PMVictoriaESPPEm Resource

From: Terry, Tomeka
Sent: Monday, October 03, 2011 4:06 PM
To: VictoriaESP Resource
Subject: FW: Courtsey copy of Exelon letter NP-11-0044 - Environmental Report Revisions
Attachments: NP-11-0044 Environmental Report Revisions.pdf

From: Joshua.Trembley@exeloncorp.com [mailto:Joshua.Trembley@exeloncorp.com]
Sent: Monday, October 03, 2011 10:20 AM
To: Terry, Tomeka
Cc: david.distel@exeloncorp.com
Subject: Courtsey copy of Exelon letter NP-11-0044 - Environmental Report Revisions

Tomeka,

Please find attached a courtesy electronic copy of Exelon letter NP-11-0044 transmitting VCS ESPA Environmental Report revisions. The letter was submitted this morning via the EIE process.

The revisions identified in the referenced letter result from reevaluation of the San Antonio Bay Bio-statistical Analyses.

Please let me know if you have questions or would like to discuss the content of the letter.

Thank you and have a good day,
JT

610-765-5345

Hearing Identifier: Victoria_ESP_Public
Email Number: 361

Mail Envelope Properties (0A64B42AAA8FD4418CE1EB5240A6FED14A91C81F72)

Subject: FW: Courtsey copy of Exelon letter NP-11-0044 - Environmental Report Revisions
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From: Terry, Tomeka

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Exelon Generation

NP-11-0044
September 30, 2011 10 CFR 52, Subpart A

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Exelon Nuclear Texas Holdings, LLC
Victoria County Station
Early Site Permit Application
Update on Anticipated Environmental Report Revisions
Docket No. 52-042

References:
(1) Exelon Nuclear Texas Holdings, LLC letter to USNRC, Application for Early Site Permit for Victoria County Station, dated March 25, 2010

(2) Exelon Nuclear Texas Holdings, LLC letter to USNRC, Environmental Report Revisions to Incorporate Additional Supporting Information, dated June 24, 2010

(3) Exelon Nuclear Texas Holdings, LLC letter to USNRC, Notification of Anticipated Environmental Report Revisions, dated February 15, 2011

(4) Exelon Nuclear Texas Holdings, LLC letter to USNRC, Update on Anticipated Environmental Report Revisions, dated May 5, 2011

Exelon Nuclear Texas Holdings, LLC (Exelon) submitted an application for an early site permit (ESP) in Reference 1 for the Victoria County Station (VCS) site. That submittal consisted of six parts as described in the referenced letter.

In Reference 2, Exelon supplemented the ESP Environmental Report (ER) with the results of an approximately year-long bio-statistical study evaluating the potential effects of proposed VCS water withdrawals from the Guadalupe River on the ecological health of the San Antonio Bay system. Exelon subsequently notified the NRC via Reference 3 that it had determined that the results of the bio-statistical study should be reevaluated, and that ER revisions reflecting changes resulting from the study reevaluation would be provided to the NRC by May 13, 2011. Upon initiating the bio-statistical study reevaluation, Exelon identified additional opportunities to enhance the study and revised (in Reference 4) the anticipated date for submittal of the associated ER revisions from May 13, 2011, to the third quarter 2011.

Revisions to ER Subsections 5.2.2.1 and 5.2.4 resulting from reevaluation of the bio-statistical study are provided as Attachment 1. Revisions to ER Subsections 5.11.3.2 and 5.11.8 are presented in Attachment 2. Substantive revisions to the aforementioned subsections include:

ER Subsections 5.2.2.1 and 5.2.4 (Attachment 1)

- The South Central Texas Regional Water Planning Group (Region L) Water Availability Model (WAM) "Present Conditions" run has been used to define baseline conditions in the Guadalupe-San Antonio (GSA) watershed in lieu of the Texas Commission on Environmental Quality (TCEQ) Current Conditions WAM (WAM Run 8).

  The TCEQ Current Conditions model originally used in the bio-statistical study assumes almost 106,000 acre-feet per year of withdrawals under certificate of adjudication (COA) 18-5178, representing nearly full use of the water right. In contrast, the Region L Present Conditions model assumes annual use of approximately 4,200 acre-feet per year under COA 18-5178. Since COA 18-5178 is the preferred senior water right for VCS makeup water withdrawals, this change in the modeled present hydrological demand conditions (i.e., the baseline conditions for the bio-statistical analyses) improves the ability to evaluate potential impacts associated with VCS operation.

- Output from a calculation estimating VCS cooling basin makeup water withdrawals and return flows has been used in the bio-statistical study revision to depict a more representative profile of the expected plant surface water use. The original study assumed a generic industrial water use pattern for VCS with no return flows to the Guadalupe River from the cooling basin.

- Additional detail has been presented to facilitate the reader's understanding of the statistical significance of the study findings.

ER Section 5.11.3.2 and 5.11.8 (Attachment 2)

- The updated bio-statistical evaluation used two Region L WAM runs, dubbed "Region L Baseline" and "Region L Cumulative Effects", in addition to the TCEQ WAM run (Run 3) employed in the original study. Similar to TCEQ WAM Run 3, the new scenarios conservatively assume full use of existing water rights. However, these additional scenarios include different assumptions regarding return flows and upper basin operations, providing a broader characterization of possible future hydrological conditions in the GSA basin.

- Additional detail has been presented to facilitate the reader's understanding of the statistical significance of the study findings.

The bio-statistical report conclusions did not change as a result of reevaluating the analyses.

Please note that the ER revisions presented in Attachment 1 and Attachment 2 have been shown relative to the supplemental ER text provided in Reference 2. That is, the changes resulting from Reference 2 have been incorporated into the ER and appear in black and white, with new additions and deletions appearing in color in Attachment 1 and Attachment 2. Changes presented herein, as well as those persisting from Reference 2, will be incorporated into the next routine revision of the ESPA, planned for no later than March 31, 2012.

Regulatory commitments established in this submittal are identified in Attachment 3.

If additional information is required, please contact Joshua Trembley at (610) 765-5345.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 30th day of September, 2011.

Respectfully,

Marilyn C. Kray
Vice President, Nuclear Project Development

Attachments: (1) Markup Pages of Victoria County Station ESPA ER Subsections 5.2.2.1 and 5.2.4
(2) Markup Pages of Victoria County Station ESPA ER Subsections 5.11.3.2 and 5.11.8
(3) Summary of Regulatory Commitments

cc: USNRC, Director, Office of New Reactors/NRLPO
USNRC, Project Manager, VCS, Division of New Reactor Licensing
USNRC, Environmental Project Manager, VCS, Division of New Reactor Licensing
USNRC Region IV, Regional Administrator

ATTACHMENT 1

Markup Pages of Victoria County Station
ESPA ER Subsections 5.2.2.1 and 5.2.4

5.2.2.1 Surface Water

The source of the plant's makeup water would be the Guadalupe River as described in Section 3.4. The RWMU system would deliver up to 75,000 acre-feet per year at a maximum rate of 217 cfs as makeup water to the cooling basin to replenish losses through evaporation, basin seepage, blowdown discharges, and cooling tower drift. The water would be diverted into an approximately 3150 feet long intake canal and an approximately 200-foot long intake basin located on the southwest side of the Guadalupe River.

The location, flow data, period of record, and drainage area for the U.S. Geological Survey (USGS) gaging stations on the Guadalupe and San Antonio Rivers near the VCS site are presented in Subsection 2.3.1.1.1. Long-term stream flow data is not available for the Guadalupe River at the location of the Exelon RWMU system, approximately 430 feet upstream of the saltwater barrier. The nearest upstream gaging stations with long-term records are the Victoria gage (USGS 08176500) on the Guadalupe River and the Goliad gage (USGS 08188500) on the San Antonio River. The drainage areas for the Victoria and Goliad gages are 5198 square miles and 3921 square miles, respectively. The drainage area for the abandoned gaging station on the Guadalupe River near Tivoli is 10,130 square miles. Based on these drainage areas, the Victoria and Goliad gages monitor flows from approximately 90 percent of the total drainage area that contributes to the flow in the Guadalupe River at the diversion to the RWMU system. Flows in the Guadalupe River at the point of diversion were estimated by summing the reported flows at the Victoria and Goliad gaging stations and multiplying that sum by the ratio of the drainage area of the Guadalupe River at Tivoli to the sum of the drainage areas of the Guadalupe River at Victoria and San Antonio River at Goliad (10,130 ÷(5198 + 3921) = 1.11). Based on these estimates, the maximum VCS water use of 217 cfs represents 5 percent of the annual mean flow in the Guadalupe River (4341 cfs) based on 10 years (1997 through 2006) of flow data.

<u>Water Use Evaluation</u>

The potential water use impacts were evaluated as if the makeup water would be supplied to the VCS cooling basin under an assumed existing senior water right. This provides a conservative estimate of the potential impacts because under a senior water right, Exelon would have "first call" on diverting the water during periods when the Guadalupe River flows were low. The potential impact in terms of the volume of river flow being diverted would be higher than in the case of more junior water rights that would be restricted from using water during periods of low river flow.

Section 2.3.2.3.3 discusses the availability of water under the rights held either jointly or directly by the GBRA and Union Carbide Corporation (UCC). A surplus of more than 115,000 acre-feet per year is projected in 2060 under the GBRA/UCC water rights. Section 2.3.2.3.3 also

discusses existing water rights in the Guadalupe and San Antonio river basins in addition to those held by GBRA/UCC. For the potentially available portions of these water rights, Exelon estimates a current surplus of approximately 39,000 acre-feet per year. The priority dates of these rights vary from 1895 to 1997. The largest portion of the unused water is associated with a senior right. Because the evaluation of VCS water use assumes a relatively senior water right, the impacts of obtaining water through any combination of the potentially available water rights or a new appropriation would be consistent with, and likely less than, those presented below. The regional water planning process described in Section 2.3.2.3.3 considers the use of water allocated under existing rights during a repeat of the 1950s drought of record and through the planning horizon, as well as projected demands, shortages, and potential water use conflicts.

Exelon could supply the makeup water demand at VCS via a new water right. The priority date assigned to a new water right would restrict diversions to the Exelon RWMU system to periods in which demands under the existing, more senior water rights could be met. Further, for a new water right the TCEQ may impose special conditions, including potential restrictions on withdrawals during periods of low river flow (e.g., environmental flow conditions). These considerations would constrain the VCS withdrawals during periods of low river flow. The diversion of water during periods of relatively high flow or low demand by other water users would reduce the impacts relative to acquisition of water under a more senior existing water right.

The daily makeup water withdrawals over the 60-year historical period (1947 through 2006) given the projected water availability under an existing senior water right were calculated based on the Guadalupe-San Antonio (GSA) River Basin Water Availability Model (WAM; TNRCC Dec 1999). To assess VCS surface water use impacts as a function of run-of-river flows, the estimated VCS daily makeup water withdrawal rates were compared with the range of daily river flow conditions estimated over the 60-year historical period. The frequency distribution of the daily VCS makeup water withdrawal as a percentage of the daily Guadalupe River flow for that 60-year period is shown in Table 5.2-1 and Figure 5.2-3. The estimated plant water withdrawal was less than 15 percent of the Guadalupe River flow 85 percent of the time. Approximately 17 percent of the time, the plant either needed no additional makeup water, or no water was available for plant use as the result of low flow conditions. The withdrawal rate exceeded 30 percent of the estimated river flow less than 3 percent of the time.

Historical data shows the Guadalupe River flows at the diversion to the GBRA canal system are lower during the summer and fall months, with the lowest flows typically occurring in August and October. Table 5.2-2 and Figure 5.2-4 provide a summary of the estimated VCS makeup water withdrawal as a percentage of the Guadalupe River flow by month and by season. Consistent with the trend observed in the river flows, the VCS surface water withdrawal as a percentage of the monthly and seasonal flow of the Guadalupe River would be typically higher in the summer and fall months.

The VCS makeup water withdrawal rate would depend on the flow rate of the Guadalupe River, the priority of the water right, the water level in the cooling basin, and the blowdown flow from the cooling basin. Variations in makeup water availability would be accommodated by allowing the cooling basin water level and quality to fluctuate within acceptable ranges.

The cooling basin would be designed to contain enough makeup water to support the operation of the plant for several months during potential low river flow periods. There is one authorized surface water diversion from the Guadalupe River downstream of the source of the VCS water supply. That water right authorizes diversion of 272 acre-feet per year for a crawfish farming operation near the outlet of the river into San Antonio Bay (Table 2.3.2-10).

Water rights totaling 175,501 acre-feet per year and authorized for municipal, industrial, and irrigation use (Table 2.3.2-12) are held either jointly or directly by the GBRA and UCC. As shown in Tables 2.3.2-9 and 2.3.2-10, the GBRA/UCC water rights are senior (priority) to most other permitted water rights on the Guadalupe River. The principle of priority appropriation or "first-in-time-first-in right" is applied, which means that the most senior, or oldest, water right has first call on flows. Exelon continues to coordinate with the GBRA to ensure that ample water will be available for VCS in the future. As discussed previously, a significant volume of potentially available water rights exist in the Guadalupe and San Antonio Rivers. Exelon would finalize contractual agreements to withdraw water under one or more existing rights and/or a new water right(s) at the COL stage. The analysis of the projected water consumption concludes that Exelon would divert a small percentage of water that reaches the saltwater barrier and the San Antonio Bay system. The potentially available portions of existing water rights in the Guadalupe River indicate that an agreement could be reached to secure sufficient water to meet the VCS demand.

One of the fundamental elements of the South Central Texas (Region L) regional water planning process is the quantification of surface water and groundwater supplies reliably available during a repeat of the drought of record (1950–1957) and throughout the planning horizon. Surface water supplies available to each water right are computed using the Guadalupe-San Antonio River Basin Water Availability Model originally developed by the TCEQ and refined for regional water planning purposes subject to natural hydrology, prior appropriation, and hydrologic assumptions approved by the TWDB.

Although not specifically envisioned in the development of the 2006 Region L Water Plan, the proposed use of surface water by VCS under agreement with the GBRA is consistent with the plan assumptions. Legal use of existing surface water rights on a priority basis is a fundamental assumption in evaluating water supply. Hence, uses of all existing surface water rights are reflected in the water availability projections of the Region L Regional Water Plan, which include consideration of the drought of record conditions. Additionally, ~~the development of~~ the 2011 South Central Texas ~~Region~~ (Region L) Regional Water Plan was approved by Region L on

August 5, 2010, and submitted to the TWDB for review and inclusion in the 2012 State Water Plan in September 2010. ~~has been ongoing since February 2006. The Initially Prepared Plan was approved during February 2010~~. The ~~Initially Prepared Plan~~ 2011 Region L Regional Water Plan includes updated regional water demand projections for steam-electric power generation including those projected for the VCS ~~P~~project. The ~~Initially Prepared Plan~~ 2011 Region L Regional Water Plan also includes a recommended project to supply water to ~~the~~ VCS ~~Project~~ (i.e., the "GBRA-Exelon Project"). Analysis conducted for the Regional Water ~~Planing~~ Planning Group using the state's surface water availability model, as modified for regional planning purposes, concludes that sufficient water is available for the VCS ~~P~~project (~~TWDB Feb 2010~~ SCTRWPG 2010).

As described previously, the frequency distribution of the daily VCS makeup water withdrawal as a percentage of the daily Guadalupe River flow for a 60-year historical period (which included the drought of record [1950–1957]) estimated that approximately 17 percent of the time either the plant needed no additional makeup water (i.e., the cooling basin water level was at or above the design pool elevation), or no water was available for plant use as the result of drought conditions. The VCS cooling basin is designed to sustain plant operation for several months during drought conditions.

Projected surface water demands, supplies, and needs for Victoria and Calhoun Counties, as presented in the 2006 Regional Water Plan, are summarized in Table 2.3.2-14. As shown in the table, after meeting the projected Calhoun County surface water demands and Victoria County surface water needs, a surplus of more than 115,000 acre-feet per year remains under the combined GBRA/ UCC water rights in the time period during which the VCS units would be operating. Additionally, approximately 39,000 acre-feet per year of currently permitted water is estimated to potentially be available, and new water right applications are pending.

VCS Bio-statistical Study

Although VCS water withdrawals would generally represent a relatively small percentage of annual Guadalupe River flow, Exelon undertook an approximately year-long study to evaluate the potential effects of these water withdrawals on the ecological health of the San Antonio Bay system. The study reported in TPWD's 1998 document, Freshwater Inflow Recommendations for the Guadalupe Estuary of Texas (Pulich et al. 1998), sought to identify the hypothetical freshwater inflow patterns necessary to optimize fisheries harvests in the bay system. In contrast, the objective of the VCS analysis was to develop and utilize statistical relationships between freshwater inflows and surrogate representations of ecosystem health to identify potential effects associated with the proposed VCS water diversions.

In its guidance towards establishing relationships between freshwater inflows and estuarine health, the Science Advisory Committee (SAC, established through Senate Bill 3 of the 77th

Texas Legislature) provided a brief summary discussion on estuarine ecosystems and their major physiochemical and biological variables. Figure 5.2-5 is a highly simplified diagram prepared by the SAC to represent causal relations among such estuarine processes. Despite the simplifications made in such a depiction, the diagram demonstrates that the estuarine ecosystem is highly dynamic and complex, being comprised of many variables and their interactions. The SAC has noted that it is not feasible to quantify each of the cause-and-effect relations diagrammed in Figure 5.2-5. Instead the complexity of Figure 5.2-5 has been further distilled by the SAC to represent the most fundamental relations of inflow to the ecosystem in a form that may be feasible for determining inflow requirements. Figure 5.2-6 presents a conceptual schematic of the causal connection(s) between "inflow" and "biology." (SAC 2009)

Inflows are one of the principal components contributing to estuarine ecology for which man exhibits some influence, and were hence of primary interest to the VCS bio-statistical study. Flow and salinity are known to exhibit strong correlations, a relationship that is strengthened in San Antonio Bay by the rather enclosed geomorphology of the bay system (Figure 5.2-7). Because the bay is somewhat sheltered from direct salinity intrusion from the Gulf of Mexico, Gulf salinities take a relatively long time to intrude into the system via the natural passes (e.g., Aransas Pass and Pass Cavallo). Accordingly, freshwater inflows typically have a longer-lasting influence on San Antonio Bay salinities relative to other Texas Bays (e.g., Galveston Bay and Matagorda Bay), with salinities generally higher, and the influences of tides and wind on water quality more noticeable, during periods of low freshwater inflow (Slack et al. 2009).

Rather than develop relationships between salinity and the biology of the system, the VCS bio-statistical study focused upon the ~~more direct~~ relationship between representations of San Antonio Bay biology and freshwater inflow. ~~Both species, or organism, abundance and salinity are affected by factors other than inflow. Such a fact makes it difficult to extract a simple relation of either purely on inflow. As noted in Figure 5.2-6, the ultimate target is a relation to the "biology".~~ While salinity exhibits a more direct relation to inflow, as noted in Figure 5.2-6, the ultimate target is a relation to the “biology”. SAC 2009 notes that it is possible to establish a direct relation of biology to inflow, though the data requirements and analytical methods to establish such a relation are demanding. Studies typically focus upon salinity rather than abundance for the simple reason that salinity data are typically readily available, whereas biological data are not. In San Antonio Bay, however, there are ample biological data available to study biology directly. Secondly, inferring biological reactions through salinity can be misleading, as estuarine organisms generally function over a wide range of salinities. While these organisms exhibit preferences, they can exist outside of their preferred salinity conditions, complicating the relationship between salinity and biology and hampering the characterization of the organisms' dependence upon inflow. For example, as explained by the Guadalupe, San Antonio, Mission, and Aransas Rivers and Mission, Copano, Aransas, and San Antonio Bays Basin and Bay Expert Science Team (GSA BBEST), “[j]uvenile and adult blue crabs are tolerant

of a wide range of environmental conditions, having been found in habitats…ranging from freshwater…to hypersaline lagoons with [salinities] up to 117 psu" (practical salinity unit; GSA BBEST March 2011). Lastly, salinity is but one of several pathways by which inflow can exert an influence on abundance (see Figure 5.2-5). Focusing entirely upon salinity may result in overlooking other flow-modulated responses or wholly misinterpreting a nonsalinity response to inflow. By analyzing directly the relation of organism abundance to freshwater inflows, there is a better chance of capturing all of the flow-modulated effects.

Thus, the primary interest in the VCS study was the bio-statistical analysis of organism density (abundance) and its relation to freshwater inflows. The methodology utilized in the VCS bio-statistical study is consistent with the present knowledge on developing relationships in highly dynamic systems described in the SAC's document to the Basin and Bay Expert Science Teams, Methodologies for Establishing a Freshwater Inflow Regime for Texas Estuaries (SAC 2009). As described in greater detail in the subsequent discussion, this VCS bio-statistical study was completed in the following major steps:

1. Identification of key estuarine species to evaluate (via average annual abundance) as a proxy for bay health.

2. Data retrieval from the Texas Parks and Wildlife Department (TPWD) Coastal Fisheries Database and preparation for use with statistical analysis tools.

3. Quantification of historical freshwater inflows to the San Antonio Bay system and characterization of these flows using annual and seasonal representations.

4. Identification and culling of statistical relationships between the average annual abundance of the selected species and freshwater inflows, including the assessment of the potential effects of other independent variables (namely fisheries harvest data and water temperature) on organism abundance.

5. Utilization of the TCEQ Water Availability Model (WAM) and the South Central Texas Regional Water Planning Group (Region L) Guadalupe-San Antonio (GSA) WAM to simulate "without-project" ~~(i.e., baseline)~~ and "with-project" hydrological demand scenarios, as well as several ~~and~~ potential future hydrological scenarios, such that the best-fit statistical relationships could be used to assess potential effects on the abundance of the selected organisms.

As noted above, the first study task was to select the estuarine species to be evaluated as a measure of present and potential future bay health. Brown shrimp (Penaeus aztecus or Farfantepenaeus aztecus), white shrimp (Penaeus setiferus or Litopenaeus setiferus), blue crab (Callinectes sapidus), and eastern oyster (Crassostrea virginica) were chosen as important San

Antonio bay species. These are four of the key organisms utilized during the application of the Texas Water Development Board (TWDB) and TPWD's "State Methodology for San Antonio Bay" (Longley 1994). As described in TPWD's 1998 report, Freshwater Inflow Recommendations for the Guadalupe Estuary of Texas, the selected species "are representative dominant fisheries organisms or ecologically important prey species common in the Guadalupe Estuary based on TPWD Coastal Fisheries Program surveys" (Pulich et al. 1998). Thus, the abundance of these organisms provides a measure of the ecological productivity of the San Antonio Bay system, including a partial measure of the availability of food for certain predatory species. Notably, as discussed in Subsection 2.4.1.5, blue crabs are one important food source for the federally endangered whooping crane (Grus americana). Accordingly, the average annual abundance of the four species listed above were chosen as the proxy for the ecological health of the San Antonio Bay system in the VCS bio-statistical study.

The next step was to retrieve San Antonio Bay abundance data for the selected species. The source of such biological data used in the VCS study, the TPWD Coastal Fisheries Database, is a compilation of data collected by the TPWD utilizing various sample methodologies. This dataset contains data from 1976 to 2008, varying by the sample gear utilized. In contrast to San Antonio Bay fisheries harvest data, which were used by some previous efforts such as the above-referenced 1998 TPWD inflow recommendations study, the Coastal Fisheries Database information is obtained via random sampling; thus, the sampling schedule and locations are not subject to external factors like fuel and market seafood prices. Approximately 787,000 records (with up to 40 separate entries per record) were obtained from the TPWD database, representing all of the readily available data of this nature historically collected by the TPWD for the selected species. Once retrieved, abundance data for each organism were normalized by volume of water, area of sample, and sampling time, depending upon the geartype in which the organism was caught, to prepare for statistical analysis. Ultimately, the development of biological parameters consisted of four phases: the initial development of database tools to process the Coastal Fisheries data; the analysis of the geographic distribution of sampling events; the detailed analysis of sampling data; and, finally, specific analyses of organism densities.

The task of quantifying freshwater inflows for use in the statistical analyses began with the development of the hydrologic data for the San Antonio Bay system watershed. These data were developed from a variety of sources, including the USGS and TWDB. Daily mean flow data were obtained for five USGS stream flow gages on the Guadalupe and San Antonio Rivers and Coleto Creek (a tributary to the Guadalupe River) for their entire periods of record. The TWDB provided modeled daily runoff values for 13 ungaged watersheds within the San Antonio Bay watershed for the period 1977–2008, as well as estimates of the diversions from and return flows to these ungaged watercourses. The TWDB and USGS data were compiled to develop a daily representation of total freshwater inflows to San Antonio Bay for the period 1977 through

2008 (i.e., the period of record for the historical biological data obtained for use in the study).

Using the daily data, parameters of freshwater inflow were developed to serve as independent variables in the statistical comparisons to average organism abundance. The most important aspect of the year-to-year variation in annual discharge is how it is manifested in the annual seasonal floods and the summer low-flow period (SAC 2009). Some years exhibit a pronounced and extended seasonal pulse (also known as a "freshet"), while in other years the spring freshet may be totally absent. Correspondingly, in some years the summer low-flow period may be shortened or even eliminated by unusual runoff, and in other years may be prolonged while the flows dwindle. The SAC indicates that preliminary statistical analyses (based on work performed in Matagorda Bay) using seasonal freshets as an independent variable have better explained the variation of abundance for several major species than similar analyses using calendar-period flows (i.e., bimonthly or annual periods). The SAC recommends that, "If available, a freshet analysis may prove a useful characterization of estuarine inflows for purposes of assessing the response of biology (SAC 2009)." This representation of flow, and its suggested use by the SAC, represents the evolving thinking of the scientific community with respect to the relation of freshwater inflow to estuarine health.

Thus, while earlier efforts, such as the those reported for the TPWD's 1998 inflow recommendations study (Pulich et al. 1998), focused on gaged flow averaged temporally, either as annual means or as "seasonal" (i.e., bimonthly volumes), the flow component of the VCS bio-statistical analysis was based on the premise that substantial explanation of ecological response depends upon the space-time variation of inflows. Accordingly, in addition to evaluating the relationships between annual freshwater inflow volumes and organism abundance, more refined representations of inflow were developed to recognize the importance of seasonal pulses (i.e., "freshets") and the intervening drier periods. Furthermore, the seasonal freshets (and the associated low-flow periods between them) were characterized by two methods, one assigning a 3-month time frame after the onset of the freshet in the hydrological record, and the other with a varying freshet duration dictated by identifying both the freshet onset and ending in the hydrologic data via the application of a mathematical algorithm (termed the "FRESHET Methodology"). In all, eleven seasonal characterizations of freshwater inflow were used to develop the inflow-related independent variables for statistical analysis:

- Annual freshwater inflow
- 3-month spring freshet (3 calendar months starting with freshet onset)
- Summer dry period between 3-month freshets
- 3-month fall freshet (3 calendar months starting with freshet onset)

- Winter dry period between 3-month freshets
- Summer lowest 3-month flow (3 calendar months starting with low-flow onset)
- Winter lowest 3-month flow (3 calendar months starting with low-flow onset)
- Spring freshet using "FRESHET Methodology" (mathematically identified pulses of flow in the hydrologic record)
- Summer dry period between freshets identified with the FRESHET Methodology
- Fall freshet using FRESHET Methodology (mathematically identified pulses of flow in the hydrologic record)
- Winter dry period between freshets identified with the FRESHET Methodology

It should be noted that hydrologic data was temporally related to the biological data through the development of a relative time frame referred to as an "effective hydrologic period." For each organism, the effective hydrologic period is that 12-month period in which the hydrology is considered to influence the given organism, considering its life cycle traits (e.g., moving in or out of the bay at a given time of year). In addition to the freshwater inflow-related parameters developed from the annual and seasonal inflow volume representations described above, parameters of water temperature and commercial fishing harvest data were developed for use in the statistical analyses.

With the dependent (i.e., average annual organism abundance for the selected key species) and independent (i.e., based on freshwater inflow representations, fisheries harvest data, and water temperature data) variables prepared, statistical regressions were developed to assess which, if any, relationships of organism abundance to freshwater inflow yielded statistically valid and meaningful tools for the subsequent analysis of potential effects on the ecological health of San Antonio Bay. Approximately 60,000 multivariate linear regressions ~~analyses~~ were performed and subsequently analyzed (facilitated by statistical analysis tools developed for the project) to identify their capability in predicting average annual abundance. The regressions ultimately identified to relate organism abundance to fresh water inflow are presented below, wherein "Adj. R^2" represents the percent of variance explained by a regression and "A" represents the relative annual organism abundance in the bay. The adjusted R^2 is used, as an increased number of variables can cause an artificial increase in R^2. It should be noted that the descriptor "Whole Bay" indicates that organism abundance was aggregated across the San Antonio Bay system, rather than for a specific sampling location(s). This methodology was selected because the TPWD's program of random sampling leads to variation in the total

number and frequency of sampling events at individual sampling locations that hinders the development of statistical relationships at a specific point(s) in the bay system. The identified regressions are as follows:

White Shrimp:

Whole Bay Otter Trawl White Shrimp related to Total San Antonio Bay 3-Month Summer Low-Flows

Adj. $R^2 = 0.586$
$A = 0.433 + 1.97x10^{-5}$ DQ3

This equation relates average annual white shrimp abundance, as represented by sampling in San Antonio Bay using an otter trawl, to the magnitude of the lowest 3-month cumulative flow occurring between March and August (as represented in the above equation by DQ3). This equation explains approximately 59 percent of the variance of the data.

Eastern Oyster:

Whole Bay Oyster Dredge Eastern Oyster related to Total San Antonio Bay 3-Month Spring Freshet Flows

Adj. $R^2 = 0.218$

$A = 2285.44 - 5.59x10^{-4}$ SQ3

This equation relates average annual eastern oyster abundance, as represented by samples collected in San Antonio Bay using an oyster dredge, to the magnitude of the 3-month cumulative high flow occurring between January and June (as represented in the above equation by SQ3). This equation explains about 22 percent of the variance of the data.

Blue Crab:

Whole Bay Otter Trawl Blue Crab related to Colorado Total San Antonio Bay 3-Month Summer Intervening Flows:

Adj. $R^2 = 0.280$

$A = 3.843 + 1.52x10^{-5}$ SINTQ

This equation relates average annual blue crab abundance, as represented by sampling in San Antonio Bay using an otter trawl, to the average monthly magnitude of intervening flows occurring between the spring and fall 3-month freshets (as represented in the above equation

by SINTQ). This equation explains approximately 28 percent of the variance of the data.

The explained variances offered by the eastern oyster and blue crab relationships to freshwater inflows are weak, suggesting other external factors unrelated to inflow, as currently represented, also contribute to variations in these organisms' average annual abundances. No discernable statistical relationship between average annual brown shrimp abundance and freshwater inflow variables resulted from this analysis.

To use the identified linear regressions to evaluate the potential effects on San Antonio Bay health resulting from the proposed VCS water withdrawals, the ~~TCEQ GSA~~ Region L WAM ~~(see Subsection 2.3.2.3.3)~~ was chosen as an available and accepted means of modeling baseline and with-project hydrological scenarios. The following WAM simulations were used to evaluate potential project-specific impacts in the VCS bio-statistical study:

~~Current~~ Present Conditions without VCS Scenario (Present Conditions) — The ~~Current~~ Present Conditions Scenario uses results from a Region L WAM simulation that represents current conditions with respect to water availability for individual water rights. The Region L Present Conditions WAM used in the VCS bio-statistical study includes the following assumptions:

- The maximum diversion amount being sought by each individual water right is established as the actual maximum annual use in the 10 years prior to when the WAM was originally developed (~~mid-1980s to mid-1990s~~ 1990 -1999) as reported by the individual water rights owners. Additionally, the Region L Present Conditions WAM has been updated to reflect changes in water use patterns for seven major water rights and reservoirs in the GSA watershed since 1999.

- The maximum storage capacity of all reservoirs specified as the actual year-2000 storage capacity (rather than the authorized maximum storage amount); and

- Return flows associated with individual water rights and within the basin are ~~accounted for in accordance with actual operations~~ set to 2006 reported levels, adjusted for San Antonio Water System (SAWS) direct recycled consumptive water use of about 24,900 acre-feet per year (based on contracts for consumptive use). The Region L Present Conditions WAM contains approximately 157,000 acre-feet per year of discharges, including 70,306 acre-feet per year of SAWS discharges (accounting for the aforementioned direct recycled water use).

- The model assumes a total use of 73,900 acre-feet per year of the Guadalupe-Blanco River Authority (GBRA) Lower Basin rights, including a diversion of 4,199 acre-feet per year under the most junior GBRA right, Certificate of Adjudication (COA) #18-5178. The total amount of 73,900 acre-feet per year is greater than the historical average cumulative use of approximately 50,000 acre-feet per year, as derived from GBRA's reported historical usage

of its lower basin rights.

Present Conditions with VCS Scenario – ~~Comparative Scenario One — Comparative Scenario One~~ The Present Conditions with VCS Scenario incorporates the data sets and assumptions from the ~~Current~~ Present Conditions without VCS Scenario, except that up to 75,000 acre-feet is annually diverted from the river under ~~Certificate of Adjudication~~ COA 18-5178 (proxy used to represent potential water supply for the proposed VCS) at a maximum instantaneous diversion rate of 217 cfs. ~~The representative water use is incorporated into the model run using an assumed monthly diversion pattern for a potential onsite cooling water impoundment. No discharges to the river from blowdown from the proposed onsite cooling reservoir were included in the scenario input data.~~ As discussed earlier in Subsection 5.2.2.1, VCS makeup water withdrawals over the period 1947 through 2006 were modeled using the GSA WAM (TNRCC Dec 1999) and assuming withdrawals under an existing senior water right (COA 18-5178). These modeled withdrawals, adjusted to account for modeled cooling basin blowdown to the Guadalupe River, were added to the existing COA 18-5178 demand of 4,199 acre-feet per year at a monthly time-step. The remaining approximately 26,800 acre-feet per year of the 106,000 acre-feet per year permitted under COA 18-5178 are left unused. The bio-statistical study simulation extends from 1947 to 1989, representing the period of overlap between the Region L Present Conditions WAM (1934-1989) and modeled VCS withdrawals and blowdown flows (1947-2006). ~~That is, the Current Conditions Scenario~~ The Present Conditions with VCS Scenario uses conservative assumptions consistent with the Present Conditions without VCS Scenario and is intended to represent the incremental effect on fresh water inflows to the bay resulting from surface water diversions associated with VCS operation.

Comparison of the Present Condition without VCS and Present Conditions with VCS models indicates an average decrease in inflows to San Antonio Bay of approximately 5,300 acre-feet per month with VCS in operation, with a standard deviation of about 3,200 acre-feet per month. This reduction represents about 3.4 percent of the average monthly inflows to the bay system. The approximate inflow reduction at higher flows (i.e., at or above the 90th-percentile flow) is approximately 9,600 acre-feet per month, or about 2.6 percent of the inflow magnitude without VCS in operation. At the lowest flows (i.e., at or below the 10th-percentile), inflow to San Antonio Bay increases by about 1 percent with VCS in operation, due primarily to modeled blowdown from the VCS cooling basin.

~~A second~~ Three additional comparative scenarios ~~("Comparative Scenario Two")~~ that ~~was~~ were ~~developed~~ used to conservatively model potential future conditions in the basin ~~is~~ are discussed in the cumulative impacts analysis presented in Section 5.11.

The hydrologic scenarios (i.e., ~~current conditions~~ Present Conditions without VCS and Present Conditions with ~~the~~ VCS ~~Project~~) were then used in conjunction with the previously described linear regressions relating average annual organism abundance to freshwater inflows to evaluate the potential effects on the health of the San Antonio Bay system (i.e., compared to the

current health of the bay) associated with proposed VCS water withdrawals from the Guadalupe River. ~~Based on the analysis of the potential impacts to the key species assessed in this study, the following conclusions were drawn:~~ The results of the evaluation are summarized in Table 5.2-3.

Inspection of Table 5.2-3 indicates that the estimated potential reductions (relative to abundance predictions made using the Present Conditions without VCS model) in white shrimp abundance range from approximately 4 percent to 18 percent, with the larger potential changes predicted at lower abundances (i.e., occurrence frequencies exceeded 90 percent of the time). For blue crab, the estimated potential decrease in abundance relative to the modeled present conditions is approximately 3 percent at higher abundances (i.e., occurrence frequencies exceeded 10 percent of the time). Lower blue crab abundances are driven by the constant in the regression and therefore yield no apparent change between the hydrologic scenarios. No negative impacts are identified for eastern oyster, as all modeled scenarios result in increases in oyster abundance.

Given the wide range of variability in the historically (1977-2008) observed organism abundances of white shrimp, blue crab, and eastern oyster, the identified regressions relating average annual abundances for these organisms to freshwater inflow are relatively weak, with particularly low explained variance for blue crab and eastern oyster. Accordingly, a sensitivity analysis was performed to determine at what level of statistical confidence in the predictions potential impacts are determined. Statistical confidence (starting at $\alpha = 0.05$, or 95 percent confidence) was iteratively adjusted until a negative impact was discernible from the Present Conditions without VCS scenario. As one lowers the level of statistical confidence, the associated confidence bounds in the prediction constrict. Thus, the statistical confidence of a discernible potential impact has been characterized at the first identification of a negative impact exceeding the corresponding confidence level. As presented in Table 5.2-3, statistical confidence in the predicted abundance reductions for white shrimp and blue crab are at most 12 percent and 6 percent, respectively. There is at most 2 percent statistical confidence in the predicted increases in eastern oyster abundance.

It is standard to employ a 95 percent confidence level in statistical assessments of biology (McDonald 2009). At this level of confidence, none of the potential impacts of the various future hydrologic scenarios analyzed is statistically discernible. If the confidence level is reduced to that approximate to one standard deviation (approximately 68 percent), these potential impacts are still not-statistically discernible. While the low confidences in the predictions are not surprising considering the relatively weak regressions, they underscore the fact that other external factors unrelated to freshwater inflow (as characterized in the bio-statistical evaluation) contribute to variations in organism abundances in San Antonio Bay.

Based on the analysis of the potential impacts to the key species assessed in this study, the following conclusions were drawn:

- No statistically significant relationships between key species abundance and annual freshwater inflows to San Antonio Bay were identified. However, a small number of statistical relationships associated with seasonal inflows were developed using the FRESHET and the 3-Month Freshet methodologies. Thus, the original hypothesis that pulses of flow, or the period between these pulses, are more significant to estuarine health than annual flows appears to be valid. Further, the 3-Month Freshet methodology provides a readily implementable means of evaluating flows utilizing the ~~State of Texas'~~ South Central Texas Regional Water Planning Group's current tool for such an assessment, ~~TCEQ's~~ the Region L GSA WAM.

- The identified statistical relationships between eastern oyster and blue crab abundances and freshwater inflow parameters are weak (i.e., there are small amounts of explained variance for these relationships). The results of the analyses conducted during this study indicate that other external factors unrelated to freshwater inflows (as represented within the VCS study) contribute to variations in oyster and blue crab abundances.

- Using the developed linear regressions and comparing abundances predicted by the Present Conditions without VCS hydrological model to those predicted by the Present Conditions with VCS hydrological model, there is the potential for decreases in white shrimp and blue crab abundances. However, the predicted changes in the abundances of these organisms due to VCS water withdrawals are not discernible at the 95 percent confidence level of the prediction, a standard biological assessment criterion. Specifically, there is at most 12 percent confidence in the predicted reductions (see Table 5.2-3).

- ~~The statistical relationships identified between freshwater inflow parameters and species abundance were used in conjunction with the Present Conditions with VCS hydrological model to evaluate the potential effects of water use by VCS. This evaluation determined that implementation of the VCS project would yield no discernible change in the predicted abundance of white shrimp. Similarly, no discernable change can be seen in predicted blue crab and eastern oyster abundances utilizing the relatively weaker statistical relationships in conjunction with Comparative Scenario One~~.

~~Thus, with respect to freshwater inflows to San Antonio Bay, the project-specific scenario analyzed, and the methodologies employed therein, the study did not indicate that the VCS project would impact the future health (i.e., as compared to the current health) of the key San Antonio Bay organisms evaluated.~~ Thus, with respect to freshwater inflows to San Antonio Bay, the project-specific scenario analyzed, and the methodologies employed therein, the study did not indicate that the VCS project would yield a statistically discernible impact (at the 95 percent confidence level) on the predicted future abundances (i.e., as compared to current abundances) of the key San Antonio Bay organisms evaluated. The study results are consistent with the

conclusion that VCS water use impacts on the ecological health of San Antonio Bay would be small.

Summary

Surface water use impacts as a result of the VCS surface water withdrawals from the Guadalupe River would be SMALL based on the following findings:

- The maximum instantaneous diversion for VCS water use of 217 cfs represents 5 percent of the annual mean flow of the Guadalupe River at the proposed point of diversion, based on 10 years (1997–2006) of flow data.

- The cooling basin would be designed to contain enough water to support the operation of the plant for several months during low river flow periods. Variations in makeup water availability would be accommodated by allowing the cooling basin water level and quality to fluctuate within acceptable ranges. Additionally, as discussed in Subsection 5.2.1, the site groundwater model predicts that cooling basin seepage would create a small base flow in tributaries within the Guadalupe-San Antonio River System.

- The daily makeup water withdrawals over the 60-year historical period (1947 through 2006) assuming a senior priority date were calculated based on the Guadalupe-San Antonio River Basin Water Availability Model (TNRCC Dec 1999). To assess VCS surface water use impacts as a function of run-of-river flows, the estimated VCS daily makeup water withdrawal rates were compared to the range of daily river flow conditions estimated over the 60-year historical period. The frequency distribution of the daily VCS makeup water withdrawal as a percentage of the daily Guadalupe River flow for the 60-year period estimates that VCS water withdrawal would be less than 15 percent of the Guadalupe River flow 85 percent of the time; and the withdrawal rate would exceed 30 percent of the estimated river flow less than 3 percent of the time. Based on this evaluation, freshwater inflows to the San Antonio Bay system for the period of record would be relatively unaffected by VCS water use.

- The VCS water withdrawals would be obtained from one or more water rights. The surplus available under senior (priority) GBRA/UCC unallocated water rights or other existing water rights in the Guadalupe-San Antonio River Basin is sufficient to meet the VCS site demand.

- A bio-statistical study was conducted to evaluate the potential effects of VCS water withdrawals on the ecological health of the San Antonio Bay system, using the average annual abundance of four key estuarine species (brown shrimp, white shrimp, blue crab, and eastern oyster) as a representation of bay health. The TPWD Coastal Fisheries Database provided approximately 787,000 records for the selected species for the period

1977–2008. Freshwater inflow data were obtained from the TWDB and the USGS and aggregated to estimate daily inflows to the bay system over the same period, from which seasonal (i.e., "freshet") and annual representations of inflow were characterized. Roughly 60,000 multivariate linear regression analyses were performed and evaluated to identify their ability to relate freshwater inflows to the average annual abundances of the selected species, ultimately yielding a relationship for white shrimp and relatively weaker relationships for blue crab and eastern oyster. No relationship was identified for brown shrimp. The identified regressions were utilized in conjunction with hydrological scenarios developed using the ~~TCEQ~~ Region L GSA WAM to assess current San Antonio Bay conditions and potential effects on the selected organisms' abundances associated with the proposed VCS water withdrawals from the Guadalupe River. ~~With respect to the freshwater inflows to San Antonio Bay, the project-specific scenario analyzed, and the methodologies employed therein, the VCS bio-statistical study did not indicate that the VCS project would impact the future health (i.e., as compared to the current health) of the key San Antonio Bay organisms evaluated.~~ With respect to freshwater inflows to San Antonio Bay, the project-specific scenario analyzed, and the methodologies employed therein, the study did not indicate that the VCS project would yield a statistically discernible impact (at the 95 percent confidence level) on the predicted future abundances (i.e., as compared to current abundances) of the key San Antonio Bay organisms evaluated. The study results are consistent with the conclusion that VCS water use impacts on the ecological health of San Antonio Bay would be small.

- The Present Conditions with VCS hydrological model used in the bio-statistical evaluation indicates that at lower flows (i.e., flows exceeded 90 percent of the time) there is a modeled net increase of approximately 1 percent in freshwater inflows to San Antonio Bay with VCS in operation, primarily due to modeled blowdown from the VCS cooling basin.

5.2.4 References

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Table 5.2-3

Organism Abundances Estimated using the Present Conditions with VCS Hydrological Model, including Potential Changes Relative to Abundances Estimated using the Present Conditions without VCS Hydrological Model

Organism	Occurrence	Present Conditions without VCS Project -abundance (number / acre-foot)	Present Condition with VCS Project - abundance (number / acre-foot)	Potential VCS Project Impact on Present Conditions (number / acre-foot)	Percent change from Present Condition with VCS Project	Statistical Confidence in the Predicted Change
White Shrimp	90% Exceedance	1.18	0.96	-0.22	-18.37%	at most 12%
	10% Exceedance	8.69	8.31	-0.38	-4.35%	
	Average	4.43	4.13	-0.30	-6.88%	
Eastern Oyster	90% Exceedance	1,380.16	1,391.47	11.31	0.82%	at most 2%
	10% Exceedance	2,181.07	2,188.34	7.27	0.33%	
	Average	1,868.01	1,878.16	10.15	0.54%	
Blue Crab	90% Exceedance	3.84	3.84	0.00	0.00%	at most 6%
	10% Exceedance	10.31	10.03	-0.29	-2.76%	
	Average	6.82	6.58	-0.25	-3.63%	

ATTACHMENT 2

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ESPA ER Subsections 5.11.3.2 and 5.11.8

5.11.3.2 **Ecological Impacts of Water Use (Terrestrial and Aquatic) Water Use Evaluation**

As stated in Subsection 5.11.2, the net result of the LGWSP and VCS cooling basin makeup water withdrawals and the VCS blowdown discharge would be a small reduction in the Guadalupe River flow compared to current conditions. Despite the small reduction in flow, the combination of the GBRA and VCS consumptive use of water from the lower Guadalupe River basin would result in reduced freshwater inflows into the Guadalupe estuary and San Antonio Bay, which support aquatic species and migratory birds. The potential of reduced freshwater inflows into the Guadalupe River estuary and San Antonio Bay is a possible concern for the whooping crane (Grus americana). The whooping crane is an endangered species that overwinters and forages in habitats on the periphery of the Guadalupe River estuary and San Antonio Bay (see Subsection 2.4.1). There are differing professional and scientific opinions regarding the impacts of freshwater inflows on the whooping cranes and their habitat.

For example, the U.S. Fish and Wildlife Service (USFWS) Whooping Crane Coordinator has observed the whooping crane population at the Aransas National Wildlife Refuge (ANWR) for approximately 30 years. Based upon his observations, he has expressed the opinion that there is a relationship between marsh salinities, blue crab populations, and whooping crane mortality rates. He has stated that with reduced freshwater inflows and high marsh and bay salinities, blue crabs do poorly and whooping crane mortality rises (comments dated June 5, 2009, included in Slack et al. Aug 2009).

In contrast, as discussed in Section 2.4, Texas A&M University recently conducted a multi-year study evaluating the relationships among freshwater inflows, whooping cranes and their prey, Linking Freshwater Inflows and Marsh Community Dynamics in San Antonio Bay to Whooping Cranes (Slack et al. Aug 2009). Among the many results of this project, field and laboratory studies documented that the diet of wintering cranes can vary annually (including wolfberry fruit, blue crabs, clams, snails and other items); blue crabs are not always the dominant food item; blue crab abundance and distribution are influenced by a combination of environmental factors (water levels, wind speed, temperature and salinity); salinity levels alone do not determine crab abundance and distribution; and wolfberry production is strongly influenced by salinity levels during summer leaf production. Many of these findings were incorporated into computer models examining impacts of freshwater inflows on whooping cranes and their food over an 11-year period (1997–2007). These models suggested that food supply within the bay area does not appear to be limiting, even during the lower inflow years, but also that the relationship between salinity and whooping crane energetics and/or survival remains unclear.

As discussed in Subsection 2.4.1.5, the Whooping Crane Eastern Partnership (WCEP) reported high mortality rates for the Aransas-Wood Buffalo population of whooping cranes during 2008–2009. According to WCEP, the majority of losses appear to have occurred during migration.

Several possible factors for this mortality level have been identified such as extreme drought which affected food sources and fresh drinking water available in the wintering grounds and disease (e.g., infectious bursal disease (IBD)). Further, chick mortality at Wood Buffalo National Park in Canada was also high, potentially due to higher than average rainfall while the chicks were young. Data from specific analyses (e.g., necropsies, water quality and food source abundance data correlation) was not included in the WCEP assessment. (WCEP Nov 2009)

Due to the fact that only four crane carcasses were recovered, the reports of mortality during the 2008–2009 overwintering period were based primarily on the apparent absence of birds during USFWS aerial census events. These missing birds, which were documented as arriving at ANWR during earlier aerial censuses, accounted for up to 19 of the 23 suspected mortalities (USFWS 2009a and USFWS 2009b).

During the 2008-2009 overwintering season at ANWR, above-normal upland and water hole use was noted, scattering the cranes over a geographical area beyond their typical territory (USFWS 2009a). As described in the January 2009 USFWS aerial census report, "This makes it very difficult to determine the identity of pairs and family groups and leads to much uncertainty during the census count" (USFWS 2009a). Limited visibility due to weather conditions and smoke from prescribed burns, as well as flight time limitations, were noted on multiple census flights, adding to the difficulty in spotting the widely dispersed cranes (USFWS 2009a). Considering these and other factors, it is possible that the extent of whooping crane mortality during the 2008–2009 overwintering period could be lower than reported.

Given the few carcasses recovered, questions also remain regarding the causes of the reported whooping crane deaths. USFWS reports from the first half of 2009 postulated that the birds absent during the later aerial census counts succumbed to injury, predation, and/or disease resulting primarily from food-related stress (particularly related to small amounts of wolfberries and blue crabs) believed to be brought on by the regional drought conditions (USFWS 2009b). Additionally, the need for the cranes to fly to upland areas to find fresh water to drink was cited as an energy burden that could have further weakened the birds (USFWS 2009b). However, as discussed previously, empirical research indicates that the crane diet is rich and varied, and even when blue crab and wolfberry numbers are low, cranes can meet their daily energy and protein requirements by efficiently foraging on foods such as insects, snails, and razor clams (Slack et al. Aug 2009). As an example, cranes were noted eating fiddler crabs immediately prior to their early departure from ANWR in spring 2009 (USFWS 2009b). Furthermore, the flock departed ANWR relatively early in the 2009 (USFWS 2009b). Previous research has indicated that birds will generally migrate earlier than usual when food availability allows for rapid fattening and good physical condition (Studds and Marra 2007).

Additionally, other factors could have contributed to crane mortality. As noted in the USFWS report Whooping Crane Recovery Activities, October 2008–October 2009, the National Wildlife

Health Center in Madison, Wisconsin was able to isolate a virus very similar to IBD in a recovered juvenile carcass. One of the symptoms of IBD is emaciation, even when a bird is receiving adequate food. If it turns out the virus is a form of IBD, this would be the first case ever documented in a crane from the Central Flyway (USFWS 2009b). Taking into account the available information, there is uncertainty regarding the specific cause or causes of death for the whooping crane mortalities reported over the 2008-2009 overwintering period at ANWR.

Additional studies have been proposed to further clarify the relationship among freshwater inflows, salinity, and whooping cranes. Freshwater inflows provide nutrient and sediment loading to the estuary, and they are one factor affecting salinity gradients in the bay system.

Regional Water Plan Cumulative Effects Analysis

The 2011 South Central Texas (Region L) Regional Water Plan was approved by Region L on August 5, 2010, and submitted to the TWDB for review and inclusion in the 2012 State Water Plan in September 2010 (SCTRWPG 2010). As discussed in ~~Reference~~ Subsection 5.11.2, preparation of the 2011 Initially Prepared Plan included use of hydrologic models to quantify the cumulative effects of implementation of the South Central Texas Regional Water Plan through the year 2060. The TCEQ water availability model, modified for regional water planning purposes, was used to simulate freshwater inflows to the Guadalupe Estuary given full implementation of the recommended water management strategies (the Regional Water Plan case). Three additional simulations were performed for comparison with the Regional Water Plan case:

- The first comparison scenario, the Baseline (Full Permits) case, included the assumptions used elsewhere in the 2011 Initially Prepared Plan to determine surface water supply reliability and perform technical evaluations of surface water management strategies. These assumptions included full utilization of existing surface water rights and treated effluent discharges representative of expected future conditions.

- The second comparison simulation, the Present Conditions case, was intended to be a realistic, but somewhat conservative, portrayal of current basin conditions with respect to springflows, surface water rights use, and effluent discharges.

- The third comparison scenario, the Natural Conditions case, is an historical set of theoretical streamflows and estuarine inflows, in which the effects of mankind on water resources have been removed.

Two ecologically based assessments, based on spring / early summer freshwater pulse criteria and low-flow inflow criteria, were used to compare simulated inflows to the Guadalupe Estuary under the four estuarine inflow scenarios described above (i.e., the Regional Water Plan,

Baseline (Full Permits), Present Conditions, and Natural Conditions cases). The freshwater pulse evaluation was used to compare Guadalupe Estuary inflow conditions based on occurrences below a target inflow of 526,000 acre-feet over the critical four month period from April–July. The low-flow inflow evaluation was focused on whether enough freshwater would be available to maintain salinity conditions within reasonable tolerance ranges and enable sufficient populations of organisms such as oysters, shrimp, and crabs to survive drought periods. This analysis identified periods where inflows were simulated to be below a drought tolerance level for key estuarine species for six or more consecutive months during the March–October period. Six months was selected because it represents a significant portion of the life-cycle of several principal estuarine species. Both of the ecologically based assessments relied, in part, upon the freshwater inflow recommendations of the Texas Parks & Wildlife Department (TPWD) and the Texas Water Development Board (TWDB) discussed in Section 2.3.

For the spring/early summer freshwater pulse criteria, the 49-year simulations indicated that the numbers of years with April–July freshwater pulses below the target value (derived, in part, from TWDB and TPWD recommendations) were:

Natural	**Present Conditions**	**Baseline (Full Permits)**	**Regional Water Plan**
19	20	23	24

The numbers of occurrences with simulated estuary inflows below the drought tolerance level (based, in part, on TWDB and TPWD recommendations) for six consecutive months or longer were:

Natural	**Present Conditions**	**Baseline (Full Permits)**	**Regional Water Plan**
3	5	8	8

From the results, it can be seen that the simulated natural conditions were responsible for most of the years when the simulated estuary inflows did not meet the target freshwater spring/early summer pulse criterion. Relative to the present conditions, the differences from the Present Conditions simulation to the Baseline (Full Permits) and the Regional Water Plan case simulations resulted in 3 to 4 additional occurrences over the 49-year simulation period. For the low-flow inflow condition, the difference for the Baseline (Full Permits) and Regional Water Plan case simulations relative to the Present Conditions case simulation is 3 additional occurrences. It should be noted that 3 of the 8 predicted occurrences when inflows did not meet the drought tolerance criterion resulted from the 1950s drought of record. The other 5 occurrences are isolated events.

The results also indicate that the decrease in modeled inflows to the Guadalupe Estuary would primarily be realized as a result of the increase in water use from the Present Conditions to the Baseline (Full Permits) case. Considering the full utilization of permitted rights is very conservative for evaluating the cumulative impacts of the considered projects. As discussed in Sections 2.3 and 5.2, many permit holders do not currently withdraw the full volume of water authorized by their rights. During normal and high inflow periods, additional inflow reductions beyond the Baseline (Full Permits) case as a result of fully implementing the 2011 Region L Water Plan were predicted to be relatively small. Additionally, as discussed in Subsection 5.11.2, implementation of the 2011 Region L Water Plan is expected to slightly increase inflows to the Guadalupe Estuary relative to the Baseline (Full Permits) case during dry or drought periods.

VCS Bio-statistical Study

As discussed in Subsection 5.2.2.1, a bio-statistical study was conducted to evaluate the potential effects of VCS water withdrawals on the ecological health of the San Antonio Bay system, using the average annual abundance of four key estuarine species (brown shrimp, white shrimp, blue crab, and eastern oyster) as a representation of bay health. The TPWD Coastal Fisheries database provided approximately 787,000 records for the selected species for the period 1977–2008. Freshwater inflow data were obtained from the TWDB and the USGS and aggregated to estimate daily inflows to the bay system over the same period, from which seasonal (i.e., "freshet") and annual representations of freshwater inflow were characterized. Roughly 60,000 multivariate linear regression analyses were performed and evaluated for their ability to relate freshwater inflows to the average annual abundance of the selected species, ultimately yielding a relationship for white shrimp and relatively weaker relationships for blue crab and eastern oyster. No relationship was identified for brown shrimp.

To use the identified linear regressions to evaluate the potential effects on San Antonio Bay health resulting from the proposed VCS water withdrawals, the South Central Texas Regional Water Planning Group (Region L) Guadalupe-San Antonio (GSA) Water Availability Model (WAM) and TCEQ ~~Water Availability Model~~ WAM (see Subsection 2.3.2.3.3) ~~was~~ were chosen as ~~an~~ available and accepted means of modeling present "without-VCS" and "with-VCS" ~~baseline~~ demand scenarios, as well as several ~~and~~ potential future hydrological scenarios, as follows:

~~Current~~ Present Conditions without VCS Scenario (Present Conditions) — The ~~Current~~ Present Conditions Scenario uses results from a Region L WAM simulation that represents current demand conditions with respect to water availability for individual water rights. Comparisons to the present demand conditions are consistent with the TCEQ's procedure for evaluating surface water permit applications, wherein the current demand scenario is modeled using a WAM. The Region L Present Conditions WAM used in the VCS bio-statistical study includes the following

assumptions:

- The maximum diversion amount being sought by each individual water right is established as the actual maximum annual use in the 10 years prior to when the WAM was originally developed (~~mid-1980s to mid-1990s~~ 1990 -1999) as reported by the individual water rights owners. Additionally, the Region L Present Conditions WAM has been updated to reflect changes in water use patterns for seven major water rights and reservoirs in the GSA basin since 1999.

- The maximum storage capacity of all reservoirs specified as the actual year-2000 storage capacity (rather than the authorized maximum storage amount); and

- Return flows associated with individual water rights and within the basin are ~~accounted for in accordance with actual operations~~ set to 2006 reported levels, adjusted for San Antonio Water System (SAWS) direct recycled consumptive water use of about 24,900 acre-feet per year (based on contracts for consumptive use). The Region L Present Conditions WAM contains approximately 157,000 acre-feet per year of discharges, including 70,306 acre-feet per year of SAWS discharges (accounting for the aforementioned direct recycled water use).

- The model assumes a total use of 73,900 acre-feet per year of the Guadalupe-Blanco River Authority (GBRA) Lower Basin rights, including a diversion of 4,199 acre-feet per year under the most junior GBRA right, Certificate of Adjudication (COA) #18-5178. The total amount of 73,900 acre-feet per year is greater than the historical average cumulative use of approximately 50,000 acre-feet per year, as derived from GBRA's reported historical usage of its lower basin rights.

~~Comparative Scenario One~~ Present Conditions with VCS Scenario — This project-specific scenario simulates basin conditions with the VCS project in operation and no other changes from the ~~Current~~ Present Conditions Scenario. The use of the Present Conditions with VCS Scenario ~~Comparative Scenario One~~ in evaluating the potential direct effects on the ecological health of San Antonio Bay associated specifically with the proposed VCS water withdrawals is discussed in Subsection 5.2.2.1.

~~Comparative Scenario Two (Full Authorization~~ TCEQ WAM Run 3 Scenario~~)~~ — This scenario assumes that all currently authorized water rights are used up to their full authorization with no return flows to the GSA basin. The TCEQ WAM Run 3 Scenario is a conservative representation of water rights utilization and discharges in a possible future condition. The model run is used by the TCEQ to assess water availability and possible impacts of new water rights applications and assess incremental effects of new diversions. ~~For the VCS bio-statistical analysis, it was used to present results of a possible future condition that could result with or without the VCS project in operation if all existing surface water rights are fully utilized. That is,~~

~~assuming VCS water withdrawals via an existing water right, the resulting modeled future conditions would be the same with or without the VCS project, with the exception that the annual diversion pattern in the model was not modified to recognize the use pattern of the proposed VCS project with off-channel storage~~. This WAM simulation incorporates several assumptions, including:

- All existing surface water rights in the Guadalupe-San Antonio basin model are fully exercised (that is, used 100 percent) at their authorized annual diversion and impoundment amounts.

- No return flows or effluent discharges throughout the basin.

- Springflow discharges from the Edwards Aquifer consistent with aquifer management rules in effect at the time the WAM was developed (1999).

Region L Baseline Scenario – The Region L Baseline Scenario (as named by Region L) is based on the previously described TCEQ WAM Run 3, modified to include return flows and upper basin operational assumptions. This model assumes full use of permitted water rights, includes Edwards Aquifer permitted pumping (minimum supply of 320,000 acre-feet per year during drought), and adds return flows equal to 2006 reported effluent returns adjusted for SAWS consumptive use of direct recycled water. Hydrologic assumptions for the Region L Baseline model are discussed in Sections 7.1.3.1.3 and 3.2.3.1 of the Region L 2011 Regional Water Plan. This model is used in the TWDB approved Region L planning process as the future baseline condition for evaluating implementation of water management strategies recommended in the 2011 Region L Regional Water Plan. (SCTRWPG 2010)

Region L Cumulative Effects Scenario – The Region L Cumulative Effects Scenario (also known as the "Regional Water Plan" scenario) is based on the Region L Baseline model described above. In addition to the previously described Region L Baseline model assumptions, the Cumulative Effects scenario includes implementation of the Regional L 2011 Regional Water Plan Recommended Water Management Strategies (see Appendix D, Table 1 of SCTRWPG 2010). Thus, the Cumulative Effects scenario portrays the potential cumulative effects of all recommended water management strategies and full utilization of permitted water on streamflow and estuarine inflow. Consistent with the Present Conditions without VCS and Region L Baseline scenarios, the Region L Cumulative Effects model was developed and approved through the Region L regional water planning process. This scenario is conservative in its assumption that all of the recommended water strategies will be implemented.

~~The Full Authorization Scenario accounts for the annual volume of water that would be used by VCS assuming diversion of an existing water right and, therefore, represents a possible, although conservative, representations of future hydrologic conditions with or without the project~~

~~(noting that no modification was made to the diversion pattern authorized under Certificate of Adjudication 18-5178 as a proxy for water diverted for VCS in this scenario).~~

The Region L Baseline, Region L Cumulative Effects, and TCEQ WAM Run 3 model scenarios represent alternative characterizations of potential future conditions in the GSA basin. Unlike the Present Conditions without VCS and Present Conditions with VCS scenarios, all three of these models depict full utilization of existing GSA water rights, including Certificate of Adjudication (COA) 18-5178. As previously described, COA 18-5178 is the preferred water right under which makeup cooling water would be supplied from the Guadalupe River to the VCS cooling basin. Thus, these scenarios (i.e., Region L Baseline, Region L Cumulative Effects, and WAM Run 3) characterize a range of potential future freshwater inflow conditions to the San Antonio Bay system, regardless of whether VCS is constructed and operated. It should be noted that none of these full utilization models has been modified to reflect the VCS-specific withdrawal and blowdown patterns included in the Present Conditions with VCS model. Rather, they reflect full use of COA 18-5178 (up to approximately 106,000 acre-feet per year) assuming a standard use pattern.

In the event that VCS were to obtain a portion of its makeup water under the new water rights totaling 189,484 acre-feet per year applied for by GBRA (see Subsection 5.11.2), the use of the applicable portion of the makeup water would be junior to all existing water rights and likely include environmental flow restrictions being developed by TCEQ in the Senate Bill 3 process (see Subsection 2.3.2.1.1). Additionally, because GBRA's pending water right is a recommended water management strategy in the 2011 Region L Regional Water Plan (SCTRWPG 2010), makeup water withdrawals under the new right are included in the Region L Cumulative Effects model. As described above, the Region L Cumulative Effects model is conservative in its assumption that all of the recommended water strategies will be implemented.

Figure 5.11-2 provides a comparison of the historical frequency distribution of monthly freshwater inflows to San Antonio Bay with similar distributions generated using the five modeled hydrological scenarios (Present Conditions without and with VCS, Region L Baseline, Region L Cumulative Effects, and TCEQ WAM Run 3) used in the bio-statistical evaluation. The relatively tight pairing of the lines depicting the Present Conditions without VCS and Present Conditions with VCS scenarios demonstrates the relatively small impact that operation of VCS would have on monthly inflows to the bay (see Subsection 5.2.2.1) compared to the modeled present demand. The comparatively larger gap between the lines representing the Present Conditions without VCS scenario and the three full utilization scenarios indicates that the bulk of reductions of inflows to the San Antonio Bay system results from full utilization of existing water rights. This observation is consistent with the findings of the cumulative effects analysis conducted in the Region L 2011 Regional Water Plan, as summarized earlier in Subsection 5.11.3.2.

The ~~developed~~ selected hydrologic scenarios ~~(i.e., Current Conditions and Full Authorization)~~ were used in conjunction with the previously described linear regressions (see Subsection 5.2.2.1) relating average annual organism abundance to freshwater inflow parameters to evaluate the potential effects on the health of the San Antonio Bay system (i.e., compared to the current health of the bay through the use of key organism abundance as a surrogate for bay "health") associated ~~with the full use of currently authorized water rights and no return flows (i.e., the Full Authorization Scenario)~~ with the Region L Baseline, Region L Cumulative Effects, and TCEQ WAM Run 3 hydrological scenarios. ~~Based on this highly conservative analysis of the potential impacts to the key species abundance assessed, it was determined that potential decreases in the frequencies of occurrence of white shrimp abundance (relative to the frequencies modeled using the Current Conditions Scenario) are possible over a range of organism abundance (measured in organisms per acre-foot of water sampled). Because the frequencies of occurrence of organism abundance modeled using the Full Authorization Scenario approach but do not fall beyond the lower statistical confidence bound (95 percent) derived from the methodologies employed in the study, a quantified magnitude of the potential decreases is not proffered. That is, although the baseline and comparison modeling results diverge enough to discern the potential for changes in how often given organism abundance occur, the results of the two scenarios remain statistically indistinguishable given the inherent uncertainty in the relationship between abundance and freshwater inflow. It should be noted that the potential for decreases would be evident when considering the full use of currently authorized water rights and no return flows, with or without implementation of the VCS project. No changes in abundance of blue crab or eastern oyster were discernable utilizing the relatively weaker relationships for those organisms, and no statistically meaningful linear regression was identified for brown shrimp (see Subsection 5.2.2.1).~~ The results of these analyses are summarized in tables 5.11-4, 5.11-5, and 5.11-6, respectively.

Inspection of tables 5.11-4, 5.11-5, and 5.11-6 indicates that the estimated potential changes (relative to abundance predictions made using the Present Conditions without VCS model) in white shrimp abundance range from approximately 12 percent to 50 percent, with the larger potential changes predicted at lower abundances (i.e., occurrence frequencies exceeded 90 percent the time). For blue crab, the estimated potential changes in abundance relative to the modeled present conditions abundance range from approximately 12 percent to 15 percent, all estimated to occur at higher abundances (i.e., occurrence frequencies exceeded 10 percent of the time). Lower blue crab abundances are driven by the constant in the regression and therefore yield no apparent change between the various hydrologic scenarios. No negative impacts are identified for eastern oyster as all modeled scenarios result in increases in oyster abundance.

Given the wide range of variability in the historically (1977-2008) observed organism abundances of white shrimp, blue crab, and eastern oyster, the identified regressions relating average annual abundances for these organisms to freshwater inflow are relatively weak, with

particularly low explained variance for blue crab and eastern oyster. Accordingly, a sensitivity analysis was performed to determine at what level of statistical confidence in the predictions potential impacts are determined. Statistical confidence (starting at $\alpha = 0.05$, or 95 percent confidence) was iteratively adjusted until a negative impact was discernible from the Present Conditions without VCS scenario. As one lowers the level of statistical confidence, the associated confidence bounds in the prediction constrict. Thus, the statistical confidence of a discernible potential impact has been characterized at the first identification of a negative impact exceeding the corresponding confidence level. Tables 5.11-4, 5.11-5, and 5.11-6 present the statistical confidences in the predicted abundance changes for each species and hydrological scenario. The greatest level of confidence in the prediction of an impact occurs for each organism via the Region L Cumulative Effects scenario, with confidences ranging from 6 percent to 66 percent. These predicted negative impacts (at the aforementioned confidences) are first exhibited in the higher abundances of white shrimp and blue crab.

It is standard to employ a 95 percent confidence level in statistical assessments of biology (McDonald 2009). At this level of confidence, none of the potential impacts of the various future hydrologic scenarios analyzed are statistically discernible. If the confidence level is reduced to that approximate to one standard deviation (approximately 68 percent), these potential impacts are still not-statistically discernible (with the possible exception of the potential impacts from the Region L Cumulative Effects scenario on blue crab abundances at a 66 percent confidence level). While the low confidences in the predictions are not surprising considering the relatively weak regressions, they underscore the fact that that other external factors unrelated to freshwater inflow (as characterized in the bio-statistical evaluation) contribute to variations in organism abundances in San Antonio Bay (see Section 5.2.2.1 for additional discussion).

As previously described in the Region L Plan cumulative effects analysis discussion, the assumption that all existing water rights are fully utilized is conservative for the purpose of evaluating cumulative effects in the GSA basin. Thus, although the VCS bio-statistical study report identified the potential for changes in modeled white shrimp and blue crab abundances (relative to abundances predicted using the Present Conditions without VCS hydrological models) using the Region L Baseline, Region L Cumulative Effects, and TCEQ WAM Run 3 models, the hydrological inputs are conservative. Furthermore, the predicted changes are discernible at confidence levels ranging from less than 3 percent to 66 percent, well below the 95 percent confidence level typically employed in biological assessments. Accordingly, the VCS bio-statistical study results are consistent with the conclusion that the cumulative impacts of VCS water use on the ecological health of San Antonio Bay would be small.

~~Recognize that the Full Authorization Scenario utilized in the VCS bio-statistical study is similar to the "Baseline (Full Permits)" WAM run used in the previously described Region L planning process. One significant difference between these model runs is that the VCS study's Full Authorization Scenario assumes no return flows, whereas the Region L Full Permits scenario~~

~~assumes effluent discharges representative of expected future conditions. For the reasons discussed previously, the Region L Full Permits scenario is very conservative for evaluating the cumulative impacts of the considered projects. The additional conservatism associated with the Full Authorization Scenario relative to the Full Permits scenario dictates that any cumulative impacts analysis based on the Full Authorization Scenario will be similarly (i.e., highly) conservative. Thus, although the VCS bio-statistical study report identified (based on the methodologies employed therein) the potential for changes in white shrimp abundance modeled using the Full Authorization Scenario, the hydrological inputs yielding the results are highly conservative. Given this degree of conservatism, the VCS bio-statistical study results are consistent with the conclusion that the cumulative impacts of VCS water use on the ecological health of San Antonio Bay would be small.~~

Summary

Based on the information provided in the cumulative effects assessment prepared as part of the Region L 2011 ~~Initially Prepared Plan~~ Regional Water Plan, the discussion of cumulative hydrologic impacts presented in Hydrology and Water Use, and the results of the VCS bio-statistical study, it is concluded that the cumulative impacts on freshwater inflows to the Guadalupe Estuary would be small. Accordingly, although the relationship of freshwater inflows, salinity, and other factors to whooping crane health and energetics remains unclear, the cumulative impacts on aquatic and terrestrial wildlife relying on the Guadalupe Estuary and San Antonio Bay system, including whooping cranes and their habitat, would be SMALL.

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Table 5.11-4

Organism Abundances Estimated using the Region L Baseline Hydrological Model, including Potential Changes Relative to Abundances Estimated using the Present Conditions without VCS Hydrological Model

Organism	Occurrence	Present Conditions without VCS Project -abundance (number / acre-foot)	Region L Baseline - abundance (number / acre-foot)	Potential Region L Baseline Impact on Present Conditions (number / acre-foot)	Percent change from Present Condition by Region L Baseline	Statistical Confidence in the Predicted Change
White Shrimp	90% Exceedance	1.18	0.58	-0.59	-50.45%	at most 27%
	10% Exceedance	8.69	7.66	-1.04	-11.92%	
	Average	4.43	3.57	-0.86	-19.45%	
Eastern Oyster	90% Exceedance	1,380.16	1,410.93	30.77	2.23%	at most 3%
	10% Exceedance	2,181.07	2,209.54	28.47	1.31%	
	Average	1,868.01	1,897.48	29.47	1.58%	
Blue Crab	90% Exceedance	3.84	3.84	0.00	0.00%	at most 19%
	10% Exceedance	10.31	9.05	-1.26	-12.25%	
	Average	6.82	6.12	-0.70	-10.26%	

Table 5.11-5

Organism Abundances Estimated using the Region L Cumulative Effects Hydrological Model, including Potential Changes Relative to Abundances Estimated using the Present Conditions without VCS Hydrological Model

Organism	Occurrence	Present Conditions without VCS Project -abundance (number / acre-foot)	Region L Cumulative Effects abundance (number / acre-foot)	Potential Cumulative Effects Impact on Present Conditions (number / acre-foot)	Percent change from Present Condition by Cumulative Effects	Statistical Confidence in the Predicted Change
White Shrimp	90% Exceedance	1.18	0.76	-0.42	-35.72%	at most 45%
	10% Exceedance	8.69	6.74	-1.95	-22.43%	
	Average	4.43	3.54	-0.89	-20.04%	
Eastern Oyster	90% Exceedance	1,380.16	1,448.96	68.80	4.98%	at most 6%
	10% Exceedance	2,181.07	2,203.81	22.74	1.04%	
	Average	1,868.01	1,910.59	42.58	2.28%	
Blue Crab	90% Exceedance	3.84	3.84	0.00	0.00%	at most 66%
	10% Exceedance	10.31	8.91	-1.40	-13.57%	
	Average	6.82	6.00	-0.82	-12.06%	

Table 5.11-6

Organism Abundances Estimated using the TCEQ WAM Run 3 Hydrological Model, including Potential Changes Relative to Abundances Estimated using the Present Conditions without VCS Hydrological Model

Organism	Occurrence	Present Conditions without VCS Project -abundance (number / acre-foot)	TCEQ Run 3 - abundance (number / acre-foot)	Potential TCEQ Run 3 Impact on Present Conditions (number / acre-foot)	Percent change from Present Condition by TCEQ Run 3	Statistical Confidence in the Predicted Change
White Shrimp	90% Exceedance	1.18	0.63	-0.55	-46.47%	at most 39%
	10% Exceedance	8.69	7.39	-1.30	-15.01%	
	Average	4.43	3.27	-1.16	-26.28%	
Eastern Oyster	90% Exceedance	1,380.16	1,438.18	58.02	4.20%	at most 5%
	10% Exceedance	2,181.07	2,215.36	34.29	1.57%	
	Average	1,868.01	1,914.35	46.34	2.48%	
Blue Crab	90% Exceedance	3.84	3.84	0.00	0.00%	at most 32%
	10% Exceedance	10.31	8.60	-1.72	-16.64%	
	Average	6.82	5.90	-0.92	-13.51%	

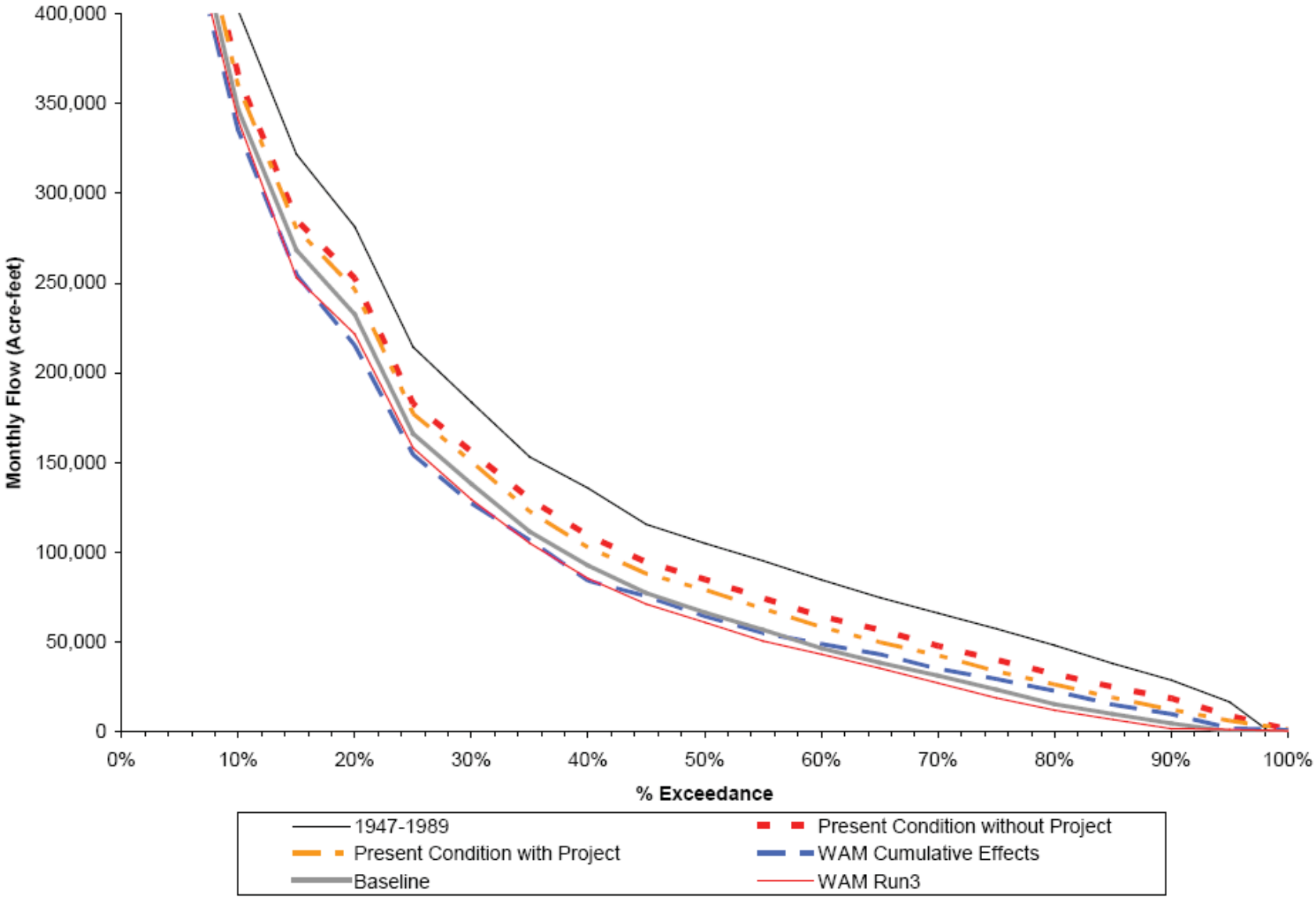

Figure 5.11-2 Comparison of the 1947-1989 Monthly Historical Freshwater Inflow Frequency Distribution to Similar Monthly Distributions for the Five Modeled Hydrological Scenarios used in the Bio-statistical Evaluation

ATTACHMENT 3

SUMMARY OF REGULATORY COMMITMENTS

(Exelon Letter to USNRC No. NP-11-0044, dated September 30th, 2011)

The following table identifies commitments made in this document. (Any other actions discussed in the submittal represent intended or planned actions. They are described to the NRC for the NRC's information and are not regulatory commitments.)

COMMITMENT	COMMITTED DATE	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	Programmatic (Yes/No)
Environmental Report (ER) Sections 5.2.2.1, 5.2.4, 5.11.3.2, and 5.11.8 will be updated to reflect changes resulting from reevaluation of the San Antonio Bay bio-statistical analyses. The revisions will be included in the next periodic ESPA update, to be submitted to the NRC no later than March 31, 2012.	March 31, 2012	Yes	No