

**U.S. Fish and Wildlife Service
Recovery Plan for the
Peppered Chub (*Macrhybopsis tetranema*)**



Top: Peppered chub; Bottom: Canadian River habitat north of Amarillo, TX.
Photo credit: USFWS

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Purpose and Disclaimer

This document presents the U.S. Fish and Wildlife Service's (USFWS) plan for the conservation of the peppered chub. The Recovery Plan is the second part of the USFWS's 3-part recovery planning framework and includes the statutorily required elements pursuant to section 4(f) of the Endangered Species Act (ESA). This Recovery Plan is informed by the first part of the framework, a Species Status Assessment (SSA). The SSA report delivers foundational science for informing decisions related to the ESA and includes an analysis of the best available scientific and commercial information regarding a species' life history, biology, and current and future conditions that characterizes the species' viability (i.e., ability to sustain populations in the wild over time) and extinction risk. We will also prepare a Recovery Implementation Strategy (RIS), the third part of the framework. The RIS is an easily updateable operational plan that is separate and complementary to the Recovery Plan that details the on-the-ground recovery activities needed to complete the recovery actions contained in the Recovery Plan.

Recovery plans describe the envisioned recovered state for a listed species (when it should no longer meet the ESA's definitions of a threatened or endangered species) and include a recovery strategy, recovery criteria, recovery actions, and the estimates of time and cost needed to achieve it. Plans are published by the USFWS and are often prepared with the assistance of recovery teams, contractors, State agencies, and others. Recovery plans do not necessarily represent the views, official positions, or approval of any individuals or agencies involved in plan formulation, other than the USFWS. They represent the official position of the USFWS only after they have been signed by the Regional Director as approved. Recovery plans are guiding and planning documents only; they are intended to establish goals for long-term conservation of listed species and define criteria that are designed to indicate when the threats facing a species have been removed or reduced to such an extent that the species may no longer need the protections of the ESA. There are many paths to accomplishing recovery of a species, and recovery may be achieved without all criteria being fully met. Recovery of a species is a dynamic process requiring adaptive management that may, or may not, fully follow the guidance provided in a Recovery Plan.

Identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this Plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation.

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An electronic copy of this draft Recovery Plan will be made available on the [ECOS webpage for peppered chub](#).

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Recovery Plan for Peppered Chub

(*Macrhybopsis tetranema*)

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Species Overview

We conducted a Species Status Assessment (SSA) for the Arkansas River shiner (*Notropis girardi*) and Peppered Chub (*Macrhybopsis tetranema*) (USFWS 2018, entire), which provides a thorough review of the two species' taxonomy, natural history, habitats, ecology, populations, and range. An SSA analyzes individual, population, and species' requirements, factors affecting the species' survival, and conditions to assess the species' current and future viability in terms of resiliency, redundancy, and representation (USFWS 2015, entire). The SSA Report also includes a brief overview of existing and potential conservation actions for both species. The SSA can be found on the [peppered chub ECOS webpage](#).

The following is a brief overview of the life history and status of the peppered chub. Please refer to the SSA Report (USFWS 2018, entire) for a more detailed discussion and complete literature citations.

Status and Distribution

The peppered chub (*Macrhybopsis tetranema*) is a small minnow once widespread and common in the western portion of the Arkansas River basin in Kansas, New Mexico, Oklahoma, Arkansas, and Texas. As flow patterns, channel complexity, habitat connectivity, surface and groundwater quantity, and water quality of rivers in the Southern Great Plains changed over time due to climate change, persistent drought, and human alteration, so has the status and distribution of the peppered chub. The peppered chub is now functionally extirpated from 94 percent of its former range (2,601 river miles [rmi] or 4,186 river kilometers [rkm]; Luttrell et al. 1999, p. 981) and is restricted to a portion of the South Canadian River (identified as Canadian River on USGS topographic maps) in eastern New Mexico and the Texas panhandle (170 rmi [274 rkm]; Figure 1). Until 2012, the species was thought to also persist in the Arkansas and Ninnescah rivers in Kansas; however, information based on a substantial number of surveys targeting the peppered chub suggests the species is functionally extirpated from the Ninnescah River (Pennock et al. 2017, p. 57). On March 30, 2022, the U.S. Fish and Wildlife Service (USFWS) listed the species as endangered, with 872 rmi (1,403 rkm) of designated critical habitat within the Arkansas River basin (Figure 1) under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.; hereafter ESA) (87 FR 11188). Designated critical habitat includes river habitat up to bank full height. Primary threats to the species include habitat degradation and fragmentation by impoundments, altered flow regimes, modified geomorphology, decreased water quality, and the introduction of invasive species. Many of these stressors can be related to climate change, associated persistent drought, and surface and groundwater extraction.

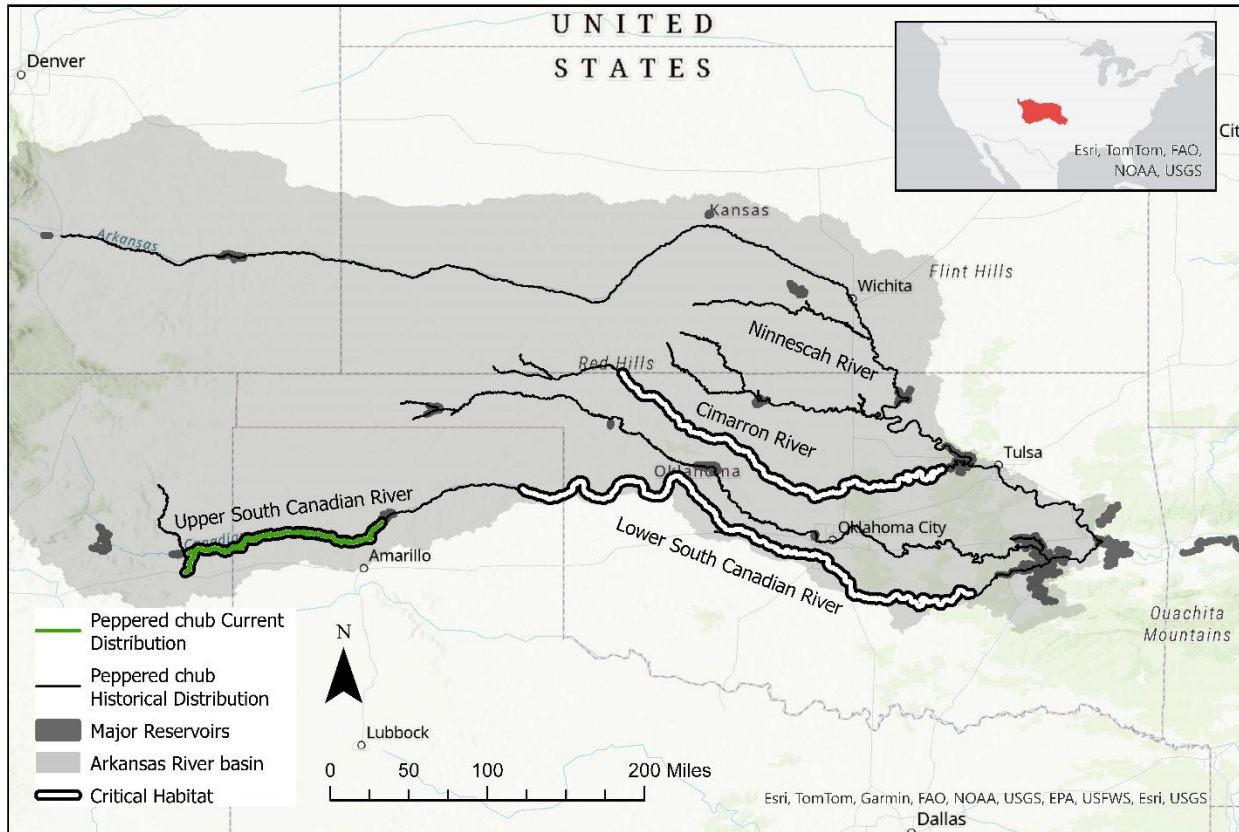


Figure 1. Peppered chub historical and current distribution adapted from the peppered chub SSA (USFWS 2018, p. 8) and critical habitat (87 FR 11217). *Note the width of critical habitat displayed on this map is not to scale. Critical habitat is designated as river habitat up to bank full height, which is enlarged on this map for easier viewing.

In the final rule to list the peppered chub as endangered with critical habitat (87 FR 11188), we designated 197 rmi (317 rkm) in the Upper South Canadian River, 400 rmi (644 rkm) in the Lower South Canadian River, and 275 rmi (443 rkm) in the Cimarron River as critical habitat. The Upper South Canadian River is occupied by the species, whereas the other critical habitat units were considered unoccupied at the time of listing. Although unoccupied by peppered chub, the Lower South Canadian River and Cimarron River units contain the physical and biological features (PBFs) essential for the conservation of the species. PBFs are ecological and biological components which support feeding, breeding, and sheltering that reflect the species' life history needs. The critical habitat designation identified the following PBFs:

- PBF 1: Unobstructed river segments greater than 127 rmi (205 rkm) in length that are characterized by a complex braided channel and substrates of predominantly sand, with some patches of silt, gravel, and cobble.
- PBF 2: Flowing water with adequate depths to support all life stages and episodes of elevated discharge to facilitate successful reproduction, channel and floodplain maintenance, and sediment transportation.
- PBF 3: Water of sufficient quality to support survival and reproduction, which includes,

but is not limited to, the following conditions: (1) Water temperatures generally less than 98.2 degrees Fahrenheit (36.8 degrees Celsius); (2) Dissolved oxygen concentrations generally greater than 3.7 parts per million (ppm); (3) Conductivity generally less than 16.2 millisiemens per centimeter (mS/cm); (4) pH generally ranging from 5.6 to 9.0; and (5) Sufficiently low petroleum and other pollutant concentrations such that reproduction and/or growth is not impaired.

- PBF 4: Native riparian vegetation capable of maintaining river water quality, providing a terrestrial prey base, and maintaining a healthy riparian ecosystem.
- PBF 5: A level of predatory or competitive, native or nonnative fish present such that any peppered chub population's resiliency is not affected.

Habitat, River Flows, and Reproduction

Habitat of the peppered chub consists of the main channels of wide, shallow, sandy bottomed rivers and larger streams of the Arkansas River basin (Wilde et al. 2000, p. 39). Adult peppered chub prefer shallow channels where currents flow over clean fine sand (Collins et al. 1995, p. 45; Cross and Collins 1995, p. 62). They avoid calm waters and silted stream bottoms and appear more adapted for headwaters of streams than do other members of the (former) speckled chub (*M. aestivalis*) complex (Layher and Brinkman 2005, p. 5). They typically select swifter currents than the Arkansas River shiner (which occurs in similar habitat) during winter, spring, and summer (Bonner 2000, p. 8), and tend to select a slightly greater proportion of habitats with cobble substrate during the spring and gravel substrate during the summer (Bonner 2000, p. 17). Within the Canadian River of New Mexico and Texas, peppered chub generally occur in deeper waters. Wilde et al. (2000, pp. 15-21) did not observe correlations between specific water temperatures, dissolved oxygen concentrations, conductivity, pH, or current velocity with the presence of peppered chub. This suggests adaptations to tolerate variable conditions present in the drought-prone prairie rivers it inhabits, including a relatively high capacity to endure elevated temperatures and low dissolved oxygen concentrations, although actual tolerance ranges are unknown.

Prairie stream fish such as the peppered chub are members of a reproductive guild that broadcast spawn non-adhesive, semi-buoyant eggs, which remain suspended in the water column until hatching. Known as pelagic spawning, this reproductive strategy appears to be an adaptation to highly variable environments, where stream flows are unpredictable and suspended sediments and shifting sand can cover eggs laid in nests or crevices (Bonner 2000, p. 35). Once saturated with water after spawning, semi-buoyant eggs remain suspended in the water column as long as a stream flow is present. Fertilized peppered chub eggs develop as they drift, and hatch 25-28 hours after fertilization (Bottrell et al. 1964, p. 398; Robison and Buchanan 1988, p. 183). Bottrell et al. (1964, pp. 395, 397) found that captive raised peppered chub eggs hatched on average 25.5 hours after fertilization and "on the third day the young fish begins to swim with purposeful movements and to take food" (Bottrell et al. 1964, p. 397). Though the peppered chub may only live long enough to reproduce during one spawning season, (usually between May and August), the species has been observed to spawn multiple times during a single spawning season under a variety of flow regimes, from no flow to high flow (Bonner 2000, p. 34). However, periods of flowing water are essential for reproductive success. Eggs spawned and hatched in

isolated pools are not likely to survive (Wilde et al. 2000, p. 107) due to lack of flow, causing the eggs to sink to the bottom where they may be smothered or poorly oxygenated. Therefore, a minimum flow is important for maintaining population recruitment, as it allows eggs to remain suspended as they develop. Platania and Altenbach (1998, p. 566) estimated that for the broadcast-spawning minnows, which includes the peppered chub, eggs could drift 45-90 rmi (72-144 rkm) before hatching and, depending on fry developmental rates, could be transported a total distance as great as 134 rmi (216 rkm) before becoming free-swimming juveniles. This estimate indicates that a substantial length of free-flowing river is required for successful reproduction and recruitment. In addition, Perkin and Gido (2011, p. 371) analyzed 60 river fragment lengths within the Great Plains, as well as literature accounts of population status for eight pelagic spawning minnows (including peppered chub) within these fragments, to derive thresholds of stream length associated with extirpations. They estimated the minimum threshold for stream fragment length associated with population persistence for peppered chub to be approximately 127 rmi (205 rkm).

Periodic high flows are also essential for successful reproduction and recruitment for pelagic broadcast spawning fish. High discharge pulses help to maintain a more complex channel morphology that represents peppered chub preferred habitat. River impoundments, tributary impoundments, and off-channel reservoirs can alter the natural flow regime upon which entire river ecosystems are adapted (Poff et al. 1997, p. 772; Bunn and Arthington 2002, p. 492; Richter et al. 2003, p. 207). Important components of flow regime include the magnitude, frequency, duration, predictability, and rate of change of hydrologic conditions (Poff et al. 1997, p. 770). Impoundments and other structures often reduce the magnitude and frequency of high flows, which can cause channel narrowing and homogenization, significant alteration of riparian plant communities, restriction of downstream transport of sediment and nutrients, and altered river substrates (Poff et al. 1997, pp. 773–777; Mammoliti 2002, pp. 223–224). Additional implications include more frequent channel drying and pool isolation. Although juvenile and adult peppered chub have adaptations to survive in isolated pools with reduced oxygen and concentrated dissolved solids, egg and larval life-stages are compromised or likely eliminated depending on the length of time in stagnant pools. Due to a typical lifespan of less than 2 years and the current limited distribution of the species, reduced stream flow conditions due to prolonged drought and surface and groundwater extraction that adversely impact reproduction and recruitment success rates may hasten the threat of extinction.

Influences on Species Viability

Section 4(a) of the ESA describes five factors that may lead to endangered or threatened status for a species. These include A) the present or threatened destruction, modification, or curtailment of its habitat or range; B) overutilization for commercial, recreational, scientific, or educational purposes; C) disease or predation; D) the inadequacy of existing regulatory mechanisms; or E) other natural or manmade factors affecting its continued existence. The largest threats to the peppered chub are the loss of continuous stream habitat necessary for pelagic spawners and altered hydrology (Factor A). Below, we discuss stressors impacting the species' viability and correlate those to the five listing factors.

Stressors affecting the viability of the peppered chub, discussed in Chapter 3 of the SSA (USFWS 2018, pp. 22-38), include altered flow regimes, stream fragmentation, modified

geomorphology, decreased water quality, and introduction of invasive plant species (e.g., salt cedar and phragmites) (Factor A). The sources of these stressors are primarily related to the construction of impoundments and water use, including depletion of available surface and groundwater, which alter hydrology and fragment streams. Additional sources of stressors include climate change, persistent drought (Factor E), and bank armoring from the establishment of non-native plant communities, in-stream gravel mining and dredging (Factor A), off-road vehicle use within the species' habitat (Factors D and E), and commercial bait harvest (Factor B).

Altered Flows, Stream Fragmentation, and Modified Geomorphology

Impoundments and surface water diversions have contributed to the decline of wide, shallow sand bed river channels that are characteristic of peppered chub habitat (Factor A; Worthington et al. 2014, entire; USFWS 2018, pp. 24-25). Their effects on baseflows have resulted in intermittent river drying and fragmentation, which has negatively affected the species' ability to move freely throughout the system. These alterations have also resulted in a reduction in the magnitude and frequency of moderate and high flows necessary for maintaining wide and shallow braided channels (Poff et al. 1997, pp. 773-777). Widespread vegetation encroachment has armored riverbanks, contributing to channel narrowing and incision. This has led to the river becoming more isolated from its historical floodplain and affects the species' ability to access important low velocity floodplain habitat during high-flow events. These low velocity floodplain areas serve as valuable nursery habitat for developing hatchling and juvenile fish. Limited floodplain access and river fragmentation result in eggs and larvae being flushed further downstream and impede upstream movement. These physical alterations tend to limit the species' ability to repopulate upstream areas and, in some parts of the species' historical range, have resulted in complete extirpation.

High demand for groundwater resources has contributed to a permanent decline in stream flow and the subsequent loss of pelagic broadcast spawning fishes, as streams are increasingly decoupled from shallow aquifers (Perkin et al. 2017, p. 7374). Groundwater pumping has decreased overall fish habitat availability and, like surface water diversion and impoundments, has promoted encroachment of invasive plant species that cause water loss through increased rates of evapotranspiration and armored banks, increased channel incision, and increased river fragmentation through more frequent channel drying (Stromberg et al. 2007, p. 387).

Within the Southern Great Plains, average air temperatures have increased, and projections indicate this trend will continue over this century (Factor E; Shafer et al. 2014, pp. 442-445). Precipitation within the southern portion of the Southern Great Plains is expected to decline, with extreme events such as heat waves, sustained droughts, and extreme rainfall events becoming more frequent (Shafer et al. 2014, p. 445, Fig. 19.4; Walsh et al. 2014, pp. 28-40). These additional environmental stressors negatively affect peppered chub due to the species' limited range, life history needs related to river flows and distances, and its inability to disperse naturally outside of its single existing river system.

Water Quality

Adequate water quality is necessary to maintain suitable conditions for the peppered chub

(Factor A). Impairments can arise from contaminants or the alteration of basic water chemistry and affect nutrient dynamics. Dissolved oxygen levels may be reduced by increased nutrients in the water column from agricultural runoff, wastewater effluent, and livestock operations (USFWS 2018, p. 34). Increased water temperature from climate change and extended low-flow conditions can exacerbate low dissolved oxygen levels, especially when reduced flows strand fish in isolated pools. Similarly, as flows decline, the species can be subjected to increased salinity (USFWS 2018, p. 34). Land use activities that affect water quality include irrigated cropland, concentrated animal feeding operations, gravel mining, oil and gas operations, municipal solid waste sites, and stormwater runoff from urban and other developed areas (Factor A).

Other Influences

Additional stressors to peppered chub discussed in Chapter 3 of the SSA include in-stream sand/gravel mining and dredging, recreational off-road vehicle use within habitat (Factor A), introduction of invasive species (Factors A and C), and commercial bait harvest (Factor B). However, based on the extent and frequency of these stressors, the effects are less likely or unlikely to impact the species' overall viability. Chapter 3 of the SSA (USFWS 2018, pp. 34-38) discusses these stressors in more detail and discusses related ongoing and potential management actions targeted to improve peppered chub populations.

Recovery Strategy

Our recovery strategy is to support at least three self-sustaining peppered chub populations into the foreseeable future. To accomplish this, we plan to:

- 1) Improve the existing population and its associated habitats in the upper South Canadian River.
- 2) Improve habitat quality in historically occupied river segments that have the highest potential to accommodate future reintroductions of the species.
- 3) Reintroduce peppered chub into at least two historically occupied river segments and monitor their status.

We intend to focus on habitat and stream flow restoration and preservation, which is predicated on an increased understanding of the relationship of peppered chub's life history requirements with the physical, chemical, and ecological conditions of its environment. Implementation of this Recovery Plan will necessitate inclusion of the best available scientific and commercial information as it becomes available.

Recovery of the peppered chub will require developing and maintaining watershed-scale partnerships among federal, state, tribal, and local agencies, private landowners, and other stakeholders. Because the species is currently limited to one extant population with multiple stressors affecting its habitat, recovery of the peppered chub is likely to be a long-term, challenging process. Therefore, the success of the Recovery Plan will rely on the implementation of recovery actions conducted by conservation partners, while maintaining partner coordination within and among watersheds.

Management Units

We identified four geographically separate management units across the species' current and historical ranges (Figure 2). Each management unit provides at least some elements needed for peppered chub survival and all provide adequate stream length necessary for successful reproduction and recruitment. There is currently one occupied management unit and three unoccupied management units. We consider each management unit to support, or potentially support, a separate population. The purpose of identifying management units in this Recovery Plan is to:

- 1) Establish separate units across the species' range to allow for site-specific recovery actions, and
- 2) Promote local and targeted watershed partnerships to improve delivery, efficiency, and communication of recovery activities and promote flexible management strategies.

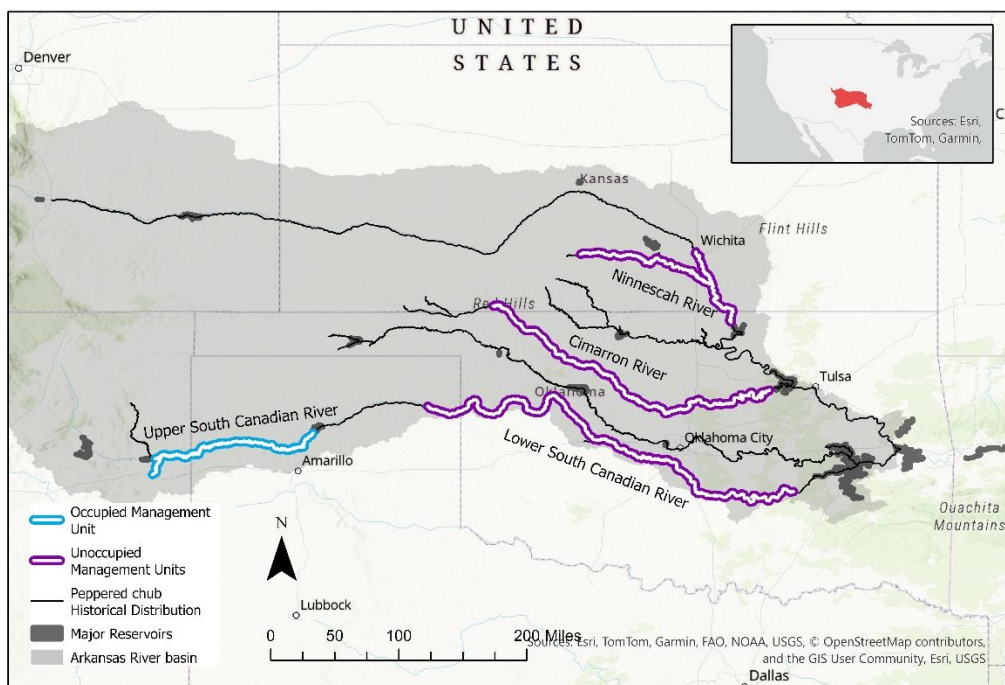


Figure 2. Occupied (i.e., Upper South Canadian River) and unoccupied (i.e., Ninnescah/Arkansas, Cimarron, and Lower South Canadian River) management units for the peppered chub.

Occupied Management Unit

The Upper South Canadian River management unit is currently the only occupied management unit. Our strategy in this unit is to curtail the decline of the species and its habitat through developing an environmental flow strategy, monitoring the species to assess its status, and implementing additional research as necessary to ensure recovery actions are effective into the foreseeable future.

The South Canadian River flows from west to east, originating in eastern New Mexico. The river is impounded by Conchas Lake, just downstream of its headwaters, and then by Ute Reservoir, approximately 40 rmi (64 rkm) upstream of the New Mexico/Texas border. Revuelto Creek is a major tributary to the South Canadian River, entering just downstream (~6 rmi; 10 rkm) of Ute Reservoir dam. Once the South Canadian River enters Texas, it travels without obstruction another 131 rmi (211 rkm), until it reaches the delta of Lake Meredith north of Amarillo, Texas. We refer to the 171-rmi (275 rkm) stretch of river (or 181-rmi stretch (291.3 rkm) including the 10-rmi [16 rkm] stretch of Revuelto Creek before its confluence with the South Canadian River) between Ute Reservoir and Lake Meredith as the Upper South Canadian River management unit, which is known to be entirely occupied by peppered chub and occurs almost completely on privately-owned land. River flows in this stretch are altered primarily by Ute dam (USFWS 2018, p.25), which provides seepage flows (i.e., water that naturally leaks through the dam's foundation or abutments). Ute Reservoir was created to provide a sustainable supply of water for domestic use for communities that rely on the declining Ogallala Aquifer. Revuelto Creek, entering the river just downstream of Ute dam, provides a significant portion of stream flow within the South Canadian River, including high-pulse flow events that support habitat maintenance (USFWS 2018, p. 83) and peppered chub reproduction. Ute dam infrequently releases excess water, according to requirements under the Canadian River Compact, but these releases are not predictable. Projected future demands on water from the reservoir associated with the Eastern New Mexico Rural Water System pipeline and other uses could decrease dam seepage and possibly the magnitude and/or frequency of future Canadian River Compact releases. However, in the *2005 Arkansas River Shiner (Notropis girardi) Management Plan for the Canadian River from U. S. Highway 54 at Logan, New Mexico to Lake Meredith, Texas*, the State of New Mexico committed to managing and maintaining existing base flow of 3-5 cubic feet per second (cfs) from Ute Dam, as measured at the USGS Logan gage. This commitment has resulted in the State of New Mexico's acquisition of up to 5 cfs of seepage water rights at the Logan gage as well as funding and engineering plans to modify infrastructure to facilitate controlled releases independent of seepage. Infrastructure modifications and operations to maintain existing baseflow have yet to occur, so the specific response of the species and habitat to this action is unclear at this point.

Other challenges to maintaining adequate surface water flows and habitat to support the peppered chub in the Upper South Canadian River watershed include groundwater withdrawals for irrigation and potential increases in salinity. The U.S. Bureau of Reclamation's Lake Meredith Salinity Control Project (Canadian River Municipal Water Authority 2018, entire) is estimated to reduce base flows in the South Canadian River downstream of its confluence with Revuelto Creek by 14 percent (Bureau of Reclamation 1995, p. 19). As a part of annual fish surveys, the USFWS monitored conductivity (as an estimate of salinity) at two sites in the Upper South Canadian River (U.S. Hwy 87 crossing north of Amarillo and U.S. Hwy 385 crossing near Tascosa, Texas) with values ranging from 1,047 - 4,167 $\mu\text{S}/\text{cm}$ (2,577 $\mu\text{S}/\text{cm}$ average), all within the suitable range for the peppered chub (USFWS 2018, p. 15).

Unoccupied Management Units

We have identified three management units that are currently unoccupied: the Lower South Canadian River, Ninnescah/Arkansas River, and Cimarron River management units. These units were historically occupied by peppered chub and currently exhibit favorable habitat features,

indicating their potential to accommodate future reintroductions.

Our strategy for these management units is to further evaluate each individually and determine which may have the highest likelihood of successful reintroduction and future population resiliency. Our assessment of unoccupied management units will be based on the potential for successful peppered chub reintroductions and will account for current and future habitat conditions, the level of management actions needed (if any) to accommodate reintroduction, and the ability/commitment of partners to ensure success of such reintroductions. Once reintroductions are implemented, our strategy will be to continue to implement water conservation and management within two or more of these management units with reintroduced populations, monitor the species to assess its status, implement additional research and management practices, and ensure survival into the foreseeable future. If resources allow and corresponding partnerships are developed, simultaneous reintroductions into multiple unoccupied units could provide an opportunity to monitor the species' response to different environments, help inform management strategies, and provide additional population redundancy. More information on each unit is provided below.

Lower South Canadian River Management Unit

We refer to the approximately 400-rmi (644 rkm) reach consisting of the South Canadian River originating at the U.S. 83 bridge north of Canadian, Texas, and extending downstream to the U.S. 75 bridge northwest of Calvin, Oklahoma, as the Lower South Canadian River management unit. This unit occurs almost entirely on privately-owned land. Lake Meredith (Sanford Dam) does not release water or provide any seepage flow, resulting in a highly altered hydrology and substrate (unsuitable for peppered chub) for several miles downstream of the dam. Numerous downstream tributary and groundwater inputs contribute to riverine flows, such that hydrological conditions likely become suitable for Arkansas River shiner near Canadian, Texas, and thus, also likely suitable for peppered chub (the Arkansas River Shiner was last observed near Canadian, Texas in 2011). The peppered chub was last observed in the Lower South Canadian River in 1999 in its most downstream reaches near Byng, Oklahoma, and the species has not been detected upstream of this area since 1959 (USFWS 2018, p. 56). Additional survey work and hydrologic study within the Lower South Canadian River Management Unit is needed.

As the river moves from west to east in Oklahoma, it widens and becomes more turbid. Arkansas River shiners, which share many life history characteristics with peppered chub, are known to exist from Camargo, Oklahoma downstream to the upper end of Lake Eufaula. This suggests that this stretch of river may also be capable of supporting peppered chub. Water demands, primarily for crop irrigation and livestock in western portions of the Lower South Canadian River, are mostly supplied through groundwater. As the river nears central Oklahoma, water depletion transitions from groundwater to surface water, primarily for municipal and industrial needs, including a significant portion of surface water used as cooling water for Oklahoma Gas and Electric at Lake Konawa. Nutrient loads in the Lower South Canadian River are relatively low; however, nitrogen and phosphorus have shown increases (Oklahoma Water Resources Board 2012, entire). Conductivity in the Lower South Canadian River averages 1,684 $\mu\text{S}/\text{cm}$, indicating that salinity levels are relatively low compared to the Upper South Canadian River or other rivers historically occupied by the peppered chub.

Although potentially suitable conditions exist in the Lower South Canadian River downstream of Lake Meredith near the town of Canadian, Texas, a 100-rmi (161 rkm) stretch downstream of this area likely experiences drying more often than in the past. This makes upstream movement and repopulation of broadcast spawning fish challenging. Within the SSA, we determined that from a low-flow perspective, the Lower South Canadian River is in a comparatively good condition (USFWS 2018, p. 95). However, peak flows in the South Canadian have been drastically attenuated, thereby limiting or eliminating floodplain inundation and thus access to low velocity nursery habitat. As a result, the channel has been greatly narrowed, and vegetation (often non-native) has armored the banks, which results in a negative feedback loop of continued channel incision and further floodplain isolation. Additional survey work and hydrologic and geomorphic study within this stretch of river are needed.

Ninnescah/Arkansas River Management Unit

The Ninnescah/Arkansas River management unit comprises ~213 rmi (343 rkm) consisting of the South Fork Ninnescah River originating where favorable habitat begins at the Highway 54/400 bridge east of Pratt, Kansas, and extending downstream to the River Road Bridge east of Newkirk, Oklahoma. This management unit also includes the Arkansas River mainstem originating at the Lincoln Street Bridge in Wichita, Kansas downstream to the confluence of the Ninnescah River. Major impediments to flow include the Cheney Reservoir on the North Ninnescah River (not part of this management unit) upstream of the North Ninnescah River's confluence with the South Ninnescah River; a water diversion structure at Kingman, Kansas; and the Kaw Dam and Reservoir (completed in 1976) occurring at the downstream terminus of this management unit. Over 95 percent of this unit is in the state of Kansas and occurs almost entirely on privately-owned land. A small amount of this unit is publicly owned in the form of bridge crossings, road easements, etc. Peppered chub were observed in the Ninnescah River in surveys between 2000 and 2012. The Ninnescah/Arkansas River management unit was the most recently occupied of the three unoccupied units. Although surveys suggest the species was extirpated after the drought in 2010 to 2011, current habitat conditions suggest this stretch may now be capable of supporting peppered chub, making it important to the conservation of the species.

Development of methods for restoring aquatic habitats and reintroducing fish into unoccupied habitat are ongoing. The state of Kansas has identified the peppered chub as a Tier I species of greatest conservation need in its State Wildlife Action Plan (Rohweder 2015, p. 55). The state plan was developed to help guide the Kansas Department of Wildlife and Parks and its conservation partners in the planning and implementation of measures to address priority wildlife issues and actions which could improve habitat conditions (Rohweder 2015, p. ii). Habitat restoration, such as removal or modification of fish barriers, has also been identified in the (Kansas) Recovery Plan for the peppered chub (Layher and Brinkman 2005, p. 16). The USFWS's proposed rule to list the peppered chub as endangered (85 FR 77108) also proposed to designate a portion of this management unit (179-rmi [288 rkm]) within Kansas and Oklahoma as critical habitat. In 2021, the state of Kansas signed the Kansas Aquatic Species Conservation Agreement: A Programmatic Safe Harbor Agreement and Candidate Conservation Agreement with Assurances for Fourteen Aquatic Species in Kansas, which was amended to cover 21 species in total, including the peppered chub, and covers the entire portion of this unit that falls within the boundaries of the state of Kansas. Because of the existence of the Agreement, the USFWS excluded this unit from critical habitat designation within the final rule (87 FR 11188)

after the determination that the benefits of exclusion of the area outweigh the benefits of inclusion. The remaining segment (12 rmi [19 rkm], less than seven percent) of the unit occurring in Oklahoma was determined to no longer meet the criteria for critical habitat and therefore was also excluded from the final critical habitat designation.

Cimarron River Management Unit

The Cimarron River originates in far northeastern New Mexico, travels northeast into Colorado, and then into Kansas for a significant stretch. The river briefly drops into Oklahoma before moving northeast back into Kansas for a short stretch and then back into Oklahoma. Flows become substantial at the easternmost crossing of the Oklahoma/Kansas state line, where water travels ~275 rmi (~443 rkm) before reaching Keystone Lake and its confluence with the Arkansas River. Except for a temporary earthen dam and related canal upstream of Buffalo, Oklahoma, there are no impoundments on the Cimarron River, making it one of Oklahoma's longest free-flowing rivers. We refer to this ~275-rmi (~443 rkm) segment between the Oklahoma/Kansas State line downstream to the OK 51 bridge northeast of Oilton, Oklahoma, as the Cimarron River management unit, which occurs almost entirely on privately-owned land.

The peppered chub was last observed in the Cimarron River unit in 2011. It is possible that significant drought conditions in the late 1980s and early 1990s led to the peppered chub decline and eventual extirpation in the Cimarron River. The current condition of the unit, however, is likely to support populations once again (USFWS 2018, p. 150). A similar species, the shoal chub, has reestablished populations and continues to persist in the Cimarron River after previously experiencing significant declines (Luttrell et al. 1999, pp. 984–985), indicating this unit may be suitable for the peppered chub.

Within the final rule for the peppered chub (87 FR 11188), the USFWS designated this ~275-rmi (~443 rkm) segment as critical habitat. A relatively small portion of the proposed critical habitat unit extended into the state of Kansas (approximately six percent, 85 FR 77108); however, that area is covered by the Kansas Aquatic Species Conservation Agreement and was therefore excluded from the final critical habitat designation.

Populations established in any currently unoccupied management units would increase redundancy (and guard against catastrophic events) by increasing the number of populations geographically separated from the Upper South Canadian River population.

Recovery Criteria

This section defines objective, measurable downlisting and delisting criteria. These criteria are designed to be met through implementation of the recovery actions in this Recovery Plan. Recovery criteria are divided into two sets: those that meet demographic (population) needs and those that address habitat and flow requirements necessary to support populations into the foreseeable future. The SSA analyzed the projected future condition of the peppered chub 20 and 50 years into the future (USFWS 2018, p. 126). Our projections of habitat and flow requirements necessary to support the species are based upon projections 20 years into the future. Demographic goals may require another 10 years to become established once habitat and flow

trends are suitable. The peppered chub may be considered for downlisting from endangered to threatened or removal from the List of Endangered and Threatened Wildlife (delisting) when the following criteria are met:

Downlisting Criteria: The peppered chub may be considered for downlisting to threatened when the following criteria are met.

Criterion 1 - At least two wild peppered chub populations are self-sustaining. Each population must be in a separate management unit (e.g., Upper South Canadian, Arkansas/Ninnescah, Cimmaron). Populations are considered self-sustaining when the following demographic conditions are satisfied:

- a) In each population, annual wild recruitment is occurring and measured across six or more survey years within a 10-year period, with the last three consecutive survey years indicating wild recruitment. Wild recruitment will be demonstrated by the presence of Age-0 (i.e., young-of-year, wild, not hatchery-released) fish or by repeated observations of adult peppered chub which are not hatchery reared.
- b) In each population, peppered chub are distributed throughout a river reach of at least 127 rmi (205 rkm), as demonstrated by documentation of wild peppered chub at a minimum of three accessible sites spanning at least 127 rmi (205 rkm, representative of the upstream, midpoint, and downstream reaches of the unit) for at least three consecutive survey years.

Justification: Demographic goals may require 10 years (e.g., rearing individuals, repeated stocking efforts, and assessing population viability) following the establishment of suitable habitat and flow trends. Therefore, Criterion 1 includes a 10-year moving window of species sampling data (sub-criterion 1a), during which the last three consecutive years must indicate wild recruitment. The six or more survey years provides for flexibility in the scenario that recruitment in some years could be low or more difficult to detect and/or the scenario in which some years' surveys are not able to be performed (e.g., due to weather, logistics, staff resources). These measures help to demonstrate population viability and sustainability in the wild. Research suggests that at least 127 rmi (205 rkm) of unfragmented flowing river are needed for peppered chub egg and larval development (Perkin and Gido 2011, p. 374). Although it is possible that shorter segments could sustain peppered chub, the work of Perkin and Gido (2011, p. 374) represents the best available information, indicating that approximately 127 rmi (205 rkm) are needed for population persistence. Within the stream reach, documented natural recruitment across multiple sites over three consecutive years would be considered indicative of a self-sustaining population. Criterion 1b ensures the population is widespread enough to withstand interannual variations in individual survival and reproductive output. Most peppered chub do not live longer than 18 to 20 months and reproduce for only one season (Bonner 2000, p. 63). Consecutive years of poor recruitment may have detrimental effects on the population overall.

Criterion 2 - River connectivity throughout the two occupied management units is sufficient to support peppered chub movement necessary for successful reproduction and recruitment, as evidenced by meeting sub-criteria a, b, and c:

- a) Baseflows (flow rate and seasonal variation) necessary to maintain adequate river connectivity for peppered chub movement, successful reproduction and recruitment have been determined,
- b) Baseflows measured at USGS gage(s) throughout the two management units are stable to increasing over the course of a 20-year trend, and
- c) Baseflows necessary to meet peppered chub life history needs in sub-criterion 1b (peppered chub throughout at least a 127-mile stretch of river) are present and met in years 18-20 of sub-criterion 2b.

Justification: Water availability and riverine flow rates impact nearly all life stages and demographic rates of the peppered chub, including survivorship, spawning, and recruitment. Additional research and analyses are required to clarify the specific range of hydrological conditions necessary for peppered chub viability. At the writing of this Plan, scientific data were not available to prescribe a specific river flow rate, pattern, or flood/drought frequency for the species. Criterion 2 provides our best understanding of the species' needs related to riverine flow and allows for new information to be incorporated as it becomes available.

Criterion 3 - Flow patterns throughout the two occupied management units reflect a flow regime (peak and moderate flows, appropriately timed, and of adequate duration and frequency) and water quality conditions (salinity, water temperature, dissolved oxygen, and pollutant levels) that result in the maintenance and creation of river habitat suitable for the peppered chub. Additional research and analysis are required to elucidate the specific range of hydrological conditions required to facilitate the creation and maintenance of suitable riverine habitat. The following sub-criteria may be used to measure flow patterns:

- a) Determine hydrologic patterns and water quality conditions necessary to maintain and create suitable peppered chub habitat, and
- b) Channel width and complexity are stable or improving for at least 20 years.

Justification: Natural pulses in flow can be habitat-forming and help maintain a natural channel morphology which benefits all life stages of peppered chub. In particular, periodic high flows are essential for successful reproduction and recruitment for pelagic broadcast spawning fishes, such as the peppered chub. This criterion is meant to emphasize the need for a natural flow regime to compliment the water availability emphasized in Criterion 2. Most peppered chub do not live past their second winter (18-20 months) and spawn only once in their lifetime (Bonner 2000, p. 63). Consecutive years of suboptimal flow regime and subsequent poor recruitment may have detrimental effects on the population overall. Currently, the seasonal hydrology required to support the species is largely undefined; however, additional research should be prioritized to identify an effective flow regime that supports unfragmented, self-sustaining populations of wild peppered chub (see also demographic sub-criteria 1a and 1b).

We envision the timing and sequence of Recovery Criteria such that the earliest Criterion 1 could be accomplished is likely to be the latter 10 years of the 20-year period specified in Criterion 2. Criterion 3 would need to be accomplished alongside Criterion 2 for the shortest possible time to recovery.

Delisting Criteria: The peppered chub may be considered for removal from the List of Endangered and Threatened Wildlife (delisted), when *all* downlisting criteria above are met *and* the following delisting criterion is also met.

Criterion 4 - At least three wild peppered chub populations are self-sustaining (as defined by downlisting Criterion 1, above). Each population must be in a separate management unit (e.g., Upper South Canadian, Arkansas/Ninnescah, Cimmaron). The establishment and persistence of reintroduced populations into currently unoccupied reaches of the peppered chub's historical range will be contingent upon achieving habitat-based downlisting Criteria 2 and 3 across all three occupied management units.

Justification: Populations established in the currently unoccupied management units would increase redundancy (and guard against catastrophic events) by increasing the number of populations geographically separated from the Upper South Canadian River population.

Progress toward meeting down- and delisting criteria should be measured throughout implementation of this Recovery Plan. Careful planning and consideration of the timing of surveys and the ongoing implementation of propagation and reintroduction efforts will be instrumental in addressing recovery criteria.

Recovery Actions

The following is a list of prioritized, site-specific management actions that when fully implemented are expected to result in the recovery of the peppered chub (Table 1). Implementation of this Recovery Plan is strictly voluntary and dependent on the cooperation and commitment of numerous partners in conservation. A separate Recovery Implementation Strategy (RIS) will provide additional detailed, site-specific, near-term activities needed to implement the recovery actions identified below and will identify potential implementing partners. We intend to update the RIS as frequently as needed by incorporating new information, and at least every five years to include the findings of future 5-year status reviews. Therefore, the RIS will provide a greater degree of site specificity than the more broadly defined recovery actions in the Recovery Plan.

As stated in the Disclaimer, Recovery Plans are advisory documents, not regulatory documents. A Recovery Plan does not commit any entity to implementing the recommended strategies or actions contained within it for a particular species, but rather provides guidance for ameliorating threats and implementing conservation measures, as well as providing context for implementation of other sections of the ESA, such as section 7(a)(2) consultations on Federal agency actions, development of Habitat Conservation Plans, or the establishment of experimental populations under section 10(j). Priorities for recovery actions are assigned using the following guidelines:

Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: An action that must be taken to prevent a substantial decline in species population/habitat quality or some other substantial negative effect short of extinction.

Priority 3: All other actions necessary to meet the recovery criteria.

The assignment of these priorities does not imply that some recovery actions are of low importance, but instead implies that lower priority items (i.e., Priorities 2 and 3) may be deferred while higher priority items (i.e., Priority 1) are implemented.

Table 1. Recovery actions for the peppered chub, including recovery action number, action theme, description, corresponding recovery criteria, association with the five listing factors, and recovery action priority number. Action themes are also grouped by color.

Recovery Action Number	Action Theme	Action Description	Recovery Criteria	Association with Five Factors	Recovery Action Priority Number
1	Habitat Conservation and Restoration	Develop and implement a water management strategy for the Upper Canadian River management unit. Water management strategies will consider base, intermediate, and peak flows that support the peppered chub's life history, as well as the establishment and maintenance of adequate channel width and complexity necessary to support peppered chub populations into the foreseeable future. This will involve supporting and working with stakeholders to implement water management practices to maximize natural flow regimes, as well as implementing water releases from reservoirs where possible. This action will be informed by Action 16.	2 and 3	Factor A	1

2	Habitat Conservation and Restoration	Evaluate the three unoccupied management units (Lower South Canadian, Arkansas/Ninnescah, and Cimarron Rivers) and develop priorities for peppered chub reintroductions. These management units each have the potential to support peppered chub populations but may first require some level of habitat and/or flow modification and management. Prioritization of the three unoccupied management units will be based on the potential for successful peppered chub reintroductions and will account for current and future habitat conditions, level of needed management actions (if any) to accommodate reintroductions, and the ability of partners to provide the resources needed for such reintroductions.	1 and 4	Factor A	2
3	Habitat Conservation and Restoration	Develop and implement water management strategies for the unoccupied management units identified through implementation of Action 2 above. Priorities have been developed and management unit(s) selected for peppered chub reintroduction in Action 2. For reintroductions to be successful, water management strategies will be developed and will consider base, intermediate, and peak flows that accommodate the peppered chub's life history, including adequate hydrology to establish and maintain channel width and complexity necessary to support peppered chub populations into the foreseeable future.	2 and 3	Factor A	2

4	Habitat Conservation and Restoration	Control invasive species in riparian areas throughout the species' range. Establish and strengthen partnerships to manage, control, and eradicate (where feasible) invasive species encroachment along the riparian corridor of the Upper South Canadian River and the selected unoccupied management unit(s), as identified by implementation of Action 2 above. Implement riparian restoration to slow vegetative encroachment of salt cedar (<i>Tamarix spp.</i>), common reed (<i>Phragmites australis</i>), ravenna grass (<i>Saccharum ravennae</i>), and other invasive plants to maintain wider, complex (braided) channels more suitable for successful reproduction and recruitment. If flow patterns are adequate to maintain natural channel widths, then it is possible this action would not be necessary. However, until flow events reach a magnitude, frequency, and duration that can maintain or expand channel width and complexity, this action will be necessary to curb further losses to peppered chub habitat.	2 and 3	Factor A	2
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5	Habitat Conservation and Restoration	Restore floodplains associated with management units. Establish partnerships to design and implement floodplain restoration in targeted areas to aid in egg and larval development, potentially shorten river length needed for successful recruitment, and to promote further upstream movement of peppered chub populations. For example, if peppered chub are reestablished within the Lower South Canadian River and adequate floodplain access was made available in western Oklahoma during the spawning season, eggs and larvae may not be displaced as far downstream. With adequate flow conditions over the following 18 months, natural reproduction could then re-populate upper stretches of the South Canadian River upstream of the Oklahoma/Texas border where peppered chub have not been observed since 1959.	2 and 3	Factor A	2
6	Habitat Conservation and Restoration	Develop and implement a plan for fish passage, flow barrier assessment, and potential removal or rehabilitation of barriers. This action is targeted at smaller physical barriers that either affect fish movement or restrict flows to management units. Barriers affecting fish movement in mainstem rivers should be given high priority, as even small or partial barriers could have significant consequences for peppered chub reproduction. Barriers in tributaries will be prioritized separately, based on the degree of restriction and opportunities with conservation partners for rehabilitation or removal.	2 and 3	Factor A	2

7	Habitat Conservation and Restoration	Preclude the need for new reservoir construction within all management units. Strengthen work with stakeholders to identify alternatives to new reservoir construction (on mainstem rivers and their larger tributaries) to meet future water supply demands or flood control needs.	2 and 3	Factor A	1
8	Habitat Conservation and Restoration	Implement long-term management commitments or conservation agreements across the species' range to ensure water quality and quantity are sufficient (>127 river miles; 205 river kilometers of river length) to support at least three self-sustaining populations of peppered chub. Additional research is required to determine the necessary water quality and quantity parameters required by peppered chub. Based on these findings, specific management commitments or conservation agreements should then be implemented to the greatest extent possible. These commitments must be robust and with such high certainty of implementation that their continued benefit to the species is reasonably expected to continue for at least 30 years, or more, into the future.	2, 3, and 4	Factor A	1

9	Habitat Conservation and Restoration	Define and distribute information on potential threats to water quality within the range of the peppered chub as they are identified. Use existing and new information (e.g., obtained from Action 19) to better define water quality needs of the peppered chub to meet its life history requirements, as well as the organisms that comprise its diet, and potential threats, to ensure water quality continues to meet those needs. Information in this subject area is limited; therefore, flexible management based on new information from species-specific studies will be essential to ensure long-term viability of the species.	3	Factor A	2
10	Habitat Conservation and Restoration	Develop and implement best management practices for good water quality within management units. Strengthen work with stakeholders to determine the source of pollution discharges negatively affecting the peppered chub and take steps to avoid and minimize future surface water contamination. Plans should be developed to avoid, if possible, or contain and remediate catastrophic spills within the watersheds occupied by the species. Make state and federal spill responding agencies aware of identified peppered chub management units.	3	Factor A	2
11	Population Conservation	Continue to implement a range-wide monitoring program. Working with state partners, the USFWS will continue to participate in and conduct monitoring for peppered chub. Additional reporting and coordination between the USFWS and state wildlife agencies will be necessary to ensure standard protocols are consistent and being implemented such that results can be used to address Recovery Criterion 1.	1 and 4	Factor A	1

12	Population Conservation	Develop a comprehensive Captive Propagation and Contingency Plan (CPCP) consistent with the USFWS Policy regarding Controlled Propagation of Species Listed Under the ESA. A comprehensive CPCP should be developed to guide captive maintenance and breeding programs and a reintroduction strategy for the peppered chub. The goal of the captive propagation portion of the CPCP will be to outline the steps necessary to provide a representation of the genetic characteristics of wild populations. The contingency portion of the CPCP will also establish the collection targets and protocols needed to respond to crisis situations. Contingency planning should not be delayed until the completion of genetic, breeding, and reintroduction studies, but should be updated as these studies are completed. The CPCP should be developed in coordination with agencies that would likely be involved with the collection efforts, including the USFWS, state agencies, and experts from academic institutions with relevant expertise. Identifying facilities suitable for captive propagation and contingency portions of the CPCP is necessary for its success. Institutions involved in collection efforts would need to hold appropriate state and federal permits. For each facility, a Participation Plan should be developed in coordination with the USFWS that outlines the level of commitment to cooperate (long-term versus short-term holding facilities), qualified personnel to collect and transport animals, research to be conducted, and level of information to be collected. The CPCP and Participation Plans should be periodically reassessed (for example, annually) and altered as necessary.	1 and 4	Factor A	1
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13	Population Conservation	Establish and maintain a captive breeding program. A captive population of the peppered chub would serve as a refugia population and a source for reintroductions. Captive propagation of peppered chub and their reintroduction into identified management units will address the limited redundancy of the species. The number of individuals in captivity, their genetic structure, and effectiveness of the captive breeding program should be monitored in accordance with a Captive Propagation and Contingency Plan (CPCP; Action 12, above). Captive peppered chub populations should be monitored closely for disease and other health concerns. When reintroductions are planned, precautions should be taken to ensure individuals to be introduced are free from disease or other harmful agents. Commitments to long-term monitoring and management of captive and reintroduced populations will be necessary. Biological and genetic information on the species should be collected in captivity, particularly information on reproduction and early life stages, in accordance with the CPCP (Action 12, above).	1 and 4	Factors A and C	1
14	Population Conservation	Develop and implement a Reintroduction Plan. Develop and implement a plan that outlines parameters for the release of captive-bred individuals and translocation of individuals from occupied management unit(s) into identified management units. This plan will be informed by Actions 10, 11, 12, and 13 above.	1 and 4	Factor A	2
15	Population Conservation	Develop and implement a Biobanking Plan. Develop and implement a plan that provides for conservation of the species' genetic diversity and ability to recover in the case of a catastrophic event.	1 and 4	Factor A	2

16	Research and Management	Research and develop hydrologic targets necessary to support all peppered chub populations. Utilize existing information and conduct additional research to inform the development and implementation of hydrologic regimes throughout the management units, which support peppered chub. Information in this subject area is limited; therefore, flexible management based on new information from species-specific studies will be essential to ensure long-term viability of the species.	3	Factor A	1
17	Research and Management	Continue to develop knowledge of the species' life history, ecology, habitat requirements, and behavior and apply that knowledge to restore and protect appropriate habitats. Perpetuation of the peppered chub in the wild depends on a thorough knowledge of the species' life history, ecology, habitat requirements, and behavior, and application of that knowledge to restore and protect appropriate habitats.	2 and 3	Factor A	1
18	Research and Management	Continue range-wide genetic studies on peppered chub populations. The ability of a species to persist over the long term is determined in part by the amount of genetic variation that is retained by a species. Studies of peppered chub genetic status as a unique species have been developed (Echelle et al. 2018, entire), but additional genetic monitoring will be essential to determine changes in genetic diversity and its implications for population viability into the foreseeable future.	1 and 4	Factor A	1

19	Research and Management	Improve understanding of the nature, extent, and role of water quality degradation in the decline of the species, as well as whether existing water quality standards are sufficient for species' protection and recovery. Many land use activities and their resultant discharges (both point and non-point sources) have the potential to affect water quality, and therefore the peppered chub and its habitat. These include discharges from industrial sites, wastewater treatment plants, runoff from concentrated animal feeding operations and grazing land, return flows from agriculture, and other sources. The impacts of these activities and their discharges on peppered chub are not well understood and should be examined further.	3	Factor A	1
20	Research and Management	Improve understanding of climate change effects to river flows, water quality, and species' viability. Continue to learn and utilize new tools as they become available to help better understand future climate projections and related tools on how those projections will affect hydrology, habitat, water quality, and species' viability.	1, 2, 3, and 4	Factors A and E	1

21	Research and Management	Improve understanding of the nature and extent of interaction between other fish species (native and non-native) and peppered chub, and the possible role of these species in the peppered chub's decline. The potential impacts to peppered chub based on competition with other fish species is not well understood. For example, the Red River shiner (<i>Notropis bairdi</i>) became prevalent in the Cimarron River in the 1980s, as the Arkansas River shiner (species with analogous distribution, life history, and threats) was beginning to decline. Determining the level of impact the introduction of Red River shiner and other non-native species have on declining peppered chub populations is crucial to developing effective restoration and management techniques.	1 and 4	Factor C	2
22	Research and Management	Improve understanding of the effectiveness of management actions. As recovery actions for the peppered chub are implemented, effectiveness monitoring should be included to the greatest extent practicable. This information, with updated knowledge of the species' life history and ecology (Recovery Action 17) will be essential for flexible management.	1, 2, 3, and 4	Factor D	2
23	Research and Management	Develop and implement a flexible management program and ensure that appropriate research and management activities are implemented to achieve recovery. To maintain a flexible management approach for the recovery of the peppered chub, it will be necessary for the USFWS and its conservation partners to continually analyze new and additional information regarding the biological, physical, and chemical conditions of identified management units for the peppered chub.	1, 2, 3, and 4	Factor D	2

24	Partnerships and Collaboration	Identify key partners for each management unit. Identify key partners in each of the four management units. Partners may include tribes, private landowners, municipalities, groundwater management districts, non-government organizations, industry, and state and federal agencies.	1, 2, 3, and 4	Factor E	1
25	Partnerships and Collaboration	Develop and implement a communications plan to enhance collaboration with partners. Develop a plan that outlines how collaboration among partners identified in Action 24 will be implemented. The plan will include a process on how to best share information and how frequently that information will be shared.	1, 2, 3, and 4	Factor E	3
26	Partnerships and Collaboration	Integrate existing conservation plans and measures. Evaluate and integrate existing conservation plans and measures (e.g., existing industry BMPs) from state, federal, and non-government organizations to identify common goals and assist with recovery actions.	1, 2, 3, and 4	Factor E	3
27	Outreach and Communication	Develop and implement an outreach and communications plan for the peppered chub. A comprehensive outreach and communications plan will be developed jointly by the USFWS and its partners. Some basic considerations and ideas for such a plan include identifying key audiences, key messages, and methods of disseminating information such as regular meetings, social media, USFWS webpages, news outlets, etc.	1, 2, 3, and 4	Factor E	3

Time and Cost Estimates

The estimates of the time needed to implement recovery actions (Table 2) are a guide for meeting the recovery criteria and actions discussed in this Plan. The initiation and completion of recovery actions are subject to the availability of funds, as well as other constraints affecting the parties involved. The total cost of recovery stated in this Plan is only a rough estimate and may change substantially as efforts to recover the species continue. Thus, detailed cost breakdowns for each management unit with expected annual costs are not known at this time. While we have the statutory responsibility for developing and implementing this Recovery Plan, recovery of peppered chub will necessitate the involvement of federal, tribal, state, private, and local partners. The continued expertise and contributions of these and additional agencies and interested parties is needed to implement the recovery actions identified in this Plan. To enhance the effectiveness of this Recovery Plan, the USFWS will develop and adopt a Recovery Implementation Strategy (RIS) as a flexible way to update and revise step-down recovery activities as needed.

With successful implementation of this Recovery Plan, we expect the status of the peppered chub to improve such that we can delist the species in approximately 30 years, with a total estimated cost of \$71,175,000. This timeframe is based on expectation of full funding, implementation as provided for in the Recovery Plan and RIS, high degree of success in executed actions, and full cooperation of partners.

Table 2. Estimated time and costs for peppered chub Recovery Actions.

Recovery Action Number	Recovery Action Description	Estimated Annual Cost	Estimated Time (Years)	Total Cost
1	Develop and implement water management for the Upper Canadian River management unit.	\$300,000	20	\$6,000,000
2	Evaluate the three unoccupied management units (Lower South Canadian, Arkansas/Ninnescah, and Cimarron River) and develop priorities for peppered chub reintroductions.	\$100,000	5	\$500,000
3	Develop and implement water management strategies for the unoccupied management units identified through implementation of Action 2 above.	\$300,000	30	\$9,000,000
4	Control invasive species in riparian areas throughout the species' range.	\$300,000	15	\$4,500,000
5	Restore floodplains associated with management units.	\$600,000	15	\$9,000,000
6	Develop and implement a plan for fish passage, flow barrier assessment, and potential removal or rehabilitation of barriers.	\$600,000	15	\$9,000,000
7	Preclude the need for new reservoir construction within all management units.	\$100,000	10	\$1,000,000
8	Implement long-term management commitments or conservation agreements across the species' range to ensure water quality and quantity are sufficient to support at least three self-sustaining populations.	\$100,000	30	\$3,000,000
9	Define and distribute information on potential threats to water quality within the range of the peppered chub as they are identified.	\$100,000	10	\$1,000,000
10	Develop and implement best management practices for good water quality within management units.	\$500,000	15	\$7,500,000
11	Continue to implement a range-wide monitoring program.	\$80,000	30	\$2,400,000
12	Develop a comprehensive Captive Propagation and Contingency Plan consistent with the USFWS Policy regarding Controlled Propagation of Species Listed Under the ESA.	\$75,000	3	\$225,000
13	Establish and maintain a captive breeding program.	\$125,000	30	\$3,750,000
14	Develop and implement a Reintroduction Plan.	\$180,000	6	\$1,080,000

15	Develop and implement a Biobanking Plan.	\$100,000	6	\$600,000
16	Research and develop hydrologic targets necessary to support peppered chub populations.	\$100,000	10	\$1,000,000
17	Continue to develop knowledge of the species' life history, ecology, habitat requirements, and behavior and apply that knowledge to restore and protect appropriate habitats.	\$200,000	20	\$4,000,000
18	Continue range-wide genetic studies on peppered chub populations.	\$60,000	8	\$480,000
19	Improve understanding of the nature, extent, and role of water quality degradation in the decline of the species, as well as whether existing water quality standards are sufficient for species' protection and recovery.	\$200,000	10	\$2,000,000
20	Improve understanding of climate change effects to river flows, water quality, and species' viability.	\$20,000	20	\$400,000
21	Improve understanding of the nature and extent of interaction between other fish species (native and non-native) and peppered chub, and the possible role of these species in the peppered chub's decline.	\$60,000	4	\$240,000
22	Improve understanding of the effectiveness of management actions.	\$50,000	15	\$750,000
23	Develop and implement a flexible management program and ensure that appropriate research and management activities are implemented in a timely manner to achieve recovery.	\$25,000	20	\$500,000
24	Identify key partners for each management unit.	\$10,000	5	\$50,000
25	Develop and implement a communications plan to enhance collaboration with partners.	\$10,000	20	\$200,000
26	Integrate existing conservation plans and measures.	\$250,000	10	\$2,500,000
27	Develop and implement an outreach and communications plan for the peppered chub.	\$25,000	20	\$500,000
Total				\$71,175,000

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Appendix A: State Wildlife Agency Comments and Responses

The initial draft of this Recovery Plan was developed internally by a team of USFWS biologists; however, we provided an early version of the Draft Recovery Plan to state wildlife agencies (New Mexico Game and Fish Department, New Mexico Interstate Stream Commission, Texas Parks and Wildlife Department, Oklahoma Department of Wildlife and Conservation, and Kansas Department of Wildlife and Parks) for a 60-day review period beginning September 9, 2024. We received comments from all agencies, except Oklahoma. In general, comments were supportive of the Plan. Several commentors requested more specific, measurable details be included in the recovery criteria. There is insufficient scientific information to provide more accurate details, so we have noted those additional research needs throughout this Recovery Plan. We made edits as described below, and in some instances, additional language and/or citations were added to the Recovery Plan for clarity. We appreciate all of the comments and suggestions that are included below with our responses.

Comment: We received several minor, non-substantive changes and corrections throughout this document (e.g., spelling errors, grammatical revisions, units) to revise the readability and clarity of the document.

Response: We incorporated these comments and edits as appropriate. A full summary of such changes is not provided.

Comment: We received several comments with additional information that did not involve suggested changes or clarifications to the Plan.

Response: These comments have been noted for use in the RIS and/or future Species Status Assessment revisions.

Comment: Reviewer noted that some entities recognize a different taxonomy for peppered chub.

Response: We have noted this for the Species Status Assessment. Because the change in family does not affect the listing or Recovery Plan, we have kept the original classification for consistency across documents.

Comment: We received several comments regarding the inclusion and/or clarification of the roles of hydrology, drought, climate change, and gravel mining as stressors for peppered chub.

Response: In most cases, we added language and reworded sections to incorporate these comments. However, some language was unchanged depending on the relevancy and urgency of certain threats in particular sections of the document.

Comment: We received a comment on critical habitat in Kansas visualized in Figure 1 and that designated critical habitat does not extend into Kansas.

Response: We edited Figure 1 to reflect existing designated critical habitat as published in the final listing rule (87 FR 11188).

Comment: Several reviewers noted that researching minimum flows for species' survival and persistence should be priority.

Response: We agree. While the science is reasonably strong on the flow and stream length needed for successful spawning, uncertainties remain, and there are many complexities in determining the "how, where, and when" for flows. We revised one sentence on this for clarity. Also see sub-criterion 2a and Actions 17 and 20. More details on necessary research will be included in the RIS.

Comment: Reviewer noted conflicting statements regarding fish survival in isolated pools.

Response: We have revised these statements for consistency and clarity.

Comment: Reviewer requested additional detail and justification in sections titled "Altered Flows, Stream Fragmentation, and Modified Geomorphology" and "Other Influences."

Response: These details are covered in the Species Status Assessment, and to keep the Recovery Plan focused and succinct, we have chosen not to include additional detail and justification in these sections.

Comment: Reviewer noted redundancy in the goals and recovery strategy.

Response: We removed "recovery goals" from this document and revised the language in our Recovery Strategy to reduce this redundancy.

Comment: The term "supportive hydrology" was questioned, as it was not described or defined in the document.

Response: We have reworded this statement for clarity and removed the term "supportive hydrology."

Comment: Reviewers commented that the Ninnescah/Arkansas River management unit did not cover portions of the peppered chub's historical range, and one requested that the Arkansas River from the confluence of the Ninnescah River to Lincoln Street Dam in Wichita, Kansas be incorporated to the Ninnescah/Arkansas River Management Unit (Priority 2).

Response: We implemented this change and updated Figure 2 and the text describing this management unit.

Comment: Reviewer suggested including landownership information in all management unit descriptions.

Response: We have incorporated this information as available and feasible.

Comment: One reviewer commented that the statement on “developing an environmental flow strategy” seemed vague.

Response: This is intentional, as the details of said strategy have yet to be determined; developing this strategy will be part of the recovery activities in the RIS.

Comment: Reviewer requested including the approximate length of the Revuelto Creek section in the Upper South Canadian River management unit.

Response: We have added the distance from the dam to Revuelto Creek. The total mileage of the management unit is also included in the description.

Comment: Reviewer highlighted that the Ninnescah/Arkansas River management unit has had recent modifications that have fragmented the unit. The reviewer suggested that fish passage or barrier removal work was needed before this segment should be designated as a priority unit.

Response: We recognize that there are challenges with barriers and stream length in this management unit; however, we are leaving this area as an identified Unoccupied Management Unit so that it may still be prioritized for reintroduction, habitat modifications, or other activities that may support the species’ recovery. We revised the text and added the mentioned barrier to the text for clarity.

Comment: We received a correction on the records of observation in one of the management units, from 2000-2013 to 1964-2012.

Response: We corrected our statement to say “2000-2012,” and we left the start of the range at 2000 (rather than 1964) to highlight recent records.

Comment: A reviewer questioned why the Ninnescah/Arkansas River management unit was considered a priority if the species has not been observed since 2013.

Response: While it is true that peppered chub was extirpated in 2010/2011 (likely due to drought), that stretch of river now appears to be capable of supporting peppered chub.

Comment: Reviewer commented that identifying causes of extirpation is critical before considering repatriating peppered chub.

Response: We agree this is important. We revised the relevant text to clarify that the believed cause of extirpation was the drought in 2010/2011, but suitable habitat remains and could support peppered chub in the future.

Comment: We received a comment that a few of the recovery criteria were not objective or measurable, and the reviewer advocated for measurable criteria.

Response: We recognize the importance of objective and measurable criteria. Several reviewers suggested changes to the criteria, and we believe that the reviewer's concern has been addressed with these revisions.

Comment: A reviewer suggested a need to incorporate imperfect detection components to infer sampling error and false absences in surveys and monitoring.

Response: We agree, and imperfect detection will be more specifically addressed in the RIS.

Comment: Reviewer requested flexibility in Criterion 1 through removal of the young-of-year requirement for documenting wild recruitment. The reviewer felt that finding adult peppered chub over a five-year time span would be indicative of recruitment. The reviewer also asked about the use of eDNA.

Response: We agree that finding adult peppered chub across a longer time span can also indicate natural recruitment, and we have provided additional flexibility to account for this in Criterion 1. Regarding eDNA, because there is uncertainty around how long DNA would persist in the environment if fish were absent, and because size and abundance of fish cannot be determined using eDNA, we are not utilizing eDNA for fulfillment of Criterion 1 in this Recovery Plan. The use of eDNA may be further addressed in the upcoming RIS, as it is a significant conservation tool.

Comment: Reviewer asked for clarification on how hatchery fish will be distinguished from wild fish in Criterion 1.

Response: There are multiple options for distinguishing between hatchery and wild caught fish, such as tagging hatchery fish or a pause in stocking, etc. We intend to provide further details regarding distinguishing between wild and hatchery fish in the RIS.

Comment: Regarding sub-criterion 1a, a reviewer asked where the numbers of survey years come from (six or more survey years within a 10-year period).

Response: We added clarification on this in the justification, "The six or more survey years provides for flexibility in the scenario that recruitment in some years could be low and or more difficult to detect and/or the scenario in which some years surveys are not able to be performed (e.g., due to weather, logistics, staff resources, etc.)."

Comment: We received a comment regarding sub-criterion 1b that because peppered chub are highly mobile and utilize different conditions that are favorable to their life history stage, it could be difficult to document them at multiple locations. They contended that if the river is unfragmented, it should be considered occupied, and documenting individuals at upper, middle, and lower sites is unnecessary.

Response: We left this criterion unchanged. While peppered chub may occupy an unfragmented stretch of river, that does not necessarily mean the population has recovered. The general terms of “upstream, midpoint, and downstream” and requirement of only three sites allows for flexibility in sampling. The USFWS and its partners will likely be covering more than three sites a year, with the intent to cover as much longitudinal river length as possible. Detecting peppered chub from at least three of these generalized areas provides greater assurance that the population has recovered.

Comment: Reviewer was concerned that two to three 127-mile reaches would not indicate recovery as the species might only occupy about 15% of the species’ historical range.

Response: The criterion sets a minimum threshold of 127 contiguous miles within a reach, but this threshold does not limit the species to reaches of that length (i.e., peppered chub may occupy longer reaches and more of its historical range). Additionally, the purpose of this Recovery Plan is to describe "when it [peppered chub] should no longer meet the ESA's definitions of a threatened or endangered species." While more occupied reaches and improvements to habitat might increase the species' viability, this criterion serves as a framework for USFWS to assess when protections under the ESA may no longer be required and peppered chub no longer meets the ESA's definition of a threatened or endangered species.

Comment: We received several comments regarding our use of 127 unfragmented river miles (rmi) as a benchmark taken from Perkin and Gido (2011). Reviewers questioned the strict use and interpretation of this benchmark, suggesting a river stretch of approximately 120 miles (for example) could also support self-sustaining populations.

Response: We agree that 127 rmi should not be interpreted as a strict benchmark, wherein 127 and greater rmi sustain populations, but less than 127 rmi do not. However, the best available information suggests that an *approximate* length of 127 rmi gives reasonable assurance that a population would persist. We included additional clarification regarding our use of this benchmark in the criterion justification.

Comment: Criterion 2 is lacking a justification section.

Response: We have added a justification for consistency throughout the document.

Comment: We received a comment asking about our research plan for determining hydrological patterns and water quality conditions needed to create suitable peppered chub habitat.

Response: These details will be included in the recovery activities in the RIS.

Comment: Reviewers cautioned that providing additional water under projected drought would be unrealistic.

Response: We added a justification for Criterion 2, which partially addresses this comment. Additionally, this criterion does not necessarily require more water. Instead, the criterion sets a minimum threshold where baseflows would be stable (i.e., the criterion does not provide an exact baseflow—lower or higher than present baseflows—which must be stable). We hope that future research will provide clarity on what baseflows are needed to meet peppered chub life history needs.

Comment: Reviewer clarified that the timelines for the criteria are regarded as rolling windows.

Response: We agree. We have revised the text to be more explicit that this can occur over any 20-year period.

Comment: A reviewer asked if mechanical alteration has been considered to achieve desired habitats given low flows.

Response: This is an option, and these details will be included in the RIS.

Comment: Regarding Criterion 3, a reviewer mentioned that we include water quality conditions as a parameter, but water quality is not included in sub-criteria a through c.

Response: We have added water quality to sub-criterion 3a as suggested.

Comment: We received a comment regarding sub-criterion 3a and achieving a “natural flow regime.” First, patterns necessary to sustain peppered chub are unknown, and second, achieving natural flow patterns is unlikely given constraints on the system (e.g., climate change, damming, and groundwater pumping).

Response: We do not expect to restore flows or add water, necessarily, to historical conditions. Rather, we anticipate mimicking or approximating the necessary flow regimes which are supportive of all peppered chub life history needs. For clarity, the word “natural” has been removed from this criterion.

Comment: Regarding Criterion 3, a reviewer pointed out that we begin the criterion with “Until such information is available, the following criteria may be used to measure flow patterns,” but sub-criterion 3a includes determining needed flow patterns. The reviewer also asked about the research plan for determining needed flow rates.

Response: We deleted the phrase “until such information is available...” to improve the criterion’s readability. Our plan for determining needed flow patterns is covered in Actions 17, 19, and 20, and additional details will be provided in the RIS and recovery activities.

Comment: We received a comment that sub-criterion 3c would fit better under Criterion 1.

Response: We removed sub-criterion 3c altogether as it was redundant with Criterion 1. Originally, 3c read, “Criterion 1 above (successful recruitment during a 10-year period) is achieved during the second half of this 10-year period or later.”

Comment: A reviewer suggested setting a minimum timeframe for updating the RIS.

Response: There is no required timeframe for RIS updates. However, we added language to clarify how often we intend to update the RIS at a minimum. The sentence originally read, "We intend to update the RIS as frequently as needed by incorporating new information, including the findings of future 5-year status reviews." The sentence now reads, "We intend to update the RIS as frequently as needed by incorporating new information, and at least every five years to include the findings of future 5-year status reviews."

Comment: We received a suggestion to clarify references to action priority numbers.

Response: We clarified the description of priority numbers. The sentence originally read, "The assignment of these priorities does not imply that some recovery actions are of low importance, but instead implies that lower priority items may be deferred while higher priority items are being implemented." The sentence now reads, "The assignment of these priorities does not imply that some recovery actions are of low importance, but instead implies that lower priority items (i.e., Priorities 2 and 3) may be deferred while higher priority items (i.e., Priority 1) are implemented."

Comment: A reviewer noted a need to install more USGS gages in the Upper South Canadian to better measure flows and implement recovery actions.

Response: We have noted this recommendation for the RIS.

Comment: A reviewer asked if the USFWS had identified funding for more research on the peppered chub and Arkansas River shiner.

Response: Funds may be provided through Section 6 grants, and additional recommendations can be included in the RIS.

Comment: A reviewer suggested adding “drinking” to the uses of the water from the Ute Reservoir.

Response: We updated this statement to include “domestic purposes” as that includes lawn irrigation, dishwashers, washing machines, and flush toilets, as well as drinking water.

Comment: Regarding Recovery Action 2, a reviewer noted that the Ninnescah River will need fish passage work prior to it being a priority for reintroductions.

Response: This has been noted for the RIS.

Comment: A reviewer noted the potential need to consider the sequence of actions.

Response: This has been noted for consideration in the RIS.

Comment: A reviewer asked if there are any opportunities to expedite the permitting process for state and federal agencies involved in collections for propagation.

Response: There are several options available to expedite permitting for state and federal agencies involved in collections for propagation.

Comment: A reviewer suggested changing Action 6 from Priority 1 to 2.

Response: We changed this action to Priority 2.

Comment: Regarding Action 9, reviewers asked if the PBF parameters described on pages 7-8 could be used as targets.

Response: The parameters on pages 7-8 provide great starting points for research and recovery actions. Further, species-specific research may suggest modifications to those parameters.

Comment: Reviewers suggested switching Action 11 from the Habitat Conservation and Restoration theme to the Research and Adaptive Management Theme.

Response: We moved this action to the "Research and Management" theme and renumbered the table accordingly.

Comment: Reviewer corrected Action 15 to refer to Actions 14 as well as 11–13.

Response: This has been corrected.

Comment: Regarding Action 17, a reviewer noted that determining the species' habitat needs, including water quantity targets, will be key to recovery, and that if this is not covered under this action, then it should be added.

Response: Water quantity targets and other habitat criteria are covered under "habitat requirements," and more specific details of what that will entail will be included in the RIS.

Comment: A reviewer suggested reprioritizing Action 18 from 2 to 1 because it ties into captive propagation.

Response: We revised Action 18 to Priority 1.

Comment: A reviewer requested justification be provided regarding why stressors described in the “Other Influences” section are less likely to impact peppered chub.

Response: We added language to clarify that we expect these stressors are less likely to impact peppered chub due to their extent and frequency.

Comment: A reviewer asked that we group Action 11 with Action 1 as Action 11 informs Action 1.

Response: Several reviewers asked that Action 11 be moved to the "Research and Adaptive Management" theme. We moved Action 11 to the “Research and Management” theme in response to those comments and added a note to Action 1 clarifying that Action 1 would be informed by what is now Action 16 (previously Action 11).

Comment: Reviewer questioned why Action 6 is a Priority 1 action since the Upper South Canadian is currently occupied and barriers have not been specifically identified.

Response: Action 6 was revised to be Priority 2.

Comment: Reviewer noted that the first time captive propagation is mentioned is in Action 13 and asked why this is not discussed earlier regarding reintroductions.

Response: We use the terms “reintroduce” and “reintroduction” throughout the document, and they are meant to incorporate either captive propagation or translocations as appropriate.

Comment: Reviewer commented that because environmental conditions and new research might substantially change the outlook for peppered chub, it may be beneficial to have more flexible criteria.

Response: We agree with the need for flexibility to adapt to changing conditions and new information. Recovery plans are guidance documents to help the USFWS understand when a species may be considered recovered and potentially delisted, utilizing the best available information at the time the plan was written.

Comment: Regarding Action 2, reviewer questioned if the Upper South Canadian would also need evaluating.

Response: No, this action is specific to the Unoccupied Management Units because peppered chub are no longer there, and those units are translocation or reintroduction sites. The Upper South Canadian already has peppered chub and is not specified in this action.

Comment: Reviewer indicated that Actions 1 and 3, as worded, appeared to be redundant.

Response: We agree the wording could have led to some confusion. We have revised the language in these two actions for clarity. We reworded Action 1 to be specific to extant populations and Action 3, with a lower RPN, to focus on currently Unoccupied Management Units.

Comment: Regarding Actions 9 and 10, reviewers noted that water quality is not the main threat to peppered chub relative to flow regime and water quantity. They suggested changing these actions from Priority 1 to 2.

Response: We agree and have revised these actions accordingly.

Comment: Reviewer noted that Action 11 should rank as one of the highest priorities within the Priority 1 recovery actions.

Response: This is noted for the RIS.

Comment: A reviewer suggested switching Action 24 from Priority 3 to 1 because partners will be critical in implementing recovery actions.

Response: We agree that partners will be critical in implementing recovery actions for the peppered chub and have updated the action priority number accordingly.

Appendix B: Draft Recovery Plan Peer and Technical Review and Public Comment

The initial draft of this Recovery Plan was completed by a team of USFWS biologists and then provided to state wildlife agencies across the species' range for initial review (see comment and response summary in Appendix A). The USFWS revised the Recovery Plan based on that review and then conducted a 30-day public comment period starting August 19, 2025, and closing on September 19, 2025. During the public comment period, the USFWS also requested peer review from 16 species experts and groups; however, we received no responses. During the public comment period, we received comments from eight commentors (i.e., the New Mexico Department of Game and Fish, the New Mexico Interstate Stream Commission, the Kansas Department of Wildlife and Parks, the Oklahoma Attorney General, the Oklahoma Farm Bureau, the Kansas Farm Bureau, the Petroleum Alliance of Oklahoma, and the United States Bureau of Reclamation). We made edits as described below, and in some instances, additional language and/or citations were added to the Recovery Plan for clarity. A summary of comments and our responses are provided below.

Comment: Several commenters expressed concern regarding the feasibility and sustainability of water releases from Sanford Dam (Lake Meredith), noting that the dam was not designed for continuous releases and that water storage is regulated under the Canadian River Compact. They highlighted historical data indicating limited and inconsistent water flows in the South Canadian River, which would prevent stable conditions for species' recovery. Commenters warned that all water users may be impacted by implementation of the Recovery Plan.

Commenters emphasized that Oklahoma's rivers and groundwater are appropriated for various uses, including irrigation, public water supply, and mining. They pointed out that altering stream water or groundwater permits to allocate flows for species recovery would require both the permit holder's agreement and approval from the Oklahoma Water Resources Board, making implementation complex and challenging.

They also noted that the USFWS has yet to determine the necessary water flows to recover the chub or to adequately assess existing flows in proposed management units, despite the availability of relevant stream flow data.

Additional concerns focused on the Recovery Plan's lack of evaluation of how altered river flows might affect existing wildlife and habitats, particularly along the Lower South Canadian and Cimarron Rivers. Commenters cautioned that changes to hydrology could have unintended ecological consequences and opposed displacing established riverine communities for the uncertain restoration of a single species.

Response: We recognize that reservoir releases may not be feasible at this time and understand the complex challenges of water management that involve a variety of water users. While not explicitly discussed in the Recovery Plan, we hope to explore ways to

manage water which align with landowners' interests in the upcoming Recovery Implementation Strategy (RIS), as well as include all partners and stakeholders who may be affected by water management within the range of the species.

If relevant flow data are available and are not discussed in the species' SSA, we encourage our partners to provide that data, so that we might include that information in future documents. This species is scheduled for a five-year status review in 2027, and additional information could be included in that review.

We also recognize that altering the system may impact existing wildlife and habitat; however, given that the peppered chub is native to the system, we anticipate that any changes would benefit native wildlife and habitat in the long-term.

Comment: One commenter expressed concern that the Draft Recovery Plan's proposed water quality targets and best management practices (BMPs) lack specificity, particularly regarding contaminants from oil and gas operations. They noted that the absence of clearly defined water quality standards and thresholds may result in regulatory uncertainty and costly compliance measures for affected industries. The commenter also requested that any new BMPs or spill remediation plans (referenced in Action 10) account for existing industry practices to avoid duplicative regulation and emphasized the importance of involving industry stakeholders in the development of practical, cost-effective measures. They also sought clarification on how compliance costs for water quality standards would be assessed in the RIS, especially for industries operating in the South Canadian River.

Response: The Recovery Plan does not identify specific water quality targets because additional research is needed, particularly for real-world exposures to multiple chemical stressors. The existing pollutant-by-pollutant approach to setting water quality standards does not reflect ambient conditions for most aquatic organisms, resulting in uncertainty about what constitutes truly protective targets. The goal of the water quality actions outlined in Actions 8, 9, 10, and 19 of the Plan is to conduct research to identify pollutants or constituents likely impacting water quality such that they are hindering or preventing peppered chub recovery. Once identified, the USFWS will work with state and federal agencies, industry, municipalities and other partners to target and reduce sources of the identified constituents of concern. This coordination would reduce any duplicative efforts and secondarily reduce costs. Additionally, the use of the term "water quality targets" in Action 9 was not intended to be equated with or usurp the authority of EPA or state agencies to implement the Clean Water Act or establish water quality standards. We use the term "targets" as non-regulatory water quality goals needed to achieve recovery. We have revised Action 9 to provide clarity.

The BMPs referred to in Action 10 include existing and potential new best practices designed to protect water quality. Duplicative or redundant practices would not provide a

net benefit to recovery and would be avoided. BMPs are generally widely accepted and utilized by industry, with many practices already mandated by state or federal law, but they are not designed to be static, and non-statutory or -regulatory BMPs should be revised as needed. New BMPs could apply to a variety of activities across the landscape but would serve to reduce point and non-point source pollution identified as contributing to the decline of peppered chub.

Comment: Commenters expressed support for the Draft Recovery Plan's emphasis on partnerships and outreach (Actions 24–27), noting the need for watershed-scale collaboration among federal, state, tribal, local agencies, private landowners, and other stakeholders. However, concerns were raised regarding the lack of detail on the role of industry stakeholders, particularly the oil and gas sector, operating on private lands within the Lower South Canadian River and Cimarron River management units.

Specifically, commenters requested clarification on how the USFWS will engage oil and gas stakeholders in partnership activities (Action 24) and proposed establishing regular communication channels (Action 25) to better align recovery objectives with operational needs. Additional feedback urged the integration of existing industry best management practices—such as water recycling and spill prevention—into conservation planning (Action 26) to avoid duplicative efforts. Commenters also emphasized the importance of incorporating industry input into the development of the RIS to enhance plan specificity and effectiveness.

Response: The USFWS acknowledges the important role that partners play in the management of fish and wildlife resources and the recovery of the peppered chub. As such, there are three Actions (24, 25, and 26) dedicated to partnerships and collaboration. These actions are described generally to allow for flexibility in how these actions are implemented. Action 25 calls for the development of a communications plan, which would provide many of the details the commenters have requested. Development of the RIS and communications plan with partners will commence once this Recovery Plan is finalized.

Comment: Commenters expressed concern regarding proposed reintroduction actions (Actions 12, 13, and 14) for the peppered chub, specifically questioning how reintroduction sites will be prioritized to minimize overlap with oil and gas industry operations and whether translocation of wild individuals could reduce costs and regulatory expansion. Additional questions were raised about the habitat conditions required for reintroduction in unoccupied management units, the methods for monitoring population declines to distinguish between anthropogenic and natural causes, and whether the RIS will include cost-benefit analyses comparing captive propagation and translocation. Another commenter opposed the introduction or reintroduction of listed species onto public or private lands.

Response: The substantial loss of peppered chub populations across the species' range and the species' current existence at a single location within the South Canadian River emphasize the need for a captive population. Additionally, reintroduction of peppered chub into other parts of its historical range is likely the only means by which the species may be recovered. The prioritization of potential reintroduction sites would be identified in the future, once a captive population was established. Monitoring requirements and habitat suitability would be a part of any reintroduction plan. Translocating individuals for reintroduction may be a viable option for recovery. The use of translocations is not specifically mentioned in the Draft Recovery Plan but was addressed in a response to comments in Appendix A. Additionally, we have made a change to Action 14 to explicitly include translocations. How we reintroduce peppered chub (e.g., captive rearing versus translocations) will depend on the capacity of our partners, available funding, maximizing efficacy, and the status of both the captive and wild populations of peppered chub.

Comment: Two commenters raised several issues regarding the clarity and feasibility of funding for the proposed recovery actions. Concerns were expressed about reliance on federal appropriations and partner contributions, with requests for more detailed information on how necessary funds will be secured and whether private stakeholders, such as the oil and gas industry, will bear costs through regulatory compliance or partnership contributions (Actions 24–26), particularly on private lands. Commenters further requested that the USFWS provide historical data on recovery funding for other listed species to help assess feasibility and clarify where the peppered chub ranks among recovery funding priorities. Questions were also posed regarding the estimated \$71.175 million cost, including the proportion expected from private stakeholders and a request for cost breakdowns by management unit and industry sector. Additionally, commenters asked whether voluntary industry contributions would be incentivized via regulatory relief.

One commenter also noted that groundwater is private property in Oklahoma and observed that the draft Plan does not anticipate purchasing groundwater or associated rights, nor does it estimate the cost of such acquisitions.

Response: Under Section 4(f)(1)(B)(iii) of the Endangered Species Act (ESA), the USFWS is required to provide estimates of the time required and the cost to carry out those measures needed to achieve a recovery plan's goal. This cost estimate does not commit any entity (e.g., industry, academia, state or federal agencies) to funding recovery actions nor does the estimate affect federal appropriations. The time and cost estimates are intended to provide the public with our best assessment of full implementation of the plan in meeting the recovery criteria.

There are federal and state programs that incentivize restoration projects by prioritizing projects that focus on listed species and implement recovery actions, for example, the

USFWS' Cooperative Endangered Species Conservation Fund, state Wildlife Actions Plans, and USDA Environmental Quality Incentives Program. Regarding data on recovery funds for other species, the USFWS provides an annual report to Congress per Section 18 of the ESA on expenditures for listed species that is publicly available.

Comment: Several commenters expressed concern regarding the Plan's compatibility with Oklahoma water law, requesting clarification on how recovery actions align with existing state statutes and regulations. Several submissions highlighted the role of Oklahoma's environmental agencies and emphasized the importance of respecting state sovereignty in the implementation of recovery measures. One comment underscored Kansas's primacy in conservation and dewatering issues, urging the USFWS to recognize Kansas's leadership in managing local water resources. In addition, commenters questioned the legal authority of the USFWS with respect to water conservation and land management activities within Oklahoma, seeking further explanation of the USFWS' jurisdiction under federal law.

Response: As noted under the Purpose and Disclaimer; Recovery Plans and Recovery Implementation Strategies are guidance documents only. They provide goals for long-term conservation of listed species and define criteria that would indicate when a species may no longer need protection under the ESA. Actions and criteria within a Recovery Plan do not create any legal obligations beyond existing legal requirements. We recognize the authority the States have in managing resources to meet the needs of their constituents; as such we also rely upon the States as important partners in the conservation of fish and wildlife resources. The recovery of the peppered chub will depend on these very partnerships.

Comment: Two comments were received regarding how the Plan will address private property rights and existing permitted water use. Commentors noted that while the Plan aims to halt habitat degradation and improve conditions for species' reintroduction, the Plan does not sufficiently discuss its integration with private property interests. Additionally, commenters emphasized that, because 95% of the Ninnescah/Arkansas River management unit is privately owned, the Recovery Plan should prioritize recognizing these interests. They recommended that the RIS include incentivized, voluntary measures to land managers that assist in the recovery of peppered chub.

Response: The USFWS recognizes the wide variety of landownership and uses occurring across the range of the peppered chub. We value the role that private landowners play in the stewardship of fish and wildlife resources. This is why the Recovery Plan emphasizes partnerships with all stakeholders in Actions 24 through 26 and why the RIS will be developed with input from stakeholders, including private landowners and industry. The Recovery Plan is a guidance document, and participation in recovery activities is completely voluntary. We agree that incentives for implementing recovery actions could

be a useful tool and an important part of species' conservation to be further explored in the RIS.

Comment: One commenter expressed concern regarding Action 5 of the Draft Recovery Plan, which proposes large-scale floodplain restoration within the South Canadian and Cimarron River management units to facilitate upstream movement of peppered chub populations. The commenter stated that this approach would require substantial financial investment, take an extensive amount of time to complete, and could delay progress toward recovery. The commenter suggested that more narrowly focused microhabitat restoration efforts in areas with the highest probability of success could serve as a more efficient and cost-effective alternative, while also reducing potential land and water use conflicts, particularly for the oil and gas industry. The commenter also recommended that the USFWS reconsider the extent of the area designated as critical habitat.

Response: Recovery of the peppered chub is likely to require substantial efforts to restore stream function in portions of the species' range. Action 5 calls for restoration of floodplains "in targeted areas." Strategic micro-habitat restoration could be a part of this effort. We hope to work with our partners to implement this action effectively.

Evaluation of critical habitat is not part of the recovery planning process.

Comment: A commenter expressed concerns regarding Action 6, which prioritizes the removal or rehabilitation of small barriers to improve fish passage, and Action 7, which aims to prevent new reservoir construction in drought-prone areas. The commenter requested clarification on the criteria for barrier selection and prioritization, assessment and minimization of impacts to existing infrastructure (such as pipelines), and whether exemptions or streamlined permitting would be available for infrastructure with negligible effects on peppered chub habitat. Additionally, the commenter sought information on how Action 7 will address industry water storage needs and the feasibility of alternatives like off-channel storage, as well as whether economic impact assessments will be conducted to ensure cost-effective modifications to existing infrastructure.

Response: Action 6 regarding barrier remediation is based on the peppered chub's need for unimpeded streams to complete its life history. Action 6 provides the general guidance by which to prioritize fish barriers within the range of the species. Exemptions for permits or conducting economic analyses are beyond the scope of the Recovery Plan; however, we note that the USFWS provides financial assistance for barrier removal projects through the National Fish Passage Program. Action 7 provides the initial step, working with stakeholders, to identify alternatives to reservoir development to meet future water supply demands. We welcome all ideas that would improve stream connectivity within the range of the species.

Comment: Commenters requested clarification on how the Recovery Plan and its accompanying RIS will comply with Department of the Interior Secretarial Order 3441, which implements Executive Order 14303, Restoring Gold Standard Science, by ensuring federally funded research is transparent, rigorous, and impactful, and that Federal decisions are informed by the most credible and impartial scientific evidence available.

Response: The USFWS fully implements all Secretarial and Executive Orders as they pertain to various agency activities. This includes SO 3441 and EO 14303, which are explicit in the purpose of federally funded research which would apply to any federal funding or agency collection of data related to the peppered chub Recovery Plan.

Comment: Commenters noted that the Recovery Plan identifies significant gaps in information regarding the peppered chub and its habitat, which may undermine effective decision-making and recovery strategy implementation. They strongly encouraged the USFWS to emphasize additional research and data collection, particularly in relation to Actions 16, 17, and 20, and recommended prioritizing and dedicating funding to improve scientific understanding and support recovery efforts, especially given future challenges such as climate change and water availability. Table 2 of the Recovery Plan was noted as providing cost estimates but not firm funding commitments, and commenters urged the USFWS to ensure timely and effective research through dedicated resources.

Response: We agree that the emphasis on additional research is important. We acknowledge this need throughout the document, and we have added recovery actions related to needed research. However, the ESA requires that decisions be made on the best available information, which the USFWS will continue to do as new information is made available. We also agree that funding additional research is important to recovery of the peppered chub and note that several federal sources exist that can be directed at research actions.

Under the ESA, the USFWS is required to provide estimates of the time required and the cost to carry out the measures needed to achieve a recovery plan's goal. However, this cost estimate does not commit any entity (e.g., industry, academia, state or federal agencies) to funding recovery actions nor does the estimate affect federal appropriations.

Comment: Some commenters supported Criteria 1 and 4 as grounded in available science but stated that Criteria 2 and 3 lack specificity, rely on insufficient data, and may not be suitable as recovery criteria at this time. Commenters urged the USFWS to provide clearer justification, ensure criteria are measurable, reconsider the structure and ordering of criteria related to flow and habitat needs, and move criteria dependent on unresolved scientific questions to the RIS until adequate information is available.

Response: We recognize that these criteria do not establish distinct thresholds or ranges (e.g., a level of acceptable cubic feet per second); however, these criteria reflect the best

available science regarding the major threats to the species (i.e., lack of perennial water and disruption of the natural flow regime). One commenter even recommended placing Criterion 2 before Criterion 1 to underscore the importance of perennial water. As additional information becomes available, we anticipate refining our understanding of the flow and flow regime needed for species' recovery.

Comment: One commenter requested clarification on how the term “self-sustaining” would incorporate external factors such as drought or invasive species.

Response: The Recovery Plan provides the conditions for which “self-sustaining” would be considered achieved for peppered chub populations under Criterion 1. A self-sustaining population is defined using the demographic parameters outlined in Criterion 1 and incorporates a 10-year timeframe. Threats to the species, such as drought, may inhibit the establishment of a self-sustaining population, which is the reason for recovery actions aimed at reducing the effects of threats acting on the species.

Comment: Several comments were received regarding the rigidity of the 127-river mile length needed to support a peppered chub population, as well as the caveats from the study used to support the stream length.

Response: We agree that some flexibility is needed in basing a necessary stream length to support peppered chub populations; however, the best available information indicates that a minimum 127-river mile unobstructed stream segment would sustain a population, provided other necessary habitat factors exist. Shorter segments are likely possible through other restoration efforts, which is the reason for floodplain restoration in Action 5 to help to reduce the length of stream needed for juvenile survival and recruitment. Additionally, research Actions 16 and 17 focus on habitat and hydrologic needs of the species to continue to understand the species' needs, which may influence several factors including stream length.

Comment: Comments were received concerning the specifics of Criterion 2 and how existing water use would affect baseflow thresholds, the utility of water reuse technology to avoid water restrictions and the 20-year timeframe. Another commentor requested that the oil and gas industry be included in determining baseflows.

Response: We are still trying to understand exactly how existing water use impacts flow in the various management units and what flow is needed to support the recovery of peppered chub. We discuss historical impacts of water use, especially groundwater pumping, in the SSA report (USFWS 2018, pp. 23-31). Given Criteria 2 and 3, we hope to improve our understanding of the baseflows and flow regime needed for the recovery of peppered chub.

We are also open to water reuse technologies which serve to increase streamflow in the various management units.

The 20-year timeframe referenced in the Recovery Plan follows the future scenarios outlined in the SSA (USFWS 2018, pp. 123-159) and allows for the species' demographic parameters to demonstrate recovery following habitat management.

As stated in several other responses, we intend to coordinate with and rely on our partners to formulate and implement the RIS for this Recovery Plan, including activities related to Criterion 2.

Comment: Several comments involved Criterion 3: Commenters raised concerns about water-quality criteria, requesting that thresholds be tied to existing EPA or State standards, that pollutant limits be clearly defined and justified, and that baseline studies be conducted to distinguish natural from anthropogenic sources. One suggested that Criterion 3 was not objective or measurable, citing a lack of clarity in determining water quality standards, hydrologic patterns, and what “improving” means regarding channel width and complexity.

Response: Criterion 3 related to water quality is not intended to be equated with or usurp the authority of EPA or state agencies to implement the Clean Water Act or establish water quality standards. The Plan and criteria therein are meant to outline what the USFWS thinks is needed for recovery of the listed species. Our current understanding of the role of water quality degradation in the decline of the species is poor, and Action 19 emphasizes the need for research so that we can better understand the water quality needed for recovery of the peppered chub, including sources of water quality degradation. More details on Action 19 will be provided in the upcoming RIS.

Comment: Commenters noted that Criterion 4 is more clearly supported by existing research and provides measurable benchmarks, but they questioned whether a certain number of populations alone sufficiently captures species' viability. Commenters also recommended prioritizing reintroduction sites that minimize conflicts with energy infrastructure and suggested that alternative triggers—such as genetic diversity or resilience metrics—could support faster progress toward recovery. Commenters additionally asked whether two self-sustaining populations could serve as a foundation for experimental approaches to establishing a third.

Response: While there are other means for measuring species' viability, the species currently exists as one population. Adding populations of high resilience is needed to increase the species' redundancy and representation and overall viability. Requiring three self-sustaining populations is a straightforward (though not easy), measurable, and objective criterion that points to recovery of the peppered chub.

Prioritization of sites for reintroduction will be based on the potential for success and will account for current and future habitat conditions, level of needed management actions (if

any) to accommodate reintroductions, and the ability of partners to provide the resources needed for such reintroductions.

Though not explicitly mentioned in the Recovery Plan, the USFWS can use experimental populations provided the populations will contribute to the conservation of the species.

The usefulness of this approach can be further explored in the RIS and with our partners.

Comment: One commenter expressed concern that the Recovery Plan proposes altering water levels and flow regimes in several rivers, including the lower South Canadian and Cimarron Rivers, even though neither river currently supports peppered chub populations. The commenter stated that the Plan does not adequately evaluate or disclose the potential adverse effects these changes may have on Oklahomans who rely on these rivers for agriculture, utilities, and oil and gas operations, all of which are important to the state's economy. The commenter also noted that the USFWS anticipates implementing river-related actions over a 30-year period at an estimated cost of approximately \$71 million and asserted that the Plan does not sufficiently justify the risks posed to these sectors relative to the expected conservation outcomes.

Response: As a guidance document, the Recovery Plan does not impose any regulatory restrictions or mandates or commit any entity to funding recovery actions. Rather, the Plan provides the actions that, if implemented, would achieve the delisting criteria and result in the species being evaluated for removal from the Lists of Endangered and Threatened Wildlife. The process for recovery implementation is best accomplished through voluntary participation of stakeholders throughout the region. For this reason, the Recovery Plan is dependent on partnerships to implement actions toward conservation of the peppered chub.

Comment: One commenter stated that the Draft Recovery Plan creates confusion by referring to management units as "Priority 1 (occupied)" and "Priority 2 (unoccupied)" while also assigning separate priority rankings in Table 1, which apply across both occupied and unoccupied areas. The commenter noted that using the same term—"Priority"—for two different concepts makes the Plan's prioritization scheme unclear and could result in conflicting interpretations of which areas should receive emphasis during implementation. The commenter also expressed concern that labeling unoccupied units as "Priority 2" implies they are of lesser importance, despite the Plan indicating that these areas contain suitable habitat and will be essential to achieving recovery.

Response: The USFWS agrees that the use of "Priority" as it pertains to management units is confusing, since that term also refers to recovery action ranking. We have revised the Plan to address the management units as either "occupied" or "unoccupied" indicating their status regarding current occupation by the peppered chub. Referring to the difference in occupation is purposeful, since maintaining the stability and health of the currently occupied unit is necessary not only for recovery, but to prevent extinction of the

last known population of the peppered chub. As reintroduction to new units is accomplished, so follows the importance of maintaining those newly occupied areas.

Comment: One commenter had concerns regarding the discussion on potential reductions in dam seepage and future Canadian River Compact releases associated with the Eastern New Mexico Rural Water System (ENMRWS) pipeline and other water-use activities. The commenter stated that the Recovery Plan does not reflect the State of New Mexico's commitments to support downstream flows from Ute Reservoir, including planned modifications to the reservoir's outlet works that would allow controlled releases independent of seepage. The commenter asserted that upgrading the outlet works represents a prudent and necessary step for long-term conservation of peppered chub and that without the ENMRWS project, these improvements would likely not occur, leaving peppered chub habitat downstream dependent on uncontrolled seepage flows subject to reservoir elevation and potential sediment buildup. The commenter requested that the Plan acknowledge these commitments and better account for how planned infrastructure modifications will support the species' conservation needs.

Response: We greatly appreciate efforts by the State of New Mexico to maintain downstream flows in the South Canadian River, and we agree that the discussion of future flow conditions downstream of Ute Reservoir should acknowledge this effort. At the time of writing the Recovery Plan, these infrastructure improvements have not yet been completed, so we have revised the text to acknowledge the planned infrastructure improvements while retaining concern for the uncertainties that still exist.

Comment: One commenter requested continuing participation from representatives of the oil and gas industry and requested the opportunity to review a revised draft to avoid unworkable water management actions.

Response: Following careful review of the comments received on the draft Plan, the next step of the recovery planning process is to revise the draft as needed, finalize, and distribute. We anticipate continued participation with all stakeholders during the creation of the RIS and the implementation phase of the Recovery Plan.

Comment: One commenter suggested that the Recovery Plan provide detailed hydrologic targets to specify acceptable water withdrawal amounts based on species-specific data rather than broad assumptions.

Response: The Recovery Plan is not a regulatory document, but rather a guidance document on how recovery of the species may be achieved. Providing targets for water withdrawals is not within the scope of recovery planning.

Comment: One commenter asked if conservation incentives would be provided for industry participation rather than mandatory restrictions.

Response: As noted under the Purpose and Disclaimer; Recovery Plans and Recovery Implementation Strategies are guidance documents only. They provide goals for long-term conservation of listed species and define criteria that would indicate when a species may no longer need protection under the ESA. Actions and criteria within a Recovery Plan do not create any legal obligations or restrictions beyond existing legal requirements. The Recovery Plan itself does not provide specific incentives for implementation; however, there are several federal and some state programs that provide funding incentives for listed species conservation.

Comment: A commenter expressed concern regarding the accuracy of statements in the Plan about river flow impacts attributed to Ute Reservoir and stream flow provided by Revuelto Creek within the Upper South Canadian River management unit. The commenter requested more precise attribution of flow alterations to specific sources and suggested that the Plan evaluate the proportional impacts of various contributors to flow changes. Additionally, the commenter recommended enhanced data collection efforts to improve the reliability of future assessments.

Response: The section in question is regarding the historical impact of the creation of Ute reservoir on the Canadian River and flow limitations in the South Canadian River. The SSA for the peppered chub provided several citations regarding the impact of reservoir development on streams. Additionally, the SSA provided information from USGS gage data within the river pre- and post-dam construction, which shows an 89 percent decrease in flow in the South Canadian downstream of the dam following the creation of Ute Reservoir. Similar information supports the statement in the Plan regarding contributing flows from Revuelto Creek. We have added the SSA citation with page numbers to support these statements in the Recovery Plan. We agree that additional data collection and ongoing evaluation are essential to recovery of the species, which the Plan provides guidance and flexibility for addressing.

Comment: A commenter noted that the Plan's language regarding reintroductions into unoccupied units is unclear about the role of partnerships, as it states such actions could occur "if...partnerships exist." The commenter recommended that the Plan adopt a more active stance, explicitly indicating that the USFWS will pursue the development of necessary partnerships. The commenter suggested revising the language.

Response: We agree with the comment and have revised the sentence as suggested by the commenter.

Comment: One commenter noted that Action 24 directs identification of key partners for each management unit but does not address actively pursuing those partnerships. The commenter suggested that the Recovery Plan should emphasize outreach efforts and proactive development of partnerships, as such relationships are unlikely to form without deliberate action. The

commenter recommended that the Plan explicitly recognize the need for active engagement in building these collaborations.

Response: We agree that active engagement is important to building and maintaining partnerships. Action 25 is intended to address this comment as it directly relates to Action 24 through the development and implementation of a plan for partner collaboration.

Comment: One commenter questioned whether the order of the PBFs matters for the species' persistence. The commenter agreed that long, connected reaches are important but emphasized that PBF 2—continuous and sufficient flows—appears to be the most critical factor for regulating the species' continued presence. The commenter noted that, according to the document, species extirpation in longer reaches suggests that while reach length is relevant to viability, the availability of adequate flows is the primary determinant of current persistence.

Response: The order of the PBFs does not indicate greater importance or significance, and their order in the Recovery Plan follows the order of the PBFs as described in the final rule designating critical habitat for the species (FR 11188). Both sufficient flow and stream length are important to maintaining peppered chub populations.

Comment: One commenter noted that the Upper South Canadian River Management Unit is described as 171 river miles (rmi), consisting of 40 rmi from downstream of Ute Reservoir to the New Mexico-Texas border and 131 rmi from the Texas border to the delta of Lake Meredith. The commenter pointed out that the Recovery Plan also states the 171 rmi includes 10 rmi from Revuelto Creek and questioned whether the total length should be 181 rmi if the 10 rmi from Revuelto Creek are in addition to the previously described segments.

Response: We added language to expressly consider the river miles of Revuelto Creek.

Comment: A commenter raised concerns regarding statements in the Draft Recovery Plan for the Ninnescah/Arkansas River management unit that note the reestablishment of the shoal chub (*Macrhybopsis hyostoma*). The commenter stated that, based on intensive surveys conducted over the past decade, there is no evidence of shoal chub presence in the management unit, with the most recent records dating to 1984. They requested that, unless recent data confirming reestablishment is available, these statements be removed from the Recovery Plan to prevent confusion.

Response: The commenter is correct; the shoal chub has reestablished in the Cimarron River, not within the Ninnescah/Arkansas River management unit. We have removed that statement.

Comment: A comment from a state agency that reviewed an earlier draft noted that Action 16 has been changed from “Habitat Conservation and Restoration” to “Research and Management,” and recommended that its description be revised to emphasize research and development of

hydrologic regimes rather than implementation. The commenter further suggested that Action 1 is responsible for implementing the research generated by Action 16. To clarify this relationship, the commenter proposed rephrasing the language from “develop and implement hydrologic regimes” to “inform the development and implementation of hydrologic regimes throughout the management units.”

Response: We agree with the commenter and have revised the action as suggested.

Comment: One commentor suggested changing the order of Criterion 1 and Criterion 2 to emphasize that perennial flows and water of good quality are the primary factors in the species’ persistence.

Response: Though perennial flows with water of good quality are certainly needed for long-term persistence of peppered chub, the order of the criteria are laid out such that the first criterion represents demographic goals for recovery, and the latter criteria are habitat-related. We have chosen to retain the current order of criteria to avoid switching between demographic- and habitat-related criteria.

Comment: Several commenters stated that Criteria 2 and 3 appear redundant, are difficult to distinguish from one another, and may be more appropriately addressed as research or implementation actions within the RIS until sufficient baseline data are available.

Response: We have revised the justifications for Criteria 2 and 3 to more clearly differentiate the two criteria and their purpose for furthering recovery of the peppered chub.

Comment: We are concerned that unclear flow requirements may lead to overly restrictive regulations, increased compliance costs, or limited water access.

Response: Recovery plans serve only as guidance documents and do not set new regulatory requirements or limits.