sheets as presented in Appendix C. Field work sheets, and multi-probe calibration records are part of the field data record. All sampling event, station ID, location, sampling time, date, water depth, and sample collector's name/signature are recorded. Values for all measured field parameters are recorded. Detailed observational data are recorded such as water appearance, weather, biological activity, stream uses, unusual odors, specific sample information, missing parameters, days since last significant rainfall, and flow severity.

Recording Data

For the purposes of this section and subsequent sections, all field and laboratory personnel follow the basic rules for recording information as documented below:

1. Legible writing in indelible, waterproof ink with no modifications, write-overs or cross-outs;
2. Correction of errors with a single line followed by an initial and date;
3. Close-outs on incomplete pages with an initialed and dated diagonal line.

Field sampling activities will be documented in a field data sheet. Each sampling station will have an individual field data sheet. All field data sheets will be archived in a binder in the UTMSI. An example of the field data sheet is given in Appendix C. The field data sheet will include the following parameters:

Station ID
Sample Type
Date and Time of Collection
Sample Collection Depth
Sample Collector
Sample Location (latitude and longitude) from a GPS

Instantaneous grab samples (pH, temperature, salinity, conductivity, DO, and depth) will also be recorded on the field data sheet. These measurements are used to verify the depth of the mixed layer. Any unusual sampling occurrences will be noted on the field data sheet.

Deviations from Sampling Method Requirements or Sample Design, and Corrective Action

Examples of deviations from sampling method requirements or sample design include but are not limited to such things as inadequate sample volume due to spillage or container leaks, failure to preserve samples appropriately, contamination of a sample bottle during collection, storage temperature and holding time exceedence, sampling at the wrong site, etc. Any deviations will invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the UTMSI Project Manager, in consultation with the UTMSI QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TMDL Project Manager both verbally and in writing in the project progress reports and by completion of a corrective action report (CAR).

Corrective Action Reports (CARs) document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. CARs will be included with project progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TCEQ immediately both verbally and in writing.

B3 Sampling Handling and Custody

Chain-of -Custody

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, and analysis. A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is used to document sample handling during transfer from the field to the laboratory and among contractors. The following information concerning the sample is recorded on the COC form and submitted to the TCEQ TMDL Project Manager along with Progress Reports.

1. Contact and shipping information for sender and receiver
2. Site identification
3. Sample type
4. Sample ID number
5. Date and time of collection, shipping, and receiving
6. Number of containers
7. Comments on sample condition
8. Custody transfer signatures and dates and time of transfer
9. Name of collector
10. Name of laboratory

Chain-of-custody (COC) procedures require that possession of samples be traceable from the time the samples are collected until analytical results completed and submitted. A complete chain of custody form is intended to accompany the transfer of samples to the analyzing laboratory. To meet TCEQ requirements, a COC form will be completed for all samples collected and kept in file records. An example of the chain of custody form to be used is provided in Appendix D. For this project, only the UTMSI analytical laboratory will be used.

Failures in Chain-of-Custody and Corrective Action

All failures associated with chain-of-custody procedures are immediately reported to the UTMSI Project Manager. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The UTMSI Project Manager, in consultation with the UTMSI QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data, and the sampling event should be repeated. The resolution of the situation will be reported to the TCEQ in the quarterly progress report. Corrective action reports will be maintained by the UTMSI QAO and submitted to the TCEQ TMDL Project Manger along with the project progress report.

B4 Analytical Methods

Not Applicable for this Project.

B5 Quality Control

Sampling Quality Control Requirements and Acceptability Criteria

The minimum Field QC Requirements are outlined in the TCEQ Surface Water Quality Monitoring Procedures Manual. Specific requirements are outlined below. Field QC Samples are reported with the data report. See Section C2.

All measurements obtained for this study will be subject to quality control procedures. Quality control samples to be obtained during the field program include field splits. Quality control samples in the laboratory will consist of analysis of laboratory equipment blanks, method blanks, standard reference materials, and field duplicates.

Field Measurement Quality Control Requirements and Acceptability Criteria

Detailed QC requirements for field instruments are contained within each individual method and laboratory quality assurance manuals (QAMs). The minimum requirements that all participants abide by are stated below. Field QC sample results are reported with the laboratory data report (see Section C2).

<u>Field duplicate</u> - Field duplicates are used to assess precision. A field duplicate is a deployment of a second multiparameter sonde at the same time and location as the main field sampling sonde. Both samples are carried through the entire calibration and analytical process. Field duplicates are analyzed on 10% of samples analyzed or one per sampling period whichever is greater. Acceptability criteria are outlined in Table A.1 of Section A7.

Precision is calculated by the relative percent deviation (RPD) of duplicate results as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set. For duplicate results, X_1 and X_2, the RPD is calculated from the following equation:

$$\mathbf{RPD = \{ (X_1 - X_2) / \langle (X_1+X_2)/2 \rangle \} * 100}$$

Performance limits and control charts are used to determine the acceptability of duplicate analyses.

B6 Instrument/Equipment Testing, Inspection and Maintenance

All sampling equipment testing and maintenance requirements are detailed in the TCEQ *Surface Water Quality Monitoring Procedures Manual (2003)*. Equipment records are kept on all field equipment and a supply of critical spare parts is maintained by the UTMSI Field Supervisor.

All laboratory tools, gauges, instrument, and equipment testing and maintenance requirements are contained within laboratory QAMs. Testing and maintenance records are maintained and are available for inspection by the TCEQ. Instruments requiring daily or in-use testing may include, but are not limited to sondes, refrigerators, and laboratory pure water. Critical spare parts for essential equipment are maintained to prevent downtime.

Equipment used for sample collection (e.g. peristaltic pumps and tubing, sample bottles, etc.) will be cleaned according to the specific procedures document for each procedure (See Appendix J).

B7 Instrument Calibration and Frequency

Field Equipment calibration requirements are contained in the *Surface Water Quality Monitoring Procedures Manual (2003)*. Post calibration error limits and the disposition resulting from error are adhered to. Data not meeting post-error limit requirements invalidates associated data collected subsequent to the pre-calibration and are not submitted to the TCEQ.

Detailed laboratory calibrations are contained within the QAMs. The laboratory QAMs identifies all tools, gauges, instruments, and other sampling, measuring, and test equipment used for data collection activities affecting quality that must be controlled and, at specified periods, calibrated to maintain bias within specified limits. Calibration records are maintained and are available for inspection by the TCEQ. Equipment requiring periodic calibrations include, but are not limited to, thermometers, pH meters, balances, incubators, turbidity meters, and analytical instruments.

Calibration of all field instruments used for measurement of parameters (e.g., temperature, pH, DO, and salinity) will be performed as described in Appendix H. Following field sampling the instrument will be post-calibrated using the same specifications used to calibrate. Pre- and post calibration information will be recorded for each field day and used to verify data acceptability.

B8 Inspection/Acceptance of Supplies and Consumables

Each new batch of supplies are tested before use to verify that they function properly and are not contaminated. The laboratory QAMs provides additional details on acceptance requirements for laboratory supplies and consumables.

B9 Non-Direct Measurements

No non-direct measurements will be used in this phase of the project. Only data collected directly under this QAPP will be submitted to the TRACS database.

B10 Data Management

Data Management Protocols are addressed in the Data Management Plan which is in Appendix E of the document.

References

TCEQ, 2003. *Surface Water Quality Monitoring Data Management Reference Guide.*

TCEQ, 2003. *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment and Tissue*.

USEPA. 1996d. Guide to Method Flexibility and Approval of EPA Water Methods. U.S. Environmental Protection Agency (USEAP), Office of Water, Washington, D.C. EPA 821-D-96-004.

ASSESSMENT/OVERSIGHT

C1 Assessments and Response Actions

The following table presents an example of types of assessments and response actions for data collection activities applicable to the QAPP.

Table C.1 - Assessments and Response Actions.

<table>
<tr><th>Assessment Activity</th><th>Approximate Schedule</th><th>Responsible Party</th><th>Scope</th><th>Response Requirements</th></tr>
<tr><td>Status Monitoring Oversight, etc.</td><td>Continuous</td><td>UTMSI Project Manager</td><td>Monitoring of the project status and records to ensure requirements are being fulfilled. Monitoring and review of contract laboratory performance and data quality.</td><td>Report to TCEQ in Progress Report. Ensure project requirements are being fulfilled.</td></tr>
<tr><td rowspan="2">Laboratory Inspections</td><td>Dates to be determined by the TCEQ lab inspector</td><td>TCEQ Laboratory Inspector</td><td rowspan="2">Analytical and quality control procedures employed at the laboratory and the contract laboratory.</td><td>30 days to respond in writing to the TCEQ to address corrective actions.</td></tr>
<tr><td>Annually</td><td>UTMSI QAO</td><td>Implements corrective action. Report sent to TCEQ Project Manager.</td></tr>
<tr><td rowspan="2">Monitoring Systems Audit</td><td>Dates to be determined by TCEQ</td><td>TCEQ QAS</td><td rowspan="2">The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP. Field sampling, handling and measurement; facility review; and data management as they relate to the TMDL Project.</td><td>30 days to respond in writing to the TCEQ to address corrective actions.</td></tr>
<tr><td>Annually</td><td>UTMSI QAO</td><td>Report sent to TCEQ QAS. UTMSI QAO resolves any deficiencies.</td></tr>
<tr><td>Performance Evaluation Samples (PES)</td><td>Annually</td><td>UTMSI QAO</td><td>Checks competency of the laboratory and the contract laboratory to perform analyses.</td><td>Report sent to TCEQ Project Manager. UTMSI QAO Resolves any deficiencies. Verifies satisfactory performance with second set of PES.</td></tr>
</table>

Corrective Action

The UTMSI Project Manager is responsible for implementing and tracking corrective action procedures as a result of audit findings. Records of audit findings and corrective actions are maintained by both the TCEQ and UTMSI Quality Assurance Officers. If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work is specified in the TCEQ QMP and in agreements or contracts between participating organizations.

C2 Reports to Management

Laboratory Data Reports

Laboratory data reports contain the results of all specified QC measures listed in section B5, including but not limited to equipment blanks, filter and reagent blanks, laboratory duplicates, and laboratory control standards and calibrations. This information is reviewed by the UTMSI QAO and compared to the pre-specified acceptance criteria to determine acceptability of data before forwarding to the UTMSI Project Manager. This information is available for inspection by the TCEQ.

Reports to UTMSI Project Management

The project team working on this study will be small and highly integrated. All issues will be compiled, coordinated, and documented by the project manager and dealt with through direct communications with the appropriate personnel. There will be no indirect management through any intermediate supervisory personnel except as described in the project management flow chart.

Reports to TCEQ Project Management

Monthly Progress Report - Summarizes the UTMSI's activities for each task; reports problems, delays, and corrective actions; and outlines the status of each task's deliverables. Results of the evaluation are submitted to the TCEQ Support Services Division, Procurements and Contracts Section.

Monitoring Systems Review Checklist and Report of Significant Corrective Actions - Following the annual audits performed by the UTMSI, the monitoring systems audit checklist along with recommendations and corrective actions is sent to the TCEQ. Any issues affecting data quality or project outcome will be reported to the TMDL Project Manager, and documented in the monthly reports to TCEQ.

Reports by TCEQ Project Management

Contractor Evaluation - The UTMSI participates in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards.

DATA VALIDATION AND USABILITY

D1 Data Review, Verification and Validation

For the purposes of this document, verification means the processes taken to determine compliance of data with project requirements, including documentation and technical criteria. Validation means those processes taken independently of the data-generation processes to determine the usability of data for its intended use(s). Integrity means the processes taken to assure that no falsified data will be reported.

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the data quality objectives which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the data quality objectives defined for this project will be considered acceptable, and will be reported to the TCEQ for entry into the SWQM portion of TRACS.

The procedures for verification and validation of data are described in Section D2. The UTMSI Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity. The Laboratory Supervisor is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and accuracy, and reviewed for integrity. The UTMSI Data Manager will be responsible for ensuring that all data are properly reviewed and verified, and submitted in the required format to the project database. The UTMSI QAO is responsible for validating the data. Finally, the UTMSI Project Manager, with the concurrence of the UTMSI QAO, is responsible for validating that all data to be reported meet the objectives of the project and are suitable for reporting to TCEQ.

Table D.1 - Data Verification Tasks.

Data to be Verified	**Field Supervisor and Staff**	**Laboratory Supervisor and Staff**	**Data Manager**	**Project Manager/ QAO Task ***
Collection and analysis techniques consistent with SOPs and QAPP *SWQM Procedures, Volume 1*	✔	✔	✔	✔
Field QC samples collected for all analyses as prescribed in the	✔			✔
Field documentation (e.g. biological, stream habitat) complete	✔			✔
Instrument calibration data complete	✔	✔		✔
Sample documentation complete	✔	✔	✔	✔
Field QC results within acceptance limits	✔			✔
Field QC results attached to DB check list			✔	✔
Sample identifications	✔	✔	✔	✔
Chain of custody complete/acceptable	✔	✔	✔	✔
Calculations	✔	✔	✔	✔
Data entered in required format	✔	✔	✔	✔
TCEQ TAG ID number assigned			✔	✔
TAG IDs correct			✔	
Valid parameter codes			✔	✔
Time based on 24-hour clock			✔	
Absence of transcription error	✔	✔	✔	✔
Source codes 1, 2, and Program codes used correctly			✔	✔
Reasonableness of data	✔	✔	✔	✔
Electronic submittal errors	✔	✔	✔	✔
Sampling and analytical data gaps	✔	✔	✔	✔

Data to be Verified	Field Supervisor and Staff	Laboratory Supervisor and Staff	Data Manager	Project Manager/ QAO Task *
Field results attached to data review checklist			✔	
Verified data log submitted			✔	

*Project Manager/QAO will monitor only 10% of data for QA/QC purpose
All the others entities are required to inspect 100% of the data prior to approval
F = Field (Only field related)

D2 Data Verification and Validation Methods

All data will be verified to ensure they are representative of the samples analyzed and locations where measurements were made, and that the data and associated quality control data conform to project specifications. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the data each task generates or handles throughout each process. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and data on chain-of-custody forms and hard copy output from instruments.

Verification, validation and integrity review of data will be performed using self-assessments and peer review, as appropriate to the project task, followed by technical review by the manager of the task. The data to be verified (listed by task in Table D.1) are evaluated against project specifications (Section A7) and are checked for errors, especially errors in transcription, calculations, and data input. Potential outliers are identified by examination for unreasonable data, or identified using computer-based statistical software. If a question arises or an error or potential outlier is identified, the manager of the task responsible for generating the data is contacted to resolve the issue. Issues which can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the task manager consults with higher level project management to establish the appropriate course of action, or the data associated with the issue are rejected. The performance of these tasks is documented by completion of the data review checklist (Appendix F) by the UTMSI Data Manager.

The UTMSI Project Manager and QAO are each responsible for validating that the verified data are scientifically valid, defensible, of known precision, accuracy, integrity, meet the data quality objectives of the project, and are reportable to TCEQ. One element of the validation process involves evaluating the data again for anomalies. The UTMSI QAO or Project Manager may designate other experienced water quality experts familiar with the water bodies under investigation to perform this evaluation. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data, before data validation can be completed.

A second element of the validation process is consideration of any findings identified during the monitoring systems audit conducted by the TCEQ QAS assigned to the project. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. Finally, the UTMSI Project Manager, with the concurrence of the QAO validates that the data meet the data quality objectives of the project and are suitable for reporting to TCEQ.

D3 Reconciliation with User Requirements

No decisions will be made by the project team based on the data collected. These data will be subsequently analyzed and used by the TCEQ for TMDL development, stream standards modifications, permit decisions, and water quality assessments.

Data will be reprorted to TCEQ. Data provided will meet the requirements for the 305 (b) assessment as outlined in TCEQ's *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data, 2002.*

List of Appendices