SCIENTIFIC REVIEW OF PROPOSED MINIMUM FLOWS AND LEVELS FOR DONA BAY/SHAKETT CREEK BELOW COW PEN SLOUGH

Scientific Peer Review Report

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Scientific Peer Review of Proposed Minimum Flows and Levels for Dona Bay/Shakett Creek below Cow Pen Slough, Florida

EXECUTIVE SUMMARY

These studies were conducted by the Southwest Florida Water Management District (the District) because Florida Statutes (§373.042) mandate the District's evaluation of minimum flows and levels (MFLs) for the purpose of protecting the water resources and the ecology of Shakett Creek and the Donna Bay estuary from "significant harm" that might result from potential future freshwater diversions from the contributing watersheds. With appropriate water management, including science-based MFL rules for environmentally safe operation of water supply impoundments and diversions, the District can ensure that Shakett Creek, Dona Bay and their associated tidal (estuarine) marshes and brackish wetlands will continue to provide essential food and cover for the myriad of marine and estuarine-dependent fish and wildlife that need them for survival, growth and reproduction.

Historically, the Dona Bay watershed included approximately 10,000 acres, consisting primarily of native upland habitats such as pine flatwoods, cabbage palm hammocks and wetlands. Most significantly, the original Cow Pen Slough was, primarily, a wetland drainage that conveyed runoff to the Myakka River. It consisted of large, slow flowing marshes that ultimately discharged into the Myakka River.

Conversion of the historical watershed included excavation of Cow Pen Slough by a series of deeply incised canals that more efficiently drained and significantly altered the character, function and values of the natural wetlands. Furthermore, the construction of the Intracoastal Waterway and Venice Inlet has resulted in an increased reach of Gulf marine waters into the Dona and Roberts Bay (DARB) estuarine region. The more efficient connection to the Gulf of Mexico has influenced water levels and circulation, sedimentation, salinity, and the numbers and kinds of plants and animals inhabiting the study area.

On the other hand, the diversion of Cow Pen Slough from the Myakka River watershed into Shakett Creek and the Dona Bay watershed, the connection of Curry Creek and Roberts Bay to the Myakka River via the Blackburn Canal, and the transformation of the region's natural land cover to agricultural uses (e.g., improved pastures, citrus and row crops) have increased freshwater inflows tremendously, especially during the "wet" season. Taken together, the combination of increased inflows and marine influences has created a strong salinity gradient over a relatively short distance in the DARB area, resulting in rapid, high-amplitude salinity oscillations that are not well tolerated by much of the marine life of interest here.

In the Dona Bay estuary, the major features include the most downstream control structure (i.e., the CPS2 dam) on Cow Pen Slough, the channelized reach of upper Shakett Creek, the emergence of the Shakett Creek into a broader and more natural lower creek east of US 41, the highway bridge at US 41, the upper, middle and lower Dona Bay system, and the ICW-Venice Inlet area. Major features in the Roberts Bay estuary involve the channelized reach of the Blackburn Canal, remnants of the historic Curry Creek, the emergence of Curry Creek into a broader and more natural lower creek east of US 41, the highway bridge at US 41, the upper, middle and lower Roberts Bay system, and the ICW-Venice Inlet area. The entire region is tidally affected, with the effect increasing closer to the Venice Inlet near the Gulf of Mexico.

The District's researchers found that Dona Bay and Shakett Creek appear to be depressed in both number of benthic (bottom dwelling) species and abundance when compared to the other nearby bays, such as Lyons Bay. The Lyons Bay watershed has not been altered to the same extent as the adjacent Dona Bay watershed. As a result, the oyster and seagrass populations of Lyons Bay have been found to be generally healthier than those of Dona Bay. In addition, salinity has been found to be consistently higher and less variable in Lyons Bay than in Dona Bay. Thus, it is widely accepted by the District and others in Sarasota County that the implementation of plans to restore the watershed and its hydrologic condition will have a high probability of improving water quality, oyster populations, and seagrass communities in the DARB system.

The District's approach for setting the MFL was to determine inflows to Dona and Roberts Bay without the flows from the two diversions. This means that the baseline condition for the system does not include this large interbasin transfer of water and, consequently, the proposed MFL is only for the two original tributaries to the DARB system (Fox and Salt Creeks). Baseline flows, as well as various inflow reduction scenarios, were used in association with a hydrodynamic model to predict estuarine salinity. The model was used to evaluate the amount of available habitat in the estuary during three different portions of the year (seasonal blocks) for each flow reduction scenario. Habitat was defined in terms of the volume, bottom area, and length of shoreline exposed to water of different salinity ranges (< 10, < 15, or < 20). The MFL was designed so that reduced flows from Fox and Salt Creeks would never result in more than a 15% decrease in available habitat (either as volume, bottom area, or shoreline length) when compared to the baseline condition.

The Scientific Review Panel (the Panel) finds that the District's hydrological analyses are more or less adequate, as are the numerical simulations. Although the Panel has numerous suggestions for improvement, if the District's exclusion of the majority of freshwater inflows to the DARB system is accepted, then it appears to the Panel that the model applications have the accuracy and resolution to simulate circulation and salinity patterns in enough detail for use in decision-making.

The Panel also supports the District's finding that changes in the shallow-water distribution of estuarine-dependent fishes and shellfish is related to freshwater inflow and salinity regimes. Freshwater discharges attract these organisms, particularly the young-of-the-year, into areas that provide habitat (i.e., food and cover) in which they can survive and grow. Such is the case in the DARB system, especially during low flow periods. Nevertheless, District researchers indicate that this is happening without providing the usual trophic (food-chain) benefits, suggesting that a less erratic inflow regime may result in more efficient production of estuarine fish and crustaceans. Theoretically, the District's proposed MFL should help mitigate any negative impacts on the exposed young of these estuarine-dependent species from natural drought during their peak seasonal utilization of estuarine nursery habitats in the springtime. But with the complete exclusion of flows from Cow Pen Slough and Blackburn canals, it is not certain that the District's MFL will provide sufficient protection all the time.

The District is to be commended for voluntarily committing to independent scientific peer review of its MFLs determinations. The Panel finds that the District's goals, data, methods and conclusions, as developed and explained in the MFL report, are generally reasonable and appropriate. One exception might be the District's policy decision to exclude all inflows from the long-standing Cow Pen Slough and Blackburn canals, and any related water quality or biological analyses and relationships, from the determination of the MFL. Excluding these flows means there are NO (emphasis added) empirical relationships between freshwater flow and water quality constituents, benthos, fishes or other important ecological components used in the District's MFL determination. This leaves little existing physical, chemical and biological information upon which to base the MFL determination. The Panel believes that the environmental consequences of changing inflows to Cow Pen Slough should be evaluated in relation to current conditions in order to better understand impacts of the proposed MFL and its net benefits to the ecosystem. Another Panel concern arises from indications that the baseline conditions used in the report are saltier than historic conditions.

Given the lack of data for Fox and Salt Creeks, the normal uncertainties inherent in the HSPF and EFDC model predictions for baseline conditions, and the fact that there has not been an analysis of the consequences of changing inflows to Cow Pen Slough, the Panel does not believe there is enough scientific information available to allow withdrawals from Fox and Salt Creeks at present, particularly during low flow seasons (Blocks 1 and 2). Therefore, the Panel recommends that the District follow the Precautionary Principle and establish initial MFLs with little or no withdrawals from Fox and Salt Creeks until adequate scientific information can be collected and evaluated to determine with more confidence how changes in inflow will affect the DARB system. The Panel urges continued monitoring in the future to verify that any MFL is having its intended effect of protecting the ecological health and productivity of the DARB system.

INTRODUCTION

The Southwest Florida Water Management District (the District) is mandated by Florida statutes to establish minimum flows and levels (MFLs) for state surface waters and aquifers within its boundaries for the purpose of protecting the water resources and the ecology of the area from "significant harm" (Florida Statutes, 1972 as amended, Chapter 373, §373.042). The District implements the statute directives by annually updating a list of priority water bodies for which MFLs are to be established and identifying which of these will undergo a voluntarily independent scientific review. Under the statutes, MFLs are defined as follows:

1. A minimum flow is the flow of a watercourse below which further water withdrawals will cause significant harm to the water resources or ecology of the area; and
2. A minimum level is the level of water in an aquifer or surface water body at which further water withdrawals will cause significant harm to the water resources of the area.

Revised in 1997, the Statutes also provide for the MFLs to be established using the "best available information," for the MFLs "to reflect seasonal variations," and for the District's Board, at its discretion, to provide for "the protection of nonconsumptive uses." In addition, §373.0421 of the Florida Statutes states that the District's Board "shall consider changes and structural alterations to watersheds, surface waters and aquifers, and the effects such changes or alterations have had, and the constraints such changes or alterations have placed on the hydrology of the affected watershed, surface water, or aquifer…." As a result, the District generally identifies a baseline condition that realistically considers the changes and structural alterations in the hydrologic system when determining MFLs. While this is always important, it is especially important in the DARB system where ~77 % of freshwaters that have been flowing into the area for the past half century may be eliminated, in part to restore the watershed's original drainage patterns, as well as to provide supplies for the region's growing water needs.

Current state water policy, as expressed by the State Water Resources Implementation Rule (Chapter 62-40.473, Florida Administrative Code) contains additional guidance for the establishment of MFLs, providing that "…consideration shall be given to the protection of water resources, natural seasonal fluctuations, in water flows or levels, and environmental values associated with coastal, estuarine, aquatic and wetlands ecology, including:

1. Recreation in and on the water;
2. Fish and wildlife habitats and the passage of fish;
3. Estuarine resources;
4. Transfer of detrital material;
5. Maintenance of freshwater storage and supply;
6. Aesthetic and scenic attributes;
7. Filtration and absorption of nutrients and other pollutants;
8. Sediment loads;
9. Water quality; and
10. Navigation."

After a site visit on September 16, 2008 to perform a reconnaissance survey of the Dona and Roberts Bay system, including their tributaries, the Panel discussed the scope of the review and subsequently prepared their independent scientific reviews of the draft report and associated study documents. The reviews were compiled by the Panel Chair and edited by all Panel Members into the consensus report presented herein.

BACKGROUND

The quantity, quality and timing of freshwater input are characteristics that define an estuary. Freshwater inflows affect estuarine (tidal) areas at all levels; that is, with physical, chemical and biological effects that create a vast and complicated network of ecological relationships (Longley 1994). The effects of changes in inflows to estuaries are also described in Sklar and Browder (1998) and reviewed in Alber (2002). This scientific literature describes and illustrates how changing freshwater inflows can have a profound impact on estuarine conditions: circulation and salinity patterns, stratification and mixing, transit and residence times, the size and shape of the estuary, and the distribution of dissolved and particulate material may all be altered in ways that negatively effect the ecological health and productivity of coastal bays and estuaries.

Inflow-related changes in estuarine conditions consequently will affect living estuarine resources, both directly and indirectly. Many estuarine organisms are directly linked to salinity: the distribution of plants, benthic organisms and fishery species can shift in response to changes in salinity (Drinkwater and Frank 1994, Ardisson and Bourget 1997). If the distributions become uncoupled, estuarine biota may be restricted to areas that are no longer suitable habitat for their survival, growth and reproduction. Potential effects of human activities, particularly freshwater impoundment and diversion, on the adult and larval stages of fish and invertebrates include impacts on migration patterns, spawning and nursery habitats, species diversity, and distribution and production of lower trophic level (food) organisms (Drinkwater and Frank 1994, Longley 1994). Changes in inflow will also affect the delivery of nutrients, organic matter and sediments, which in turn can affect estuarine productivity rates and trophic structure (Longley 1994).

There are a number of approaches for setting the freshwater inflow requirements of an estuary. The District has selected to use a “percent-withdrawal” method that sets upstream limits on water supply diversions as a proportion of river flow. This links daily withdrawals to daily inflows, thereby preserving natural streamflow variations to a large extent. This type of inflow-based policy is very much in keeping with the approach that is often advocated for river management, where flow is considered a master variable because it is correlated with many other factors in the ecosystem (Poff et al. 1997; Richter et al. 1997). In this case, the emphasis is on maintaining the natural flow regime while skimming off flows along the way to meet water supply needs. Normally, regulations are designed to prevent impacts to estuarine resources during sensitive low-inflow periods and to allow water supplies to become gradually more available as inflow increases. The rationale for the District's MFL, along with some of the underlying biological studies that support the percent-of-flow approach, is detailed in Flannery et al. (2002).

REVIEW

Developing minimum flow rules requires several steps: (1) setting appropriate management goals; (2) identifying indicators to measure characteristics that can be mechanistically linked to the management goals; (3) reviewing existing data and collecting new data on the indicators; and (4) assembling conceptual, qualitative, and quantitative models to predict behavior of the indicators under varying flow regimes. The first two steps above represent the overall approach to setting the minimum flow rule.

The District's management goal for Dona Bay and Shakett Creek below Cow Pen Slough was developed to limit potential changes in aquatic and wetland habitat availability associated with reductions in seasonal blocks of freshwater inflows (SWFWMD 2008). A hydrodynamic model was employed to estimate selected salinity habitat availabilities under a baseline inflow condition versus various flow reduction scenarios. A criteria of no more than a 15% change in habitat availability, as compared to the estuary's baseline condition, was used as the threshold for "significant harm." While the use of 15% as a threshold is a management decision, the Panel agrees that this is a reasonable approach for avoiding the most serious negative impacts on the ecosystem. The remainder of this report is focused on review of the data, methods and analyses used as a basis for the District's recommended MFL.

Specifically, the District's proposed MFL was determined based on the following procedure:

1. A 1948 pre-channelization watershed was defined for the bay and estuary complex that excludes a large amount (~78.9%) of the system's current watershed (Figure 1). This was done to remove artificial inflows (i.e., interbasin transfers) from the Cow Pen Slough canal, completed in 1966, and the Blackburn canal, which was constructed in the 1950s. Both of these dredged canals were part of watershed protection plans and were built to alleviate flooding on the nearby Myakka River. Excluding their unnatural contributions to the estuary's inflows in the "baseline condition" was seen by the District as a return to a more natural flow regime and environment for the Shakett Creek estuary and the Dona Bay System (Figure 2).

   Since long-term freshwater inflow records do not exist, a mechanistic model (i.e., the Hydrological Simulation Program--Fortran or HSPF model) was used for simulation of rainfall runoff to Dona Bay from the lesser watershed of the baseline condition (Intera 2007). This lesser watershed included only the original Fox, Salt and Shakett Creek drainage basins. A historical period of 21 years (1985-2005) was used in the development of the ungaged inflow estimates. Seasonal intervals of similar flow levels were blocked out to represent low (Block 1), medium (Block 2) and high (Block 3) inflows. The low flow block extends from April 20 through June 25, the high flow block runs from June 26 through October 26, and the rest of the year (i.e., before Block 1 and after Block 3) is assumed to represent an intermediate or medium flow block of time.

Figure 1. Existing greater watershed of the Dona and Roberts Bay System.

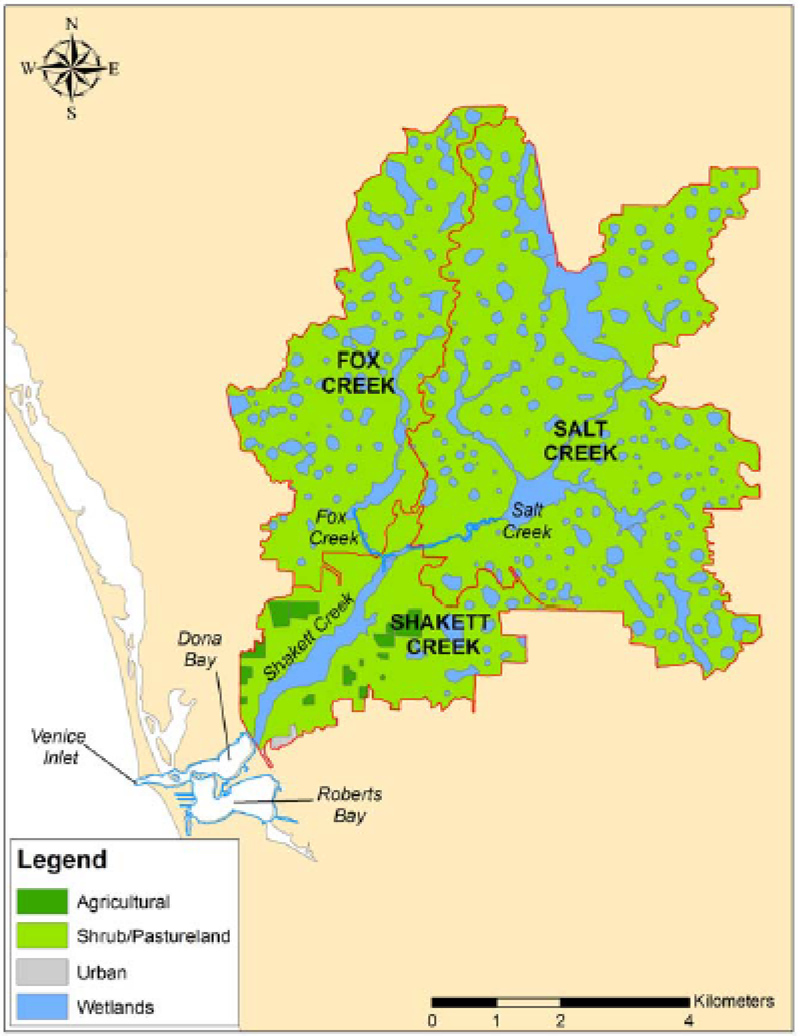

Figure 2. Historical lesser watershed of the Dona Bay System with major tributaries and land use circa 1948.

2. A hydrodynamic (circulation) and conservative mass (salinity) transport model (i.e., the Environmental Fluid Dynamics Code or EFDC) was applied to the baseline condition of the DARB system to estimate the length, area and volume of selected salinity habitats over a representative three-year (1986-1988) simulation period (ATM 2007). The model was also used to predict salinities at four locations along the salinity gradient (Figure 3) under various reduced inflow scenarios in order to identify minimum flows needed by the estuary. Percent flow reductions evaluated ranged from -5% to -30%.

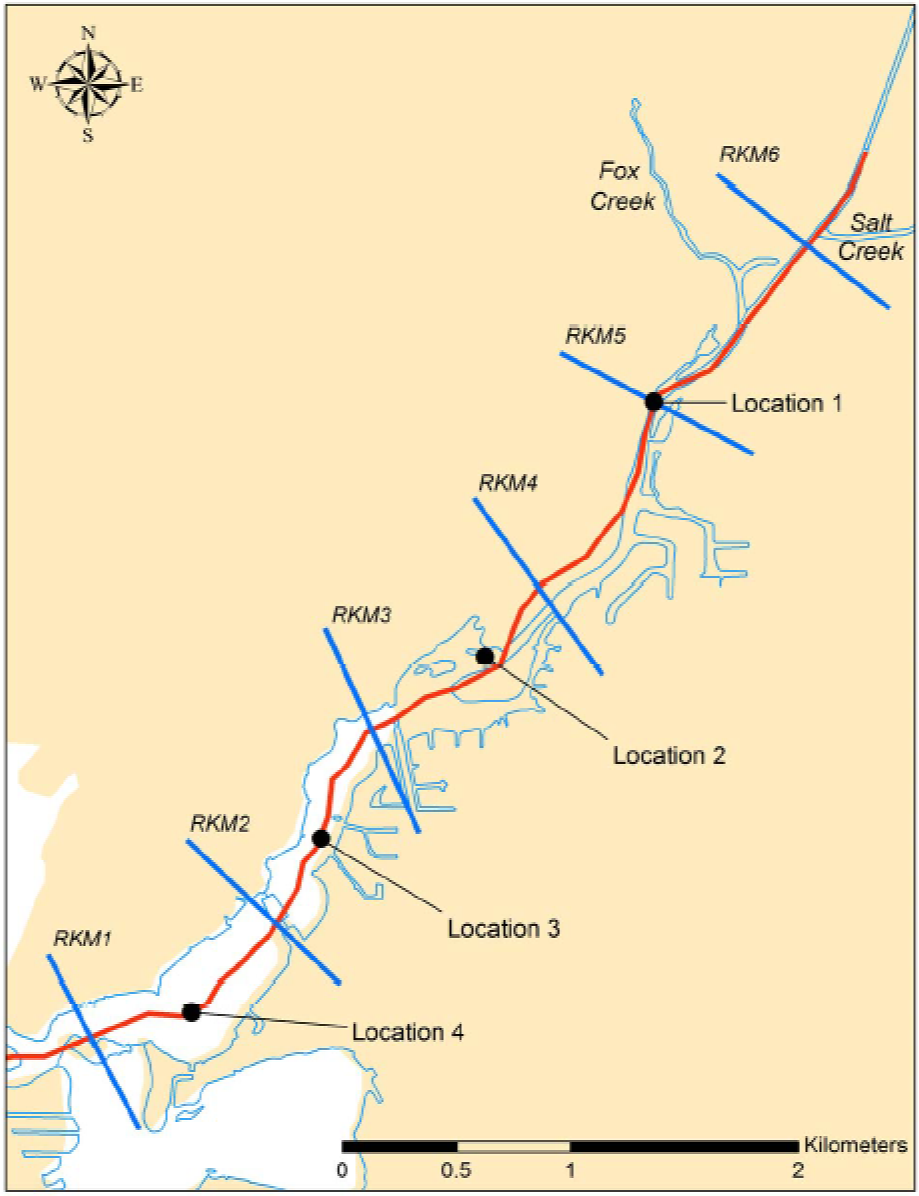

Figure 3. Map of river reach locations and their river kilometer boundaries used to analyze salinity regimes in Dona Bay/Shakett Creek under various freshwater inflow scenarios.

3. Habitat assessment metrics were developed in order to estimate the amount of available habitat that meets biologically-relevant salinity criteria. These included the length of natural shoreline for shoreline vegetation, the area of bottom habitat for benthos and submerged aquatic vegetation, and the volume of water for fishes over various salinity ranges.

4. Biologically-relevant salinities used in the MFL determination were based on (a) the 10 ppt bottom of the optimal range for larval oysters, the bottom of the tolerance range for adult oysters and the minimum spawning needs of bay anchovies; (b) the 15 ppt bottom of the optimum ranges for adult oysters and sand seatrout, and near the spawning peak of bay anchovies; and (c) the 20 ppt peak range for oyster larvae, which is also within the optimum ranges of adult oysters and sand seatrout.

5. Predicted salinity habitat lengths, areas and volumes were used to construct cumulative distribution function (CDF) plots for each of the three salinity criteria (i.e., <10 ppt, <15 ppt, and <20 ppt). The predicted CDFs were compared to CDFs under baseline conditions to determine the percent change under each reduced inflow scenario. A criteria of no more than a 15% change in any habitat availability as compared to baseline was used as the threshold for "significant harm."

6. The District's proposed MFL is defined as the flow that maintains at least 85% of the biologically-relevant salinity habitats in the estuarine system under the baseline scenario. Resulting inflow reductions from the baseline condition varied from 3-11% during Block 1 (low flow season), 3-12% during Block 2 (intermediate or medium flow season), and 10-18% during Block 3 (high flow season). The most limiting (i.e., lowest) flow reduction allowed under Block 1 was 3% for water volumes less than 15 ppt, 3% for bottom areas less than 10 ppt under Block 2, and 10% for bottom areas less than 10 ppt under Block 3. Thus, the District recommended an MFL for Fox and Salt Creeks with allowable flow reductions of only 3% in Block 1, 3% in Block 2, and 10% in Block 3.

DARB Hydrologic and Hydrodynamic Simulations

The MFL analysis of the DARB system is based upon results from two numerical models; namely, the HSPF hydrologic (rainfall runoff) model and the EFDC hydrodynamic and salinity model. Panel comments given below relate to those models and their applications.

In the MFL determination, a baseline flow period must be established. The baseline flow for the DARB MFL analysis was taken to be the predicted flow from an HSPF model simulation for the period of 1985 – 2005 (Intera 2007). Although rainfall from 1985 – 2005 was employed in the simulation, the area's land use and watershed boundaries were taken to be those that existed in 1948. Existing flows from the Cow Pen Slough and Blackburn canals were assumed to be zero, since those flows were not in the DARB system in 1948. The District has explained the reasoning behind adopting this baseline flow in the MFL report, as well as in separate correspondence with the Panel.

For calibration purposes, an HSPF application was first made using actual rainfall from 1985 - 2005. This application used the existing Dona Bay watershed of about 47,000 acres and current land use. The baseline application also used rainfall from 1985-2005, but it used the 1948 watershed area and historic land use. The baseline computed significantly lower flows into Dona Bay because a much smaller watershed of about 10,000 acres was assumed to exist in 1948, and because only about 10% of the watershed was urban in 1948 as compared to about 50% at present.

The MFL analysis utilized three seasonal flow blocks. Block 1 represents low flows, with Blocks 2 and 3 representing medium and high flows, respectively. An inspection of Figure 6.2 in the modeling report (Intera 2007) reveals that the average daily baseline flows for Blocks 1 and 2 are about 1/3 of existing flows, whereas for Block 3 the baseline flows are perhaps only 1/5 of the existing flows. The maximum baseline flows are also much less than existing maximum flows from the Cow Pen Slough and Blackburn canals.

HSPF model application--In developing the pervious land segments in the HSPF model, it appears that only the land use grid was used. No discussion of the soil textures or their variability within the watershed was mentioned in Appendix 2, although soil variability is discussed in the body of the ungaged flow report (Intera 2007). The assumption of a uniform infiltration rate of 1.31 in/hr over all the land segments implies that the soil texture was assumed to be uniform throughout the watershed in the HSPF model. With a variable soil texture, a composite map should be constructed whereby the land use and the soil texture are cross referenced, with each pervious land segment having a unique land use and soil texture classification within a particular sub-basin.

The statement is made that *"Dividing the basins into land segments practically eliminates the parameter lumping typically found in hydrologic models"* (Intera 2007). While discretizing the pervious land segments is an improvement over assuming a constant parameter for the whole sub-basin, the HSPF is still a lumped-parameter model. There does not appear to be any routing between land segments. Hence the overland flows are assumed to be placed (lumped) within the channel system without any consideration being given to additional infiltration as water flows across multiple pervious land segments.

The Intera (2007) report gives the following statistical (coefficient of determination = R^2) measures of the HSPF model's performance at the daily level:

Location	$\mathbf{R^2}$
Howard Creek	0.4125
Myakka River near Myakka City	0.4791
Myakka River near Sarasota	0.3302
Cow Pen Slough 1 Dam	0.5748
Cow Pen Slough 2 Dam	0.5020

Based on published HSPF applications, Munson (1998) finds that a "good" calibration has an $R^2 > 0.9$ at the annual level, > 0.8 at the seasonal level, and > 0.6 at the daily level.

From the results given above for the Dona Bay area, the model does not seem to capture the watershed variability very well.

EFDC Model --Unfortunately, the MFL analysis of the DARB system has to rely almost totally on results from a three-dimensional (3-D) numerical hydrodynamic (circulation) and conservative mass (salinity) transport model known as the Environmental Fluid Dynamics Code (EFDC). This is because the previously developed regression equations relating freshwater inflows to various biota and habitats in the estuary used flows from Cow Pen Slough, which are not included in the baseline flow defined by the District.

The EFDC code is well known in the scientific community and is supported by the EPA. The grid employed by EFDC is an orthogonal curvilinear grid in the horizontal plane and a sigma stretched grid in the vertical. The vertical sigma grid allows for a more accurate representation of the bottom of the water body, but errors can occur when computing long-term stratification in channels with adjacent shallow areas if the horizontal resolution is insufficient.

The grand domain of EFDC model application covered a large area ranging from Big Sarasota Bay in the north, on through the Gulf Intracoastal Waterway (ICW) to Lemon Bay in the south; however, the District's MFL analysis only used results from that portion of the computational grid covering Dona Bay and Shakett Creek (Figure 4). The depths over most of Dona Bay and Shakett Creek are around 2 m, without a definable deeper channel. The number of horizontal grid cells across the bay range from about 10 or so in the lower bay to only one in upper Shakett Creek, with the average cell size across the bay being 40 m. From Figure 2.3 in Appendix 6, it can be seen that the impact of the US 41 highway bridge is modeled by blocking much of the flow with zero-depth cells. The grid extends offshore into the Gulf of Mexico far enough to minimize the influence of freshwater inflows on the Gulf salinity boundary condition.

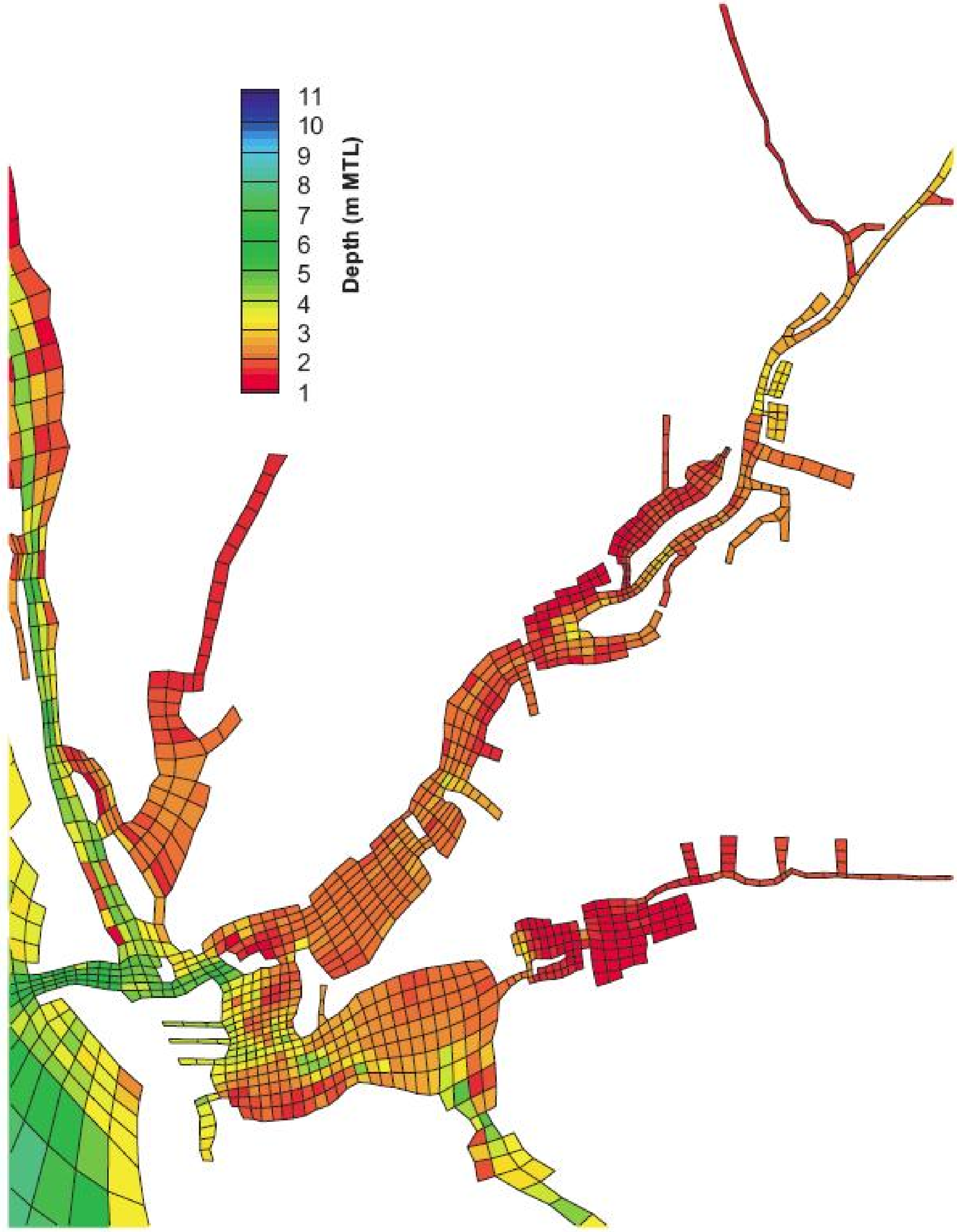

Figure 4. DARB model grid and bathymetry.

The EFDC model was calibrated using data from May 2004 to September 2004. Model validation was conducted by simulating conditions from May 2003 to September 2004. Inflow boundary conditions for model calibration consisted of observed flows from Cow Pen Slough and Blackburn Canal; predicted flows for Salt, Fox and Shakett Creek from the HSPF simulations, and predicted flows at several other locations using estimated flows from Fox and Shakett Creeks multiplied by a ratio of watershed areas. A point source inflow was prescribed at the Venice Reverse Osmosis Treatment Plant. The prescribed salinity boundary conditions were set to be a constant 34 ppt on the open Gulf boundary and monthly values recorded in northern Lemon Bay at the southern ICW boundary. Water surface elevations on the Gulf portion of the grid were measured values at the USGS Venice gage, but were adjusted to match computed values to the observed values at Venice. Water surface elevations at the southern ICW boundary were taken to be the observed values at the USGS Shakett gage. Obviously, this isn't exactly correct, but the boundary is far enough removed from Dona Bay to have little impact on salinity computations in Dona Bay and Shakett Creek. Rainfall and wind data were specified at the water surface. The wind data came from the Sarasota Airport, with the rainfall data coming from the NOAA gage at Venice. The boundary conditions specified appear to be reasonable.

As noted previously, a longer simulation was conducted during the model validation phase. The inflows were as prescribed above, although the first year of the Blackburn Canal data was estimated because observed data weren't available. The salinity, wind and rainfall data were also as prescribed above; however, the USGS Venice gage did not have tide data for the entire period. Thus, predicted tides for a station at Bradenton Beach were employed for setting the offshore boundary. The dampening that occurred between the offshore water surface elevations and the southern ICW boundary during the calibration period was applied to the predicted offshore water surface elevations in the model to specify conditions at the ICW southern boundary for model validation.

For both model calibration and validation, there were three USGS continuous-recording data stations and an additional 25 sampling stations in Dona Bay, Shakett Creek, and Roberts Bay where monthly salinity data were collected. Salinity data were collected near the surface, near the bottom, and at one-meter intervals in the water column of the monthly sampling stations. At the USGS stations, only near surface and near bottom salinities were collected.

An inspection of the calibration results for the period of May 2004 to September 2004 (Appendix 6) shows that the computed water surface elevations compare well with the recorded values at the three USGS stations, but this is the easiest part of the modeling. Given the rather severe restriction at the US 41 Bridge, more dampening of the tidal signal at the Shakett Creek gage would be expected; however, neither the recorded data nor the computed values show much dampening.

Near surface and near bottom salinities were compared with recorded values at the USGS Venice, Dona Bay and Shakett Creek gages. The model responds quite well to freshwater inflows, with salinity values at Shakett Creek ranging from zero to 30 ppt. Generally, the computed and recorded salinities compare reasonably, especially during periods of low freshwater inflow, but the model seems to under predict water column stratification at times. Therefore, the Panel questioned how many "sigma" layers were used in the model, since this information isn't given in the report (ATM 2007). During the simulation period, the large stratification that can occur in the system (see Figure 4.8 in SWFWMD 2008) doesn't show up in either the recorded data or in the model results.

As noted above, the validation exercise covered the period of May 2003 to September 2004. Thus, the validation period started one year earlier than the calibration period and continued through the calibration period. Salinity results aren't presented for the Venice gage. At the USGS Dona Bay gage, the computed results don't compare very well with the recorded data for the first three months or so; however, once low inflows occur, the results improve significantly. During this period the Blackburn Canal flows weren't measured values, but rather were estimated values. This could be a reason for the poor early comparison or perhaps the initial salinity conditions were still having an effect on the simulation.

Model salinities were also compared with the monthly salinities collected at the 25 stations in Dona Bay, Shakett Creek and Roberts Bay. During low flow periods the comparison of model salinities with the observed data was quite good, since they aren't changing much. On the other hand, the comparison wasn't as good during higher flow periods. Comparing data collected only once a month is not ideal because the measured salinity may change significantly from hour-to-hour and day-to-day, which is why modelers universally desire continuous-recording instrument data for calibrating and validating model simulations of tidal elevations, freshwater inflows and salinities.

EFDC Model Application --For the purposes of MFL determination, the EFDC model was applied for the three years of 1986-1988 (ATM 2007). These three years were selected from the base period of 1985-2005 because they most closely mimicked the flow duration curves for the entire 21 years for all blocks. The model was first applied using estimated inflows from the 1948 watershed simulation with the HSPF model to create baseline results for bottom area, water volume, and shoreline length for salinities less than 20, 15, and 10 ppt. Simulations were then made assuming reductions ranging from 5 to 30% in the estimated freshwater inflows from the Salt and Fox Creeks. These results were presented as Cumulative Distribution Function (CDF) plots for each of the three seasonal blocks in order to visually represent the amount of time and spatial extent of habitat availability defined by salinity levels of 10, 15 and 20 ppt, where the habitat assessment metrics were shoreline length, bottom area and water volume. By computing the difference in area under the habitat value – time curve between the baseline and a particular flow reduction scenario for each block, the impact of the flow reduction was estimated. As in all recent District's MFL studies, a habitat reduction no greater than 15% was considered to be the maximum acceptable limit.

The greatest response for each of the salinity levels and flow reductions was for Block 3 (high flow). In addition, the habitat showing the greatest response was the shoreline length because surface salinity is most responsive to flow reductions, and the length of shoreline habitat is dependent on the surface salinity in this MFL determination.

Based on all of the CDF plots generated from the EFDC model's computed salinity, it was concluded that a 3% reduction in Salt and Fox Creeks flows could be allowed for Blocks 1 and 2, with a 10% reduction allowed for Block 3 flows.

In summary, the EFDC model developed for the MFL determination of the DARB system appears to be adequate as far as grid resolution, model calibration and model validation. Its application to the three year (1986-1988) period and the generation of the CDF plots to determine appropriate levels of acceptable flow reduction are also reasonable given what the District is left to work with in the MFL determination. However, the accuracy of the predicted HSPF flows that drive the EFDC computations are open to question. Nevertheless, since the MFL analysis is based on differences in habitat values between the baseline condition and a flow reduction simulation, rather than absolute values, the issue of the accuracy of the HSPF flow prediction is minimized to some extent.

Bottom Habitats

In May/June of 2004 (the dry season), Mote Marine Laboratory personnel collected bottom samples for benthic macroinvertebrates and sediment analysis within Dona, Roberts and Lyons Bays (Cutler 2006). A total of 3,720 macroinvertebrates representing 199 taxa were collected from 19 sample sites. Total taxa collected were Roberts Bay 137 taxa, Lyons Bay 105 taxa and Dona Bay 90 taxa. Perhaps the most notable features of this study was the lack of any freshwater zones. Indeed, the salinity regime at the time of sampling would probably be more accurately described as marine rather than estuarine, since most of the observations were above 30 ppt. As a result, there was a total lack of oligohaline fauna. Small crustaceans (e.g., Tanaids, amphipods and Mysids) were the principal groups represented in the benthos, particularly at the most upstream stations. These organisms are known to be well adapted for exploitation of areas that undergo significant tidal salinity variations, and most can readily colonize much lower salinity waters.

Cutler (2006) found that faunal similarity analysis indicated that the three bays maintain different species composition and abundance characteristics. In particular, Dona Bay and Shakett Creek appear to be depressed in both number of species and abundance when compared to the other nearby bays. He hypothesized that this benthic community depression is related to inordinately high flows during the wet season in Shakett Creek.

The Lyons Bay watershed has not been altered to the same extent as the nearby Dona Bay watershed. As a result, the oyster and seagrass populations of Lyons Bay have been found to be generally healthier than those of Dona Bay (Estevez 2006, Jones 2004, 2005, 2007). Also, salinity has been found to be consistently higher and less variable in Lyons Bay than in Dona Bay. Thus, it is widely accepted by the District and others in Sarasota County that the implementation of watershed/hydrologic restoration activities will have a high probability of improving water quality, oyster populations, and seagrass communities in Dona Bay.

In a recently completed Dona Bay Watershed Management Plan (Kimley-Horn and Associates, Inc. 2007), the authors found that conditions in Dona Bay are more stressful than those in Roberts Bay, and considerably more stressful than in the contiguous estuary of Lyons Bay. The Plan concludes that large influxes of freshwater inflow from the expanded watershed are associated with reductions in salinity, increases in the variability of salinity, decreases in average oxygen conditions, decreases in the minimum dissolved oxygen values, and a significant increase in loads of nitrogen, phosphorus and total suspended solids to Dona Bay. The combination of these impacts is most probably responsible for the reduced abundance and health of various estuarine habitats in DARB. Especially impacted are the benthic communities (e.g., seagrass, oysters and clams) that are unable to migrate away from stressful conditions. For this reason, the Plan identifies these ecological communities as useful "bio-indicators" of the estuary's health.

Submerged aquatic vegetation (SAV, primarily seagrasses), the hard clam *Mercenaria campechiensis*, and the American oyster, *Crassostrea virginica* are all considered valued ecosystem components in the region (Kimley-Horn and Associates, Inc. 2007). Aerial photography indicates that only 36% of Dona Bay's total surface area has seagrass; however, Roberts Bay has approximately 43% seagrass and Lyons Bay is estimated to have 75% of its area covered by seagrass (Estevez 2006). Major seagrass losses, such as those in the DARB system, typically cause large decreases in the productivity of fisheries within the affected areas (Livingston 1987).

Live hard clams occur in Lyons Bay but only dead clams were collected from either Dona Bay or Roberts Bay (Estevez 2005). This may not be surprising considering that larval and juvenile clams are more susceptible to low salinities; adult *Mercenaria* can tolerate long exposures to lowered salinities by tightly closing their thick valves. On the other hand, sudden increases in salinity exceeding 8 ppt are also lethal to hard clams. Shell growth is lowest in summer (wet season) when temperatures are highest and salinities are lowest, both stresses on the physiology of the clams. Eversole (1987) describes the hard clam as only moderately euryhaline (read: not broadly salt tolerant) and concludes that optimum salinities for egg development, larval growth and survival, and adult growth are in a fairly narrow range of 24 to 28 ppt. As a result of this and other information, Estevez (2006) recommended a bottom salinity of 20 ppt as the lowest average salinity genuinely suitable for hard clams in the DARB system.

Adult oysters can briefly tolerate lower salinities, but salinities less than 6 ppt are not tolerated for longer than 2 weeks, nor are salinities lower than 2 ppt tolerated for more than a week without significant mortality in the population. To protect recruitment, Estevez (2006) states that salinity during local spawning seasons should be above 10 ppt, while optimal survival and growth of oyster larvae and spat in a natural setting are only observed in salinities between 12.5 and 20 ppt, which limits many marine predators, parasites and disease organisms. Salinities in DARB areas where oyster reefs are desired can have large fluctuations between 10 ppt and 28 ppt, and they will do best in hard-bottom areas with good circulation and mixing to facilitate their filter-feeding life style (Estevez 2006).

In conclusion, all reported measures of oyster abundance and condition indicate that the DARB system and its tributaries experience intermittent conditions that severely limit oyster survival, growth and reproduction (Estevez 2006, Jones 2004, Jones 2005, Jones 2007). While it is obvious that oysters have the potential to grow and reproduce in Dona

Bay and Shakett Creek, they are clearly killed off on a fairly regular basis here, as well as in Roberts Bay and Curry Creek, by large freshwater pulses that basically "sterilize" the area of most marine and estuarine species.

Ichthyoplankton and Fishes

Three gear types were used to monitor organism distributions in the DARB system: a plankton net deployed during nighttime flood tides and a bag seine and otter trawl deployed during the day under variable tide stages (Peebles et al. 2006). The study area was divided into five collection zones and monthly sampling began in March 2004 and ended in June 2005. The two summer rainy seasons and high inflows during the spring of 2005 created a broad salinity regime within the DARB system.

Peebles et al. (2006) identified the eggs of herrings (clupeids), scaled sardine (*Harengula jaguana*), Atlantic thread herring (*Opisthonema oglinum*), bay anchovy (*Anchoa mitchilli*), striped anchovy (*A. hepsetus*) and several sciaenid fishes in the collections. If the abundance of early larvae is considered to be more or less proportionate to the abundance of eggs, then the researchers also suggested that silver perch (*Bairdiella chrysoura*), seatrouts (*Cynoscion arenarius* and *C. nebulosus*) and kingfishes (*Menticirrhus* spp.) are the sciaenids that are spawning in the area. Also spawning in the area are blennies, the hogchoker (*Trinectes maculatus*), skilletfish (*Gobiesox strumosus*) and gobies (*Bathygobius soporator*, *Gobiosoma* spp. and *Microgobius* spp.). Further, the repeated collection of small juveniles of live-bearing gulf pipefish (*Syngnathus scovelli*), chain pipefish (*S. louisianae*) and the lined seahorse (*Hippocampus erectus*) was viewed as an indication that these species are also reproducing near or within the area.

Prey availability, retention and transport are influenced by freshwater inflows; therefore, alteration of flows would appear to have the lowest potential for impacting many taxa during the period from November through February, which is the period when the fewest taxa were present (Peebles et al. 2006). The highest potential to impact many species would appear to be from June through October. Few clear seasonal patterns of taxon richness were evident in the DARB system, which may be attributed to both the relatively short duration of nekton sampling and the unusual hydrological (relatively low flow) conditions encountered during the study. Peak recruitment tended to occur in winter and summer for offshore spawners, spring and summer for estuarine spawners, and late spring and winter for resident species.

Of the 57 plankton net taxa, 49% exhibited significant responses to freshwater inflows to the DARB system. Similarly, about 70% of the 27 pseudo-species from seine and trawl samples were significantly related to freshwater inflows. Furthermore, approximately half of the significant responses had R^2 values > 50%, and these strong responders were dominated by estuarine, rather than freshwater, taxa. Most of the relationships were negative, indicating that the taxa exhibited significant downstream movement in response to inflow, which suggested to the researchers that the reductions in abundance were caused by their movement into the Gulf or lateral bays (Peebles et al. 2006).

According to the researchers, the estuarine fauna demonstrated a distributional affinity for the two point sources of freshwater inflow (i.e., Cow Pen Slough and Blackburn canals), which were flowing uncharacteristically low during their study. This finding was evident both in the community structure and in the distributions of individual species. In conclusion, Peebles et al. (2006) found that freshwater inflows appear to be serving as an attractant to estuarine fish and crustaceans in the DARB estuary during low flow periods, but perhaps without providing the usual trophic benefits, suggesting that a less erratic inflow regime may result in more efficient production of estuarine fish and crustaceans. However, since the researchers used observed inflows to the estuary, including those from Cow Pen Slough, the District opted to discard these results when making the MFL determination.

Spotted seatrout (*Cynoscion nebulosus*), snook (*Centropomus undecimalis*), and red drum (*Sciaenops ocellatus*) are common residents of the tidal (estuarine) waters of the DARB system (Estevez 2006). They are affected by salinities in variable ways and at different life stages, thus, a single salinity regime is not suitable for all estuarine-dependent species. Additionally, these three fish species need a rich and diverse invertebrate and fish-based food chain for their growth. Large and abrupt salinity changes have been observed to cause either mass migrations from, or mortalities of, adult seatrout in Florida estuaries (Tabb 1966). Large pulses of freshwater into Shakett Creek probably do not compromise the osmoregulatory abilities of common estuarine-dependent fishes, but increased flows can wash weakly motile juveniles and their prey from their preferred lower salinity habitats near the freshwater sources.

Based on a review of seatrout, snook and red drum salinity requirements (Estevez 2006), salinities outside a more or less seasonally appropriate level within the nursery grounds and spawning areas are not conducive for successful production of these three species. When red drum and seatrout larvae are present, a larval tolerance range of 15 -35 ppt will help reduce metabolic stress and mortality (Holt and Banks 1989). On the other hand, juvenile snook must have access to freshwater nursery areas, such as those that exist in the upper reaches of Shakett and Curry Creeks. Salt-water encroachment in these areas will decrease availability of prey species consumed by juvenile snook. In addition, the existing flood control structures (i.e., the CPS2 dam) may block juvenile snook from a large part of their favored nursery habitat in this watershed.

The increasing salinities bring with them more marine conditions, including the invasion of marine predators, parasites and disease organisms (Overstreet 1978 and Overstreet and Howse 1977). Theoretically, the District's proposed MFL should help mitigate any negative impacts on the young of these estuarine-dependent fish species from natural drought during their peak seasonal utilization of estuarine nursery habitats in the springtime. However, with the complete exclusion of flows from Cow Pen Slough and Blackburn canals, it is not certain that the District's MFL will provide sufficient protection at all times.

Other Panel Comments and Concerns

The District is to be commended for their thorough response to the questions raised by the Panel Members after the initial reading of the District's draft report. As the District moves forward to plan and supply water in the future to the people, their economy and their environment, the Panel strongly recommends that the District continue to monitor the DARB system for the purpose of verifying that the MFL is having its intended effect of maintaining ecological health and productivity. The verification monitoring should include streamflows, tidal flows, basic water quality, salinity, DO, chlorophyll, seagrasses, benthos and fisheries, particularly during the dry season, which coincides with the spring peak utilization of nursery habitats by estuarine-dependent organisms.

The Panel recognizes that the policy decision to include or exclude existing flows from Cow Pen Slough and the Blackburn Canal is up to the District. Whether one agrees or disagrees with that decision, the Panel feels the MFL report would be strengthened and made more understandable if the following issues are addressed in the final MFL report:

1. An evaluation of the consequences of changing inflows to Cow Pen Slough in relation to current conditions.

   Rationale: It is the Panel's understanding that altered flows are not necessarily required to be returned to their original conditions if such recovery could cause adverse environmental or hydrologic impacts (it is noted that several examples where this has been the case exist in previous MFL reports from the District). Cow Pen Slough and Blackburn Canal have been in place for more than 50 years, during which time the plants and animals in the system have presumably shifted in response to the altered flow. The report presents relationships between flow at the CPS2 dam structure and current conditions in the estuary (e.g., water quality and biotic resources) that could be used to evaluate the effects of decreasing flow. This analysis is also important in the context of evaluating the effects of potential future withdrawals for regional water use.

Of particular relevance to this point are the results of a recent effort to develop a Dona Bay Watershed Management Plan (Kimley-Horn and Associates, Inc. 2007). The Plan was prepared with funding assistance from the District and is referenced in the District's MFL report. It addressed the following general objectives:

a) Provide a more natural freshwater/saltwater regime in the tidal portions of Dona Bay.
b) Provide a more natural freshwater flow regime pattern for the Dona Bay Watershed.
c) Protect existing and future property owners from flood damage.
d) Protect existing water quality.
e) Develop potential alternative surface water supply options that are consistent with and support other plan objectives.

The Watershed Management Plan recognizes that the diversion of a significant portion of the Myakka River watershed into the Dona Bay watershed via the Cow Pen Slough canal has dramatically increased freshwater inflows to Dona Bay in a sporadic manner (Figure 5). The Watershed Management Plan makes an effort to consider a number of watershed restoration scenarios that could potentially "re-balance" and create a more natural water budget. Under the Plan, the re-balanced hydrology would more closely reflect pre-diversion conditions and restore more natural seasonal salinity regimes in the estuary. Also, a draft Dona Bay Monitoring Plan was developed to allow benefits to the estuary, its water quality and its living resources to be quantified from future implementation of the Watershed Management Plan.

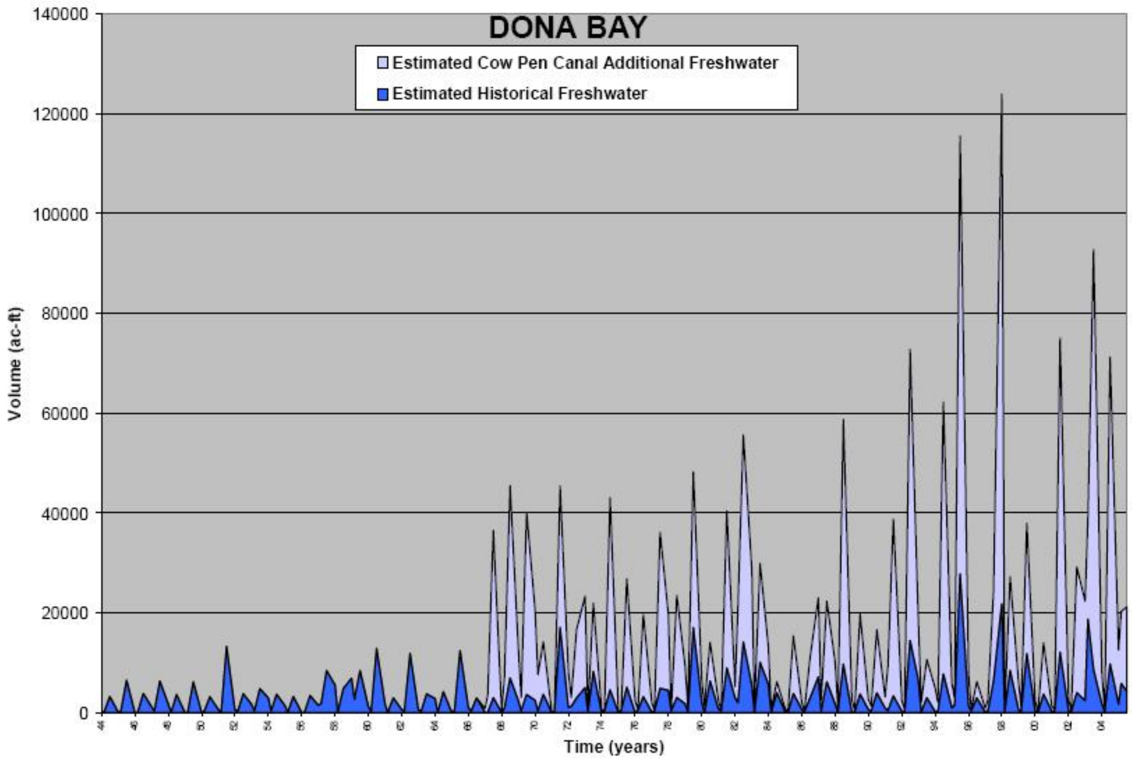

Figure 5. Estimated Historical and Potentially Excess Freshwater Inflows to Dona Bay (1944-2005).

In the end, the Watershed Management Plan concludes that the implementation of a 15 mgd water supply withdrawal would reduce over 40% of the excess freshwater diverted by the Cow Pen Slough canal without doing any real harm to the estuarine ecosystem and its living resources, and potentially creating several ecological benefits, such as a concurrent reduction in pollutant loads delivered to Shakett Creek and Dona Bay. However, inflows to Roberts Bay through the Blackburn Canal were not included in this analysis either (Figure 6).

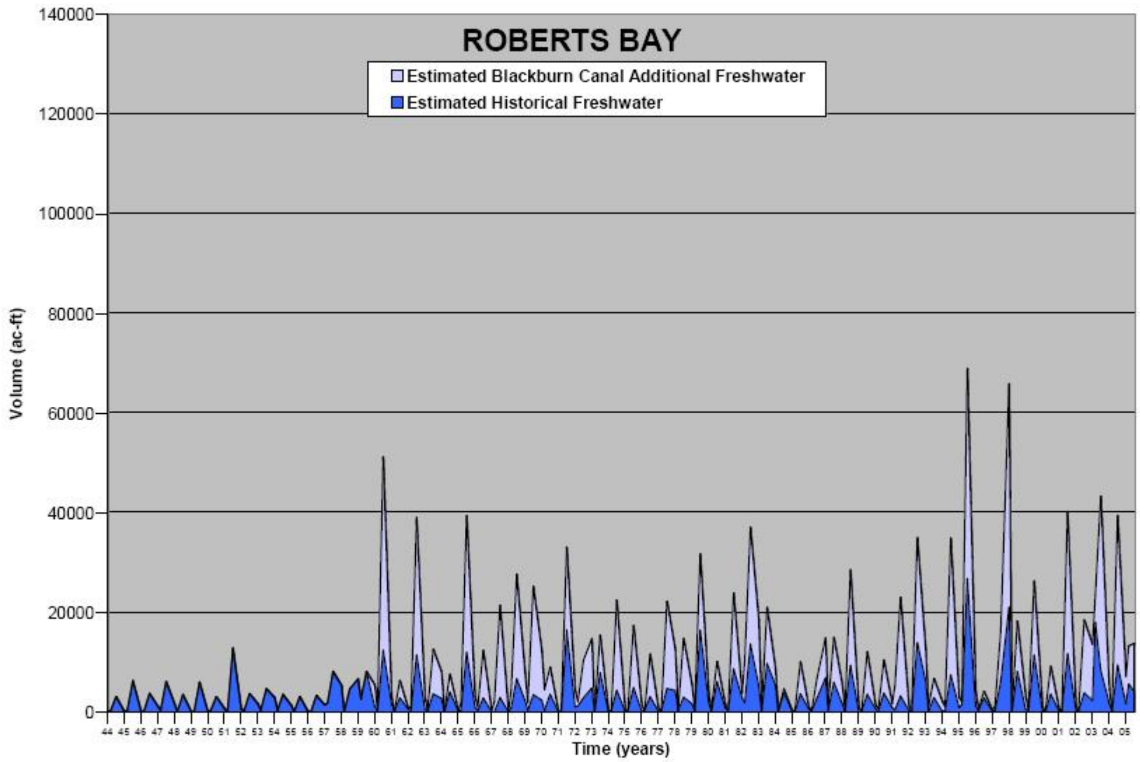

Figure 6. Estimated Historical and Potentially Excess Freshwater Inflows to Roberts Bay (1944-2005).

As mentioned before, these inflows are excluded by the District as a policy matter. However, there are a number of unspecified scientific assumptions that underlie this policy decision. Primarily, the District must be assuming that the ecological changes that will occur in affected habitats that have adapted to these higher freshwater inflows over the past half century, will not produce any unacceptable "net" harm to living resources of interest (e.g., wetlands and fisheries) when they are excluded in the MFL analysis and eventually removed from the system. In order to bring more confidence and certainty to its MFL determination, the District should consider making a similar analysis to that in the Plan with even higher reductions (e.g., up to 100%) of inflows from the Cow Pen Slough and Blackburn canals.

2. A comparison of how the habitat (volume, bottom area, length of shoreline) under baseline conditions compares to current conditions.

Rationale: The baseline conditions used in the report are dramatically different from current conditions, but these are never directly compared. The Panel suspects that the low-salinity habitat (defined as < 10 ppt) would be extremely reduced given that during the Block 3 (high inflow) season, surface salinity currently averages 2.4 ppt in the upper reach of Dona Bay and 6.5 ppt in the upper reach of Roberts Bay (Figures 4-10 and 4-12 in SWFWMD 2008); whereas such low-salinity water was available for a maximum of only 28% of the time during baseline conditions. If a more stable, saltier environment is desirable (i.e., for seagrass expansion) and the low-salinity habitat is not important, then this case should be made explicitly along with a clear characterization of the expected changes.

3. A reconsideration of baseline in light of historic conditions.

Rationale: The baseline condition is not only saltier than existing conditions, but also saltier than historic conditions due to the fact that the structural alterations that have occurred (e.g., Venice Inlet) are ones that increase the amount of Gulf water that enters the mouth of the Bay. This means that the starting condition (before removing water to set the MFL) is already saltier than the Bay has ever experienced. It would be useful to understand the extent to which the effect of dredging and other physical alterations that influence tidal flows from the Gulf are mitigated by the increased freshwater inflows from the canals. The Panel believes that the numerical EFDC model could be used to address the impact of the structural changes by making a "hindcast" application using the existing computation grid with bathymetric changes where appropriate. The Panel is not suggesting that the structural alterations that have occurred can be reversed, but rather that a more appropriate baseline condition may be one that corresponds to the historic salinity regime of the estuary rather than just the approximated historic inflows.

4. Additional data collection for Fox and Salt Creeks prior to allowing withdrawals.

Rationale: Fox and Salt Creeks are the focus of the MFL determination but there is not a lot of data for these two creeks presented in the District's report (SWFWMD 2008). Neither are gauged, there was no salinity or other water quality data collected in these areas, and it is unclear whether there were stations sampled for biological characteristics (e.g., macroinvertebrates and fish). Although neither creek has a substantial influence on the current salinity regime of the DARB system, this would potentially change under the assumed baseline conditions. The Panel notes that during the site visit provided by the District it appeared that Fox Creek had some of the best intertidal habitat and an indication that there is currently fresh water reaching the area, based on the Panel's visual identification of the presence of the black needle rush, *Juncus roemarianus*, along the shoreline.

Given the lack of data for Fox and Salt Creeks, the normal uncertainties inherent in the HSPF and EFDC model predictions for baseline conditions, and the potentially large ecological shifts that may occur in response to removing water from the interbasin diversions, the Panel does not believe there is enough scientific information available to allow any withdrawals from these two creeks, particularly during low flow seasons (Blocks 1 and 2). Therefore, the Panel recommends that the District follow the Precautionary Principle and establish the initial MFLs with little or no withdrawals from Fox and Salt Creeks until more scientific information can be collected and evaluated to determine with more confidence how changes in inflow will affect the DARB area. Further, the Principle of Adaptive Management suggests that it would be useful for the District to revisit this topic periodically when enough new data becomes available for a more and better analysis than that presented here.

ERRATA and EDITORIAL COMMENTS

Page	Paragraph	Line	Comment
All			While the report uses English units in accordance with the Governor's requirement for simplicity in writing, in many cases metric units still are used rather than common English units. The Panel notes a couple of exceptions − distance, expressed in kilometers, and water depth, expressed in meters. Some readers would probably say these are the wrong exceptions, finding river miles and depth in feet much more readily understandable by the public. Metric units should probably be reserved for chemical concentrations and related water quality parameters that are not familiar to the general public anyway.
xv	3		The distinction between baseline and historical flows is confusing. The report suggests that flows that existed prior to major structural alterations were considered "baseline" but that this is somehow not historical. Later (pp. 1-4) the report states that the MFL will be less than the historic flow, but the MFL would presumably always be less than the flow to which it is being compared.
xvi	5	4	Does "the metrics discussed above" mean volume, bottom area, and shoreline length?
2-4			The two purple areas in the legend for Figure 2-2 are not distinct.
2-10	2		Are the drainage areas provided for the different control structures cumulative?
2-15	1	3	The Panel is not familiar with the use of the term "leakance." Do you mean leakage? Presumably, this refers to channel losses due to infiltration of surface waters into the water bearing strata of the underlying water table/groundwater formation (aquifer).
2-16 Thru 2-18			A table showing 25th, 50th and 75th percentiles for the different gage predictions (and also the observed flows at Blackburn vs. predictions) would be useful. Also, can the runoff model results for CPS2 be extracted and quantified?
2-23 And 2-25			The HSPF model results for inflows to Dona Bay (Figure 2-22) and empirical model results for Roberts Bay (Figure 2-25) are indicative of extreme episodic events. The effects of large non-normal data distributions are illustrated in these graphs by differences up to 300% between measures of central tendency (mean average and median flows) in the same month.
2-27	1		Why not also compare runoff to observations in 2004-2006 when both gages were operating? That might be better than relying entirely on the models with their potential errors.

Page	Paragraph	Line	Comment
3-4	4	10	The greatest bottom area is shown at rkm 2.5 and doesn't extend to rkm 1.0 (Figure 3-9). Thus, the sentence that begins "In Roberts Bay…" needs to be corrected.
3-14	2		It is not clear exactly what "deep fringing wetlands" means and how it contrasts with "patchy fringing wetlands." Perhaps "deep" refers not to water depth, but to the width of the fringing vegetation. Does this mean that deep fringing wetlands are more or less continuous, while patchy fringing wetlands are spotty?
3-16			Figures 3-16 and 3-17 are difficult to see. They should either be expanded to full page or deleted.
4-5	1	3	The word "turbidity" is repeated twice.
4-5	1	6	The word "color" is repeated twice.
4-6	3		The fact that a 3-day average flow of 79 cfs, with a high flow of 204 cfs on the sampling date, was not sufficient to flush out the salt wedge suggests that the 3-day average may not be all that useful as a way to represent what is occurring. The point is that at a flow of 204 cfs the system is stratified (see Figure 4-8). Also, the example in the next paragraph again shows that the system remains stratified even at much higher (462 cfs) 3-day average flows, though the greatest stratification has moved downstream a couple of kilometers (see Figure 4-9).
4-16	1	4	What are the "benthic organisms of interest to the Sarasota County government?"
4-18	1		The justification provided for why flows were averaged over 3 days in this salinity analysis is that plots yielded fewer outliers than daily (same day?) flows. Were other averaging periods tested as well, such as 2-day or 5-day flows antecedent to the lagged salinity sampling day? Or was the 3-day average just a lucky guess?
4-25 Thru 4-27			How does chlorophyll observed in Dona Bay compare to other nearby bay and estuary systems? Mean and standard deviations might also be useful in better understanding this system.
4-28	3		Both sentences in the paragraph beginning "Block 1…" need revision as they are somewhat confusing. Also, while the location of the sampling stations shown in Figure 4-1 is generally informative, the reader might be better served by referring in the text to their river kilometer position instead since that's what's shown in Figures 4-30 through 4-35.
5-6			Figure 5-4 may be unnecessary as it just repeats a portion of what is already given in Table 5-1.
5-14	3		Where are the data on the similarity indices that were used?
5-16			The conclusion that the benthic taxa in the DARB are similar to that found in Charlotte Harbor is not well-supported. The point that the benthos is dominated by high salinity species also is not made clearly.

Page	Paragraph	Line	Comment
5-18	4 and 5		This shows that the change in oysters is not a function of change in flow but rather filling (habitat loss), particularly in Roberts Bay. The observation that live oysters were found in Lyons Bay could be due to multiple factors—just because it's correlated with salinity doesn't mean that's the cause. For example, it could be due to differences in pollutant levels or in the abundance of predators, parasites and disease organisms.
5-25			This discussion is more detailed than what was presented in other sections of the report, and most of it is not about fish *per se*.
5-26			The fact that the rkm ranges given in Table 5-6 are in Dona Bay is not noted but should be.
5-29	5	6-10	Shouldn't the discussion about "new recruits" and "peak abundances" be referenced to Figure 5-19 instead of 5-18?
5-34	1	10	If fish were attracted upstream due to the lower-than-normal flows experienced during this study, wouldn't that also happen under the flows being considered as historical or baseline?
5-37			The finding (shown in Table 5-8) that pink shrimp of one size class (< 10 mm) have such a different relationship with flow to that of another (> 11 mm), to the point where the sign of the slope changes, deserves some discussion and explanation. Same thing applies to bay anchovies (26-35 mm vs. > 36 mm).
5-42	1	2	The evidence that salinity becomes more variable at higher flows is not evident here. Higher flows generally shorten the salinity gradient; while lower flows generally elongate the salinity gradient; however, making a site-specific salinity more variable normally requires the flow itself (either high or low) to become more variable over time.
6-4	1		Why is sand seatrout included in the "biologically-relevant salinities?" It is not included in Appendices C, D, E, F, G, H or I. Indeed, their larvae are only mentioned once on page 5-28 as being caught in the plankton-net. Is there any evidence this species is important in this estuary?
6-6	1		There is no citation to the ATM 2007 hydrodynamic modeling report here or in the references at the end of the MFL document on page 9-1.
6-10	1	2	The text says the EFDC model's domain comprised the area of Dona Bay "upstream of the Intracoastal Waterway and Shakett Creek." However, the referenced Figure 6.9 shows a computational grid that includes Shakett Creek and Cow Pen Slough.

Page	Paragraph	Line	Comment
7-1			The District should consider providing an illustration of average surface and bottom salinity in each reach during each seasonal block of the baseline period, which the reader can then compare with the current condition salinities shown on pages 4-13 and 4-14. This should be done before moving on to the CDFs.
7-9			When presenting model results, a map would be useful to see how far upstream salinities are changed under the baseline scenario.

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