5.2 Water-Related Impacts

This section describes the impacts of hydrologic alterations on the availability and quality of water resources and the plant water supply, as well as water-use impacts associated with the operation of STP 3 & 4. The following topics are covered:

- Hydrologic alterations resulting from operations of STP 3 & 4 and impact on offsite locations and the effects of these alterations on other water users
- Adequacy of water supplies to meet plant water needs
- Water quality changes and possible effects on water use
- Practices that would minimize or avoid hydrologic alterations having adverse impacts

The evaluation of impacts from hydrologic alterations and water quality changes caused by the operation of STP 3 & 4 is discussed in the following sections.

5.2.1 Hydrologic Alterations and Plant Water Supply

There are no known future diversions from the Colorado River planned for downstream of the STP site. The operation of STP 3 & 4 would not alter surface water flow patterns at the site, including the flood plain areas, with the possible exception of the Colorado River, which will be discussed further in this section. The impact of hydrologic alterations caused by STP 3 & 4 operational activities on offsite locations would be limited to maintenance activities along the existing transmission rights-of-way, which would be similar in nature to those from the existing operation of STP 1 & 2. The possible alteration impacts would be SMALL and would not warrant additional mitigation.

The STP 3 & 4 closed-cycle cooling system would require makeup water supplied to the Main Cooling Reservoir (MCR) from the Colorado River to replace that lost to evaporation, drift (entrained in atmospheric water vapor), and blowdown (water released to purge solids). As discussed in Subsection 2.3.2, the MCR is an industrial reservoir and is not considered to be waters of the state (Reference 5.2-1). Seepage losses from the MCR to groundwater are attributed to STP 1 & 2 operation and the addition of STP 3 & 4 would have insignificant impact on the seepage rates (Section 3.3). As discussed in Section 3.3, groundwater used for potable and sanitary use, power plant makeup and other plant uses, and for makeup water for the Ultimate Heat Sink (UHS) (mechanical draft cooling towers) would be pumped from groundwater wells. Conservative water use projections for simultaneous operation of both STP Units 3 and 4 are summarized in Table 3.3-1, and include a total estimated normalized groundwater demand of approximately 975 gpm (approximately 1574 acre-feet/year), and approximately 3434 gpm for maximum short-term steady-state conditions. Table 3.3-1 also indicates that the estimated normalized groundwater demand for UHS makeup is approximately 885 gpm (both units) under normal use conditions, and approximately 3,203 gpm (both units) for maximum short-term steady-state conditions. As detailed further in Section 2.3.1.2.4.3, STPNOC intends to install at least one additional site groundwater well with a design capacity of 500 gpm. The additional well(s) would be properly permitted under applicable Coastal Plains Groundwater Conservation District (GPGCD) and TCEQ requirements, and would not involve a request for an increase in the existing permit limit. As discussed in Section 2.3.1.2.4.3, with consideration for the need to maintain groundwater storage capacity to provide for peak site water demands, total site groundwater demand will remain below the existing site groundwater permit limit during construction, initial testing, and operation of STP Units 3 and 4. Notwithstanding, the MCR and Colorado River remain as alternative sources in the unlikely event that unanticipated peak site water demands would require additional water sources.

The expected normalized rate of withdrawal of Colorado River water (Section 3.3) to replace water losses from the MCR due to STP 3 & 4 operations (ignoring natural evaporation since it is already accounted for under Units 1 and 2) is approximately 22,799 gpm (normal operating conditions) and 47,489 gpm (short-term peak conditions). These surface water removal rates are sufficient to provide MCR makeup for the approximately 23,190 gpm (average annual forced evaporation during normal operating conditions at an assumed 100 percent load factor) and 49,000 gpm (maximum short-term forced evaporation) attributable to STP 3 & 4 heat loads. As discussed in Subsection 2.3.2, the STP site is currently permitted to withdraw 102,000 acre-feet per year or a normalized rate of 62,234 gpm. This permitted withdrawal rate is sufficient to support operation of all four STP units.

MCR makeup water would be pumped from the existing STP Reservoir Makeup Pumping Facility (RMPF) on the Colorado River to the MCR to replace evaporative losses, and blowdown from the MCR, as required. Blowdown to maintain MCR water quality and level (Figure 3.3-1) would be through the existing discharge system. Water would be withdrawn from the MCR for main condenser and turbine system cooling and returned to the MCR. The MCR also would receive blowdown from the STP 3 & 4 UHS and STP 3 & 4 processed waste flows. There would be no direct discharges of individual waste streams to the Colorado River or to groundwater.

The most significant water loss from the STP 3 & 4 cooling water system would be through evaporation of water from the MCR. Blowdown to the Colorado River from the MCR would occur if required to maintain water quality in the MCR. Blowdown would occur in accordance with the existing Texas Pollutant Discharge Elimination System (TPDES) permit.

Water diverted to the MCR is currently considered lost to potential downstream surface water users and downstream aquatic communities and is considered a consumptive loss. The groundwater pumped from the existing site wells serving the STP site would also be considered a consumptive loss because the water would be either consumed or discharged to the MCR.

The assessment that follows conservatively assumes that all Colorado River water pumped to the MCR and all groundwater pumped from the wells is consumed. In reality, some water returns to the Colorado River as groundwater flow as the water seeps from the MCR and infiltrates the upper shallow portion of the groundwater system beneath the MCR. The water then flows toward the Colorado River where it discharges. Water from the MCR is also released through the pressure relief wells located in the above-grade dike surrounding the MCR. Water from these relief wells is discharged to a surface water ditch that surrounds the MCR and flows away from the reservoir through the STP site's natural drainage features.

As discussed in Subsection 2.3.2, the projected firm water demands for stored water in the Highland Lakes located upstream of the STP site on the Colorado River is currently still less than the total firm water available. Therefore, it is extremely remote that firm water rights would be reduced, even under extreme drought conditions. If conditions are worse than the drought of record, which occurred from the late 1940s through the 1950s (Subsection 2.3.2), the LCRA must curtail and distribute the available supply of firm water among all of its firm water supply customers on a pro rata basis (Reference 5.2-3). As discussed in Subsection 2.3.2, the STP site currently has surface water rights for 102,000 acre-feet per year and an additional 20,000 acre-feet/year of backup water for two-unit operation and 40,000 acre-feet/year for four-unit operation during periods when the water necessary to maintain the MCR at or above an elevation of 27 feet mean sea level is not available from the Colorado River. If this situation were to occur, the backup water would be released by the LCRA from firm stored water or any other sources of water originating upstream of the Bay City Dam (Reference 5.2-4).

Operation of STP 3 & 4 would not create any new impacts in the vicinity of the flood plain. The infrastructure constructed in the floodplains is currently used for STP 1 & 2. The current facilities would support STP 3 & 4. There would be no new infrastructure built in support of STP 3 & 4 in the flood plain areas adjacent to the site that would create impacts resulting from alterations to the flood plain flow paths.

5.2.2 Water Use Impacts

5.2.2.1 Surface Water

Long-term (1948–2005) daily Colorado River flow records were used to estimate the annual mean, the lowest annual mean, and the lowest daily mean flows of the Colorado River in the vicinity of the STP site (Reference 5.2-5).

Based on the planned cooling system configuration (Figure 3.3-1), surface water removal from the Colorado River for STP 3 & 4 (ignoring natural evaporation since it is already accounted for under Units 1 and 2) is estimated to be at a normalized rate of 22,799 gpm under normal operating conditions and 47,489 gpm under maximum operating conditions (see Table 3.3-1). These surface water removal rates are sufficient to provide MCR makeup for the approximately 23,190 gpm (average forced evaporation during normal operating conditions at an assumed 100 percent load factor) and 49,000 gpm (maximum short-term forced evaporation) attributable to STP 3 & 4 heat loads. The long-term monthly average Colorado River flow upstream of the STP site at the closest U.S. Geological Survey (USGS) Gauging Station 08162500 (Figure 2.3.1-5) near Bay City (Reference 5.2-5) varies from 374,748 gpm to 1,919,518 gpm (Table 5.2-1).

Approximately 12.7 percent or less (Table 5.2-1) of the estimated monthly mean Colorado River flow near Bay City would be lost to makeup. Makeup withdrawal for maximum use operations from the Colorado River projected for STP 3 & 4 represents 4.0 % of the historical annual mean flow (1,180,344 gpm [2630 cfs]) of the river near Bay City. However, the annual mean flow during 2006 was 303,834 gpm (677 cfs) (Reference 5.2-5). The projected normal use withdrawal of 22,799 gpm for STP 3 & 4 during a 303,834 gpm (677 cfs) flow event would represent 7.5 percent of flow. As discussed in Subsection 2.3.1.1, the probable minimum flow rate at Bay City is estimated as zero. If there is no downstream flow, the Colorado River near the STP RMPF intake structure would be occupied by tidal water. Because Segment 1401 is considered tidal, there is no established 7Q10 value for the Colorado River for Segment 1401 (Reference 5.2-5). The closest stream gauge to the STP site where 7Q10 data is maintained is the Bay City USGS Gauging Station 08162500 where, from October 1, 1976 through December 31, 2005, the 7Q10 (7 consecutive day low period over a 10-year period) was determined to be 20 cfs (Reference 5.2-6). Because of the zero probable minimum flow at Bay City and a low 7Q10 value of 20 cfs, the 7Q10 water flow value will not be used to determine potential impacts.

As discussed in Subsection 2.3.2 and indicated in Table 2.3.2-9, STP 1 & 2 currently withdraws surface water as needed from the Colorado River after confirming that the flow at the USGS Bay City Gauging Station is capable of supporting the withdrawal of surface water in accordance with the current STP 1 & 2 surface water withdrawal permit. Surface water flow of the Colorado River will continue to be monitored for flow before the withdrawal of surface water for STP 3 & 4 operations to ensure that surface water could be pumped in accordance with the current STPNOC surface water use permit. This practice helps ensure that water withdrawn from the Colorado River is acceptable for supply into the MCR.

Surface water withdrawals would be in accordance with current STPNOC water rights permits and contracts with the Lower Colorado River Authority (LCRA). Therefore, during low-flow days, withdrawal of surface water for the operation of STP 3 & 4 could have a SMALL impact on the availability of fresh water downstream of the site and not warrant additional mitigation. The cumulative impacts of all four operating units are discussed in Section 10.5.

5.2.2.2 Groundwater

As discussed in Subsection 2.3.2, groundwater wells would be used to supply makeup water to STP 3 & 4 for the UHS, service water for the power plant makeup and use, and water for the potable and sanitary systems. Based on the results of an operating plant (Units 3 and 4) water balance calculation (Reference 5.2-13) and a site groundwater use calculation (Reference 5.2-14), STPNOC has determined that the STP site groundwater operating permit limit provides adequate groundwater supply for water uses required for the operation of STP Units 1 and 2 and the construction, initial testing, and operation of STP Units 3 and 4. The permit allows groundwater withdrawals from the five site production wells up to a limit of 9000 acre-feet over the permit term of approximately 3 years. For discussion purposes, this permit limit may be described herein as "approximately 3000 acre-feet/year," recognizing that groundwater withdrawal in a single year may exceed 3000 acre-feet provided that total withdrawals over the permit term do not exceed 9000 acre-feet. As a point of reference, if the permit limit were exactly 3000 acre-feet/year (which is not necessarily the case due to slight variances in the permit term with each permit renewal), the equivalent “normalized” withdrawal rate assuming continuous pumping every minute of every day of each year would be approximately 1860 gpm.

Historical groundwater withdrawal rates associated with operation of Units 1 and 2 are provided in Table 2.3.2-18. This data shows that from 2001 through 2006, annual groundwater use for operation of STP Units 1 and 2 averaged approximately 798 gpm (approximately 1288 acre-feet/year). A small but not insignificant portion of this amount has been diverted to the MCR as a result of manual operation of the groundwater well pump and header system. With the installation of appropriate automated groundwater well pump and header system controls, this diverted groundwater would be available for use by Units 3 and 4. However, as documented in the site groundwater use calculation (Reference 5.2-14), it has been determined that even if this water were not available to Units 3 and 4, the existing STP site groundwater operating permit limit provides adequate groundwater supply for water uses required for the operation of STP Units 1 and 2 and the construction, initial testing, and operation of STP Units 3 and 4.

Water uses projected for the operation of STP Units 3 and 4 are derived from system design data as well as from operational water use data for specific systems for which such data is available (Reference 5.2-13). As detailed in Table 3.3-1, conservative water use projections for simultaneous operation of both STP Units 3 and 4 include a total estimated normalized groundwater demand of approximately 975 gpm (approximately 1574 acre-feet/year), and approximately 3434 gpm for maximum short-term steady-state conditions.

When evaluating whether the total site groundwater demand can be satisfied by the available groundwater supply, the site groundwater use calculation (Reference 2.4S.12-24) considers the schedule projected for each use, and evaluates the total site groundwater usage at each point in time from the commencement of STP Units 3 and 4 construction until both Units 3 and 4 are in operation (i.e., Units 1, 2, 3 and 4 are operating simultaneously). With consideration for the need to maintain water storage capacity to provide for peak site water demands, this evaluation confirms that total site groundwater demand remains below the existing site groundwater permit limit during construction, initial testing, and operation of STP Units 3 and 4. Notwithstanding, the MCR and Colorado River remain as alternative sources in the unlikely event that unanticipated peak site water demands would require additional water sources.

As detailed further in Section 2.3.1.2.4.3, STPNOC intends to install at least one additional site groundwater well with a design capacity of 500 gpm. As documented in the site groundwater use calculation (Reference 5.2-14), this additional capacity will allow for sufficient groundwater withdrawal to meet water uses required for: (1) operation of STP Units 1 and 2 and the construction, initial testing, and operation of STP Units 3 and 4; and (2) potential temporary capacity reduction as a result of equipment failure/unavailability. As with the existing five site production wells, the new well(s) would be installed to depths within the deep portion of the Chicot Aquifer. As discussed in Subsection 2.3.1, the proposed new well(s) would be required to be at least 4000 feet from STP 1 & 2 and STP 3 & 4 to prevent potential subsidence of the facilities. Any additional wells would be properly permitted under applicable CPGCD and TECQ requirements, and would not involve a request for an increase in the existing permit limit.

To determine potential offsite impact during the operation of STP 3 & 4, drawdown at the site boundary was calculated. The drawdown calculation assumes a continuous pumping rate of 1860 gpm, which as discussed above is a normalized approximation of the current permit limit, and is conservative for purposes of the drawdown calculation. The drawdown calculation also assumes that all water is pumped from a single onsite well. The minimum distance allowed by the CPGCD between permitted wells is 2500 feet (Reference 5.2-7). Therefore, the 2500-foot distance was used for the most conservative model distance from an STP site well to any potential offsite well. As with Section 4.2, a confined nonleaky aquifer scenario was used to determine the drawdown at the offsite groundwater well location closest to the STP 3 & 4 well location. Data used to input to an analytical distance-drawdown model is described in Subsection 2.3.1 and are referenced in Table 5.2-2.

A confined nonleaky scenario would most likely represent actual site conditions. The hydrologic parameters used in support of a confined nonleaky aquifer scenario are included in Table 5.2-2. The Theis nonequilibrium well equations (Reference 5.2-8) for a confined nonleaky scenario are as follows:

$s = [Q/4(3.14)T](W(u))$ $\qquad u = r^2S/4Tt$

where:

s = drawdown (ft) $\qquad T$ = transmissivity, ft^2/day

Q = pumping rate, ft^3/day $\qquad t$ = time since pumping started, days

$W(u)$ = Theis well function $\qquad S$ = coefficient of storage

r = distance to pumping well, ft

The assumptions made were that the aquifer is homogeneous, isotropic, of uniform thickness, and of infinite aerial extent. The assumptions also include that the potentiometric surface before pumping is horizontal; the well is pumped at a constant discharge rate; the well is fully penetrating and flow is horizontal; the well diameter is infinitesimal so that storage within the well can be neglected; and water from storage is discharged instantaneously with decline of head.

An assumption was made that all of the water to be pumped was from a fully penetrating single well (any site well). The results of the confined nonleaky scenario model indicated that drawdown from normal operation of STP 3 & 4 of the deeper portion of the Chicot Aquifer potentiometric surface 2500 feet from a single STP site well was 38 to 42 feet based on an average pumping rate of 1062 gpm over a period of 40 years. The pumping rate of 1062 gpm 1860 gpm (conservative normalized approximation of the permit limit) less the Units 1 and 2 average annual withdrawal rate

(798 gpm). Drawdown values for the deep portion of the Chicot Aquifer for the above pumping case are included in Table 5.2-2.

In reality, the actual withdrawal resulting from the pumping of an STP well 2500 feet away would result in less drawdown than assigning all of the total pumping rates to one well. For example, the projected drawdown of (Table 5.2-2) over a 40-year period at a pumping rate of 1062 gpm would result in a drawdown of 38 to 42 feet. Pumping at a rate of no more than 500 gpm over a 40-year period in any single well would result in a drawdown of 18 to 20 feet 2500 feet from that well. These values assume that no two pumping wells adjacent to each other are used at the same time. If this were to occur, the effects of the two wells being pumped simultaneously would result in an overlap of drawdown and would likely lower drawdown in areas between the pumping wells. The additive effect could extend off site. However, most of the additive effect form the onsite pumping of multiple wells would remain on the STP site.

Because of the confining unit between the deep and shallow portions of the Chicot Aquifer, STPNOC concludes that there would be no impact to the shallow portion of the aquifer during operation of STP 3 & 4. However, STPNOC concludes that impacts due to increased pumping during operational activities at STP 3 & 4 to the deeper portion of the Chicot Aquifer would be SMALL and would not warrant mitigation. The cumulative impacts of all four units on groundwater resources are discussed in Section 10.5S.

5.2.3 Water Quality Impacts

5.2.3.1 Surface Water Quality

Mechanical draft cooling towers, such as the ones proposed for the STP 3 & 4 UHS, remove waste heat by allowing water to evaporate to the atmosphere. The water lost to evaporation must be replaced continuously with makeup water to prevent the accumulation of solids and solid scale formation. To prevent buildup of these solids, a small portion of the circulating water with elevated levels of solids is drained or blown down, and cooling tower water chemistry must be maintained with anti-scaling compounds and corrosion inhibitors.

Similarly, because conditions in cooling towers are conducive to the growth of fouling bacteria and algae, a biocide must be added to the system. This is normally a chlorine or bromine-based compound, but occasionally, hydrogen peroxide or ozone is used. Table 3.6-1 lists water treatment chemicals currently used for STP 1 & 2 and that would likely be used in STP 3 & 4.

Water drawn from the Colorado River is expected to require limited treatment to prevent biofouling in the makeup intake structure and makeup water piping. Additional water treatment would take place in the cooling tower basins, and would include the addition of biocides, anti-scaling compounds, and dispersants. Sodium hypochlorite and sodium bromide are used to control biological growth in the existing circulating water system and would likely be used in the new system as well. TPDES Permit No. WQ0001908000, issued in 2005 (Reference 5.2-9), regulates the outfalls that discharge to the MCR, which assures that necessary treatment and monitoring for nonradioactive contaminants occurs before discharge to the MCR. The permit limits total residual chlorine (0.05 milligrams per liter daily maximum) from any single generating unit for more than two hours per day unless longer periods are required for macroinvertebrate control. Processed wastewater discharged from STP 3 & 4 facilities to the MCR would be similar to that currently discharged under the STP 1 & 2 TPDES permit. STPNOC would submit the necessary applications to TCEQ for permitting the proposed STP 3 & 4 discharges to the MCR.

The existing TPDES permit states that discharges from the MCR may not exceed 12.5% of the flow of the Colorado River at the discharge point. Additionally, discharges are not permitted when the river flow is less than 800 cfs.

As discussed in Section 2.3.1.1.2.1, the 7000-acre MCR is unlined, allowing seepage of water from the MCR through the reservoir floor. During the design stage, total seepage from the MCR, based on a maximum operating water level of 49 feet above MSL, was estimated to be 3530 gpm, or approximately 5700 acre-ft/yr. Seepage discharge from the MCR has two flow paths: (a) part of the seepage is collected by the relief well system, which is installed in the sands of the Upper Shallow Aquifer, and is then discharged to surface waters; and (b) part of the seepage bypasses the relief wells and continues in the Upper Shallow Aquifer in a southeasterly direction to the Colorado River. In addition to these two seepage flow paths, water can be discharged from the MCR through blowdown to the Colorado River.

Discharge from the MCR cannot occur when the Colorado River is less than 800 cfs and cannot exceed 12.5% of the river flow (Reference 5.2-9). As discussed in Subsection 2.3.2, there is currently no routine discharge from the MCR to the Colorado River. STP 1 & 2 has discharged water from the MCR to the Colorado River once, in 1997. Projections of the MCR water quality and additional demands upriver could necessitate the use of the STP permitted reservoir blowdown system to maintain water quality by 2010. MCR water quality is currently maintained by selective pumping during high river flow conditions (>1200 cfs) (Reference 5.2-10). If upstream demands increase, the availability of water at a flow greater than 1200 cfs could be reduced.

During normal operation, water in the MCR evaporates, causing an increase in constituents in the MCR, such as total dissolved solids (TDS). Blowdown from the MCR to the Colorado River would occur as necessary to maintain the MCR water quality at an average of 3000 micro-Siemens per centimeter (μS/cm) (Reference 5.2-4). This conductivity measurement is a good indicator for the TDS levels in the MCR. The current TPDES permit (Reference 5.2-10) allows an average MCR discharge rate of 144 MGD with a daily maximum of 200 MGD. The permit pH range for water discharged from the MCR is between 6.0 and 9.0 standard units. The water temperature daily average limit is 95°F with a daily maximum of 97°F. The total residual chlorine daily maximum is 0.05 milligrams per liter (mg/L) (Reference 5.2-10). Limits on outfall concentrations, rates, and schedules for STP 3 & 4 operational discharges to the MCR would be determined through the TPDES permitting process. STPNOC would submit the new or modified permit provisions to the NRC when they become available.

The maximum calculated duration of continuous blowdown to the Colorado River for two-unit operation is 88 days and for four-unit operation is 73 days. These results are based on simulations using the historical flow record of the Colorado River. In the year with the maximum duration of continuous blowdown, the annual diversion limit is reached earlier in the year for the four-unit scenario because of the higher consumption, as compared with the two-unit scenario. When the annual limit is reached, no further makeup to the MCR is allowed in that year according to the diversion rules and as a result, blowdown is not permitted either (except under extreme rainfall events). Therefore, the four-unit scenario shows a shorter duration of continuous blowdown. Blowdown occurrences are governed by the operating rules of the MCR that depend on the dynamic relationships of multiple parameters including water level, conductivity and temperature in the MCR, and the flow of the Colorado River.

The MCR is routinely monitored for constituents other than TDS, such as metals and salts, to determine effectiveness of the water treatment program to minimize biofouling and condenser scaling and corrosion. Surface water quality data for metals and salts for two rounds of samples collected from the MCR in 2006 are presented in Table 2.3.3-3. These low concentrations of metals and salts indicate the high quality of the water contained in the MCR and reflect the source term for water leaving the MCR. Current water quality at the site is discussed in Section 2.3.3 and surface water quality is specifically discussed in Section 2.3.3.1. As discussed above, discharges to the MCR for STP 3 & 4 water treatment would be comparable to STP 1 & 2 with the use of biocides and anti-scalants. Because STP 3 & 4 are not anticipated to regenerate ion exchange resin, STP 3 & 4 would actually discharge less chemicals to the MCR than currently discharged from STP 1 & 2. Due to the additional reservoir makeup required to offset evaporation and the limited amount of discharge from STP 3 & 4, the concentrations of chemicals and other constituents in the MCR water would be expected to increase only slightly, if at all. Existing constituents in the MCR are comparable to the state drinking water standards, except for aluminum and arsenic which are not attributed to plant operation and introduced from ground and surface water sources. Therefore, the impacts to water quality in the MCR due to addition of STP 3 & 4 are expected to be SMALL. Similarly, impacts to other surface water bodies which directly or indirectly receive water from the MCR also would be SMALL.

The MCR water budget and water quality model is set up to simulate the operation of all four units (existing STP 1 & 2 and proposed STP 3 & 4) at the STP site. The simulation uses historical Colorado River flows as well as projected flows accounting for the proposed Lower Colorado River Authority/San Antonio Water System diversions to evaluate the incremental impact on water and aquatic resources from the addition of proposed STP 3 & 4 under anticipated changes in the water supplies of the Lower Colorado River Basin. Based on modeling to evaluate the impacts of adding STP 3 & 4 to the MCR system, the amount of TDS would increase slightly. Using historical Colorado River flows, the mean TDS was calculated to increase from 2,178.5 mg/L to 3,076.8 mg/L, and using the proposed Lower Colorado River Authority/San Antonio Water System diversions, the mean TDS was calculated to increase from 2,256.0 mg/L to 3,838.8 mg/L (Reference 5.2-13). However, the number of days of blowdown required to maintain acceptable levels of TDS would change by less than

1% (Reference 5.2-13). The reach of the Colorado River associated with MCR blowdown is within the tidal influence of the Gulf of Mexico. River TDS varies significantly from practically freshwater to saltwater in this area. Additionally, any blowdown to the Colorado River is limited to less than 12.5% of the river flow and to only when river flow is greater than 800 cubic feet per second, so the TDS would be within the range normally seen for this reach of the river. Therefore, impacts to the Colorado River from TDS would be SMALL.

As discussed in Subsection 2.3.3, during 2004 Segment 1401 of the Colorado River (the reach of the river associated with STP) was listed as fully supporting aquatic life, contact recreation, and general use (Reference 5.2-11). As indicated in Reference 5.2-12, Segment 1401 was added to the list of impaired waters due to the presence of bacteria. The STP 1 & 2 wastewater treatment facility currently discharges treated water to the MCR where it is diluted by water of the MCR and reused. The waste water from current STP 1 & 2 facilities does not discharge directly to the Colorado River.

Impacts of chemicals in the proposed MCR blowdown on the Colorado River water quality would be SMALL and would not warrant mitigation. STPNOC would submit the necessary permit applications to TCEQ for review for a modified or new TPDES permit for STP 3 & 4 facility discharges to the MCR and from the MCR to the Colorado River. TCEQ would evaluate potential effects of STP 3 & 4 on the MCR water quality and the Colorado River water quality and determine if adjustments are necessary to the current TPDES permitted 001 outfall limits. STPNOC would monitor the MCR water quality on a regular basis in conjunction with the MCR water level to determine if and when blowdown is necessary. STPNOC would continue to monitor flow of the Colorado River prior to withdrawing surface water and discharging water to the Colorado River.

Tritium produced in the STP 1 & 2 reactor coolant systems is released via liquid discharges to the MCR. Tritium is a radioactive isotope of hydrogen and is a part of the water molecule. Although radioactive effluents are treated to remove impurities by the Liquid Waste Processing System (LWPS) prior to discharge, tritium cannot be removed because it is chemically part of the water molecule. Since tritium is part of the water it does not concentrate in the environment and is only diluted when it comes in contact with off-site water.

Sampling for radionuclides in water at the site is performed as part of the site's Radiological Environmental Monitoring Program (REMP). Surface water quality data for radionuclides from sampling in 2005 are presented in Table 2.3.3-4 and tritium concentrations in surface water, including the MCR, from 1995-2005 are presented in Table 2.3.3-5. STP 1 & 2 discharge about 2000 Curies (Ci) of tritium to the MCR annually. The tritium concentration in the MCR has been relatively constant for many years, and well below the EPA drinking water standard for tritium of 20,000 pCi/L and the NRC reporting limit of 30,000 pCi/L under the REMP.

STP 3 & 4 may add an additional 16 Ci each year to the MCR from tritium. This much lower value is due to the difference in the reactor design and water chemistry for STP 3 & 4 compared to STP 1 & 2. Consequently, the concentration of tritium in the MCR may increase, but the average increase would be less than 1%. Year to year fluctuations in precipitation, reservoir makeup, evaporation rate, and STP 1 & 2 release rates would have a greater effect on tritium concentration than any contributions from STP 3 & 4.

Table 12.2-22 of the FSAR indicates the average annual release concentration of tritium to the MCR from the operation of STP 3 & 4 would be 8.38 pCi/L. Historically, the highest concentrations of tritium reported in the MCR for the operation of STP 1 & 2 are at MCR Blowdown #216 and are approximately 10,000 pCi/L (See Table 2.3.3-5). Overall monitoring of surface water from Table 2.3.3-5 averages approximately 6,000 pCi/L. Based on these values, the additional input of an average of 8.38 pCi/L from STP 3 & 4 would not significantly increase the tritium concentrations in the MCR, and would be well below the EPA drinking water standard. Hence, any discharge to the groundwater or to an offsite body of water like the Colorado River would be safe even before dilution. Therefore, the impact of tritium in the MCR or discharged to the Colorado River would be SMALL.

As discussed in Section 2.3.1.1.2.1, approximately 68%, or 3850 acre-ft/yr, of the total expected MCR seepage would be discharged through the relief wells and into surface waters. The distribution of relief well surface water discharge results in approximately 28% being returned to the Colorado River, 53% to Little Robbins Slough, 18% to the East Fork of Little Robbins Slough and <1% being returned to the West Branch of the Colorado River. Because the levels of tritium in the MCR are below the EPA drinking water standard, the impact of tritium in discharges to the Colorado River, Little Robbins Slough, the East Fork of Little Robbins Slough, and the West Branch of the Colorado River from the relief wells would be SMALL.

The remaining 32%, or 1850 acre-ft/yr, of the total expected MCR seepage would move into the Upper Shallow Aquifer and migrate to the southeast, discharging at the Colorado River. The discharge point of groundwater from the Upper Shallow Aquifer to the Colorado River is over 4,000 feet from the MCR. At a travel time of 40 feet/yr, groundwater would not reach surface water discharge points for approximately 100 years. The half-life for tritium is 12.3 years, meaning that during the 100 year travel time, the tritium concentrations in groundwater would decay over 8 half lives resulting in a concentration of less than 1% of the original concentration seeping from the MCR. If the initial groundwater concentration of tritium is 10,000 pCi/L, the concentration upon arrival at surface water discharge points without taking dilution over time and distance into consideration would be less than 100 pCi/L, which is well below the EPA drinking water standard of 20,000 pCi/L. Therefore, the impact on surface water from the Upper Shallow Aquifer discharge would be SMALL.

5.2.3.2 Groundwater Quality

The shallow aquifer zone in this area contains water of marginal to poor quality. Results of chemical analyses taken before STP 1 & 2 operation indicated that this water was objectionable for potable use because of total hardness, chlorides, metals, and TDS. For these reasons, potable water, and water for other plant uses, is obtained from the deep aquifer.

As part of the REMP, groundwater quality is monitored from Upper Shallow Aquifer wells within 6 miles of the site. Results of the analyses are presented in Section 2.3.3. Surface water quality data for metals and salts for two rounds of samples collected from the MCR in 2006 are presented in Table 2.3.3-3. The low quantities of metals and salts reflect the high quality of water present in the MCR and reflect the source term for groundwater seepage to the Upper Shallow Aquifer. Section 5.2.3.1 discusses the environmental impacts of TDS and other constituents in the MCR due to the addition of STP 3 & 4 and concludes that those impacts are SMALL. Because the source of any TDS or other constituents in groundwater is from the MCR, the environmental impacts of the TDS or other constituents in the groundwater would also be SMALL.

In addition, the quality of water discharged to the MCR and the quality of the water discharged from the MCR are currently maintained to meet TCEQ-permitted levels, and would continue to be maintained with the addition of STP 3 & 4. Additionally, as discussed in Section 5.2.3.1, the quality of the water in the MCR is and would remain high, and would not adversely impact biota if consumed. Given the high quality of the MCR water, any discharge from the MCR to the groundwater would not result in significant impacts to groundwater. As stated in Section 2.3.1.1.2, there would be no significant changes in the design of the MCR for the addition of STP 3 & 4 and there would be insignificant changes in the seepage rates from the MCR due to the addition of STP 3 & 4. In addition, UFSAR 2.4.13.4, Monitoring or Safeguard Requirements, indicates that Upper Shallow Aquifer groundwater levels are monitored periodically through piezometers installed appropriately around the site. Significant changes in water levels or basic groundwater flow patterns would be evaluated to determine if additional monitoring of groundwater would be required. Groundwater quality data from the piezometers can also be evaluated to determine if any additional monitoring frequencies or new monitoring well points need to be established. Therefore, impacts to the Upper Shallow Aquifer as a result of the operation of STP Units 3 & 4 would be SMALL.

As discussed above in Section 5.2.3.1, tritium contributed to the MCR by STP 3 & 4 is expected to increase the tritium concentration by less than 1%. Currently, almost half of the tritium is removed from the reservoir annually. Tritium in the MCR is also diluted by reservoir makeup water diverted from the Colorado River and direct rainfall. Tritium concentrations also decrease due to radioactive decay. For these reasons, the environmental impacts of tritium in the MCR and in other surface waters from the operation of STP 3 & 4 are SMALL because the tritium levels are below the EPA drinking water standard for tritium of 20,000 pCi/L and the NRC reporting limit of 30,000 pCi/L under the REMP. Any discharge offsite via the above pathways to surface waters or groundwater would also remain below established limits and would continue to be confirmed per the REMP. Therefore, impacts of four-unit operation on the shallow aquifer would be SMALL.

Furthermore, the results of radionuclide analyses for 2005 are presented in Table 2.3.3-9 with tritium being the only constituent reported above detection levels (260 pCi/L) at 1,600 pCi/L. The location of the well with the detectable tritium concentrations is located adjacent to the MCR and 3.8 miles south of STP 1 & 2. In 2006, groundwater from 16 wells in the Upper Shallow Aquifer was analyzed quarterly for tritium. The analytical results are summarized in Table 2.3.3-10. The only well reporting tritium above the detection limit of 300 pCi/L was piezometer well number 435-02, located 700 feet west of the MCR embankment and 2.9 miles southwest of STP 1&2. Detected tritium concentrations ranged from 309 to 593 pCi/L, well below the EPA drinking water standard of 20,000 pCi/L. (Note that the detection level varies based on the background and the size of the sample).

Table 12.2-22 of the FSAR indicates the average annual release concentration of tritium to the MCR from the operation of STP 3 & 4 would be 8.38 pCi/L. Historically, the highest concentrations of tritium reported in the MCR for the operation of STP 1 & 2 are at MCR Blowdown #216 and are approximately 10,000 pCi/L (Table 2.3.3-5). Overall monitoring of surface water from Table 2.3.3-5 averages approximately 6,000 pCi/L. Based on these values, the additional input of an average of 8.38 pCi/L from STP 3 & 4 would not significantly increase the tritium concentrations in the MCR.

As discussed in Section 2.3.1.1.2.1, discharge to the environment from the MCR occurs from seepage through the reservoir floor to the groundwater. Groundwater flow from the MCR is intercepted in part by the relief well system, installed into sands of the Upper Shallow Aquifer. Groundwater is discharged from the passive relief wells and collected in toe and drainage ditches around the periphery of the MCR embankment and then discharged to surface water.

As described in Section 2.3.1.1.2.1, a portion of the seepage from the MCR would not be captured by the relief well system (approximately 32%). The ODCM model for the site has been prepared utilizing well data that suggests migration of groundwater seeping from the MCR into the Shallow Aquifer travels at approximately 40 ft/yr. The nearest offsite well used for watering livestock is located 1,400 feet from the reservoir. Conservatively assuming the flow is directly to this well, groundwater would not reach this well for 35 years. The half-life for tritium is 12.3 years, meaning that during the 35 year travel time, the tritium concentrations in groundwater would decay 2.8 half lives or to approximately 16 percent of the original concentration seeping from the MCR. If the initial groundwater concentration of tritium is 10,000 pCi/L, the concentration upon arrival at the offsite well would be approximately 1,600 pCi/L without taking dilution over time and distance into consideration. The tritium concentration is still well below the EPA drinking water standard for tritium of 20,000 pCi/L. Therefore, the impact on users of the well water from the Upper Shallow Aquifer would be SMALL.

The shallow aquifer is separated from the deep aquifer by more than 150 feet of predominantly clay sediments which effectively seal the deep aquifer from reservoir seepage. Therefore, there would be no environmental impacts to the deep aquifer from tritium produced by operation of STP 3 & 4.

5.2.4 References

5.2-1 TCEQ (Texas Commission on Environmental Quality) 2007. Letter from Kelly Holligan (TCEQ) to R. A. Gangluff (STP Nuclear Operating Company) Re: Cooling Water Intake Structures Phase II Rules; South Texas Project Electric Generating Station; TPDES Permit No. WQ0001908000, June 27, 2007.

5.2-2 Operating Permit, STP Nuclear Operating Company, Historical User Permit No. OP-04122805, Coastal Plains Groundwater Conservation District, March 2005.

5.2-3 LCRA (Lower Colorado River Authority), Water Management Plan for the Lower Colorado River Basin, May 2003.

5.2-4 STPNOC (South Texas Project Nuclear Operating Company), 2006. Amended and Restated Contract by and between the Lower Colorado River Authority and STPNOC. Effective as of January 1, 2006.

5.2-5 USGS (U.S. Geological Survey) Water Year 2006 Report, Colorado River, USGS Station 08162500 near Bay City, Texas, April 24, 2007.

5.2-6 Holligan (Karen Visnovsky Holligan), 7Q10 Flows. E-mail from Karen Visnovsky Holligan (TCEQ) to Bridget Twigg (TtNUS) June 13, 2007.

5.2-7 CPGCD (Coastal Plains Groundwater Conservation District), Rules of the Coastal Plains Groundwater Conservation District, adopted May 25, 2004.

5.2-8 “Groundwater and Wells,” Fletcher G. Driscoll, 2nd Edition, Johnson Filtration Systems Inc., St. Paul, Minnesota, 1989.

5.2-9 TCEQ, STP Nuclear Operating Company, TPDES Permit No. 001908000 Renewal. July 21, 2005.

5.2-10 STPNOC (South Texas Project Nuclear Operating Company), South Texas Project Electric Generating Station Certificate of Adjudication 14-5437, May 1, 2005, Rev. 1.

5.2-11 TCEQ 2004 Texas Water Quality Inventory and 303(d), April 14, 2007.

5.2-12 TCEQ 2006 Texas Water Quality Inventory and 303(d), April 27, 2007.

5.2-13 NRC (Nuclear Regulatory Commission) 2009. Response to RAI 05.02-05, U7-C-STP-NRC-090091 (ML092150963). July 30, 2009.

5.2-14 “Plant Water Balance,” Fluor Nuclear Power Calculation No. U7-SITE-G-CALC-DESN-2001.

5.2-15 “Site Groundwater Use for Construction, Initial Testing, Startup, and Operations,” Fluor Nuclear Power Calculation No. U7-SITE-G-CALC-DESN-2002.

Table 5.2-1 Comparison of Colorado River Flows and STP 3 & 4 Cooling Water Flows

	Mean Monthly River Flow [1], [2]	Maximum [3] River Withdrawal for Makeup (2 units)	Percent of Mean Monthly River Flow Lost to Maximum Makeup (2 units)	Maximum Total Evaporation Rate (2 units) [1]	Percent of Average Flow Lost to Evaporation
January	1,150,274	47,489	4.1	49,000	4.3
February	1,455,907	47,489	3.3	49,000	3.4
March	1,281,324	47,489	3.7	49,000	3.8
April	1,225,224	47,489	3.9	49,000	4.0
May	1,642,608	47,489	2.9	49,000	3.0
June	1,919,518	47,489	2.5	49,000	2.6
July	844,642	47,489	5.6	49,000	5.8
August	374,748	47,489	12.7	49,000	13.1
September	787,195	47,489	6.0	49,000	6.2
October	1,103,150	47,489	4.3	49,000	4.4
November	1,248,562	47,489	3.8	49,000	3.9
December	1,100,906	47,489	4.3	49,000	4.5

[1] All flows in gallons per minute

[2] Reference 5.2-4

[3] Maximum water withdrawal occurs during normal operations

Table 5.2-2 Drawdown Inputs for Confined Nonleaky Aquifer Scenario/Operations

Case	1	2	3	4	5
Distance (feet) [1]	2,500	2,500	2,500	2,500	2,500
Storage Coefficient [2]	0.00076 to 0.00022	0.00076 to 0.00022	0.00076 to 0.00022	0.00076 to 0.00022	0.00076 to 0.00022
Transmissivity [2] (feet^2/day)	4,444	4,444	4,444	4,444	4,444
Time (Days)	3,650	7,300	10,950	14,600	14,600
Flow, Q (gpm)	1,062	1,062	1,062	1,062	500
Drawdown at any potential off-site well location 2500-foot distance	33 to 37	35 to 40	37 to 41	38 to 42	18 to 20

Case 1 to 4 - STP 3 & 4 pumping at remaining permit rate (1860 gpm – 798 gpm).
Case 5 STP 1 & 2 pumping at current maximum design yield of 500 gpm for the production wells.
[1] Section 2.3.2
[2] Section 2.3.1