Horseshoe and Bartlett Reservoirs Habitat Conservation Plan

ANNUAL IMPLEMENTATION REPORT

2011

PUBLIC REVIEW VERSION

Verde River at Horseshoe Reservoir

PREPARED FOR:

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 W. Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951

PREPARED BY:

Salt River Project
Environmental Services Department
PAB 352
P.O. Box 52025
Phoenix, Arizona 85072-2025

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

CERTIFICATION

Under penalty of law, I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate, and complete.

1/23/2012

Charles E. Paradzick
Sr. Ecologist
Biological and Cultural Resource Services
Environmental Services Department
Salt River Project

Date

1. Introduction

On May 30, 2008, the U.S. Fish and Wildlife Service (FWS) issued an Incidental Take Permit (ITP) pursuant to Section 10(a)(1)(B) of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended, to Salt River Project (SRP) for southwestern willow flycatcher *(Empidonax traillii extimus)* ("flycatcher"), yellow-billed cuckoo *(Coccyzus americanus)* ("cuckoo"), bald eagle *(Haliaeetus leucocephalus)*, razorback sucker (*Xyrauchen texanus*), Colorado pikeminnow (*Ptychocheilus lucius*), Gila topminnow (*Peociliopsis occidentalis occidentalis*), spikedace (*Meda fulgida*), loach minnow (*Tiaroga cobitis*), roundtail chub (*Gila robusta*), longfin dace (*Agosia chrysogaster*), Sonora sucker (*Catostomus insignis*), desert sucker (*Catostomus clarki*), speckled dace (*Rhinichthys osculus*), lowland leopard frog (*Lithobates yavapaiensis*), Northern Mexican gartersnake (*Thamnophis eques megalops*), and narrow-headed gartersnake (*Thamnophis rufipunctatus*). The activity covered by the ITP is the continued operation by SRP of Horseshoe and Bartlett dams and reservoirs. The ITP is conditioned upon SRP's implementation of the Horseshoe and Bartlett Reservoirs Habitat Conservation Plan ("H-B HCP") (Salt River Project 2008).

The H-B HCP provides measures to minimize and mitigate incidental take of the 16 species listed above "to the maximum extent practicable and ensures that incidental take will not appreciably reduce the likelihood of the survival and recovery of these species in the wild" (FWS 2008). Flycatcher and cuckoo (covered bird) mitigation efforts include operation of Horseshoe Reservoir to support tall dense vegetation at the upper end of the reservoir, and off-site acquisition and management of suitable nesting habitat. Minimization and mitigation efforts for covered native fish, frog, and gartersnake (aquatic species) includes operation of Horseshoe Reservoir to minimize non-native fish production, stocking of covered native fish, and supporting stream and water supply protection projects in the Verde River watershed.

2. Annual Reporting Requirements

Obligation: SRP is required to submit an annual report to FWS, City of Phoenix, Arizona Game and Fish Department, and U.S. Forest Service describing all H-B HCP activities occurring during the past year. A draft report must be sent to FWS prior to the annual meeting in October/November of each year. The report is to be finalized by February 1st of the following year.

Actions: SRP submits this report to the FWS, City of Phoenix, Arizona Game and Fish, and U.S. Forest Service to fulfill the annual reporting requirement. The report covers all activities relating to the Horseshoe and Bartlett Reservoirs HCP from November 1, 2010 through October 31, 2011, including a summary of reservoir operations, management activities, monitoring results, status reports and planned future activities.

3. Horseshoe Lake Operation ITP Compliance

a. Horseshoe and Bartlett Operation Summary

Obligation: SRP is required in this annual report to provide a summary of reservoir operations.

Action: Below is a summary of reservoir operations from SRP hydrologists of the 2011 water year (October 2010 – September 2011) and a forecast for the upcoming year. The summary includes watershed conditions for both the Salt and Verde systems.

Summary: The La Niña this winter had the greatest influence on Salt and Verde reservoir operations this past water year. The strongest indicator, El Niño Southern Oscillation (ENSO), shifted last winter from El Niño to La Niña conditions. Conditions all winter indicated a moderate to strong La Niña event with Equatorial Pacific sea surface temperatures well below normal. Since 1950, there have been eighteen La Niña winters. The majority of those eighteen winters have been dry with six being normal and four being above normal on the SRP watershed. Forecasts from the National Weather Service and the Climate Prediction Center calling for a greater likelihood of dry for the winter and early summer verified. The runoff this winter was only 42% of median. The precipitation this monsoon season on the Salt and Verde watersheds was 76% of normal but runoff volumes from the monsoon season typically do not impact operations. The seasonal river swap from the Salt System to Verde System was initiated on November 21, 2010, slightly later than usual due to maintenance requirements at Roosevelt Dam.

Winter Precipitation: Sea surface temperatures across the Equatorial Pacific during the Fall of 2010 were cooler than normal indicating that the Southern Oscillation was in a moderate-to-strong La Nina phase going into the winter of 2010/2011. Typically, this condition is associated with below normal cool-season precipitation across the Southwestern United States with the biggest impact in Arizona usually observed during the months of December – March.

Compared to recent autumns, precipitation events across Northern Arizona were frequent during October and November 2010, and the Salt/Verde watershed recorded an average precipitation accumulation of 2.53” or 82% of normal for the first two months of water year 2011. December began on a relatively dry tack, but a significant change in the weather pattern across the Western United States occurred around mid-month and led to a series of three productive storm-systems affecting Arizona during the latter half of the month. Combined, these systems yielded the winter’s and water year’s only “wet” month by producing a Salt/Verde watershed average accumulation of 3.11” by the end of December which is 186% of the normal monthly total.

Although these systems' productivity raised uncertainty in seasonal forecasts that were overwhelmingly calling for below normal precipitation across the Southwestern United States during the cool season, any doubts quickly evaporated as the third driest January on record was observed on the Salt/Verde watershed. An average precipitation accumulation of only 0.06", which is 3% of normal for the month, was recorded across the Salt/Verde watershed during January 2011, and although much wetter in comparison, the average watershed accumulations for February and March were also convincingly below normal.

All totaled for the period from December 1, 2010, through March 31, 2011, the Salt/Verde watershed received an average precipitation accumulation of 5.40" which is 66% of normal. One interesting aspect of this period is that the Verde River Basin, which received an average precipitation of 6.17" or 75% of normal was substantially favored compared to the Salt River Basin that received an average precipitation of 4.65" or 57% of normal.

Summer Precipitation: After the typically dry months of April, May and June, the North American monsoon spread northwards and into most of Arizona during the first few days of July. A persistent influx of moisture supported widespread thunderstorms around the state for the first two weeks of the month before the first monsoon "break" occurred around mid-month. This "break" was relatively short-lived with moisture returning and supporting another "burst" in monsoonal thunderstorms during the latter part of July. Two smaller "bursts" that were separated by short "breaks" were observed in the first half of August, but after mid-August, the monsoonal circulation over the Southwestern United States broke-down with westerly winds returning aloft. Disturbances within the westerlies interacted with moisture pushed into the region from decaying tropical storms on at least two occasions in September, but July, with an average accumulation of 2.05" or 96% of normal, was the only summer month in which the average precipitation accumulation across the Salt/Verde watershed approached the long-term normal amount.

For the summer months of July through September, the Salt/Verde watershed as a whole received an average accumulation of 4.88" which is 76% of normal. As opposed to the cool season months, precipitation during the summer months was nearly equally distributed between the Salt River Basin, which received an average accumulation of 4.83" or 75% of normal, and the Verde River Basin, which received an average accumulation of 4.91" or 76% of normal.

For the water year, October 1, 2010, through September 30, 2011, the Salt/Verde watershed average precipitation accumulation was 13.96" or 71% of normal with the Salt side receiving 12.3" or 62% of normal versus the Verde's 15.7" or 79% of normal (Fig. 1).

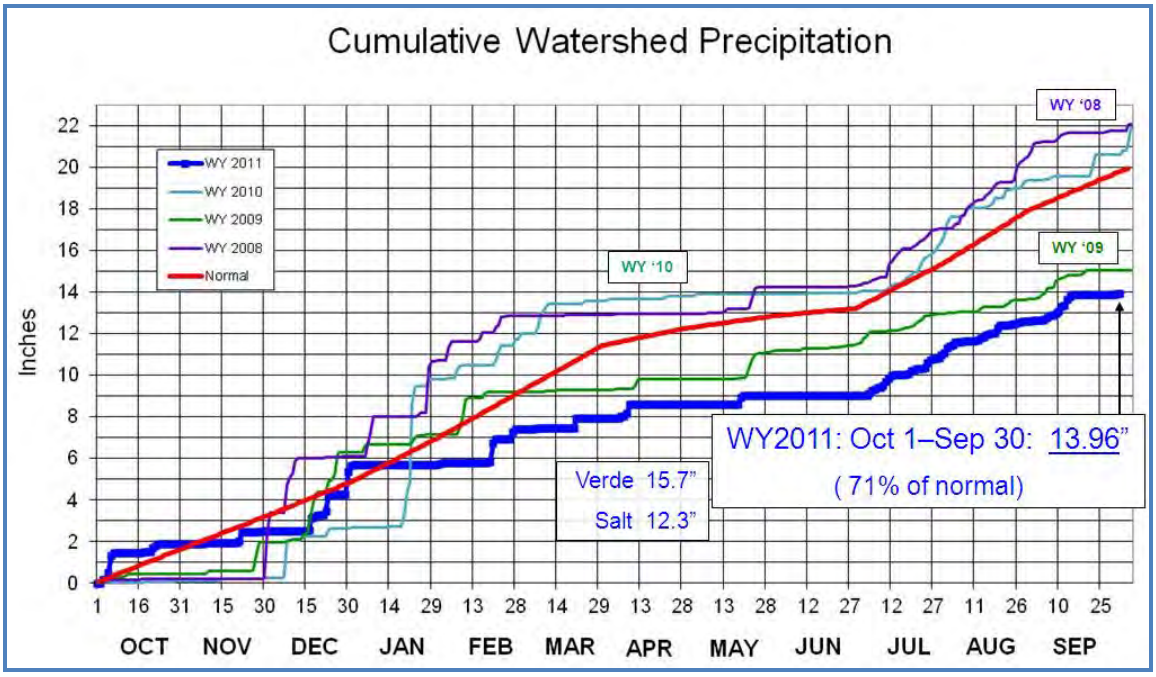


Figure 1. Cumulative watershed precipitation on the Salt River and Verde River watersheds for October 2010 – September 2011 (blue line).

Reservoir Status: The reservoir system was 88% of capacity heading into water year 2011 due to above median runoff from the 2010 winter season and near normal precipitation from the 2010 monsoon season. The winter season began favorably with December precipitation being 186% of normal. However, the wet December was an anomaly given the moderate La Niña (below normal sea surface temperatures over the equatorial Pacific). Total runoff this winter (January-May) was approximately 222,000 acre-feet which is 42% of median and ranked as the 22nd driest winter on record. Total runoff from the monsoon (July-September) produced about 72,000 acre feet (Fig. 2). Total storage decreased from 88% of capacity to 68% capacity during water year 2011.

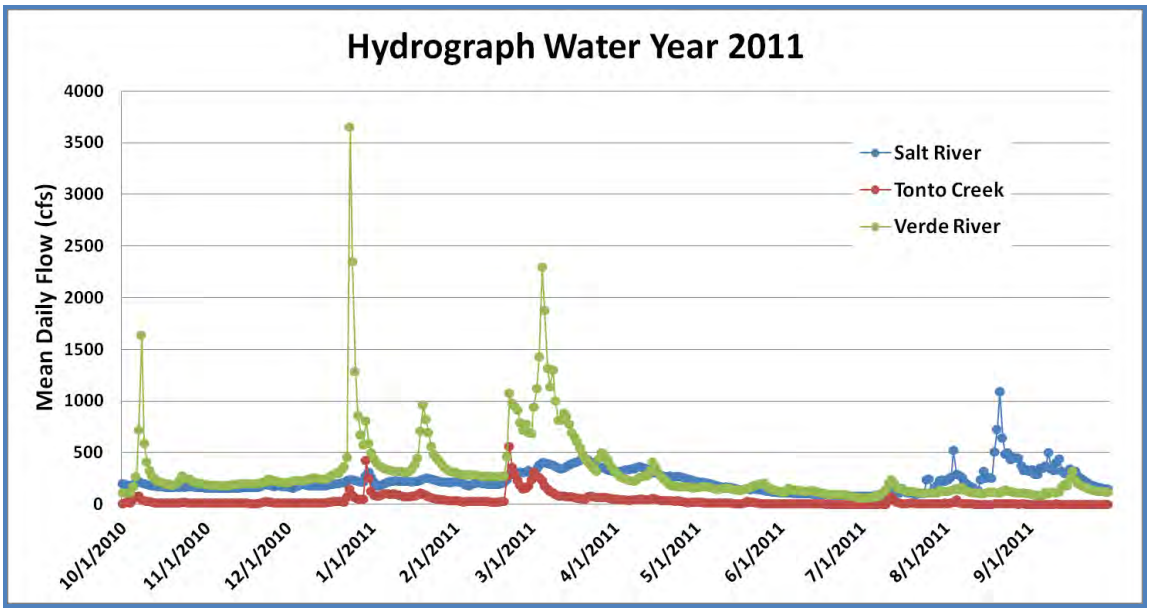


Figure 2. Daily flow (cfs) for the 2011 water year for the Salt River, Tonto Creek, and Verde River.

Verde Operations: The winter runoff and the Bartlett Dam maintenance project had the most influence on operations at Horseshoe reservoir (Fig. 4). Typical operations call for the water order to be switched from the Verde system to the Salt system in May leaving Bartlett release at minimum. Water stored behind Horseshoe Dam is also typically moved as soon as possible downstream to Bartlett Reservoir to reduce the amount of loss from seepage and evaporation, and meet H-B HCP objectives. Horseshoe Dam lake elevation increased from September of 2010 into January of 2011. The release from Horseshoe Reservoir was reduced to 25cfs on September 1, 2010 to hasten the Bartlett drawdown (Fig. 5). The water was stored at Horseshoe Reservoir to aide in the inspection and maintenance required for the Bartlett Dam bulkhead. The bulkhead is used to block flow so work can be performed on the outlet works at Bartlett Dam. During the inspection, deliveries were made from the spillway because the outlet works should not be operated with divers in the water. The project was completed on January 4, 2011 and water was moved downstream to Bartlett Reservoir the remainder of the month. The winter runoff increased the storage at Horseshoe Reservoir in March to a peak of about 33,000 acre-feet before being moved downstream to Bartlett Reservoir in May 2011. The water order was switched back to the Salt system on May 4, 2011. The water order may be switched sooner depending on the winter runoff. However, a deviation from typical operations was not implemented and the water order remained on the Verde system due to maintenance at Roosevelt Dam in late April. The lake levels for Horseshoe and Bartlett reservoirs are shown below.

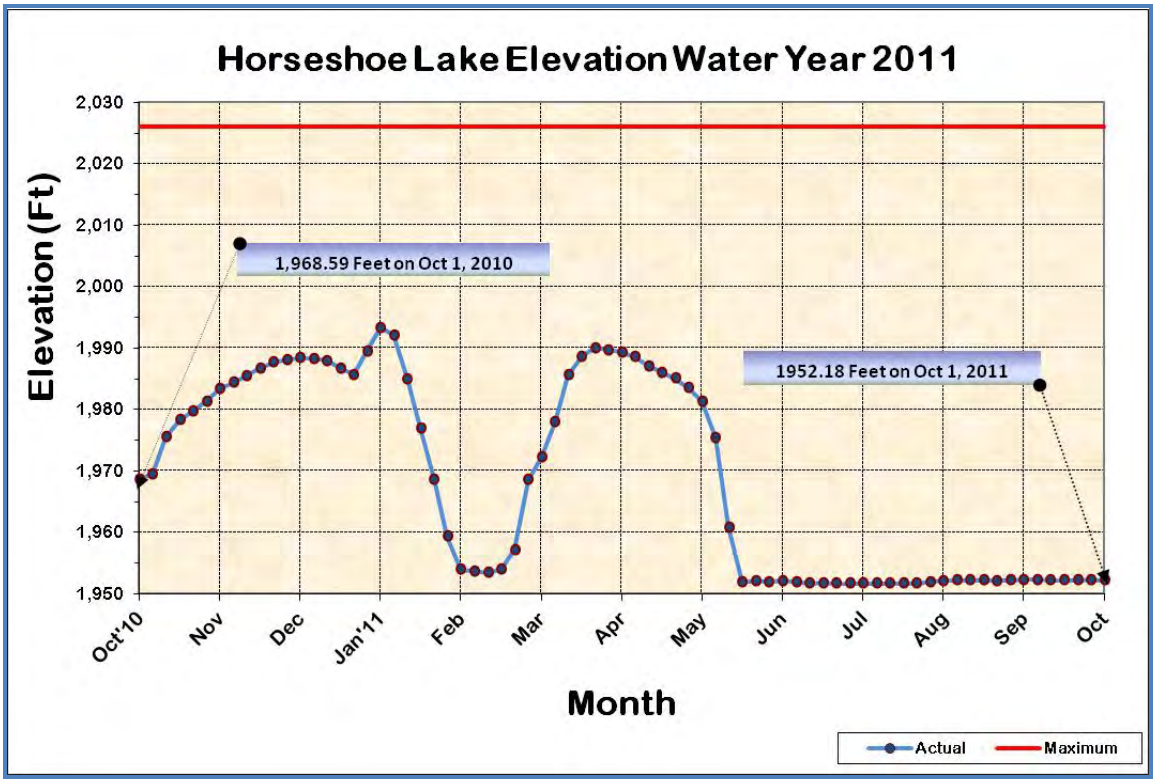


Figure 3. Horseshoe Reservoir storage for November 2010 – October 2010.

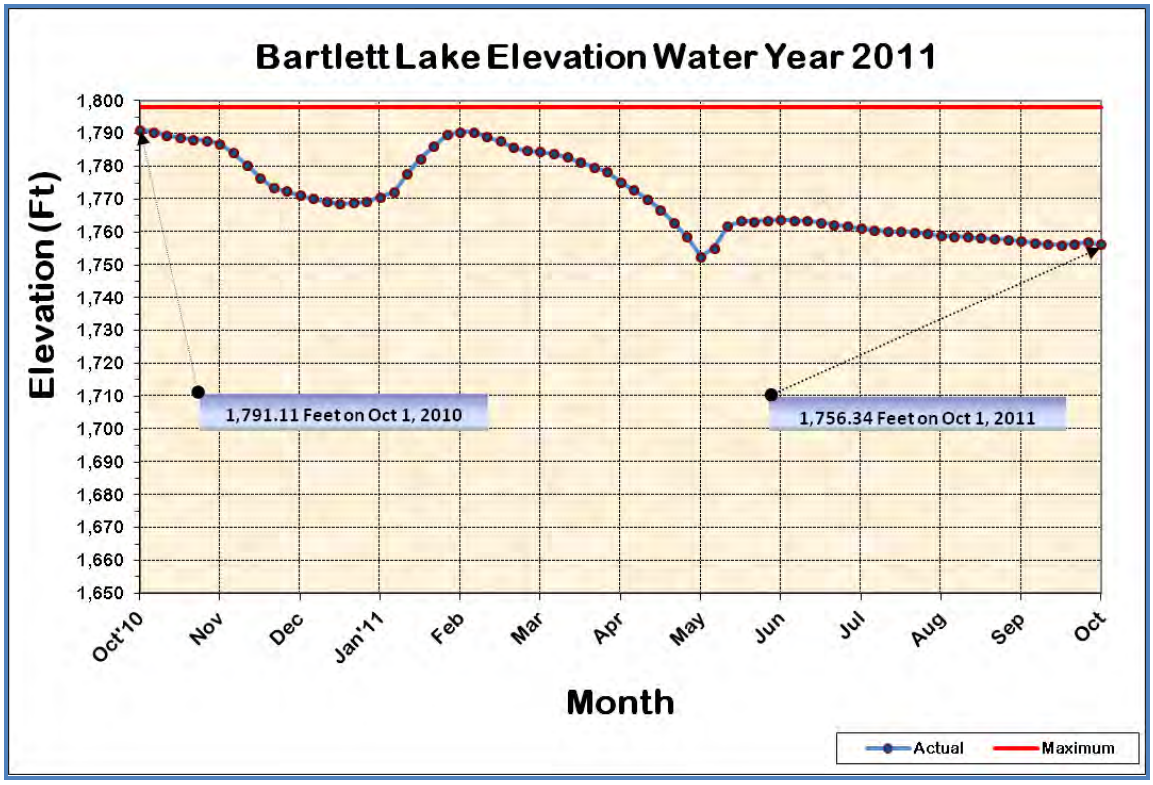


Figure 4. Bartlett Reservoir storage for October 2009 – September 2010.

Roosevelt Operations: Roosevelt operations were most influenced by the lack of winter runoff. Even with La Niña conditions in place, there was potential for Roosevelt Dam to fill and force water releases over Granite Reef Diversion Dam due to the abundant runoff from the previous year. However, the winter of 2012 produce only 77,000 acre feet of runoff into Roosevelt Reservoir. The elevation at Roosevelt Dam varied little through the winter with the water order on the Verde system and meager inflows through the winter season. On May 4th the water order transitioned back to the Salt system and reservoir levels began to decline. The water order switched to the Verde system on November 21, 2011. The transition took place later in the season than normal this year to account for the maintenance outage at Roosevelt Dam in late April 2011 that delayed the transition to the Salt system this spring (Fig. 5).

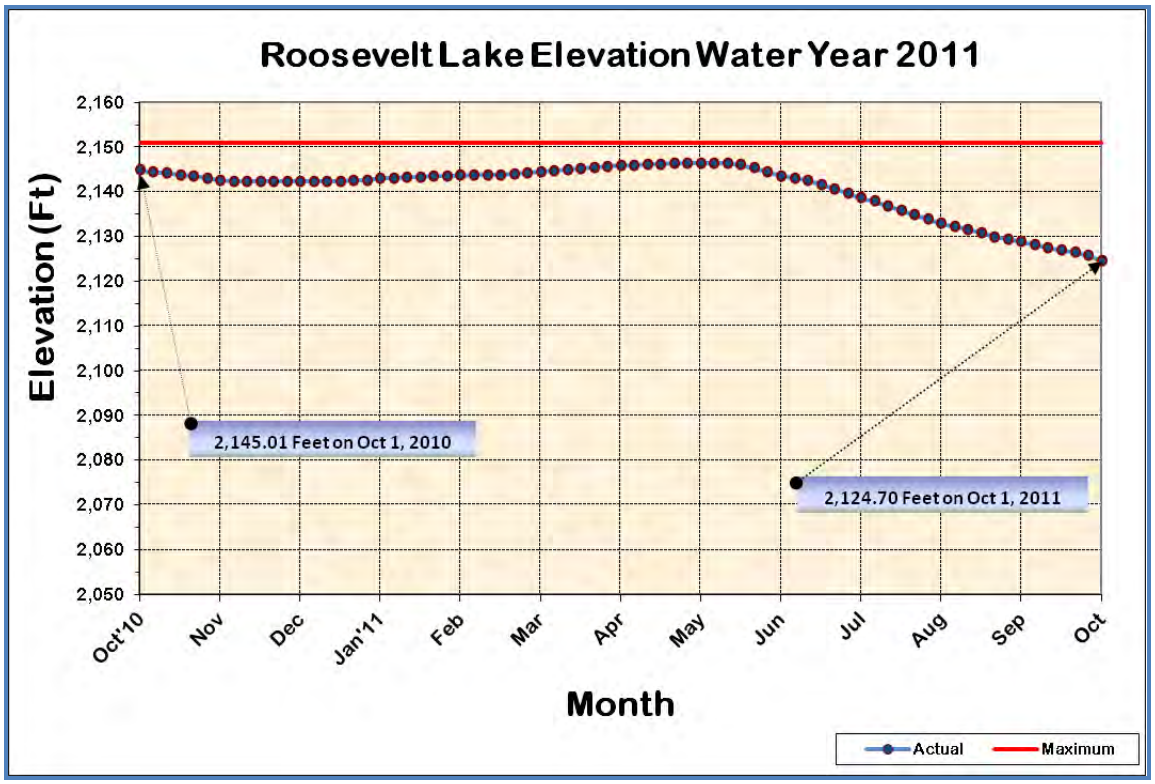


Figure 5. Bartlett Reservoir storage for October 2009 – September 2010.

Weather Outlook: Currently, La Niña conditions are again present and expected to continue. The Climate Prediction Center is predicting La Niña conditions to continue into the winter. If so, another dry winter appears imminent in Arizona's near future (Fig. 6). Preliminary reservoir storage projections indicate the total system would be at about 55% of capacity if the forecast for another dry winter verify.

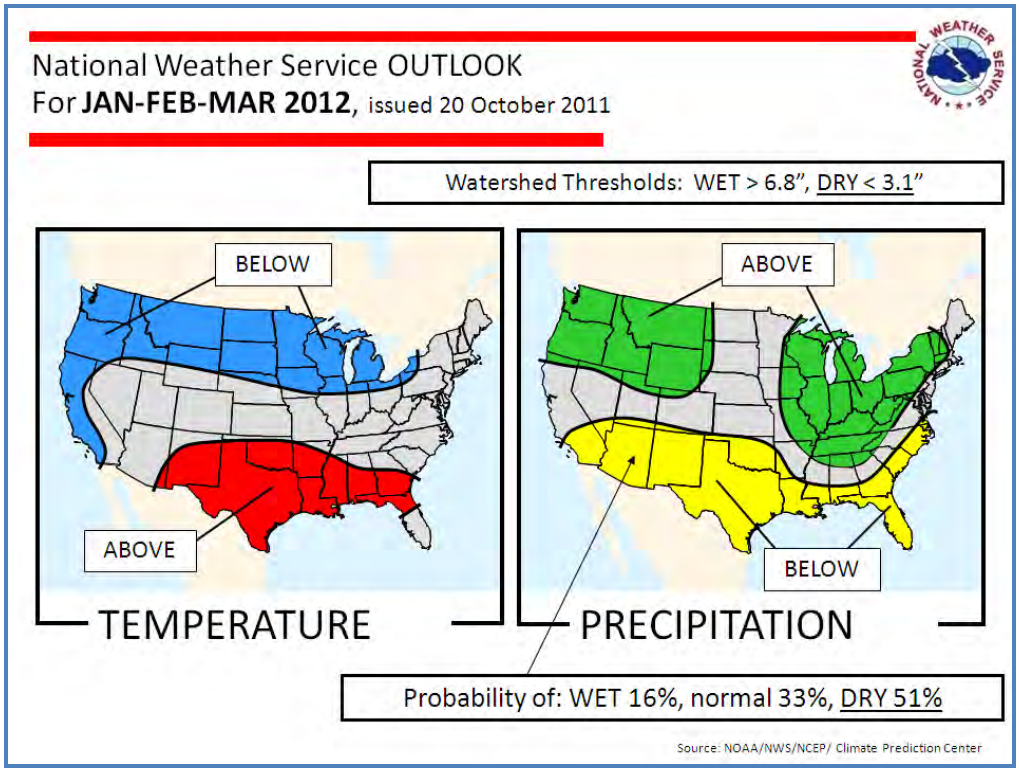


Figure 6. National Weather Service forecast for temperature and precipitation, January – March 2012.

b. Flycatcher and Cuckoo Operation Objective

Obligation: SRP will manage water levels at Horseshoe, conditional on other operation goals, to make riparian habitat available earlier in the nesting season and to maintain riparian vegetation at upper end of the reservoir. After two successive years of low water levels due to drought, Horseshoe will be filled ahead of Bartlett, if feasible, to provide water to tall dense vegetation at upper end of Horseshoe.

Action: Horseshoe storage reached a maximum of 35% full (elevation 1993') the first week of January and then rapidly dropped to <1% of storage by the last week of January. Winter snow melt and precipitation then caused Horseshoe to fill a second time to approximately 30% full by mid-March. Water levels were relatively constant for 1.5 weeks before rapid drawdown commenced and the reservoir was empty again by May 11 (see Section 3.a). Storage on May 1 was approximately 18.5% full (elevation 1981') to meet covered bird operation objectives.

2012 Action: Due to low storage levels (<50% full) in 2011, and if the runoff in 2012 is also low, SRP would, if feasible, fill Horseshoe prior to Bartlett to benefit flycatcher habitat in the upper end of the reservoir in 2013.

c. Covered Aquatic Species Operation Objective

Obligation: SRP will manage water levels at Horseshoe, conditional on other operation goals, to minimize the reproduction, recruitment, and survival of nonnative fish by rapidly drawing down the reservoir and minimizing carry-over storage. In years when the reservoir is held high for flycatchers. this will provide opportunities for razorback sucker reproduction and recruitment.

Action: As explained in Sections 3.a. and 3.b. above, rapid drawdown was implemented following the fill in January and again starting the first week of April. Horseshoe was emptied by May 11. The reservoir remained empty though October 31, 2011.

2012 Action: Due to low storage levels (<50% full) in 2011, the reservoir may be held higher in the springof 2013, if feasible, if there has been two successive years of low water.

d. Covered Bird Monitoring

i. Vegetation Monitoring

Obligation: SRP will use vegetation monitoring at Horseshoe to identify trends in the amount and height of tall dense vegetation to assist in the evaluation of whether adaptive management thresholds or ITP limits may be exceeded. Vegetation will be monitored once every three years.

Action: We estimate that of the 28 acres of potentially suitable flycatcher breeding habitat (GIS model classes 3-5) that occurred in the reservoir in 2010, 0 acres would have been unavailable on May 1, 2011 (Table 1). The average amount of potentially suitable habitat that may have been unavailable at the beginning of the 2009-2011 breeding seasons was 43 acres, which is below the 200 acre average long-term permit threshold.

Because the methodology to map and forecast breeding habitat has not been finalized, we continued to estimate the amount of potential breeding habitat in 2011 that may be unavailable in 2012 using the GIS breeding habitat model and June 2011 satellite imagery (Fig. 8). We estimated that there was approximately 82 acres of higher-probability (Classes 3 – 5) breeding habitat within the reservoir in 2011. For 2012, assuming the reservoir is at full pool on May 1, approximately 42 acres of potentially suitable habitat (classes 3-5) could be unavailable at or below elevation 2015'[1], and approximately 44 acres of

[1] Elevation 2015' was used instead of 2010' as conservative estimate for inundation impacts based on analysis and assumptions outlined in the Horseshoe – Bartlett HCP.

potentially suitable habitat is located between elevations 2015' and 2026' and would be available as breeding habitat.

Table 1. Acres of occupied and predicted willow flycatcher habitat based on GIS breeding habitat model in Horseshoe Reservoir, 2008 – 2011

		Occupied habitat (acres)		Predicted habitat Probability Classes 3-5 (acres)	
Year	Reservoir level (ft) on May 1	Occupied flycatcher habitat[1]	Occupied habitat unavailable May 1	Total within reservoir	Estimated habitat unavailable May 1[3]
2008	--	52	--	95	-
2009	2000	--	0	141	42
2010	2026	--	52	28	87
2011	1981	82	0[2]	82	0
Annual average	--		17	86	43
2012 (predicted[4])					42

[1]Flycatcher surveys preformed every 3 years within reservoir (see Section 3.d.ii).
[2]The lowest elevation of occupied habitat in 2008 (the most recent year occupancy data was available prior to May 1, 2011) was 1990 ft. Water level on May 1, 2011 was 1981 ft. Therefore, no occupied habitat was unavailable (see assumptions outlined in the H-B HCP page 109).
[3] Estimated amount of habitat unavailable on May 1 is based on the elevation of classes 3-5 of the previous year's model results, the reservoir elevation on May 1, and the assumption that the vegetation is 25 ft tall. If less than 15 ft of vegetation was not above water on May 1 the habitat was considered unavailable (see assumptions outlined in the H-B HCP page 109).
[4]Assumes reservoir at full pool on May 1; habitat assumed unavailable if located at elevations ≤2015' (see assumptions in note #3 above and the H-B HCP page 109).

SRP investigated (in coordination with the Roosevelt HCP program) if the GIS flycatcher breeding habitat model (Hatten and Paradzick 2003) coupled with LIDAR (Light Detection and Ranging) could be used as a cost effective and accurate method to delineate and forecast suitable breeding habitat within the conservation space of Horseshoe Reservoir. We anticipate that SRP will execute a contract for LIDAR acquisition by late November 2011, which will include field data collection and the LIDAR flight in mid-January 2012. LIDAR data will be integrated with the GIS breeding habitat model results and the flycatcher survey data and included in the 2012 annual HCP report.

2012 Action: In the winter and spring of 2012, SRP will acquire LIDAR data and integrate the results with the 2011 GIS breeding habitat model and flycatcher surveys to generate a breeding habitat map for the 2012 reporting period. Pending the outcome of the 2012 results, the next mapping exercise would be required in the summer of 2015.

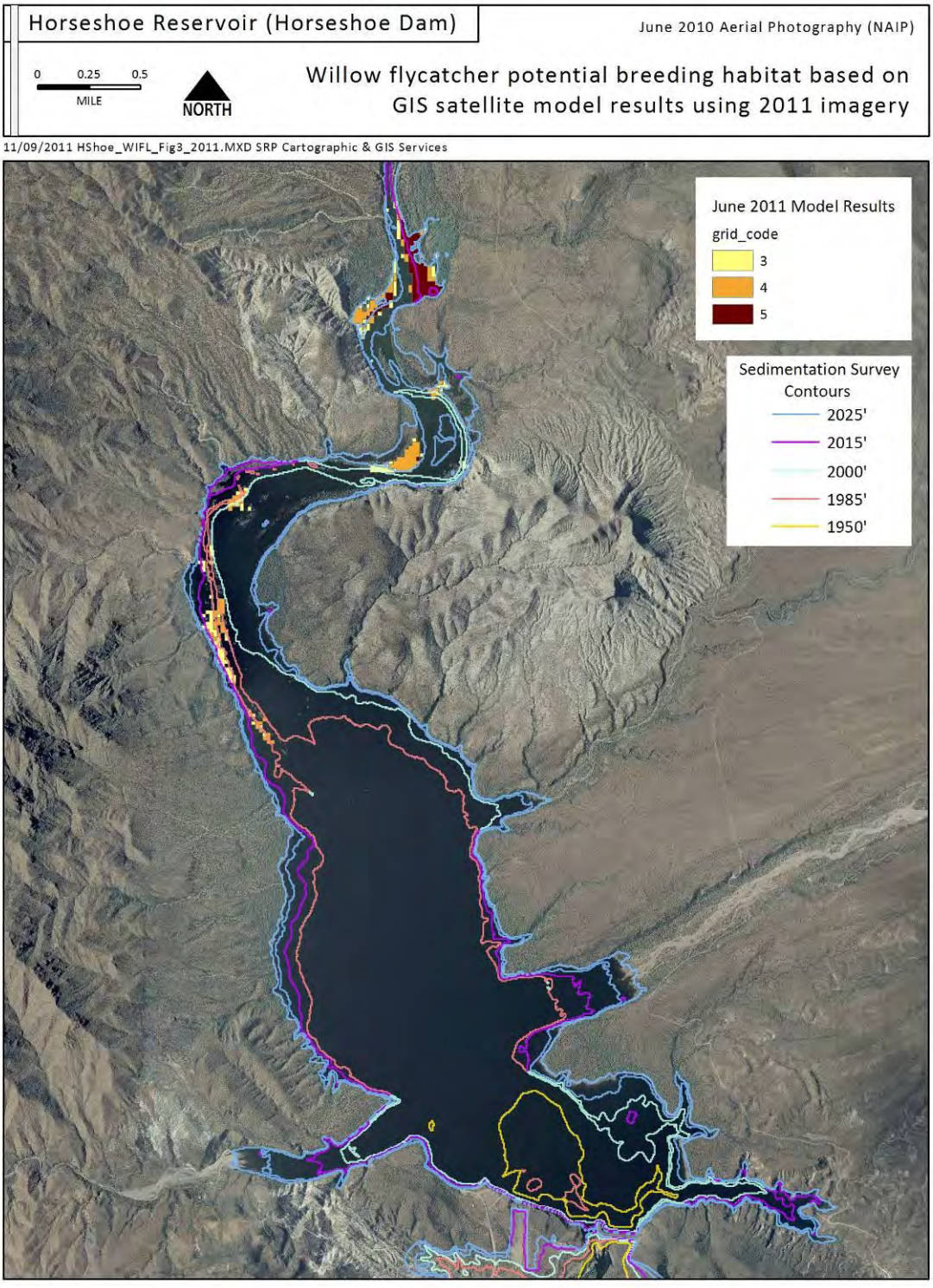


Figure 7. Willow flycatcher potential breeding habitat in Horseshoe Reservoir based on GIS satellite model results using June 2011 imagery.

[note: model grid code scale: 3 – 5 breeding probability based on Hatten and Paradzick (2003); sediment contour interval 1950' ≈ 0% storage; 1985' ≈ 25% storage; 2000≈ 50% storage; 2015' ≈ 75% storage; 2025' ≈ 98% storage.]

ii. Flycatcher Monitoring

Obligation: SRP will monitor the flycatcher population to assist in the evaluation of ITP compliance relative to thresholds for adaptive management and the cap on harm of occupied habitat. The method used to determine occupied habitat is explained in Section IV.B.1.B of the HCP. The adaptive management threshold is an annual average of 200 acres of potentially impacted occupied habitat and the cap is 400 acres. Flycatcher surveys will be conducted every three years.

Action: To determine the amount occupied habitat in 2011, SRP contracted EcoPlan Associates to survey for willow flycatchers and identify territory locations (EcoPlan Associates 2011; final survey report is included in Appendix A). Surveyors detected 10 territories within Horseshoe in a variety of habitat types (Table 2; see Appendix A). We buffered the flycatcher territories by 11.1 acres and joined the polygons and calculated the total area "occupied". We estimated that there were 80 acres of occupied habitat at Horseshoe in 2011 (Fig. 9). The occupied habitat was located between 2000 – 2004 ft reservoir elevations (Table 2).

Table 2. Willow flycatcher territories detected at Horseshoe Reservoir, 2011.

	Reservoir		
Territory Id.	Elevation (ft)	Storage (% full)	Dominant Vegetation
7	2000	46	Mixed native and tamarisk
11	2000	46	Willow
12	2000	46	Willow
13	2000	46	Willow
9	2003	51	Tamarisk
3	2004	53	Mixed native and tamarisk
5	2004	53	Mixed native and tamarisk
6	2004	53	Mixed native and tamarisk
14	2004	53	Tamarisk
15	2004	53	Tamarisk

2012 Action: Couple 2011 survey results with vegetation mapping described in Section 3.d.i. to assess future potential occupied habitat. The next flycatcher survey will be conducted in 2014.

Page removed

Contains confidential/sensitive species information

Contact USFWS

iii. Yellow-billed Cuckoo Monitoring

Obligation: SRP will monitor cuckoo at Horseshoe to identify the long-term trend in the population. The reservoir will be surveyed every three years.

Action: SRP contracted with EcoPlan Associates to conduct cuckoo surveys in 2011 (Appendix A). Surveyors detected 6 cuckoos and estimated that that there were 2 mated pairs and one unpaired adult (Fig. 10). Cuckoos used 8-m tall tamarisk dominated patches interspersed with 8 - 12 m tall Goodding's willow to habitat composed of 12 - 14 m tall Goodding's willow with very little tamarisk (see Appendix A). There were fewer detections of cuckoos in Horseshoe compared to 2008 when surveyors recorded 8 detections (estimated 3 pairs).

2012 Action: No surveys for cuckoos in 2012; the next survey will be conducted in 2014.

iv. Bald Eagle Monitoring and Emergency Rescue Protocol

Obligation: SRP will develop a coordinated plan with FWS and AGFD to identify when rescue actions would be required and the process to rescue bald eagle, bald eagle eggs, or nestlings at Horseshoe or Bartlett. The plan will include triggers for winter monitoring at appropriate effort and frequency to determine if a nest has been built in the conservation space of the reservoir and the likelihood that the nest could be impacted by spring runoff. The Plan will be completed within one year of permit issuance, and the implementation will begin within two years of ITP issuance.

Action: In 2009, SRP completed the Monitoring and Rescue Plan (see 2009 H-B HCP annual report).

Eagles did not nest within the reservoir pool during the 2011 nesting season.

2012 Action: SRP will continue to implement the monitoring and rescue plan in 2012.

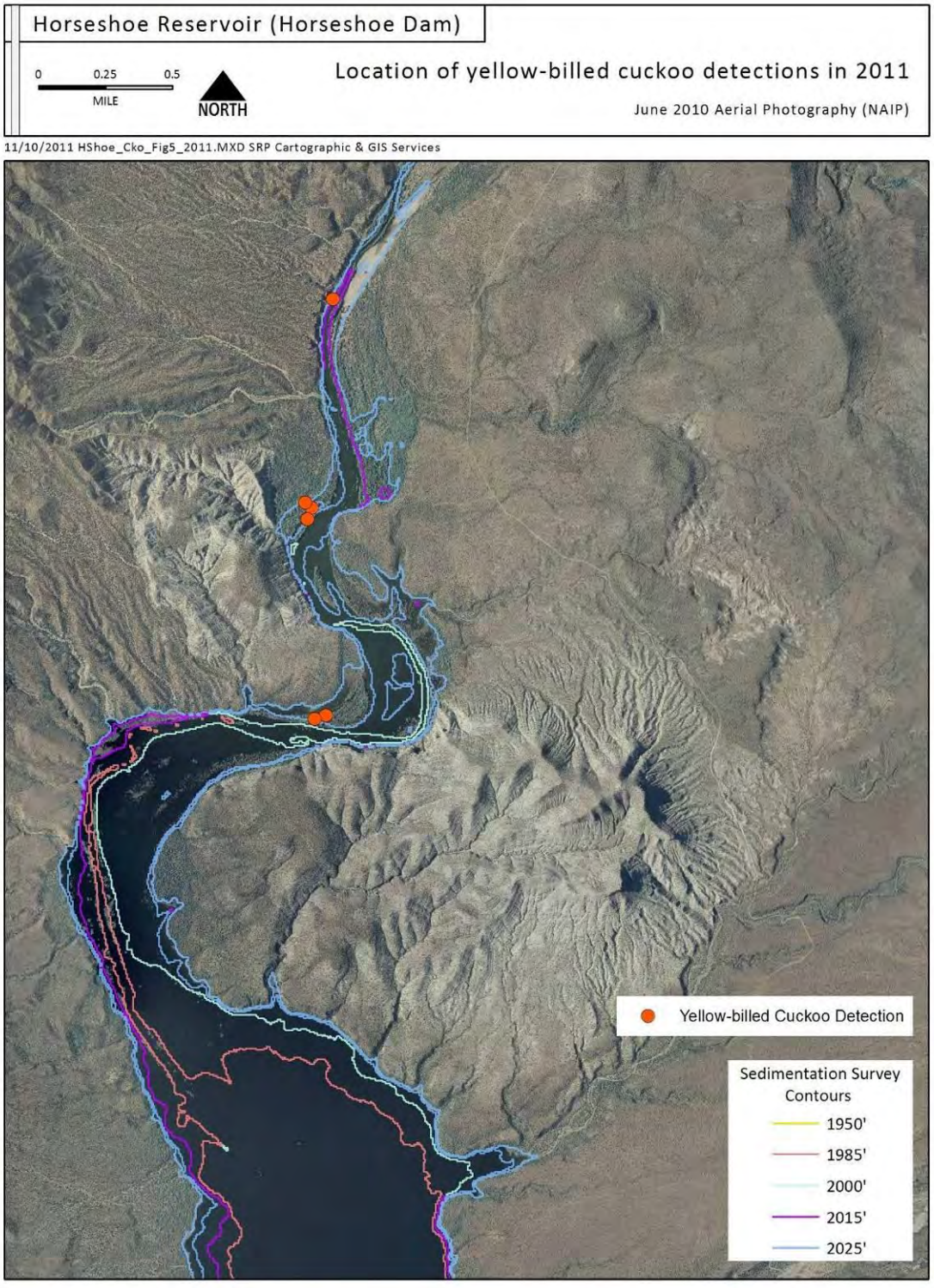


Figure 9. Location of yellow-billed cuckoo detections at Horseshoe Reservoir in 2011.

[note: Sediment contour interval 1950' ≈ 0% storage; 1985' ≈ 25% storage; 2000≈ 50% storage; 2015' ≈ 75% storage; 2025' ≈ 98% storage.]

e. Covered Aquatic Species Monitoring at Horseshoe and in the Verde River.

Obligation: SRP will monitor covered aquatic species populations and the effectiveness of minimization and mitigation measures. Periodic surveys in Horseshoe and several other locations in the Verde River will be conducted. Native fish composition and age class information will be recorded, and fish will be tagged in Horseshoe to assess movements from the reservoirs. In first 5 years of implementation surveys will be focused near Horseshoe Reservoir.

Action: SRP conducted fish surveys in 2011 at Horseshoe Reservoir, Verde River from Sheep Bridge to Horseshoe at full pool, Verde River below Horseshoe dam, and Lime Creek. As required in the HCP, the sampling effort focused on Horseshoe to assess fish composition, population structure and tagging fish to study fish movements during future survey efforts. SRP contracted with the Arizona Game and Fish Department (AGFD) Region 6 fisheries program to complete the surveys (Appendix B contains the AGFD report). During the 2010 annual meeting, SRP proposed to conduct sampling below Horseshoe dam to look for tagged fish. The location was not listed in the HCP/ITP but based on the lack of tagged fish recaptures over the last 2 years, FWS concurred that sampling the reach could provide critical data on possible movements of fish out of Horseshoe. SRP staff also assisted the Arizona Game and Fish with post-stocking monitoring in Lime Creek. (Appendix C). A summary of these efforts are described below:

Summary of Horseshoe Results:
AGFD sampled Horseshoe Reservoir on April 12 – 13 when the reservoir was approximately 25% full and again on September 13 at minimum pool. Canoe electrofishing equipment was used to conduct sampling. AGFD followed their standardized sampling protocol.

Horseshoe Spring Survey. - A total of 159 fish were captured during the April 12 - 13 survey. Largemouth bass, common carp, and bluegill comprised 45%, 33%, and 13% of the catch respectively (Fig. 11). The majority of the largemouth bass were 130 - 190 mm size class, although other size classes were captured. Similarly, multiple size classes of carp were captured, with majority between 350 – 500 mm. Of the fish captured, 131 were >150 mm and tagged or marked. Fin clips were used on carp due to low floy tag retention. No previously tagged fish were captured during the spring survey.

Horseshoe Fall Survey.- There was essentially no "pool" of water remaining in the reservoir and most sampling occurred in the riverine portions of the reservoir footprint. A total of 82 fish were captured, of which carp (79%), channel catfish (11%), and goldfish (8.5%) composed the majority of the species. One largemouth bass was captured. All fish captured during the fall survey were

>150 mm and were tagged or marked. No previously marked fish were recaptured.

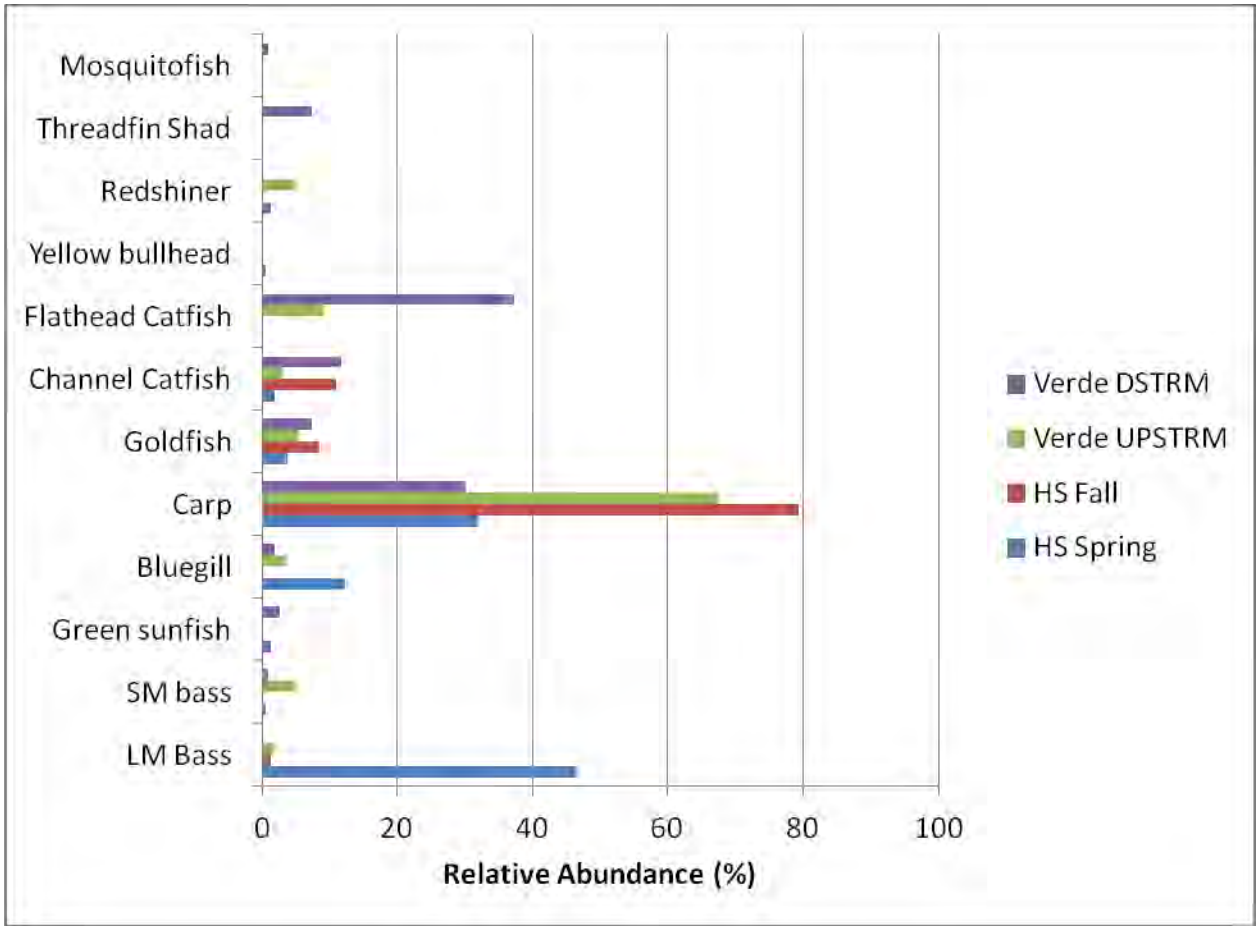


Figure 10. Composition of fish species captured in 2011 by Arizona Game and Fish Department using electrofishing equipment in Horseshoe Reservoir April 11- 12 ("HS Spring"; reservoir at 25% full), September 13 ("HS Fall"; reservoir at minimum pool); Verde River from Sheep Bridge to top of Reservoir ("Verde UPSTRM") on September 13, and Verde below Horseshoe dam ("Verde DWNSTRM") on September 14. Values indicate relative abundance of fish captured.

Summary of Verde River Sampling:

On September 13 and 14, AGFD sampled the Verde River from Sheep Bridge to the upper end of the reservoir pool (elevation 2026') and a reach starting just below Horseshoe dam downstream approximately 1.25 miles to an unnamed take out access point. Canoe electrofishing equipment was used to conduct sampling at 500 meter intervals following the AGFD's standardized survey protocol.

Verde River Upstream of Horseshoe Reservoir. - AGFD captured 165 fish (more fish were captured during sampling but data sheets were lost when a canoe capsized), including eight species, of which carp (67%) were the most abundant (Fig. 11). No tagged/marked fish were recaptured during the survey.

Verde River Downstream of Horseshoe Reservoir. - AGFD captured 110 fish, including nine species, of which flathead catfish (37%), carp (30%), and channel catfish (12%) were the most abundant (Fig. 11). No tagged/marked fish were recaptured during the survey.

Conclusions:

Primary conclusions of the surveys were:

1. The delay in drawdown in 2010 likely supported largemouth bass spawn as noted by increase number of individuals captured in the 2011 spring survey. However, the 2011 fall survey in Horseshoe and Verde River sampling showed low abundance of largemouth bass. It is unknown where or if the largemouth bass moved out of the reservoir. It is also possible that these fish may have been stranded during rapid drawdown (see #6 and 7 below).
2. Carp continues to have high abundance in both the reservoir and in the Verde River near the reservoir.
3. Annual reservoir fluctuations and inundation of floodplain-like habitat within the reservoir pool continues to favor spawning and recruitment of carp (and goldfish in some years) because these species are better able to utilize densely vegetated aquatic zones for reproduction and foraging compared to other species.
4. Based on the impact of spring drawdown in prior years, the rapid drawdown and minimization of carryover storage in 2011 is anticipated to greatly reduce the population of centrarchids (bass and sunfish) in Horseshoe in 2012.
5. Between 2005 – 2010, 4,628 nonnative fish have been marked, of which 95% are carp and goldfish, 2% are channel catfish, and 1% are largemouth bass (an additional 213 fish were marked in 2011). However, recapture of tagged/marked nonnative fish in the river or reservoir was zero during the 2005 - 2006, and 2009 – 2011 sampling efforts. In 2009, 4 marked fish were recaptured in Horseshoe but were thought to have been tagged the day before. Sampling downstream of Horseshoe dam in 2011 showed that the fish population was dominated by carp and catfish, but no tagged/marked fish were located. It remains unclear the fate of the tagged fish in Horseshoe.
6. Observations by AGFD in 2010 and by EcoPlan bird biologist in prior years field work have noted dead stranded fish when reservoir levels drop in

spring. Based on the lack of marked fish recaptured, AGFD (and SRP) suggest that a large portion of the fish in Horseshoe could be stranded annually during rapid drawdown.

7. SRP will work with AGFD to survey the reservoir, as feasible (possibly by boat or from helicopter), shortly after drawdown in 2012 to assess this hypothesis of fish stranding from rapid water elevation changes.

Summary of Lime Creek Sampling:

SRP assisted AGFD with a post-stocking survey of Lime Creek on November 3, 2011 (Fig. 12). Tony Robinson (AGFD Research Branch) provided the following summary:

> "Today, we (myself, Clay Crowder, Kyle Yarush, Jake Fousek, Bill Burger; and Marc Wicke of SRP) completed the 6-month post stocking monitoring for Gila topminnow in Lime Creek. Many thanks to SRP and the flight crew. The stream had much less water in it that when we stocked. For instance, at the barrier site, there was no water immediately downstream, and only three small isolated pools immediately upstream (see attached photos). We walked upstream about 730 meters, and it was all dry; this was in the reach where we stocked some of the topminnow. When we flew out, we could see a wetted reach further upstream that extended about 1.5 km (up to the old stove pipe). And further up from that was another wetted reach a couple hundred meters long.
>
> We captured Gila topminnow near all three sites where they were stocked back in May. We captured 412 Gila topminnow and 103 longfin dace.
>
> - Barrier Stocking Site: only three small pools, the rest of the stream was dry. Captured 244 Gila topminnow and 7 longfin dace in three seine hauls (one haul in each of the pools). No fish were captured or observed in the uppermost pool.
> - Upper Lime Creek Stocking Site: Captured 160 Gila topminnow and 96 longfin dace, and two lowland leopard frogs in 10 dip net sweeps and 4 seine hauls.
> - Lime Spring Stocking Site: Captured 8 Gila topminnow and observed 18 others. Attached a temperature logger to a 6-8 inch diameter root at GPS (425103, 3765604)."

Figure 11. Photos of Lime Creek at the barrier site and looking upstream. Photos taken November 3, 2011 during the post-stocking survey.

2012 Action: A frog and gartersnake survey will be conducted in the spring of 2012. AGFD Region 6 will coordinate and conduct the survey on the Verde River from Childs – Sheep Bridge and sample the lower portions of the major tributaries. AGFD will also conduct standardized fish sampling from Childs to Sheep Bridge in the spring. The effort will gather data on general fish population composition, abundance, and movements of marked fish. SRP will, as feasible (depending on water levels, boat/foot access, and helicopter availability), investigate the stranding of fish during and/or after rapid drawdown.

4. Status of Mitigation Property Acquisitions

Obligation: SRP must acquire and manage in perpetuity 200 acres of riparian habitat by fee title or conservation easements. Within one year of the permit issuance date, at least 150 acres of mitigation will be in place, and within 10 years an additional 50 acres will be protected.

Action: On August 11, 2009 SRP and Freeport McMoran executed a conservation agreement to secure the protection of the 150 acre preserve near Ft Thomas. No additional action is needed until 2023 when the property will be purchased in fee.

Protection of Additional 50 acres:

Following the 2010 annual meeting and discussion with FWS, SRP assessed suitable mitigation lands near Safford and the existing Ft Thomas Preserve. SRP identified a 55 acre parcel ("Indian Springs Ranch"), which contained suitable floodplain habitat (Fig. 13). SRP contacted Wesley Prophet, President and owner of Indian Springs Ranch Inc. and learned that they were interested in selling the parcel. SRP sent a letter (dated April 15, 2011) to FWS explaining our intent to pursue the purchase of Indian Springs Ranch (see Appendix C). The letter was to assure that we met the coordination obligation in the HCP, and it also documented the evaluation process, rationale (habitat suitability) for selecting that property, and its value to the conservation of flycatchers and cuckoos. FWS expressed no questions or concerns with moving forward with the acquisition.

SRP completed a Phase I Environmental Site Assessment in July 2011, an Alta Survey, opened an escrow account, and finalized a purchase contract that was forwarded to Mr. Prophet for signature to execute the purchase. However, on September 30, 2011 the escrow officer informed SRP that Mr. Prophet had died and the corporation would likely need to reorganize, elect a new president, and file with the AZ Corporation Commission prior to signing the deed and closing on the property. SRP is continuing to follow up with the escrow officer and will work to complete the acquisition as soon as feasible.

2012 Action: The following activities are planned for 2011:

The Ft Thomas Preserve (150 acre parcel) is protected under a Conservation Easement - no action is needed; land management actions are discussed in Section 5 below. SRP will continue to pursue acquisition of the Indian Springs Ranch parcel.

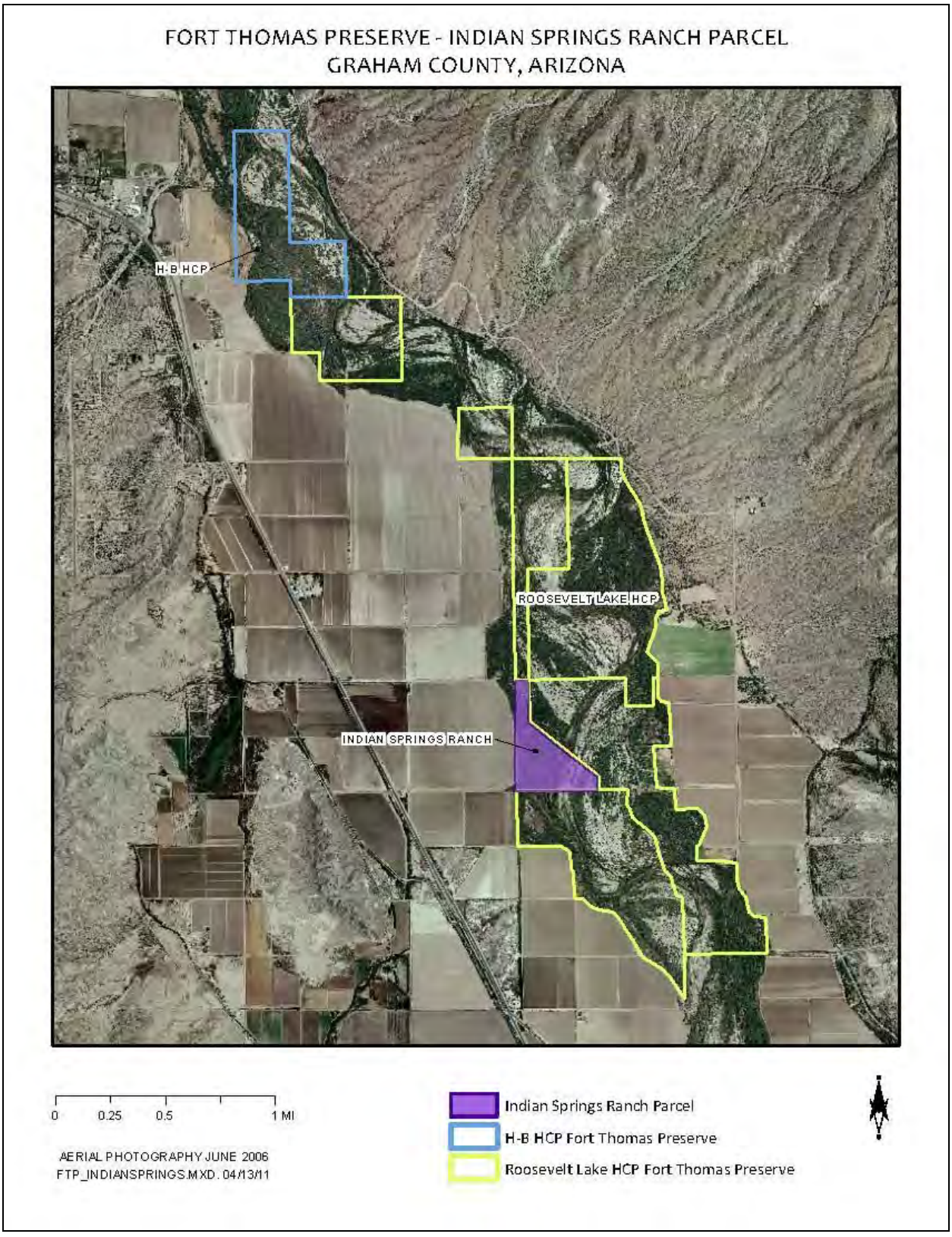


Figure 12. Map of Ft Thomas Preserve area and the 55 acre Indian Springs Ranch parcel that SRP is working to acquire as mitigation for the H-BHCP.

5. Mitigation Property Monitoring and Management

a. Fort Thomas H-B Preserve

i. Flycatcher and Cuckoo Monitoring

Obligation: SRP will conduct flycatcher and cuckoo surveys the first spring and summer following land acquisition. If flycatchers are found, SRP will conduct a second year of surveys to establish a baseline. Once baseline surveys are complete, SRP will survey for flycatcher and cuckoos every other year on average but not less than every third year.

Action: No surveys were conducted in 2011. Baseline surveys were conducted in 2008 and 2009.

Table 2. Southwestern willow flycatcher and yellow-billed cuckoo survey results for the Ft Thomas H-B Preserve, 2008 – 2009.

		Willow flycatcher			Yellow-billed cuckoo	
Year	Resident Adults	Territories	Pairs	Nests	Territory	Pairs
2008	10	6	4		1	1
2009	14	8	6	5	0	0
2010	No Survey	-	-	-	-	-
2011	No Survey	-	-	-	-	-

2012 Action: SRP will conduct flycatcher and cuckoo surveys in 2012. The survey efforts will be coordinated with the efforts required for the Roosevelt HCP at the Ft. Thomas preserve lands with the intent to provide a more robust census of the populations in the area. If the purchase of Indian Springs Ranch has not been completed by May 1, 2012, SRP will request access from the owner to conduct a survey for baseline information.

ii. Vegetation and Habitat Monitoring

Obligation: SRP will conduct field observations assessment of habitat type, structure, and density of riparian and other vegetation. On-the-ground photo documentation from fixed points will be collected during the bird surveys.

Action: No vegetation surveys or photo-points were conducted. Patrols and site visits to the property indicated that no significant vegetation changes occurred in 2011, except for those caused by the February 2011 wildfire, which is noted in the next section.

2012 Action: Photo points will be established and observation will be conducted in 2012.

iii. *Management Obligations*

Obligation: SRP's primary goal for management of these properties is to provide ecological and conservation benefits to the flycatcher and cuckoo. Management activities are focused primarily on minimizing or eliminating identified threats to riparian habitat, such as wildfire, groundwater pumping, surface water depletion, trespass livestock grazing, cowbird parasitism and vandalism. Actions to enhance the quality of habitat on a property or reverse past damage may also be conducted.

General management activities required for each property are listed below:

1. SRP will identify a manager for all acquired properties.
2. A management plan will be developed for each property within two years of acquisition in coordination with FWS and will be updated annually.
3. Management activities identified in the management plan will be implemented.
4. Cowbird management will occur on properties that are agreed to by SRP and FWS during the annual H-BHCP meeting.
5. Conservation easements shall be placed on all appropriate mitigation lands and will be held by an agency or organization acceptable to FWS.

Actions: SRP completed the following major management actions on the Ft Thomas H-B Preserve in 2011:

- TNC conducted patrols (which may include inspection and maintenance of access and signage, work and coordination with adjacent landowners and local law enforcement officials, and assistance with biological monitoring).
- SRP continued to review and revise the baseline inventory developed by Matt Turner in 2008. The Information will be incorporated into the Management Plan and Baseline report. SRP is delaying finalization of the plans in order to incorporate the Indian Springs Ranch parcel.
- Coordinated with RHCP manager and developed and awarded a fence contract. The fence was completed in late 2010 and early 2011 (Fig. 14).
- A fire occurred on a portion of the H-BHCP and the RHCP mitigation properties in February 2011 (Figs. 15-20). The section

below (prepared for and included in the RHCP annual report) summarizes the event and SRP's response:

Figure 13. Photo of newly constructed fence on the H-BHCP Ft. Thomas Preserve.

Wildfire Summary:

Two wildfires occurred on this reach of the river in 2011. The first, the River Fire, began on the afternoon of Friday, February 11 on private property adjacent to SRP's northernmost conservation easement with Freeport-McMoran. Dan Wolgast, SRP's contractor, happened to be patrolling the property when he saw the smoke. Fort Thomas Fire District personnel were on site by the time Wolgast got to the area. Wolgast immediately notified Ruth Valencia (RHCP Project Manager) at SRP. The Fort Thomas Fire District was unable to stop the fire because it had moved into a dense stand of tamarisk and was burning at a high intensity. By Monday, the fire had burned 92 acres, 46 of which were on the SRP mitigation lands. Valencia kept in touch with the Graham County Sheriff's Office

and Wolgast over the weekend to monitor the situation. By Sunday, February 13, the fire was reduced to a few hot spots. On Monday, Valencia received briefings from the Fort Thomas Fire Chief and the Bureau of Land Management (BLM) Fire Management Officer (FMO). BLM Fire Crews were assisting Fort Thomas FD because the fire had been moving in the direction of BLM lands.

By Monday afternoon, the BLM FMO contacted Valencia to inform her that wind speeds had increased and the fire was flaring up again, moving in the direction of BLM lands. By Tuesday, the fire burned an additional 40 acres on BLM and SRP lands, bringing the total area burned on SRP mitigation lands to 58 acres (46 acres on Roosevelt HCP land; 12 acres on Horseshoe-Bartlett HCP land).

On Tuesday, February 15, Valencia, Paradzick and Wolgast visited the site and met with Scott Cooke, the BLM Safford District Field Manager to get a status on fire fighting efforts. At the time, both BLM and U.S. Forest Service crews were on site putting out a few hot spots. The fire was extinguished by the end of that day. It was determined that the fire was human caused, likely from farm workers burning weeds along irrigation drains.

The second wildfire occurred on the east side of the Preserve, also likely caused by weed burning activities. SRP refers to this fire as Hancock II. On Wednesday, March 2, Valencia received a phone call from Phillip Elliott, Arizona State Forestry Fire Officer, to inform her that a small fire had occurred on the Fort Thomas Preserve and adjacent private lands. Approximately 6 acres of USBR lands (Hancock parcel) were burned. Alex Smith, USBR biologist, was notified. Wolgast visited the site on Friday, March 4 to investigate the extent of the damage.

Fortunately, the fire occurred outside of flycatcher breeding season and did not spread into known flycatcher nesting areas (Fig 20). SRP was able to map the extent of the River 3 and 4 fires on aerial photography using data files received from BLM. We overlaid flycatcher territory and nest locations on the map to determine whether any occupied habitat had been burned. Fortunately, the fires stopped short of burning a large patch of tamarisk that contained an estimated 10 nests in 2010. On the parcel acquired for the Horseshoe-Bartlett HCP, the fire stopped just short of a 2010 nest location. Nest locations were in tamarisk located on lower river banks so there may have been more moisture in that vegetation, making it less susceptible to burning.

Most of the vegetation burned was dominated by tamarisk, intermixed with coyote willow, seepwillow, Johnson grass and kochia. However, two stands of Fremont cottonwood trees were burned in the River Fire and one stand was burned in the Hancock II fire. A cottonwood tree containing a Great Horned Owl nest was burned and the owl was observed on the nest for at least a month after the fire. Biologists assumed that the nest failed because no nestlings were ever observed.

Within weeks of the fire, biologists noted that Johnson grass, tamarisk and coyote willow were resprouting. Some of the cottonwood trees appear to have survived, but we are waiting to see if they leaf out next year. We were encouraged by the rapid return of much of the coyote willow that burned. Vegetation in the area that burned during the 2007 fire on the Fort Thomas Preserve returned as a monoculture of tamarisk and kochia.

SRP is utilizing the areas burned by the 2011 fire to conduct a small-scale experiment to see if we can successfully introduce native plant species onto these sites before they turn into a tamarisk-kochia monoculture. We intend to test several restoration approaches, with various planting techniques and species. As a quick test, we seeded a mix of native grasses in a few areas where we were able to take advantage of irrigation run-off to see if grasses would establish before kochia returned. We also planted 21 one-gallon alkali sacaton grasses in the same area. We had excellent survival of potted grasses and have observed germination of seeded grasses in areas that retained moisture, but kochia still returned and is shading out the native grass.

SRP is developing a restoration plan for the other test plots and we plan to begin implementation in November 2011. Our objective is to identify planting techniques and plant species that can be used to restore tamarisk dominated areas to a more native vegetative composition. If successful, we hope to encourage more large-scale experimentation with the ultimate outcome being the restoration of patches of native vegetation within the large tamarisk stands along the edges of the Gila River throughout the Safford Valley in preparation for the possibility of tamarisk beetle infestation and to reduce the frequency and intensity of wildfire on the river.

Figure 14. Photo of Ft Thomas Preserve fire February 2011.

Figure 15. Photo of burned H-BHCP mitigation area, February 2011.

Figure 16. Photo of interior of patch near occupied willow flycatcher habitat on H-BHCP mitigation area, February 2011.

Figure 17. Photo of burned H-BHCP mitigation area, June 2011. Note regrowth of tamarisk.

Figure 18. Photo of interior of patch on edge of burned area looking toward/into occupied willow flycatcher habitat on H-BHCP mitigation area, June 2011.

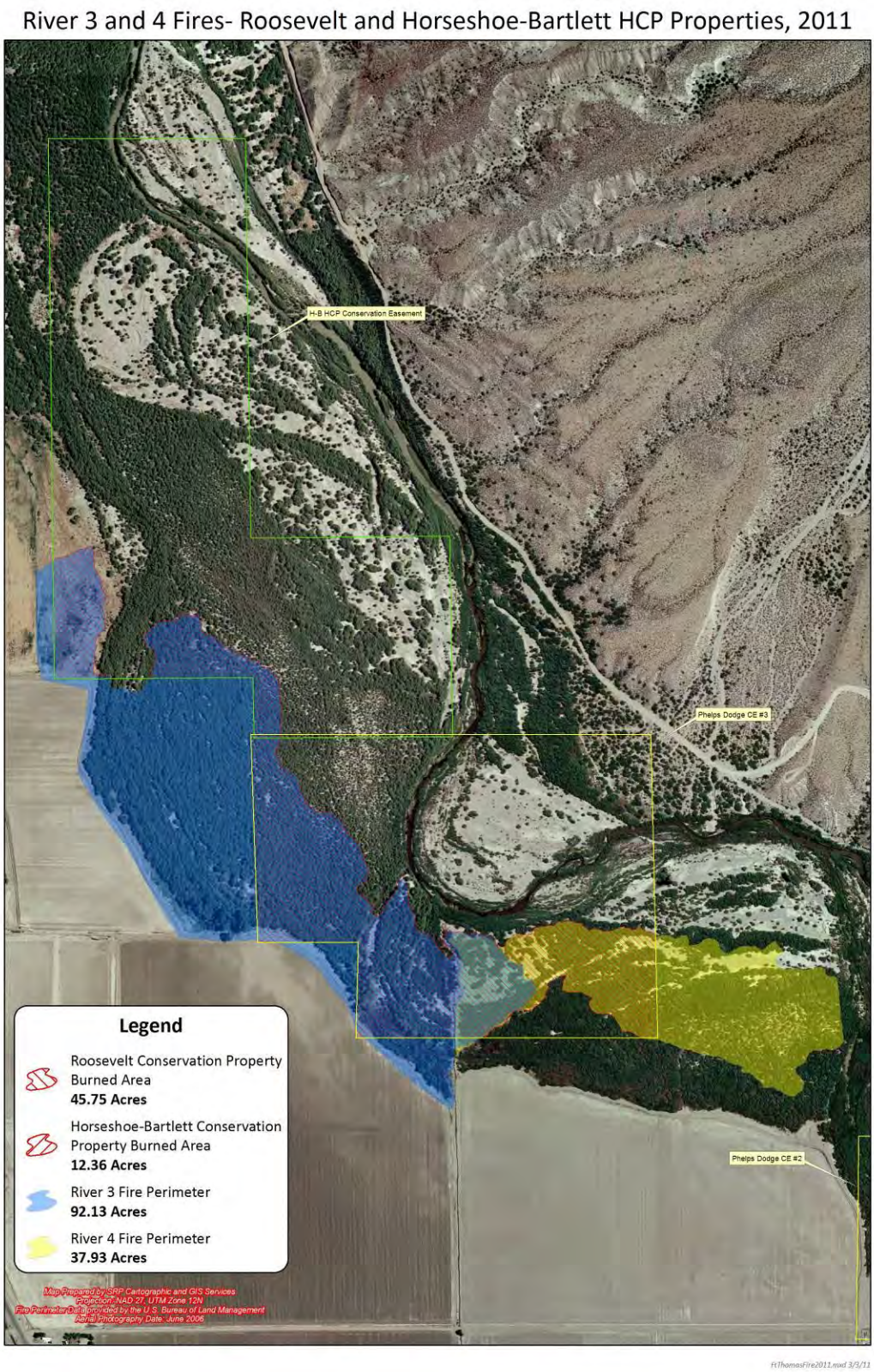


Figure 19. Map of Ft Thomas Preserve 2011 fire area.

2012 Actions: SRP plans to conduct the following management actions in 2012 on the Ft Thomas Preserve:

- Finalize the baseline and management reports.
- Develop and coordinate with RHCP a fire plan for the property.
- Continue to coordinate with BLM regarding fencing of the riparian area.
- Continue on-the-ground management activities in coordination with the Roosevelt HCP project manager.

b. Special Water Supply Protection Projects

Obligation: SRP will use its best efforts to protect future water supplies for mitigation lands.

Action: SRP provided funding to the USGS to conduct field work related to a 2-year Ecoflows project, which is a partnership among the USGS (Arizona and Utah offices), AZ Department of Water Resources, and The Nature Conservancy, to investigate the connection between stream flow in the Verde River and habitat along the riparian corridor (see Appendix D). USGS used the H-BHCP funding to conduct additional field sampling linking stream flows and channel morphology with macroinvertebrate populations. Sampling was conducted at six sites: on TNC property that is below Stillman Lake and above Campbell Ranch, at the USGS Verde River near Paulden gage, at Campbell Ranch, near Perkinsville, at the Verde River near Clarkdale gage, and at Reitz Ranch (between the Clarkdale gage and the city of Clarkdale). Pressure transducers with data loggers were also installed to monitor stage and air and water temperature at the TNC and Reitz Ranch sites.

<u>Summary List of Water Supply Protection Efforts</u>:

2009 Purchased piezometer instrumentation to measure shallow water levels to support TNC ecoflow study on the upper and middle Verde River.

2010 Installation of Sterling Springs Hatchery and USFS camp ground flow monitoring equipment – headwater springs of Oak Creek.

2011 Funded USGS to collect additional field data for EcoFlows Project on the Verde River (year 1 of 2 year project).

2012 Action: SRP will fund the second year of the USGS Ecoflow Project, which will provide for field sampling and data analysis (see Appendix D for work plan).

6. Aquatic Species Mitigation

The overall goal of the minimization and mitigation measures for covered aquatic species is to offset the direct impacts caused from stranding and passage through the outlet works, and the indirect impacts (predation and competition) caused by the increase of nonnative fish produced in the reservoirs. Minimization and mitigation obligations under the HCP include: rapid draw down of Horseshoe Reservoir; stocking adult and sub-adult razorback sucker in Horseshoe or elsewhere; installation of a fish barrier on Lime Creek; funding and supporting improvements to Bubbling Ponds Hatchery; stocking covered native fish in the Verde watershed; and watershed management activities that conserve instream flow, species, and habitats. The following implementation actions were taken:

a. Rapid Draw Down of Horseshoe Reservoir

Obligation: See Section 3.c.

Action: See Section 3.c.

2010 Action: See Section 3.c.

b. Stocking of Razorback Sucker at Horseshoe and Other Covered Species in Verde River.

Obligation: SRP will provide support for AGFD to stock razorback sucker during Horseshoe fills when conditions may be favorable. Other river segments may be stocked with razorback sucker upon mutual agreement among AGFD, FWS, and SRP. SRP will provide support to increase stocking of other covered native fish species in the Verde watershed.

Action: On April 23, 2009, SRP and AGFD executed a collection agreement to fund the operation and maintenance of Bubbling Ponds Hatchery (BPH) to support culture of covered native fish, and support transport and stocking of covered fish to meet this obligation. The collection agreement provides for SRP to annually transfer funds ($40,000) to AGFD to be utilized for O&M and stocking actions throughout the year. In August 2009, AGFD, FWS, and SRP met and identified species culture targets and stocking locations for the first 2 - 3 years of implementation (Table 3). In some instances, H-BHCP funded efforts were anticipated to be part of a multiagency effort (e.g., Fossil Creek).

In 2011, SRP continued funding AGFD O&M and stocking actions at BPH under the collection agreement. As of June 30, 2011, 12,771 native fish were stocked into the Verde River watershed (Table 4). AGFD decided to temporarily

discontinue propagation of Colorado pikeminnow due to the detection of largemouth bass virus at Dexter National Fish Hatchery, which supplies fish for Bubbling Ponds. A fish health assessment was conducted, and both Dexter and Bubbling Ponds were subsequently found to be free of the virus.

SRP also provided helicopter support and personnel during the May 2011 stocking of Gila topminnow into Lime Creek (Fig. 21).

In April 2011, SRP discussed with AGFD the status of fish on station at Bubbling Ponds and anticipated needs for stocking – no changes to the species priorities as presented in Table 4 were necessary.

Figure 20. Photos of Gila topminnow stocking in Lime Creek, May 2011.

Table 3. Proposed H-BHCP Bubbling Ponds Hatchery Culture and Stocking Summary, 2009 - ~2011.

Species	Proposed Stocking Locations[1,2]	Approximate quantity
Razorback sucker	Upper Verde	1000
	Middle Verde (Beasley-Childs)	2000
Gila Topminnow	Fossil Creek Dutchman Grave Spring Other tanks/locations in Verde watershed Lime Creek (after barrier is constructed)	1000s (for sites as approved)
Roundtail chub	Upper Verde (Stillman Lake) Houston Creek Middle Verde (Beasley-Childs) Deadhorse State Park Oak Creek West Clear Creek Fossil Creek Gap Creek Lower Verde (Bartlett-Salt River confluence)	500 (Stillman) 3000 (for other sites as approved)

[1]Pending AGFD, USFWS, and U.S. Forest Service coordination as necessary.
[2]Other locations may be considered and added with SRP, AGFD, and FWS concurrence.

Table 4. Native fish stocked by AGFD in support of H-B HCP through June 30, 2011.

Stocking Date	Species	Number stocked	Pounds stocked	Location
5/08/2009	Roundtail chub	200	12	Roundtree Creek
8/19/2009	Roundtail chub	1,987	125	Verde – Childs
1/07/2010	Colorado pikeminnow	980	1,165	Verde – Beasley Flat
3/26/2010	Razorback sucker	1,026	425	Verde – Camp Verde
3/31/2010	Razorback sucker	994	480	Verde – Camp Verde
5/20/2010	Roundtail chub	504	65	Verde – Childs
5/26/2010	Roundtail chub	1,448	65	Verde – Stillman
3/23/2011	Razorback sucker	896	684	Verde – Camp Verde
4/06/2011	Razorback sucker	900	1000	Verde – Camp Verde
5/26/2011	Roundtail chub	100	13	Private Pond -Strawberry
5/26/2011	Gila topminnow	3,736	5.8	Lime Creek
Total		**12,771**	**4039.8**	

2012 Action: Coordinate a meeting among AGFD, FWS, and SRP in April of 2012 to discuss the status of implementation, changes to the species priorities or locations, and plans for future culture and stocking effort. Continue to fund BPH O&M and stocking activities.

c. Bubbling Ponds Hatchery Improvements

Obligation: SRP will provide $500,000 in funding or in-kind support for planning, design, engineering, and fund raising to improve and expand AGFD's BPH.

Action: In 2011, AGFD used SRP funding to complete the following projects:

- Application of coatings (Aquafin 1K-2K) to the concrete raceways at the "Bass House" at BPH.
- A storage shed was constructed on site to house fish culture equipment and grounds keeping supplies.
- A 4ft high and 3900 linear ft perimeter otter fence was constructed around the facility to mitigate predation and fish loss.

SRP also provided funding to AGFD to finalize the hatchery improvement plan and conceptual design (Appendix E). The information will be used to inform subsequent hatchery improvements and for SRP to attempt to acquire federal funding for a major hatchery renovation.

2012 Actions: Continue to support AGFD BPH upgrade plan development and coordinate its planning and implementation.

d. Installation of a Fish Barrier in Lime Creek

Obligation: SRP will construct and maintain a fish barrier in Lime Creek to benefit resident, covered aquatic species such as Gila topminnow, longfin dace, and lowland leopard frogs.

Action: The barrier was completed in on on November 4, 2010 (Fig. 22). The construction of the barrier was described in detail in the 2010 H-BHCP annual report. SRP visited and inspected the barrier during the May 2011 Gila topminnow stocking. The barrier was structurally sound and functional, and, as anticipated, sediment had filled in most of the pool above the barrier.

2012 Actions: SRP will monitor barrier condition and conduct maintenance, as necessary. SRP, in coordination with AGFD and USFS, will also monitor the fish populations in Lime Creek.

Figure 21. Lime Creek fish barrier, November 2011.

e. Watershed Management Efforts

Obligation: SRP will continue, and expand where feasible, its substantial watershed management efforts to maintain and/or improve stream flows, which benefit all mainstem species.

Actions: SRP took the following actions in 2011 to protect watershed instream flow:

- Public outreach and education
- Funding research and monitoring
- Administrative and legal efforts to protect instream flows

Table 6 provides a detailed list of Watershed Management and Protection projects that occurred in 2011.

2012 Action: SRP will continue supporting watershed protection efforts in 2012.

Table 5. SRP watershed protection efforts accomplished in 2011.

Project Name	Date Initiated	Date Completed	SRP Contribution	Description and Comments	In-kind	Cash
Public Presentations	Ongoing	Ongoing	NA	8 public presentations to community groups and various agencies (e.g., Citizen Water Advocacy Group, TNC, Verde Watershed Association, Project CENTRL, Prescott Water Issues Subcommittee, 9th Grade Class Northpoint Academy in Prescott, and others)	X	
Agreement in Principle re Big Chino Groundwater withdrawals	Ongoing	Ongoing	NA	Continued work on implementing the Agreement in Principle between SRP, the City of Prescott and Prescott Valley regarding future groundwater withdrawals in the Big Chino sub-basin to ensure appropriate protections against impacts to the Upper Verde River.	X	
Legal efforts to curtail illegal groundwater pumping and surface water diversions – Verde Valley	Ongoing	Ongoing	NA	SRP continued its litigation against several groundwater pumpers in the Verde Valley who appear to be illegally diverting surface water.	x	
NAU Watershed Research and Education program	May-11	May-12	$50,000	Program and Project specific funding for NAU WREP program. Three research projects funded (Geomorphic and Hydrologic Modeling of the Schultz Fire Burn Area, Building an economically and Ecologically Sustainable Restoration and Monitoring Plan for Forested Watersheds in Northern Arizona, Sublimation from Snow in the San Francisco Peaks).		X
USGS/SRP cost share of stream gage maintenance	Jan-11	Dec-12	~$130,000	SRP's contribution to the USGS Joint Funding Agreement for the operation and maintenance of stream and reservoir gages in the Verde watershed (amount does not include reservoir gauge operations).		X
WatershedMonitor.com	Sep-07	Ongoing	NA	Maintain the website (www.watershedmonitor.com) which displays real time data for river flows and precipitation across the Salt and Verde Watersheds.	X	
Verde River Canoe Challenge	Mar-11	Mar-11	$2,500	Corporate sponsor of the Verde River Canoe Challenge. Note: 2010 Challenge was cancelled due to high water. SRP funds will carry to 2011.		X
Low Flow gages (Black Bridge, Verde Falls, Campbell Ranch, Bubbling Ponds Hatchery, Sterling Springs)	Jan-11	Jan-12	$58,300	2010 O&M and telemetry support for gages.	x	
Verde River Days	Sep-11	Sep-11	$500	SRP donation for event.		X

Table 5. SRP watershed protection efforts accomplished in 2011.

Project Name	Date Initiated	Date Completed	SRP Contribution	Description and Comments	In-kind	Cash
Yavapai College Foundation	Nov-11	Nov-11	$2,000	SRP Donation/Table sponsorship for event. Theme re sustainable economic development in the Verde Valley.		x
The Verde River – An Economy for a Sustainable Future: A Community Conversation	May-11	May 11	$2,000+	An event sponsored by the Verde Valley Regional Economic Organization, Project CENTRL, the Walton Family Foundation, TNC and Yavapai College.	x	x
Verde River Basin Partnership map support	Sep-11	Sep-11	$500	SRP provided GIS support for maps for Verde River Day	x	
Recharge of Treated Wastewater to Groundwater: What are the Risks?	Nov-10	Nov-10	$2,000	Forum hosted by the Citizen Water Advocacy Group. SRP provided staff for logistics and registration support.	x	
Arizona Water Story – Production of companion video	Jan-10	ongoing	In-Kind roughly worth $50,000	SRP has produced this water education video as part of the Arizona Water Story to assist 4th grade teachers throughout the state in teaching water science and Arizona history to their students. Copies will be distributed in the Verde Valley during any of this year's teacher workshops to be done by Alison or partner – AZ Project WET.	x	
Water Education Grants	Oct-07	Ongoing	$4,750	SRP collaborated with the towns of Prescott and Prescott Valley as well as the Yavapai County Water Advisory Committee and Arizona Department of Water Resources to provide Water Education Grants to outstanding water education programs taking place in Yavapai County.		X
Yavapai County Cooperative Extension Office /Project WET	Aug-08	ongoing	$15,000	SRP supported Edessa Carr with programming related to water education in Yavapai County. She has conducted numerous trainings on the Arizona Conserve Water curriculum guide, and worked with teachers from Prescott, Prescott Valley, Chino Valley, and Verde Valley towns.		X
Verde Valley Youth Outreach Committee	Aug-11	Ongoing	In-Kind leadership support	SRP (Alison Smith) serves on this committee to share and leverage partnerships in the Verde Valley related to youth education. Other partners on the committee include the parks, forest service, AZ Project WET, and Highland Center. Newly formed committee, so SRP's involvement is still in the infancy stages.	X	
Verde River Educator's Guide	June-11	Ongoing	Partnership – In kind development worth roughly	SRP (Alison Smith) is working with Edessa Carr and others to develop a Verde River Educator's Guide for use in the watershed. While based off of the Arizona Water Story, the Verde River Educator's Guide will be a joint project with Arizona Project WET	X	

Table 5. SRP watershed protection efforts accomplished in 2011.

Project Name	Date Initiated	Date Completed	SRP Contribution	Description and Comments	In-kind	Cash
			$40,000	rather than CAP and focuses specifically on the Verde Watershed.		
Verde River Teacher Academy	Aug-11	Summer 2012	In-kind totaling roughly $25,000	SRP (Alison Smith) is beginning plans for a Summer 2012 educator academy for four days set in the Verde watershed for teachers from the area to learn about the Verde River. Curriculum will come from the new Verde River Educator's Guide.	X	

7. Funding Methods and Assurances for HCP Implementation

Obligation: No later than 5 years after the Permit is issued, SRP shall insure that permanent funding is available to meet continuing obligations under the HCP.

Action: On March 24, 2009, SRP provided a letter to FWS indicating that we were proposing to establish an irrevocable trust to fund the H-BHCP. On November 2, the SRP Board approved an amendment to the Roosevelt Lake HCP trust, which allows for the creation and funding of a subaccount to meet the obligation of the H-BHCP. The subaccounts allow for each HCP trust fund to be managed (and reported) independently under a larger umbrella trust agreement. The H-B HCP subaccount was fund in January 2011 with approximately $6.0M to support the estimated $300,000 on average annual expenditures over the life of the permit and *in perpetuity* costs for some of the mitigation obligations.

2012 Action: Completed - no action needed in 2012.

8. HCP Implementation, Survey, and Monitoring 10-year Schedule

Obligation	Completed /Ongoing	Year									
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017+
Horseshoe Reservoir											
Flycatcher and Cuckoo Reservoir Ops	Ongoing	RD[1]	RD	RD	RD	RD	Hold?[2]	X	X	X	X
Aquatic Species Reservoir Ops	Ongoing	RD	RD	RD	RD	RD	Hold?	X	X	X	X
Vegetation Monitoring	Ongoing	X	X	X	X	X			X		
Flycatcher and Cuckoo Surveys	Ongoing	X			X			X			X
Bald Eagle Monitoring and Rescue Plan	Completed	X	X								
Bald Eagle Monitoring	Ongoing			X	X	X	X	X	X	X	X
Fish surveys:	Ongoing		X	X	X	X	X	X	X	X	X
Horseshoe			X	X	X[4]	SRP[5]	X		X		X
Verde (upstream Horseshoe)				X	X	X	-	X	?	X	?
Verde (downstream Bartlett)							-	X	?	?	?
Lime Creek		x	x	x	x	x				x	
Frog and Gartersnake survey	Ongoing					X					X
Horseshoe/Verde River Aquatic Species Mitigation											
Bubbling Ponds Hatchery (BPH) Improvements		X	X	X	X	X	X	X			
BPH O & M	Ongoing	-	X	X	X	X	X	X	X	X	X
Stocking RBS & other covered native fish	Ongoing	-	-	X	X	X	X	X	X	X	X
Lime Creek Barrier Construction	Completed	X	X	X							
Watershed Protection Projects	Ongoing	X	X	X	X	X	X	X	X	X	X
Ft. Thomas Mitigation Property (150 acres)											
Execute Conservation Easement	Completed	X	X								
Management	Ongoing		X	X	X	X	X	X	X	X	X
Purchase											2023-
Flycatcher and cuckoo monitoring[3]	Ongoing	X	X			X		X			X
Habitat monitoring	Ongoing	X	X			X		X			X
Indian Springs Ranch – Ft Thomas Preserve (55 acres)											
Identify suitable property		X	X	X	X						
Secure protection and manage						X	X	X	X	X	X
Special water supply protection projects	Ongoing	X	X	X	X	X	X	X	X	X	X

[1] Rapid drawdown and minimize pool

[2] Hold reservoir high if two successive years of low storage.

[3] Monitoring frequency dependent upon management needs and cowbird parasitism rate.

[4] Sampling for tagged fish also conducted downstream of Horseshoe dam

[5] SRP will, as feasible, investigate fish stranding in Horseshoe during and after rapid drawdown.

9. Literature Cited

Fish and Wildlife Service. 2008. Final environmental impact statement for the incidental take permit for operations of Horseshoe and Bartlett Reservoirs. March 2008. Arizona Ecological Services Office, Phoenix, Arizona.

Hatten, J. R. and C. E. Paradzick. 2003. A multiscaled model of southwestern willow flycatcher breeding habitat. Journal of Wildlife Management 67(4): 774-778.

Salt River Project. 2008. Habitat Conservation Plan Horseshoe and Bartlett Reservoirs. Submitted to the U.S. Fish and Wildlife Service Pursuant to Section 10(A)(1)(B) of the Endangered Species Act. Salt River Project, Tempe Arizona.

APPENDIX A

SOUTHWESTERN WILLOW FLYCATCHER AND YELLOW-BILLED CUCKOO SURVEYS ON THE HORSESHOE RESERVOIR STUDY AREA, ARIZONA, 2011

EcoPlan Associates, Inc.

Southwestern willow flycatcher and yellow-billed cuckoo surveys on the Horseshoe Reservoir study area, Arizona, 2011

Prepared by:
Patrick E.T. Dockens and Thomas C. Ashbeck

Prepared for:
Salt River Project

Submitted to:
Charles Paradzick
Salt River Project
PAB 352
P.O. Box 52025
Phoenix, AZ 85072-2025

EcoPlan Number:
09-281004

October 11, 2011

EcoPlan Associates, Inc.
Environmental Science & Resource Economics
701 W. Southern Ave., Suite 203, Mesa, AZ 85210

Table of Contents

Recommended Citation

Dockens, Patrick E.T., and Thomas C. Ashbeck. 2011. Southwestern willow flycatcher and yellow-billed cuckoo surveys on the Horseshoe Reservoir study area, Arizona, 2011. EcoPlan Associates, Inc., Mesa, Arizona.

1. Introduction

The Southwestern willow flycatcher *(Empidonax traillii extimus)* (WIFL) is a small, migratory passerine associated with riparian habitat in Arizona, New Mexico, southern California, southern Utah, southern Nevada, and southwestern Colorado. WIFLs are listed as an endangered species under the federal Endangered Species Act. WIFLs arrive at their summer breeding grounds in the southwestern United States in late April and remain until mid- to late August, when they begin their migration back to their wintering grounds in Central and South America.

The yellow-billed cuckoo *(Coccyzus americanus)* (YBCU) is a medium-sized (approximately 12 inches long) migratory bird ranging throughout much of the eastern and midwestern continental United States and west into New Mexico, Arizona, and California. YBCUs arrive in Arizona in mid-May and return to wintering grounds in Central and South America in late September. In Arizona, YBCUs are associated with riparian habitats, preferring densely wooded rivers and streams with high humidity (Corman and Wise-Gervais 2005). YBCUs are listed as a candidate species under the Endangered Species Act.

WIFLs and YBCUs are riparian obligate species and breed in dense riparian habitat along the edges of reservoirs, rivers, and streams, including the Verde River in central Arizona. As a result of hydrological conditions favorable to the development of suitable WIFL and YBCU habitat within Horseshoe Reservoir, stands of trees dominated by Goodding's willow *(Salix gooddingii)* and tamarisk (*Tamarix* spp.) developed within the upper reaches of the reservoir, especially along the flowing river channel. In 1993, WIFLs were documented for the first time nesting at this site (Paradzick et al. 2001). The first record of YBCUs in the study area is from 1998 (Troy Corman, Arizona Game and Fish Department [AGFD], personal communication). In 2003, the Salt River Project (SRP) and the U.S. Fish and Wildlife Service (USFWS) initiated discussions of a Habitat Conservation Plan (HCP) as part of an Endangered Species Act Section 10(a)(1)(B) permit for continued dam operations at Horseshoe and Bartlett reservoirs. From 2005 through 2008, SRP contracted EcoPlan Associates, Inc., to collect, evaluate, and report WIFL and YBCU occurrences and habitat use at Horseshoe Reservoir during preparation of the HCP. The HCP was completed in 2008 (SRP 2008), and surveys in 2011 (the first of periodic surveys) were initiated as a result of stipulations made in the HCP.

2. Study Areas

The study area comprised the lower Verde River and its floodplain from Sheep's Bridge downstream to Horseshoe Dam (Figure 1), a distance of approximately 15.3 kilometers. This reach of the Verde River flows south, with the Mazatzal Mountains to the east and the New River Mountains to the west. The Verde River is perennial, with flows above Horseshoe Dam fluctuating in response to rainfall and snowmelt. Downstream of the project area, the Verde River flows south, eventually joining the Salt River upstream of the Phoenix metropolitan area.

The Verde River, through much of its course, is a well-vegetated riparian corridor, with a section upstream of the study site designated as a Wild and Scenic River in 1984 by the U.S. Forest Service. In the study area, the river supports Goodding's willow and tamarisk along the banks and in the floodplain in various-sized habitat patches often bordered by mesquite and surrounded by upland Sonoran desertscrub (Turner and Brown 1994).

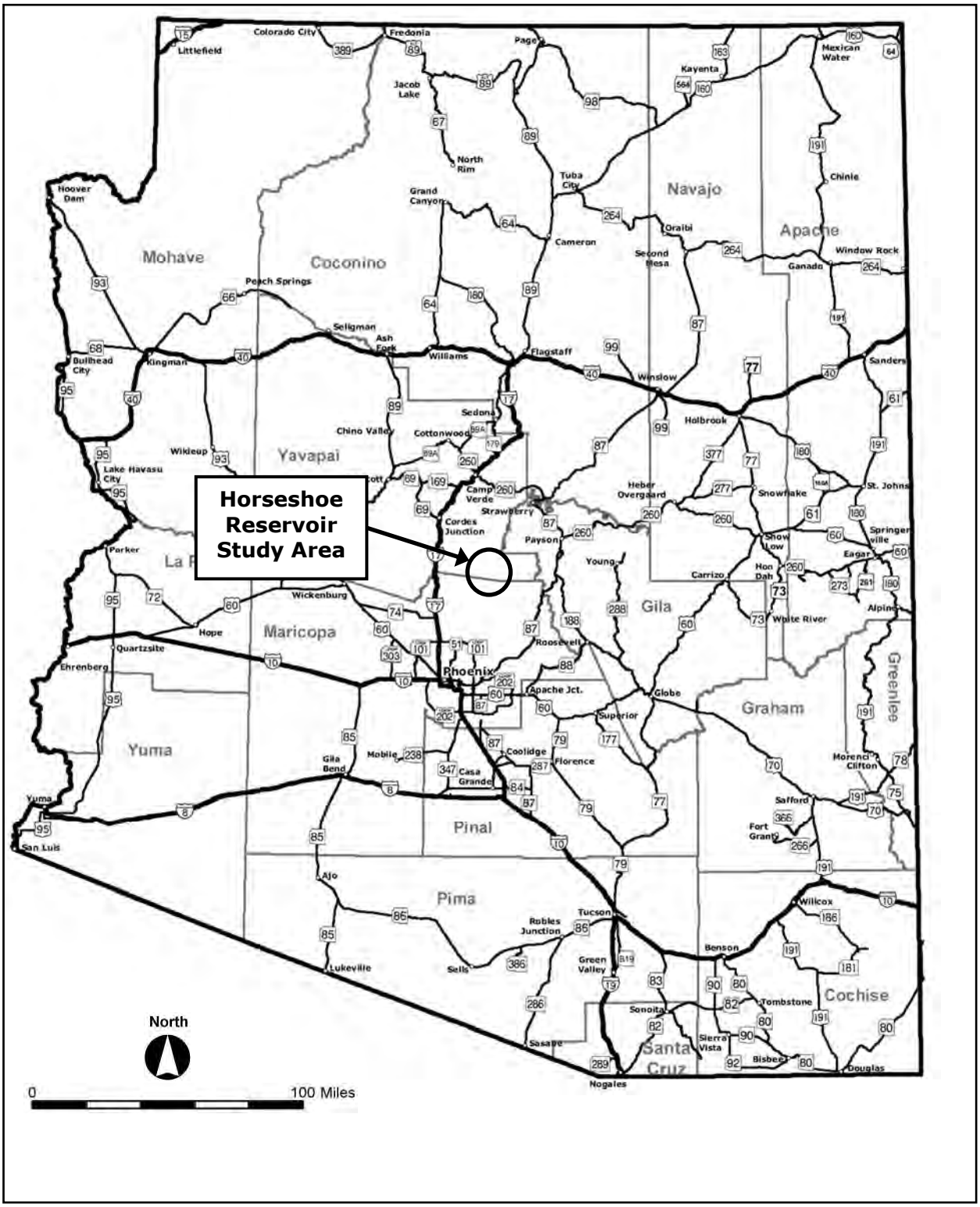


Figure 1. WIFL and YBCU study areas, Horseshoe Reservoir, Verde River, Maricopa and Yavapai counties, Arizona, 2011.

The study area contains essentially no Fremont cottonwood trees *(Populus fremontii)*, with one known exception in Deadman Creek, a tributary joining the Verde River on the east side of Horseshoe Reservoir; rare scattered individuals are upstream of Ister Flat.

The Verde River, in general, is subject to floods that result in a patchwork of scoured, cobbly, or silted areas supporting stringers of smaller willows and cottonwood near the main channel and larger willow and cottonwood trees within the floodplain farther from the main channel—all interspersed with tamarisk closer to the main channel and mesquite and tamarisk farther away. In the study area, tamarisk ranged from large monotypic stands to small patches and individuals interspersed within stands of willows on the banks of the Verde River above Horseshoe Reservoir. The operation of Horseshoe Dam often subjects the lower half of the reservoir bed to inundation for various lengths of time during the winter and summer rainy seasons, limiting the establishment of large stands of mature riparian vegetation. Though the entire reservoir below the full-pool elevation is subject to inundation, the upper half is inundated less frequently and has developed mature stands of willow and tamarisk of varying size and structure.

3. WIFL Surveys

Methods

Surveys

Surveys were conducted in all suitable habitat for migrating and breeding WIFLs. Suitable habitat at the Horseshoe Reservoir study area was identified during the 2003–2008 surveys and was confirmed during pre-survey reconnaissance. Three surveys were conducted following an accepted protocol (Sogge et al. 2010). Logistical challenges and the distance between patches of suitable habitat in the study area sometimes required the surveys to be completed on separate days. Surveys began at sunrise and ended by 10 a.m. Survey methods for WIFLs entailed playing a tape with the diagnostic "fitz-bew" vocalization for approximately 30 seconds every 30 meters, depending on the density of the habitat. Calls were broadcast to elicit responses from WIFLs in the immediate area. To minimize disturbance to potentially nesting birds, tape playback was discontinued once WIFLs were detected. Habitat patches determined to be unsuitable during initial surveys or site reconnaissance efforts were not surveyed. Habitat was considered unsuitable if the canopy was open and the vegetation was sparse.

WIFLs detected were considered residents if they displayed nesting behavior, were calling vigorously within a territory after June 14, or both. WIFLs that were detected only once during surveying efforts or that left the study area before June 15 were considered non-residents and were assumed to have moved to other areas (Sogge et al. 2010). As time permitted after surveys were completed, more intense territory investigations were conducted to detect pairs and nests.

Habitat Observations

Visual habitat observations, including general conditions and potential suitability for breeding WIFLs, nest substrate of located nests, approximate canopy height, habitat patch composition, and presence and distance to water, were noted during surveys throughout the field season.

Results

Surveys

Three protocol surveys were performed in 2011, with 57 survey hours total. Fourteen resident adults, four pairs, and 10 resident WIFL territories were detected. Six of the 10 resident WIFL territories were considered occupied by unpaired males, and seven detections were considered territories occupied by non-resident adults.

EcoPlan Associates, Inc., submitted survey results via the Willow Flycatcher Survey and Detection Form (revised April 2010) to the AGFD and the USFWS. Additional details of the surveys are contained in the appendixes. Appendix A provides photos from the Horseshoe Reservoir study area; Appendix B provides the survey form; Appendix C provides a map of detection locations; and Appendix D lists Global Positioning System (GPS) points of the locations of WIFL territories and nests.

Habitat Observations

The reservoir was fully drained before the first survey period began and remained that way throughout the 2011 survey season, though soils in the reservoir bed remained saturated through July. Approximate canopy height for all occupied patches was 12 meters. Throughout the season, the Verde River ran directly through, immediately adjacent to, or within 300 meters of occupied and unoccupied patches.

The habitat in Territories 1 and 2, the territories farthest north along the Verde River, was composed of Goodding's willow stringers 1 to 4 trees thick with a canopy height of about 8 to 12 meters. Territories 3 to 8 were located in intermixed native/nonnative patches composed of younger 6- to 10-meter-tall Goodding's willow along the river with older 10- to 12-meter-tall Goodding's willow and tamarisk on a higher bank to the east. Territories 9, 10, 14, and 15 were in a habitat of patches composed mostly of older tamarisk approximately 8 meters tall, interspersed with 10- to 14-meter-tall Goodding's willow. Territories 11 to 13 were located along the main channel of the Verde River in habitat dominated by gallery Goodding's willow, approximately 15–20 meters tall with smaller shrubby tamarisk in the understory. Territories 16 and 17 were in a young patch of Goodding's willow approximately 6 to 8 meters tall at the base of Chalk Mountain, approximately 300 meters east of the main flow channel of the Verde River.

Discussion

The number of WIFLs detected during study activities has fluctuated over the past several years in the study area (Table 1). Population numbers increased from 2002 to 2005 and have declined each year since, though the population has not reached the low recorded in 2002, stabilizing over the past few years.

Table 1. Survey summary for resident WIFLs at the Horseshoe Reservoir study area, 2002–2011.

Year	Adults	Pairs	Number of Territories	Nests	Inundation Status
2002	8	2	6	0	Base of trees in territory lowest in reservoir bed inundated during first survey
2003	19	8	11	5	Reservoir empty or nearly empty; no territories inundated
2004	24	7	17	0	Reservoir levels high enough to inundate all territories for all three surveys
2005	35	15	20	23	Reservoir began full; territories inundated for the first two surveys
2006	30	12	18	25	Reservoir empty or nearly empty; no territories inundated
2007	25	12	13	6	Five territories lowest in the reservoir bed inundated for the first survey
2008	14	7	7	1	Reservoir began full; territories inundated for the first survey
2009	No surveys conducted				Reservoir was approximately half-full on May 1 and was empty by the first week in June (SRP 2010)
2010	No surveys conducted				Reservoir was nearly full through May and, after a slow drawdown, was empty by late August (U.S. Geological Survey 2011)
2011	14	4	10	0	Reservoir empty or nearly empty by early May; no territories inundated

Sources: Dockens and Ashbeck 2005, 2006, 2007, 2008; EEC 2004; Munzor et al. 2005

Habitat along the main channel of the Verde River west of Chalk Mountain was occupied this year by resident WIFLs, though no WIFLs were detected there in 2008 (Dockens and Ashbeck 2008), the last year WIFLs were surveyed in Horseshoe Reservoir. This patch continues to exhibit evidence of degradation, such as tree fall, tree mortality, and a corresponding opening of the canopy, though it appears to have slowed over the past several years. The west end of the habitat patch north of Chalk Mountain and north of the main flow channel has also exhibited some degradation, especially in areas closer to the flow channel where the trees have died or been swept away by the actions of the river. This patch contained fewer territories this year than found anytime during the past several surveys (Dockens and Ashbeck 2005, 2006, 2007, 2008). Non-residents were detected for the first time in habitat patches where WIFLs have never been detected, including young willows at the western base of Chalk Mountain and in thin stringers upstream of Ister Flat. These patches upstream of Ister Flat are approximately 2 kilometers farther upstream of any previous detection (Dockens and Ashbeck 2005, 2006, 2007, 2008) and are about halfway between Ister Flat and Sheep Bridge. Willow and tamarisk recruitment was observed along the banks of the Verde River, especially upstream of Ister Flat. This area includes the upper extant of the reservoir at full pool elevation. The establishment of new stands (patches) of trees in this reach of the Verde River where complete submersion is unlikely during full pool conditions may support suitable WIFL nesting habitat in the foreseeable future.

Adult WIFLs, pairs, territories, and nests can be expected to fluctuate within any individual population between years for many reasons. Since 2002, when surveys began in the study area,

the habitat conditions, reservoir levels (Table 1), and the number and distribution of WIFLs have changed and, therefore, can be expected to change similarly in the future.

4. YBCU Surveys

Methods

Surveys were conducted in all areas containing suitable habitat for migrating and breeding YBCUs. Suitable habitat at the Horseshoe Reservoir study area was identified during previous work (2005–2007) and during pre-survey reconnaissance. Five surveys were conducted according to the Halterman et al. (2009) protocol. Surveys began at sunrise and ended by noon or when the temperature reached 104 degrees Fahrenheit (40 degrees Celsius).

Survey methods entailed playing a recording of the diagnostic "kowlp" vocalization at intervals along a transect through suitable habitat. The call was broadcast five times, spaced 1 minute apart, at every 100 meters, depending on the density of the habitat. If a cuckoo was detected, the surveyor would not play the call again until 300 meters past the detection to avoid repeatedly detecting the same YBCU. Calls were broadcast to elicit responses from YBCUs in the immediate area. Habitat was considered suitable if the trees were more than 5 meters tall with more than 50 percent canopy cover. Habitat patches determined to be unsuitable during initial surveys or site reconnaissance efforts were not surveyed. From late May through July, during WIFL surveying, field crews would note any incidental YBCU calls heard.

Results

Surveys

Six total detections (Table 2) were recorded in three distinct areas (see Appendix E for a map of the detection locations and Appendix F for a table of YBCU detections). No incidental detections were made. Based on a summation of the survey detections, an estimated two mated pairs and one unpaired adult were present in the survey area.

Table 2. Survey results for YBCU on the Horseshoe Reservoir study area, Arizona, 2011.

Survey Number	Date[1]	Number of Detections[2]
1	June 22, 23, and 24	4
2	July 10 and 11	2
3	July 21 and 22	0
4	August 13	0
5	September 8 and 9	0

[1]Due to time constraints, some surveys were conducted over more than one day.

[2]No incidental detections were made.

Habitat Observations

Though quantitative habitat measurements were not taken, visual observations were made and noted in 2008. Detections were in habitat that ranged from 8-meter-tall tamarisk-dominated habitat interspersed with 8- to 12-meter-tall Goodding's willow to habitat dominated by 12- to 14-meter-tall Goodding's willow with very little tamarisk.

Discussion

Habitat in the Horseshoe Reservoir study area is similar to habitat used by YBCUs in other drainages in Arizona (Corman and Magill 2000, Halterman et al. 2009). Though survey results from 2011 are comparable to results from 2003–2006 and 2008, with 16, 10, 11, 8, and 6 detections, respectively (Dockens and Ashbeck 2006, 2008; EEC 2004, 2005), there appears to be a downward trend. Reasons for trends in population numbers can be difficult to ascertain because variability in year-to-year detections may be due to normal YBCU population fluctuations, fluctuations in prey availability, and changes in habitat quality, such as the maturation of habitat into suitability, degradation due to hydrological changes, or complete inundation of suitable habitat, which has occurred in the past. However, these factors were not evaluated in this study.

5. Literature Cited

Corman, T.E., and R.T. Magill. 2000. Western yellow-billed cuckoo in Arizona: 1998 and 1999 survey report. Nongame and Endangered Wildlife Program Technical Report 150. AGFD, Phoenix, Arizona.

Corman, T.E., and C. Wise-Gervais, editors. 2005. The Arizona breeding bird atlas. University of New Mexico Press, Albuquerque, New Mexico.

Dockens, P.E.T., and T.C. Ashbeck. 2005. 2005 summary report: Southwestern willow flycatcher survey and nest monitoring along the Verde River from Sheep's Bridge to the Fort McDowell Indian Reservation boundary, Maricopa and Yavapai counties, Arizona. EcoPlan Associates, Inc., Mesa, Arizona.

_____. 2006. Southwestern willow flycatcher and yellow-billed cuckoo monitoring on the lower Verde River, Arizona, 2006. EcoPlan Associates, Inc., Mesa, Arizona.

_____. 2007. Southwestern willow flycatcher surveys on the lower Verde River, Arizona, 2007. EcoPlan Associates, Inc., Phoenix, Arizona.

_____. 2008. Southwestern willow flycatcher and yellow-billed cuckoo surveys on the Horseshoe Reservoir and Fort Thomas study areas, Arizona, 2008. EcoPlan Associates, Inc., Mesa, Arizona.

EEC. 2004. Horseshoe Reservoir, Verde River, Yavapai County 2004 biological surveys. EEC, Tucson, Arizona.

_____. 2005. 2005 survey results: Yellow-billed cuckoo *(Coccyzus americanus)* Verde River North of Horseshoe Reservoir, Yavapai County, Arizona. EEC, Tucson, Arizona.

Halterman, M., M. Johnson, and J. Holmes. 2009. Western yellow-billed cuckoo natural history summary and survey methodology. Draft report, June 9, 2009. Southern Sierra Research Station and Colorado Plateau Research Station, Weldon, California, and Flagstaff, Arizona.

Munzor, O.M., H.C. English, A.B. Smith, and A.A. Tudor. 2005. Southwestern willow flycatcher 2004 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 244. AGFD, Phoenix, Arizona.

Paradzick, C.E., T.D. McCarthey, R.F. Davidson, J.W. Rourke, M.W. Sumner, and A.B. Smith. 2001. Southwestern willow flycatcher 2000 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 175. AGFD, Phoenix, Arizona.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. A natural history summary and survey protocol for the Southwestern willow flycatcher: U.S. Geological Survey Techniques and Methods 2A-10.

SRP. 2008. Habitat Conservation Plan for Horseshoe and Bartlett Reservoirs. SRP, Phoenix, Arizona.

SRP. 2010. Horseshoe and Bartlett Reservoirs Habitat Conservation Plan Annual Implementation Report 2009. SRP, Phoenix, Arizona.

Turner, R.M., and D.E. Brown. 1994. Sonoran desertscrub. *In* Biotic communities: Southwestern United States and northwestern Mexico, edited by D.E. Brown, pp. 180–221. The University of Utah Press, Salt Lake City, Utah.

U.S. Geological Survey. 2011. National Water Information System. http://waterdata.usgs.gov/nwis. Accessed October 5, 2011.

6. Personal Communications

- Troy Corman, avian monitoring coordinator, AGFD

Appendix A

Ground Photos, Horseshoe Reservoir Study Area, Arizona, 2011

Photos 1 and 2. View of the interior of habitat patches along the Verde River occupied by the northernmost non-resident WIFL detected in 2011. The left photo is Territory 1, and the right photo is Territory 2.

Photo 3. View of the interior of the habitat at Territory 14, facing south, as an example of an older stand of tamarisk with a willow overstory.

Photo 4. View of the exterior of the habitat at Territories 14 and 15, facing northwest.

Photos 5 and 6. View of the habitat along the Verde River west of Chalk Mountain.

Photos 7 and 8. View of the exterior (Photo 7) and interior (Photo 8) of the habitat patch encompassing Territories 16 and 17, facing south. This habitat patch is a fairly young patch of Goodding's willow where WIFLs were detected for the first time, though this year they were categorized only as non-resident WIFLs.

Appendix B

WIFL Survey Results and Detection Form,
Horseshoe Reservoir Study Area, Arizona, 2011

Site Name: Horseshoe Reservoir Study Area State: AZ Counties: Maricopa, Yavapai
USGS Quad Name: Chalk Mountain Elevation: 590–640 meters
Site Coordinates: Start: 3770759N, 434756E Datum: NAD27
Stop: 3763947N, 432850E Zone: 12, UTM

Survey # / Observer(s) (Full Name)	Date (m/dd/yy) Survey Time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found? Y or N (Number of active nests)	Cowbirds Detected? Y or N	Presence of Livestock, Recent Sign, Y or N	Comments About This Survey
1 Patrick E.T. Dockens Robert L. Hunt	PETD: 5/15/11: 0600 to 1000 5/16/11: 0550 to 0905 RLH: 5/15/11: 0635 to 1030 5/16/11: 0540 to 1010 5/17/11: 0611 to 0820 Total hrs: 17.82	**9**	**0**	**9**	N	Y	N	7 non-residents detected
2 Patrick E.T. Dockens Robert L. Hunt	PETD: 6/06/11: 0520 to 1000 6/07/11: 0735 to 1030 RLH: 6/06/11: 0540 to 1020 6/07/11: 0535 to 1000 6/08/11: 0545 to 0810 Total hrs: 19.08	**11**	**4**	**7**	N	Y	N	4 non-resident detected (all detected in the first survey period also)
3 Patrick E.T. Dockens Robert L. Hunt	PETD: 7/07/11: 0535 to 1000 7/08/11: 0600 to 1010 RLH: 7/07/11: 0525 to 1030 7/08/11: 0535 to 1005 7/09/11: 0554 to 0750 Total hrs: 20.10	**14**	**4**	**10**	N	Y	N	

Overall Site Summary (Total **resident** WIFLs only)	Adults	Pairs	Territories	Nests	Were any WIFLs color-banded? Yes (No)
Total survey hrs: 57	**14**	**4**	**10**	**0**	

Reporting Individual: Thomas C. Ashbeck Phone #: (480) 733-6666, x124
Affiliation: EcoPlan Associates, Inc. E-mail: tashbeck@ecoplanaz.com
U.S. Fish and Wildlife Service Permit # TE 830213-1 AZ Game and Fish Department Permit # SP 631130
Site Name: Sheep's Bridge to Horseshoe Reservoir Dam Date Report Completed: 8/1/2011

Did you verify that this site name is consistent with that used in previous years? (Yes) / No
If name is different, what name(s) was used in the past? Ister Flat, Horseshoe Reservoir
If site was surveyed last year, did you survey the same general area this year? (Yes[1]) / No
Did you survey the same general area during each visit to this site this year? (Yes) / No

Management Authority for Survey Area (circle one): (Federal) Municipal/County State Tribal Private
Name of Management Entity or Owner: Tonto National Forest, Cave Creek Ranger District

Length of area surveyed: 7.4 miles

Vegetation Characteristics: Overall, are the species at this site comprised predominantly of:

[ ] Native broadleaf plants (entirely or almost entirely, includes high-elevation willow)
[ ] Mixed native and exotic plants (mostly native)
[X] Mixed native and exotic plants (mostly exotic)
[ ] Exotic/introduced plants (entirely or almost entirely)

Identify the 2–3 predominant tree/shrub species: Tamarisk and Goodding's willow
Average height of canopy (Do not put a range): 12 meters

Was surface water or saturated soil present at or adjacent to site? (Yes[1]) / No
Distance from the site to surface water or saturated soil: 0 meters[1]
Did hydrological conditions change significantly among visits (did the site flood or dry out)? (Yes) / No

Comments:
[1] Throughout the season, the habitat was inundated or the river ran directly through the habitat patch, hence 0 meters for distance to water.

Appendix C

Map of WIFL Territory and Nest Locations,
Horseshoe Reservoir Study Area, Arizona, 2011

Page removed

Contains confidential/sensitive species information

Contact USFWS

Appendix D

GPS Points of WIFL Non-residents, Territories, and Nests,
Horseshoe Reservoir Study Area, Arizona, 2011

Page removed

Contains confidential/sensitive species information

Contact USFWS

Appendix E

Map of YBCU Detections,
Horseshoe Reservoir Study Area, Arizona, 2011

Appendix E. YBCU detection locations at the Horseshoe Reservoir study area, Arizona, 2011.

Appendix F

GPS Points of YBCU Detections,
Horseshoe Reservoir Study Area, Arizona, 2011

Appendix F. GPS points[1] of YBCU detections, Horseshoe Reservoir study area, Arizona, 2011.

Survey Number	Easting[2]	Northing[2]	Detection Notes
1	432772	3768930	Kowlps, 1 YBCU
1	432706	3767673	Kowlps, 1 YBCU
1	432668	3767706	Visual only, 1 YBCU
1	432680	3767608	Knocks, kowlps, 1 YBCU
2	432791	3766426	Knocks, 1 YBCU
2	432726	3766407	Knocks, kowlps, 1 YBCU

[1] GPS points are projected in NAD27, Zone 12, in meters.

[2] GPS points for YBCUs are estimates made by the observer in the field and reported as a bearing and approximate distance from the observer to the individual YBCU(s).

APPENDIX B

HCP 2011 FISH MONITORING SURVEYS

Arizona Game and Fish Department

HCP 2011 Fish Monitoring Surveys


Christopher Cantrell
Curtis Gill
And Jacob Jaeger
Region VI Fisheries Program
Arizona Game & Fish Department
7200 E. University Dr.
Mesa, Arizona 85207

Arizona Game and Fish Department Mission

To conserve, enhance, and restore Arizona's diverse wildlife resources and habitats through aggressive protection and management programs, and to provide wildlife resources and safe watercraft and off-highway vehicle recreation for the enjoyment, appreciation, and use by present and future generations.

The Arizona Game and Fish Department prohibits discrimination on the basis of race, color, sex, national origin, age, or disability in its programs and activities. If anyone believes they have been discriminated against in any of AGFD's programs or activities, including its employment practices, the individual may file a complaint alleging discrimination directly with AGFD Deputy Director, 5000 W. Carefree Hwy., Phoenix, AZ 85086, (623) 236-7290 or U.S. Fish and Wildlife Service, 4040 N. Fairfax Dr., Ste. 130, Arlington, VA 22203.

Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, or this document in an alternative format, by contacting the AGFD Deputy Director, 5000 W. Carefree Hwy., Phoenix, AZ 85086, (623) 236-7290, or by calling TTY at 1-800-367-8939. Requests should be made as early as possible to allow sufficient time to arrange for accommodation.

Suggested Citation:

Cantrell, C., C. Gill, and J. Jaeger 2011. HCP Fish Monitoring Report2011. Draft report to Salt River Project, Phoenix, Arizona. Arizona Game and Fish Department, Research Branch, Phoenix. 15 Pages.

Acknowledgements

Thanks to Arizona Game and Fish Department personnel Lorraine Avenetti, Amberle Vasey, Tim Grosch, Diana Rogers, Andy Mckinster, Ryan Babel, Marc Wickie, and Kent Mosher who helped conduct the fish surveys. Also a special thanks to Chuck Paradzick of Salt River Project who provided valuable feedback and comments on the draft of this report

Contents

Abstract

This report summarizes fish sampling in Horseshoe Reservoir and the Verde River by Arizona Game and Fish Department (AZGFD) in behalf of a long-term Salt River Project (SRP) Habitat Conservation Plan (HCP) for Bartlett and Horseshoe Reservoirs. The objectives of these survey and monitoring trips was to determine species composition, age-class structure, and important trends of fish populations in Horseshoe Reservoir and the Verde River based upon the operation of the lake. In addition, fish movement out of Horseshoe Reservoir and into the Verde River was examined. Four fish monitoring surveys were conducted in the 2011 calendar year. The first sampling trip was conducted in Horseshoe Reservoir in the spring. The second sampling was conducted on the Verde River from Sheep's bridge to Islet flat, upstream of Horseshoe Reservoir. The third sampling occurred again in Horseshoe Reservoir and the last trip sampled was below the reservoir from catfish point to an unnamed takeout point above Bartlett Lake. Standardized sampling protocols for electrofishing as established by AZGFD were implemented. All surveys used canoes to electrofish. To determine fish movement, nonnative fish greater than 150 mm TL were marked with either a spaghetti tag or by clipping the dorsal spine. A total of 246 fish were captured representing 9 species in Horseshoe Reservoir combined for both the spring and the fall samplings. Of those fish, 216 were marked, mostly consisting of largemouth bass (*Micropterus salmoides*) and common carp (*Cyprinus carpio*). No tagged fish were collected either upstream or downstream of the reservoir.

Background

Horseshoe Reservoir is located in the Tonto National Forest on the Verde River in Central Arizona. Horseshoe Lake is the first of the Salt River Project (SRP) lakes, on the Verde River watershed, to be fully utilized for water demands followed by Bartlett Lake. As a result from those water demands and the operation to meet those demands, SRP developed the Habitat Conservation Plan (HCP) for Bartlett and Horseshoe Reservoirs. The purpose of this HCP is to implement measures to minimize and mitigate incidental take of 16 covered bird, fish, frog, and snake species to the maximum extent practicable, and to ensure that incidental take will not appreciably reduce the likelihood of survival and recovery of these species in the wild (USFWS, 2008). The U.S. Fish and Wildlife Service Record of Decision for the HCP documented the decision to implement Alternate 2, Optimum Operation of Horseshoe and Bartlett Reservoirs and Dams (the preferred alternative). The objectives of Alternative 2 were to operate the reservoir to support stands of tall dense riparian vegetation at the upper end of Horseshoe and to manage Horseshoe water levels to minimize impacts to covered native fish, frog, and gartersnake species; and to benefit the razorback sucker. The background information presented herein was taken from the HCP (USFWS, 2008).

The overall goal of the minimization and mitigation measures for aquatic native species is to offset the future direct impacts to native fish caused from stranding and passage through the outlet works, and the indirect impacts to the native fish, frog, and gartersnake communities caused by operation of Horseshoe and Bartlett dams resulting in a small (relative to baseline) increase of nonnative fish produced in the reservoirs, which may compete with or prey upon aquatic native species. The primary means to offset the direct impacts of operation and the indirect impact of additional predation and competition by nonnative fish on covered native fish will be:

1. Minimizing or reducing nonnative fish reproduction, recruitment, and movement;

2. Augmenting/increasing native fish populations, distribution, and relative abundance;

and

3. Maintaining water flows in the Verde River above Horseshoe.

Monitoring is necessary to determine the effectiveness of minimization and mitigation measures mentioned above and make subsequent adaptive management decisions. Outcomes from monitoring efforts could result in actions described in the collection agreement between Arizona Game and Fish Department (AZGFD) and Salt River Project (AZGFD and SRP, 2009). During the first 5 years of implementation, the emphasis of monitoring will be to tag nonnative fish in Horseshoe Reservoir and survey for fish upstream and downstream in the Verde River to detect movements of marked nonnative fish out of the reservoir. Native fish population indices (i.e., composition and age-class structure) will also be assessed in the reservoir and Verde River in the immediate vicinity. Nonnative fish captured in the reservoir that are large enough will be marked to provide data on survivorship and movement patterns to help assess the effectiveness of the minimization and mitigation measures.

Fish movements in streams and reservoirs have been well studied. Recent surveys by AZGFD (Robinson 2007; Stewart 2009 and 2010) in Horseshoe Reservoir found ten species of nonnative fishes (common carp *Cyprinus carpio*, goldfish *Carassius auratus*, red shiner *Cyprinella lutrensis*, largemouth bass *Micropterus salmoides*, green sunfish *Lepomis cyanellus*, bluegill *Lepomis macrochirus*, channel catfish *Ictalurus punctatus*, flathead catfish *Pylodictis olivaris*, yellow bullhead *Ameiurus natalis*, and mosquitofish *Gambusia affinis*), and three native fish species (razorback suckers *Xyrauchen texanus*, Colorado pikeminnow *Ptychocheilus lucius*, and Sonora sucker *Catostomus insignis*). Some of the nonnative fish species have been reported to move long distances in other systems. For instance, common carp have been reported to make long distance movements in the Murray-Darling Basin in Australia (Jones et al. 2009). Carp ranging in size from 400 to 612 mm TL were found to move up to 127 km upstream and nearly 257 km downstream from their original capture location (Jones et al 2009). In Georgia, largemouth bass were found to move upstream nearly 70 km in the Savannah River (Paller et al 2005). Flathead catfish in the Missouri River had a maximum dispersal of 161 km (Travnichek 2004).

The objective of these surveys was to estimate species composition and age-class structure of fishes in Horseshoe Reservoir, the Verde River, and mark nonnative fish to detect future movement out of Horseshoe Reservoir in to the Verde River. Over the last three years, the Arizona Game & Fish Department has been intensively tagging and monitoring individual fish within Horseshoe Reservoir and the lower Verde River. To date, no tagged fish have been recaptured.

Reservoir Sampling

Methods

Study Site

The overall action area covered by the HCP is the Verde River from the Salt River confluence upstream, including both Horseshoe and Bartlett Reservoirs, to Allen Ditch Diversion near Clarkdale, Arizona (Figure 1). The extent of the 2011 reservoir surveys occurred within Horseshoe Reservoir while the reservoir was at a level of 25% or 27,760 acre feet on April 12 and 13 and <1% or 1,952 acre feet on September 13.

Fish Sampling

On April 12-13 and September 13, 2011, we conducted two electrofishing surveys within the Horseshoe Reservoir. The objective of these surveys was to estimate species composition and age-class structure of fishes in Horseshoe Reservoir and mark nonnative fish within the reservoir. Due to the fact that the boat ramp was out of the water during these surveys, electrofishing canoes were utilized to effectively collect fish species within the reservoir.

Our electrofishing canoes used for this survey each had a 30 cm diameter spherical anode suspended from a bow mounted boom and either 12 x 334 cm anodize aluminum strips that were permanently affixed to each side of the canoe or 334 cm long rat tails, which were constructed of braided steel. Both cathode types are mostly submerged during the survey. Output for both canoe electro-fishers ranged from five to seven amps to maximize catch rates while minimizing trauma to the fish. The electrofishing canoes were accompanied by another chase canoe to increase the catch rate, as well as to process the fish that were being collected.

Other gear types used in the past on Horseshoe reservoir (i.e. gill nets and fyke nets) were not used due to safety issues associated with setting and pulling these gill nets off of canoe, as well as low effectiveness of the fyke nets (Stewart 2009).

All captured fish were identified to species, measured (mm) and weighed (g). However, the wind prevented the ability to accurately weigh species at the majority of the sites, therefore only a small number of fish were accurately weighed. Fish collected in the reservoir, greater than 150 mm in total length, were marked by a Floy tagged. All goldfish and carp were anal and dorsal spine clipped due to potential low retention rate of Floy tags. During the sampling, one of the floy tagging guns broke and did not allow for a number of fish to be tagged prior to release. Each electrofishing site was based from the north end of the reservoir in both clockwise and counter clockwise directions, covering the entire shoreline of the reservoir, at an effort of 900 seconds per site. All sampling methods were conducted based on the Arizona Game and Fish standardized sampling protocol (AGFD 2004).

Analysis

Percent composition of fish was calculated for each gear type and combined for all gear types by species. Percent composition of a particular species was calculated as:

$$\%comp_s = (S/N) \times 100$$

where S is number of individuals of a given species and N is the total number of individuals of all species.

Electrofishing catch rate or catch per unit effort (CPUE) was calculated. CPUE is defined for this study as catch rates of fish per hour. One electrofishing effort was defined as a 900 second time period and mean CPUE in each area was calculated as catch per 900 seconds, times 4:

$$CPUE = \left(\frac{1}{n} \times \sum_{i=1}^{n} \left(\frac{C_i}{T_i} \right) \right) X4,$$

where C_i = catch in the ith electrofishing site, T_i = number of 900 second increments sampled in the ith transect, and n = number of transects or sites at each area.

Standard deviations (St Dev) and standard errors (SE) were calculated if over 30 fish were collected per sampling.

$$St.Dev = \frac{\sum_{i=1}^{N} (xi - x)2}{N-1} \quad \text{and} \quad SE = \frac{StDev}{\sqrt{N}}$$

where xi = the number of fish caught per site and x = the mean number of fish sampled. Length frequencies were examined for each species by collating every fish into 10 mm size classes. A minimum of 30 fish per species was determined to be suitable to accurately determine length frequencies for the species.

Results

April 12-13, 2011 Sampling

A total of 34 electrofishing sites, comprised of 30,477 shock seconds, were surveyed on April 12 and 13, 2011, covering the entire shoreline of the lake during the day. Nine species of fish were collected (Figure 1). They were common carp, goldfish, red shiner, largemouth bass, smallmouth bass, bluegill, green sunfish, channel catfish, and yellow bullhead.

A total of 159 fish were collected, with the vast majority of them being largemouth bass (45%), common carp (33%), and bluegill (13%). The other species combined to make up the remaining 9% of fish collected (Table 1). No fish collected were previously tagged or clipped. Multiple size

classes of common carp, largemouth bass were evident when the length frequencies were examined (Figures 2 and 3). The majority of the largemouth bass were between 130-189 mm, with the remaining larger fish evenly distributed within the larger ranges. The majority of the common carp were between 350-599 mm, with the larger and smaller fish evenly distributed above and below.

The total electrofishing CPUE was 19.25 fish per hour. Largemouth bass CPUE was determined to be 8.98 and common carp CPUE 6.14 (Table 1).

A total of 134 fish were tagged using either a Floy tag, anal fin clip, dorsal fin clip, or a combination of those tagging techniques. No tagged fish were recaptured during this survey.

September 13, 2011 Sampling

A total of three sampling sites, comprised of 1790 shock seconds, were surveyed on September 13, 2011 on Horseshoe Reservoir. This was the lowest known water level sampled at Horseshoe Reservoir by Arizona Game and Fish Department in recent years and only a small section was wetted enough to be able to be surveyed. Unlike previous minimum pool sampling no actual pool holding enough water was available for sampling as only a riverine portion was deep enough to sample. Only four species were detected during the sampling event. Those were goldfish, common carp, channel catfish, and largemouth bass.

A total of 82 fish were collected and Floy tagged. Common carp made up a total of 79% of the catch followed by channel catfish (11%) and Goldfish (8.5%), Table 2.

The total electrofishing CPUE was 164.9 fish per hour. Common carp CPUE was the highest at 130.7 (Table 2).

No tagged fish were recaptured during this survey.

River Sampling

Methods

Study Sites

In addition to the lake sampling, the Verde River was sampled both upstream and downstream of Horseshoe Reservoir in 2011. The upstream potion sampled ranged from Sheeps Bridge to Islet flat (Figure 6) and the downstream river portion ranged from below Horseshoe dam to an unnamed pull out point at river mile (Figure 7).

Fish Sampling

On September 13-14, 2011, we conducted two electrofishing surveys, one upstream and one downstream of Horseshoe Reservoir. The objective of these surveys was to estimate species composition and age-class structure of fishes in these sections of the Verde River and looking for tagged fish coming out of the reservoir due to the operation of the lake. This hypothesis that fish move out of the reservoir due to the operation of the lake as is stated in the BO of the HCP (USFWS, 2008).

The same electrofishing canoes were used for this survey as the reservoir surveys. All captured fish were identified to species, measured (mm), weighed (g), and inspected for any indication of being tagged. Electrofishing sites were started every 500 meters to comprise the entire stretch of the reach. All sampling methods were conducted based on the Arizona Game and Fish standardized sampling protocol (AGFD 2004).

Analysis

Percent composition, CPUE, Standard deviations and standard errors were all calculated the same as stated above in the reservoir sampling.

Results

Verde River Upstream of Horseshoe Reservoir

A total of eight electrofishing sites were sampled, however due to a canoe turning over in the river only 5 data sheets were salvaged and therefore our results only include those five sites. Those five sites resulted in 2299 shock seconds.

We collected a total of 165 fish in those five sites for a CPUE of 258.5 fish per hour. Eight species were collected including goldfish, common carp, red shiner, channel catfish, bluegill, smallmouth bass, largemouth bass, and flathead catfish. Over 67% of the catch was dominated by common carp resulting in a CPUE of 173.9 carp per hour (Table 3).

No tagged fish were captured in any of the sites sampled including the lost data sites.

Verde River Downstream of Horseshoe Reservoir

A total of five electrofishing sites were sampled in this section of the river. Those five sites resulted in 3602 shock seconds.

We collected 110 fish during this sampling effort for a CPUE of 109.9 fish per hour. Nine species were detected including, goldfish, common carp, threadfin shad, mosquitofish, channel catfish, green sunfish, bluegill, smallmouth bass, and flathead catfish. Flathead catfish and

common carp made up 67.3% of the total catch, 37.3% and 30% respectively. Flathead catfish CPUE resulted in 41 fish per hour and common carp CPUE resulted in 33 fish per hour (Table 4).

No tagged fish were captured in any of the sites sampled in this reach of the river.

Conclusions and Recommendations

During our lake sampling in April, largemouth bass made up a substantial portion of the catch. It had been 17 years since largemouth bass has been over 40% of the catch (Table 5). The increase in the bass catch is most likely due to the timely spring precipitation in 2009 and 2010 where the reservoir was unable to drain until post bass spawning allowing for a successful reproduction (Figures 8). In addition, largemouth bass were apparently beginning to recruit from the 2010 spawn through spring 2011 (Figure 8). However, interesting enough, only four bass were collected in September 2011, while the reservoir was at minimum pool. Further, only a small number of bass (3) were collected upstream and none downstream of the reservoir, lending the question, "where did all of the bass go?"

Comparing results to 2005, 2006, and 2009 common carp and goldfish were a significant portion of the catch during those years (Table 5, Figure 7). Further comparisons of these years show goldfish in the reservoir have dramatically declined. We did collect a few goldfish upstream and downstream of the reservoir. However, none of those goldfish collected were previously tagged from the reservoir. We also observe a lack of reproduction from the goldfish in the past two years, whereas common carp seem to be reproducing and recruiting (Figures 9 and 10).

These drastic fluctuations in species trends are most likely correlated with the continued fluctuation in the reservoir annually (Figures 7 and 12). This is only a general observation though, as standardization of sampling must be incorporated into future plans in order to confidently explain the changes in fish populations as a result of the reservoir fluctuation. We suggest future surveys only be conducted in the spring while the reservoir is above the boat ramp to allow nighttime boat electrofishing and gill nets to be utilized. This standardization will assist in determining fish species trends with more confidence and better data.

The riverine portions sampled should continue to be sampled as they were this year and be incorporated into an every 3 to 5 year sampling. Since this section of the river has not been sampled similarly in the past, we are unable to compare data to previous sampling efforts.

Since 2005, the Arizona Game and Department tagged 4,844 fish in Horseshoe reservoir (Table 6). As no tagged fish were caught to date, upstream, downstream, or in the reservoir, it might be hypothetical to assume the fish in the reservoir may be getting stranded as the lake drains. This was noted and discussed in 2010 when our crews observed dead fish rising as the reservoir began

filling in the fall only after a very short period of minimum pool (Figure 11 and 12). We estimated these fish to be in the hundreds.

References

AZGFD (Arizona Game and Fish Department) 2004. Standard fish sampling protocol for state of Arizona Waters. Phoenix, AZ

AZGFD (Arizona Game and Fish Department) and SRP (Salt River Project), 2009 Fish Surveys in Horseshoe Reservoir to meet Horsehoe-Barlett HCP Obligations. Collection Agreement 2009.

Jones, M.J., I.G. Stuart. 2009. Lateral movement of common carp (Cyprinus carpio L.) in a large lowland river and floodplain. Ecology of Freshwater Fish 18:72-82.

Minckley, W. L. 1973. Fishes of Arizona, Arizona Game and Fish Department, 293 p.

Paller, M. H., D. E. Fletcher, T. Jones, S., A. Dyer, J. J. Isely, J. W. Littrell. 2005.Potential of largemouth bass as vectors of 137Cs dispersal. Journal of Environmental Radioactivity 80: 27-43.

Rinne, J. N., R. M. Hughes, and B. Calamusso. (editors). 2005. Historical changes in fish assemblages of large rivers in the Americas. American Fisheries Society Symposium 45. American Fisheries Society, Bethesda, MD. 611 pp.

Robinson, A.T. 2007. Verde River and Horseshoe Reservoir Fish Surveys; Final Report to Salt River Project, Phoenix, Arizona. Arizona Game and Fish Department, Research Branch, Phoenix. 28 Pages.

Stewart, W. 2009. Horseshoe Reservoir HCP 2009 fish monitoring. Draft report to Salt River Project, Phoenix, Arizona. Arizona Game and Fish Department, Research Branch, Phoenix. 15 Pages.

Travnichek, V.H. 2004. Movement of flathead catfish in the Missouri River: examining opportunities for managing river segments for different fishery goals. Fisheries Management and Ecology 11:89-96.

"USGS Surface-Water Daily Data for the Nation." *USGS Water Data for the Nation*. Web. 25 May 2011. <http://waterdata.usgs.gov/ >.

USFWS (US Fish and Wildlife Service) 2008. Record of Decision: Horseshoe and Bartlett Reservoirs Habitat Conservation Plan Final Environmental Impact Statement, Maricopa and Yavapai Counties, Arizona.

Tables

Table 1: Catch, percent composition, CPUE, SE and numbers tagged for species caught April 12-13, 2011 in Horseshoe Reservoir

Species	Catch	% total	CPUE/hr	SE	# tagged
MISA	76	46.63	8.98	2.07	62
CYCA	52	31.90	6.14	2.06	51
ICPU	3	1.84	0.35	N/A	2
LEMA	20	12.27	2.36	N/A	8
CAAU	6	3.68	0.71	N/A	6
MIDO	1	0.61	0.12	N/A	0
LECY	2	1.23	0.24	N/A	2
AMNA	1	0.61	0.12	N/A	1
CYLU	2	1.23	0.24	N/A	2
Total	163	100	19.25	0.95	134

Table 2: Catch, percent composition, CPUE, SE and numbers tagged for species caught Sept. 13, 2011 in Horseshoe Reservoir

Species	Catch	% total	CPUE	SE	# tagged
CAAU	8	8.5	14.1	N/A	8
CYCA	65	79.3	130.7	26	65
ICPU	9	11.0	18.1	N/A	9
MISA	1	1.2	2.0	N/A	0
Total	83	100	164.9	25	82

Table 3: Catch, percent composition, CPUE, and SE for species caught Sept. 13, 2011 in Verde River upstream of Horseshoe Reservoir

Species	Catch	% total	CPUE	SE
CAAU	9	5.5	14.1	N/A
CYCA	111	67.3	173.9	27.3
CYLU	8	4.8	12.5	N/A
ICPU	5	3.0	7.8	N/A
LEMA	6	3.6	9.4	N/A
MIDO	8	4.8	12.5	N/A
MISA	3	1.8	4.7	N/A
PYOL	15	9.1	23.5	N/A
Total	165	100	258.5	38.5

Table 4: Catch, percent composition, CPUE, and SE for species caught Sept. 14, 2011 below Horseshoe Reservoir

Species	Catch	% total	CPUE	SE
CAAU	8	7.3	8.0	N/A
CYCA	33	30.0	33.0	6.9
DOPE	8	7.3	8.0	N/A
GAAF	1	0.9	1.0	N/A
ICPU	13	11.8	13.0	N/A
LECY	3	2.7	3.0	N/A
LEMA	2	1.8	2.0	N/A
MIDO	1	0.9	1.0	N/A
PYOL	41	37.3	41.0	9.8
Total	110	100	109.9	11.5

Table 5: Percent composition of fish species captured by electrofishing in Horseshoe Reservoir, 1987-2011.

Species	1987	1994	1998	1999	2005	2006	2009	2010	Spring 2011	Fall 2011	Combined 2011
Common carp	10.7	5.2	9.2	48.1	27.6	31.6	9.8	19.8	32.9	79.3	47.7
Goldfish	0.1		2.6		72.4	63.2	83.2	54.4	3.8	8.5	5.3
Red shiner		0.3		20.4		1.6	1.7	8.5	1.3		.8
Golden shiner	1.5										
Threadfin shad	1	0.5	72.6								
Channel catfish	0.1		0.5			1.0	0.1	1.6	1.9	11.0	4.9
Flathead catfish				7.4							
Largemouth bass	64.5	42.1	5.8	11.1			4.5	5.3	45.6	1.2	31.4
Smallmouth bass	1.5	15.2	0.3	5.6				7.5	0.6		.4
Black crappie	3.4	0.5	1.3								
Green sunfish			6.8	5.6			0.2	0.8	1.3		.8
Bluegill	17	36.1	0.8	1.9			0.3	1.6	12		8.1
Yellow bullhead								.2	0.6		.4
Mosquitofish						2.6	0.2				
Total fish collected	**786**	**382**	**380**	**54**	**145**	**214**	**2126**	**373**	**163**	**83**	**246**

Figures

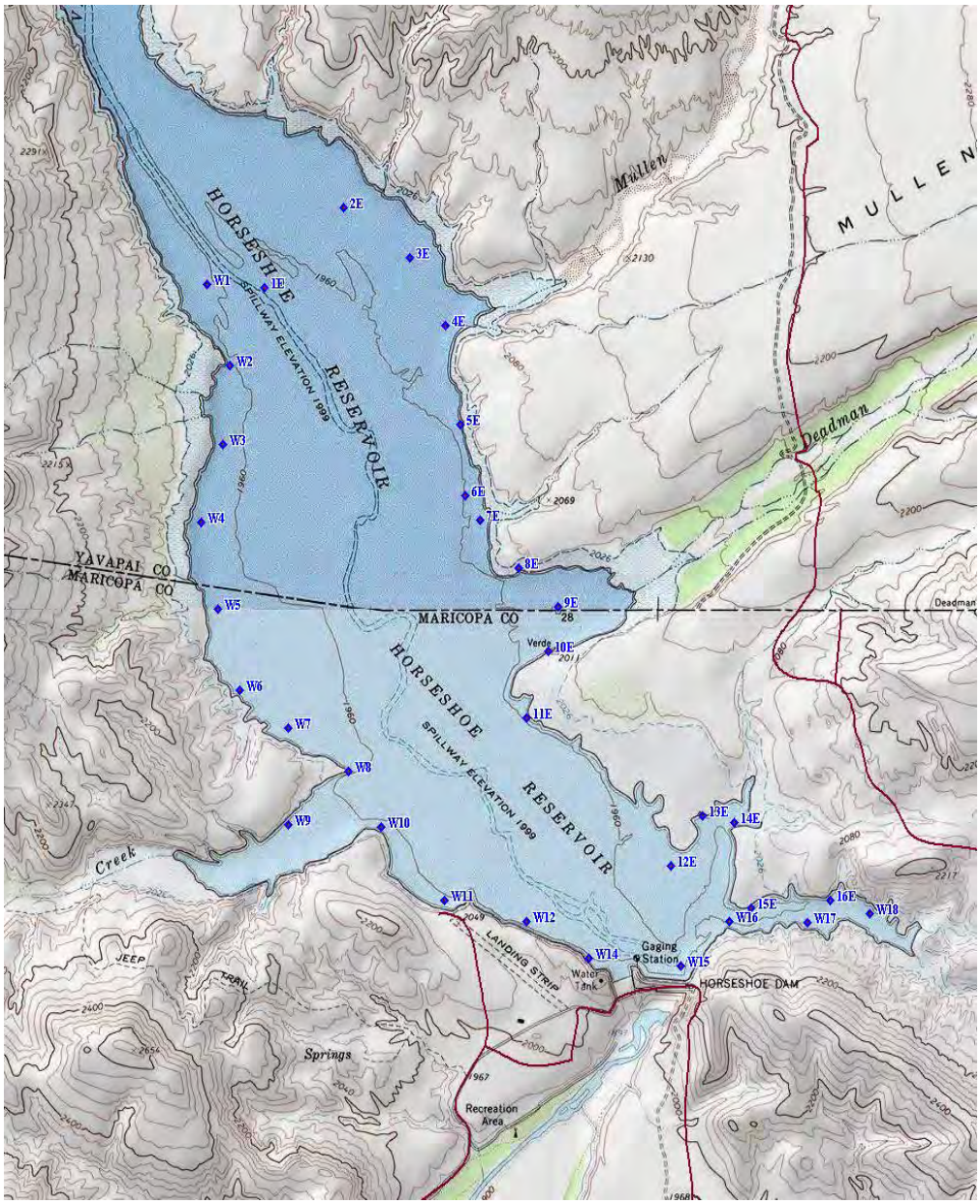


Figure 1: Survey locations in Horseshoe Reservoir April 12-13, 2011

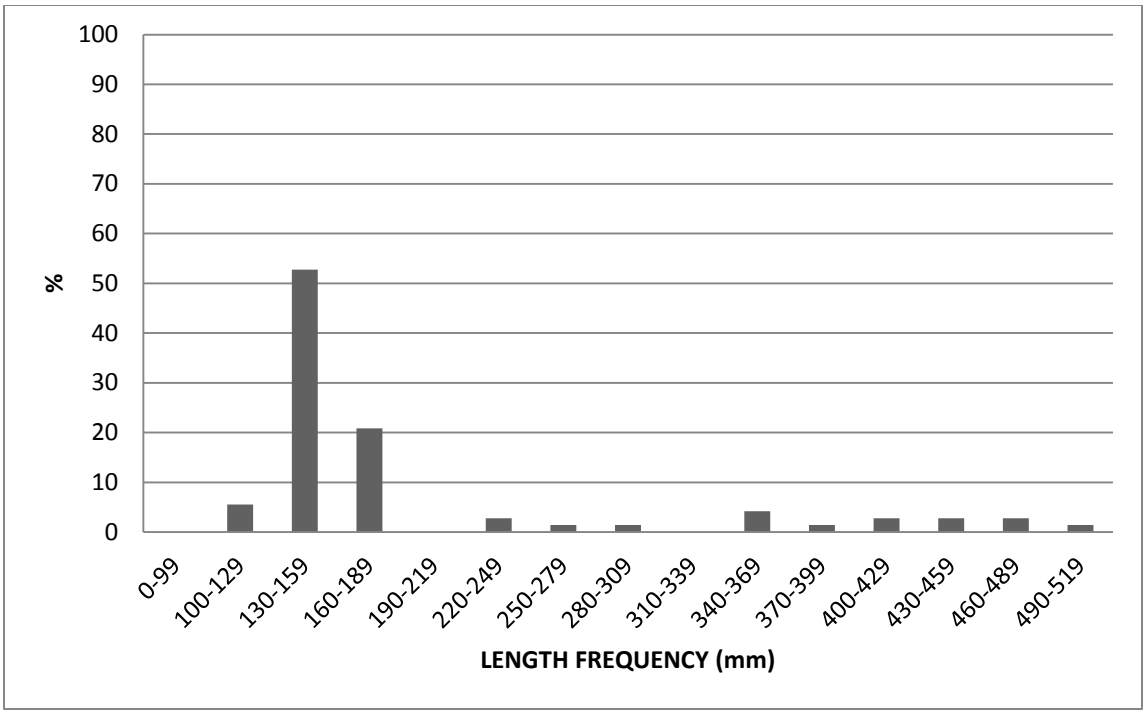


Figure 2: Length Frequency Histogram for Largemouth Bass caught on April 12-13, 2011 in Horseshoe Reservoir

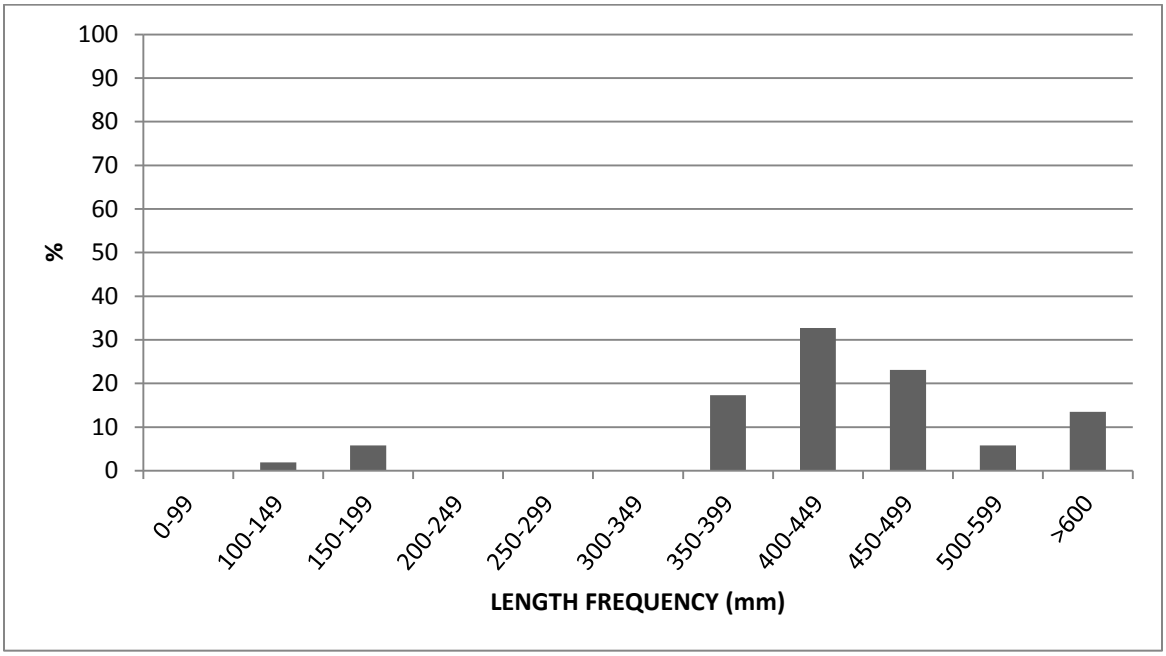


Figure 3: Length Frequency Histogram for Common Carp collected on April 12-13, 2011 in Horseshoe Reservoir

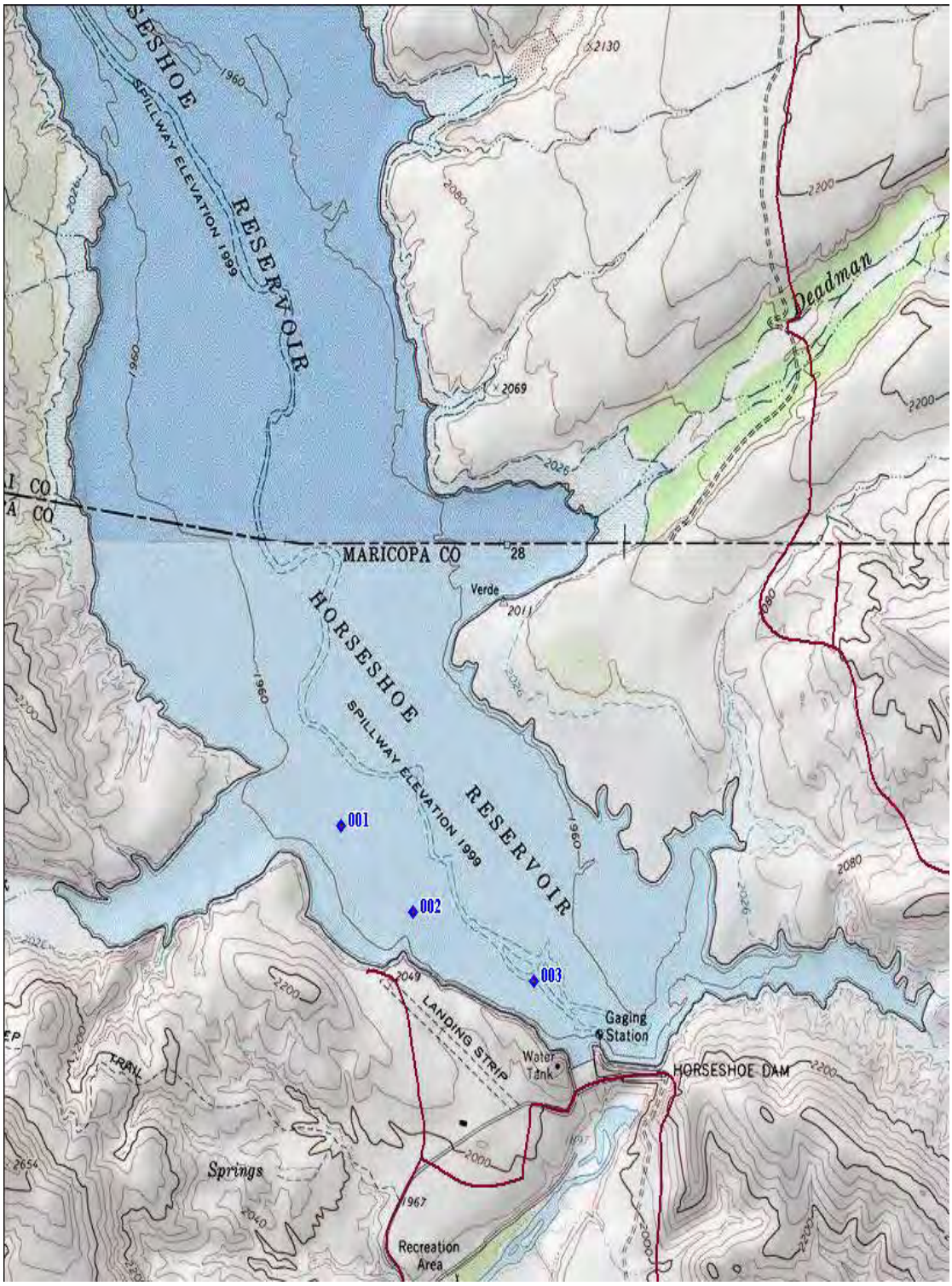


Figure 4: Survey Locations in Horseshoe Reservoir September 13, 2011

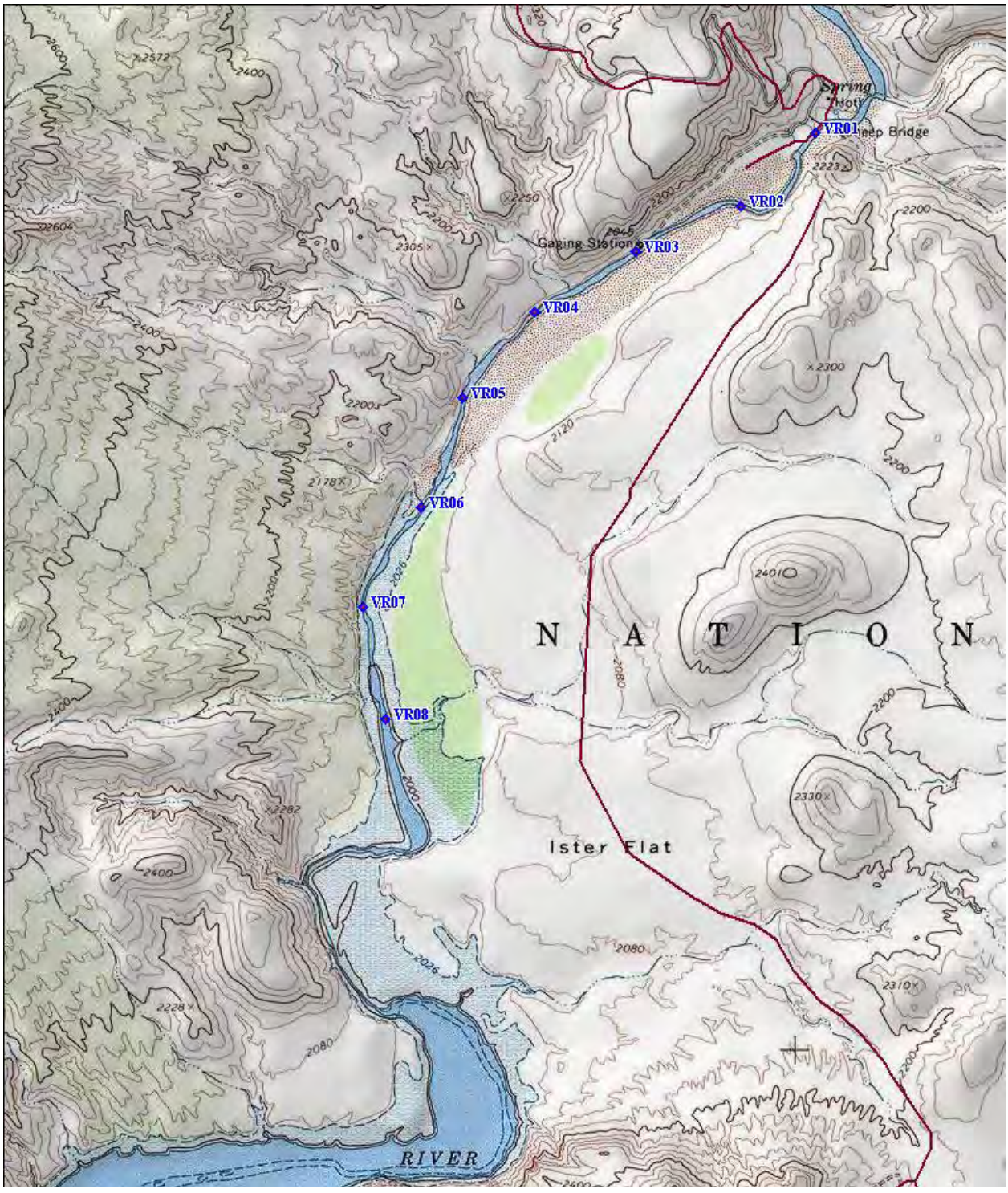


Figure 5: Survey Locations in the Verde River September 13, 2011

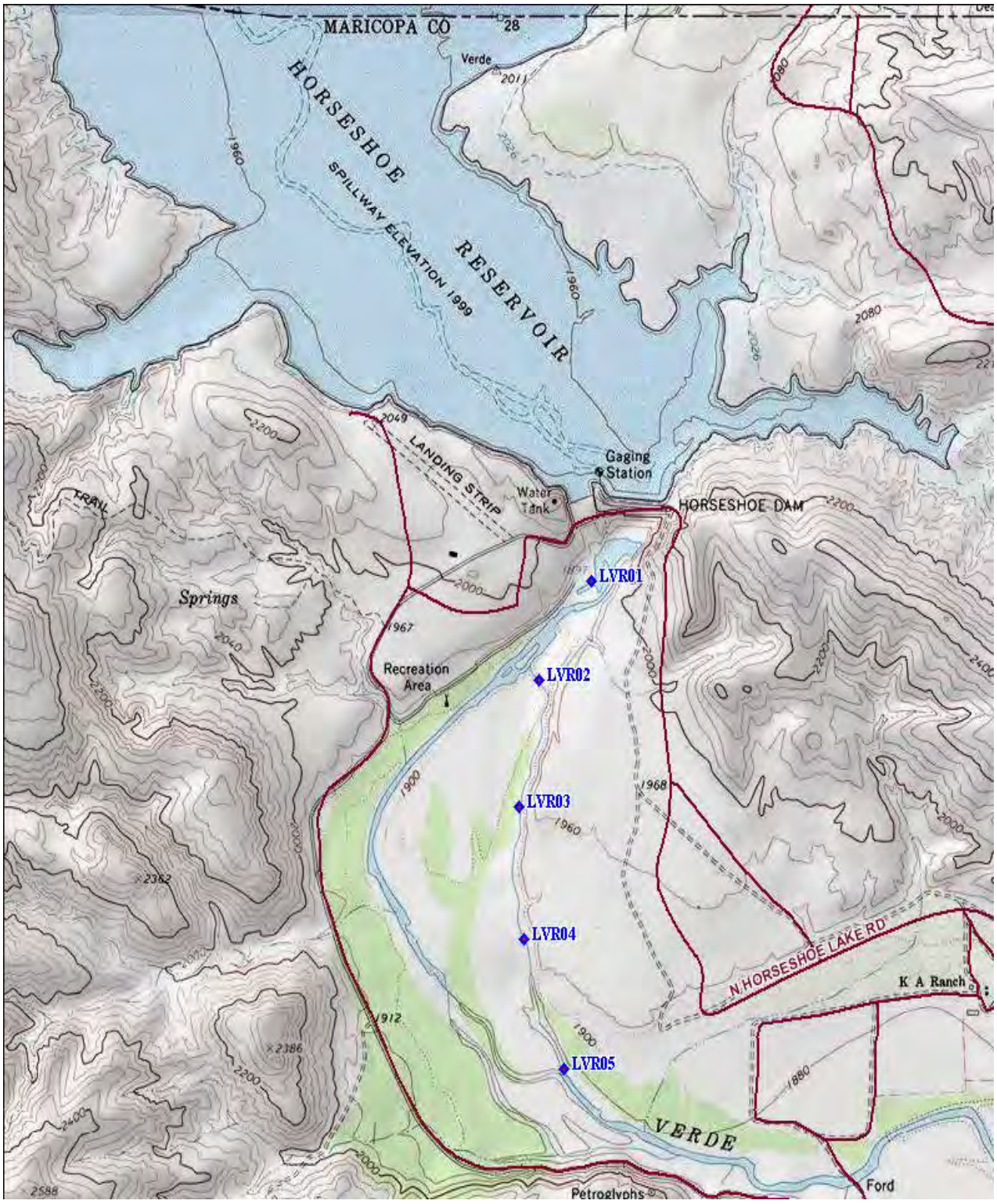


Figure 6: Survey Location in the Verde River September 14, 2011

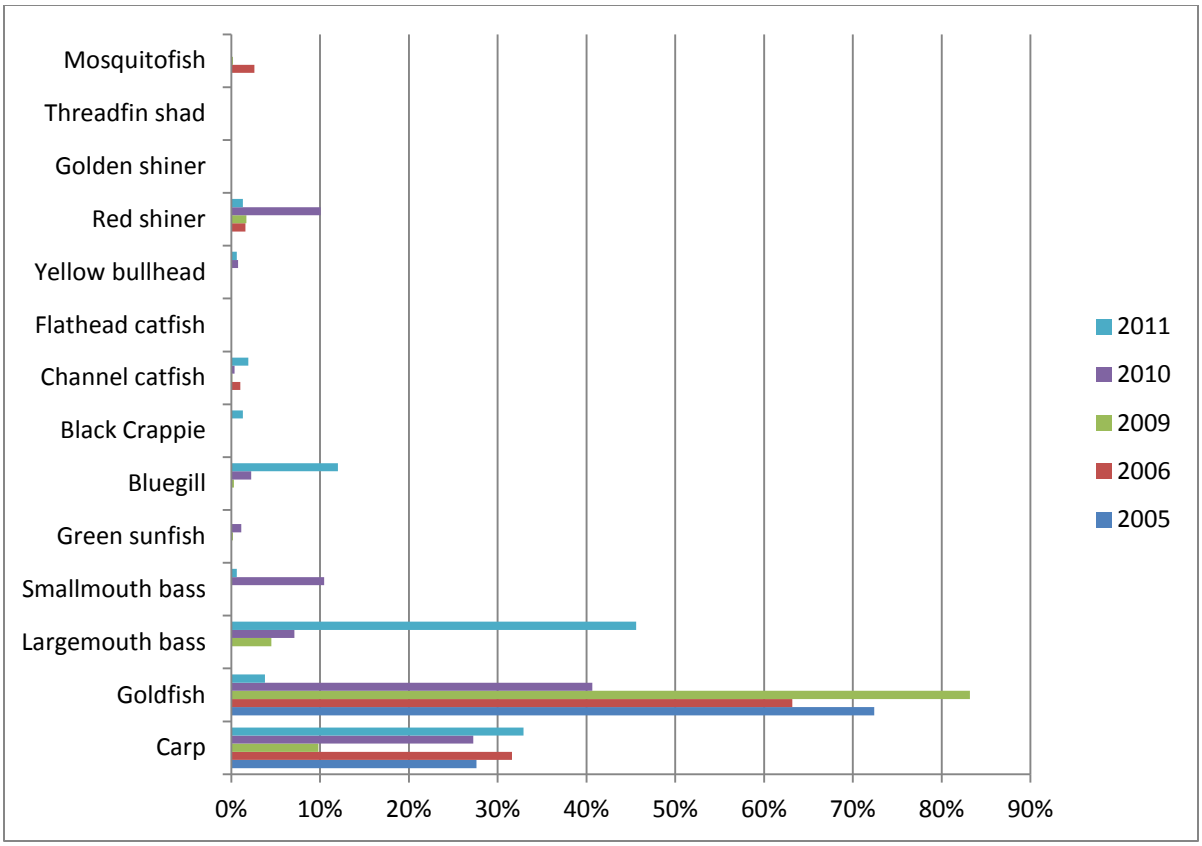


Figure 7: Percent Composition of Species Collected Since 2005

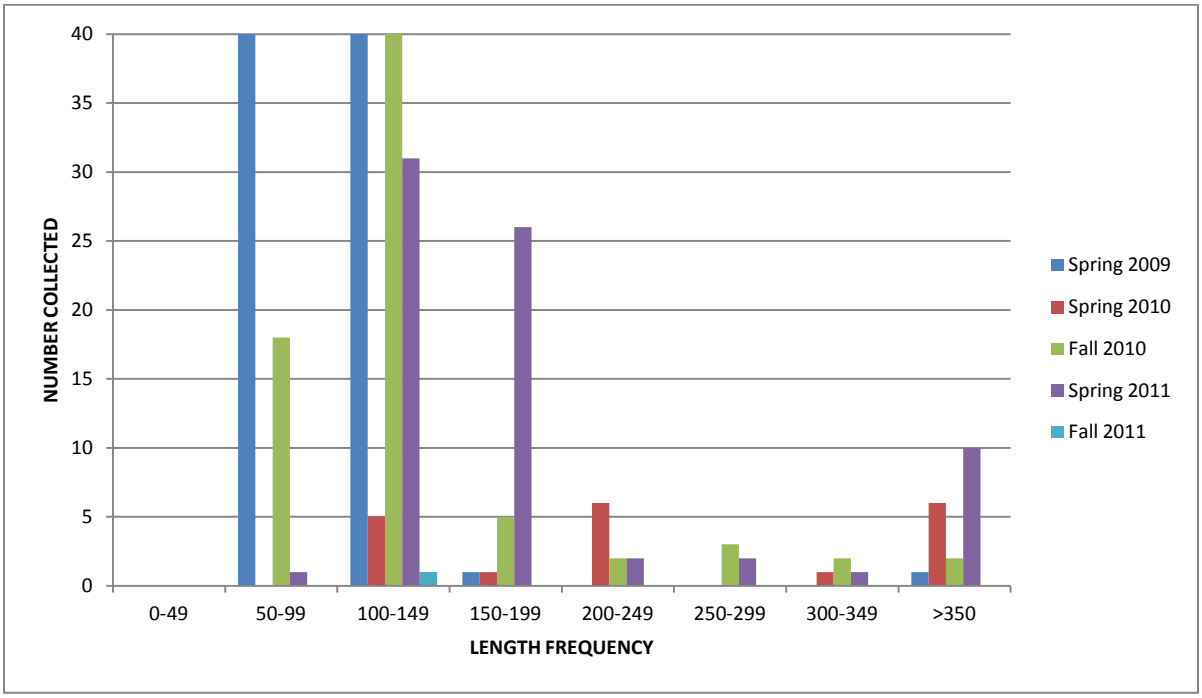


Figure 8: Length Frequency of Largemouth Bass in Horseshoe Reservoir Overtime

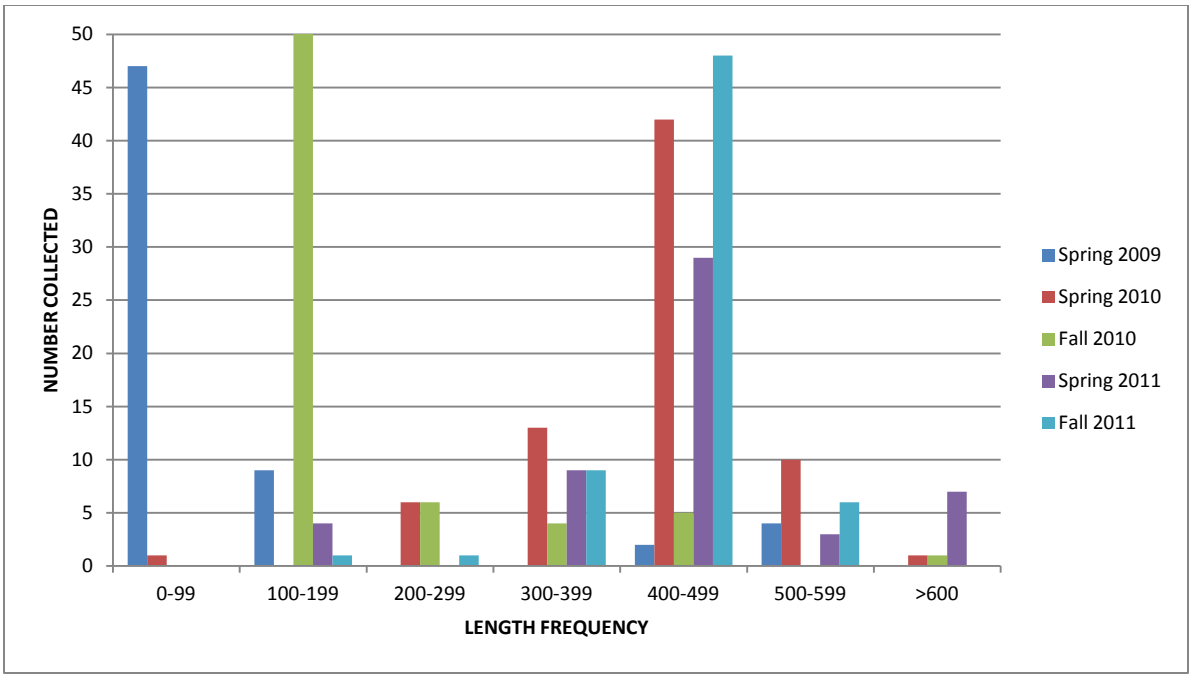


Figure 9: Length Frequency of Common Carp in Horseshoe Reservoir Overtime

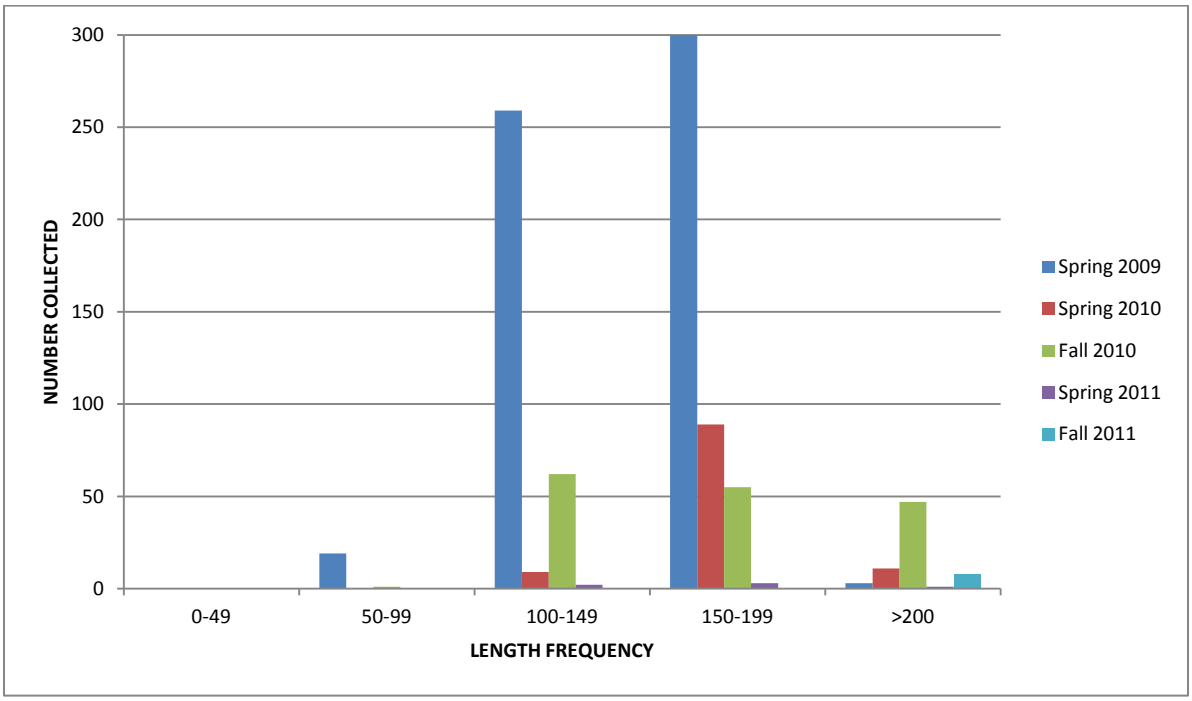


Figure 10: Length Frequency of Goldfish in Horseshoe Reservoir Overtime

Figure 11: Dead Floating Fish Observed in Horseshoe Reservoir September 2010

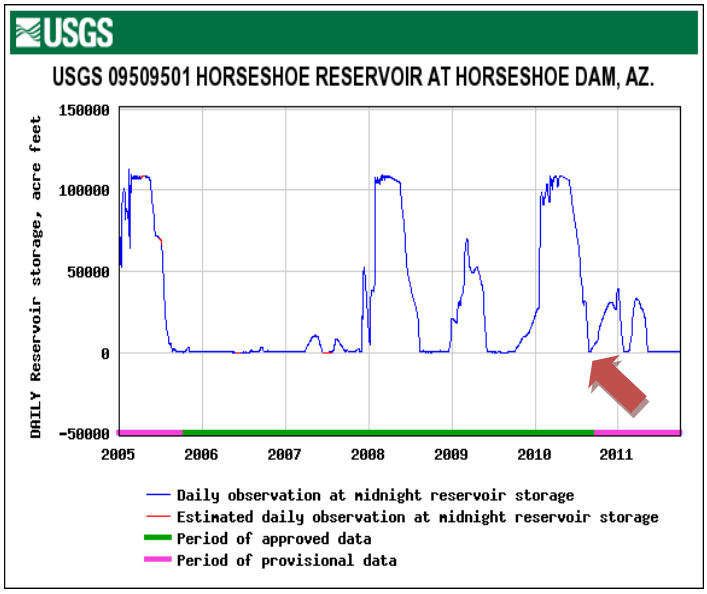


Figure 12: Horseshoe Reservoir Storage Levels Overtime. Red Arrow indicates a minimum pool level of just 2 days.

APPENDIX C

SRP LETTER TO USFWS REGARDING THE PURCHASE OF INDIAN SPRINGS RANCH

Delivering More Than Power™

SALT RIVER PROJECT
Environmental Services
Mail Station PAB352
POST OFFICE BOX 52025
PHOENIX, ARIZONA
85072-2025
(602) 236-2724

Charles E. Paradzick
Senior Ecologist

April 15, 2011

Mr. Steve Spangle
Field Supervisor
(Attn: Jeff Servoss)
Arizona Ecological Services Field Office
2321 W. Royal Palm Road, Suite 103
Phoenix, Arizona 85021

RE: Horseshoe-Bartlett Habitat Conservation Plan – Proposed Acquisition of 55 acres of Mitigation Habitat on Gila River

Dear Mr. Spangle:

To comply with the obligations of the Horseshoe-Bartlett Habitat Conservation Plan ("H-B HCP") and associated Endangered Species Act Section 10(a)(1)(b) Incidental Take Permit ("Permit") issued on May 30, 2008 by the U.S. Fish and Wildlife Service to the Salt River Project ("SRP") for the continued operation of Horseshoe and Bartlett Reservoirs, SRP must acquire and protect 200 acres of riparian lands that support southwestern willow flycatcher ("flycatcher") and yellow-billed cuckoo ("cuckoo") breeding habitat. To meet this obligation, SRP has placed 150 acres of riparian habitat near Ft. Thomas on the Gila River under a conservation easement. The property is managed by SRP to protect riparian habitat values and surveys have documented cuckoo and nesting flycatcher.

As stipulated in the H-BHCP and Permit, the remaining 50 acres of mitigation lands are to be protected[1] within 10 years of Permit issuance[2]. SRP is required to first evaluate potential lands in the Verde Valley that meet the habitat requirements[3] and cost provision[4] conditions in the HCP, and work to protect those lands if available. If lands meeting those requirements are not available, SRP, in coordination with the U.S. Fish and Wildlife Service (FWS), would locate and protect alternate riparian habitat[5].

[1] "Protected" may include purchase of fee title, acquisition of conservation easement, or protection under agreement with a third party. See H-BHCP p. 173
[2] H-BHCP p. 175.
[3] H-BHCP p. 172.
[4] H-BHCP p. 205. SRP would spend up to $11,000 per acre for mitigation lands in Verde Valley.
[5] H-BHCP p. 180.

As explained below, based on review of lands in the Verde Valley, SRP has determined that no lands meet the mitigation requirements as stipulated in the H-BHCP, and we plan to pursue land acquisition on the Gila River near SRP's existing habitat preserves. SRP will continue its watershed and instream flow protection efforts in the Verde Valley that help conserve covered aquatic species as well as the riparian habitat used by breeding flycatcher and yellow-billed cuckoo. This letter summarizes SRP's efforts to locate suitable mitigation lands in the Verde Valley, and provides for coordination with the FWS to select an alternate property, as required by the H-BHCP and Permit.

Verde Valley Land Search Findings:
As documented in SRP's 2010 H-BHCP Annual Implementation Report ("Annual Report")[6], SRP conducted an extensive review of parcels in the Verde Valley from near Clarkdale downstream to Beasley Flat. Parcel ownership, acreage of riparian habitat, habitat potential, and possible management concerns were assessed for parcels that contained floodplain. We also met with staff from The Nature Conservancy (TNC) in fall of 2009 to discuss their research and knowledge of property along the Verde River, and visited lands that could have potentially met our mitigation requirements.

As detailed in the Annual Report, we found one parcel (Spur Land and Cattle/Babbitt Property) that met the acreage requirement (50 acres). However, as noted in the Annual Report and meeting, the property is owned in trust by the Babbitt family, and TNC and SRP have made numerous unsuccessful attempts to acquire the property. The land has also a value greater than the $11,000 per acre price cap as noted in the HCP[7] (see cost analysis below). Six other parcels, which were larger than approximately 25 acres, were identified and assessed, but none contained suitable breeding habitat for flycatcher and/or would have been difficult to manage to protect and conserve habitat values, and had estimated costs greater than $11,000 per acre (see cost analysis below).

SRP's Lands Acquisition Division also conducted an inventory and cost appraisal analysis of potential floodplain lands in the Verde Valley. Their results showed that no parcels containing solely floodplain habitat were available, and that the cost per acre ranged from approximately $19,000[8] (for lands with little adjacent upland and improvements) to $33,000[9] (floodplain lands with greater amounts of uplands and improvements), which is greater than the $11,000 per acre price cap.

Based on this review of potential lands in the Verde Valley and the cost per acre analysis, SRP found that no lands meet the mitigation criteria as defined in the HCP. We then conducted a search for alternate lands on the Gila River near Ft. Thomas that would fulfill our HCP and Permit obligations[10].

[6] Draft report sent to USFWS on November 18, 2010; final report (see pages 19-26) sent on January 19, 2011.
[7] H-BHCP p. 205.
[8] approximate cost per acre of recent TNC purchase of 20 acre property "Otter Water"
[9] approximate cost per acre of TNC/State Parks purchase of 209 acre property "Rocking River Ranch"
[10] H-BHCP p. 180. "The first priority for alternate sites will be to augment mitigation lands along the Gila and San Pedro rivers where SRP is conserving habitat as part of the Roosevelt HCP."

Proposed Acquisition – Ft. Thomas "Indian Springs" Riparian Lands

Also as noted in the 2010 Annual Report and discussed at the fall implementation meeting, SRP has identified a 55 acre parcel ("Indian Springs") on the Gila River near Ft Thomas that contains suitable breeding habitat for flycatchers and cuckoos (see attachment). The property is adjacent to SRP's existing Ft. Thomas Preserve (1200 acres) managed for the Roosevelt Lake Habitat Conservation Plan ("RHCP"), and the 150-acre H-BHCP parcel is located approximately 2 miles downstream. The riparian vegetation on the parcel contains a mixture of tamarisk, willow, and cottonwood trees at densities suitable as nesting habitat for flycatcher and cuckoo. The active channel of the Gila River currently bisects the parcel, and the entire property is within the Gila River floodplain.

As described in the H-BHCP[11], the riparian habitat acquired as mitigation should include some combination of the following characteristics as provided in the Southwestern Recovery Plan:

- Floodplain and stream hydrological conditions are favorable to habitat maintenance, i.e., subject to scouring floods, sediment deposition, periodic inundation and ground water recharge, and having low stream gradient. The dynamics of the natural processes and resulting patterns of riparian vegetation on the properties support breeding habitat for both flycatcher and cuckoo. These conditions already exist on occupied and suitable habitat, which are the priority for acquisition.
    - *The parcel is located entirely in the Gila River floodplain; natural fluvial geomorphic processes support and maintain riparian habitat suitable for flycatcher and cuckoo breeding. Nesting flycatcher and cuckoo exist in close proximity up and downstream of the parcel.*

- Habitat will be located in proximity to Horseshoe within the Verde Management Unit or within the same Recovery Unit to the extent possible.
    - *Habitat is located in the Gila River Recovery Unit - the same Recovery Unit as Horseshoe Reservoir.*

- Habitat occupied by flycatchers that is currently unprotected will be the highest priority for acquisition.
    - *As recent as 2009, there was anecdotal evidence that the habitat was occupied by both flycatcher and cuckoo. The habitat is currently under private ownership and not managed for riparian protection.*

- Habitat that is suitable, but currently unoccupied in proximity to existing populations of flycatchers will be the second highest priority for acquisition.
    - *As noted above, the habitat is likely occupied or has been recently. Flycatcher nesting pairs and cuckoos were located on the RHCP Ft. Thomas Preserve directly adjacent to the Indian Spring's property boundary.*

[11] H-BHCP P. 172. Criteria is based upon the Southwestern Willow Flycatcher Recovery Plan

- Locations where relatively large blocks of riparian land and patches of potential or suitable habitat greater than 10 acres in size can be acquired and protected, or that are in proximity to other riparian land conservation efforts, in order to allow natural stream processes to function and to minimize impacts from adjacent land uses.
    - *The parcel is approximately 55 acres, of which all (or nearly all) are currently suitable as flycatcher and cuckoo nesting (dominated by tall dense tamarisk, willow, and cottonwood forest patches). The parcel is also bounded on three sides by the RHCP Ft. Thomas Preserve increasing the conservation value (size and effectiveness) of the mitigation habitat.*

- Locations where stresses to riparian habitat such as water diversions, grazing and adverse recreational uses, and stream channelization are minimized as much as possible.
    - *The parcel is well situated to be managed for long-term habitat protection. The northern, southern, and eastern boundaries are adjacent to the RHCP Ft. Thomas Preserve and would be protected from stressors (e.g., grazing, adverse recreational trespass). The western boundary is bordered by an agricultural field and can be effectively fenced to protect habitat values. Small agricultural diversions occur upstream of the property, but no large dams or diversion are present that would impede flood flows and adversely affect flycatcher and cuckoo breeding habitat quality or quantity on the property.*

- Riparian land will be acquired that has, or will have, the potential for similar or greater proportions of future flycatcher habitat found at Horseshoe, i.e., about 50 percent or more tall dense vegetation on a site-specific basis and will have moist soil or surface water during the nesting season.
    - *As noted above, the vegetation is dominated by > 50% of tall dense riparian forest suitable as nesting habitat for flycatchers and cuckoos. The parcel is in the Gila River floodplain and portions of the parcel are inundated during periodic flood events, which supports habitat persistence and moist soils during the breeding season. Additionally, the Gila River is perennial in the reach that bisects the property and would provide surface water during the nesting season.*

- Habitat acquisitions will be in a diversity of locations to minimize the risk of simultaneous catastrophic loss.
    - *The parcel is located 2 miles upstream from the other 150-acre property acquired as mitigation under the H-BHCP, and thus could be subject to simultaneous catastrophic loss (i.e., large floods or wildfire). Large flooding events could temporarily reduce habitat quantity or quality on both parcels simultaneously. However, based on tree recruitment and growth rates nesting habitat would likely be available within 3-5 years after a large scouring flood event. SRP is working closely with the local fire department, Bureau of Reclamation, Bureau of Land Management, and the Arizona State Forestry*

Division to develop a comprehensive fire plan for the entire Ft Thomas Preserve (both H-BHCP and RCHP parcels) to minimize fire impact potential. Also, considering both the RHCP and H-BHCP mitigation acquisitions, flycatcher and cuckoo breeding habitat is protected on the Verde River, San Pedro River, Salt River (Rock House), and continues to be available even at high reservoir levels at Roosevelt Lake and Horseshoe Reservoir.

Additionally, SRP remains committed to continue our aggressive protection of instream flows in the Verde River for the aquatic and riparian species covered under the H-BHCP. This flow protection program complements the work by our RHCP project manager to conserve and manage riparian habitat values both on the 125-acre Camp Verde Preserve, as well as coordinate flycatcher and cuckoo conservation actions with state and federal agencies, private landowners, and interested nongovernmental organizations in the Verde Valley and surrounding area. Together these actions will aid in the conservation and recovery of flycatcher and cuckoo, and their habitats in the Verde River watershed.

As explained above, we believe the Indian Springs property meets the mitigation obligations of the H-BHCP, and, due to its proximity to the RHCP Ft. Thomas Preserve, increases the overall effectiveness of flycatcher and cuckoo mitigation and conservation efforts in the Ft. Thomas area. We have made initial contact with the landowner of Indian Springs, and we plan to continue the process of working with them to acquire the parcel. If you have any concerns or questions regarding this potential acquisition please contact me by May 2, 2011. Otherwise, we will assume that you do not have any concerns and will continue to pursue the acquisition.

We appreciate the assistance and coordination by you and your staff as we implement the H-BHCP. Thank you.

Sincerely,

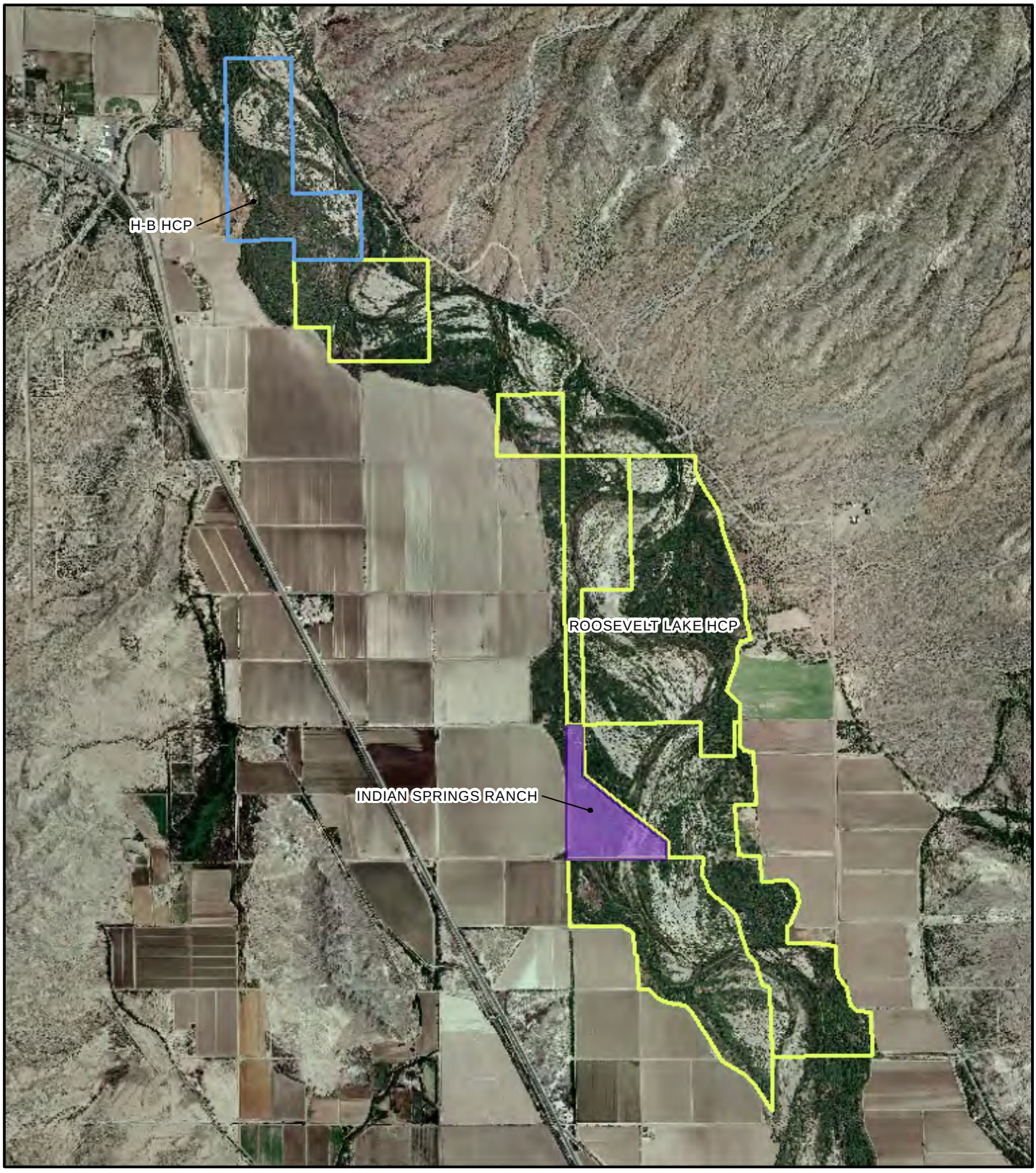
Charles E. Paradzick

Charles E. Paradzick

Attachment

cc: Tom Buschatzke, City of Phoenix, Water Resources Advisor
Bill Powell, SRP, Manager, Environmental Services and Risk Management
Kevin Wanttaja, SRP, Manager, Environmental Services
Ray Hedrick, SRP, Manager, Siting and Studies
Dave Roberts, SRP, Manager, Water Resources
Chris Banks, SRP, Sr. Land Management Agent, Lands Acquisition Department
Craig Sommers, ERO Resources

FORT THOMAS PRESERVE - INDIAN SPRINGS RANCH PARCEL
GRAHAM COUNTY, ARIZONA



0 0.25 0.5 1 MI

AERIAL PHOTOGRAPHY JUNE 2006
FTP_INDIANSPRINGS.MXD. 04/13/11

Indian Springs Ranch Parcel
H-B HCP Fort Thomas Preserve
Roosevelt Lake HCP Fort Thomas Preserve

N
S

APPENDIX D

PROGRESS UPDATE TO SALT RIVER PROJECT FOR FISCAL YEAR 2011
USGS VERDE ECOLOGICAL FLOWS STUDY

2012 WORKPLAN FOR USGS PILOT MICROHABITAT STUDIES SUPPORTING THE VERDE RIVER ECOFLOWS PROJECT WITH FUNDING FROM SRP

Progress update to Salt River Project for Fiscal Year 2011
USGS Verde Ecological Flows Study

Jim Leenhouts, USGS

The USGS has completed the first year of a two-year project investigating the connection between streamflow in the Verde River and habitat along the riparian corridor. This is the first phase of a planned two-phase project, and consists largely of obtaining biology and hydrology data from a variety of sources relevant to an evaluation and understanding of the ecological conditions in the Verde River as well as initial analyses. Additional related components are the evaluation of the Northern Arizona Groundwater Flow Model (NARGFM) as an aid in ecological studies and the estimation of monthly streamflow budgets in the Verde River and its major tributaries.

Hydrologic data for the study is available from a number of sources; streamflow gaging stations operated by Yavapai County Flood Control District (YCFCD), the Salt River Project (SRP), and the USGS provide continuous discharge records associated with sampling sites. Stage is monitored at these sites, and discharge is computed from stage with a stage-discharge rating curve. Direct discharge measurements are made regularly at gaging stations by SRP (Jennifer Hummer, SRP, verbal communication) and by the USGS. Additional discharge measurements have been made for two studies of base flow in the Verde River by the USGS, Jeanmarie Haney (TNC) at several locations including the TNC property above Campbell Ranch, by Ross and others (2010) for their hydraulic model, and at sampling sites on the TNC property above Campbell Ranch, Perkinsville, and Reitz Ranch as part of this study.

As funding for phase 1 of this project is primarily in support of compiling and analyzing existing data, SRP provided funding ($12,000) for additional fieldwork to fill in data gaps identified during our data compilation. To begin to fill in data gaps, we have identified potential sites in the upper Verde River for ongoing sampling. The sites were selected based on past sampling and available data, proximity to USGS, Yavapai County, or SRP streamflow gages, logistical considerations, access and sampling permissions, and distribution along the river. Upper Verde River sites were chosen for the initial phase of the study to provide a baseline in a relatively undisturbed reach of the river. We have conducted sampling of macroinvertebrates at six sites: on TNC property that is below Stillman Lake and above Campbell Ranch, at the USGS Verde River near Paulden gage, at Campbell Ranch, near Perkinsville, at the Verde River near Clarkdale gage, and at Reitz Ranch (between the Clarkdale gage and the city of Clarkdale). Pressure transducers with data loggers were installed to monitor stage and air and water temperature at the TNC and Reitz Ranch sites.

Compiling data from 334 macroinvertebrate samples collected by the USGS (NAWQA), AzDEQ, and the EPA (EMAP) invertebrate monitoring programs between 1992 and 2010, as well as the six additional sites, associations between macroinvertebrate community structure and hydrologic metrics derived from continuously recording stream gages will be analyzed in the second year of the project. Discharge metrics representing magnitude, frequency, timing, duration, and variation were computed for five time periods prior to sampling dates using average daily discharge. The metrics were computed for 10, 30, 90, 365, and 1095 day periods prior to the invertebrate and fish sampling dates. We will examine the link between streamflow, as represented by the metrics, and macroinvertebrate assemblages with a series of nonparametric statistical tests.

Pictures of Field Sampling

Pool survey near Paulden gage.

Channel velocity measurements near Clarkdale gage

Collecting macroinvertebrate samples

Preparing macroinvertebrate samples

2012 workplan for USGS pilot microhabitat studies supporting the Verde River Ecoflows project with funding from SRP

Background

The USGS initiated a new project in April 2010 in cooperation with the Arizona Department of Water Resources and The Nature Conservancy to study the biological and hydrological basis for ecological flows in the Verde River. Both the USGS Arizona and Utah Water Science Centers are involved in the project. The study has begun with an initial two-year phase that is primarily locating and assembling pertinent data into a data base, identifying data gaps, conducting an initial hydrologic analysis of flows in the Verde River and tributaries, and assessing the utility of the recently completed USGS Northern Arizona Regional Groundwater Model for ecoflow studies. The first phase of this study does not include field work. However, with the support of additional funding from SRP, some pilot fieldwork was completed in 2010/2011 (sampling macroinvertebrates at six sites and installing pressure transducers). One goal of the project is to analyze relations between hydrologic alteration and ecological responses in the Verde River Watershed. A first step in this process is to analyze microhabitat availability and utilization by fish and macroinvertebrates. During the summer of 2011, a graduate student at NAU conducted a fish and microhabitat study in five stream reaches. A similar effort focused on macroinvertebrates will be conducted in 2011/2012 using funding from SRP.

Field sampling

We will sample macroinvertebrates in five stream reaches of the Verde River above Horseshoe and Bartlet Dams. Three reaches will be in the main stem of the river: at the headwaters, and the Perkinsville and Paulden gauges. The remaining two reaches will be in Oak Creek and West Clear Creek. All sites have USGS streamflow gauges except the Verde River headwaters site, where SRP has a low-flow gage (at Campbell Ranch). We will be installing stage recorders that can be used to calculate higher discharges at that site. The reach length at each site will be a minimum of 200 meters and a maximum of 400 meters. The number of geomorphic channel units (GCUs; ie. riffles, runs, pools) will determine the reach length. Ideally, there will be 5-9 alternating GCUs in a reach. At each reach, macroinvertebrate invertebrate samples will be collected in discrete microhabitat types. A total of ten samples will be collected in each reach, with the distribution of samples within microhabitat types proportional to the available habitat within the reach.

Microhabitat data will be collected at each macroinvertebrate sampling site, as well as from 50 randomly selected points within the entire reach. Microhabitat data collection will include water depth and velocity measurements as well as substrate and habitat characterization. A velocity measurement will be taken using a Marsh-McBirney Flow Meter, pygmy meter, or Flow-Tracker at 6/10 depth. Depth will be measured using the wading rod of the flow meter. Reach habitat type will be classified as pool (slow-moving), run (fast-moving, deep, non-turbulent), glide (fast-moving, non-turbulent, shallow) or riffle (fast-moving, turbulent). A Wolman pebble count will be conducted along with every velocity and depth measurement by

measuring the b-axis of 15 pebbles. Riparian canopy cover percentages will be measured using a spherical densiometer. The riparian cover will be measured looking upstream, downstream, at the left and right banks and then averaged. The presence of woody debris, algae, aquatic vegetation and undercutting will be recorded.

SRP support for additional pilot work

The additional support from SRP will support field efforts, macroinvertebrate identification, data analysis, and geospatial interpretation of habitat characteristics.
SRP funding would be applied directly to this component of the Ecoflows study.

Project integration and deliverables

The pilot microhabitat study conducted with SRP support will directly integrate with the ongoing ecological flows project by bolstering the planned existing-data compilation with collection of new data. The new data collected through this workplan will be incorporated into the work of the larger project and into the final project deliverable. That deliverable is specified in contract as a USGS-Series report such as an Open File Report, a Scientific Investigations Report, or other. The final report will be available online via USGS persistent URL by the end of September 2012. Locally printed copies will be provided to SRP if requested. Data and results may also be used in scientific journal articles in addition to the formal final report. In addition to the final project report, a brief summary of the second year results will be provided by the end of this contract period (September 30, 2012).

Timeline and budget

This workplan and contract describe one year (federal FY12) of what is anticipated as a two-year effort that will parallel the timeline of the master ecological flows project. Funding provided by SRP for FY12 is $12,000, billed quarterly.

APPENDIX E

BUBBLING PONDS CONSERVATION FACILITY
MASTER PLAN

HDR

Bubbling Ponds Aquatic Species Conservation Facility

Master Plan

July 2011

HDR

TABLE OF CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

Bubbling Ponds Hatchery has been operated since 1955 by the Arizona Department of Game and Fish (AZGFD) and is currently dedicated to conservation of Arizona's native fish, as well as select amphibians, and snakes. Arizona has 20 species that have special federal status (listed as endangered or threatened) or are extinct. Moreover, Arizona ranks highest in the nation with 85.7% of native fish species that have unstable or declining trends in population. This inevitably impacts many factors that influence the ability of Arizona to improve economic growth of the State such as development, water use, maintaining outdoor recreational opportunities, mining, and Natural Resource management.

AZGFD is tasked with managing wildlife for the benefit of current and future generations. To meet objectives for protecting and restoring native aquatic species, there is a critical need to achieve this in-part through controlled propagation using fish hatcheries. At present, there is insufficient dedicated funding for native species conservation. The Bubbling Ponds Hatchery is an ideal location but has functioned well beyond its anticipated life span and is in dire need of renovation if it is to continue its legacy of producing aquatic species for Arizona and surrounding region. Salt River Project (SRP), US Fish & Wildlife Service and the Bureau of Reclamation are current partners in this endeavor to assist AZGFD in maintaining and upgrading this unique site for mitigation and conservation purposes, but if adequate funding were available, this facility has potential to become a model for conservation in the United States.

The Oak Creek watershed in which Bubbling Ponds Hatchery is located contains an environment that is rich in species diversity and extremely valued by the Audubon Society, non-profit

environmental organizations, educational institutions, adjacent municipalities, local citizens, and visitors. There are very few sites in Arizona or the western USA that have the key ingredients to achieve multi-species conservation which include ample space, adequate water supplies (and associated water rights), ability to use gravity-fed systems to minimize cost, a centralized location within the State for easy distribution, and a growing demand for a facility to serve the educational and recreational needs of a diverse and growing population.

Accordingly, this document shall serve as the Master Plan that presents a vision for creation of the **Bubbling Ponds Aquatic Species Conservation Facility**. This new conservation facility shall incorporate sustainability practices, obtain LEED certification for buildings, incorporate efficient energy alternatives, and enhance bio-security practices and research capabilities for aquatic species rearing, and incorporate enhanced educational and recreational components for a full facility renovation. The public will have improved access to specific features of the site and the new facility shall be inter-connected to AZGFD's adjacent hatchery (Page Springs Hatchery) facility and educational center via a new pedestrian bridge over Oak Creek.

The new state-of-the-art culture facilities will increase capabilities of the existing artesian water supply, while protecting against pathogens and maintaining efficient gravity flow features. Quarantine and Isolation facilities will allow for greater flexibility in species salvage or translocation efforts (due to forest fires, floods, or loss of natural habitat), as well as culturing species that are found in multiple watersheds. The research facility on site will be improved to develop and evaluate new culture and conservation techniques. Outdoor rearing ponds will be renovated to improve

overall production capabilities, improve species health, and make efficient use of water. The new facility shall incorporate space to include amphibians and freshwater mollusks, and allow for reptile conservation on-site as well.

Effluent from this facility will utilize best practices to insure that waters entering Oak Creek from the site are above minimum standards to protect this Class 3 stream. These best practices will include dedicated aquatic and riparian conservation areas to increase natural habitat for the Northern Mexican garter snake (proposed for listing), Chiricahua leopard frog, and Page springsnail.

A conceptual site plan is presented herein that portrays the vision of AZGFD's reconfiguration of the needed facilities within the existing site footprint. The planning, permitting, design and construction costs are currently estimated to be $31.5 million dollars. As the project is implemented and field investigations commence, along with permitting requirements and environmental assessments, this site has the flexibility to accommodate required adjustments and still accomplish the functions outlined in this master plan.

History and Need For Bubbling Ponds

The Bubbling Ponds Hatchery was purchased by the Arizona Game and Fish Commission in 1954. It is located about 10 miles south of Sedona on Page Springs Road (see Figure 1). In operation since 1955, a variety of fish species have been raised at the facility, including sport and native fishes. This facility is just upstream and across Oak Creek from a major trout production facility known as Page Springs Hatchery. Bubbling Ponds Hatchery has largely remained unchanged over 55 years of operation. A small hatchery building called the Bass House once provided for the incubation and early rearing of fish, but now serves primarily as a processing facility during pond harvests, and for the rearing of native amphibians. A mix of outdoor earthen and membrane-lined rearing ponds ranging from 0.5 to 1 acres in size are on site. There is an existing research facility (with a dedicated well) comprised of two metal buildings with indoor and outdoor rearing units that include of a mix of linear and circular tanks, and two small ponds. Currently there are three residences on site for staff personnel that service Bubbling Ponds and Page Springs Hatchery.

The primary water supply to Bubbling Ponds Hatchery is an open spring pond where artesian springs emanate to the surface. Water is conveyed via an open channel and intermittent pipe sections by gravity flow to distribution boxes on site. A smaller spring (Bass House Spring) feeds water to the Bass House which is used primarily for processing native fish following pond harvests and rearing native roundtail chub. These spring waters are unique to the State of Arizona based upon their temperature (68˚F), quality and volume, and are artesian in nature. Process water from the site currently discharges into Oak Creek with no primary treatment, but

it does comply with permitted water quality standards set by Arizona Department of Environmental Quality.

The need for a versatile and dedicated aquatic species conservation facility in Arizona has never been greater. This proposed facility could enable aquatic species conservation in direct support of a $1.3 billion sport fishing industry, as well as providing species mitigation options for multi-billion dollar industries related to hydropower, alternative energy development (solar), population growth & development, growing demands for water for municipal and agricultural use, public land multiple use, recreation, mining, road construction, natural disasters (forest fires), and a myriad of other potential impacts to native aquatic fauna in Arizona. Thus, estimated costs to renovate the facility would provide an enormous return on investment – only 2.4% of the annual economic impact from sport fishing alone. Dedicated funding for aquatic species conservation is also desperately needed, but initially it is envisioned that conservation shall be achieved in-part through mitigation funding from various sources, and eligible federal or state funding as available.

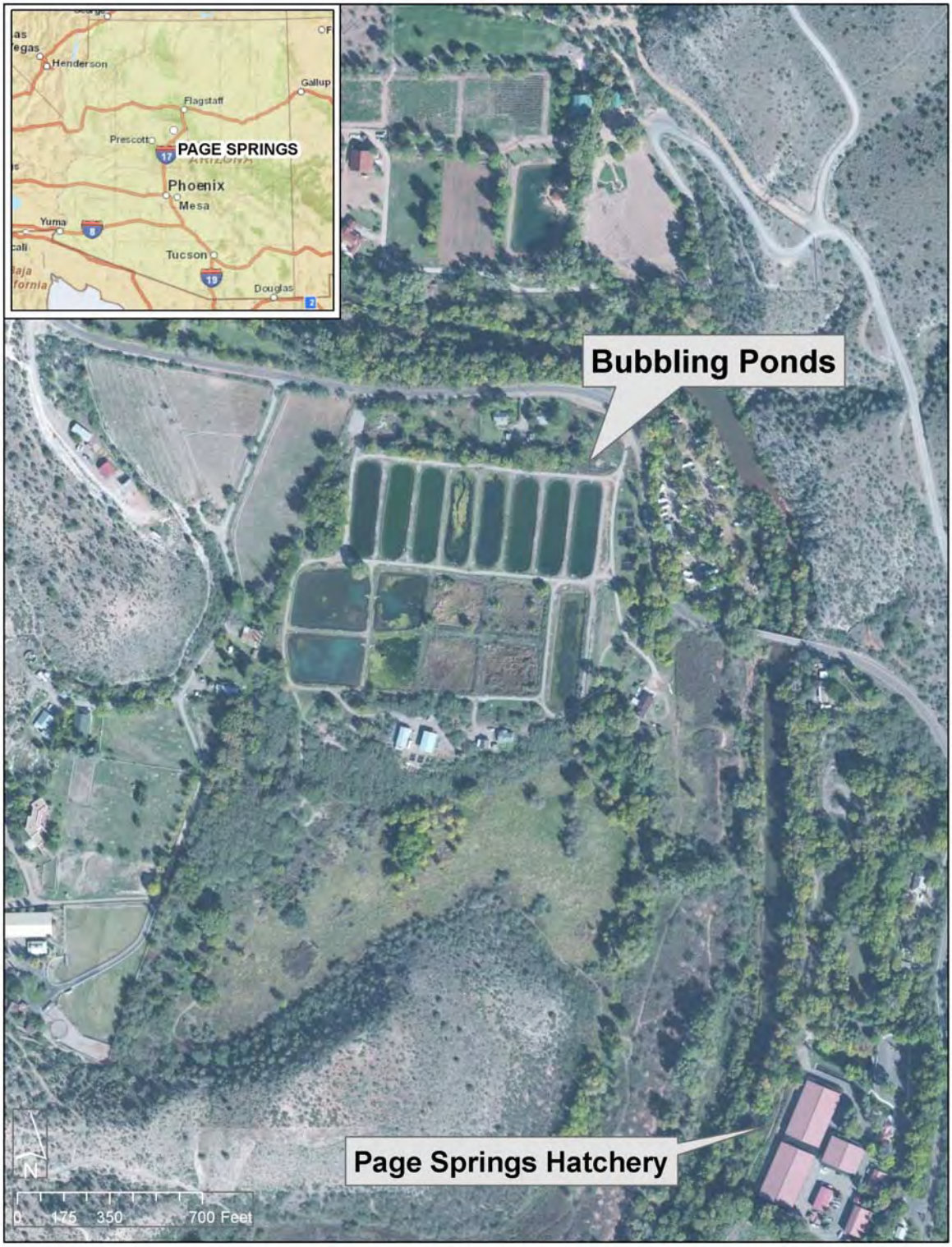


FIGURE 1. LOCATION MAP.

Currently, the Bubbling Ponds Hatchery is used for rearing three native fish species: razorback sucker, Colorado pikeminnow, and roundtail chub, along with a single pond for largemouth bass, redear sunfish, and channel catfish. Within the Research lab there is ongoing experimentation with other small-bodied native fishes including loach minnow, gila chub, spikedace, topminnow, pupfish, woundfin, humpback chub, and razorback sucker. The site, which encompasses a total of 182 contiguous acres, includes proposed conservation areas where the Northern Mexican gartersnake (a candidate species) has a population stronghold and includes preferred habitat in an around the rearing ponds. The immediate area is classified as an Important Birding Area by Audubon Society, and has abundant avian and other aquatic wildlife. The Bubbling Ponds Hatchery has significant recreational value to the public for hiking, sight-seeing, fishing, and wildlife watching.

Current fish rearing practices are using antiquated facilities that are in disrepair, and with little ability to address bio-security issues. The infrastructure is old and failing, adding to the risk of catastrophic fish loss which feeds vital conservation efforts. The facility has a need to increase its production and diversity of fish and native aquatic wildlife for augmentation of populations and mitigation, but is constrained due to facility conditions and lack of sufficient dedicated funding. Arizona Game and Fish Department (AZGFD) has developed plans for facility renovation in the past (1991) but these plans were never implemented due to lack of eligible and sufficient funding.

There are 36 fish species considered native to Arizona waters, and include 34 freshwater and two saltwater taxa. They range from inch-long topminnows to North America's largest minnow, the 6-

foot long Colorado pikeminnow. Desert pupfish, Yaqui catfish, beautiful shiner, Gila trout, and Colorado pikeminnow were once extirpated from the state, but through re-establishment efforts, these species now occur within small portions of their historical ranges in Arizona. The Monkey Springs pupfish is extinct, and the Yaqui sucker is extirpated from Arizona, but still occurs in Mexico. In fact, 20 native Arizona fish species now have special federal status or are extinct. Arizona ranks the highest of all 50 states in the percentage (85.7 percent) of native fish species with declining trends.

Arizona ranks the highest of all 50 states in the percentage (85.7 percent) of native fish species with declining trends.

Because of human-induced habitat changes, most native fish now occupy small portions of their former ranges, if they are present at all. Most species are identified as *Species of Greatest Conservation Need* (Tier 1a and 1b in Arizona's State Wildlife Action Plan) and most are listed by the USFWS as threatened or endangered under the Endangered Species Act. Several species, such as the bonytail, Colorado pikeminnow, and razorback sucker, have very small or senescent populations that must be supplemented through stocking programs to prevent them from being completely extirpated.

Arizona fish hatcheries have played a key role in recovery and conservation efforts of several native fish species including Apache trout and razorback sucker. There is an immediate need for facilities that can maintain brood stock as well as produce and propagate multiple native aquatic species for conservation efforts. Continued declines in native species will ultimately increase the potential impacts on future development as there is a common need for water and space.

It is the Department's goal to make Bubbling Ponds Hatchery a model of success by becoming the premier native aquatic species

conservation facility in the country. The Bubbling Ponds Hatchery has numerous characteristics which make it the ideal facility to expand upon recovery and conservation efforts for native fish as well as amphibians, mollusks, and reptiles while also serving to inform and educate the public about wildlife conservation. Ample water supply from natural artesian springs and adequate space, coupled with a central location within the state, make it the ideal facility for native aquatic species conservation, recovery and research. The facility is located within a world-class area for bird watching and has been identified as an Important Birding Area by Audubon Society. Thus, a conservation theme will resonate across multiple taxa as well as providing hiking trails and an improved Interpretative Center which will be utilized by federal, state, and private conservation groups for education.

The key missing part is adequate funding. Current revenue sources are either inadequate or ineligible for conservation work, and thus, dedicated appropriations will be necessary to implement this vision for Bubbling Ponds Hatchery. Partnerships will also play a key role in this effort and may include multiple federal, state, tribal, and private organizations. This Master Plan serves as the Visioning document for what is possible. Subsequent planning, design, and implementation will ultimately depend upon available resources.

FUTURE OF BUBBLING PONDS (VISION)

The importance of the Bubbling Ponds Facility has continued to grow over the years and is now critical to the mission of conservation as well as providing native aquatic species to the waters of Arizona and the Colorado River system. The Department has entered into contract agreements with the U.S. Bureau of

Reclamation and SRP to conduct mitigation effects for native fishes due to hydropower and water use development and other projects that have had negative impacts on these species. Conservation needs require that this facility be operating at a much higher capacity relative to its existing potential. This facility must address bio-security from all aspects, utilize state-of-the-art rearing facilities and techniques using modern technology to maximize potential, while maintaining flexibility, and finally it must be compliant with applicable state and federal laws.

The Bubbling Ponds Hatchery is envisioned to incorporate conservation of native fishes from multiple watersheds, amphibians, mollusks (i.e. Page springsnail) and reptiles (i.e. Northern Mexican gartersnake) with refugia and culture capabilities to mitigate and restore native populations, as well as conserve those stocks that are most critical to conservation. The Bubbling Ponds Hatchery site would include new and more efficient outdoor rearing ponds, conservation areas, and include hiking trails and interpretive/outreach tools, nature trails, two new staff residences, a modified research complex, and a new hatchery building. The boundaries of the state lands, which include both Bubbling Ponds and Page Springs Hatchery, are depicted in Figure 2. To this end, as a premier aquatic native species facility, it shall be referred to as the *Bubbling Ponds Aquatic Species Conservation Facility*.

FIGURE 2. AZ GAME & FISH COMMISSION LAND PROPERTY BOUNDARIES.

PARTNERSHIPS

AZGFD owns and operates Bubbling Ponds Hatchery and has contract agreements whereby it provides fish for the BOR Lower Colorado River Multi-Species Conservation Program, which is a 50 year conservation program. The Salt River Project (SRP) also has contract agreements for production of fish from the facility. Other agencies with potential interest in a new aquatic conservation facility are the Central Arizona Project (CAP), USFWS, Forest Service, Bureau of Land Management, and various municipalities. SRP is supportive of the capital improvements outlined in this Master Plan and will be a project sponsor for funding of this facility through available options that may include a combination of funds from U.S. Congress, state matching funds, USFWS, and nonprofit interests such as The Nature Conservancy and Audubon Society.

PROJECT GOALS

WATER

The overall intent of the Master Plan is to efficiently utilize available water that is consistent with historical use and existing water rights. The Bubbling Ponds Spring would be treated to address bio-security issues (fish and other organisms that may harbor pathogens) for native species rearing. Backup production wells are planned for augmenting the spring supply in event of jeopardy to the spring water quality, quantity and/or exposure to pathogens. Wetlands habitat would be expanded for wildlife conservation, treatment of effluent leaving the site, as well as for aesthetic and mitigation reasons. Evaporative loss from constructed wetlands would be offset in the total site water budget allocation through efficient use of water throughout the facility.

Native Species

Native fish species that have immediate conservation potential for the Bubbling Ponds Aquatic Species Conservation Facility (BPASCF) include: Colorado pikeminnow, razorback sucker, roundtail chub, headwater chub, desert sucker, Sonoran sucker, topminnow, loach minnow, longfin dace, spikedace and speckled dace. Other species may be contemplated for this facility as well. Amphibian and freshwater mollusk species of conservation interest include Page springsnail and native Chiricahua leopard frog. There is a critical need for additional research and production of threatened and endangered aquatic species in Arizona above and beyond what the existing facility can produce today. Because the species composition at any given time may change, the site would incorporate a flexible design that can accommodate a wide variety of species needs for each life stage from multiple watersheds, while minimizing the potential for escapement into the Oak Creek/Verde River watershed.

A portion of the property that encompass the hatchery site include undeveloped lands that provide habitat for the Northern Mexican gartersnake. Certain areas on the facility grounds would be dedicated towards snake conservation, and food may be provided for the neonate snakes such as rainbow trout fingerling (from Page Springs or Sterling Springs hatcheries) or other small-bodied native fishes that will be reared on site. These live fish may be placed in the wetlands complex as forage for snakes.

Based on AZGFD monitoring data from the past 4 years and radio telemetry data from the past 2 years, it has been observed that gartersnakes rely heavily on the existing fallow and unlined fish ponds throughout their active foraging season. In addition, the berms and banks of these ponds provide shelter for the snakes

throughout their active season and in some cases during hibernation (i.e., snakes spend a significant portion of the time underground in burrows within the banks and berms). The proposed hatchery renovation and improvements would alter the existing foraging areas for snakes within the Bubbling Ponds Hatchery. To mitigate for impacts to these foraging and shelter areas, it will be necessary to develop a suitable wetland complex. The objective would be to mitigate for habitat loss, improve overall habitat conditions on the hatchery grounds, and improve the long-term survivorship of snakes by relocating core activity areas away from hatchery operations. This would result in no net loss of snake habitat on the property, but also include habitat enhancements to benefit the population.

Bio-Security

Bio-security of the Bubbling Ponds site is a critical issue that will influence how the site is designed and operated. The following points are hereby highlighted in this Master Plan, but will be addressed in detail during any subsequent Design Phase:

- Prevention of fish and amphibians from unintentional access (cross-contamination) to different rearing units.
- Escapement of species non-indigenous to Oak Creek area and Verde River watershed.
- Fish, pathogen, and invasive species contamination with the incoming spring water supplies.
- For outdoor rearing facilities, predation from birds and small mammals can have major impacts to production and stress, predisposing fish to disease. Functional, yet cost effective protection for minimizing access and predation will be employed.
- Restricted access and disinfection stations for vehicles, visitor containment areas, fencing, and site

drainage will be part of the Design to address diseases or invasives entering the site.

- An isolation (quarantine) facility building is necessary to separate and potentially treat species that may be brought on site from outside the facility.
- The water supply for quarantine needs to be disease-free and of proper quality (and temperature) for rearing these animals in a controlled environment.
- The effluent from quarantine needs consideration for controlling pathogens, therapeutants and escapement of animals.
- The facility should provide adequate separation from other incoming stocks, as well as stocks currently in culture on site.
- Handling of mortalities will require a disposal plan to prevent any pathogens from reaching other portions of the site or Oak Creek.
- Prevention of Aquatic Nuisance Species (ANS) and invasives will be part of the treatment of incoming water and water leaving the site via effluent or through product delivery.

Design Considerations

AZGFD provided input through a charrette process involving 14 key staff from the agency plus additional follow up visits with water quality and permitting personnel to obtain perspectives from each area of expertise in the development of the Master Plan for the Bubbling Ponds Aquatic Species Conservation Facility. SRP personnel have also been involved as participants in the charrette process and through ongoing correspondence. As this process moves forward, AZGFD would obtain stakeholder input from multiple agencies and NGOs. This facility will be designed to a 30-year service life with the expectation that through proper maintenance, the facility would be in operation for twice as long, which is a similar life span of existing facilities.

Climate variability is a consideration of hatchery design and longevity; however even with a 1.5 to 2 degree (F) rise projected for spring water, it is not expected to have an impact on the desired rearing temperatures for the species planned for this facility.

The proposed layout as presented in this Master Plan may be revised depending upon the results of the Environmental Assessment that would be prepared as part of the preliminary engineering phase.

Efficiency of Site Design (Operational Management)

Designing the Bubbling Ponds site to meet all objectives set by AZGFD would require changes to the way the facility currently conducts its fish culture program, provides public access, and treats its hatchery effluent. The intent of the proposed layout is to create efficient use of the site while meeting bio-security objectives, and providing opportunities to the public to have a quality outdoor experience for wildlife watching.

The site layout would effectively separate production facilities from the visiting public, including vehicle parking and foot traffic. The public would have improved access to conservation areas, trails, educational information, and improved potential for viewing of wildlife. The existing Visitor Center located at Page Springs Hatchery across Oak Creek from this site would be upgraded to include more information about Bubbling Ponds Aquatic Species Conservation Facility and wildlife conservation. A hiking trail and new pedestrian bridge across Oak Creek would connect the two sites to facilitate access to conservation and wetland areas, while reducing the need for visitor parking on the Bubbling Ponds site.

An extensive floodplain analysis would be required to insure that infrastructure would not impact the floodway or be impacted adversely from flood waters. This analysis would cover Oak Creek, the hatchery property and potentially adjacent properties.

The site would be configured so that if funding occurs in phases, the site would be constructed such that priority would be given to the phase(s) and features deemed most important. Any future work would be constructed with minimal interference to

production of species currently underway. It is anticipated that two construction phases would be possible if necessary.

PHASING

It is envisioned that the Bubbling Ponds Aquatic Species Conservation Facility would be constructed as described in this Master Plan. In the event that funding is less than requested, the construction could be accomplished in two phases. The components of each phase will ultimately be determined based upon funds available. For this reason, it is not practical to determine which components would be constructed in each phase. The following description of the phased approach is only a general recommendation without benefit of actual budgetary information.

Phase One could entail improvements to the water supply system, which includes the water conveyance ditch, a new water treatment building, a bypass line, and the discharge structure to Oak Creek. The reconfiguration of all outdoor rearing ponds would be included in Phase One as well as access roads and fencing. A vehicle disinfection station and a quarantine and isolation building would be installed to address bio-security needs. The effluent treatment system would be included, consisting of a drum filter, conveyance pipes, engineered wetlands for conservation, and clarifiers that can be taken off-line if needed. Combining and relocating all discharge from the facility to one location into Oak Creek would be implemented. Improvements to visitor parking, trails, and informational kiosks would be implemented to enhance recreational, educational, and interpretive features. Investigation of surface and groundwater rights and geotechnical exploration would be initiated during Phase One as well. The logistics of phased construction would allow for continuous production of species throughout the hatchery renovation time period.

Construction of the engineered wetland complex must be implemented during the first part of Phase One to provide habitat for the Northern Mexican gartersnake prior to taking the existing fallow ponds out of commission completely.

Phase Two could incorporate fish and amphibian/mollusk propagation buildings, and improvements to the research complex. Groundwater (well) development would be initiated for production facilities and research needs. Improvements to the existing visitor center at Page Springs Hatchery and the new pedestrian bridge over Oak Creek would be completed.

Site Elements and Configuration

Water Supply

Bubbling Ponds

The main water supply for Bubbling Ponds is a spring (Bubbling Ponds Spring) located about one mile from the hatchery. The spring is home to the endangered Page springsnail and also has non-native species of fish (mosquito fish which are carriers of *Ichthyophihirius multifilis* (Ich, a ciliated protozoan parasite) present in the spring source. AZGFD has water rights to the spring water, as do other downstream users. This spring water is conveyed via an open ditch with intermittent sections of underground pipe on a gravity basis. Water flows to a head-box on the hatchery site where it is redistributed by underground pipe to all outdoor ponds. The spring flows delivered to the site are approximately 3,000 gpm (6.7 cfs) at a temperature of about 68 F (20 C), and is good quality for fish rearing activities.

While it is desirable to enclose and protect the spring from a bio-security standpoint, it is not feasible because the spring habitat is

considered vital for the snail and is essentially protected through a Candidate Conservation Agreement with USFWS. It is important that the conveyance ditch and associated portions of deteriorated pipe (30" CMP) be replaced with new pipe to the extent allowed based on private property interests and other associated considerations. This piping would provide a more reliable and sustainable conduit for the spring water to reach the hatchery site.

The spring water would gravity flow into a treatment building where it would receive mechanical filtration (drum filter) and ultraviolet light exposure for disinfection prior to use. The water would then be directed into a gas stabilization system prior to discharge into a headtank for distribution throughout the site (see Figure 3). Water would gravity-flow from the headtank to all indoor and outdoor facilities using this treated spring water. A bypass line capable of taking all spring flow around the site to the Oak Creek discharge location would be provided should there be interruptions in the flow demand from the treatment building or a need to de-fish and disinfect the site, or conduct major maintenance or repairs.

It is recommended that a groundwater well or series of wells be drilled as a backup water source (2,500 gpm) to protect the facility should contamination of the open spring render it unable to use. The well(s) would insure that the facility can continue to operate without interruption should contamination, flow impairment, water quality issues, or other interferences occur with the current spring source.

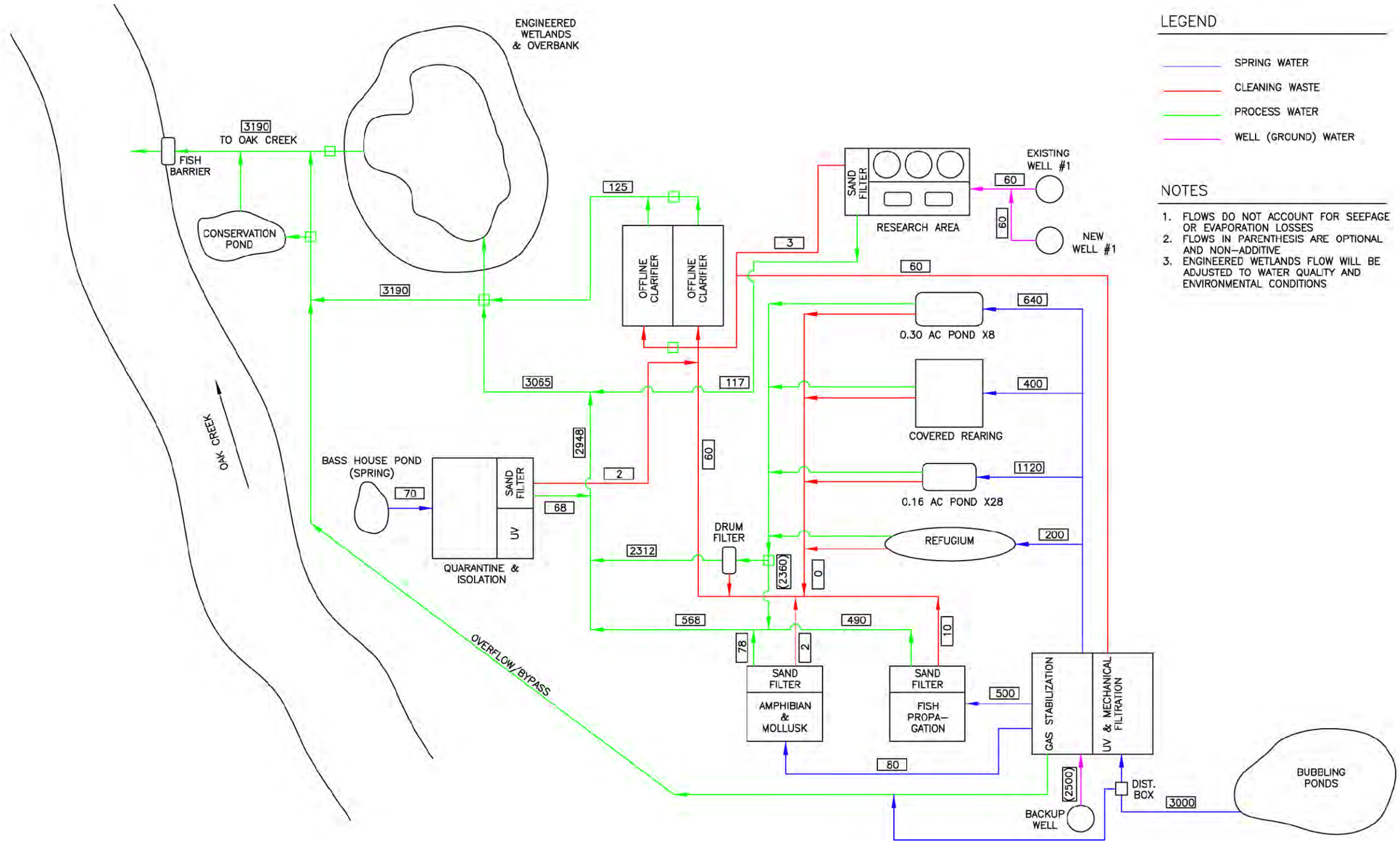


FIGURE 3. FLOW DIAGRAM.

Bass House Spring

A small artesian spring emanates on the grounds of the hatchery, referred to as Bass House Spring, and has a sustained flow of approximately 70 gpm. This spring supplies water to a small hatchery building and is used primarily for processing of harvested fish and rearing a small amount of native fish and amphibians. The spring also serves as home to the Page springsnail. The spring is semi-enclosed by fenced walls and roof, and there are no fish in the bass house spring pond. Minor improvements to the enclosure and water conveyance pipes may be necessary; however no other improvements are anticipated. This spring would be dedicated for use by the Quarantine and Isolation Facilities.

Research Wells

The Research program at Bubbling Ponds currently has one groundwater well in operation, which delivers approximately 60 gpm via artesian supply, and is located immediately adjacent to the research buildings. The Research program has essentially maximized production and rearing with available water, and will require a second well of similar capacity (60 gpm) to increase production and rearing potential for aquatic species.

Water Discharge

Arizona Department of Environmental Quality (ADEQ) classifies Oak Creek as a Tier 3 category waterway, which is considered a high quality water with exceptional recreational or ecological significance. These waters are referred to as Outstanding National Resource Waters (ONRWs). ADEQ follows EPA regulations regarding water quality standards. AZGFD, as part of its commitment to protect these waters, would incorporate ADEQ standards for water quality discharge by utilizing best practices for feeding, cleaning, and effluent treatment.

Process water leaving all indoor facilities would pass through mechanical (sand) filtration to remove solids generated from the fish culture process as well as macro-organisms, and thus prevent unintentional discharge or escapement into Oak Creek (see Figure 4). The treated process water would supply the engineered wetlands for conservation and/or flow directly into Oak Creek. The engineered wetlands would also serve as water treatment through absorption of dissolved Phosphorus and/or Nitrogen compounds. It is anticipated that effluent filtration would provide adequate treatment for discharge levels of these compounds, and that the wetlands process would be considered a polishing event (microbial breakdown and plant uptake of nutrients) for improving water quality beyond the standards as set by ADEQ and EPA. The wetlands complex will be designed to provide maximum benefit to Northern Mexican garter snake.

New outdoor rearing ponds and a covered rearing facility would have the flexibility to discharge either directly to the engineered wetlands or be filtered with mechanical filtration devices (reduction to 60-40 microns) to remove solids prior to discharge to the engineered wetlands or directly to Oak Creek.

Filtrate material from all mechanical filtration systems would be sent to a two cell offline clarifier. The clarifier would accumulate solids with no continuous discharge of water. One cell can be isolated to dry out for cleaning and removal of solids while the other cell is in operation. Solids can be disposed of on site in a conservation area for agronomic use or taken off site and disposed.

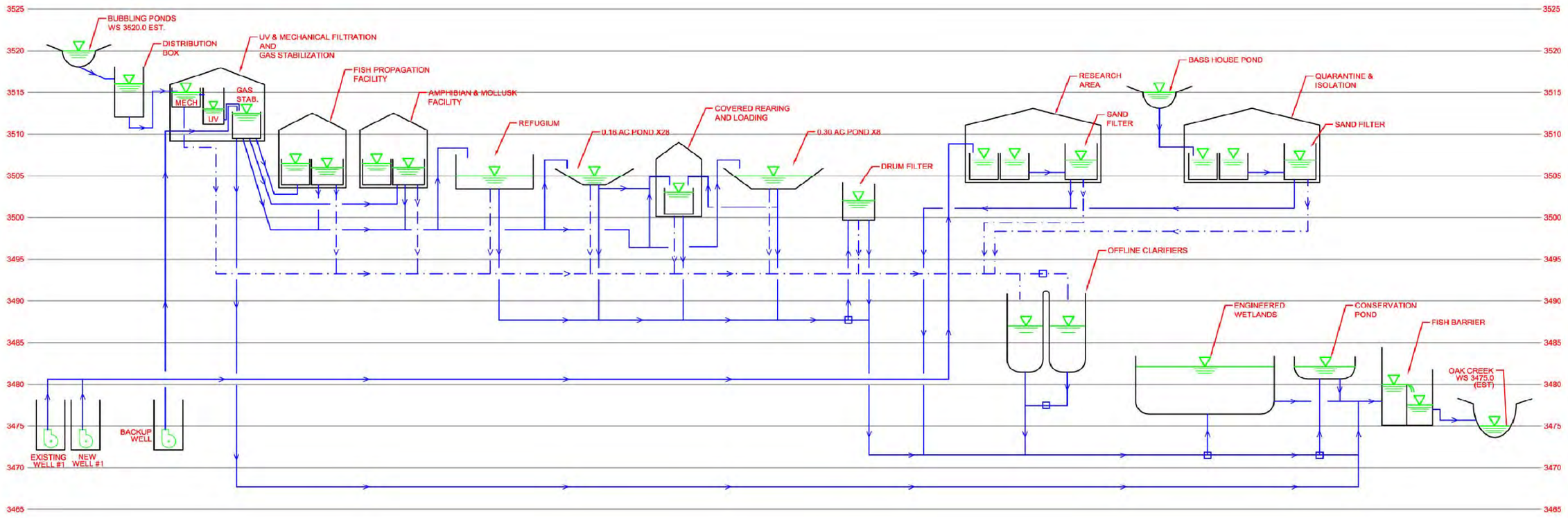


FIGURE 4. HYDRAULIC PROFILE.

All flows from the Bubbling Ponds site would be directed to Oak Creek at one discharge point. At the point of discharge a fish barrier would be installed to prevent fish residing in Oak Creek from entering the discharge pipe. During preliminary design, an evaluation will be conducted to determine if there is sufficient hydraulic head to warrant the installation of a micro-turbine for hydro-electric power generation. This evaluation would include a cost benefit analysis to determine if the power generated will offset the installation of such a unit.

Currently, a majority of process water leaving Bubbling Ponds discharges through a residential mobile home complex located between the hatchery and Oak Creek. To meet ADEQ discharge regulations, this discharge would be diverted to one discharge point located downstream of the mobile home complex.

Native Species Rearing Facilities

Fish – Indoor Facilities

The existing hatchery does not currently have adequate indoor facilities for the anticipated incubation and/or early rearing of the various threatened and endangered fish species. An indoor propagation facility is planned for the site as part of the renovation, and could be located near the entrance adjacent to the water treatment building, or it could be constructed in the area identified as the quarantine and isolation building (see Figure 5), based upon adequate elevation change between Bubbling Ponds water surface and the water surface within the hatchery facility. During preliminary design, topographic surveys will dictate the best location. This facility would serve to support administrative functions as well as provide space for production and associated support services such as food preparation and fish health diagnostics, etc. (see Figure 6). While this facility is not intended to

be open to the public, it would have a reception area to inform the public on what portions of the site are accessible and how visitors may obtain information on the functions of the Bubbling Ponds facility and the Page Springs Hatchery facility.

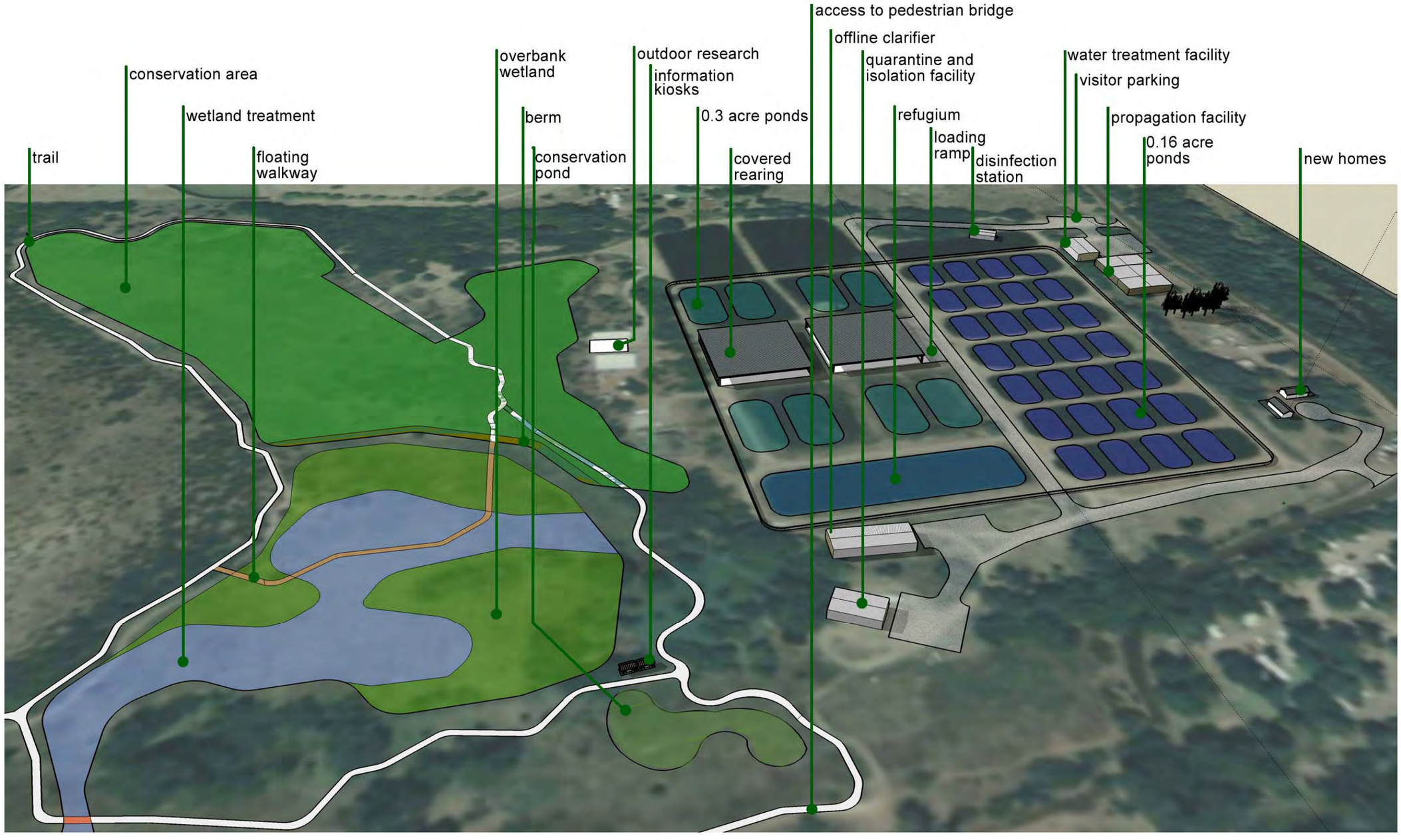


FIGURE 5. SITE PLAN.

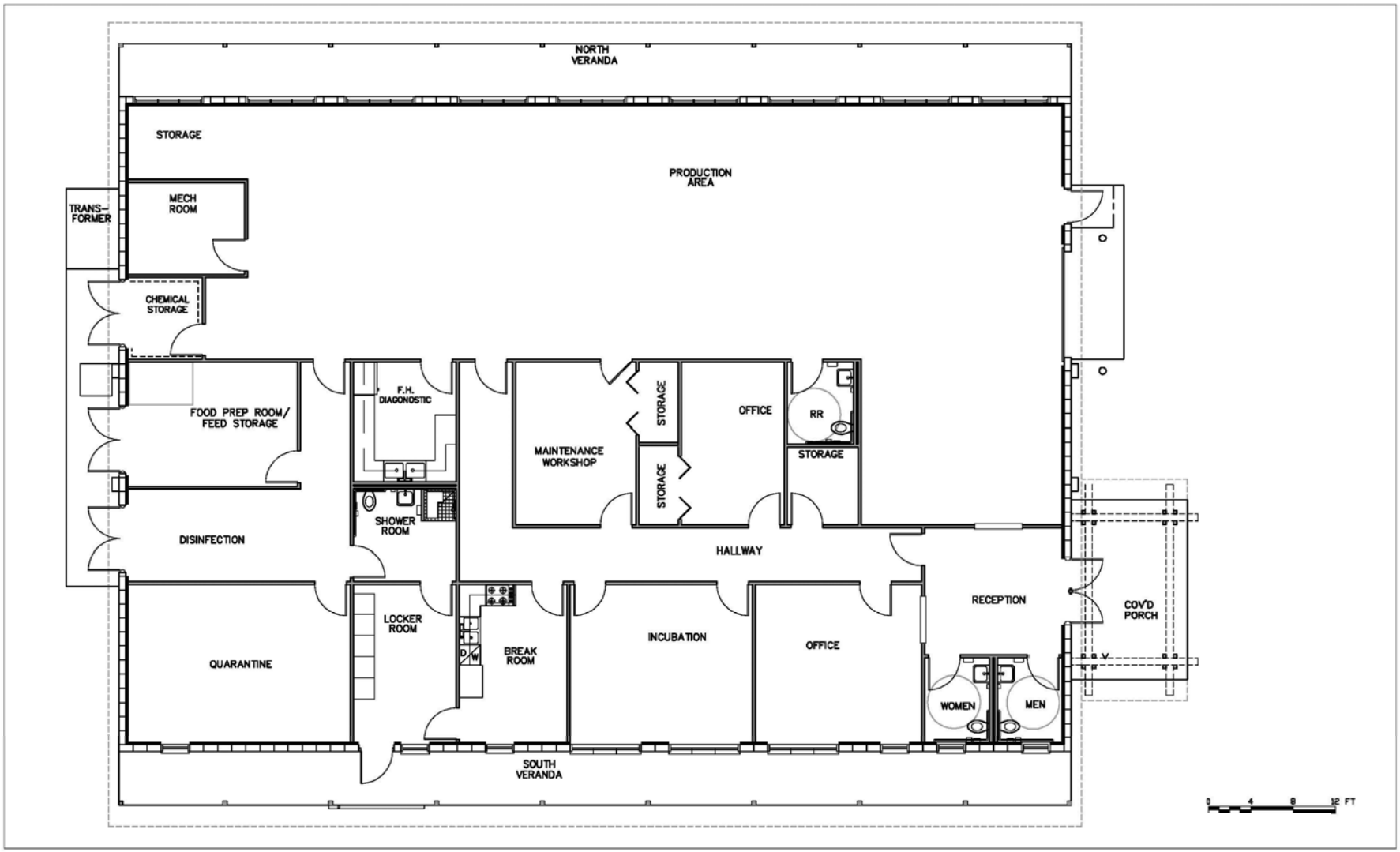


FIGURE 6. FISH PROPAGATION FACILITY.

Fish – Outdoor Facilities

The existing outdoor facilities are comprised of rearing ponds that are not functioning to their full potential. There are issues with the size and depth of the ponds, the ability to efficiently drain and harvest fish, treat fish as needed for pathogens or parasites, water quality within the ponds, discharge water quality, vegetation growth, and adequate mixing or turnover within the ponds.

A new pond system would employ the use of smaller ponds and could consist of twenty-eight 0.16-acre ponds and eight 0.3-acre ponds. The final dimension, number of ponds, and configuration may vary within the footprint as influenced by culture requirements, species, year class, research needs, site elevations, and available budget. These new and smaller ponds would be configured within the footprints of existing ponds (see Figure 5). The site plan indicates three currently used ponds along the western boundary that could be decommissioned or used for maintaining brood stock fish. All ponds would have a separate harvest drain in addition to the overflow (pass-through) drain, and would be designed to empty in two hours or less. All ponds would have a catch-kettle at the lower end to crowd and harvest fish. The pond sides would have 2:1 slopes, which minimizes predation from birds. All pond basins would incorporate a liner to minimize vegetation and water seepage. The entire pond complex would be contained within a perimeter fence to protect the facility from visitors as well as mammalian predators (otters, raccoons, etc.). In addition, the new ponds would have avian exclusion wires to prevent or discourage waterfowl from landing in the ponds.

Contained within the outdoor pond complex would be two covered rearing areas containing an assortment of intermediate sized raceways and above-ground circular tanks. These rearing units

would be used for culture of smaller groups of fish and fish processing operations. The covered rearing area would have a loading ramp that is recessed below grade to facilitate efficient transfers of fish into stocking trucks. A 500-ft long refugium would also be located within the outdoor rearing pond complex. This refugium structure would replicate natural stream conditions and be used for rearing of select species under semi-natural conditions.

Amphibians and Mollusks

An amphibian and mollusk propagation facility would be located adjacent to the fish propagation facility (see Figure 7). This facility would be used to rear amphibians and mollusks through all life phases, including maintenance of brood stock. While the water supply for this facility would be Bubbling Ponds Spring water, it is anticipated that water chemistry requirements would require additional adjustments prior to use. Hence, the production area within this facility would allow for ample space for water treatment and containment/recirculation equipment. The general public would not have access to this facility. However, the public would have an opportunity to understand the mission of this facility and view these animals at a modified educational center located at Page Springs Hatchery.

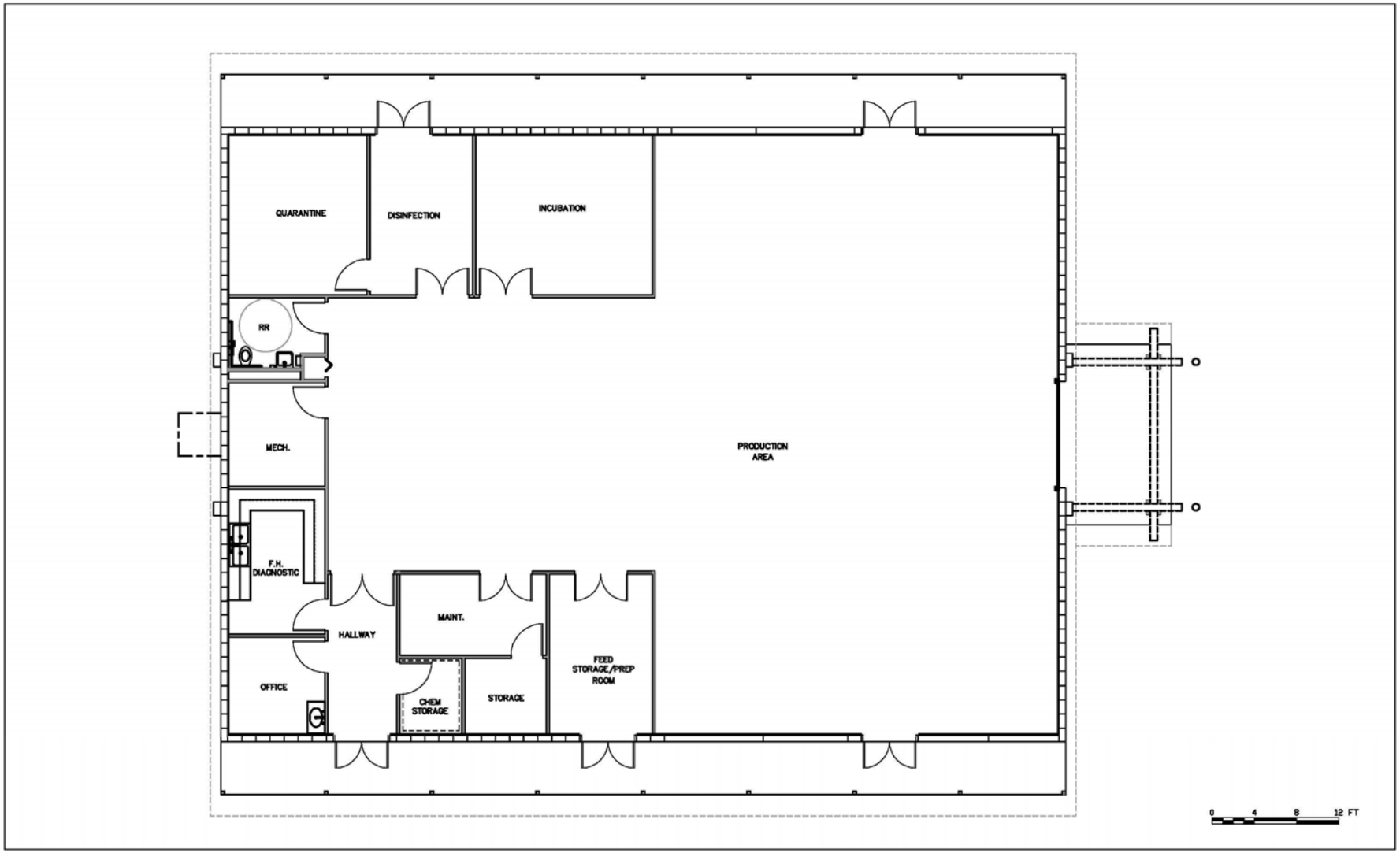


FIGURE 7. AMPHIBIANS AND MOLLUSKS PROPAGATION FACILITY.

Reptiles

The Northern Mexican garter snake is a candidate species (for listing under the Endangered Species Act), and is abundant on site due to suitable habitat in and around the existing ponds. The engineered wetlands would be designed to provide good quality habitat and open water space for this species. The wetlands shall serve as conservation areas for snakes, and the newly created habitat shall be protected and enhanced where feasible. Production of juvenile rainbow trout or other small-bodied fishes can be cultured on site for use as forage for snake neonates. If culture of additional reptiles is desired in the future, it can be accommodated within the amphibian and mollusk facility.

Quarantine and Isolation Building

A quarantine and isolation facility is required for any species being imported to the site from the wild. The animals would be quarantined in this facility until it has been determined the animals are pathogen/parasite free and pose no threats to the facility when introduced into other rearing units on site. It is anticipated that animals put into this facility would remain in quarantine for approximately 6 weeks or longer, depending upon the species and the water body from which they were transferred. The quarantine facility would be supplied by the Bass House Spring water (70 gpm) and would have recirculation capabilities to maximize water use. This facility would be designed with separate entrances for rooms to better isolate species and/or other biota from cross-contamination. Each room would have a separate drain to a discharge treatment system. All discharge from this facility would be mechanically filtered and treated with UV sterilization prior to final discharge. During the design development phase, it may be determined that a drain field, evaporation/transpiration (ET) bed or

containment structure or vault would be required to capture some or all of the discharge, depending upon the pathogen or risk(s).

Research Facility Improvements

Additional research space in a new building would enable expansion of aquatic conservation, propagation, and husbandry research projects. This building would have a metal canopy and be enclosed with chain link fence. The research area would have a separate entrance off the visitor access road. The existing outdoor research ponds would have covers or canopies installed to minimize predation and water evaporation. Other upgrades to the existing facilities include the installation of a climate controlled office within one of the existing buildings, replacement of certain culture tanks, expansion of the recirculation system from eight to ten units, and the installation of a small refugium for loach minnow or other species. An additional groundwater well is desired (60 gpm) for these research needs and to provide a back-up water source if the existing well ever experienced problems.

Conservation Areas and Public Use

A significant portion of AZGFD property, as depicted in Figure 2, has been maintained as open space for conservation areas. The Audobon Society and other conservation groups currently utilize these areas for viewing of native plants and animals as well as recreational nature walks, such as bird watching which is a popular pastime of visitors. As part of the rehabilitation of the Bubbling Ponds production facilities, conservation aspects of the site will be enhanced for wildlife as well as for education and compatible recreation purposes such as nature trails. The existing trail system

would be slightly expanded, and a portion of the pedestrian trail system is intended to cross the wetlands allowing the public to gain more information and appreciation for aquatic wildlife conservation. This pedestrian feature would be accomplished with floating or pile-supported walkways. Engineered wetlands with the ability to overbank would be installed to accomplish several functions including effluent treatment and creation of wetland habitat for plants, birds, reptiles, amphibians, waterfowl, mammals, and mollusks. The wetland would ideally contain a mosaic of habitat including open water, dense wetted vegetation for snakes, and a connecting stream from the discharge pipe that would provide habitat for lotic aquatic species.

A conservation pond would be located near the discharge outlet to Oak Creek. This pond would allow an opportunity to view some of the species being cultured on-site. The water supply for this pond would be discharge water from the on-site facilities (see Figure 3). An informational kiosk describing functions of the pond, the trail system, and other features within view would be located near the conservation pond.

The Page Springs Hatchery complex has an existing Informational and Educational (I&E) building. This facility has capability to expand and include information about the Bubbling Ponds Aquatic Species Conservation Facility and general wildlife conservation. Page Springs Information and Education center would be physically linked to Bubbling Ponds through a new pedestrian bridge over Oak Creek, which would tie into the existing trail system around Bubbling Ponds. The pedestrian bridge will link the two hatcheries, provide for efficient parking and access, and enhance bio-security of Bubbling Ponds while improving visitor experience.

Visitor parking would be slightly expanded at the main entrance to the site (see Figure 5). A hiking trail currently connects to the trail system located south of the existing pond complex, and through the proposed conservation/wetland area.

Administrative Support Facilities

Bubbling ponds currently has three residences on site for providing staff with housing to maintain a 24-hour presence in case of any emergencies as well as site security. Two additional residences would be ideal to serve Page Springs and Bubbling Ponds hatchery facilities. Solar systems for the two new residences and for the propagation facilities will be incorporated into the facility design.

A disinfection station would be placed adjacent to the access road leading away from the main visitor parking area. This station would be designed to use chemicals or steam to disinfect all vehicles which would be entering the hatchery production area to prevent the transfer of aquatic pathogens or invasive species. The disinfection station would have a clean water supply, pressure treatment equipment, chemical disinfection storage, and a leach field for used water to drain away from the disinfection station. Emergency power could be provided to the entire site from a generator in the vicinity of the water treatment building.

Construction Costs

The opinion of probable construction costs are presented below in Table 1. These costs are developed from the concepts outlined in this report and presented as 2011 U.S. dollars. Quantities and dimensions are estimated from available information without the benefit of surveys or other field investigations such as geotechnical reports. Due to the preliminary nature of the information generated in this report, a 25% contingency has been included for the construction costs and a 10% contingency included for other project costs. If the project is divided into two or more phases, these costs would likely increase over a single phase concept.

TABLE 1. OPINION OF PROBABLE CONSTRUCTION COSTS.

ITEM	QUANTITY	UNIT	COST	AMOUNT	TOTAL
MOB / DEMOB @ 5%	1	LS	996400	996,400	996,000
SITEWORK					1,282,000
CLEAR AND GRUB	20	ACRES	4,500	90,000	
GRADING	100,000	SY	0.25	25,000	
EXCAVATION	500	CY	20	10,000	
FILL	500	CY	25	12,500	
EROSION CONTROL	1,800	LF	5	9,000	
CONSTRUCTED WETLANDS	5	ACRES	75,000	375,000	
ONSITE ACCESS ROADS	1	LS	621,459	621,459	
FENCING	1	LS	139,000	139,000	
REARING AND RESEARCH					$12,884,000
FISH PROPAGATION FACILITY	5,888	SF	220	1,295,360	
AMPHIBIAN PROPAGATION FACILITY	4,920	SF	220	1,082,400	
0.16 ACRE PONDS	28	EA	116,957	3,274,800	
0.3 ACRE PONDS	8	EA	249,363	1,994,900	
COVERED REARING AND PROCESSING FACILITY					
BLDG W/ CIRCULARS (25 - 30' DIA)	25,600	SF	74	1,904,000	
BLDG W/ CONC RCWYS (36 - NOM 8'X80')	25,600	SF	68	1,744,000	
REFUGIUM	1	LS	800,000	800,000	
QUARANTINE AND ISOLATION FACILITY	1	LS	608,000	608,000	
RESEARCH SYSTEM IMPROVEMENTS	1	LS	146,000	146,000	
DISINFECTION STATION	1	LS	35,000	35,000	
VISITOR ACCOMMODATIONS					$851,000
PARKING, 30 CARS + 12 OVERSIZE	17,700	SF	6	106,200	
TRAILS & SIGNAGE	1	LS	200,000	200,000	
VISITOR CENTER UPGRADES	1	LS	200,000	200,000	
CONSERVATION POND	1	LS	130,300	130,300	
PEDESTRIAN BRIDGE, 100' SPAN, STEEL	1	LS	164,300	164,300	
KIOSK	1	LS	50,000	50,000	
RESIDENCE	2	LS	175,000	175,000	$175,000
WATER SUPPLY					$3,480,000
SPRING LINE REPLACEMENT	3,000	LF	205	615,000	
WELL-PRODUCTION, 1000 GPM, 700' DP	3	EA	650,000	1,950,000	
WELL-RESEARCH, 60 GPM, 700' DP	1	LS	200,000	200,000	
WATER TREATMENT FACILITY	1	LS	560,000	560,000	
POND DRUM FILTER WITH SMALL BLDG	1	LS	95,000	95,000	
OFFLINE CLARIFIER	1	LS	60,000	60,000	

ITEM	QUANTITY	UNIT	COST	AMOUNT	TOTAL
YARD PROCESS PIPING	1	LS	951,200	951,200	$951,000
ELECTRICAL					$305,000
SITE ELECTRICAL	1	LS	150,000	150,000	
SOLAR	1	LS	120,000	120,000	
SITE GENERATOR, 35 KW	1	LS	35,000	35,000	
TOTAL CONSTRUCTION COSTS					**$20,924,000**
CONTINGENCY (25%)					**$5,231,000**
TOTAL CONSTRUCTION COSTS W/CONTINGENCY					**$26,155,000**
OTHER PROJECT COSTS					
GEOTECHNICAL SITE INVESTIGATIONS					$209,000
TOPOGRAPHIC SURVEY					$138,750
CULTURAL RESOURCE SURVEY					$50,000
HYDROLOGIC, HYDRAULIC AND FLOODPLAIN ANALYSIS					$100,000
DESIGN					$2,092,000
PERMITTING					$418,000
CONSTRUCTION OVERSIGHT (5% OF CONSTRUCTION COST)					$1,046,000
AZGFD ADMIN COSTS (2% OF CONSTRUCTION COST AS PLACEHOLDER)					$418,000
SITE EQUIPMENT					$350,000
TOTAL OTHER PROJECT COSTS					**$4,821,750**
CONTINGENCY (10%)					**$482,175**
TOTAL OTHER PROJECT COSTS W/CONTINGENCY					**$5,303,925**
TOTAL COSTS W/ CONTINGENCY					**$31,458,925**

LEGEND:
CY = CUBIC YARDS
EA = EACH
LF = LINEAL FEET
LS = LUMP SUM
SF = SQUARE FEET
SY = SQUARE YARDS