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# Nutrient and DO TMDL for Phillippi Creek (WBID 1937)
# Responsiveness Summary
# EPA Region 4

July 2011

## Index of Commenters:

1. **David M. Pearce, Assistant County Attorney, Office of County Attorney, Sarasota County, FL (Janicki Environmental)**
2. **Florida Department of Transportation**

## Commenter 1: David M. Pearce, Assistant County Attorney, Office of County Attorney, Sarasota County, FL (Janicki Environmental)

*NOTE: The Office of the County Attorney in Sarasota, Florida submitted comments on the 2009 Proposed TMDL report for Phillippi Creek, which addressed 303(d)-listed impairments for dissolved oxygen, nutrients and fecal coliform bacteria. EPA previously established the TMDL for fecal coliform bacteria in a separate report. EPA is establishing the TMDLs for nutrients and dissolved oxygen at this time. The following are comments are those pertaining to the TMDL for nutrients and DO in Phillippi Creek.*

**Comment 1-1:** Thank you for the opportunity to comment on the proposed Total Maximum Daily Load ("TMDL") for dissolved oxygen, nutrients, and fecal coliform in Phillippi Creek. In the proposed TMDL, the Agency asserts that the freshwater portion of Phillippi Creek exhibits concentrations of dissolved oxygen and fecal coliform bacteria in excess of that allowed by law. In support of this assertion, the Agency relies on modeling Sarasota County shares with the Agency a strong interest in restoring Phillippi Creek to a healthier condition, but has some concerns with the modeling that it would like to discuss with the Agency.

As you know, Sarasota County has already initiated several projects to improve conditions in the Phillippi Creek basin that should be given consideration for this TMDL Septic systems are being taken out of operation and are being replaced with a modem central sewage treatment system. There is an expansion of a regional stormwater treatment system, called the Celery Fields, currently underway. These costly projects (over $200 million) demonstrate an active commitment by the County to improve water quality in Phillippi Creek. In collaboration with the Southwest Florida Water Management District, the County has nearly completed a watershed management plan for the basin that addresses the same concerns as a FDEP Basin Management Action Plan.

Other efforts include sediment abatement projects, natural land preservation, low-impact development standards, a fertilizer ordinance, and taking small wastewater plants offline. Our community invests in water quality improvements because they value living in a healthy environment.

**Response 1-1:** Sarasota County is to be commended for their ongoing efforts to reduce the delivery of point and nonpoint source pollutant loadings to Phillippi Creek. These efforts include projects designed to estimate pollutant loads, identify likely pollutant sources, and implement stormwater and wastewater improvements in the watershed. EPA recognizes that these projects represent a significant investment of time and resources on behalf of Sarasota County and the Southwest Florida Water Management District. Many of these projects will help to implement the TMDL and restore Phillippi Creek to meeting water quality standards for nutrients and dissolved oxygen.

**Comment 1-2:** Although the Agency must use water quality standards to develop TMDLs, some of those standards contain fundamental flaws which make real-world realization of those standards in every situation problematic. The surface water standards for Florida were devised in the 1970s, when much less was known about water quality and ecological interactions between nature and water.

Since that time, Florida scientists have learned that many of our waterways have concentrations of dissolved oxygen that are naturally below the State standard. There are thousands of wetlands, springs and streams in Florida that cannot, and should not, be aerated to meet the dissolved oxygen standard. Scientists at Mote Marine Laboratory tell us that low-oxygen conditions in our tidal creeks provide a critical refuge for juvenile snook because predators avoid the hypoxic conditions. Because the static numeric criteria is not appropriate in all circumstances, Sarasota County is in discussion with regional partners to establish an appropriate regional DO standard for streams. Until a proper standard is set, we risk miring ourselves in fruitless TMDL negotiations.

**Response 1-2:** Given the presence of anthropogenic sources of pollution that can cause or contribute to low dissolved oxygen, it is difficult to demonstrate that the instances when Phillippi Creek is below the DO standard are entirely natural without additional and rigorous study of the issue. As the commenter acknowledged, EPA must develop the TMDL to meet the currently adopted water quality standards for nutrients and dissolved oxygen in Class III waters. However, FDEP has the ability to make appropriate changes to the water quality standards that apply to Phillippi Creek, to adopt these changes during the state's rulemaking process, and to submit standards changes to EPA, along with supporting documentation, for review. EPA encourages additional study on Phillippi Creek and other waterbodies to determine whether site-specific conditions warrant changes to the dissolved oxygen standard applicable to them, and to confirm that such changes would continue to be protective of the waterbodies' designated uses. The TMDL for Phillippi Creek must be established pursuant to the schedule of EPA's commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998), and until such time as a new water quality standard is in place, the TMDL must target the adopted standard.

**Comment 1-3:** The County has reviewed the Agency's proposal, and has also enlisted the help of a consultant with expertise in these matters. We are concerned that the TMDL will ultimately fail for lack of ability to implement its requirements; there is simply not



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enough land in the watershed available to convert into treatment facilities for that volume of stormwater. Further, implementation is not subject to an easy solution. Phillippi Creek does not have a singular pipe discharging pollutants that can simply be removed. Loading to the watershed is almost exclusively from stormwater. To capture and purify 70 percent or more of the rainfall would amount to a Herculean task certainly beyond our abilities. The data and modeling in the proposed TMDL have strengths, but also contain broad assumptions that do not support the development of massive infrastructure projects.

**Response 1-3:** This TMDL analysis is based on 2006 through 2007 load estimates, so some of the implementation projects already completed or underway have not been reflected in this result. For example, the removal of the South Gate WWTP in 2008 has implemented a reduction of about 32 kg/day (71 lbs/day) BOD, and about 19 kg/day (43 lbs/day) TN, and 6 kg/day (14 lbs/day) TP. Thus, the removal of the South Gate discharge results in approximate reductions of 3 percent BOD, 6 percent TN and 7 percent TP from existing conditions.

Based on the SIMPLE-modeled estimates of pollutant removal for various implementation projects, implementation of the Phillippi Creek Septic System Replacement Program alone should result in enough nitrogen reductions to meet the TN TMDL (a 70 percent reduction from existing loads in the TMDL equates to removing 77,648 kg/yr of nitrogen; see table below). The same septic system replacement program should also yield substantial reductions in TP and BOD, amounting to approximately 24 percent of TP reduction and 44 percent of the BOD reduction that is called for by the TMDL.

| | TN | TP | BOD |
|---|---|---|---|
| TMDL Load (lb/day) | 201 | 56 | 618 |
| TMDL Load (kg/yr) | 33,278 | 9,271 | 102,317 |
| | | | |
| Existing Load (kg/yr) | 110,926 | 30,905 | 341,056 |
| Pollutant Load to be removed to meet TMDL (kg/yr) | 77,648 | 21,633 | 238,739 |

**Comment 1-4:** Please review the attached Review of Proposed TMDLs for Dissolved Oxygen, Nutrients, and Fecal Coliforms in Phillippi Creek. It highlights the qualities of the TMDL that could be better supported. The relatively low concentrations of chlorophyll, total nitrogen and biochemical oxygen demand do not provide a persuasive argument for load reductions. A more rigorous data set and modeling effort should produce a much improved TMDL. Our differences are best resolved in a scientific arena rather than an administrative one.

Sarasota County shares the objective of the EPA in restoring Phillippi Creek to a more healthy condition and is willing to work together to achieve our common goal. Please contact Jack Merriam at 941-232-5357 or at jmeriiam@scgov.net at your earliest convenience to discuss the TMDL, our review, and next steps in our collaboration.



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**Response 1-4:** Although most of the chlorophyll-a measurements in Phillippi Creek are relatively low, the average TP concentration exceeds FDEP's screening threshold for streams of 0.22 mg/L, as well as the recently promulgated numeric instream protective criterion for phosphorus in Peninsula streams (annual geometric mean of 0.12 mg/l, not to be exceeded more than once in three years). Dissolved oxygen concentrations measured in Phillippi Creek show a wide range and are frequently below the Class III freshwater criterion of 5 mg/l, even at different times of the year.

As the TMDL and Modeling report discuss, the sub-basin, which is the third largest in Sarasota County, is the largest contributor of freshwater, nutrients, and metals to Roberts Bay (FDEP, 2003). Phillippi Creek episodically receives large volumes of stormwater and has historically had elevated levels of ammonium, low dissolved oxygen concentrations, and high concentrations of fecal coliform, and is believed to be a major source of nitrogen to Sarasota Bay (Dillon and Chanton, 2008).

Studies on Phillippi Creek suggest that sediment oxygen demand is an important factor affecting DO concentrations. Phillippi Creek has been studied over the years along with other tidal creeks in the Florida peninsula. The Year 2000 Biological Community Analysis for Big Slough, Hudson Bayou and Phillippi Creek Basin, Sarasota County, Florida documented anaerobic sediment odors, tannic water color, and the presence of aquatic macrophytes and periphyton April of 2000 at two sites in Phillippi Creek. The Sarasota County Phillippi Creek Basin Master Plan, Characterization of Ecological Conditions and Impacts of Stormwater Runoff, describes Phillippi Creek as a detrital based system that receives large loads of detritus from the watershed (Estevez, E.D., 1994). This detritus decomposes and through BOD and SOD consumes dissolved oxygen from the water column.

Given the presence of anthropogenic sources of pollution that can cause or contribute to low dissolved oxygen, it is difficult to demonstrate that the instances when Phillippi Creek is below the DO standard are entirely natural and not caused or exacerbated by anthropogenic pollution.

**Comment 1-5:** It is important to note that in its latest assessment, the FDEP has assigned WBID 1937 as EPA Integrated Report Category 4D for dissolved oxygen (DO) rather than Category 5. This category is reserved for WBIDs which are impaired but the causative agent has not been identified. This category designation implies that a TMDL is not required at this time for DO standards exceedances. Despite this designation, the EPA has issued a proposed TMDL for this waterbody based on DO exceedances. This document provides a review of the proposed TMDLs for DO, nutrients and fecal coliforms for WBID 1937 in Phillippi Creek. The next section provides a summary of the TMDL document. This is followed by a review of the data as provided in the documents. Next is a section providing a review of the modeling report, which describes the model on which the TMDLs are based. The final section provides conclusions reached as to the appropriateness of the proposed TMDLs and supporting model results, and recommendations for potential methods to address identified problems with the proposed TMDLs.

**Response 1-5:** As the commenter has noted, FDEP uses category 4D for waters considered impaired for dissolved oxygen (i.e. they are not meeting the applicable water



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quality standard), but for which a causative pollutant has not yet been identified from their initial assessment. However, such a designation does not mean that the waterbody is not impaired, or that a TMDL does not need to be developed for it. The TMDL for Phillippi Creek must be established pursuant to the schedule of EPA's commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998).

**Comment 1-6:** As described above, examination of the DO data from WBID 1937 found occurrences of values below 5.0 mg/L, resulting in impairment according to the Class Ill freshwater criterion. Most of the observations ranged between 4 and 9 mg/L (Figure 2.5), not a wide range given natural variability. Various other constituents influence DO, including DO production by algae, DO consumption by chemical transformation (nitrification of ammonia), and DO consumption by decomposition of organic material (BOD, TOC, and sediment oxygen demand (SOD)).

**Response 1-6:** The TMDL report discusses the various natural and anthropogenic influences on DO concentrations noted by the commenter. The full range of concentrations in the DO data is 0.88 mg/L to 13.16 mg/L. That is a fairly broad range, and since most of the data were collected during the late morning or early afternoon, when photosynthesis will support DO concentrations, it is not reflective of the full diurnal swing. While most of the data range between 4 mg/L and 9 mg/L, approximately 13% of the values were below 4 mg/L, and approximately 6% were greater than 9 mg/L.

**Comment 1-7:** As seen if Figure 3.1, the overwhelming majority of the water column chlorophyll a values, both corrected and uncorrected, were less than 10 µg/L. It is probable that floating algal mats will have impacts on oxygen dynamics in the waterbody in addition to those resulting from water column phytoplankton. The authors of the TMDL document state that the presence of the algal mats, and the chlorophyll data record, provide "...a potential for algal blooms during the warmer months of the year" (USEPA, 2009a). However, the data record, shown in Figure 3.1, does not indicate the occurrence of algal blooms.

**Response 1-7:** The report acknowledges the data record does not show frequent high concentrations of corrected chlorophyll. The chlorophyll-*a* concentrations in the Phillippi Creek dataset range from as low as 1 to as high as 31 µg/l, with a mean of 2.4 µg/l. However, it is important to realize that measuring chlorophyll concentrations in a water sample only provides a "snapshot" of chlorophyll concentrations at the time and place the sample was taken, and the measurement only captures phytoplankton, the free-floating algae, and will not capture other types such as attached algae (periphyton), algae growing on bottom sediments (benthic), and other aquatic plants (macrophytes). Despite the lack of many high chlorophyll concentrations in the data record, algal mats were observed during a site visit in the lower part of the watershed (see Figure 5 in TMDL report). Although it would be difficult to know how persistent these mats are without further visits, their presence does support the notion that Phillippi Creek is receiving excessive nutrient inputs and they may also explain why the data record does not show more excursions. Phillippi Creek is known to receive high amounts of stormwater runoff, and is believed to be a major



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contributor of nitrogen to Roberts Bay and to Sarasota Bay. EPA believes it is necessary to establish TMDLs to protect this waterbody, and the waterbodies downstream.

**Comment 1-8:** Evaluation of the total phosphorus (TP) concentrations showed that these levels exceeded the FDEP screening threshold for streams of 0.22 mg/L (USEPA, 2009a). Total nitrogen (TN) concentrations ranged from 0.14 mg/L to 2.47 mg/L, with a mean of 1.15 mg/L, with most of this as Total Kjeldahl Nitrogen (TKN). TKN is the sum of organic nitrogen and ammonia, and high concentrations of TKN can result from organic matter decay. Nitrification of ammonia, a component of TKN, consumes DO in the water column.

An analysis was performed to determine the algal growth-limiting nutrient, nitrogen or phosphorus. It was found that the ratio of TN to TP ranged between 0.2 and 6.7, with a mean of 3.2. The authors of the document note that a ratio less than 7.2 generally indicates nitrogen limitation, so that nitrogen is indicated as the limiting nutrient in Phillippi Creek (USEPA, 2009a).

The results of this analysis indicated that since the limiting nutrient is TN, if DO concentrations are a function of nutrient concentrations, then the nutrient of primary concern would be TN. Since TP was not found to be limiting, a reduction in TP loading is unlikely to result in decreases in algal growth, and thus impact DO concentrations, until the TN:TP ratio becomes greater than the 7.2 referenced by the authors.

**Response 1-8:** The typical ratios of TN to TP in Phillippi Creek, and the identification of the possible limiting nutrient, were provided as part of the discussion of water quality data. In reality, a simple TN:TP ratio is an oversimplification of the dynamics in aquatic systems. Nutrient limitation is dynamic over both space and time. Waterbodies may spend some fraction of the time in co-limitation, aquatic organisms may adapt to changing conditions, and other factors may influence which nutrient most affects productivity. EPA believes that in most cases, it is important to design a remediation strategy that controls both nitrogen and phosphorus in order to prevent the either from causing or contributing to a water quality impairment in the immediate waterbody, or downstream. Clarifying language has been added to the TMDL report.

**Comment 1-9:** Factors other than oxygen production by photosynthesis and consumption by respiration also affect oxygen levels in the water column. These factors include reaeration, temperature solubility, and BOD (a measure of the amount of oxygen consumed by organisms in breaking down organic material). BOD concentrations in Phillippi Creek WBID 1937 were examined, and found to typically be at or below the Method Detection Limit of 2.0 mg/L, with an average of 2.0 mg/l.

Based on the available BOD data, it does not appear that BOD is an important source of DO depletion in the water column. As described above for TP, it is unclear how a reduction in BOD, as proposed in the TMDL, will improve DO values sufficiently to meet the 5.0 mg/L criterion.



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The authors of the proposed TMDL report also examined TOC data, provided in Figure 3.2. TOC is supplied by vegetation and wastewater discharges, among other sources. Decomposition of TOC consumes DO. The authors state the TOC "...shows some correlation with dissolved oxygen such that an increase in organic matter (as indicated by TOC is associated with a decrease in dissolved oxygen..." (USEPA, 2009a). However, no quantitative evaluation of any relationship between TOC and DO is provided, and visual comparison of the data presentations in Figures 2.5 and 3.2 does not indicate a relationship. Values of TOC are typically between 10 and 15 mg/l, not highly variable, while ranges in DO are more variable, typically between 4 and 9 mg/l. Any relationship between TOC and DO concentrations in WBID 1937 should be more clearly supported by data analysis.

**Response 1-9:** As the TMDL and modeling report discuss, the evidence suggests that Phillippi Creek is affected by low reaeration, high detrital loading, strong photosynthetic activity, and elevated SOD. Since the BOD dataset consists of only 15 samples, and only measurements of 5-day BOD (as opposed to long-term BOD), it is difficult to draw firm conclusions about the full influence of BOD on dissolved oxygen concentrations. However, the modeling predicted that a 70 percent reduction in BOD and nutrients would allow Phillippi Creek to attain a daily average DO of 5 mg/l. Please note that the TMDL did not call for 70% reductions in SOD. Rather, the existing SOD was estimated to be around 1.75 $g/m^2/day$, and an SOD of 1.0 $g/m^2/day$ was used in the TMDL scenario (a reduction in SOD of approximately 40%). Reductions in BOD and nutrients should significantly reduce SOD. BOD is a measure of the amount of oxygen consumed by organisms as they break down organic material in the water column, and SOD is created when organic matter and sediment introduced into the water column settle to the bottom. Both exert an oxygen demand on the water column.

The fact that Phillippi Creek data showed that dissolved oxygen concentrations tended to be lower when total organic carbon (TOC) concentrations were higher was mentioned to further support the other evidence suggesting that high levels of organic matter are contributing to low DO levels. The correlation does not explain all of the variation in DO concentrations, but then the TMDL itself was not targeted to TOC. The strength of the relationship does not affect the TMDL values, as the TMDL is based on modeled oxygen demand and nutrients.

**Comment 1-10:** To develop a TMDL to improve DO, the USEPA (2009a) determined that even though chlorophyll a and B0D values were low, TMDLs for DO and nutrients were warranted. The document states that "...the very wide range in DO concentrations suggests a strong influence of photosynthesis and respiration" (USEPA, 2009a) although the typical range in DO values as shown in Figure 2.5 was between 4-9 mg/L. This is not a very wide range in DO in shallow southwest Florida streams. The authors note in their "Summary of Data Assessments" that "Sediment oxygen demand is thought to be an important factor affecting DO concentrations" (USEPA, 2009a). However, no measurements of sediment oxygen demand (SOD) were available. Chlorophyll a values are relatively low, BOD values are very low (at Method Detection Limit), and there was



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no evidence provided that TOC and dissolved oxygen were correlated. The limiting nutrient was determined to be nitrogen based on a TN:TP ratio.

Despite the lack of empirical evidence that DO was controlled by chlorophyll a and BOD production, a mechanistic model was developed to link watershed loadings to nutrient and chlorophyll concentrations. This model combined hydrodynamic and water quality models of the Phillippi Creek watershed, and provided an evaluation of the reduction in nutrient and BOD loadings which resulted in achievement of the DO criterion of at least 5.0 mg/L. A review of the model is provided in the following section.

**Response 1-10:** The majority of these concerns were already introduced in previous comments; please see Responses # 1-2, 1-4, 1-6, 1-7 and 1-9 for a discussion of the water quality assessment, the range of DO concentrations and TMDL targets to achieve the DO standard. EPA acknowledges that the modeling analysis could be improved with direct measurements of SOD and reaeration in the stream. However, an effort was made to confirm that the SOD rates used in the model are within the range of SOD rates measured in similar tidal rivers. Measured rates from similar tidal rivers were used as a starting point in the water quality model, and these rates were adjusted to reflect the measured DO in Phillippi Creek. SOD rates were also computed with the Quantitative Environmental Analysis, LLC (QEA) and Mississippi State University sediment flux model that is based on DiToro's sediment flux model. This SOD model estimates SOD rates from the observed water column nitrogen, phosphorus and carbon loads, volume, flow rate and water temperature. The final SOD rate was determined to be appropriate for this Phillippi Creek model.

**Comment 1-11:** A one-dimensional model of the creek, with no vertical differences in flows, may not be the most appropriate model to adequately represent the dynamics of the system, especially in those areas influenced by tidal action. Density stratification is often found in tidal areas where freshwater inflows occur, resulting in typical estuarine circulation patterns of denser saltier water moving upstream in the lower water column and less dense fresher water moving downstream in the upper water column. If the combined hydrodynamic and water quality models were to be used to examine the system in the area downstream of the freshwater/saltwater interface, or in any area where vertical density differences exist, this could be problematic in simulating conditions comparable to those observed.

**Response 1-11:** The commenter is correct that a one-dimensional hydrodyanamic model will not account for vertical differences in the water column. As discussed in the modeling report, the approach assumes that flow is predominantly one-dimensional, that Coriolis and other accelerations normal to the direction of flow are negligible, that channels can be adequately represented by a constant top width with a variable hydraulic depth (i.e., "rectangular"), that the wave length is significantly greater than the depth, and that bottom slopes are moderate. Although no strict criteria are available for the latter two assumptions, most natural flow conditions in large rivers and estuaries would be acceptable. However, since the modeled area was the freshwater- albeit tidally-influenced- portion of the creek, and since there was no evidence of significant vertical stratification in this portion of the creek, a one dimensional model was deemed to be



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adequate for this application. As Figure 4 in the modeling report shows, the water surface elevations predicted by the model matched well with observed elevations at the mouth of Phillippi Creek.

**Comment 1-12:** The upstream flows to the model domain were developed using drainage area ratio method based on gaged flow data from Sarasota County Station PH-5, located on Phillippi Creek (see Figure 2.4), just downstream of the head of the eastern branch of the model domain as shown in Figure 4.1. A unit area runoff was calculated for the period 2006-2007 from these data. Gaged flows were used as inflows to the eastern branch head and the northern branch flows were estimated using the drainage area ratio method.

Application of the drainage area ratio method may be problematic in this instance as the watershed land uses are different. The eastern, portions of the watershed contain significant areas of agricultural land use, while the watershed of the northern branch does not. Both hydrologic and pollutant loading estimates have been developed for this area from Sarasota County's Spatially Integrated Model for Pollutant Loading Estimates (SIMPLE) and should provide more reliable estimates of flows from the northern branch than the drainage area ratio method. The SIMPLE output could have also been used as a comparison to the estimated flows at the head of the northern branch as a validation exercise. Downstream of the head inflow locations, the DYNHYD model used SIMPLE model flows as flow input making it all the more curious as to why SIMPLE model estimates were not used upstream. How or where these flows were incorporated into the DYNHYD model is unclear.

**Response 1-12:** The flows estimated from USGS gage 02299780, adjusted for drainage area, were used as the starting flow entering the model from the mainstem and the other tributary. The hydrodynamic model also needs information on how much incremental flow is added by the land areas draining to the stream, downstream of the boundaries; these estimates were derived from the flow volumes predicted by the SIMPLE model and input into the DYNHYD model at junctions 42 and 29 (near PH-5 and PH-4). The decision was made to base the hydrodynamic model boundary flows on measured streamflow data because USGS gage 02299780 is located only a short distance downstream of the mainstem model boundary, and a short distance upstream of the tributary confluence. This gage captures the majority of watershed flows that would enter the modeled portion of the watershed. The location of this gage is not readily apparent in the watershed maps within the TMDL or modeling reports, but as explained in the report, gage 02299780 is located in essentially the same location as monitoring station PH-5 (see Figure 3 in the TMDL report for the location of PH-5). It is usually preferred to use measured streamflow data, when such data are available. Since there is no USGS gage on the tributary, its boundary flow was also estimated from measured streamflow data at gage 02299780. It is true that the majority of the approximately 7 percent of the total watershed area used for agriculture is in the mainsteam headwaters, the difference is not an extreme one and the other factors that affect flow, such as soils/geology and rainfall amounts were expected to be similar.



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**Comment 1-13:** The descriptions of how the SIMPLE model results were incorporated into DYNHYD is unclear and ambiguous. There is no information provided concerning the inclusion of SIMPLE model flow results from point sources discharging in the watershed, especially those with discharge utilized for irrigation. Further, the description of the DYNHYD model construct is insufficient. There is no definition of the segmentation scheme presented for the DYNHYD model, and no information provided on the associated physiographic information (segment lengths and depths) for each segment. The appropriate lengths for these segments should be a function of the expected stream flows to be evaluated. The derivation of the timestep used in the model calculations should also be provided, as this is a function of both the stream flow and segmentation scheme. No mention is made of structures in the system which may impact the water surface elevations, although at least one salinity structure does exist in the system. A comprehensive explanation of the flows used as input, with the flow input locations and segmentation scheme, should be provided for a more complete explanation of the hydrodynamic model construct.

**Response 1-13:** Please see the above response (#1-12) regarding incorporation of SIMPLE flow volumes into the DYNHYD hydrodynamic model. The total pollutant loads predicted by the SIMPLE model were aggregated for four areas of the watershed (tributary, headwater, middle and mouth) and input into the water quality model at four WASP segments (48, 47, 41, and 28, respectively). Pollutant loads from point sources and nonpoint sources, including septic tanks and irrigation sources, are included in the SIMPLE loading estimates. Please refer to the SIMPLE model documentation, which is cited (as Jones Edmunds and Associates, 2009a and 2009b) in both the TMDL and modeling reports for additional details on the SIMPLE modeling. These references, as well as the hydrodynamic and water quality model files, are included in the Administrative Record for this TMDL and are available upon request. Details about the lengths, widths, depths, and cross-sectional areas used, etc are available in these files. Note that the segment lengths used generally correspond to the segments from Sarasota County's ICPR model, although some of the smallest segments were combined. The ICPR model is where information on the cross-sectional dimensions was derived. Figure 9 in the modeling report shows the model domain, and Section 3.2.3 discusses the channel geometry and segmentation in the model. In the TMDL report, Section 7.1.1 describes the DYNHYD model network (channels and junctions) and Figure 18 depicts a simplified representation of the correspondence between DYNHYD channels/junctions and WASP model segments. In response to the commenter's concern, a figure depicting the modeled segments (DYNHYD channels) for Phillippi Creek was added to the modeling report. (Generally speaking, WASP segments correspond to DYNHYD junctions but will be one number lower- i.e. DYNHYD Junction #29= WASP segment #28.) Structures were not included in the modeling, as explained on page 6 of the modeling report.

**Comment 1-14:** The authors of the model report (USEPA, 2009b) suggested that the model simulation period (2006-2007) incorporated wet, dry and normal periods of rainfall. However, this is only correct relative to the 2000-2007 period, as shown in Figure 4.2. Examination of the long-term record shows an annual average rainfall of



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approximately 54 inches, so that the entire 2006-2007 period is relatively dry compared to the long-term record. This has implications when simulating DO, as residence times are longer during dryer periods, allowing more uptake of nutrients and elaboration of algal biomass with resultant decomposition than during wetter periods. Additionally, dryer periods are typically warmer as well, as less lower-temperature freshwater enters the system. Lower velocities during these low flow periods will also result in lower DO. Higher water temperatures associated with lower inflows also result in lower DO solubility. Use of the 2006-2007 period is therefore only representative of relatively dry conditions, and therefore results in a bias in the model.

**Response 1-14:** EPA evaluated the previous ten years to select a modeling period. Between 1999 and 2008, the average annual rainfall at the Sarasota Bradenton Airport was 42 inches. The time period chosen for the model did incorporate a wet and a dry year relative to this average. EPA believes it is important to target more recent years, both to overlap with the time period for the SIMPLE model estimates and so that the TMDL would be more reflective of current conditions in the stream.

**Comment 1-15:** The choice of the downstream tidal boundary condition is also perplexing. The boundary conditions were set using data from Port Manatee in Tampa Bay, the nearest NOAA tidal gage. It is expected, however, that the tides in Roberts Bay are different from those in Tampa Bay, given the difference between the two locations and the difference in physiographic settings. There are water surface elevation data available from sites much closer to the mouth of Phillippi Creek, including sites in New Pass (operated by Mote Marine Laboratory), Venice (operated by the National Data Buoy Center), and Anna Maria (operated by University of South Florida).

**Response 1-15:** The possibility of using data from station PH-8 at the mouth of Phillippi Creek was investigated. The available data from station PH-8 appeared to be truncated at low tide, and only measured from about mean sea level to high tide. As the commenter noted, the downstream model boundary was populated with water surface elevation data measured at a NOAA tide station in Port Manatee, Florida (station #8726384), which provided a complete and continuous record for the selected modeling period. The figure below compares water surface elevations from Port Manatee (black line) and PH-8 (red line). Despite the fact that the tide data used to populate the downstream model boundary were measured at a greater distance from Phillippi Creek, the model predictions of water surface elevations in the lowest modeled segment match the observations extremely well at the river mouth station (see second figure below) and the USGS gage 4.8 miles upstream (see Figures 5 & 6 in the modeling report).



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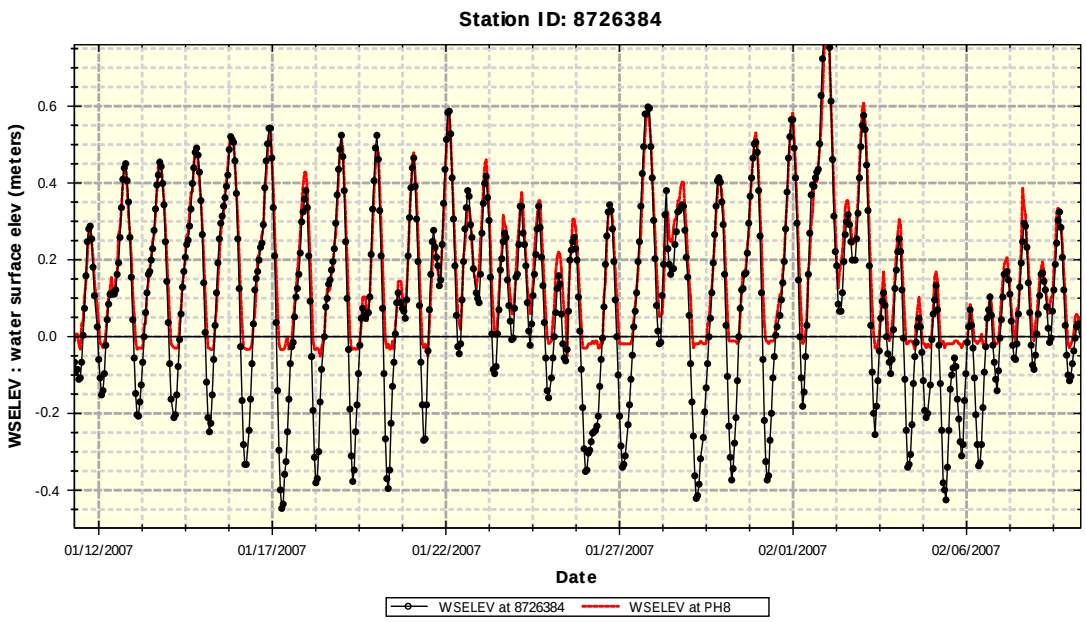


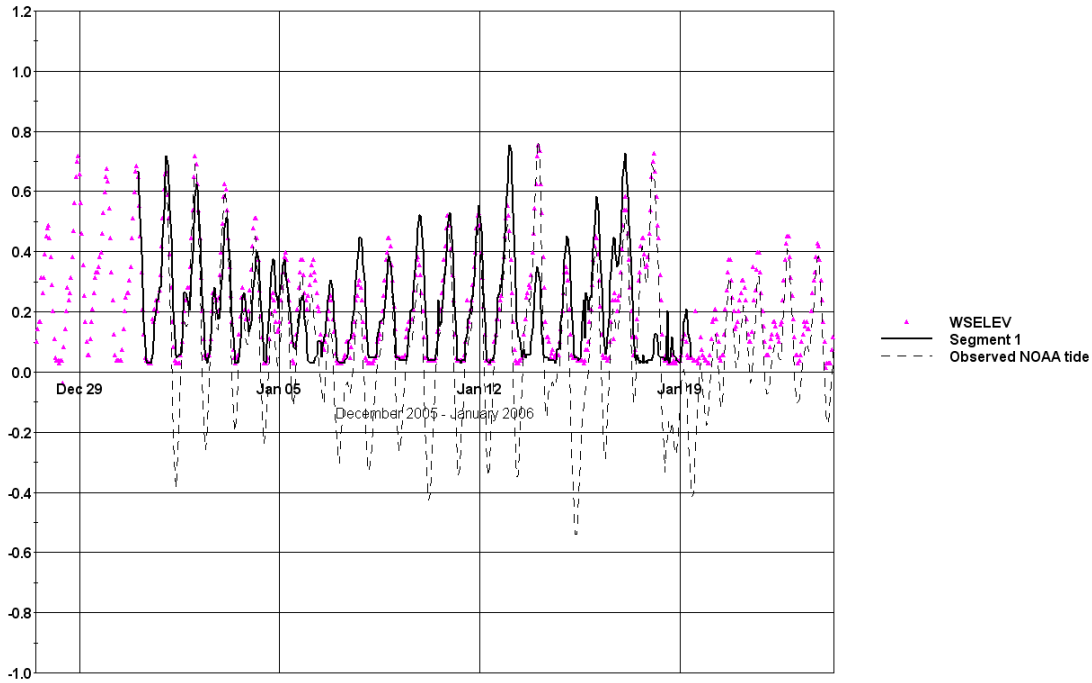


**Comment 1-16:** The calibration objectives for the hydrodynamic model were to "...adequately represent the physics of the system by propagating momentum and energy based upon freshwater inflow, and the downstream tidal water surface elevation" (USEPA, 2009a). However, no quantitative calibration criteria were provided, and no quantitative analyses of the relationships between predicted and observed water surface elevations or flows in the system were presented. Time series plots of observed and



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predicted hourly elevations over the entire two year period were provided. One site was labeled Phillippi Creek at Roberts Bay. The location of this site is not provided. If observed elevations existed at the mouth of the creek, they should have been used to provide the downstream boundary elevation conditions, not data from Port Tampa as described in the preceding paragraph.

**Response 1-16:** EPA decided to provide graphical representations of the goodness of fit of the model predictions for ease in understanding the results. EPA compared model predictions against the measured data overall and determined that the model calibration was sufficiently predictive. Figures 3 and 4 in the modeling report show that the model boundary conditions for water surface elevations are set to the NOAA tide data at the mouth of Phillippi Creek at Roberts Bay near station PH-8. The location of PH-8 can be seen in Figure 3 of the TMDL report (Locations of Sampling Stations in the Phillippi Creek Watershed). Figure 4 in the modeling report shows a zoomed-in view of the water surface elevation data in Figure 3 (of the modeling report). Figure 5 in the same modeling report shows the predicted and observed water surface elevations about 4.8 miles upstream at the USGS gage 02299800 (same location as Phillippi Creek ARMS station PH-4), and Figure 6 shows a zoomed view of the same data. Figure 7 shows predicted and observed water surface elevations farther upstream at USGS gage 02299780 (same location as Phillippi Creek ARMS station PH-5, and FDEP station 3520). The locations of monitoring stations are depicted in Figures 8 and 9. Please see Response #1-15 above for an explanation of the decision to not use elevation data from the mouth of Phillippi Creek.

**Comment 1-17:** The time series plots are difficult to evaluate. The plots display observed and predicted elevations as red dots and red lines, respectively making the differences difficult to interpret. Time series comparisons were provided at the location of the USGS gage 02299800 at the bridge on Bahia Vista Street, 4.8 miles upstream of the mouth, and at the location of USGS gage 02299780 on Bahia vista Street as well as at the Roberts Bay site. As with the downstream comparison, it is very difficult to compare the predicted and observed elevations at these locations from these time series plots. However, it is seen that the observed water surface elevations at USGS 02299800 are sometimes much higher (1 m or more) than the predicted conditions. Further, the predicted elevations typically over estimate observed conditions at USGS 02299780. No mention is made of structures in the system which may impact the water surface elevations, although at least one salinity structure does exist in the system. Further description of the segment physiography should provide additional information which would be useful in calibration of the water surface elevation predictions.

**Response 1-17:** The model predictions of water surface elevations match the observations extremely well at the river mouth station and the USGS gage 4.8 miles upstream. The predictions near the headwaters are about 0.1 meter, or roughly one foot lower than the observed elevations, and this was attributed to the presence of weirs in Phillippi Creek. The weirs were not included in the model since they are only expected to influence the flow and water quality during extreme low flow situations. Despite the fact that the weirs were not included, the model predictions of water surface elevation are



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a good fit to observations at USGS gage 02299800 and at the mouth of the creek (see Figures 3 through 7 of the modeling report). Figures 3 and 5 provide an overview of the hydrology calibration by displaying all modeled and observed water surface elevations for the modeling period at their respective stations. Figures 4 and 6 show zoomed in segments of these same plots to make the data easier to evaluate.

**Comment 1-18:** The information provided in the report does not support the conclusion that the hydrodynamic model is calibrated. Calibration statistics are typically expected to be presented as assurance that a model is reproducing observed responses to observed forcing conditions (i.e., winds, tides, freshwater inflows). No calibration statistics are provided for the hydrodynamic model. Appropriate calibration statistics, such as Root Mean Square Error, Mean Error, Relative Error, Absolute Mean Error, and r2 relationships, should be provided for the hydrodynamic model water elevation and streamfiow output. Additionally, plots of predicted versus observed values, and plots of residuals, would allow examination of potential biases in predictions. None of these quantitative calibration evaluations were completed for the hydrodynamic model, so that the status of the calibration cannot be evaluated.

**Response 1-18:** Please see responses 1-16 and 1-17 for a discussion of the calibrated hydrologic model.

**Comment 1-19:** There is little explanation provides as to how the SIMPLE model pollutant loads are introduced to the water quality model. There is no explanation of how loadings from point sources are estimated, included those originating from irrigation with reclaimed water. The locations of the loading points in the model domain likely greatly influence the predicted spatial variability in water quality.

**Response 1-19:** Please see the response to Comments #1-12 and #1-13 for information about incorporation of SIMPLE results in the modeling of Phillippi Creek. As explained in the modeling report, point and nonpoint source loads were added into the model indirectly, at the model boundaries or as incremental flows. Additional details about SIMPLE-Monthly, including the irrigation and point source modules, may be found in the final Design Report and Operations Manual for SIMPLE-Monthly that are part of the Administrative Record for these TMDLs.

**Comment 1-20:** The downstream boundary conditions for water quality were developed from observed data in Roberts Bay. This is inappropriate, as Phillippi Creek discharge affects conditions both north and south of Roberts Bay, so that more appropriate water quality boundary conditions should be set at the northern end of Roberts Bay, by Big Sarasota Pass, and in Little Sarasota Bay to the south. Utilizing observed conditions in Roberts Bay for downstream boundary conditions is only appropriate when simulating observed conditions. If modified conditions for flows and loads are included in scenario simulations, the conditions in Roberts Bay would not remain those based on observed conditions, but would be impacted by the simulation flows and loads. For appropriate consideration of the effects of Phillippi Creek discharge on Roberts Bay, the model domain should be expanded to include Roberts Bay as well as Phillippi Creek.



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**Response 1-20:** As the commenter noted, water quality data from Roberts Bay were used to define the downstream (i.e. tidal) boundary for the model. The upstream portion of Phillippi Creek that was the focus of the TMDL is far enough from the downstream boundary that the boundary conditions did not significantly impact the impaired WBID (WBID 1937).

**Comment 1-21:** The model document does not provide an explanation of the WASP segmentation scheme and its relationship to the DYNHYD segments. It is important that the WASP segmentation scheme be described to ensure that areas where expected water quality conditions are dissimilar (due to sediment type, flow conditions, etc.) are represented by different segments, so that spatial variability in not smoothed over. It is-also important to understand the segment size in relation to flow variability and residence time, as biological processes within a segment are dependent on how long the water mass remains in the segment for uptake of nutrients, elaboration of algal biomass, decomposition of organic materials, and associated oxygen demand.

**Response 1-21:** As discussed in Response #1-13, Figure 9 in the modeling report shows the model domain, and Section 3.2.3 discusses the channel geometry and segmentation in the model. In the TMDL report, Section 7.1.1 describes the DYNHYD model network (channels and junctions) and Figure 18 depicts a simplified representation of the correspondence between DYNHYD channels/junctions and WASP model segments. In response to the commenter's concern, a figure depicting the modeled segments (DYNHYD channels) for Phillippi Creek was added to the modeling report. A total length of 13 kilometers is included in the Phillippi Creek WASP water quality model, which is split into 51 segments ranging from 100 to 700 meters long and from 5 to 142 meters wide. The model files are included as part of the Administrative Record for the TMDLs and are available upon request. Details about the segment lengths, widths, and depths, etc are available in these files.

**Comment 1-22:** One primary assumption influencing the water quality model construct was that observed low DO values in the system were a product of high algal production and respiration, despite water quality measurements of low BOD at or near detection limits, relatively low TN of 1.1 mg/L, and low chlorophyll-a values of 4.2 pg/L (USEPA, 2009a, b). The authors state that

> "Due to the lack of SOD [sediment oxygen demand] measurements, reaeration measurements, aquatic macrophyte and periphyton measurements the approach for developing this TMDL is based primarily on the water chemistry data and the evidence of low reaeration, high detrital loading, strong photosynthetic activity, and strong SOD" (USEPA, 2009b).

A statement is made that the greatest consumption of water column DO is through SOD, although no data are provided to support this.

**Response 1-22:** The majority of these concerns were already introduced in previous comments; please see responses #1-2, 1-4, 1-6, 1-7 and 1-9 for discussions about the water quality assessment, the range of DO concentrations, the relationship between BOD



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and SOD and TMDL targets to achieve the DO standard. Other studies have suggested, and the modeling supports, that Phillippi Creek is affected by low reaeration, high detrital loading, strong photosynthetic activity, and elevated SOD. As discussed in response #1-10, EPA acknowledges that the modeling analysis could be improved with direct measurements of SOD and reaeration in the stream. However, an effort was made to confirm that the SOD rates used are within the range of SOD rates measured in similar tidal rivers.

**Comment 1-23:** The flow conditions during the 2006-2007 period were representative of dry conditions, as discussed above. Given the dry low-flow conditions during this period, it is expected that relatively low DO conditions would occur, as flow-induced reaeration would be diminished and long residence times would allow for more opportunity for oxygen consumption through decay of organic matter. The flow conditions during this period are not representative of a variety of flow conditions, but rather of low flow conditions.

**Response 1-23:** Please see Response #1-14 for an explanation of the choice to base the TMDL on the 2006 & 2007 data. It is also important to remember that USEPA regulations at 40 CFR 130.7(c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The critical condition is the combination of environmental factors creating the "worst case" scenario of water quality conditions in the waterbody. By achieving the water quality standards at critical conditions, it is expected that water quality standards should be achieved during all other times. TMDLs are also required to incorporate a Margin of Safety to account for uncertainty in the relationship between a pollutant load and the resultant condition of the waterbody. The Margin of Safety for this TMDL was implicit, and relied upon the simulation of a “worst case” condition from January 2006 through December 2007.

**Comment 1-24:** The water quality model is parameterized with SOD and reaeration rates that yield DO values below 4 mg/L during some portion of the 1996-2007 time period in some portions of Phillippi Creek. The assumption was made that SOD played a large role in driving DO concentrations in the system, given the low measured chlorophyll a concentrations, although no SOD data were available. A sensitivity analysis was performed using the model to estimate the relative importance of DO-consuming constituents. The authors found that SOD consumed the most oxygen, followed by plant respiration and BOD. For the calibration model run, a spatially and temporally constant value of 1.75 g/m2/day was used for SOD (USEPA, 2009b).

It is likely that Phillippi Creek contains spatially varying sediment types within the WASP model domain. Sandy bottoms would exert less SOD on the water column than would more organically rich bottom areas. WASP has the ability to vary SOD both spatially and temporally, so that consideration should be given to variation of SOD based on bottom type to aid in calibration of the model.

**Response 1-24:** EPA acknowledges that the modeling analysis could be improved with direct measurements of SOD and reaeration in Phillippi Creek. However, no such



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measurements have been made in that would allow for characterization of the spatial and temporal variation of SOD in this specific stream. EPA investigated the possibility of conducting a limited stream reconnaissance and SOD sampling in Phillippi Creek. Unfortunately, constraints from both budget and staff time have not allowed for such a study. The SOD rates used were informed by a database of SOD in similar tidal rivers.

**Comment 1-25:** The low chlorophyll a values observed in the system were at first look inconsistent with the observed DO concentrations less than 5.0 mg/L, which the authors interpreted to indicate relatively high productivity. Observations of macrophytes and periphyton in the system, as described in the TMDL document (USEPA, 2009a), led the model developers to assume that these were the cause of the diurnal DO pattern which displayed the low DO values (USEPA, 2009b).

The model developers set the upstream boundary conditions for chlorophyll to 15 μg/L, apparently in an attempt to provide organic matter supply to increase oxygen demand. This is considerably higher than the mean value of 4.2 μg/L observed in the system, and higher even than the maximum observed chlorophyll a value of 12.0 μg/L (USEPA, 2009a). To incorporate macrophytes and periphyton into the model, the developers turned off transport of phytoplankton, so that the chlorophyll component of the water quality model was considered representative of non-moving algae.

This simulation of chlorophyll as a surrogate for periphyton and macrophytes, with transport turned off, presents some problems, however. Most importantly, water column phytoplankton can have very different uptake and growth rates than do macrophytes, with some measured data showing phytoplankton annual productivity of approximately three times that of macrophytes (Wetzel, 1964). The relationship of water column phytoplankton uptake rates to those of periphyton and macrophytes in the Phillippi Creek system is unknown, but it is inappropriate to lump these into one surrogate chlorophyll constituent with one set of rates.

The WASP model should provide the capability to simulate more than one chlorophyll class. Separate chlorophyll groups could be used to simulate periphyton and macrophytes, with transport turned off, while still simulating water column chlorophyll and allowing transport of this component. This would allow comparison of predicted and observed water column chlorophyll concentrations, allowing a further check on model calibration. As currently constructed, the water quality model does not allow transport of algal biomass, and associated oxygen production and demand, downstream, clearly an unrealistic constraint. Without allowing algal transport, any comparisons to observations which do include the effects of transport are obviously compromised.

**Response 1-25:** Please refer to Response #1-6 for a discussion of the DO concentration data. As discussed in Sections 2 and 4.4.1 of the modeling report, existing information indicated that macrophytes and periphyton cause strong diurnal variation in DO concentration in Phillippi Creek. This photosynthetic activity was represented in the water quality model by phytoplankton kinetics with no transport. With transport off



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phytoplankton will not move with the water current, thus simulating periphyton or macrophytes in the model.

While the modeling approaches used for phytoplankton and periphyton are similar, periphyton differ from phytoplankton in a number of fundamental ways:

- Periphyton do not move with the water current, as do phytoplankton,
- Periphyton typically dwell on or near the bottom, so are not impacted by the average light in the water column but the light reaching the bottom (substrate).
- Periphyton are limited by the amount of substrate available for growth.
- There is typically a maximum density for attached plants.

These differences were considered when configuring the model so that the model would represent the actual DO dynamics as close as possible. Chlorophyll-a was not used as a calibration parameter since it is not a good indicator of macrophyte and periphyton density.

**Comment 1-26:** The stated objective of the model is "...to demonstrate that this set of models adequately predicts water quality in the Phillippi Creek tidal river system..." (USEPA, 2009b). However, as for the hydrodynamic model, no quantitative calibration criteria were provided, and no quantitative analyses of the relationships between predicted and observed water quality constituents in the system are presented.

Time series plots of observed and predicted DO, nitrogen species, and phosphorus species were provided for a site near Bee Ridge Road, and of oxygen demand for a site near the bridge on Fruitville Road. The authors state that the "...model predicts each of these nutrient parameters well" (USEPA, 2009b), based solely on the time series plots provided, it appears, but do not provide any quantitative analysis of the calibration results.

The model is not calibrated, despite the statement in the document. Based on examination of the time series plots, the model is not accurately simulating the water quality in the system. The time series plots provided indicate that the model typically overpredicts observed DO, nitrogen species, and phosphorus species, as well as significantly overpredicting observed BOD by a factor of 4-10 times. The time series plots do not provide assurance that the model predicts observed conditions during the 2006-2007 period, for any of the constituents examined.

Appropriate calibration criteria should be selected that would allow discernment of responses to changes in forcing functions commensurate with the changes in response functions (water quality constituents) necessary to meet water quality rule requirements. Additionally, rather that the selected water quality sites where time series comparisons were presented for observed and predicted water quality, predictions for each of the segments of the water quality model should be compared to any existing water quality data as appropriate to evaluate the calibration. Comparisons of water column chlorophyll a predictions to observed data should also be made to aid in calibration.



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Calibration statistics are typically expected to be presented as assurance that a model is reproducing observed responses to observed forcing conditions (i.e., nutrient loads, transport, oxygen demand, reaeration) No calibration statistics are provided for the water quality model. Appropriate calibration statistics, such as Root Mean Square Error, Mean Error, Relative Error, Absolute Mean Error, and r2 relationships, should be provided for the water quality model constituents. Additionally, plots of predicted versus observed values, and plots of residuals, would allow examination of potential biases in predictions. None of these quantitative calibration evaluations were completed for the water quality model, so that the status of the calibration cannot be evaluated.

**Response 1-26:** The watershed and water quality models were calibrated using the best available information at the time of the TMDL development. EPA compared model predictions against the measured data overall and determined that the model calibrations were sufficiently predictive for estimating the pollutant loading reductions needed.

**Comment 1-27:** The model was used to derive loading reductions which resulted in model predicted concentrations of DO which did not violate the 5.0 mg/l criterion. The model scenario with reductions of nutrients and oxygen demanding substances which provided this attainment of the DO criterion as termed the TMDL model. This scenario included a 70 percent reduction in BOD, nutrients, and SOD.

It is not known if the scenario resulted in attainment of the DO criterion in all segments of the WASP model, as the results from only one segment, near the downstream end of the WBID boundary, was provided. It is also not known what various scenarios were modeled. As nitrogen was determined to be the limiting nutrient, then initial scenarios should involve only reductions in nitrogen loads, until a determination was made that the criterion could not be met using only these reductions. Scenarios incorporating various reductions of nutrient and BOD loadings should have been attempted in developing appropriate load reductions for the TMDL.

**Response 1-27:** The TMDL approach was to reduce nutrients and BOD until DO was predicted to meet the applicable water quality standard (5mg/l) in WBID 1937 of Phillippi Creek. Although numerous other reduction scenarios are possible, EPA took this approach because most implementation options will result in reductions of both nutrients, as well as oxygen-demanding substances. Please see Response #1-8 for a discussion of limiting nutrients and the choice to address both TN and TP in the TMDL. As noted in Response #1-4, the average TP concentrations exceed FDEP's screening thresholds for streams, as well as the instream-protective value criterion for freshwater streams in the Peninsula Watershed Region that was recently promulgated by EPA. As discussed in response #1-9, the TMDL did not call for a direct 70% reduction in SOD. Rather, it called for reductions in nutrients and BOD that would cause the SOD to be reduced.

**Comment 1-28:** The proposed DO and nutrient TMDLs developed by USEPA in Phillippi Creek WBID 1937 are based on a hydrodynamic and water quality model scenarios which indicate that 70% reductions in loadings of TN, TP, and SOD are



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necessary to achieve water quality standards with respect to DO. The model used to arrive at these reductions is not calibrated to correctly relate loadings to water quality in the system, with no provision of calibration criteria or calibration statistical analyses for the hydrodynamic model or the water quality model. It is recognized that there is a lack of data for the system with respect to oxygen demand from biomass decomposition in the water column and SOD. This lack of data makes it difficult to identify the pollutant of concern primarily responsible for the DO criterion violation. However, given the data available, alternative model constructs are possible which are more likely to provide defensible estimates of loading reductions needed.

Loadings reductions of 70 percent would be extremely costly to achieve, in terms of both time and money. Prior to promulgating such reductions, there is a responsibility to ensure that the reductions are based on best available knowledge of the system. The model employed for this effort, and used to arrive at the proposed reductions, is not capable in its current state of simulating observed conditions given observed input data for flows and loadings. This should be rectified before utilizing the model to examine loading reductions necessary to meet water quality standards.

**Response 1-28:** The concerns raised in this summary comment have already been introduced by previous comments. Please review Responses #1-16 and 1-26 for a discussion of model calibrations, Responses #1-9 and 1-10 for a discussion of sediment oxygen demand, and Response #1-3 for a discussion of the achievability of the pollutant reductions.

EPA is establishing this TMDL for Phillippi Creek pursuant to the schedule of EPA's commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998). The TMDL is based upon the information available at this time. However, the TMDL may be revised if the available information changes, for example, if the water quality standards are changed, or if additional data or information become available.

**Comment 1-29:** An attempt should be made to derive empirical relationships between pollutant loadings and DO concentrations. This would require no assumptions about the biological rates involved in relating algal DO production and consumption, or about SOD. This is especially important as no data exist for SOD or for macrophyte and periphyton production within the system, and any rates applied to algal processes would require either use of literature values or actual field data collection. An empirical evaluation would be much less time consuming than model development and calibration as well.

**Response 1-29:** The suggestion to base the TMDL on empirical relationships between pollutant loadings and DO concentrations is noted. There is merit to that suggestion; however, it is also important to remember that such an approach also relies on assumptions and has its own advantages and disadvantages. EPA elected to use models to mechanistically analyze the likely effects of BOD, TN, and TP loads on DO concentrations in the Phillippi Creek watershed. The hydrodynamic model DYNHYD was used to simulate water movement through the stream channel considering variable upstream



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flows and downstream tidal controls. A WASP eutrophication model was used to evaluate the in-stream impacts of pollutant loads from both point and nonpoint sources. Current pollutant loads were estimated using the SIMPLE model, and these loads were reduced until model simulations indicated the DO criterion of 5 mg/L was attained. We believe this approach to be appropriate for determining nutrient and DO TMDLs protective of Phillippi Creek.

**Comment 1-30:** If the empirical approach does not provide defensible results, then the data and model construct deficiencies of the existing model should be addressed. This may involve data collection efforts, although it is recognized that this may take some time. Employment of a mechanistic approach should include several revisions to the current model, as follows:
- The hydrodynamic and water quality models must be appropriately calibrated, utilizing water column chlorophyll as well as macrophyte and periphyton rates to simulate oxygen production and demand.
- Consideration of sediment type underlying each water quality model segment should inform the selection of SOD, with use of the WASP sediment diagenesis submodel if possible to calculate SOD both spatially and temporally.
- Quantitative calibration criteria should be established consistent with the magnitude of the changes in water quality constituent concentrations necessary to meet water quality standards.
- Assurance of model calibration should be provided in a quantitative manner, including statistical analysis of the relationships between predicted and observed water elevation, flows, and water quality constituents. Evaluation of bias in the predictions should include predicted versus observed plots, and analysis of residuals.
- Only after sufficient assurance is in hand that the model is calibrated should the evaluation be completed to determine loading reductions sufficient to meet water quality requirements.
- Any mechanistic model development should utilize boundary conditions far enough away from the mouth of the creek so that no impacts to the boundary conditions are likely from changes in model flows or loadings (e.g., boundary conditions at Big Sarasota Pass and Little Sarasota Bay).
- Consideration should be given to the advisability of utilizing a vertically resolved construct for both the hydrodynamic and water quality, models, to account for processes (circulation, water quality dynamics) which are dependent upon location in the water column. An understanding of the sampling depths for the observed water quality data should provide direction on whether this is necessary or not.

**Response 1-30:** The concerns raised in this summary comment have already been introduced by previous comments. Please review Responses #16 and 26 for a discussion of model calibrations, Response #1-25 for a discussion of macrophytes and periphyton, Responses #1-9, 1-10, and 1-24 for a discussion of sediment oxygen demand, Response # 1-20 for a discussion of the boundary data near the river mouth, and Response #1-11 for a discussion of the appropriateness of using a one-dimensional hydrodynamic model.

**Comment 1-31:** For both the empirical and mechanistic approaches, evaluation of loading reductions necessary to meet the DO criterion should include various reductions



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of nutrient and BOD loads, with initial examination of nitrogen load reductions alone, since this is the limiting nutrient in the system. If nitrogen loads are insufficient to meet the DO criterion, then combinations of reductions of TN, TP, and BOD loadings should be tested, not only one reduction rate for all three constituents.

**Response 1-31:** Please see Response #1-8 for a discussion of limiting nutrients and the choice to address both TN and TP in the TMDL, and Response #1-27 for a discussion of modeling scenarios.

## Commenter 2: Florida Department of Transportation

**Comment 2-1:** The modeling developed for the Phillippee Creek TMDL is fairly good. There are a number of key pieces of information that are missing in the presentation, and it appears that the assumptions utilized in defining the SOD values may not be reasonable. It is our determination that higher baseline existing SOD values, that more accurately reflect the high levels of detrital input to the system are warranted. This may allow the use of the Covar method to define the reaeration rather than using the constant input value. Presently the DO values in the system, and the seasonal patterns of the water chemistry are not being captured. Additionally, the determination of a target reduction of 70 percent in the SOD value is not a reasonable target. This would put the SOD value at levels not appropriate for this type of system. The model should demonstrate more completely that it is simulating the flows and depths, therefore given the level of cross-section data, the velocities should be accurate. **Until the model is shown to more accurately simulate the measured patterns and levels in the DO and water chemistry, this TMDL should not be finalized.**

**Response 2-1:** Many of the concerns raised in this comment have been introduced by the previous commenter. Please see responses #1-10 and 1-22 for a discussion of the SOD values used in the modeling. Please see responses #1-16 and #1-26 for a discussion of calibration of the hydrology and receiving water models, respectively, and #1-18 for a discussion of the achievability of the reductions. Please see responses #1-9 and #1-27 for a discussion of SOD and the TMDL allocations/reductions.

**Comment 2-2:** KEY COMMENTS 1. The report identifies very high SOD values in the studies sited on page 25, these range from 2.31 to 8.36. This report also has a quote early on that stated "*The Sarasota County Phillippi Creek Basin Master Plan, Characterization of Ecological Conditions and impacts of Storm water Runoff, describes Phillippi Creek as a detrital based system that receives large loads of detritus from the watershed (Estevez, ED., 1994). This detritus decomposes and through BOD and SOD consumes dissolved oxygen from the water column from early on which says that this is a system high in detrital matter*". Not sure why then the lower SOD value of 1.75 was utilized based upon the QEA model. Clearly there is evidence that the QEA determined SOD values may not be reasonable. Given the reliance on the use of a constant, potentially low reaeration rate, this is supported.



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**Response 2-2:** The concerns expressed in this comment were previously addressed. Please see response #2-1.

**Comment 2-3:** KEY COMMENTS 2. The simulated DO values compared to the measured data show that the model as it stands is not properly simulating the DO conditions.

**Response 2-3:** The concerns expressed in this comment were previously addressed. Please see response #2-1.

**Comment 2-4:** KEY COMMENTS 3. There are clear seasonal patterns in the chemistry data shown in figures 17 through 22 that the model is simply not capturing. It is one thing to miss data point when it is random, but where there are clear patterns that aren't being captured, the model needs to be fixed.

**Response 2-4:** The concerns expressed in this comment were previously addressed. Please see response #2-1.

**Comment 2-5:** KEY COMMENTS 4. The model looked for a 70 percent reduction in nutrients, BOD and SOD. A 70 percent reduction in SOD would put the SOD values at 0.525. On a high detrital system such as this, this is most likely not an attainable goal even under natural conditions.

**Response 2-5:** Please see response #1-3 for a discussion of the achievability of the 70% reduction, and responses #1-9, #1-27 and #2-1.

**Comment 2-6:** Endpoints/Water Quality Targets 6. Nutrient reductions are proposed in order to meet the requirement that dissolved oxygen be at least 5.0 mg/l at all times, including normal daily and seasonal fluctuations. The Impaired Waters Rule allows for waters to be de-listed if the impairment is determined to be caused by a natural condition. In the absence of other evidence of impairment, this criterion is unreasonable for many of the streams in Florida. High summer temperatures combined with low flow conditions will result in dissolved oxygen values less than 5 mg/l even in pristine, healthy streams. The dissolved oxygen standard of 5 mg/l at all times is very likely to be unattainable in many streams in Florida.

**Response 2-6:** The concern expressed in this comment was addressed in response #1-2.

**Comment 2-7:** Endpoints/Water Quality Targets 7. The Impaired Waters Rule allows for up to 10 percent of the dissolved oxygen measurements to fall below the standard of 5 mg/l before a water body is verified as impaired for dissolved oxygen. Yet once a water body is on the verified list, the methodology used to develop the TMDL, no matter how flawed or uncertain, must ensure zero violations of the standard. This conflict between the verification process and the TMDL process results in targets that are not reasonable and quite probably unattainable.



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**Response 2-7:** Water quality standards may account for natural variation using clearly expressed magnitude, duration and frequency. As the commenter acknowledges, the applicable dissolved oxygen standard is a daily average of 5 mg/l, and a mandate to maintain normal daily and seasonal fluctuations above that level. EPA must develop the TMDL to meet the currently adopted water quality standards for dissolved oxygen in Class III waters.

**Comment 2-8:** Water Quality Assessment/Data Review: 8. The stations in Figure 3 could be more clearly labeled.

**Response 2-8:** The figure has been revised to make it easier to see the sampling station locations. Please note that sampling stations 21 FLGW3502 and 21FLGWFLO0100 are in essentially the same location near Bee Ridge Road.

**Comment 2-9:** TMDL Methodology: Determination of the Assimilative Capacity/Modeling: 10. Need to show flow calibrations at the USGS stations to go along with the water surface elevation calibrations.

**Response 2-9:** Please see response #1-26 for a discussion of model calibration.

**Comment 2-10:** TMDL Methodology: Determination of the Assimilative Capacity/Modeling: 11. The report states that a constant reaeration value of 0.5 per day was used because the velocities in the model are too high, therefore using Covar would not be accurate. Given the accurate cross-sectional data as well as the available water surface elevation and flow data, the model should be able so accurately simulate the velocities in the system to go with the depths.

**Response 2-10:** Concerns expressed in this comment were addressed by response #2-1.

**Comment 2-11:** TMDL Methodology: Determination of the Assimilative Capacity/Modeling: 12. The modeling should use more reasonable values of SOD and get the calibration by keeping Covar and using a higher SOD.

**Response 2-11:** The concerns expressed in this comment were discussed in responses #2-1 and #2-10.

**Comment 2-12:** TMDL Methodology: Determination of the Assimilative Capacity/Modeling: 13. The report identifies very high SOD values in the studies sited on page 25, these range from 2.31 to 8.36. This report also has a quote early on that stated "*The Sarasota County Phillippi Creek Basin Master Plan, Characterization of Ecological Conditions and Impacts of Storm water Runoff describes Phillippi Creek as a detrital based system that receives large loads of detritus from the watershed (Estevez, E.D., 1994). This detritus decomposes and through BOD and SOD consumes dissolved oxygen from the water column from early on which says that this is a system high in detrital matter*". Not sure why then the lower SOD value of 1.75 was utilized based upon the



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QEA model. Clearly there is evidence that the QEA determined SOD values may not be reasonable. Given the reliance on the use of a constant, potentially low reaeration rate, this is supported.

**Response 2-12:** This comment is the same as comment #2-2; please refer to the corresponding response.

**Comment 2-13:** TMDL Methodology: Determination of the Assimilative Capacity/Modeling: 14. The simulated DO values compared to the measured data show that the model as it stands is not properly simulating the DO conditions.

**Response 2-13:** Since this comment is the same as comment #2-3, please refer to the corresponding response.

**Comment 2-14:** TMDL Methodology: Determination of the Assimilative Capacity/Modeling: 15. There are clear seasonal patterns in the chemistry data shown in figures 17 thorugh 22 that the model is simply not capturing. It is one thing to miss data point when it is random, but where there are clear patterns that aren't being captured, the model needs to be fixed.

**Response 2-14:** This comment is the same as comment #2-4; please refer to the corresponding response.

**Comment 2-15:** TMDL Methodology: Determination of the Assimilative Capacity/Modeling: 16. The model looked for a 70 percent reduction in nutrients, BOD and SOD. A 70 percent reduction in SOD would put the SOD values at 0.525. On a high detrital system such as this, this is most likely not an attainable goal even under natural conditions.

**Response 2-15:** Since this comment is the same as comment #2-5, please refer to the corresponding response.

**Comment 2-16:** TMDL Methodology: Determination of the Assimilative Capacity/Modeling: 17. The report states the use of SOD rates were also computed with the Quantitative Environmental Analysis, LLC (QEA) and Mississippi State University sediment flux model that is based on DiToro's sediment flux model (QEA, 5/29/2003). This SOD model estimates SOD rates from the observed water column nitrogen, phosphorus and carbon loads, volume, flow rate and water temperature. These estimated rates are approximately 1.5 g/m2lday. The modeled SOD clearly don't match with other SOD values measured in the area, this may be because the loads being calculated and the ultimate sources of SOD are not accounted for. If the SOD can't be used to calibrate what the DO is doing then something is wrong.

**Response 2-16:** The concerns raised in this comment have been addressed in other responses. Please see responses 1-10 and 1-22 for a discussion of the SOD values used, and 1-26 for a discussion of model calibration.



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**Comment 2-17:** TMDL Methodology: Determination of Load Reduction: 18. There are issues with the model calibration relative to determination of the SOD and the presentation of the dissolved oxygen calibration.

**Response 2-17:** The concerns raised in this comment have been addressed in other responses. Please see responses 1-10 and 1-22 for a discussion of the SOD values used, and 1-26 for a discussion of model calibration.

**Comment 2-18:** TMDL Methodology: Determination of Load Reduction: 19. The targeted SOD levels in the TMDL scenario are unreasonable and most likely not achievable.

**Response 2-18:** The concerns raised in this comment have been addressed in other responses. Please see responses #1-10 and #1-22 for a discussion of the SOD values used. Please see responses #2-1 for a discussion of the achievability of the TMDL scenario.

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