



# United States Department of the Interior

FISH AND WILDLIFE SERVICE  
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In Reply Refer To:  
Region 2: SE

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DEC 49 1986 FWS, SE Field Station  
Asheville, NC

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Dear Colonel Genetti:

This responds to your letter of September 5, 1986, requesting Formal Section 7 consultation as provided by the Endangered Species Act of 1973, as amended (Act). The Federal action under consultation is your proposal to issue a Section 404 and Section 10 permit to the Colorado River Municipal Water District (CRMWD) that will facilitate the construction and operation of the proposed Stacy Dam, Reservoir, and Pump Station on the Colorado River in Coleman, Concho, and Runnels Counties, Texas. The proposed action will affect the threatened Concho water snake (Nerodia harteri paucimaculata).

The Concho water snake was listed as a threatened species on September 3, 1986. Critical habitat, proposed for the snake on January 22, 1986, was deferred until the economic data on the impact of that proposal could be gathered and assessed. This biological opinion is based upon the U.S. Army Corps of Engineers' (Corps) September 5, 1986, biological assessment; the July 1986 Draft Environmental Statement (DEIS); pertinent literature; data in our files including recent surveys conducted by the U.S. Fish and Wildlife Service (FWS) and CRMWD; and communications with Concho water snake authorities (Francis Rose, Norm Williams, Norm Scott, and Terry Maxwell) and a population ecology expert (Michael Soule).

On February 21, 1986, the Corps requested FWS prepare a Section 7 Conference Report for the Concho water snake under Section 7(a)(4) of the Act. That report, dated May 5, 1986, concurred with the Corps' finding that Stacy Dam was likely to jeopardize the continued existence of the (then proposed) Concho water snake and was likely to adversely modify proposed critical habitat. The conference report found no feasible alternatives that would accommodate the construction and operation of Stacy Dam. This biological opinion supercedes the conference report. Water supply alternatives previously suggested in the conference report were not considered in this opinion because they did not fit the feasibility criteria of reasonable and prudent alternatives.

BIOLOGICAL OPINION

The Stacy Reservoir Project is likely to jeopardize the continued existence of the Concho water snake. Reasonable and prudent alternatives are provided that remove the threat of jeopardy. Adverse modification of proposed critical habitat will also occur as stated in the conference report. The reasonable and prudent alternatives contained in this biological opinion dealing with habitat protection within the proposed critical habitat will continue to provide habitat for the snake, while other alternatives will make the range of the snake more continuous outside of the proposed critical habitat. Together, these alternatives will provide for the survival and recovery of the Concho water snake and thus eliminate adverse modification. Assurances that these alternatives will be funded and carried out must be made prior to final Federal approval of the permit application.

PROJECT DESCRIPTION

Project description information was obtained from a number of sources, including the permit application, biological assessment, State water appropriation permit, and DEIS. The proposed Stacy Dam would be located on the mainstream Colorado River at River Mile 615.1, 15.9 river miles downstream from the confluence of the Colorado with the Concho River. The dam would create a maximum pool of 19,200 surface acres, extending 46 miles up the Colorado and Concho Rivers in Coleman, Concho, and Runnels Counties, Texas. The conservation pool elevation (1551.5 ft., m.s.l.) would equal 554,340 acre feet (af). A pump station and pipelines would also be constructed. Construction of Stacy Dam is scheduled to start in May 1987.

Total yearly diversion from the reservoir allowed by the State water appropriation permit would be 103,000 af for domestic and municipal purposes, and 10,000 af for industrial purposes. Up to 15,000 af/yr of the above total can be a transbasin diversion to the Brazos River system, thus providing water for use by the City of Abilene and customers in Taylor and Jones Counties, Texas. Other cities planning to use Stacy Reservoir water include: Odessa, Big Spring, Snyder, San Angelo, Midland, Stanton, and Robert Lee. The maximum diversion rate authorized from the reservoir for municipal use is 191.34 cubic feet per second (cfs).

## BACKGROUND INFORMATION

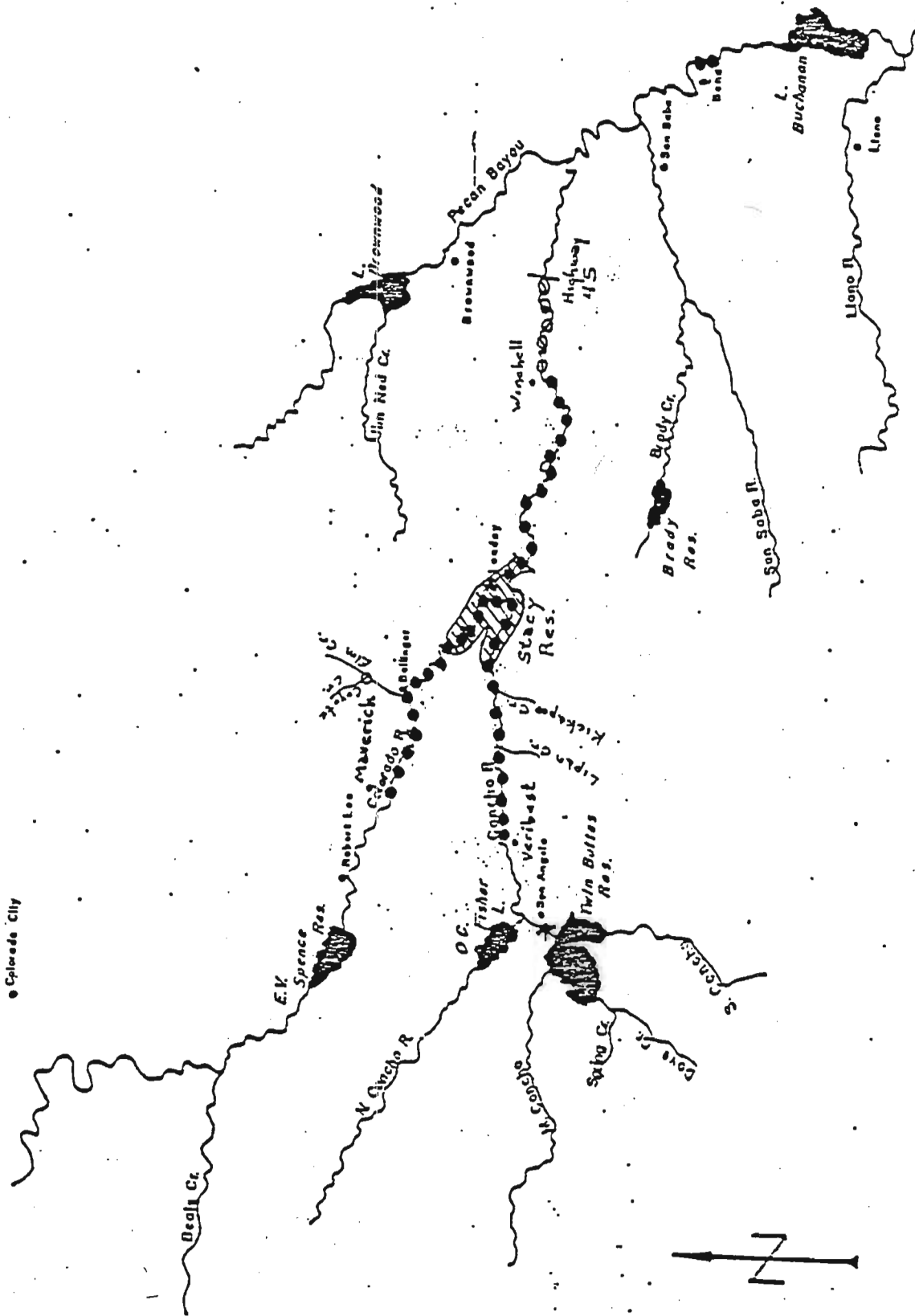
The Concho water snake (*Nerodia harteri paucimaculata*) and the Brazos water snake (*Nerodia harteri harteri*) together constitute the species *Nerodia harteri*, known collectively as Harter's water snake. The Brazos water snake, found only in the Brazos River drainage of Texas, was discovered in 1936 by Phillip Harter and described in 1941 by H. Trapido. The Concho water snake, found only in the Colorado River drainage of Texas, was discovered in 1944 by J. Marr and described as a distinct subspecies by Tinkle and Conant in 1961. Status surveys were conducted from 1979-1985 for both subspecies (Flury and Maxwell 1981, Scott and Fitzgerald 1985, Rose 1985) and indicated the Concho water snake's range had declined by 28 percent, primarily as a result of continuing habitat loss and modification. Conversely, these status surveys showed the range of the Brazos water snake had not declined significantly and existing threats to its habitat did not threaten its survival. Based on these surveys, FWS found the Concho water snake warranted Federal listing as threatened, and the Brazos water snake did not warrant Federal listing at this time.

### Past and Present Distribution

Historically, the Concho water snake occurred over about 276 river miles of the Colorado and Concho Rivers, and a few associated tributaries. Now the subspecies is distributed discontinuously over approximately 199 river miles of mainstream reaches in Runnels, Tom Green, Concho, McCulloch, Coleman, Brown, Mills, San Saba, Irion, and Lampasas Counties (see Figure 1). The highest concentration of snakes centers around the confluence of the Colorado and Concho Rivers. Recent surveys by CRMWD suggest a few Concho water snakes still occur in tributaries to the Colorado and Concho Rivers. A small population of water snakes (5 individuals) was found in Elm Creek and its tributary, Coyote Creek. Elm Creek is a tributary of the Colorado River near Ballinger, Texas. A few individual Concho water snakes were recently observed in three Concho River tributaries, Spring (2), Kickapoo (2), and Lipan (1) Creeks, but are not known to represent viable populations.

### Habitat Requirements

Concho water snake habitat has been described in several publications and reports (Tinkle and Conant 1961, Williams 1969, Conant 1975, Flury and Maxwell 1981, Tennant 1984, and Scott and Fitzgerald 1985). Habitat use differs significantly between adult and juvenile Concho water snakes. Juveniles are most often found in rocky or gravelly areas adjacent to shallow water flowing over rocky



●●● Good Concho water snake habitat  
 ○○○ Peripheral habitat

Figure 1.

shoals or riffles. These areas are unshaded most of the day and contain a large percentage of flat rocks under which juveniles hide for thermal regulation and protective cover. Distribution of these habitat areas appears to be extremely important. Riffle frequency in occupied Concho water snake habitat ranges from 1.5 to 3 riffles per mile with the best habitat containing the highest riffle rates. In the reach of the Colorado River extending from the Highway 45 crossing downstream to the town of Bend, riffle frequency is only 0.5 per mile and Concho water snakes do not occur.

Adult Concho water snakes use a wider range of habitats including shallows, pools, overhanging woody vegetation, and rocky shorelines. Adults flee to the water for escape cover, with a preference for pools of greater than 2 feet in depth. While it is possible that individual adult Concho water snakes may survive in a reservoir habitat, no Concho water snakes, either adult or juvenile, have ever been found in any Concho or Colorado River reservoir.

### Life History

Knowledge of the reproduction and population biology of the Concho water snake is limited. Williams (1969) conducted the only study of the population ecology of the species, and the following information is taken primarily from his thesis. The Concho water snake emerges from hibernation in mid-March to mid-April, and mating is thought to occur soon thereafter. Newborn snakes (young-of-the-year) were first seen by Williams on September 7, although they have been observed in late August by other biologists (Norm Scott, personal communication). Captive Concho water snakes have given birth to from 7 to 22 young (Tennant 1984), and Williams found that recruitment (young-of-the-year) increased the population eight-fold. Hibernation occurs in late October to late November, depending upon weather and temperatures.

Female Concho water snakes apparently reach sexual maturity at the end of the summer following birth, and rarely reproduce more than twice. Williams found that the life span of the adults rarely exceed three years, although data from other water snakes indicates that maximum life spans are generally much longer. Williams documented an 80 percent mortality of juvenile Concho water snakes over winter.

Concho water snakes feed only on fish, and have been observed feeding both during the day and at night. Feeding behavior involves anchoring the body around rocks, usually in shallow water, and probing among the rocks, trapping fish prey in cracks and crevices. Williams found that three fish species made up 94 percent of the food of his study population; red shiner (Notropis lutrensis), plains killifish (Fundulus zebrinus), and speckled

chub (Hybopsis aestivalis). Several other fish species have been found in Concho water snake stomachs, and the snake is thought to be an opportunistic predator on most small, shallow-water fishes.

Because of the more restrictive habitat requirements of juvenile Concho water snakes, their foraging habitat requirements were chosen as the primary factor in interpreting habitat modeling data (see Habitat Modeling section) and in designing the reasonable and prudent alternatives. The restriction of juvenile Concho water snakes to low-gradient, loose-rock shoals adjacent to silt-free cobble and gravel shallows or riffles is thought to result primarily from three factors: 1) juvenile snakes have limited energy levels (Pough, 1977) which restricts feeding to shallow waters where fish prey are most vulnerable; 2) the exposed rocky shoals act as thermal sinks, providing the necessary warmth for rapid growth as well as protection from terrestrial predators; and 3) the shallow water adjacent to the shoals provide relatively predator free feeding areas, as opposed to pools which support large predatory fish.

#### DESCRIPTION OF ENVIRONMENTAL BASELINE

Section 7 Interagency Cooperation Regulations require FWS to consider cumulative effects to listed species as well as effects due solely to the Federal action at hand in the biological opinion. An environmental baseline is developed prior to consideration of future cumulative effects. Categories of impacts that should be considered in this analysis include existing impacts not previously subject to consultation, impacts that have been evaluated through Section 7 consultation, and private and State actions (needing no Federal authorizations) reasonably certain to occur. This analysis has been performed in accordance with the legal opinion of the Department of the Interior, Associate Solicitor for Conservation and Wildlife, as set forth in a memorandum dated August 21, 1981, and the most recent Section 7 Regulations, 50 CFR Part 402, dated June 3, 1986.

Habitat of the Concho water snake has been affected by four large reservoirs on the mainstream Colorado and Concho Rivers, and by several smaller impoundments on tributary streams. Such water development has contributed to the current environmental baseline conditions for the snake. At least three separate aspects of these impoundments have resulted in losses of Concho water snake habitat: inundation of habitat, downstream impacts, and population fragmentation.

Within the influence of impoundments on both rivers, the gravel riffle habitat has been inundated, leaving reservoir shorelines apparently unsuitable for the snake. Below existing dams on the Colorado River, the normal river flow has been severely reduced or curtailed, and floodflow scouring which maintains the stream bed and defines channel characteristics has been eliminated. Without such scouring flows, the rocky streambed and riparian

zone become covered with silt, eliminating the gravel-bottomed riffle areas and shoals required for juvenile snakes, and allowing the former channel to become choked with vegetation. The documented losses of Concho water snakes as a result of Robert Lee Dam (E.V. Spence Reservoir) on the Colorado River are discussed later in this section.

A third, less understood impact to Concho water snakes resulting from dam construction has been population fragmentation. Prior to the construction of Lake Nasworthy and Twin Buttes Reservoir on the upper Concho River system, there were documented Concho water snake populations in Dove Creek and the South Concho River. Even though the actual reaches that once supported snakes in most of these Concho River headwaters have not been inundated, the populations have been all but extirpated. The subsequent construction of Twin Buttes Reservoir on the South Concho River compounded the separation problem in this drainage (see Figure 1). Recent surveys of all of these tributaries located only two Concho water snakes in Spring Creek, a tributary of Dove Creek.

Population fragmentation is expected to have several adverse impacts: (1) it will reduce the amount of habitat available to the organism through physical isolation; (2) it will result in loss of the best available habitat, leaving more peripheral, suboptimum habitat; (3) it will restrict genetic interchange and population influx between populations; (4) it will leave the isolated populations much more vulnerable to environmental variations and natural catastrophes; and (5) it will prevent recolonization of suitable habitat after catastrophic losses. Isolation of Concho water snake populations by dams on the South Concho River is the probable cause of the disappearance of viable populations from these headwaters. Fragmentation must therefore be addressed in this opinion to assure viability of the three remaining populations of Concho water snakes after their separation by Stacy Reservoir.

In addition to flow reductions due to the mainstream reservoirs, there have been declines in flows of the Colorado and Concho Rivers resulting from additive impacts of smaller water impoundments and water diversions. These flow declines began very early in the history of European settlement in the area. Overall declines in the average annual discharge since 1935 of the Colorado River at Ballinger, Texas and the Concho River at Paint Rock, Texas are 65 and 61 percent; respectively. The loss of flow in these rivers has reduced or eliminated suitable habitat as well as impacting the fish food base for the Concho water snake. Also, water pollution and sedimentation problems have been exacerbated due to a lack of water diluting volumes.

Future impacts which act cumulatively to impact the species include increased stream siltation due to land management practices in the watershed, the continued use of agrichemicals which may

affect the snake or its food base, and changes in levels of point-source water pollution. There are no known major water development activities which could take place without Section 7 consultation.

#### Stream Flows and Concho Water Snake Habitat

Stream flow records for the Colorado and Concho Rivers were reviewed from 1908 to present (see attached). Comparisons were made before and after Robert Lee Dam was constructed on the Colorado River (1968) and before and after O.C. Fisher (1951) and Twin Buttes Reservoir (1962) were constructed on South Concho River. River channel morphology results from a complex series of parameters that combine to produce stability. Bankful flow (Pb), the discharge which fills the channel to capacity such that additional flow will cause overbank flooding, is a physical index of the most dominant range of channel-forming flows. The geometric mean of an annual peak flow series (Pgm) represents the relative magnitude of all peaks in the series and approximates Pb (Lowhan 1982). The channel-forming effectiveness of Pgm is determined by its volume and frequency of occurrence (duration). Prior to construction of Robert Lee Dam, Pgm at Ballinger averaged 15,907 cfs (0.98 days/year). After Robert Lee, Pgm dropped to 4,374 cfs (0.08 days/year). Similarly, on the Concho River at San Angelo, Pgm before O.C. Fisher Dam was 17,391 cfs (0.30 days/year) and after construction dropped to 9,747 cfs (0.83 days/year). After construction of Twin Buttes, Concho River Pgm dropped to 1,285 cfs (0.81 days/year). Since 1965, with all dams in place on the Concho and Colorado Rivers, Pgm at Winchell, 54.5 miles below Stacy Dam site, has averaged 11,211 cfs (0.81 days/year); prior to 1965 it averaged 27,536 cfs (0.98 days/year).

FWS believes that the Concho River has stabilized at its presently reduced flows, perhaps due to the numerous low-head irrigation dams along its course, but that the Colorado River continues to change as a result of the construction of Robert Lee Dam. Reduction of Pgm from 15,907 cfs (0.98 days/year) to 4,374 cfs (0.08 days/year) in the Colorado River, measured at Ballinger, has resulted in silt accumulations, vegetation encroachment and stream narrowing at least to Maverick. Under existing flow regimens in the Colorado River, this process will continue downstream, resulting in the continuing reduction of snake habitat, particularly juvenile habitat.

In 1965-67, Norm Williams studied a flourishing population of Concho water snakes immediately below the yet-to-be constructed Robert Lee Dam. The habitat consisted of:

"...deep still pools, shallow riffles, swift rapids, and isolated stagnant pools. The river bed varies from a hard, smooth limestone to gravel and deep mud.



"The water level fluctuates greatly during the year. In late August of 1966, the river was a fairly fast moving stream, with water filling the bed. During the fall, winter, and spring months rain filled the river to overflow. Drought periods during the summer months lowered the water level appreciably so that only a slow trickle was observed. The width of the river varied during periods of normal flow from a few feet to as much as 20 yards. The depth varied normally from a few inches to two feet in isolated pools. During the flooding of the late spring of 1967, a depth of ten feet or more was not uncommon. During the one year period of this study noticeable changes in the banks and river bed occurred due to this flooding. New sand and gravel bars and debris piles were formed. The river bed was altered slightly to form new riffles and pools" (Williams 1969).

Today, that same reach of the Colorado River is a low-flow stream channel about 10 feet wide. Silt and vegetation have encroached on most of the original channel, covering the rocky riffles and burying the pools. Concho water snakes are no longer found in this reach of the Colorado River. Scott and Fitzgerald (1985) described it this way:

"We found that the habitat immediately below Robert Lee was very different from the same area figured in Williams (1969). Instead of a swift-flowing stream running over rocky riffles between shallow and deep pools, we found a muddy, sluggish trickle choked with salt cedar. Apparently, the lack of scouring floods allowed the rocky streambed to become covered with silt which provided an excellent substrate for the invasion of salt cedar and other perennial trees, grasses, and sedges. Brnovak (1975) had noted similar changes as early as 1973-1975. About 45 km below Robert Lee, silt deposition was noticeably less, rocky riffles appeared, salt cedar was much less common, and we found the first N. h. paucimaculata. Downstream from this point near Maverick, the species seemed to be regular if not abundant."

Below Maverick, the effects of the reduced flows from Robert Lee Dam have not adversely altered water snake habitat. In this instance, lower flows themselves do not appear to be detrimental to the snake or its principle food items, but above Maverick the loss of gravel riffles for juvenile snake foraging and resting habitats due to siltation and vegetation encroachment is detrimental. Good water snake habitat on the Colorado River presently extends downstream from Maverick to Winchell, a distance of 123 miles.

Below Winchell, geology of the area dictates gradual changes in the Colorado River, resulting in fewer and smaller riffles. For

about the next 24 miles of stream, Concho water snakes persist but their distribution centers around fewer and fewer riffles. Eventually, the snake disappears completely from the Colorado River, somewhere near Highway 45, and for the next 80 miles no Concho water snakes have been found. Downstream from this devoid reach, below Bend, Texas, a small, remnant population of Concho water snakes exists in 10 miles of habitat. The reason for the lack of water snakes above Bend has been explained by Scott and Fitzgerald (1985) as a lack of suitable habitat. Riffles are too widespread to allow successful colonization and the sandstone substrate may not allow for good gravel habitats. In other areas, where clean gravel riffles occur more frequently than every half mile, snakes prosper. Where gravel riffles decrease to less than 1 per mile or the riffles become embedded in silt or sand, snakes decline or disappear.

Habitat changes and pollution in the upper Concho River have eliminated Concho water snakes from San Angelo to Veribest (11 river miles). The Concho River still supports a good population of Concho water snakes from Veribest to the confluence of the Colorado River.

#### HABITAT MODELING

As a part of this consultation, FWS initiated additional collection of data on Concho water snake habitat. Data collected were primarily hydrologic and were used to establish flow levels necessary for survival of the water snake, to quantify habitat losses to the project and the potential habitat gains through various alternatives. The FWS Instream Flow Incremental Methodology (IFIM) was used to analyze currently available habitat and to predict habitat levels at various stream discharges. Biological data on suitability of various habitat parameters (water depth, water velocity, substrate, and cover) were assembled by a group of five biologists knowledgeable about the Concho water snake or similar species, and by a group of three biologists knowledgeable about the fishes which form the food base of the snake. These suitability data were assembled during a three day meeting in Midland, Texas on September 9-11, 1986. Measurements of existing physical conditions on the Concho and Colorado Rivers were taken from September 22 - October 3, 1986, using standard IFIM methods. Biological and physical data were analyzed at various flows using the Physical Habitat Simulation (PHABSIM) program developed by the FWS for other projects. This program provided predictions of available habitat at various flows, as weighted useable area (WUA), which is the available habitat weighted for levels of quality. Habitat estimations were made for juvenile foraging area, juvenile resting area, adult foraging area, adult basking area, and the areas needed by four species of forage fish. The program also provided predictions of the WUA which exists in the area to be lost to inundation, altered by project stream flow changes, or gained by various manipulations of physical habitat parameters.

PHABSIM analysis estimated there are presently 6,311,788 ft<sup>2</sup> of WUA of juvenile foraging habitat in the Colorado and Concho Rivers. After consideration of all the habitats utilized by Concho water snakes, juvenile foraging habitat was the parameter chosen to describe impacts associated with Stacy Dam because FWS believes it is the most limiting factor for the subspecies. The analysis also showed that total losses associated with the Stacy project (inundation zone and reduction of flows) will be 1,637,308 ft<sup>2</sup> WUA (26 percent). Reasonable and prudent alternatives presented in this opinion compensate for these projected losses.

### Viability Analysis

Much of the rationale behind the reasonable and prudent alternatives relates to this modeling (see attached viability analysis). Although several of the assumptions in this model are open to question, the basic ideas appear correct. These include: even without Stacy Dam, the Concho water snake is likely to be lost in the upper Colorado River and decline greatly in the lower Colorado River; loss of habitat increases vulnerability; increase in habitat is more important than an increase in numbers in the face of catastrophe; riffle frequency determines isolated population survival; population fragmentation increases susceptibility to extinction (especially due to catastrophe); greater environmental variation (flood or zero flows) promotes extinction; management intervention may enhance the viability of the snake above current (pre-dam) status.

The viability model suggests that without alternatives, construction of Stacy Dam will lead to the loss of Concho water snakes in the Colorado River but not in the Concho River, and will increase chances of catastrophic extinction by up to 20 fold. It also suggests the following alternatives will reduce or even eliminate that risk: 1) reduction of environmental variation (reduce very high or zero flows); 2) creation of additional habitat (riffles close enough to permit frequent dispersal), especially in the Colorado River; 3) artificial dispersal of genetic materials. These three suggestions, plus the protection of isolated areas, form the basis of the following alternatives.

Four basic assumptions directed development of these alternatives: 1) Concho water snake habitat, that will allow the subspecies to carry out all phases of its life history, can be artificially created and maintained; 2) no changes should be suggested for river reaches supporting good populations of Concho water snakes because efforts may do more harm than good, and because an increase in the numbers of snakes is less important than the expansion of snake habitat; 3) newly created habitats may not be of equal value (WUA) to habitat being lost, because creation of new habitat is yet to be tested while the reaches being lost contain some of

the best Concho water snake habitat available; 4) long-term commitments to best management practices will be maintained by all parties.

### REASONABLE AND PRUDENT ALTERNATIVES

Reasonable and prudent alternatives are those alternative actions that can be implemented in a manner consistent with the intended purpose of the action and consistent with the scope of the Federal agency's authority and jurisdiction and will avoid jeopardizing the species. The principal objective of these alternatives is the creation of habitat for the Concho water snake within its historic range. Changes in water regime resulting from Stacy Dam and implementation of these alternatives are expected to result in the loss of 1,738,033 ft<sup>2</sup> (WUA) of juvenile water snake habitat and the creation of up to 2,629,449 ft<sup>2</sup> (WUA) of new habitat. Occupation of the new habitat by Concho water snakes will be carefully monitored to assure long-term success. Flexibility to test methods of creating the necessary water snake habitat will be provided via a cooperative agreement that allow progressive implementation of alternatives. Successful alternatives will be implemented rapidly; alternatives that fail to achieve the required goal will be improved. There are four basic areas that are the focus of this consultation regarding impacts of the proposed Stacy project on the Concho water snake: (1) the Colorado River downstream from Stacy Dam to Pecan Bayou, (2) Stacy Reservoir within and adjacent to the maximum reservoir pool, (3) the Colorado River upstream from Stacy Reservoir to Spence Reservoir and, (4) the Concho River upstream from Stacy Reservoir to San Angelo.

*up to 2+M  
ft<sup>2</sup> of habitat  
but what could  
have and be  
How does  
monitoring  
insure success?*

Reasonable and prudent alternatives have been developed to eliminate jeopardy and adverse modification, and involve an integrated set of activities in each of the areas of concern. These alternatives act together as a functional unit, and must be fully implemented in each area to insure the continued existence of the Concho water snake. The continued existence of the Concho water snake after Stacy Reservoir will also be supported by active research incorporated into long-term management efforts. These efforts will fall upon CRMWD, through Corps permit requirements, and are outlined in the following alternatives.

#### I. Monitoring

CRMWD will monitor the Concho water snake and its habitat in order to provide a continuous record of their well-being and to determine if the alternatives are working as planned. Monitoring will occur three times each year, in April-May and again in September and October, in each of the three river reaches isolated by Stacy Reservoir (upper Colorado River, lower Colorado River, and Concho River). Five specific juvenile habitat areas supporting healthy populations of Concho water snakes will be selected in each reach. These permanent monitoring sites will be searched completely once

each spring and twice each autumn for snakes. Lengths and weights of all Concho water snakes at each site will be recorded, the animals will be cold branded for individual identification and then released. Presence of food items will be noted, but the snakes should not be handled so as to cause them to regurgitate food items. Numbers of individuals of other species of Nerodia should also be recorded.

Young-of-the year snakes are expected to make up the bulk of the autumn individuals measured. A second trip to each locality about four weeks after the first autumn marking will then be made in an attempt to recapture and remeasure marked snakes in order to determine growth and survival. Spring monitoring will look for marked snakes as well as measuring and marking individual snakes. During the autumn monitoring period, fish near each site will also be sampled by seine to determine approximate estimates of abundance and species diversity. Flow rates, suitability of the habitats for snakes, length of the selected habitats, vegetation encroachment and other physical parameters important to water snakes will also be noted. Stream channel profiles will be measured each year for each monitoring site using the suitability criteria and IFIM methods used during this consultation. Suitability measurements of selected juvenile snake habitat are expected to yield better criteria through experience. Feedback through monitoring will help to ensure that management alternatives are modified with time to more efficiently preserve constituent elements of proposed critical habitat. An annual report on monitoring will be submitted to the FWS by December 31 of each year. Monitoring is necessary during construction of Stacy Dam and the filling of Stacy Reservoir, and should continue for 10 years.

## II. Studies

Although several status and distribution surveys have been carried out on the Concho water snake, little information is available on basic life history and biology. The following is a list of studies necessary to more accurately determine the habitat/life stage needs of this species. Information derived from these studies will be continuously incorporated into ongoing alternatives in order to "fine tune" management efforts. All should start immediately.

- A) Life history study, including age, growth, reproduction, hibernation, food and feeding, behavior, predation, competition, habitat descriptions and utilization, thermo-regulation and movement. Other likely biological parameters may be added as the study proceeds. Five years.

- B) Genetic viability of the existing population and the isolated subpopulations. Two years.
- C) Physical habitat studies, including stream channel stability, sediment source and deposition, vegetation encroachment and water chemistry. Three years.
- D) Information on availability and distribution of food items. Two years.
- E) Energy budget and growth of all three water snake species at different life stages under natural and controlled conditions. Three years.
- F) Evaluation of the various proposed management alternatives within this opinion, with recommendations for improvements. Ten years.

Studies will act, along with monitoring (I), to ensure that active management alternatives are appropriately adjusted to diminish adverse impacts to proposed critical habitat. Some of this information would be needed regardless of the construction of Stacy Dam, while other important studies are a direct result of the proposed construction. FWS is willing to share the cost of the life history and energy/growth studies with CRMWD. All other studies are the responsibility of CRMWD. Study plans must be approved by FWS before studies are initiated.

### III. Upper Colorado River Management. (net +249,197 ft<sup>2</sup> WUA)

The upper Colorado River between Robert Lee Dam and Maverick once supported a good population of Concho water snakes, prior to the closure of Robert Lee Dam. Presently, no Concho water snakes occupy this reach but continue to do well from Maverick to below Ballinger. The objectives of this alternative are to reconstruct Concho water snake habitat in the Colorado River from Robert Lee Dam to Maverick and to stop the continued downstream encroachment of silt and vegetation on juvenile foraging areas below Maverick. This alternative will create 349,922 ft<sup>2</sup> of WUA of Concho water snake juvenile foraging habitat, but will also result in the loss of 100,725 ft<sup>2</sup> WUA below Maverick due to increased flows. The losses (10 percent) are more than offset by the gain (34 percent) and the expansion of snake habitat by more than 30 river miles. The following items will be necessary to implement the rehabilitation.

*But! you don't know just if  
you can create habitat*

A. Flow releases required from E.V. Spence Reservoir:

It is the responsibility of CRMWD to create and maintain good Concho water snake habitat in this reach. The following alternatives are designed to meet that responsibility. Options that delay the alternatives due to high water or drought do not abrogate that overall responsibility.

1. Minimum Flow.

In order to provide suitable habitat for the Concho water snake and its food base, a minimum flow in the channel year round is required. CRMWD will release water from E.V. Spence Reservoir at flows sufficient to maintain at least 10 cfs throughout the reach of the Colorado River from Robert Lee to the USGS flow gauge at Ballinger. This flow will not be dependent upon presence or absence of flow into the reservoir, is in addition to releases for downstream water rights and shall not be depleted below the 10 cfs level by any water user. A 10 cfs flow will provide optimal juvenile feeding habitat for Concho water snakes in this reach at its present configuration, as shown by PHABSIM modeling.

2. Channel Maintenance Flow.

To maintain a stable channel morphology, a high flow is needed for flushing of sediments. Although the flow that originally formed the Colorado River channel in this area (Pgm) is no longer possible [15,907 cfs (0.98 days/year)], it is expected that 600 cfs released from E.V. Spence Reservoir for a period of 3 consecutive days once every 2 years should be sufficient to maintain a channel of reduced size. This flow must be released during the winter (November through February) to avoid adverse effects on juvenile and hatching Concho water snakes, and should correspond with natural flood events, if available, to maximize the scouring effect. The release of channel maintenance flows will not be dependent upon flow into the Reservoir. Maximum flow release from Robert Lee Dam is dependent upon water levels. If insufficient head exists to release 600 cfs during the first year of a two year cycle, maximum flows available will be released the second year for the same duration (3 days).

High flow releases from Lake E.V. Spence will be made in such a manner as to minimize harm to Concho water snakes. Due to prior commitments of CRMWD to meet downstream water right holders water requirements



(such releases normally occur in July and August, annually, and have duration of 48 to 72 hours), it may be necessary from time to time to release water at rates up to 500 cfs. CRMWD will use its best efforts not to exceed 75 cfs after August 20, the earliest hatching date known for Concho water snakes. In addition to special releases, it may be necessary from time to time to utilize the spillway structure at Lake E.V. Spence to alleviate flood conditions that may develop upstream from Robert Lee Dam in accordance with the terms and conditions contained in the water permit to CRMWD from the State of Texas, authorizing the impoundment of water in Spence Reservoir.

CRMWD will not be required to release channel maintenance flows (as described in this section) during periods of extended drought or conditions that may call for water rationing by the municipalities serviced by CRMWD.

B. Channel and habitat rehabilitation:

1. Vegetation and Silt Removal.

In order to recreate appropriate juvenile Concho water snake habitat in the upper Colorado River from Robert Lee to near Maverick (30 miles), it will be necessary to remove the existing encroaching silt and vegetation from the riffle areas. The requested channel maintenance flow releases are not expected to effectively remove already established vegetation. Mechanical removal is suggested. CRMWD should submit a plan for this effort by May 1987 for Corps and FWS review and approval.

2. Addition of Rock. - *this will require addition of rock forever?*

Channel maintenance flows move rocks downstream. Construction of Robert Lee Dam has prevented the recharge of the rock substrates that were naturally found in this reach of the Colorado River. Existing rock substrates are now either transported out of the system or have become covered with sediment. It will be necessary to reconstruct this substrate. Rock will include a mix of sizes from medium gravels to large boulders, and should be placed both laterally and cross channel to form bars and riffle areas. Rock used in habitat rehabilitation or creation should be of slab limestone origin and at least 50 percent (including all size categories) should be flat, slab-like rock. The new habitat areas must have shallow water



associated with the rock, and a general slope of 10 percent or less. Riffle habitats will be clustered in groups or complexes and will have an average frequency of 3 per mile, similar to that found in the best known Concho water snake habitat. Riffles will range in length from 100-450 feet and average 150 feet long. Width of the rock/gravel shoals should be sufficient to allow snakes to utilize them from the low flow periods (10 cfs) to the ordinary high water mark. Placement of new habitat must be designed to minimize sedimentation or washout problems and mimic natural pre-Spence Reservoir patterns. New habitat will be monitored for success and replaced or modified as necessary to ensure long-term success in Concho water snake survival and reproduction.

C. Concho water snake reintroduction:

It is not likely that adequate numbers of Concho water snakes will quickly move upstream to colonize all the newly created habitat. It will thus be necessary to move snakes upstream to the restored habitats. Such transplants are to come from the area on the Colorado River to be inundated by Stacy Reservoir and will consist of approximately equal numbers of males and females. Snakes should not be moved into newly created habitat until the presence of a sufficient food base has been confirmed. This food base is expected to move in the area naturally, but may have to be stocked if natural movement does not occur rapidly.

D. Protection of rehabilitated habitat and existing, minimum and dominant flows:

For long-term maintenance of the rehabilitated habitats and flows, it will be necessary to protect the newly created habitat areas from water and gravel harvesting, lowhead dam construction, road and bridge construction and any other channel modification or development that might be proposed. CRMWD will use its legal authorities to prevent water development within the Colorado River channel, and elsewhere in the watershed when such development will impound over 200 acre feet. CRMWD will also discourage water development within the watershed under the 200 acre feet category. Protection of flows by authority of CRMWD may benefit proposed critical habitat on the Colorado River above the inundation of Stacy Reservoir.

IV. Lower Colorado River Management (net + 2,059,019 ft<sup>2</sup> WUA).

Concho water snake habitat in this reach presently varies from good between Stacy Dam and Winchell, to fair between

Winchell and the Highway 45 bridge, to unoccupied below Highway 45. The goal of this alternative is to protect the good habitats and to upgrade the fair and unoccupied reaches to good habitats. Flow reductions will result in the loss of 186,758 ft<sup>2</sup> WUA of juvenile foraging habitat that will be offset by the creation of 2,245,777 ft<sup>2</sup> WUA of new habitat. This alternative serves to protect critical habitat constituent elements below Stacy Dam through guaranteed minimum flows, channel maintenance, proper stream temperature regime and habitat improvement actions.

A. Flow releases from Stacy Reservoir:

1. Minimum Flow.

Release flows from Stacy Dam sufficient to maintain 11.0 cfs in the Colorado River between April and September, and 2.5 cfs between October and March of each year, from Stacy to Pecan Bayou. These flow requirements (slightly higher than flows stipulated in the CRMWD State water permit), represent instantaneous minimums, and are to be protected throughout the lower reach of the river. Eleven cfs minimum flow was chosen for Concho water snakes because the PHABSIM model indicated that it was the lowest flow that would provide near optimal juvenile foraging and resting habitat in the reduced Colorado River channel below Stacy. Continuous flows are necessary to maintain juvenile foraging habitats (shallow riffles) and for the forage fish upon which the snake depends. These flows will not be dependent upon the presence or absence of water flowing into Stacy Reservoir, and must be protected from legal and illegal water diversion.

2. Channel Maintenance.

It will be the responsibility of CRMWD to assure that the Colorado River below Stacy Dam remains suitable habitat for the Concho water snake. Present flow (Pgm) at Stacy required to maintain the existing channel are 7,728 cfs (0.60 days/year). Due to reduced discharges following the construction of Stacy Dam, the river will stabilize at a smaller channel. A computed flow of 2,500 cfs for 2 consecutive days once every 2 years will be sufficient to maintain snake habitats in the new channel. The 2,500 cfs will be released according to the same criteria under which channel maintenance flows are released from Spence Reservoir (see III A.2). The release of this channel maintenance flow will not be dependent upon flows into Stacy Reservoir. Periodic flows from Mustang and Home

Creeks will also provide some flushing of the Colorado River, but alone will not be sufficient to stop encroachment of vegetation on riffle areas that make up juvenile snake habitat, and will do nothing to maintain the reach from Stacy Dam to Mustang Creek. If 2,500 cfs fails to provide complete flushing of sediments below Stacy Dam, CRMWD will be responsible for mechanical removal.

### 3. Temperature.

Release of waters from Stacy Dam significantly colder than the ambient water temperature of the Colorado River will result in the death of many water snakes and most of the forage fish for many miles downstream. During warm weather, Stacy Reservoir will stratify, resulting in the deeper waters (hypolimnion) maintaining a consistent temperature of about 55° F. During autumn, winter, and spring, stratification is disrupted and the reservoir will be approximately the same temperature as the river. Release of hypolimnetic waters from Stacy Reservoir during the summer months when ambient river water temperatures could be 80°F must not occur. When the reservoir is stratified, all releases will come only from the warmer, epilimnetic surface waters. Because channel forming flows will be released only during November-February when the reservoir is not stratified, they will not be a problem. Permit release flows required by the Lower Colorado River Authority should come only from epilimnetic waters.

## B. Habitat Improvement

### 1. Stacy Dam to Winchell. (-186,758 ft<sup>2</sup> WUA)

Within the reach of the Colorado River from Stacy Dam to Winchell, water snake habitat is good, and snakes are abundant. Changes in water flows after construction of Stacy Dam are expected to reduce Concho water snake habitat in this reach by 186,758 ft<sup>2</sup> WUA. However, the river is not expected to aggrade as happened below Spence Reservoir because of differences in soil type and land management practices below Stacy. Snakes are expected to remain in this reach of the river, but at reduced numbers corresponding to the reduced habitat, and no further efforts (besides those discussed in A. above) are proposed.

2. Winchell to Pecan Bayou (+2,245,777 ft<sup>2</sup> WUA)

From Winchell to Pecan Bayou, the Colorado River changes its bedrock strata and enters an area of extensive sandstone. Snakes and riffle habitats continue to be found throughout the first 24 miles of this formation, but at a reduced rate, and eventually disappear completely. Within the river reach between Winchell and Pecan Bayou (49 river miles), CRMWD has an unparalleled opportunity to improve and create new water snake habitat in an area that now has only limited water snake utilization. Reduced flows in this reach due to Stacy Dam should allow extensive instream manipulation in order to create new juvenile water snake feeding and resting habitat. Numerous low head dams or gabions will be constructed that will act as partial barriers to gravel and cobble, creating new riffles above and below them. Height of the barriers should be sufficient to create rock riffles 450 feet long associated with each barrier, but should not exceed one foot. These newly created snake habitats should be interspersed with existing shoals and riffles to provide an average of at least three per mile of stream. Barrier shape should concentrate low water flows towards the active channel of the stream, and the barriers should be firmly attached to the substrate to withstand the high flows anticipated from at least a 100 year flood. If natural rock recruitment is not sufficient to form riffles and shoals in association with these barriers within 3 years following their construction, then rock meeting the criteria set forth in III B2 will be placed above and below these barriers to form the specified habitat. Reaches of the Colorado River below Pecan Bayou are not recommended for improvement because sustained maintenance of riffle habitats within the area may be physically impossible. Flows and sand/silt contributed by Pecan Bayou and the San Saba River and other tributaries are likely to wash out or bury instream structures and associated snake habitats during flood flows.

V. Concho River Management

There are presently 19 low head dams (some exceeding 6 feet in height) on the Concho River below San Angelo. These dams interrupt gravel transport downstream, inundate long stretches of river, and may hinder snake movement. The FWS considered removal of all or some of these structures in order to expose additional juvenile foraging habitat. However, ownership and legal status of the dams is unknown, and their existence may have even benefited water snakes

by stopping downstream changes to the Concho River that have destroyed habitat below Robert Lee Dam on the Colorado River. Therefore, CRMWD will determine the status of each of the low head dams on the Concho River below San Angelo and investigate the feasibility of their removal. This report should be completed and sent to the Corps and FWS by December 31, 1987. If removal of all 19 dams is feasible, a total of 142,389 ft<sup>2</sup> (WUA) of juvenile water snake habitat could be created.

VI. New Reservoir Habitats, Stacy Reservoir Management  
(+33,750 ft<sup>2</sup> WUA)

In order to replace juvenile foraging habitat lost due to Stacy Reservoir (-1,450,550 ft<sup>2</sup> WUA), habitat along the new reservoir shore must be made more suitable for Concho water snakes. Based on available information on both subspecies, FWS believes that the Concho and Brazos water snakes are ecological similar. Although they are on different river systems, both seem to be limited by similar habitat features (e.g., flat shallow rocky riffles). Although no Concho water snakes have been found in reservoirs, all ages of the Brazos water snake (*N. h. harteri*) have been found along the upper reaches of Possum Kingdom Reservoir and Lake Granbury on the Brazos River. Reservoir morphology on the Brazos River differs significantly from existing reservoirs on the Colorado and Concho Rivers, with the former occurring on stream cut limestone beds in a topography of moderate relief and the latter on silt and loam in an area of low relief. The major rocky areas resembling water snake habitat on Spence, Twin Buttes, Nasworthy and O.C. Fisher Reservoirs (Colorado and Concho River Reservoirs) are found along the dams as riprap. Because of the embedding and boulder size used for dam ripraps, Concho water snakes do not inhabit these areas. FWS believes that the large, imbedded rock does not provide suitable habitat for water snakes, hence they are not found there. Stacy Reservoir is to be built in a limestone area geologically similar to Possum Kingdom and Lake Granbury, but with less relief, and may provide some water snake habitat. In order to improve chances of Concho water snakes inhabiting Stacy Reservoir, 45 new reservoir habitats will be constructed. Rock sizes will range from medium gravels to large boulders of slab limestone origin, at least 50 percent of all size categories being of flat, slab-like limestone. The new reservoir habitats are to be 150 feet wide and reach from 5 feet above the conservation pool level (1,551.5 ft.) of the reservoir down to the river channel (Figure 2). Extending new reservoir habitats from above the high water level to the river channel will allow utilization at all reservoir levels. Slopes should not exceed 1 in 10, the maximum reservoir shoreline slopes Brazos water snakes inhabit. This slope will allow at least 5 feet of

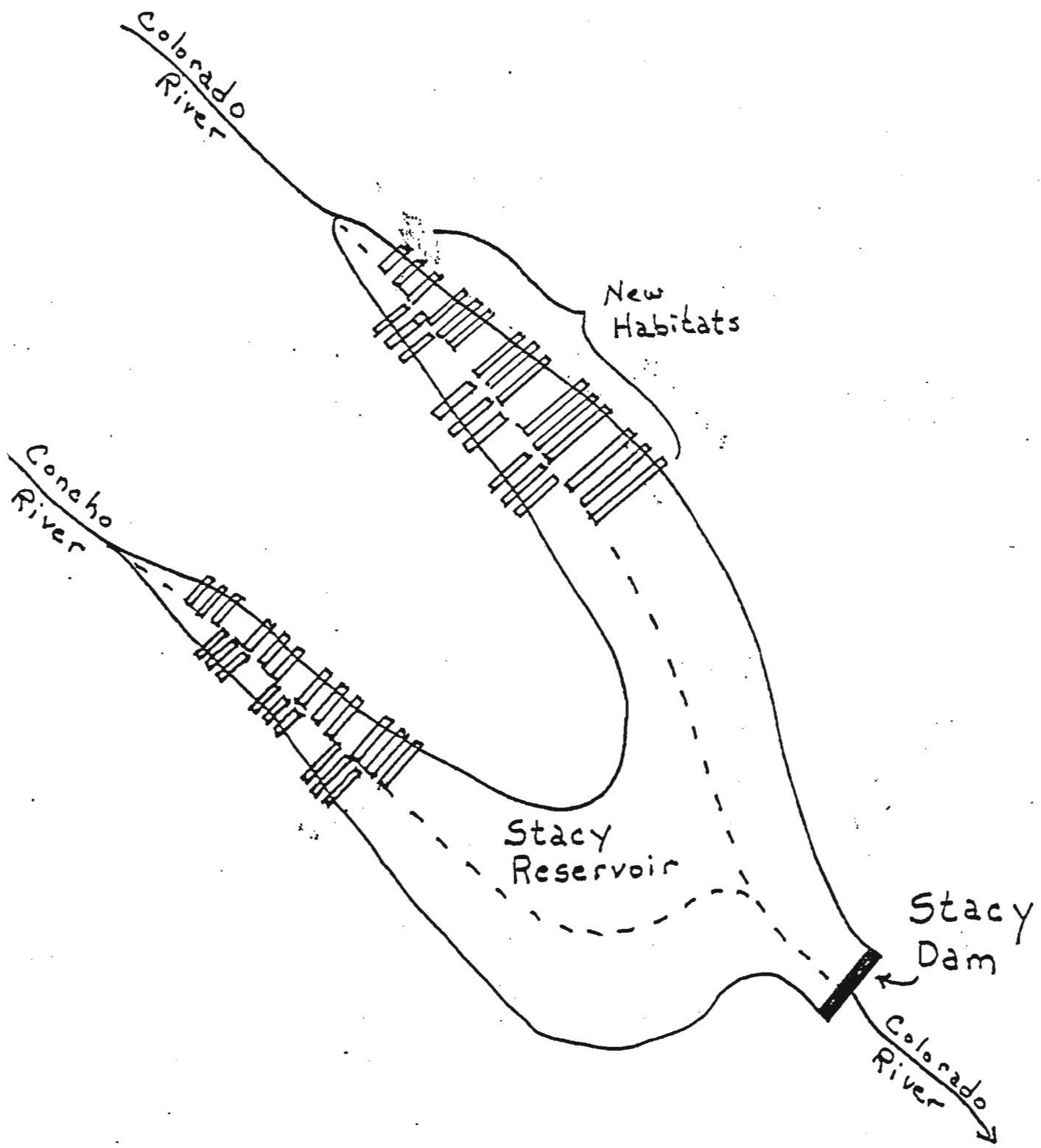


Figure 2. New Habitats, Stacy Reservoir.

juvenile water snake foraging area at the preferred depth of less than 0.5 feet. New reservoir habitats, like riffles in the rivers, will be clumped (3/mile) and concentrated at the upstream 1/3 of the reservoir. Snakes will occupy the habitats naturally as rising reservoir waters inundate natural riffles. Snakes forced out of the river channels by rising reservoir levels will survive in these areas until the fluctuating water level drops again. Permanent occupancy may also occur on habitats usually submerged. It is unknown if changing water levels will result in siltation of these artificial habitats, but if silt, sediments or vegetation does become a problem, plans to clear them must be made. Stacy Reservoir habitat improvements are recommended to conserve some constituent elements of proposed critical habitat within the inundation zone. Such measures may allow snakes to occupy the reservoir and reoccupy both river channels during lower reservoir levels. When 45 artificial habitats are constructed, juvenile feeding and resting habitat will be increased by 33,750 ft<sup>2</sup> WUA, 1.9 percent of the lost habitat. Care should be taken to prevent the artificial habitats from becoming boat launching ramps by limiting access to them. This alternative may be phased in over a 15 year period in order to assess success and correct any flaws that might exist. CRMWD must complete at least 10 habitats, scattered throughout upper 1/3 of the reservoir area by the time the dam is closed. Design and construction of the remaining structures will depend upon success of the first 10 habitats. Corps and FWS will make that evaluation within 5 years after the habitats are flooded.

Additional basking areas will be provided within the reservoir by allowing the larger trees to stand rather than removing them. A good forage base of minnows is expected to inhabit the reservoir, including Notropis lutensis, Notropis stramineus, Pimephales promelas, Pimephales vigilax, and Gambusia affinis.

#### VII. Tributary Stream Habitats

While loss of prime water snake habitat and proposed critical habitat in the Colorado and Concho Rivers is being partially offset by habitat improvements above and below Stacy Reservoir, additional secure habitat is needed. Several of the smaller tributaries of the Colorado and Concho Rivers are known or believed to support Concho water snakes. CRMWD personnel captured 5 Concho water snakes in Elm Creek and its tributary, Coyote Creek in 1986. Kickapoo Creek, Spring Creek, and perhaps Lipan Creek may still support a few Concho water snakes. CRMWD will negotiate with private land owners for protection of Elm Creek and its tributary in the area of suitable water snake habitat (7 miles). Protection of Elm Creek should provide long-term preservation of Concho water snake habitat. CRMWD will continue to search tributary

streams to determine if additional Concho water snake populations occur.

VIII. Maintenance of Genetic Heterogeneity.

The isolation of Concho water snake populations by Stacy Reservoir could result in a loss of genetic diversity. Isolated artificial populations and isolated natural tributary populations could suffer the same fate. In order to insure sufficient genetic heterogeneity in all populations, it will be necessary to move snakes from one population to another. At least five female Concho water snakes should be transferred to each of the 3 isolated populations from its nearest neighboring population once each year during mid summer (June-August). Population geneticists have determined that only one individual is necessary to maintain the heterogeneity, but survival of transferred snakes suggests a slightly larger number is more appropriate.

IX. Employment of a Full-Time Biologist.

CRMWD will hire a full-time biologist, acceptable to CRMWD and FWS, to oversee the implementation of these alternatives and interact onsite with the engineers and equipment operators during construction of Stacy Dam and the new snake habitats. This individual must have the authority to assure that all stipulations are followed and be able to interact with FWS to alter the alternatives if new ideas or methods of protecting water snake habitat are determined. Monitoring snake habitats and portions of the proposed studies could also be supervised by this individual. A ten year length of employment will be necessary to coordinate and analyze all alternatives.

X. Cooperative Agreement

An agreement will be signed by the principal parties to assure that all phases of the biological opinion will be carried out before and after construction of Stacy Dam. This agreement will also point out joint responsibility for modifying alternatives if future information indicates adjustment is necessary.

Nonconstruction alternatives (I, II, V, IX, and X) should begin as soon as practical. Alternatives III, IV, VI, VII will be delayed for up to one year in order that thorough field studies and much additional data concerning the Concho water snake as possible can be gathered. Alternative VIII need not start until Stacy Dam is closed.



RISK ANALYSIS

A risk analysis for the Concho water snake was performed using a panel of the most knowledgeable biologists available (analysis attached). The conclusion of that work was that without Stacy Dam, the subspecies had a 11 percent chance of extinction over the next 25 years. With Stacy Dam in the equation (but without any reasonable and prudent alternatives), extinction chances increased to 40 percent over the same period. The alternatives included herein as reasonable and prudent decreased extinction probability by 1-11 percent independently, with the highest decreases coming from maintaining remaining water snake habitat (minimum and channel forming flows), creation of artificial riffles in historic reaches not now supporting water snakes, and creation of artificial habitats. Chances of individual alternatives reducing extinction are not cumulative unless considered that way by the original panel. When the panel considered the impacts of the construction of Stacy Dam and the cumulative effects of all the proposed alternatives, they estimated the chances of water snake extinction to range from 10-25 percent, indicating the impact of Stacy Dam to range from a +1 to a -14 percent over the existing river conditions without Stacy. However, none of the panel considered Stacy would benefit the survival of the Concho water snake, with the most optimistic scores indicating a neutral effect.

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One factor that was not considered in the risk analysis was the continued downstream encroachment of silt deposition in the Colorado River below Spence Reservoir. Hydrologists believe the Colorado River will continue to aggrade between Maverick and the confluence as a result of Robert Lee Dam, but at a slower rate than has occurred between 1968 and present. With the minimum and channel maintenance flows requested from Spence Reservoir as part of reasonable and prudent alternatives for Stacy, these same hydrologists believe that this reach of the Colorado River will stabilize sooner and with more water snake habitat than if those flows were not available. It is unknown how this information might have affected the risk analysis panel, but some sensitivity testing of the model indicates it is insensitive to habitat loss unless such loss is very widespread. It is likely that knowledge of the continuing loss of Colorado River habitat would have resulted in the panel slightly increasing the chances of extinction under the "no change" alternative and slightly decreasing the chance of extinction under the "Stacy Dam" alternative.

INCIDENTAL TAKE

When the reasonable and prudent alternatives are implemented, there will still be some incidental take of Concho water snakes, but not to the extent that it will jeopardize the subspecies. Construction at the dam site may directly kill some individuals. Hatchlings that are present during reservoir filling may succumb due to a lack of proper feeding conditions, cover, or greater

predation. A few additional snakes may be taken in the process of improving the existing rocky riffles. Concho water snakes will also be taken above and below Stacy Reservoir as new stream flows alter existing habitats. Under these circumstances, FWS is required to address 1) the impact of this taking upon the subspecies, 2) reasonable and prudent measures necessary or appropriate to minimize such impacts, and 3) terms and conditions that must be complied with by the Corps or applicant that minimize those impacts.

The maximum extent of incidental take anticipated is that which occurs in conjunction with the loss of 1,738,033 ft<sup>2</sup> WUA. As stated, above, such take will result from dam construction, reservoir filling, altered flows and habitat manipulation efforts. A reasonable and prudent measure to reduce take is that a CRMWD employee will be on hand at times when take is likely to occur, to salvage snakes. Terms and conditions of incidental take are: 1) that CRMWD notify FWS prior to any activity likely to result in take, 2) that any snakes salvaged be immediately reported to FWS or placed as per prior agreement with FWS, and 3) any Concho water snake mortalities be reported to FWS. If the extent of anticipated incidental take is exceeded because destruction of juvenile habitat is greater than 1,738,033 ft<sup>2</sup> WUA, the Corps must reinitiate Section 7 consultation and stop CRMWD from further habitat destruction that will result in takings until a new biological opinion with an updated incidental take statement is issued.

#### SUMMARY-BIOLOGICAL OPINION

The Stacy Project, if built without the reasonable and prudent alternatives presented in this document will jeopardize the continued existence of the Concho water snake and adversely modify its proposed critical habitat. In the Section 7 Interagency Cooperation Regulations (50 CFR 402.02) "...jeopardize the continued existence of (means) to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both survival and recovery of a listed species in the wild..." "Destruction of adverse modification (means) a direct or indirect alteration that appreciably diminishes the value of critical habitat for both survival and recovery of the ...species." "Reasonable and prudent alternatives (refer) to alternative actions identified through formal consultation... that the Director believes will avoid jeopardy or adverse modification...."

In the case of the jeopardy standard, guaranteed implementation of reasonable and prudent alternatives will eliminate the likelihood of jeopardy by restoring deteriorated habitats, bringing disjunct populations together, breaking physical barriers to gene flow, guaranteeing stream flows for critical life stages and forage fishes, and monitoring and studying population health and adjusting management activities. Proposed critical habitat will be modified with all alternatives in place, but as above, the

alternatives reduce the impacts of such modification within the proposed critical habitat to levels that do not significantly diminish the value of proposed critical habitat (or its constituent elements) for survival and recovery of the Concho water snake. Therefore, the Stacy Project with reasonable and prudent alternatives adopted, is not likely to result in the "destruction or adverse modification" of the proposed critical habitat, nor is the project likely to "jeopardize the continued existence of" the Concho water snake.

### CONCLUSION

This biological opinion is based on the best scientific and commercial information currently available. Reinitiation of formal Section 7 consultation is not required unless new information reveals effects of the action that may affect the Concho water snake in a manner not considered, if the action is modified in a manner not considered in this opinion, or new species are listed that may be affected by the action. Failure to comply with reasonable and prudent alternatives will nullify the incidental take clause, and thus any project activities will constitute violations of Sections 7 and 9 of the Act.

If habitat creation and improvement measures set forth in the Reasonable and Prudent Alternatives section of this document are successfully completed and occupied by Concho water snakes, a maximum total of 2,629,449 ft<sup>2</sup> WUA of juvenile foraging habitat will be created (Table 1). The total gain represents a recovery of 161 percent over the total losses of 1,637,308 ft<sup>2</sup> WUA to the Stacy project, and will increase existing habitat from current 6,311,788 ft<sup>2</sup> WUA to 7,203,204 ft<sup>2</sup> WUA. However, the alternatives include many experimental techniques, and the probabilities of success for the alternatives range from 0.05 to 0.50 (see attached Risk Analysis). Therefore, to ensure a nonjeopardy condition and avoid an adverse modification of critical habitat using alternatives whose success will not be known until following project completion, a significantly larger amount of habitat must be created or restored than is lost to the project. Therefore, reasonable and prudent alternatives must be agreed to and carried out to allow for success uncertainties. The alternatives set forth in this document will remove the likelihood of jeopardy from construction and operation of the Stacy project.

As required by law when a jeopardy biological opinion is issued, the Federal agency shall notify the Service of its final decision on the action receiving that opinion. We appreciate working with the Corps and CRMWD in developing this document. Thank you for your interest in conserving endangered species.

Sincerely yours,


  
Regional Director

TABLE 1. Losses and maximum gains of Concho water snake juvenile foraging habitat in ft<sup>2</sup> weighted useable area (WUA) with construction of Stacy Reservoir and implementation of alternatives.<sup>1</sup>

	<u>Total Before Stacy</u>	<u>Gain</u>	<u>Loss</u>	<u>Total after Stacy and Alternatives</u>
Upper Colorado River (Robert Lee Dam to Ballinger) (57 mi)	1,028,878	+ 349,922	- 100,725**	1,278,075
Stacy Reservoir (46 mi)	1,450,550	+ 33,750*	-1,450,550	33,750
Colorado River (Stacy Dam to Winchell) (55 mi)	2,806,900	0	-186,758	2,620,142
Colorado River (Winchell to Pecan Bayou) (49 mi)	756,800	+2,245,777	0	3,002,577
Concho River (61 mi)	268,660	+ 0	0	268,660
Totals (290 mi)	<u>6,311,788</u>	<u>+2,629,449</u>	<u>-1,738,033</u>	<u>7,203,204</u>

\*Phased project, over 12 years.

\*\*Loss results from requested minimum flows.

<sup>1</sup>Computed from typical water year (1970-1985)

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