WOLF CREEK
NUCLEAR OPERATING CORPORATION

Forrest T. Rhodes
Vice President
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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-137
Washington, D. C. 20555

Subject: Docket No. 50-482: Annual Environmental Operating Report

Gentlemen:

Enclosed is the Annual Environmental Operating Report which is being submitted pursuant to Wolf Creek Generating Station (WCGS) Facility Operating License NPF-42, Appendix B. This report covers the operating of Wolf Creek Generating Station for the period of January 1, 1991 to December 31, 1991.

Very truly yours,

Forrest T. Rhodes
Vice President
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PTR/mes

Enclosure

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WOLF CREEK GENERATING STATION

ANNUAL ENVIRONMENTAL OPERATING REPORT

1991

ENVIRONMENTAL MANAGEMENT SECTION

WOLF CREEK NUCLEAR OPERATING CORPORATION

P.O. BOX 411

BURLINGTON, KS 66839

APRIL 1992

WOLF CREEK NUCLEAR OPERATING CORPORATION
WOLF CREEK GENERATING STATION

1991 ANNUAL ENVIRONMENTAL OPERATING REPORT

1.0 INTRODUCTION

Wolf Creek Nuclear Operating Corporation (WCNOC) has committed to minimizing the impact of Wolf Creek Generating Station (WCGS) operation on the environment. The 1991 Annual Environmental Operating Report is being submitted in accordance with the objectives of the Environmental Protection Plan (EPP) as required by Facility Operating License NPF-42. The purpose of this report is to demonstrate that the plant operated during 1991 in an environmentally acceptable manner.

2.0 ENVIRONMENTAL MONITORING

2.1 AQUATIC [EPP Section 2.1]

2.1.1 Impacts of Water Withdrawal on the Neosho River

The owners of WCGS have contracted with the Kansas Water Resources Board to pump 9.672 billion gallons per calendar year from the tailwaters of the John Redmond Reservoir (JRR) to Wolf Creek Cooling Lake (WCCL). During 1991, 6.810 billion gallons or 70 percent of the contracted allotment were pumped. Auxiliary raw water was pumped similar to past years at a rate of approximately 1.2 million gallons per day and comprised about 5 percent of the total pumped. The remainder was transferred to WCCL via the makeup pumps, which operated from March 13 through April 15, August 2 through September 17, and from October 26 through October 31. The makeup pumps were also operated for short periods on May 27 and July 26, 1991.

Measurements taken during 1991 by the United States Geological Survey indicate that downstream flows in the Neosho River at Burlington were largely unaffected by makeup pumping activities, unlike that suspected during

1990. In 1990 downstream flow reductions were presumed to have resulted from blockages experienced in the diversion pipe from which makeup water was released from JRR. The blockages reduced flow below the 120 cfs required to supply water to the makeup pumps. Due to insufficient discharge from this pipe, the makeup pumps appeared to take a portion of the water released from JRR intended to maintain downstream flows. Evaluations determined that no adverse environmental impacts occurred as a result. In 1991, adequate water was released through the pipe to the makeup pumps, so pumping activities did not reduce downstream flows.

The Final Environmental Statement/Operating License Stage (FES/OLS) postulated that makeup water withdrawal of 41 cfs (average annual predicted makeup requirements) during drought conditions would extend the duration and severity of low-flow conditions below JRR. This, in turn, was expected to reduce riffle habitat which would adversely affect Neosho madtom populations. This combination of circumstances - makeup water withdrawal during very low river flows - occurred during the 1991 pumping. Normal downstream flow conditions were maintained and no reduction attributed to WCGS' 1991 withdrawals occurred. Sampling conducted during November 1991 after the withdrawals, found Neosho madtoms present in numbers similar to previous years.

2.1.2 Chlorine Discharges to Wolf Creek Cooling Lake

Circulating Water System Discharge:

Total residual chlorine (TRC) was postulated in

Section 4.2.6.1 of the FES/OLS to range between 0.68 and 1.08 mg/l at the Circulating Water System (CWS) discharge. Three 30-minute doses per day at 411 pounds of chlorine per dose were projected to produce these concentrations. These chlorine doses were expected to cause periodic, appreciable mortality among aquatic organisms in a conservatively estimated 40 acres of the discharge area of WCCL (FES/OLS, Section 5.5.2.2).

Administered by the Kansas Department of Health and Environment (KDHE), the WCGS National Pollutant Discharge Elimination System (NPDES) permit allows TRC to be a maximum of 0.2 mg/l in the circulating water effluent. Chlorine dose duration is limited to two hours per day. In practice, WCGS has fallen well below the NPDES allowable limits. Actual chlorine dosages to the CWS have averaged approximately 58 pounds per day. Compliance with the permit limits for daily maximum TRC was 100 percent. The two hour chlorination dose duration limit was exceeded by 41 minutes on February 23, 1991, but for the year, compliance was still greater than 99 percent. Monitoring during 1991 detected a daily average TRC concentration of less than 0.1 mg/l, well below the 0.2 mg/l permitted level. In Section 5.5.2.2 of the FES/OLS, the proposed chlorination treatments were not expected to meaningfully affect the overall biological productivity of WCCL. Because the actual monitored values during CWS chlorination were well below the evaluated levels and no fish mortalities attributable to chlorination were observed, permitted chlorine discharges during 1991 were not considered to have had appreciable effects on the cooling lake environment.

Essential Service Water System Discharge:

During 1991, a continuous diversion of approximately 18,000 gpm of Service Water System (SWS) flow to the Essential Service Water System (ESWS) was completed as part of Plant Modification Request (PMR) 02149. This was intended to provide microbiologically induced corrosion and sedimentation control. This flow diversion differed from that before 1990 when they had only occurred in an effort to prevent winter ice formation at the ESWS intake.

In the EPP, the Nuclear Regulatory Commission (NRC) defers regulation of water quality issues to the NPDES permit administered by the State of Kansas. In 1989 the KDHE established a 1.0 mg/l TRC limit for the SWS flow diversion through the ESWS. Compliance with the TRC limit in 1991 was 100 percent. No fish mortalities or water quality changes attributable to PMR 02149 implementation were observed during 1991.

2.1.3 Cold Shock

In the event of a rapid decline in plant power level during winter, fishes attracted to the WCGS heated discharge could experience mortality due to "cold shock", a quick reduction in body temperature. In reference to licensing document evaluations, the WCGS EPP Section 2.1 (c) states, "Cold shock effects on fish due to reactor shutdowns could cause significant mortality to aquatic species in the cooling lake". There were no cold shock mortality events observed during 1991.

2.1.4 Impingement and Entrainment

Impacts of entrainment and impingement were projected to be significant in the WCGS EPP. Condenser mortality for entrained organisms was expected to approach 100%. Because of this, sampling efforts to monitor entrainment impacts were not required by the NRC and have not been implemented at WCGS. Through casual observations, fish impingement at the WCCL circulating water intake was considered minimal during 1991, thus no sampling efforts to monitor impingement impacts have been initiated.

2.1.5 Impacts of Wolf Creek Cooling Lake Discharges to the Neosho River

Cooling lake discharges into the Neosho River are regulated by NPDES permit limitations. Since discharges are sporadic, chiefly from stormwater runoff and infrequent blowdowns, water is sampled on the first day of each discharge and weekly thereafter until the end of each respective discharge. Effluent parameters measured include a flow rate estimate, temperature, pH, total dissolved solids, sulfate, and chloride concentration. Discharges of these parameters are regulated to maintain a zone of passage in the Neosho River for aquatic organisms at the Wolf Creek confluence. Consequently, the flows allowed from WCCL may range from zero to unrestricted, depending upon water quality and temperature similarities with the Neosho River. In 1991, no NPDES violations at the WCCL discharge were observed and at no time did water quality criteria restrict WCCL discharge to the Neosho River. Based on monitoring studies completed, there have been no apparent deleterious effects to Neosho River water quality

or productivity due to WCCL discharges.

2.2 TERRESTRIAL [EPP Section 2.2]

2.2.1 Control of Vegetation in the Exclusion Zone

The composition and structure of vegetation in the 453 ha (1120 acre) exclusion zone were selectively controlled to be compatible with the function and security of station facilities. Most areas in the immediate vicinity of the power block have been planted and maintained in a lawn-type condition. Other areas within the exclusion area have been mowed for security and aesthetic purposes.

2.2.2 Vegetation Buffer Zone Surrounding Wolf Creek Cooling Lake

To create a 500 acre buffer zone around WCCL, agricultural production activities were curtailed in 1980 below an approximate elevation of 1095' MSL, eight feet above WCCL normal operating surface water elevation (1087' MSL). This border ranges from approximately 200 to 400 feet adjacent to the lake shoreline. Previously grazed or hayed native tallgrass areas were left undisturbed. Previously cultivated lands were allowed to advance through natural successional stages or native grass stands were reestablished. Land management activities specified in an annual land management plan included controlled burning and native tallgrass seeding to enhance and/or maintain the designated buffer zone with a naturally occurring biotic community.

2.2.3 Herbicide Use for Maintenance of Wolf Creek Generating Station Structures

A soil sterilant was applied on selected gravel areas of WCGS. These include the Protected Area Boundary, various lay-down storage yards, meteorological tower, support building borders, storage tank berms, switchyard, hazardous waste and waste oil storage areas, and on-site railroad beds. The herbicides applied consisted of 8 pounds of Karmex (EPA Reg. No. 352-247) and 4 to 6 pounds of Oust (EPA Reg. No. 352-401) per 100 gallons of water. Application rates ranged from 20-50 gallons per acre. These herbicides are registered by the Kansas Department of Agriculture. No environmental impacts from herbicide treatment of WCGS facilities were identified.

Selected areas of problem trees and brush were cut or sprayed along the Rose Hill and LaCygne 345 KV transmission lines associated with WCGS lands. The cut trees were stump treated to control resprouting with Tordon RTU (EPA Reg. No. 464-510). The spray was a brush herbicide mixture which included Tordon 101 (EPA Reg. No. 464-306) and Garlon 3A (EPA Reg. No. 464-546) mixed in equal amounts to make a one percent solution in water. A wetting agent and drift inhibitor were also used. All chemicals were registered for use in Kansas. The transmission line right-of-ways were treated by a contractor commercially licensed by the Kansas Department of Agriculture. All label instructions were followed. No environmental problems were observed from herbicide treatment of these right-of-ways in the vicinity of WCGS.

2.2.4 Waterfowl Disease Contingency Plan and Monitoring

A waterfowl disease contingency plan was maintained to provide guidance for station biologists in the event of suspected or actual disease outbreaks. The contingency plan lists appropriate federal and state wildlife agency contacts to be made by WCNOC in the event of such problems. During routine wildlife monitoring and surveillance activities taking place over this reporting period, no waterfowl mortality attributable to disease pathogens was identified.

2.2.5 Fog Monitoring Program [EPP Subsection 4.2.1]

Visibility monitoring was initiated in December 1983 and continued through 1987. The purpose of this study was to evaluate the impact of waste heat dissipation from WCCL on fog occurrence along U.S. 75 near New Strawn, Kansas. Upon conclusion of 1987 data collection, it was determined that sufficient information was available to evaluate cooling lake fogging and that all commitments relevant to fog monitoring had been satisfied. Because no problems were identified by these data, no formal fog monitoring program was conducted during 1991. Through casual observations, Environmental Management personnel did not observe any incidents of man-made fog along U.S. 75 during 1991. In addition, there were no reports of such incidents from individuals or local agencies responsible for traffic safety. Implementation of mitigative actions or further monitoring was not warranted.

2.2.6 Wildlife Monitoring Program [EPP Subsection 4.2.2]

A wildlife monitoring program was initiated to monitor and assess wildlife populations or parameters most likely to be impacted by the operation of WCGS. As outlined in the 1990/1991 annual wildlife study plan, specific objectives of the wildlife monitoring program were to assess waterfowl, waterbird, and bald eagle usage of WCCL. Because these annual monitoring programs target each migration season (autumn through early spring), this EPP reporting period overlaps with part of the 1991/1992 monitoring program. The objectives of this program were the same as for the 1990/1991 season. Wildlife monitoring results are summarized in the attachment to this report.

2.2.7 Land Management Program [EPP Subsection 4.2.3]

Land management activities on all company-owned lands except within the 453 ha (1120 acre) WCGS exclusion area were designed to achieve balances between agricultural production and conservation values. An annual management plan was formulated to address needs and propose accepted techniques for land maintenance, soil conservation, and wildlife management. These included construction or repair of livestock fences and ponds, and the construction or establishment of terraces, waterways, and permanent vegetative covers. A summary of the 1991 Land Management Report appears in the attachment to this report.

3.0 ENVIRONMENTAL PROTECTION PLAN REPORTING REQUIREMENTS

3.1 PLANT DESIGN OR OPERATING CHANGES [EPP Section 3.1]

Proposed plant design and operational changes which have the

potential to affect the environment must receive an environmental evaluation prior to implementation. A summary of each modification or operating change which required an environmental evaluation in 1991 is presented. There were no changes in station design or operation nor were there tests or experiments that involved an unreviewed environmental question during 1991.

Evaluation 91-1: Replacement of Betz C-82 with Betz C-94 Biocide for Treatment of SWS and ESWS

This evaluation addressed a small change in the biocide formulation used in the SWS and the ESWS. The change was to substitute Betz C-82 with C-94, another Betz product. The C-82 product was evaluated during 1990 and shown to have no adverse environmental impacts. The two biocides are identical except for the percent of NaBr, the active ingredient. C-82 has 46% compared to C-94's 40% which lowers the freezing point of the solution. Dosage rates were to remain similar. Therefore, C-94 was considered to have a smaller impact probability than C-82, which was previously determined to be insignificant.

Evaluation 91-2: Procedure Formulation for Removal and Addition of Sand and Carbon Filter Media

An environmental evaluation was completed of two procedures dealing with the operating instructions for the removal and replacement of sand and charcoal filter media in the Water Treatment Plant. The evaluation focused on the waste sand and charcoal filter media. Both were determined to be nonhazardous and could be disposed of at a landfill with a Solid Waste Disposal Authorization from the KDHE. Releases to the environment or any adverse impacts would not occur.

Evaluation 91-3: Modification of an Existing Site Building to Accommodate Storage of Mixed Waste

This was an evaluation of the potential nonradiological issues relevant to the EPP of constructing and managing a mixed waste storage area. Mixed waste, for purposes of this evaluation, included waste which met the regulatory criteria to be considered both a low level radioactive waste and a hazardous waste. This evaluation's scope did not address regulatory compliance as it relates to these wastes, just how the construction activities relate to EPP concerns. An existing building outside the Exclusion Area Boundary, but within the Owner Controlled Area Boundary, was to be modified to house the facility. All affected areas were previously disturbed during plant construction. The proposed design allowed for extended storage durations with no potential for groundwater contamination. Spill control measures were also incorporated. No adverse nonradiological impacts were anticipated.

Evaluation 91-4: Change in SWS and ESWS Discharge Flow Path to the Lime Sludge Pond

This evaluation addressed a temporary change in a discharge flow path of a portion of the SWS and ESWS cooling water as a result of valve leakage testing. The flows normally discharge with the cooling water effluent but were to be diverted to the Lime Sludge Pond. Effluent from this pond is currently an NPDES regulated discharge outfall. The leak test procedure involved isolating and draining the SWS and ESWS piping crossties and determining the leak rate of the crosstie valves. This crosstie piping contained water pumped from WCCL. No previously unevaluated chemicals were present in the piping. The addition of an estimated 100 gpm flow to the Waste Water Treatment Facility during testing was expected

to be insignificant. No adverse environmental impacts nor NPDES violations would result from this temporary flow change.

Evaluation 91-5: Change in the ESWS Discharge to the Storm Drain System

This evaluation addressed ESWS flow balance testing which would cause a portion of ESWS's normal flow path to be redirected from the ESWS discharge (NPDES outfall 006) to the Oil/Water Separator (NPDES outfall 002). The flow was not to have any thermal loads, contain biocides, or any scale control agents. The increased flow's potential to flush oil through the Oil/Water Separator was addressed in the temporary procedures written to govern the testing. The procedure called for checking for excess oil and removing it as required to prevent this. No adverse environmental impacts or NPDES permit violations would occur as a result of this testing.

Evaluation 91-6: Chemical Cleaning of Main Condenser

This was an evaluation of environmental considerations of a condenser cleaning process scheduled during Refuel V. The cleaning was to use Betz DE-1762 to remove carbonate scale. Carbon dioxide and approximately 325,000 gallons of waste cleaning solution were to be by-products of the process. The carbon dioxide would be vented to the atmosphere and the waste DE-1762 solution would be discharged with cooling water to the cooling lake. Verbal approval to discharge the solution was obtained from the KDHE. Procedural changes were instituted to assure compliance with a KDHE discharge concentration limit of 175 mg/l of DE-1762. Using available aquatic toxicity data and expected maximum discharge concentrations of the waste solution, no adverse environmental impacts were expected to occur.

Evaluation 91-7: Dredging of the Ultimate Heat Sink (UHS) and Sediment Disposal in the Cooling Lake

This evaluation involved environmental effects of dredging the UHS substrate and disposing of sediments in an area of the cooling lake remote from the UHS. The possible impacts to aquatic organisms from high turbidities were not considered significant to the lake as a whole due to the small size of the expected discharge plume. This area was conservatively estimated to cover 40 acres. Siltation effects to fish and invertebrate eggs or larvae were not considered probable since the dredging would take place during the fall and winter period. Spawning and feeding habitats of cooling lake fishes due to siltation would not be lost because the substrate at the discharge site was primarily a wave-swept shoreline already consisting of clays and wave deposited sediments similar to that being discharged from dredging. The large distance between the sediment discharge site and the cooling lake's spillway eliminated potential NPDES dissolved solids exceedances. All appropriate Kansas Division of Water Resources and United States Army Corps of Engineers Section 404 permits were obtained prior to dredging. No adverse environmental impacts would result from this project.

Evaluation 91-8: Petroleum Product Recovery From Groundwater at Vehicle Maintenance Shop

This evaluation addressed a change in the volume and composition of a discharge effluent caused by pumping groundwater and associated diesel fuel from a recovery well. The diesel came from a leaking underground transfer pipe which was recently replaced between the storage tank and the fuel pump. The groundwater and diesel pumped from the recovery well was to be discharged to the

Vehicle Maintenance Shop oil/water separator. The effluent from the separator drains into a storm drain which ultimately discharges to the cooling lake. The separator would effectively remove the diesel and the quality of the water reaching the lake was expected to be good. There would be an increase in effluent volume due to pumping activities, but this was not expected to jeopardize the effectiveness of the separator. No adverse environmental impacts would occur.

3.2 NONROUTINE ENVIRONMENTAL REPORTS

3.2.1 Submitted Nonroutine Reports

There were no nonroutine environmental reports involving significant impacts submitted to the NRC during 1991.

3.2.2 Unusual or Important Environmental Event Evaluations

No unusual or important environmental events reportable under specifications in the EPP were identified during 1991.

3.3 ENVIRONMENTAL NONCOMPLIANCES [EPP Subsection 5.4.1]

At WCGS in 1991, nonradiological environmental noncompliances or noteworthy events were recorded along with the details surrounding them. These included such things as an accidental halon release, a diversion tank overflow, diversion of Neosho River flow to WCCL, various minor oil spills, a bird mortality event, use of uncalibrated fish scales, and study plan schedule deviations. These events were evaluated and determined not to be reportable pursuant to EPP criteria.

ATTACHMENT

SUMMARY OF
ENVIRONMENTAL INVESTIGATIONS
AT WOLF CREEK GENERATI" STATION, 1991

Wolf Creek Nuclear Operating Corporation

Environmental Management

Burlington, Kansas

CONTENTS

1. 1991 LAND MANAGEMENT ACTIVITIES

This report addresses the implementation of the land management program during 1991 at WCGS. The goals this program was designed to achieve were (1) preserve or improve both agricultural and natural resources, (2) prudently maximize rent income from agricultural lands, (3) satisfy licensing commitments and (4) foster good relations with local agricultural and natural resource communities. Much of the program effort went into achieving the first two goals with the latter two being integrated within them. By accomplishing these, a land management program which balanced production and conservation values was achieved thus satisfying Section 4.2.3 of the EPP and the final goal.

The lands at WCGS included in the 1991 program were primarily grasslands, croplands, and woodlands. The improved properties around the power block area, switchyard and plant support buildings were not part of this program. The lands were used for various purposes depending on the location and capability of each area. Most were leased for grazing, haying, and crop production. A strip around the WCCL shoreline was maintained in a naturally occurring biotic community to satisfy Section 2.2(b) of the EPP. Others were unsuitable for agricultural production, left unused to preserve lake shoreline stability, or reserved for their wildlife value.

Grasslands at WCGS consist of areas leased for grazing and hay production and unleased areas maintained for regulatory compliance. Grazing rates, durations, and rotations were controlled on the grazing leases. Mowing and bale removal dates were specified on hayland leases. Controlled burning, noxious weed control, and fence construction on these leases and on unleased lands provided for optimum native prairie areas capable of supplying long term rent income, reducing soil erosion, and providing high quality wildlife habitat.

Cropland areas at WCGS are fields within the property boundary unflooded by WCCL. Most are upland areas along the sides of the lake with some bottomland along Wolf Creek upstream from the lake. Program objectives for

The croplands were to reduce soil erosion, maintain rent income, and increase wildlife benefits. Conservation farming specifications in the leases, terracing, and wildlife food/cover strip management were used to achieve these objectives.

Implementation in 1991 of the land management program achieved the goals of preserving agricultural and natural resources, maximizing rent income, satisfying regulatory commitments, and maintaining good relations with agricultural and natural resource communities. A larger area than the EPP required 500 acre buffer strip was maintained in a naturally occurring biotic community. Continued high interest in renting WCGS lands from local farmers other than existing tenants indicated that WCGS has a good reputation in how it manages its lands. Soil conservation efforts progressed in 1991, reducing silt inputs to the lake and improving long term productivity of the cropland. The 1991 program obtained desired results and WCGS benefited from its implementation.

2. 1991 WATER QUALITY MONITORING ACTIVITIES

Surface water quality monitoring during 1991 was completed to gather data to assess operational impacts from the WCGS on the Neosho River and WCCL. It also contributed to the baseline data collected during past years. Long term monitoring has documented concentrations of general water quality parameters, aquatic nutrients, organically-derived materials, certain trace metals, and phytoplankton productivity.

Neosho River

Surface water quality studies in the Neosho River near WCCL have been conducted at locations above and below the Wolf Creek confluence since 1973. Seasonal mean concentrations of most water quality parameters during 1991 were within previously established ranges for the study area and no between-location differences were seen for any of the parameters monitored. During 1991 the annual mean concentration of four parameters indicated a continued decreasing trend. These were total suspended solids (TSS), total dissolved solids (TDS), nitrates, and orthophosphates. These decreases were attributed to the drought conditions prevalent during late 1990 and through most of 1991. The lack of stormwater influence reduced annual averages of TSS and TDS in the water which also reduced turbidity, which was the lowest observed since monitoring began. Low levels of these parameters are generally considered indicators of good water quality. Nitrate and orthophosphate are important aquatic nutrients and are necessary for high productivity in a water-body, although harmful if in excess. They are commonly added to an aquatic system via storm runoff. The levels monitored during 1991 were detectably lower, but apparently not lacking enough to become a limiting factor to the Neosho River's productivity. Consistent chlorophyll a levels support this observation.

Overall in 1991, the water quality data suggest that the quality of water in the river has improved. Since filling of WCCL began in 1981, flows from

Wolf Creek into the Neosho River have been limited to seepage, releases for testing of blowdown procedures, and runoff events. No discharges from WCCL of sufficient volume to reach the river occurred during 1991. There have been no apparent deleterious effects to water quality in the Neosho River due to operation of WCGS based on available water quality monitoring data.

Wolf Creek Cooling Lake

Surface water quality studies of WCCL began when the lake was initially filled during 1981. Water quality was greatly influenced by makeup water being pumped from the Neosho River during that year. Between 1982 and 1986, makeup water was generally added only during routine use of the auxiliary raw water pumps and quarterly testing of the makeup water pumps. Since 1987, use of makeup water increased to a high of 6.8 billion gallons in 1991. Despite this increase, WCCL water quality has been generally independent from influence of the Neosho River makeup water. Concentrations of water quality parameters were similar among locations in the cooling lake, with only slight differences at the shallower upstream sampling site than near the main dam and the station intake. Many parameters' concentrations were within the ranges monitored during past years with no apparent trends developing. Two, total iron and turbidity, exhibited declining trends. Iron was very low and continues its downward trend toward its detection limit. Reduced turbidity is likely a result of reductions of sediment inputs and turbulence from the lack of storm runoff events during 1991. Given the presence of sufficient and consistent aquatic nutrient levels, the lower turbidity should increase photosynthetic activity. This was evident from rising chlorophyll a measurements. These trends were not considered to be caused by station operation and were generally considered indicators of good water quality.

There were changes to the concentrations of some parameters in 1991 that may have been caused by WCGS operations. Increasing trends have developed for calcium, magnesium, sodium, chlorides, and sulfate levels. These

contributed to the concurrent upward trend evident for alkalinity, conductivity, and TDS. Sodium, chlorides, sulfate, and magnesium are by-products of WCGS water treatment processes discharged to WCCL via a lime sludge pond but, the pond's discharge volume is minute compared to the lake. Consequently, these inputs were not considered the primary factor for the increasing trends observed. The reduction in storm water runoff events during the past few years coupled with the continuous high evaporation rates resulting from heated circulating water discharge during station operation were considered responsible. Concentration of these parameters in the lake due to the aforementioned reasons was expected in licensing evaluations. However, present levels are from 50 to 90 percent lower than levels predicted during a prolonged drought. Also, 1991 levels of chlorides, sulfates, and TDS were not high enough to limit discharges from WCCL based on NPDES water quality criteria.

Surface water temperatures in the cooling lake while the station was operating have been, as expected, warmer than during preoperational years. This was especially evident during 1991 at the upstream monitoring location. This area received heated effluent during the spring and summer when southerly winds prevailed. Bimonthly temperature and dissolved oxygen profiles at this four meter deep location showed mixed, well oxygenated water except during this warm weather period. Surface to bottom profiles yielded 31°C to 27.5°C and 34.5°C to 29°C for June and August, 1991 respectively. The declines were gradual with no apparent thermocline developing. Conversely, dissolved oxygen (DO) profiles at the same location for the same months did show stratification at three meters at which DO declined from approximately 7 ppm to around 4 ppm.

At the deeper locations by the station intake and in the main body of the lake, temperature profiles showed thermal stratification developing in June and August with no apparent thermocline during October. The DO profiles at these locations also showed oxygen levels from 10 m to 18 m starting to decrease in April, becoming anoxic in June and August and increasing during

October. Well oxygenated waters were present during the rest of the year. During past monitored years, formation of an anoxic hypolimnion either was formed strongly in August and dispersed by October (1988 and 1989), or formed in June and dispersed by August (1986 and 1987). Anoxic layer formation in 1991 was most similar to 1988 and 1989 conditions. Considering data prior to and including 1991, stratification patterns in WCCL appear to be independent of the generating station's intake, warming, and discharge of circulating water, with the exception of the shallower upstream monitoring site. No changes to the expected thermal impacts to WCCL due to operation of WCGS has occurred.

3. ASIATIC CLAM MONITORING ACTIVITIES
(Corbicula fluminea)

The Asiatic clam (Corbicula fluminea) has been reported to cause biofouling problems in power plant cooling systems. The first report of Corbicula near WCGS occurred in August 1986 when immature clams were collected at long-term monitoring sites located on the Neosho River upstream and downstream of the Wolf Creek confluence. To compliment the on-going ecological monitoring program, a discrete survey has been conducted annually to identify the distribution of Corbicula in the vicinity of WCGS. During June 1991 their presence was discovered in WCCL. This prompted monitoring to determine the concentration and peak occurrence of Corbicula juveniles in the WCGS intake waters. This report presents the findings of the sampling efforts conducted during 1991.

The distribution of Corbicula fluminea in the Neosho River expanded since previous monitoring. Upstream colonization into the spillway area of JRR was observed and likely occurred during 1990. 1991 individuals became large enough and numerous enough to be easily detected. Expansion in the river above JRR was not apparent during 1991.

The densities of Corbicula in the Neosho River continued to decline gradually at most established sampling sites. This is a common post-colonization reaction of many Corbicula populations in the United States. None were found in the Makeup Water Screenhouse (MUSH) forebays where high concentrations were expected to develop. Establishment in the MUSH will more directly release juveniles into the makeup water pumped to WCCL.

Corbicula was observed in WCCL for the first time on June 27, 1991. Size distribution of those found indicated that colonization likely occurred during 1990. This would have been simultaneous with the establishment of the JRR spillway population. Makeup water pumping most likely transported the clams as planktonic juveniles to WCCL from the Neosho River. Monitoring

revealed that the 1991 distribution in WCCL was patchy and confined to the west shoreline. The densities of known patches were typical of young expanding populations. These patches consisted of a wide range of substrate types including clay, silt, gravel and combinations thereof. Protected slack water to moderately wave-swept shorelines were inhabited. No Corbicula specimens were found in the sediments from WCGS intake forebays nor from lake areas in close proximity to these intake structures. No evidence of the clam was found in plant cooling systems. In addition, no planktonic juvenile clams were found in the cooling lake immediately in front of the circulating water intake.

The WCCL population was discovered early in its colonization of the lake providing early warning of potential plant infestation. Although the current distribution is not in or close to cooling water intakes, it's expected that the clams will spread to these areas. Based on how quickly they moved within the river and to WCCL, this could be within the next year, almost certainly within two years. Annual surveys were completed in compliance with department procedures to monitor distribution and abundance of Corbicula in the vicinity of WCGS.

4. 1991 FISHERY MONITORING ACTIVITIES

Fishery monitoring surveys were conducted on WCCL from April through October 1991. These resulted in the collection of 2,613 individual fish representing 11 families and 30 species. Collection methods used were fyke netting, seining, electrofishing and gill netting. Data collected were used to describe the fishery which was subsequently evaluated based on the goal of increased plant reliability through reduced gizzard shad impingement. Catch data calculated as percent relative abundance for all gears combined showed gizzard shad highest (28.2%) and white bass next (14.4%). This shad percentage represents an increase of 2.5% from 1990; and was the highest to date. Next were bluegill (11.2%), smallmouth bass (7.1%) and walleye (5.0%). When total biomass of all species in the standardized effort was considered, wiper were highest at 17.3% followed by white bass (14.6%), walleye (10.8%), bigmouth buffalo (10.7%), smallmouth bass (6.1%), smallmouth buffalo (6.0%), gizzard shad (5.9%), and common carp (5.9%). Largemouth bass biomass fell in 1991 from comprising in the past a high percentage of the biomass statistic to only 4.7 percent. Considering a life expectancy of five to seven years and that the age of the older wiper year class was ten in 1991, it was surprising that natural mortality didn't reduce their number further. Wipers from the 1988 and 1989 stocking supported the 1991 biomass statistic, but the older 1981 year was still present in large numbers. Gizzard shad biomass from 1990 to 1991 rose from 3.9% to 5.9%, which was the highest measured to date. Shad biomass has varied slightly since lake fill but has rarely exceeded 5%.

Growth and body condition data using Proportional and Relative Stock Density (PSD, RSD), relative weight (W_r) and condition factor (K_{TL}) continued to show large average sizes, slowing growth of early predator year classes and low to moderate condition for Wolf Creek predators. Wiper growth continued but at rates which were more modest and variable than in its earliest years. Growth of crappie, white bass, and walleye continued at moderate rates. Largemouth bass growth continued to decline but was still within

acceptable limits. For all Wolf Creek predators, average sizes were large and the proportion of mature fish (quality size and larger) versus smaller, immature fish (stock size) was also large, leading to very high PSD's. At the same time, condition of these predators was generally lower than the averages from other Kansas impoundments. In contrast, both gizzard shad PSD and Wr values were close to the top of reservoirs surveyed in Kansas. While these qualities in shad have been shown to be optimal for production of a good prey base, few young-of-the year gizzard shad in WCCL remain through their first winter. Little or no survival of the last four year classes of gizzard shad indicates that the combination of predation pressure and winterkill was adequate to control expansion of the WCCL shad population. Thus, no impingement problems have been experienced so far. The sportfish/roughfish ratio in Wolf Creek was very high when compared with other reservoirs in the midsection of the United States. The unusually low number of gizzard shad and equally unusually high number of predators in WCCL meant predator condition was low but more importantly, so were impingement rates.

5. WILDLIFE MONITORING ACTIVITIES

The wildlife monitoring activities targeted possible impacts from station operation to migratory and wintering water birds in the vicinity of WCGS. The results presented here cover the 1990/1991 winter monitoring season and the first half of the 1991/1992 season. The general objectives of the program were to document and assess any trends or impacts to migrating or wintering populations of waterbirds, waterfowl, and threatened or endangered species that may be caused by station operation. Use of WCCL may expose birds to transmission line collision mortality or to disease outbreaks. Damage to local agricultural crops by large waterfowl concentrations using WCCL was also a concern. To document and assess such occurrences or increased potential for such, specific objectives of the program were to monitor how many and where waterbirds, waterfowl, and threatened and endangered species used WCCL during the winter migration season and compare these to the norm observed since station operation began.

During the 1990/1991 season thirty-four species of waterbirds and waterfowl were observed with Franklin's gull and mallard being most abundant. Mallard usage has normally been comparatively high. During the fall of 1991, similar usage was observed. During operational winters, the heated effluent provided previously unavailable open water habitat on WCCL. This, in combination with seclusion and close, abundant food supplies, has usually kept wintering birds on WCCL longer than during preoperational seasons. Significant ($p \leq 0.05$) preferences for areas of WCCL providing these factors were found during most operational seasons, although not the case during 1991. No disease or crop depredation problems were observed. No significant transmission line collision events nor the increased potential for such were observed.

The bald eagle was the only threatened or endangered species that was consistently observed using WCCL. Its usage on WCCL declined during the first two years after plant operation began while remaining constant on

JRR. A large increase was observed during the next two winters. A marked decline on both reservoirs was observed during 1989/1990 with only a very slight recovery observed during the 1990/1991 winter. During the fall of 1991, eagle numbers reflected usage experienced during the same time periods of earlier monitoring. Initial operational usage on WCCL declined primarily because of the two mild winters which caused gizzard shad, a vulnerable and preferred food resource, to be more available on JRR than WCCL. The winters of 1987/1988 and 1988/1989 were colder and station operation enhanced usage. This provided winter killed gizzard shad not usually abundant on WCCL. During the 1990/1991 season and the first half of the 1991/1992 monitoring season, bald eagle usage of WCCL reflected patterns identified for mild winters. With regression analysis it was shown that since the addition of heated effluents, the colder the air temperatures were, the greater the percentages were of area birds using WCCL. No incidence of bald eagle collisions with WCGS transmission lines have been found as a result of the usage patterns observed.