# Arizona Water Protection Fund
# Application Cover Page
# FY 2024

WPF2402

**Title of Project:** Christopher Creek Restoration Project

**Type of Project:**
- ☒ Capital or Other
- ☐ Water Conservation
- ☐ Research

**Stream Type:**
- ☒ Perennial
- ☒ Intermittent
- ☐ Ephemeral

**Your level of commitment to maintenance of project benefits and capital improvements:**
☐ < 5 years ☐ 5-10 years ☐ 11-15 years ☒ 16-20 years

**Applicant Information:**

Name/Organization: Arizona Council of Trout Unlimited
Address 1: 40 South Twelve Oaks Blvd.
Address 2:
City: Chandler
State: AZ
ZIP Code: 85226
Phone: 925-785-5583
Fax: 480-767-2785
Tax ID No.: [redacted]

**Inside an AMA:** Yes ☐ No ☒

**If yes, which AMA:**
- ☐ Douglas
- ☐ Phoenix
- ☐ Tucson
- ☐ Prescott
- ☐ Pinal
- ☐ Santa Cruz

**Type of Application:**
- ☒ New
- ☐ Continuation

**Contact Person:**

Name: Alan Davis
Title: Chair
Phone: 925-785-5583
Fax: 480-767-2785
e-mail: chair@az-tu.org

**Any Previous AWPF Grants:**
☐ Yes ☒ No

**If yes, please provide Grant #(s):**

**Arizona Water Protection Fund Grant Amount Requested:**

**$208,302.24**

If the application is funded, will the Grantee intend to request an advance:
☒ **Yes** ☐ **No**

**Matching Funds Obtained and Secured:**

| Applicant/Agency/Organization: | Amount ($): |
|---|---|
| 1. Applicant | 9,500 |
| 2. AZSFWC | 44,799 |
| 3. Desert Fish Habitat | 10,333 |
| 4. USFWS Partners/ | 25,000 |
| **Total:** | 79,299 |

Has your legal counsel or contracting authority reviewed and accepted the Grant Award Contract General Provisions?
☒Yes ☐No ☐N/A

**Signature of the undersigned certifies understanding and compliance with all terms, conditions and specifications in the attached application. Additionally, signature certifies that all information provided by the applicant is true and accurate. The undersigned acknowledges that intentional presentation of any false or fraudulent information, or knowingly concealing a material fact regarding this application is subject to criminal penalties as provided in A.R.S. Title 13. The Arizona Water Protection Fund Commission may approve Grant Awards with modifications to scope items, methodology, schedule, final products and/or budget.**

| Alan C. Davis | Chair (925) 785-5583(M) |
|---|---|
| **Typed Name of Applicant or Applicant's Authorized Representative** | **Title and Telephone Number** |
|  | August 20, 2023 |
| **Signature** | **Date Signed** |

# R-C Pond and Christopher Creek Restoration Project
# Executive Summary:

## Project Overview:

The R-C Pond and Christopher Creek Restoration Project initiative is aimed at revitalizing and preserving aquatic ecosystems, enhancing recreational fishing opportunities, and providing conservation education at the Grand Canyon Council Boy Scouts of America's R-C Scout Ranch in Gila County, near Payson. The project involves restoring the deteriorating R-C Scout Ranch pond, rejuvenating Christopher Creek, and creating model desert fish habitats to support native species.

## Background:

Originally conceived as a fish pond restoration and youth conservation education endeavor, the project expanded to include stream restoration possibilities. Discussions with the Arizona Council Trout Unlimited and the Arizona Game and Fish Department highlighted the potential to create a desert fish habitat for Roundtail Chub and Longfin Dace, while also restoring Christopher Creek as a blue-ribbon fishery for recreational Gila trout.

## Project Phases:

## The project is divided into three phases:

## Evaluation and Feasibility:

In Spring 2020, the R-C Scout Ranch pond was transformed into a healthy, fishable pond by removing sediment, cattails, and invasive vegetation. Spawning beds were created, and the pond was restocked with Roundtail Chub. Access pathways were improved, and road drainage enhancements were made.

## Pond Restoration, Pipeline, and Spring-box Replacement:

The second phase involves comprehensive restoration of the R-C pond, including draining, dredging, and restocking with native species. Infrastructure improvements, includes replacing the pipeline and spring box. Pond embankments were reinforced to prevent erosion.

## Christopher Creek Restoration:

The final phase encompasses the restoration of approximately half a mile of Christopher Creek. This involves stream structures for habitat enhancement, erosion controls, and habitat expansion by directing spring outflows upstream to create additional riffle habitat.

**Goals:**

The project's goals for the next five years are:

**Ecological:** Establish healthy aquatic ecosystems, protect native fish habitats, and restore creek banks and water quality.

**Educational:** Provide conservation education opportunities for both summer camp attendees and year-round school programs.

**Recreational:** Enhance fishing opportunities for youth and adults by improving pond and creek conditions.

**Management:** Create a multi-stakeholder group to maintain physical changes, ensuring ongoing education and recreational programs.

**Objectives:**

The project's objectives include:

- Addressing erosion and non-native plant invasion.
- Offering year-round conservation education programs.
- Preventing livestock and elk damage to riparian areas and water quality.
- Establishing recreational fishing opportunities.
- Restoring Christopher Creek with soil pockets and native species, creating a blue-ribbon trout fishery.

**Solutions:**

The project has implemented a range of solutions, including:

- Clearing, dredging, and restocking the R-C pond with native fish species.
- Improving road drainage, pedestrian access, and pond embankments.
- Installing erosion controls to reduce runoff and protect trout habitat.
- Rebuilding pipelines, spring boxes, and creating new access points for fishing.

**Years of Benefit:**

The project is envisioned as a multi-year endeavor with ongoing benefits such as:

- Regular conservation education classes for summer camp and school programs.
- Maintenance by scout groups, fishing clubs, and schools to sustain improvements.
- Controlled public access to the pond and creek, considering camp schedules and fees.

By implementing these initiatives, the R-C Pond and Christopher Creek Restoration Project aims to create sustainable ecosystems, enrich education opportunities, expand recreational fishing, and foster collaborative stewardship among various stakeholders.

# R-C POND AND CHRISTOPHER CREEK RESTORATION
# PROJECT OVERVIEW

## Background

This project began as a possible fish pond restoration, youth conservation education, and a youth recreational fishing opportunity on the Grand Canyon Council BSA (GCC)'s R-C Scout Ranch, Gila County near Payson.

In 2018, several members of the Arizona Council Trout Unlimited (AZTU) in discussion with GCC, identified R-C Scout Ranch pond's great potential for youth recreational fishing opportunities, and the stream restoration possibilities.

The Grand Canyon Council, Boy Scouts of America owns and operates R-C Scout Ranch as a summer camp. The camp is in Gila County along Christopher Creek. Infrastructure at the camp includes a pond utilized for fishing, a spring head diversion and circa 1946 pipe works that carry water across the creek to the pond. The spring and pond infrastructure are near the end of their useable lifespan and are deteriorating. The pond filling with sediment, and becoming over taken by emergent vegetation became shallower making it nearly unusable. In addition, the spring box, pipeline, and support structure for the pipeline are leaking and need frequent repair.

Through subsequent discussions with the Arizona Game and Fish Department (AZGFD) Aquatics managers, and consultation with U.S. Fish and Wildlife Service, we quickly realized we could create a model desert fish habitat for a refuge population of Roundtail Chub and Longfin Dace, while providing youth conservation education and recreational fishing opportunities.

Additional prospects included approximately half-mile reach of Christopher Creek stream restoration opportunity that would create a "blue-ribbon" fishery and allow stocking of recreational Gila trout.

To help Identify additional problems, challenges, and opportunities, and map a project strategy, we engaged Natural Channel Designs (NCD), a Flagstaff, AZ environmental consulting firm. NCD laid out an overall plan we subsequently divided into three phases:

- Evaluation and feasibility;
- Pond restoration, pipeline, and spring-box replacement; and,
- Restoration of approximately one-half-mile of Christopher Creek into a "blue-ribbon" fishery able to support a year-round population of recreational native Gila Trout.

**Evaluation and Feasibility:**

In Spring 2020, we begun the pond transformation by renovating and restoring the existing R-C Scout Ranch fish pond into a healthy, fishable pond. We drained, dredged, burned, poisoned, and removed cattails, created spawning beds, and refilled the pond.

**Pond restoration, pipeline, and spring-box replacement**:

We have since:

- Drained, burned, dredged, poisoned, and mechanically removed cattails from 3/8 AC± R-C pond;
- Refilled pond and added spawning beds to the shallow portion of pond
- Restocked the pond with a recovery population of Endangered Species Act (ESA) threatened Roundtail Chub
- Cleared over 800 liner feet of brush, from pond perimeter
- Improved pedestrian pond access
- Graded 850 ft of road, and dug 850 ft of drainage ditch improving road drainage, diverting rain-water run-off, adding water bars and other grading improvements, including rip-rap along road.
- Improved the pedestrian pond access, adding 150 ft crushed gravel pathways, cleared brush
- Restored and strengthened eroding pond and stream embankments with 300 cu yds of earthen fill and riprap along 150 ft length
- Reseeded and added 150 ft environmental erosion control fabric

These actions have created, protected, and help maintain a model intact healthy aquatic ecosystem supporting desert fish habitats. To further enhance this model desert-fish habitat, we will plant milkweed fostering additional erosion control, and help attracting Monarch butterfly; stock Chiricahua leopard frog, an EPA threatened amphibian; and finally, we will add EPA threatened narrow-headed garter snakes. This model desert fish habitat will play the pivotal role in youth education programs. Additionally, these changes will make the pond more accessible to all anglers.

Winter 2022-23, we plan repair and replacement of the pipeline and spring box, completing the second phase of this project.

**Christopher Creek Restoration:**

The final phase of this project is the Christopher Creek restoration work. This project is extensive.

Natural Channel Design's work plan, thorough a geomorphic evaluation identified and established the feasibility of Christopher Creek restoration. Among NCD's findings are

- The habitat potential for this reach of Christopher Creek is very high because of the relatively large spring flow available for both the pond and stream channel. The

camp can keep the Pond water quality quite high with only a portion of the spring output and redirect the remaining output to the channel maintaining it in a perennial condition, keeping aquatic life alive through low-flow periods.

- All proposed stream structures provide hiding habitat at low discharge or preserve current habitat by stabilizing in place. All structures we add will utilize native rock or logs. We may import some larger rocks. Detail drawings of the various structures are in the attached drawings.
- Finally, NCD recommends that we direct the springbox outflow upstream in the channel to the property line to "wet up" an additional 260-feet± of riffle habitat and potentially a large bedrock pool just upstream of the property line. This would provide a larger habitat area with a relatively small investment in infrastructure.
- Install fencing along property line and build cattle/elk exclosure to protect and prevent riparian degradation and fecal contamination.
- Mitigate future damage by installing erosion controls that will reduce runoff and associated turbidity while hardening access points for trout stocking and other recreational use.

Once the work is complete, AZGFD will stock native, non-recovery, recreational Gila trout.

Completion of this work will establish a recreational year-round fishery capable of sustaining a holdover population of trout and provide a blue-ribbon quality trout water.

## Goals

This plan establishes ecological, educational, recreational, and management goals for the next 5 years:

- Ecological: Eliminate roadway erosion and other soil erosion runoff into stream, and create a model desert fish habitat and refuge populations of native roundtail chub and longfin dace in the R-C Scout Ranch Pond. Eliminate livestock fecal contamination and riparian habitat degradation. Stock native, non-recovery, recreational Gila trout in Christopher Creek. Provide additional native habitat and plant milkweed fostering additional erosion control, and help attracting Monarch butterfly; stock Chiricahua leopard frog, an ESA threatened amphibian; and add ESA threatened narrow-headed garter snakes.
- Educational: Provide conservation education opportunities for both summer camps as well as a year-round opportunity for Arizona school youth.
- Recreational: Enhancing the pond as well as restoration of Christopher Creek will increase recreational fishing opportunities for both youth and adults.
- Management: Establish a multi-stakeholder group, e.g., scout troops, fishing clubs, schools, etc. to accomplish the ecological, educational, and recreational goals to maintain the physical changes, and insure continuing educational and recreational programs.

## Objectives

Our objectives are multiple-fold:

- Stop and arrest the road and pond bank erosion, and stop non-native plant invasion
- Provide year-round conservation education opportunities for summer camp youth and year-round school programs
- Exclude livestock and elk that wander onto the property and damage fragile riparian species and contaminate the water with fecal coliform.
- Establish youth and adult recreational fishing opportunities
- Restore the .53-mile reach of Chirstopher Creek above the box canyon by installing soil pockets and planting native species.
- Create a blue-ribbon reach of Christopher Creek providing a year-round trout fishery using recreational native Gila trout.
- Mitigate future damage by installing erosion controls that will reduce runoff and associated turbidity while hardening access points for trout stocking and other recreational use.

## Statement of Problems/Causes

The problems encountered on R-C Scout Ranch stem from erosion, neglect and ordinary wear and tear requiring replacement. The problems we identified are:

- Erosion of roadway into R-C Pond and Christopher Creek
- Erosion of Pond bank into Christopher Creek
- Erosion of pond bank into pond
- Degradation and erosion of spring box and spring head diversion
- Degradation and failure of circa 1946 pipeline.
- Fecal contamination and riparian degradation by cattle who meander in from adjacent National Forest lands

## Statement of Solutions

The solutions that we identified include number of projects we previously identified in the section entitled “pond restoration, pipeline, and spring-box replacement.”

Among the solutions are:

- drained, burned, poisoned, and mechanically removed cattails from R-C pond;
- added spawning beds to the pond;
- restocked the pond with recovery population of roundtail chub;
- divert rain runoff from road by additional grading and drainage ditch construction;
- improved pedestrian pond access by adding 150 feet of crushed gravel pathways, cleared brush, etc.
- seeded and added 150 foot of environmental erosion fabric along the pond bank.
- Road improvement and hardening of access to support AZGFD Trout stocking for Christopher Creek

- Install fencing along property line and build cattle/elk exclosure to protect and prevent riparian degradation and fecal contamination.

## Statement of Project Years of Benefit to the Resource and General Public

We identified this project as a multiyear project and consequently we need several phases to complete the work. During our evaluation, we identified the following things necessary for the ongoing project:

- annual conservation education classes during both summers camp and the academic year;
- ongoing maintenance by scout groups, fishing clubs, and schools to keep and maintain the new improvements;
- allow new public access to R-C pond, and improved Christopher Creek.

Allowing public access, presents problems that are unavoidable. Among these problems are:

- no access allowed when camp is in session,
- no personal vehicles allowed on site, and finally,
- require registration and an optional rod fee to limit access, know who is on the property, and defray some expenses of public access.

We can enhance the pond can by encouraging vegetation growth (grasses) around the embankment limiting sediment runoff into the pond. We can better manage area foot traffic by creating a gravel path with several rock casting platforms around the pond edges providing anglers with a focused access site to the pond edge. Finally, we can strengthen the outflow area with a rock rundown below the pipe outlet preventing further erosion and creating a designated overflow channel in case the pipe becomes blocked with debris.

**1Earaly Picture of overgrown pond**

**2Aging pipeline**

**3 Spring Box**

**4 Christopher Creek looking downstream, post highwater event**

# Project Location & Environmental Contaminant Information
# FY 2024

**Project Location Information: Christopher Creek, R-C Scout Ranch**

| 1. County: Gila | 2. Section(s): 26 | 3. Township: 11N | 4. Range: 12E |
|---|---|---|---|

5. Watershed: Salt
6. 8 or 10 Digit Hydrologic Unit Code (HUC): _____
7. Name of USGS Topographic Map where project area is located: Promontory Butte
8. State Legislative District: 01

(Information available at: https://redistricting-irc-az.hub.arcgis.com/pages/official-maps

9. Land ownership of project area: Private
10. Current land use of project area: Youth camp
11. Size of project area (in acres): 88±
12. Stream Name: Christopher Creek
13. Length of stream through project area: .53±
14. Miles of stream benefited: .53 miles±
15. Acres of riparian habitat: 32 acres± will be:

☒ Enhanced
☒ Maintained
☒ Restored
☐ Created

16. General description and/or delineation for the area of impact of the project within the watershed.
Restore, repair and enhance the creek and riparian area that will improve the habitat quality, sustainability of the stream, and support a year-round fishery for recreational native Gila trout.

17. Provide directions to the project site from the nearest city or town. List any special access requirements:
19887 E AZ Highway 260, Payson, AZ 85541 ; Milepost 271.5. Contact Camp Ranger: Craig Burkholder, 928-478-4500

**Environmental Contaminant Location Information**

1. Does your project site contain known environmental contaminants? ☐ **YES** ☒ **NO** If yes, please identify the contaminant(s) and enclose data about the location and levels of contaminants:

2. Are there known environmental contaminants in the project vicinity? ☐ **YES** ☒ **NO** If yes, please identify the contaminant(s) and enclose data about the location and levels of contaminants:

3. Are you asking for Arizona Water Protection Fund monies to identify whether or not environmental contaminants are present? ☐ **YES** ☒ **NO**

# Christopher Creek Restoration Project
# Scope of Work

**[TASK # 1**

## Task Title: Stream Enhancements - Rock Vane Channel/Bank Protection

**Task Description:** Enhance and create six-geomorphic areas for stream enhancements. These riffles and pools are the areas where we will excavate as needed, add various materials, such as rock barbs, cross-vane weirs, create log overhangs, add boulder rock clusters, and install rock sills and toe rock. Additional work includes fence repair and debris removal.

**Task Purpose/Objective:** Restore the headwater sections of Christopher Creek to a healthy aquatic habitat. These enhancements will create a sustainable habitat allowing for the reintroduction of recreational Gila trout and restore youth and recreational fishing.

**Deliverable Description:** Create Stream enhancements

**Deliverable Due Date:** Fall 2024 to Spring 2025

**Responsible Personnel:** Josh Criswell

**Task Cost (rounded to the nearest dollar):** $135,249

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**TASK # 2**

## Task Title: Construction of new upstream pipeline

**Task Description:** Install a water pipeline upstream of the existing spring, creating an additional 240-feet of aquaculture habitat during summer dry periods

**Task Purpose/Objective**
Purpose is to increase the size of available habitat during dry periods when Christopher Creek does not have seasonal flow. A new upstream pipeline from the existing spring box, would be installed to provide water to a ~240-foot section of bedrock pools.

**Deliverable Description:**
Install 280 LF of 6-inch PVC pipe to an upstream pool.

**Deliverable Due Date**
Spring 2024

**Responsible Personnel: Josh Criswell/ Rod Buchanan**

**Task Cost (rounded to the nearest dollar):** $18,139

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**TASK # 3**

## Task Title: Springbox Reconstruction

**Task Description:** Construct new springbox approximately 3-ft perimeter from the existing spring box, encompassing all existing structures within a single structure. Remove existing structures upon completion of new spring box.

**Task Purpose/Objective**

The existing spring box is in poor condition. The original spring box went dry as the spring outflow migrated away from the original structure. The newer structure has been undermined and spring flow passes below the walls in several areas. Building the new structure and keying the walls into 12-18" bedrock are key factors in replacement of this spring box.

**Deliverable Description**

New spring box and pipeline connections

**Deliverable Due Date**

Fall 2023

**Responsible Personnel:** Josh Criswell, Rod Buchanan, and contractor Ken Richter.

**Task Cost (rounded to the nearest dollar):** $10,931

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**TASK # 4**

## Task Title: Pond Pipeline Reconstruction

**Task Description:** Install a water pipeline from the existing spring, replacing the aging, leaking, failing circa 1946 metal and PVC aerial pipeline with a new underground pipeline.

**Task Purpose/Objective**

Purpose is to increase the size of available habitat during dry periods when Christopher Creek does not have seasonal flow. A new upstream pipeline from the existing spring box, would be installed to provide water to a ~240-foot section of bedrock pools.

**Deliverable Description**

**Deliverable Due Date**

**Responsible Personnel**

**Task Cost (rounded to the nearest dollar):** $57,106

**TASK # 5**

## Task Title: Pond Enhancements

**Task Description:** Smooth hillside next to pond and fill with material and top soil. Install double net erosion control fabric over pond hillside, install sedge plugs in hillside (harvested onsite), and spread seed over entire hillside area. Install crushed gravel pathway adjacent to hillside and along pond.

**Task Purpose/Objective**

The banks of the pond are relatively bare of vegetation with a heavily utilized trail along the edge. The bare banks regularly erode into the pond from roadway runoff and the bare hillside. Planting native grasses and sedges along this hillside and adding a crushed gravel path will stop the hillside erosion and help prevent soil erosion into the pond

**Deliverable Description**

Pond hillside enhancements and walkway improvement

**Deliverable Due Date**

Fall - Winter 2023

**Responsible Personnel:** Josh Criswell, Rod Buchanan, and contractor Ken Richter.

**Task Cost (rounded to the nearest dollar):** $9,837

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**TASK # 6**

## Task Title: Road Grading / Drainage

**Task Description:** Regrade 830-ft of roadway and clean or create ditch along a very steep 14% grade. Create seven bars, and add one water crossing along this stretch of dirt roadway.

**Task Purpose/Objective**

Purpose of this grading work is to divert the winter and monsoon rain runoff from eroding and destroying the roadway and adding soil erosion into the pond and stream.

**Deliverable Description**

Road Grading and Road Drainage Work

**Deliverable Due Date**

Fall - Winter 2023

**Responsible Personnel:** Josh Criswell, Rod Buchanan, and contractor Ken Richter

**Task Cost (rounded to the nearest dollar):** $11,698


# *Arizona Water Protection Fund FY2024 Grant Application Detailed Budget*
## *Arizona Council of Trout Unlimited - Christopher Creek Restoration*

| **Task 1: Stream Enhancements - Rock Vane Channel/Bank Protection** | | | | | |
|---|---|---|---|---|---|
| | **Quantity** | **Unit** | **Unit Cost** | **Total** | **Notes** |
| **Direct Labor Costs** | | | | | |
| Mobilization/Demobilization | 1 | LS | $6,665.00 | $6,665 | |
| Install 2 Rock Barbs (Excavator, Loader, 1 laborer) | 8 | hours | $475.72 | $3,806 | |
| Install 3 Rock Cross Vane Weirs (Excavaor, Loader, 1 Laborer) | 24 | hours | $475.72 | $11,417 | |
| Install 50 ft of Toe Rock (Excavator, Loader, 1 Laborer) | 5 | hours | $475.72 | $2,379 | |
| Install 12 Boulder Clusters (Excavator, Loader) | 6 | hours | $391.41 | $2,348 | |
| Install 2 Log Overhangs (Excavator, Loader, 2 Laborers) | 12 | hours | $559.86 | $6,718 | |
| Install 2 Inner Berm Darts (Excavator, Loader, 1 Laborer0 | 8 | hours | $475.72 | $3,806 | |
| Install 2 rock sills (70 lf) (Excavator, loader, 1 laborer) | 10 | hours | $475.72 | $4,757 | |
| Stream Pool Excavation (Excavator, Laborers) | 1.5 | hours | $407.75 | $612 | |
| Remove debris from channel (Excavator, 2 Laborers) | 6 | hours | $407.75 | $2,447 | |
| Repair Fence - 2 laborers, 2 days | 32 | hours | $84.31 | $2,698 | |
| Install Rock Platforms (3 ea, Backhoe + 2 laborers) | 2 | hours | $320.91 | $642 | |
| | | | | | |
| Direct Labor Subtotal | | | | **$48,294.37** | |
| | | | | | |
| **Outside Service Costs** | | | | | |
| | | | | | |
| | | | | | |
| Outside Services Subtotal | | | | | |
| | | | | | |
| **Other Direct Costs** | | | | | |
| SWPPP (Stormwater Pollution Prevention Plan) | 1 | LS | $5,332.00 | $5,332 | |
| Permitting (404, Biological Ev, 401, Grading Permit) | 1 | LS | $7,998.00 | $7,998 | |
| Archaeological Survey/Report | 1 | LS | $5,332.00 | $5,332 | |
| Final Engineering for Stream Structures (Site specific surveys, finalize design & eopc, submittal to Gila County) | 1 | LS | $15,222.86 | $15,223 | |
| Construction Oversight (Layout, Installation assistance, Final walk through0 | 0.5 | LS | $13,836.54 | $6,918 | |
| Site Construction Contingency | 1 | LS | $8,000.67 | $8,001 | |
| | | | | | |
| Other Direct Subtotal | | | | **$48,803.80** | |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Capital Outlay, Equipment, Supplies, Per Diem, Travel, etc.** *(Note: mileage reimbursement is limited to $0.445/mile)* | | | | | |
| Procure 18" Rock | 19.5 | tons | $70.65 | $1,378 | |
| Procure 24" Rock | 83.5 | tons | $113.31 | $9,461 | |
| Procure 36 " Rock | 167.5 | tons | $113.31 | $18,979 | |
| Procure two 10'x12" logs | 2 | logs | $146.63 | $293 | |
| Non-Woven Geotextile | 1 | rolls | $399.90 | $400 | |
| Repair Fence @ lower end (3 end braces, 52 ft break away section, repair floodplain fence -12 tee posts, 1 roll ea barbed and smooth, concrete) | 1 | LS | $1,199.70 | $1,200 | |
| | | | | | |
| Other Direct Subtotal | | | | **$31,710.07** | |
| | | | | | |
| **Task Subtotal** | | | | **$128,808.24** | |
| | | | | | |
| **Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)** | | | | **$6,440.41** | |

| | |
|---|---|
| **Task 1 Total** | **$135,248.65** |

| **Task 2: Construction of new upstream pipeline** | | | | | |
|---|---|---|---|---|---|
| | **Quantity** | **Unit** | **Unit Cost** | **Total** | **Notes** |
| **Direct Labor Costs** | | | | | |
| Mobilization/Demobilization | 1 | LS | $4,398.90 | $4,399 | |
| Clearing path, excavation, backfull, anchorage | 1 | LS | $2,260.77 | $2,261 | |
| | | | | | |
| Direct Labor Subtotal | | | | **$6,659.67** | |
| | | | | | |
| **Outside Service Costs** | | | | | |
| | | | | | |
| Outside Services Subtotal | | | | | |
| | | | | | |
| **Other Direct Costs** | | | | | |
| Survey of pipeline route, Final Engineering/Design | 1 | LS | $6,665.00 | $6,665 | |
| Site Construction Contingency | 1 | LS | $965.09 | $965 | |
| | | | | | |
| Other Direct Subtotal | | | | **$7,630.09** | |

| | | | | | |
|---|---|---|---|---|---|
| **Capital Outlay, Equipment, Supplies, Per Diem, Travel, etc.** *(Note: mileage reimbursement is limited to $0.445/mile)* | | | | | |
| 6" Sch80 pvc pipe | 280 | LF | $10.66 | $2,986 | |
| | | | | | |
| Other Direct Subtotal | | | | **$2,985.92** | |
| | | | | | |
| **Task Subtotal** | | | | **$17,275.68** | |
| | | | | | |
| **Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)** | | | | **$863.78** | |

| | |
|---|---|
| **Task 2 Total** | **$18,139.46** |

| **Task 3: Springbox Reconstruction** | | | | | |
|---|---|---|---|---|---|
| | **Quantity** | **Unit** | **Unit Cost** | **Total** | **Notes** |
| **Direct Labor Costs** | | | | | |
| Footer Excavation | 2 | CY | $189.29 | $379 | |
| Footer Excavation (Rock) | 1.5 | CY | $1,153.05 | $1,730 | |
| Reinforced Concrete Wall | 59 | LF | $111.31 | $6,567 | |
| Site Construction Contingency | 1 | LS | $1,735.03 | $1,735 | |
| | | | | | |
| Direct Labor Subtotal | | | | **$10,410.20** | |
| | | | | | |
| **Outside Service Costs** | | | | | |
| | | | | | |
| | | | | | |
| Outside Services Subtotal | | | | | |
| | | | | | |
| **Other Direct Costs** | | | | | |
| | | | | | |
| | | | | | |
| Other Direct Subtotal | | | | | |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Capital Outlay, Equipment, Supplies, Per Diem, Travel, etc.**<br>*(Note: mileage reimbursement is limited to $0.445/mile)* | | | | | |
| | | | | | |
| | | | | | |
| Other Direct Subtotal | | | | | |
| | | | | | |
| **Task Subtotal** | | | | **$10,410.20** | |
| | | | | | |
| **Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)** | | | | **$520.51** | |

| | |
|---|---|
| **Task 3 Total** | **$10,930.71** |

| **Task 4: Pond Pipeline Reconstruction** | | | | | |
|---|---|---|---|---|---|
| | **Quantity** | **Unit** | **Unit Cost** | **Total** | **Notes** |
| **Direct Labor Costs** | | | | | |
| Mobilization/Demobilization | 1 | LS | $4,798.80 | $4,799 | |
| Remove Existing Pipeline and Structures | 1 | LS | $3,332.50 | $3,333 | |
| Trenching in soil and bedrock, fill | 1 | LS | $6,771.64 | $6,772 | |
| Place concrete over pipe (includes reinforcing steel) | 36 | CY | $319.92 | $11,517 | |
| Site Construction Contingency | 1 | LS | $5,731.90 | $5,732 | |
| | | | | | |
| Direct Labor Subtotal | | | | **$32,151.96** | |
| | | | | | |
| **Outside Service Costs** | | | | | |
| | | | | | |
| Outside Services Subtotal | | | | | |
| | | | | | |
| **Other Direct Costs** | | | | | |
| Geotechnical Testing | 1 | LS | $3,999.00 | $3,999 | |
| Final Engineering/Design (Includes final springbox design) | 1 | LS | $13,330.00 | $13,330 | |
| Archaeological Survey/Report | 1 | LS | $2,666.00 | $2,666 | |
| | | | | | |
| Other Direct Subtotal | | | | **$19,995.00** | |

| | | | | | |
|---|---|---|---|---|---|
| **Capital Outlay, Equipment, Supplies, Per Diem, Travel, etc.** *(Note: mileage reimbursement is limited to $0.445/mile)* | | | | | |
| 4 in. PVC Supply Pipe & Cleanout | 1 | LS | $2,239.44 | $2,239 | |
| | | | | | |
| | | | | | |
| Other Direct Subtotal | | | | **$2,239.44** | |
| | | | | | |
| **Task Subtotal** | | | | **$54,386.40** | |
| | | | | | |
| **Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)** | | | | **$2,719.32** | |

| | |
|---|---|
| **Task 4 Total** | **$57,105.72** |

| **Task 5: Pond Enhancements** | | | | | |
|---|---|---|---|---|---|
| | **Quantity** | **Unit** | **Unit Cost** | **Total** | **Notes** |
| **Direct Labor Costs** | | | | | |
| Smooth hillside next to pond (backhoe) | 2 | hr | $152.28 | $305 | |
| Install double net erosion control fabric | 2 | hours | $84.31 | $169 | |
| Install Crushed Gravel path at pond (backhoe + 2 laborers) | 2 | hours | $320.91 | $642 | |
| Install Sedge Plugs in Inner Berm darts (harvest from site) | 20 | EA | $4.00 | $80 | |
| Spread Seed | 1.5 | hour | $84.31 | $126 | |
| Site Construction Contingency | 1 | LS | $222.78 | $223 | |
| | | | | | |
| | | | | | |
| Direct Labor Subtotal | | | | **$1,544.23** | |
| | | | | | |
| **Outside Service Costs** | | | | | |
| | | | | | |
| | | | | | |
| Outside Services Subtotal | | | | | |
| | | | | | |
| **Other Direct Costs** | | | | | |
| Construction Oversight (Layout, Installation assistance, Final walk through) | 0.5 | LS | $13,836.54 | $6,918 | |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| Other Direct Subtotal | | | | **$6,918.27** | |
| | | | | | |
| **Capital Outlay, Equipment, Supplies, Per Diem, Travel, etc.**<br>*(Note: mileage reimbursement is limited to $0.445/mile)* | | | | | |
| Procure 2 rolls double net erosion control fabric plus box of staples | 2 | rolls | $159.96 | $320 | |
| Procure Gravel for path at pond | 4 | cy | $79.98 | $320 | |
| Reseed - Native Grass Mix | 1 | AC | $266.60 | $267 | |
| | | | | | |
| Other Direct Subtotal | | | | **$906.44** | |
| | | | | | |
| **Task Subtotal** | | | | **$9,368.94** | |
| | | | | | |
| **Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)** | | | | **$468.45** | |

| | |
|---|---|
| **Task 5 Total** | **$9,837.39** |

| **Task 6: Road Grading/Drainage** | | | | | |
|---|---|---|---|---|---|
| | **Quantity** | **Unit** | **Unit Cost** | **Total** | **Notes** |
| **Direct Labor Costs** | | | | | |
| Mobilization/Demobilization | 1 | LS | $2,666.00 | $2,666 | |
| Road Ditch Grading | 830 | LF | $2.09 | $1,737 | |
| Road Grading | 830 | LF | $0.71 | $586 | |
| Waterbar | 7 | EA | $473.22 | $3,313 | |
| Water Crossing | 1 | EA | $946.43 | $946 | |
| Site Construction Contingency | 1 | LS | $1,012.81 | $1,013 | |
| | | | | | |
| | | | | | |
| Direct Labor Subtotal | | | | **$10,261.17** | |
| | | | | | |
| **Outside Service Costs** | | | | | |
| | | | | | |
| Outside Services Subtotal | | | | | |
| | | | | | |
| **Other Direct Costs** | | | | | |

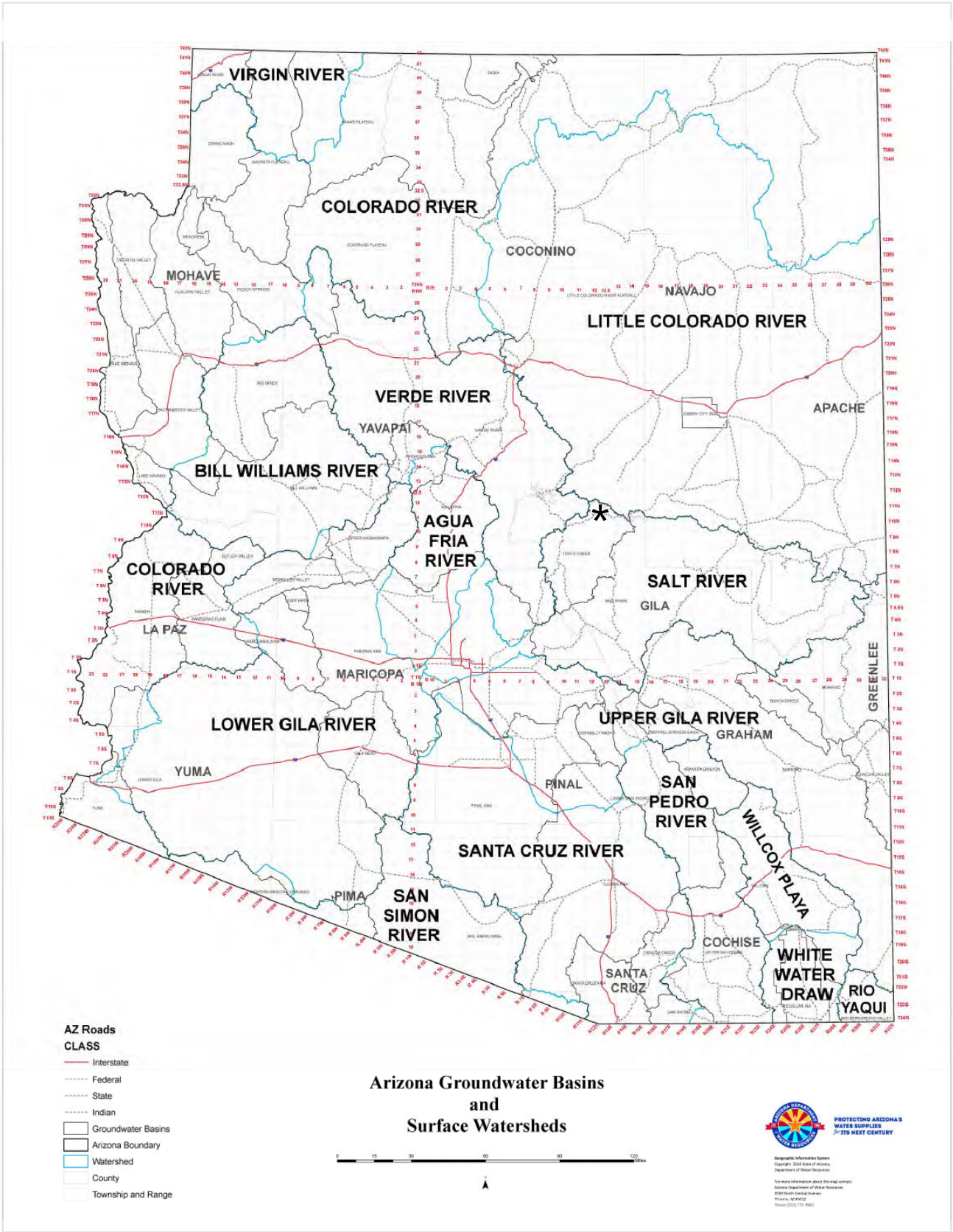
| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| Other Direct Subtotal | | | | | |
| | | | | | |
| **Capital Outlay, Equipment, Supplies, Per Diem, Travel, etc.**<br>*(Note: mileage reimbursement is limited to $0.445/mile)* | | | | | |
| 6-12" D100 RipRap | 6 | CY | $146.63 | $880 | |
| | | | | | |
| | | | | | |
| Other Direct Subtotal | | | | **$879.78** | |
| | | | | | |
| **Task Subtotal** | | | | **$11,140.95** | |
| | | | | | |
| **Optional: AWPF Administrative Costs (not to exceed 5% of Task Subtotal)** | | | | **$557.05** | |

| | |
|---|---|
| **Task 6 Total** | **$11,697.99** |

| | |
|---|---|
| **Arizona Water Protection Fund Grant Application Fund Request** | **$242,959.92** |

# *Matching Funds and Volunteer Hours*
# *August 25, 2023*

| Pond Restoration/ Conservation | Financial Donations | Volunteer Hours | In-Kind - Hours @ $31.80/hour |
|---|---|---|---|
| Individual Donations | $ 7,282.47 | | |
| Trout Unlimited | $ 9,979.06 | 152 | $ 4,833.60 |
| AZSFWC Grant | $ 44,799.00 | | |
| DFHP Grant | $ 35,333.00 | | |
| Grand Canyon Council - BSA | $ 25,000.00 | 72 | $ 2,289.60 |
| Backcountry Hunters & Anglers* | | 150 | $ 4,770.00 |
| **Total** | $ 122,393.53 | 224 | $ 7,123.20 |



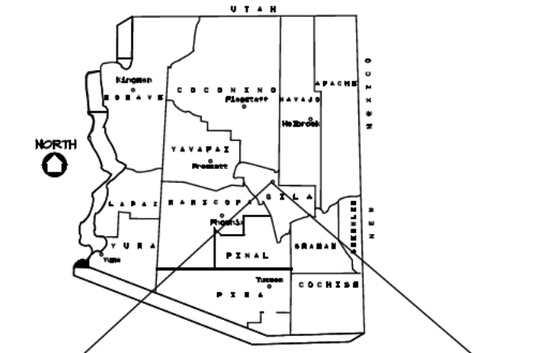

# Arizona Watershed Map
# FY 2024

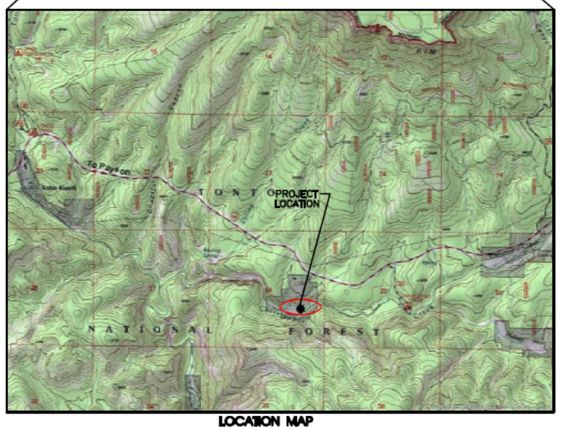
**Title of Project:** **R-C Pond & Christopher Creek Restoration Project**

**Location:** (Township/Range/Section): Gila County 26 /11N/12E

# CONCEPTUAL POND & STREAM IMPROVEMENTS
# CHRISTOPHER CREEK AT R-C SCOUT RANCH

**CHRISTOPHER CREEK AT R-C SCOUT RANCH**
**GILA COUNTY, AZ**




**LOCATION MAP**

*ARIZONA, GILA & SALT RIVER MERIDIAN*
*T11N, R12E, SEC. 26, N1/2 SE1/4*
*GILA COUNTY, ARIZONA*

**PREPARED FOR:**

ARIZONA COUNCIL TROUT UNLIMITED
13021 N. 17TH PLACE
PHOENIX, AZ 85022
PHONE: (623-229-8335

GRAND CANYON COUNCIL
BOY SCOUTS OF AMERICA
1901 E. DOBBINS RD
PHOENIX, AZ 85042

**PREPARED BY:**

NATURAL CHANNEL DESIGN, INC.
2900 N. WEST ST. #5
FLAGSTAFF, AZ 86004
PHONE: (928) 774-2336

**INDEX OF DRAWINGS**



**QUANTITY SUMMARY:**

| ITEM | QTY. |
|---|---|
| POOL EXCAVATION | 26 CY |
| 36 in. ROCK | 135 EA |
| 24 in. ROCK | 232 EA |
| 18 in. ROCK | 128 EA |
| LOGS (12 in. X 10 ft) | 2 EA |
| PLATFORM ROCKS | QUANTITY NOT INCLUDED |
| CRUSHED GRAVEL | 4 CY |
| DOUBLE NET FABRIC | 2 ROLLS |
| NON-WOVEN GEOTEXTILE | 18 SY |
| SMOOTH WIRE | 1 ROLL |
| BARBED WIRE | 1 ROLL |
| FENCE END BRACING | 3 EA |
| FENCE T-POSTS | TBD |
| SEDGE PLUGS | 20 EA |
| WILLOW POLES | 54 EA |
| SEED | 9 LB PLS |

**GENERAL NOTES**

1. Site survey data was collected by NCD in October, 2020. Topographic survey was limited to the access road to pond and along Christopher Creek.
2. Stationing provided herein refers to baseline of construction along the access road and along Christopher Creek.
3. No representation is made as to the existence or nonexistence of any utilities, public or private. Absence of utilities on these drawings IS NOT assurance that utilities are not present. The existence, location and depth of any utility must be determined by the contractor prior to any excavation. CALL BEFORE YOU DIG, Arizona Blue Stake at 811 or 1-800-STAKE-IT.
4. Unless otherwise specifically noted within the plans and details herein, all materials and workmanship shall comply with the current "MAG Uniform Standard Specification and Details for Public Works Construction". All work and materials which do not conform to the standards and specifications are subject to removal and replacement at the contractor's expense. Where conflict exists between MAG specifications and the plans, contractor shall assume that the more stringent specification applies. Contact the engineer for clarification.
5. Construction activities will be conducted in a manner consistent with all safety regulations, and other permitting as may be required by the Gila County and others.
6. Installation shall be constructed to the lines and grades as shown on the drawings. Unless an agreement exists between the project Owner and NCD to provide construction phase services that include survey layout of the project, the contractor shall retain the services of a licensed surveyor to provide layout of the project.
7. Contractor shall coordinate with the project owner for allowed locations of temporary construction yards and use of the property outsidethe limits of construction depicted within these plans.
8. Construction contractor shall, in accordance with generally accepted construction practices, assume sole and complete responsibility for the job site conditions during the course of construction of the project, including safety of all persons and property. This requirement shall be made to apply continuously and not be limited to only the normal working hours.

**EARTHWORK - ACCESS ROAD**

9. The earthwork activities shall consist of, but may not be limited to, excavation and fill related to road and ditch grading and installation of waterbars.
10. Excavation shall include grading of access road. Disturbance of existing native vegetation outside the footprint of the road and turnout ditches shall be minimized to the greatest extent possible. Care shall be taken to not damage the existing trees.
11. Sorting shall include stockpiling excavated material according to its composition to be used per fill requirments.
12. Processing shall include separating cobble and fines by screening, such as a rock grizzly or similar in order to meet fill type and quantity requirments.
13. Earthfill shall include placing and shaping materials according to their type and the grading plan. All fill materials shall be obtained from the required excavations and/or approved borrow sources.
14. Compaction shall include mechanical compaction as specified to the as determined by ASTM D698 testing methods.

**STREAM CHANNEL**

15. Efforts will be made to enter and exit the channel in locations that minimize impacts to existing woody vegetation and where impacts do not result in stream bank instability. The use of heavy equipment in the stream channel will be kept to a minimum.
16. It is recommended that equipment have rubber wheels or rubber tracks to reduce impact to vegetation. Construction equipment must be capable of moving and placing rock of 3 foot diameter or 2.5 tons. The following equipment is expected to be utilized during in-stream structure placement:
    - trackhoe/excavator with thumb (large rock and structure placement)
    - backhoe/front end loader (moving materials)
    - dump truck (miscellaneous hauling)

**FEATURE ROCK AT IN-STREAM STRUCTURES**

17. Rock shall be angular, dense, sound and free from cracks, seams, or other defects conducive to accelerated weathering and meet the requirements of MAG Section 703. The least dimension of an individual rock shall not be less than one-third the greatest dimension. Rock source shall be approved by the ENGINEER and have a bulk specific gravity of not less that 2.5 per ASTM C127. Rock riprap shall be well graded with the size range or gradation specified within the construction call-out note for each location.
18. An estimate of material quantities is included on this sheet for the convenience of the contractor. As this project is intended to use inexact materials (rocks, boulders, etc.) that are naturally sourced, and used in the construction of in-stream features, the quantities provided are to be regarded as approximate only.

**POLLUTION CONTROL/BMPs**

19. Total disturbance area related to the improvements shown herein is estimated to be more than 1.0 acre. As such, a SWPPP is anticipated to be required through ADEQ. The contractor will be required to adhere to industry standards of practice and employ Best Management Practices (BMPs) as necessary to minimize erosion and ensure that air and water pollution are minimized and held within legal limits. Any cost associated with preparing a SWPPP, submitting an NOI, or use of BMP's shall be considered incidental to the project as a whole.
20. Transportation routes for materials, personnel, and equipment to, from, and within the project shall be limited to existing roads, the work areas identified with these plans and as otherwise approved by the owner within the property limits and at the time of construction.
21. Contractor shall be responsible for all costs associated with the implementation of BMPs associated with storage and/or disposal of excess excavation materials if necessary. Such costs shall be considered incidental to the project as a whole.
22. All equipment shall be cleaned of soil, mud and plant materials prior to mobilizing to the project site. The intent of the cleaning is to remove sources of non-native and invasive weeds and seeds.
23. Contractor shall ensure that vehicles and equipment leaving the site and entering County, State or Federally governed roads are clean and free of excess mud and debris and that loads are properly covered. If necessary and depending upon the soil moisture condition at the time of construction. Contractor will be responsible for installing track-out pads, to prevent tracking of mud onto those public roads.
24. Contractor shall be responsible for maintaining an orderly, trash-free work site at all times and when completed with the installation of the rip rap, substrate, vegetation, etc. ensure that the final grades and condition of the project site is in a generally aesthetically pleasing condition. Contractor shall be responsible to returning the access/staging areas and adjacent properties (if disturbed) to their pre-project conditions.

**WORK AREA & LEGAL ACCESS**

25. The work as presented within these plans is wholly within the limits of private property. If in the course of the construction, the contractor's means and methods includes the use of other properties and/or jusidictions, it is the contractor's responsibility to gain any required access permissions and comply with any related permitting requirements.

**QUANTITY SUMMARY NOTES:**

26. The quantity of materials shown for stream channel structures is a conceptual level estimate. Estimated rock for the weirs and barbs are based on a "typical" structure. Actual material quantities may vary from structure to structure and rock quantities would need to be verified based on a final design prior to installation.
27. Rock Weirs shall include excavation to subgrade and purchase and installation of suitably sized feature rocks and footer rocks and interior substrate materails for a complete job as depicted within the plans and details provided.
28. The amount of rock excavation has not been quantified. Excavation includes all material encountered regardless of its nature or characteristics. Contractor should familiarize himself with the site conditions prior to bidding. Rock should be expected to be encountered in some portions of the work and the contractor shall be prepared accordingly. Geotechnical borings have not been performed to determine the depths to bedock.

**SURVEY CONTROL**

29. Coordinate Projection: North American Datum 1983 (NAD83)
    Horizontal Datum: Arizona State Plane Arizona East, Survey Feet
    Vertical Datum: North American Vertical Datum 1988 (NAV88)
    Geoid Model: Geoid09 (CONUS)
30. NCD Conducted an Engineering Design Survey in October of 2020 using the above referenced coordinate system. At that time, NCD set a 3/8" rebar with a blue plastic cap, marked "Natural Channel" as local control for the project as indicated by "NCD1" on Sheet 2.
31. Construction layout for the habitat improvements are are not included in these drawings. The majority of displayed structures can be "field fit"at indicated locations. However construction layout for rock cross-vane weirs, rock barbs and sills and would need to be provided once final locations, specific site surveys and final designs are produced.

**SPRING OUTFLOW:**

*ESTIMATED SPRING OUTLFLOW - 140 TO 180 GPM*
*OCTOBER 2020.*

**SEEDING SPECIFICATIONS**

*Disturbed areas, including travelways within the project will be re-seeded with native grasses. Seed shall be mechanically broadcast and incorporated into the soil appx. 0.5 inch.*

*Seed shall be purchased from a reliable supplier and include a mix of cold and warm season species.*

*Native grass seed will be applied at a rate of 9 lbs to the acre PLS (Pure Live Seed). Estimate area of disturbance is 1.0 acre.*

| Seed Mix<br>Native Grass Species | | 1 acre<br>lb PLS |
|---|---|---|
| Sideoats grama | (Bouteloua curtipendula) | 1.5 |
| Blue grama | (Bouteloua gracilis) | 1.0 |
| Fringed Brome | (Bromus ciliatus) | 1.5 |
| Slender wheatgrass | (Elymus trachycaulus spp.) | 1.5 |
| Prairie junagrass | (Koeleria macrantha) | 1.0 |
| Spike muhly | (Muhlenbergia wrightii) | 0.5 |
| Muttongrass | (Poa fendleriana) | 1.0 |
| Little bluestem | (Schizachyrium scoparium) | 1.0 |
| | | 9.0 lbs PLS |

**LIST OF ABBREVIATIONS**

| | | | |
|---|---|---|---|
| ~ | APPROXIMATELY | LF | LINEAR FEET |
| @ | AT | LS | LUMP SUM |
| AB | AGGREGATE BASE | LWC | LOW WATER CROSSING |
| AC | ACRE | MAX | MAXIMUM |
| ACP | ASPHALT CONCRETE PAVEMENT | M.E. | MATCH EXISTING |
| APPROX | APPROXIMATELY | MIN | MINIMUM |
| BNK | BANKFULL | MISC | MISCELLANEOUS |
| BOP | BOTTOM OF POOL | MPT | MALE PIPE THREAD |
| BOR | BOTTOM OF RIFFLE | N/A | NOT APPLICABLE |
| BOT | BOTTOM OF TRENCH | NCD | NATURAL CHANNEL DESIGN, INC. |
| CC | CENTER TO CENTER | NO. | NUMBER |
| CFS | CUBIC FEET PER SECOND | NTS | NOT TO SCALE |
| CL | CENTER LINE | OC | ON CENTER |
| CLSM | CONTROLLED LOW STRENGTH MATERIAL | PE | LOW DENSITY POLYETHYLENE |
| CMP | CORRUGATED METAL PIPE | PROP. | PROPOSED |
| CONC | CONCRETE | PSI | POUNDS PER SQUARE INCH |
| CP | CONTROL POINT | PVC | POLYVINYL CHLORIDE |
| CY | CUBIC YARD | R | RADIUS |
| DIA | DIAMETER | REQD | REQUIRED |
| DIPS | DUCTILE IRON PIPE SIZE | RC | ROCK CLUSTER |
| DR | DIMENSION RATIO | SCH | SCHEDULE |
| DTL | DETAIL | SF | SQUARE FEET |
| DWG | DRAWING | SHT | SHEET |
| EA | EACH | SS | STAINLESS STEEL |
| ELEV | ELEVATION | STA | STATION |
| EX | EXISTING | STD | STANDARD |
| FG | FINISHED GRADE ELEVATION | SY | SQUARE YARD |
| FL | FLOWLINE ELEVATION | SYMM | SYMMETRICAL |
| FPT | FEMALE PIPE THREAD | TBD | TO BE DETERMINED |
| FT | FEET | TOB | TOP OF BANK |
| FTG | FITTING | TOG | TOP OF GLIDE |
| GA | GAUGE | TOP | TOP OF POOL |
| GALV | GALVANIZED | TOR | TOP OF RIFFLE |
| GB | GRADE BREAK | TOS | TOP OF SLOPE |
| GPM | GALLONS PER MINUTE | TN | TONS |
| H | HEIGHT | TRIB | TRIBUTARY |
| HDPE | HIGH DENSITY POLYETHYLENE | TYP | TYPICAL |
| IE | INVERT ELEVATION | VLV | VALVE |
| IN. | INCH | W | WIDTH |
| IPS | IRON PIPE SIZE | W/ | WITH |
| L | LENGTH | WCS | WATER CONTROL STRUCTURE |
| LB | POUNDS | WSE | WATER SURFACE ELEVATION |

DRAWING NUMBER: T-01
SHEET NUMBER: 1 OF 11
DATE: 17 Dec 2020
NCD PROJECT NUMBER:

PRELIMINARY NOT FOR CONSTRUCTION

DRAWN BY: MW
DESIGNED BY: MK, AH, JE, JF
REVIEWED BY:

| NO. | DATE | BY | REVISION |
|---|---|---|---|

TITLE, LOCATION MAP, INDEX, & GENERAL NOTES

POND & STREAM IMPROVEMENTS
CHRISTOPHER CREEK AT R-C SCOUT RANCH
GILA COUNTY, AZ


Natural Channel Design
2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774-2336


Natural Channel Design

2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774-2336

| DRAWN BY: MW | | | |
|---|---|---|---|
| DESIGNED BY: MW, AH, JE, JF | | | |
| REVIEWED BY: | | | |
| NO. | DATE | BY | REVISION |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

SITE OVERVIEW, SURVEY INFORMATION, & LAYOUT CONTROL

POND & STREAM IMPROVEMENTS
CHRISTOPHER CREEK AT R-C SCOUT RANCH
GILA COUNTY, AZ

PRELIMINARY NOT FOR CONSTRUCTION

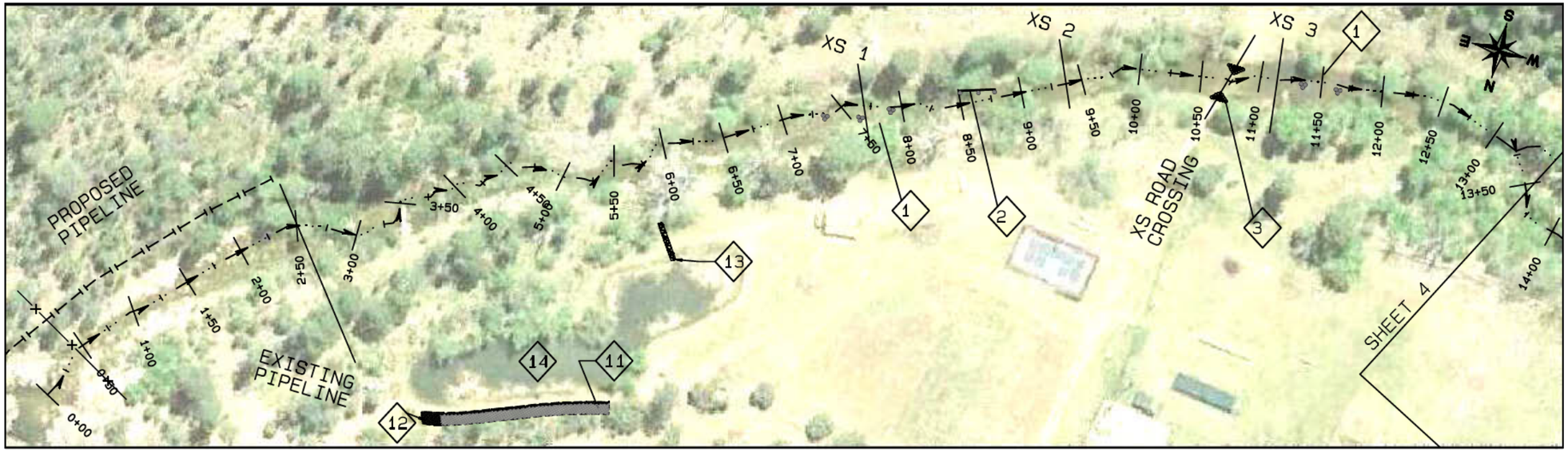
UNAUTHORIZED CHANGES & USES
THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE FOR, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

DATE: 17 Dec 2020

NCD PROJECT NUMBER:

DRAWING NUMBER: OVR-01

SHEET NUMBER: 2 OF 11




LEGEND

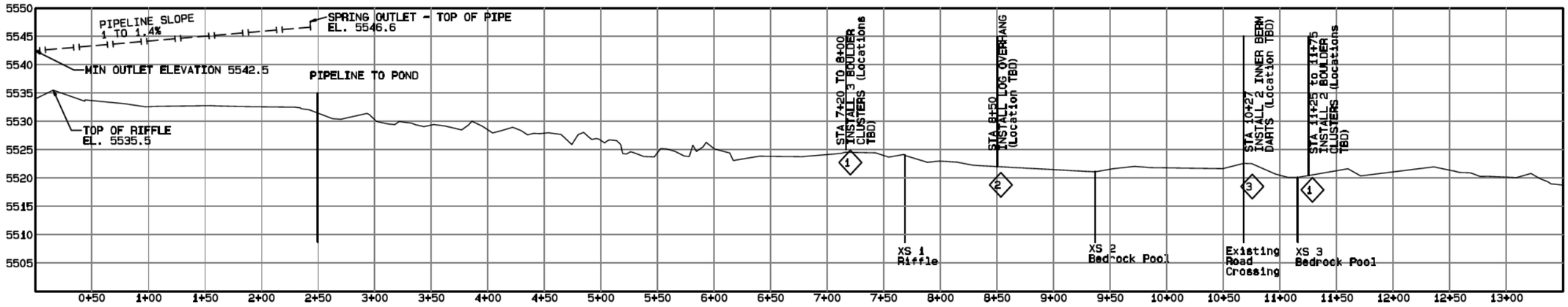
- Boulder Clusters
- Log Overhang
- Inner Berm Darts
- Rock Sill
- Rock Cross Vane Weir
- Toe Rock
- Rock Barb

10

VERT SCALE 1"=10'
HORIZ SCALE 1"=50'

50

NOTE: ALL STRUCTURE LOCAITONS TO BE DETERMINED IN FIELD PRIOR TO INSTALLATION




1. STA 7+20, 11+25, 21+00, 22+00
Install Boulder Clusters. See DETAIL SHEET 7

2. STA 8+50, 15+20
Install Log Overhangs on left side of channel
See DETAIL SHEET 7

3. STA 10+27
Install Inner Berm Darts on both sides of channel to reduce low flow channel width. See DETAIL SHEET 8

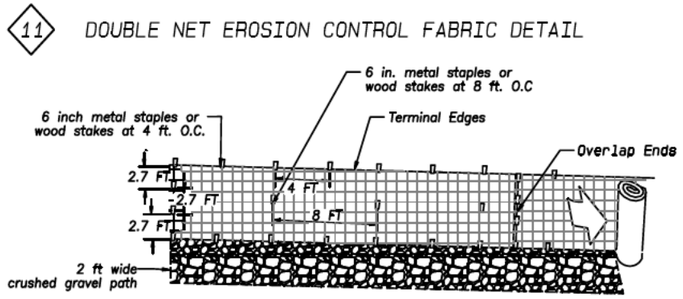
11. N SIDE OF POND - 135 linear feet
Fill small gullies along slope adjacent to pond berm with soil and smooth to blend in. Seed with a native seed mix and cover with 135 feet of double net erosion control cloth. DETAILS THIS SHEET

12. N SIDE OF POND - 150 linear feet
Place crushed gravel along a 2-foot wide path adjacent to erosion control cloth. Also create a 10 by 15 foot graveled pad at the north east end of pond and install fish cleaning station (DETAILS NOT INCLUDED)

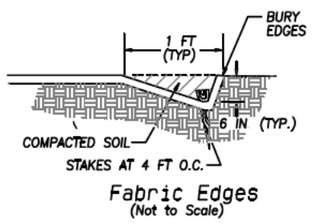
13. S SIDE OF POND - 32 linear feet
Install rock outlet chute at pond outlet. See DETAIL SHEET 9

14. VARIOUS AREAS AROUND POND - Install
rock platforms. See SHEET 10 for Details

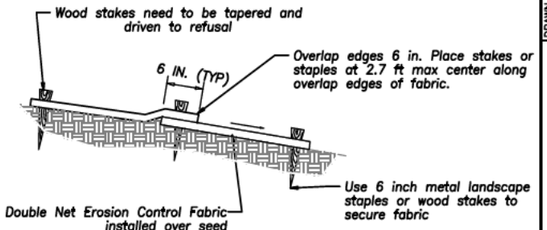
## 11 DOUBLE NET EROSION CONTROL FABRIC DETAIL




PLAN VIEW - STAKING PATTERN
(Not to Scale)




Fabric Edges
(Not to Scale)




Double Net Erosion Control Fabric installed over seed

NOTES

1. The use of erosion control fabric provides raw banks protection against erosion from overland flows while vegetation becomes established. It also acts as a mulch for seeding, helping to retain moisture and protect against seed predation.

2. Fabric is trenched on all sides except where it overlaps adjacent rolls. It is then staked on 4-foot centers with 6 inch metal landscape staples or wood stakes around the perimeter and the interior. Additional staking is used when necessary to secure any suspended areas.

DRAWING NUMBER: PP-01
SHEET NUMBER: 3 OF 9

DATE: 25 NOV 2020
NCD PROJECT NUMBER:

PRELIMINARY NOT FOR CONSTRUCTION

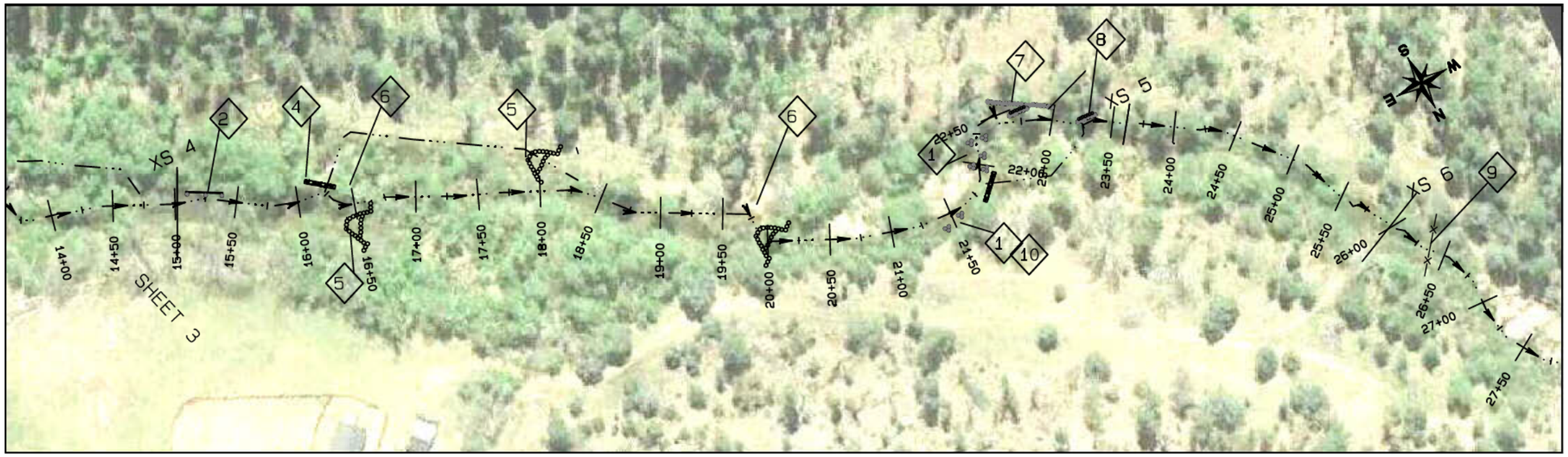
PLAN & PROFILE:
STREAM CHANNEL-STATION 0+00 TO 13+50
EROSION CONTROL FABRIC DETAIL

POND & STREAM IMPROVEMENTS
CAMP R-C, BOY SCOUTS OF AMERICA
GILA COUNTY, AZ

| NO. | DATE | BY | REVISION |
|---|---|---|---|

DESIGNED BY: MK, AH
DRAWN BY: MK

Natural Channel Design
2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774-2336

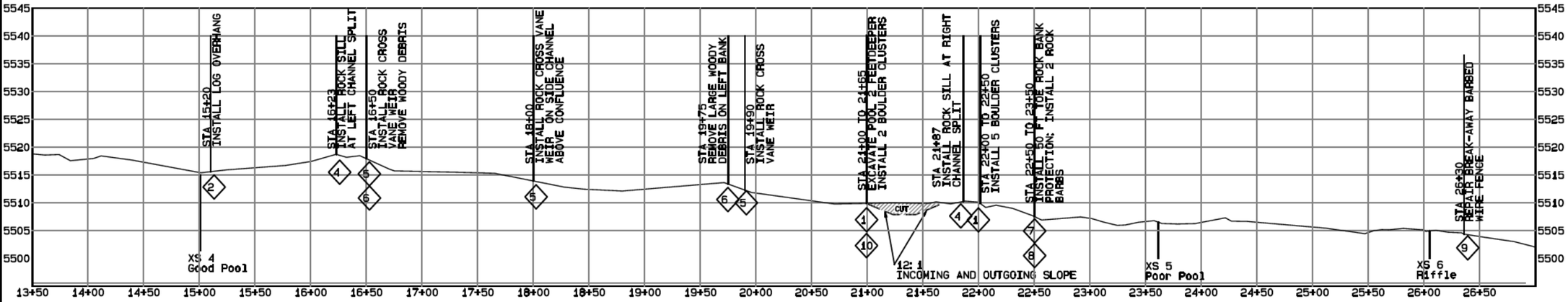



LEGEND

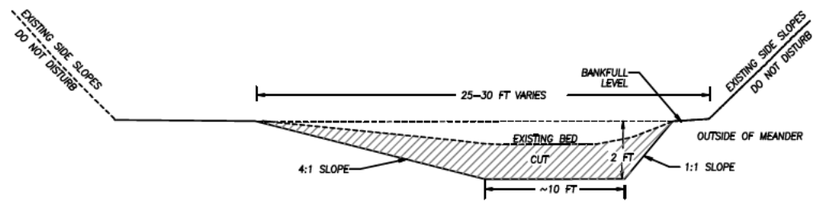
- Boulder Clusters
- Log Overhang
- Inner Berm Darts
- Rock Sill
- Rock Cross Vane Weir
- Toe Rock
- Rock Barb

VERT SCALE 1"=10'
HORIZ SCALE 1"=50'

NOTE: ALL STRUCTURE LOCAITONS TO BE DETERMINED IN FIELD PRIOR TO INSTALLATION




1. STA 7+20, 11+25, 21+00, 22+00
   Install Boulder Clusters
   See DETAIL SHEET 7
2. STA 8+50, 15+20
   Install Log Overhangs on left side of channel
   See DETAIL SHEET 7
4. STA 16+23, 21+87
   Install Rock Sills across diverging overflow channels to provide grade control.
   See DETAIL SHEET 8
5. STA 16+50, 18+00
   Install Rock Cross-Vane weirs to provide grade control
   See DETAIL SHEET 9
6. STA 16+50, 19+75
   Remove large woody debris blocking channel. Place outside of floodplain.
7. STA 22+50
   Install 50 feet of toe rock along left bank.
   See DETAIL SHEET 9
8. STA 22+50 to 23+50
   Install two Rock Barbs along left bank.
   See DETAIL SHEET 8
9. STA 26+30
   Repair barbed wire fence crossing the stream.
   See DETAIL SHEET 9
10. STA 21+00 to 21+65
    Excavate sediment in pool appx 2 feet.




10. STA 21+00
    TYPICAL POOL CROSS SECTION
    NOT TO SCALE

NOTES:

1. Excavate pool in meander approx. 2.0 ft below bankfull elevation.
2. Shape incoming and outgoing slope at 12H:1V slope.
3. Center portion of pool approx. 20 ft long.
4. Spoils to be spread over floodplain outside bankfull channel
5. Limit damage to existing vegetation to extent possible.

PRELIMINARY NOT FOR CONSTRUCTION

DRAWN BY: MK
DESIGNED BY: MK, AH
REVIEWED BY:

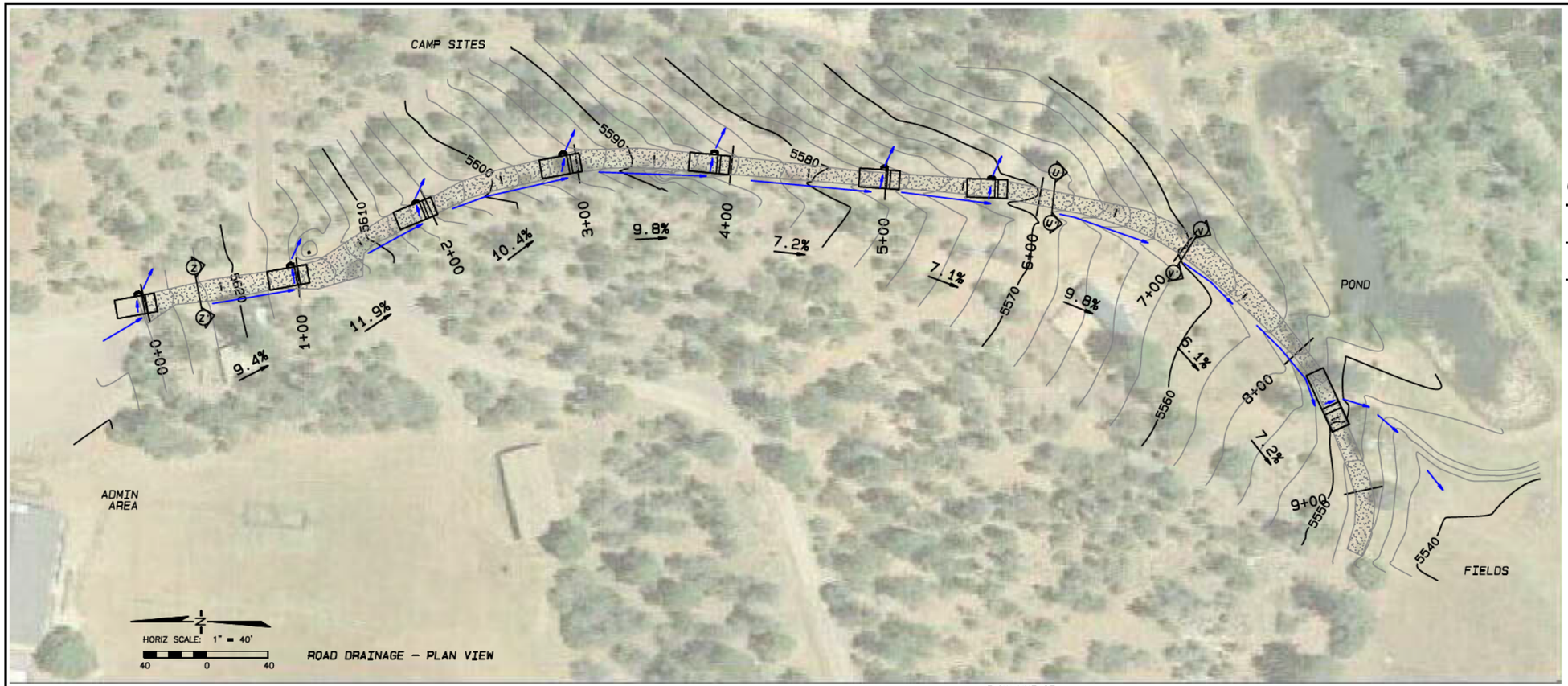
| NO. | DATE | BY | REVISION |
|---|---|---|---|

DATE: 25 NOV 2020
NCD PROJECT NUMBER:
DRAWING NUMBER: PP-02
SHEET NUMBER: 4 OF 9

PLAN & PROFILE:
STREAM CHANNEL–STATION 13+50 TO 27+00
STA 21+00 TYPICAL POOL CROSS–SECTION DETAIL

POND & STREAM IMPROVEMENTS
CAMP R–C, BOY SCOUTS OF AMERICA
GILA COUNTY, AZ

Natural Channel Design
2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774–2336



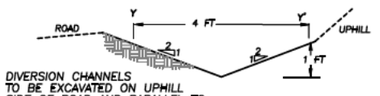

ROAD DRAINAGE – PLAN VIEW

| ROAD GRADE (%) | SOIL GROUP ON WHICH ROAD IS LOCATED OR BUILT | | | | | |
|---|---|---|---|---|---|---|
| | GROUP 1 (SAND) | GROUP 2 | GROUP 3 | GROUP 4 | GROUP 5 | GROUP 6 |
| | CROSS-DRAIN SPACING (FEET) | | | | | |
| 2 | 167 | 154 | **137** | 135 | 105 | 95 |
| 4 | 152 | 139 | **122** | 120 | 90 | 80 |
| 6 | 144 | 131 | **114** | 112 | 82 | 72 |
| 8 | 137 | 124 | **107** | 105 | 75 | 65 |
| 10 | 128 | 115 | **98** | 96 | 86 | 57 |
| 12 | 119 | 106 | **89** | 87 | 57 | 48 |
| 14 | 108 | 95 | **78** | 76 | 46 | 37 |

SPACING PER NRCS APACHE COUNTY

## CONSTRUCTION NOTES

- WATER BARS ARE TO BE ANGLED WITH RESPECT TO THE ROAD TO REDUCE THE SEVERITY OF THE "BUMP" FOR VEHICLES DRIVING ACROSS THEM.
- SPECIFICATIONS SHOWN ARE AN AVERAGE, AND MAY BE ADJUSTED BY THE ENGINEER BASED UPON EXACT FIELD CONDITIONS ENCOUNTERED AT EACH WATER BAR LOCATION.
- GROUP 3 SOIL IS ASSUMED TO BE THE TYPE AT THE SCOUT CAMP AND THIS SOIL CLASSIFICATION DEFINES A SOIL THAT DOES NOT "SOAK UP" WATER WELL DURING A STORM EVENT. THIS SOIL IS HIGHER IN CLAY AND SILT. IF SITE CONDITIONS AT TIME OF CONSTRUCTION SHOW A MORE SANDY SOIL, AN EXTENDED SPACING PER THE TABLE ABOVE MAY BE SUBSTITUTED AFTER CONSULTATION WITH THE ENGINEER.

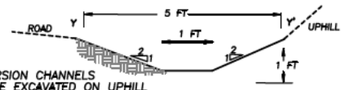



DIVERSION CHANNELS TO BE EXCAVATED ON UPHILL SIDE OF ROAD AND PARALLEL TO THE ROAD SLOPE

(Y1) ROAD CHANNEL – SECTION VIEW

(Not to scale)

TYPICAL OF ROAD BETWEEN WATER BARS

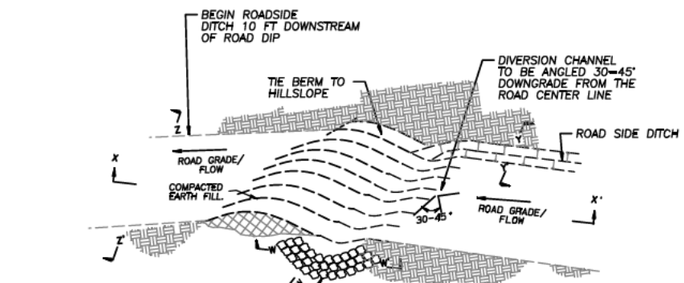



DIVERSION CHANNELS TO BE EXCAVATED ON UPHILL SIDE OF ROAD AND PARALLEL TO THE ROAD SLOPE

(Y2) ROAD CHANNEL – SECTION VIEW

(Not to scale)

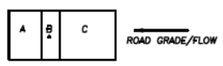
TYPICAL ± 150 FEET UPSTREAM OF FINAL WATERBAR



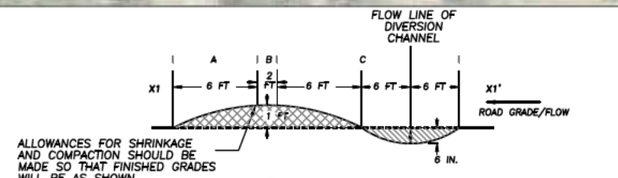

WATER BAR – ISOMETRIC VIEW

(Not to scale)

ROLLING DIP LOCATIONS ARE APPROXIMATE, SOME DEGREE OF FIELD FITTING WILL BE NECESSARY TO MATCH DIP SPACING WITH THE BEST LOCATION ON THE GROUND.




WATER BAR – PLAN VIEW



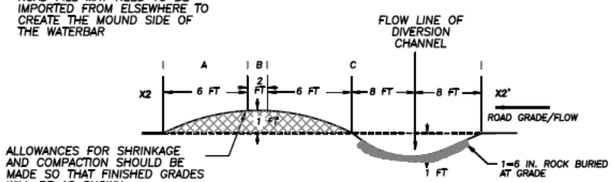

ALLOWANCES FOR SHRINKAGE AND COMPACTION SHOULD BE MADE SO THAT FINISHED GRADES WILL BE AS SHOWN.

NO BORROW FOR THIS FILL TO BE MADE WITHIN 30' OF ROAD EXCEPT MATERIAL TAKEN FROM CHANNEL.

ROAD FILL MAY NEED TO BE IMPORTED FROM ELSEWHERE TO CREATE THE MOUND SIDE OF THE WATERBAR

(X1) UPPER WATER BAR – PROFILE VIEW

(Not to scale)




ALLOWANCES FOR SHRINKAGE AND COMPACTION SHOULD BE MADE SO THAT FINISHED GRADES WILL BE AS SHOWN.

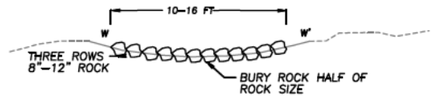
NO BORROW FOR THIS FILL TO BE MADE WITHIN 30' OF ROAD EXCEPT MATERIAL TAKEN FROM CHANNEL.

ROAD FILL MAY NEED TO BE IMPORTED FROM ELSEWHERE TO CREATE THE MOUND SIDE OF THE WATERBAR

(X2) WATER CROSSING – PROFILE VIEW

(Not to scale)

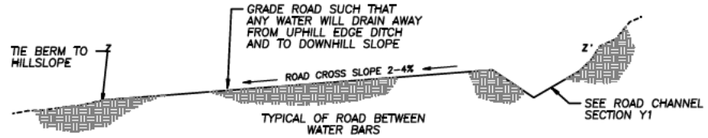
TYPICAL OF MULTIPLE WATERBARS ALONG UPPER PORTION OF ROAD




(W) SPREADER STRUCTURE – SECTION VIEW

(Not to scale)

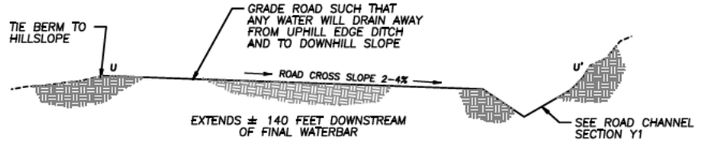
DEPICTS FLOW CROSSING AT BOTTOM OF SYSTEM AND DIVERSION TO FIELD




TYPICAL OF ROAD BETWEEN WATER BARS

(Z) ROAD UPPER – CROSS SECTION VIEW

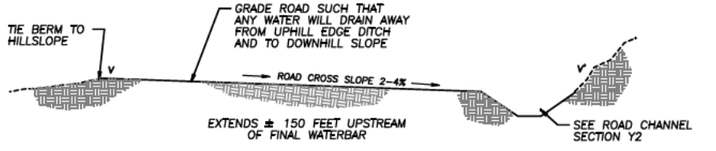
(Not to scale)




EXTENDS ± 140 FEET DOWNSTREAM OF FINAL WATERBAR

(U) ROAD MIDDLE – CROSS SECTION VIEW

(Not to scale)




EXTENDS ± 150 FEET UPSTREAM OF FINAL WATERBAR

(V) ROAD LOWER – CROSS SECTION VIEW

(Not to scale)

DRAWING NUMBER: R001
SHEET NUMBER: 5 of 11
DATE: 17 Dec 2020
NOD PROJECT NUMBER:

PRELIMINARY NOT FOR CONSTRUCTION

ROAD GRADING & DRAINAGE

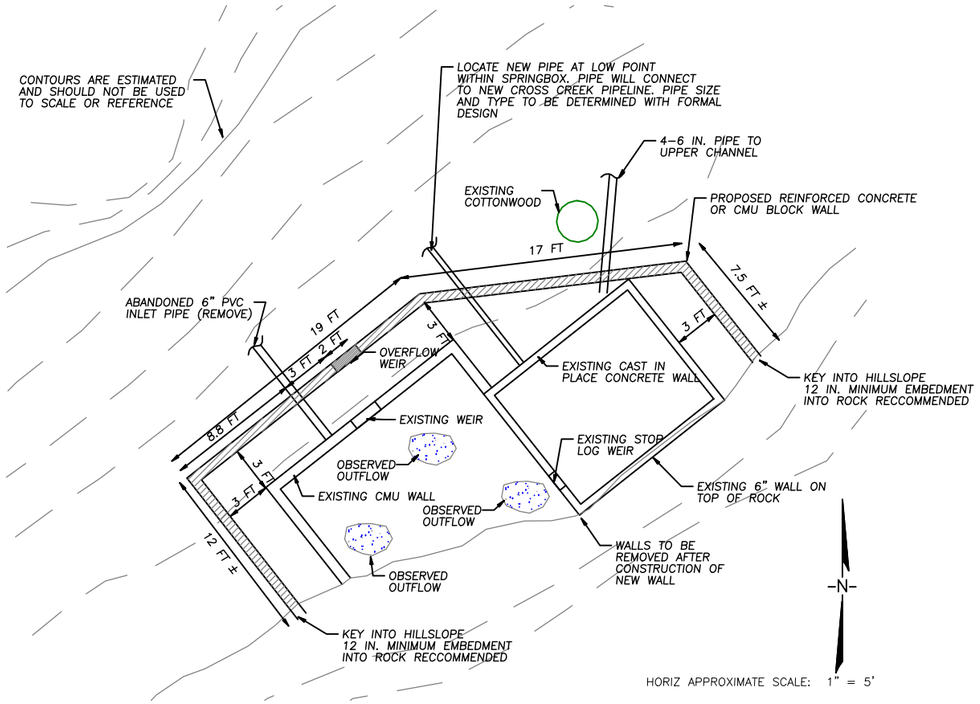
POND & STREAM IMPROVEMENTS
CHRISTOPHER CREEK AT R-C SCOUT RANCH
GILA COUNTY, AZ

| NO. | DATE | BY | REVISION |
|---|---|---|---|

DRAWN BY: JF
DESIGNED BY: MK, JF
REVIEWED BY:

Natural Channel Design

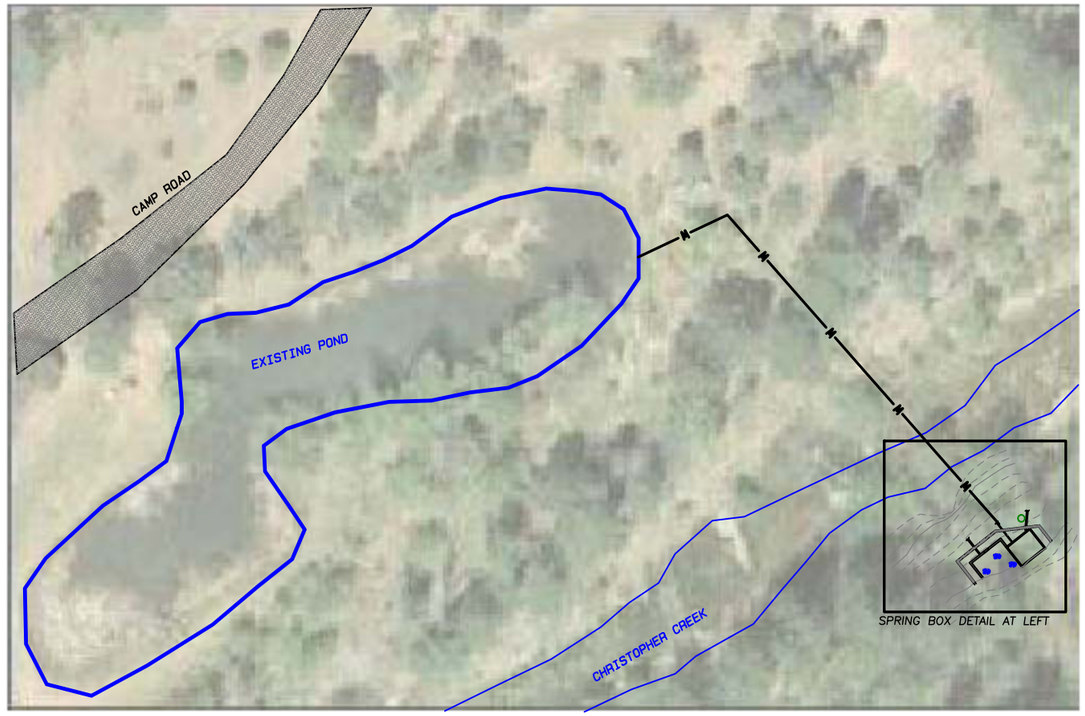
2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774-2336



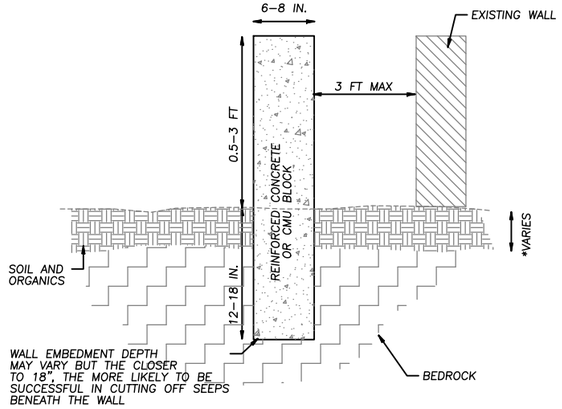

HORIZ APPROXIMATE SCALE: 1" = 5'

SPRING BOX - PLAN VIEW

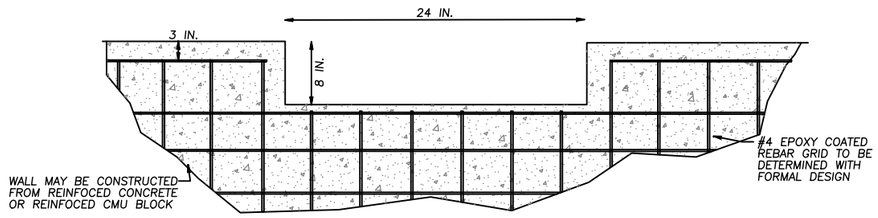
NOTE:
CONDITION OF BEDROCK IS AT THIS POINT UNKNOWN. IT IS ASSUMED THAT KEYING WALL INTO BEDROCK SHOULD GIVE THE BEST CHANCE OF SUCCESS. IF WHEN BEDROCK IS EXPOSED A FISSURE OR CRACK IS DISCOVERED, STEPS MAY BE POSSIBLE TO SEAL THE CRACKS DEPENDING UPON WHAT IS DISCOVERED AT THE TIME OF CONSTRUCTION AND THE ENGINEER SHOULD BE CONTACTED.



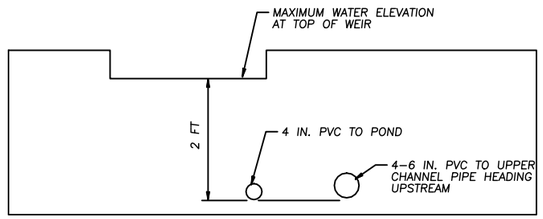

SPRING BOX LOCATION MAP
(Not to scale)



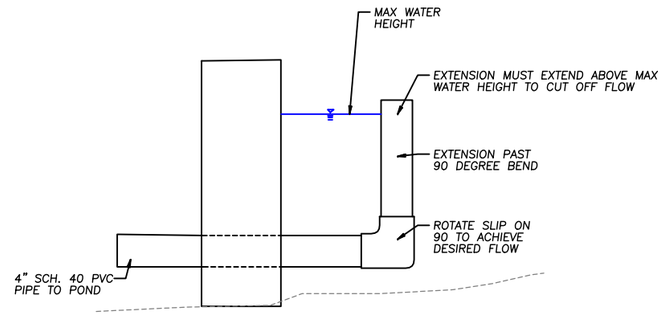

SPRING WALL - SECTION VIEW
(Not to scale)




SPRING WALL WEIR - PROFILE VIEW
(Not to scale)




SPRING WALL WEIR & PIPE OUTLETS - PROFILE VIEW
(Not to scale)




FLOW CONTROL SYSTEM - PROFILE VIEW
(Not to scale)

SPRING BOX DETAIL

POND & STREAM IMPROVEMENTS
CHRISTOPHER CREEK AT R-C SCOUT RANCH
GILA COUNTY, AZ

PRELIMINARY NOT FOR CONSTRUCTION

DRAWING NUMBER: RD01
SHEET NUMBER: 6 of 11

DATE: 17 Dec 2020
NOD PROJECT NUMBER:

UNAUTHORIZED CHANGES & USES: THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE ENGINEER PREPARING THE PLANS.

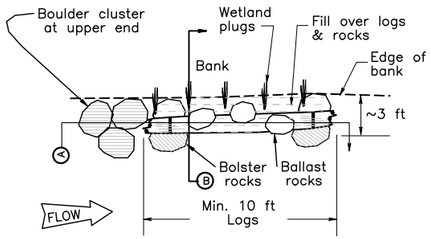
811 Arizona Blue Stake, Inc. 1-800-STAKE-IT

| NO. | DATE | BY | REVISION |
|---|---|---|---|
| | | | |

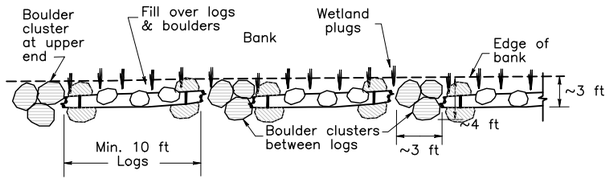
DESIGNED BY: MK, JF
DRAWN BY: JF
REVIEWED BY:

Natural Channel Design
2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774-2336

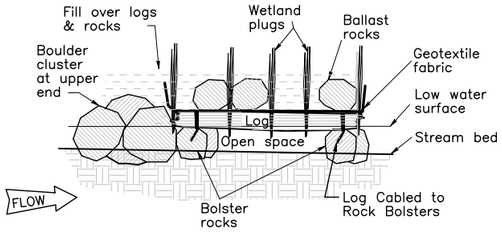
## 2 LOG OVERHANG DETAILS



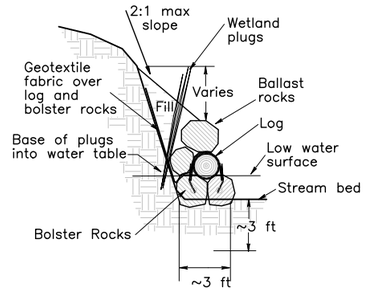

PLAN VIEW - Single Log Structure
(Not to scale)




PLAN VIEW - Multiple Structures
(Not to scale)




A PROFILE VIEW
Single Log Structure
(Not to scale)




B SECTION VIEW
(Not to scale)

### GEOTEXTILE

Runs the length of the structure and is 7 to 8 ft wide.

Geotextile shall be a non-woven fabric with a minimum tensile strength of 120 lb, greater than 50% elongation at failure, and a minimum of 60 lb puncture.

### LOGS

Species Pine, Straight juniper

Dia = 10-12 in.

L = ~10-20 ft

### BOLSTER ROCKS (see Details this sheet)

Dia = 24-30 in.

# of rocks per structure 4

### BALLAST BOULDERS

Dia = 18-24 in.

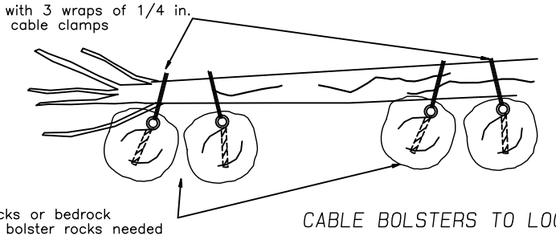
# of rocks per structure 3

### NOTES:

1. It may be easier to build each structure on the bank and lift into place.
2. Secure bolster rock to either end of log and place in the stream bed up against the bank.
3. Install Boulder Clusters in space between log structures.
4. Place geotextile fabric over logs and secure with nails. Extend fabric up bank to above bankfull height.
5. Place ballast rock on top of log and geotextile.
6. Back-fill over structure in compacted lifts to a maximum 2H:1V slope.
7. Plant native seed mix and cover with erosion control fabric.
8. Plant wetland plugs at 2 ft centers on bank-side of logs and boulder clusters.

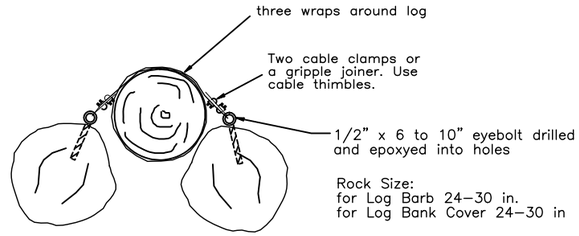
## ROCK BOLSTER ANCHOR

Secure logs to rock bolsters with 3 wraps of 1/4 in. wire rope and two galvanized cable clamps



Large bolster rocks or bedrock
Total number of bolster rocks needed is determined by log size and available rocks on site.

CABLE BOLSTERS TO LOG
N.T.S.




CABLE TO EYEBOLT IN ROCK BOLSTER N.T.S.

### NOTES

The hole diameter drilled must be no more than one-eighth inch larger than the eyebolt and shall be approximately 6-10 inches deep. Use clear, clean water to thoroughly clean drilled holes to ensure the epoxy will adhere to the rock, not the dust or silt. Fill the hole approximately two-thirds full with epoxy. Insert eye bolt Into hole several times to dispense and completely mix epoxy and eliminate air pockets. Test strength of bond after minimum cure time recommended by the epoxy manufacturer.

Secure logs to rock bolsters with a minimum of three wraps of the 1/4-in. wire rope and two cable clamps or joiners. Always remove bark at the point of contact between the cable and the log or root wad because bark will rot, resulting in slack in the anchoring cable. Notching the log to recess the cable is helpful.

Materials for rock anchors (bolsters) include:
1/4-inch diameter galvanized non-greased, wire rope
1/2-inch diameter galvanized shoulder eyebolts; 6 to 10 inch length
Galvanized cable clamps or Gripple joiners and tensioners
Cable thimbles
Epoxy resin system meeting the requirements of ASTM C881, Type IV Grade 3 Class A
(or comparable adhesive that can be used in wet or dry conditions and temperatures below 40° F)

## 1 BOULDER CLUSTERS DETAILS

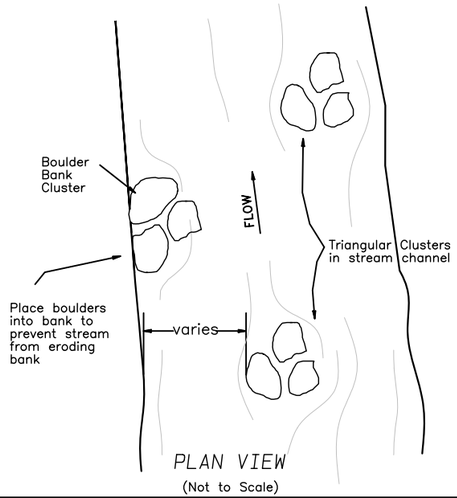
Provides overhead cover and creates scour pockets around boulders, builds quiet water resting areas, and sorts spawning gravel.

Dia = 24 min(in) 36 max(in)

# of rocks per structure ~3

### INSTALLATION NOTES

1. Boulders clusters can be placed along the channel edge and middle portion of channel (where deposition is not expected to occur).
2. Boulders can be placed in riffles, runs, glides, and open pools.
3. A suggested spacing of clusters within the same stream segment is one-third of the stream width apart, placed in a manner to break up high velocity flows.
4. Avoid locations where placement could divert the steam channel's thalweg or divert toward potentially unstable stream banks.
5. Boulders shall be large, 18 to 30 in., irregularly shaped; angular rock provides the most hiding spaces.
6. Embed the boulders into the stream bed in a triangular pattern with spaces between the boulders ranging from 6 in. to 1 ft. This spacing provides cover and other habitat needs, and ensures the creation of scour pockets. Top of boulders should be below bankfull depth, ~2.5 ft.
7. Boulder clusters can restore meanders in channelized reaches, protect eroded banks by deflecting flow, and improve gradation of substrate materials.




PLAN VIEW
(Not to Scale)

ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

UNAUTHORIZED CHANGES & USES: THE ENGINEER PREPARING THESE PLANS, CANNOT BE RESPONSIBLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES MUST BE IN WRITING AND MUST BE APPROVED BY THE ENGINEER PRIOR TO THE CHANGE. ANY UNAUTHORIZED USE OF THESE PLANS WILL BE AT THE SOLE RISK AND RESPONSIBILITY OF THE USER.

DRAWING NUMBER: DTL-01
SHEET NUMBER: 7 of 11
DATE: 17 Dec 2020
NGD PROJECT NUMBER:

PRELIMINARY NOT FOR CONSTRUCTION

DRAWN BY: MW
DESIGNED BY: MW, AH
REVIEWED BY:

| NO. | DATE | BY | REVISION |
|---|---|---|---|

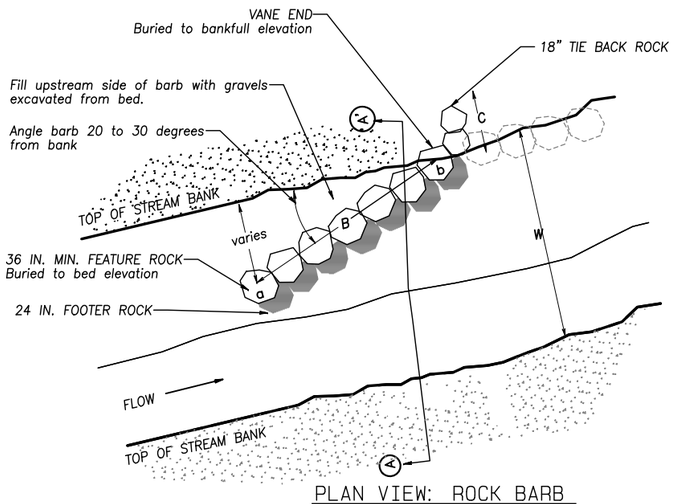
# BOULDER CLUSTERS, LOG OVERHANG & ROCK BOLSTER DETAILS

# POND & STREAM IMPROVEMENTS CHRISTOPHER CREEK AT R-C SCOUT RANCH GILA COUNTY, AZ


Natural Channel Design
2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774-2336

## 8 ROCK BARB DETAILS – (MORE DETAILED SITE SPECIFIC SURVEYS NEED TO BE CONDUCTED FOR FINAL DESIGN PRIOR TO INSTALLATION)

Provides habitat and bank protection, breaks up high velocities along outside of meander and creates small scour holes with verticle cover.




PLAN VIEW: ROCK BARB
(NOT TO SCALE)

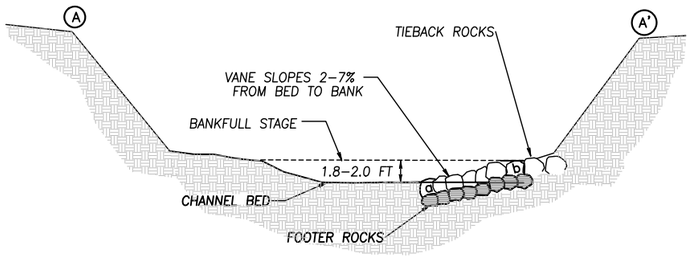
DIMENSIONS

W = 35–39 ft
B = 20–28 ft
C = 5 ft min.

TOP OF ROCK "a" BED ELEVATION
TOP OF ROCK "b" BANKFULL ELEVATION

### ROCK SPECIFICATIONS (per structure)

| | SIZE | | QUANTITY |
|---|---|---|---|
| Top Rock | 36 | in. | 9 ea. |
| Footer Rock | 24 | in. | 13 ea. |
| Tieback Rock | 18 | in. | 8 ea. |

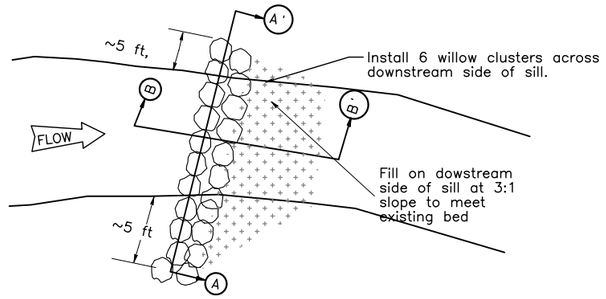



SECTION VIEW: ROCK BARB
(NOT TO SCALE)

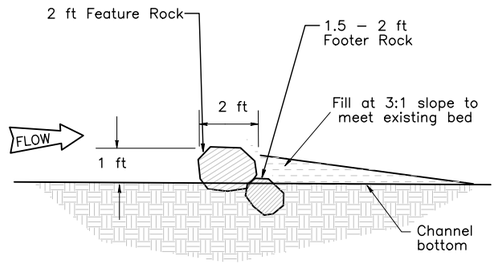
### NOTES:

1. This typical detail is for general Barb design. Specific dimensions for each installation site needs to be determined prior to construction.
2. Rock barb is utilized to slow velocities along the outside of a bend and recenter the highest velocities towards the center of the stream.
3. Rock are sized according to the shear forces exerted on them at the design flow.
4. Rock shall be angular with a specific gravity greater than 2.5.
5. Barb measurements are based on centerline of rock
6. Bury boulders at ends in substrate and in bank for tie–in.
7. Angle structure upstream at 30 deg. or less sloping from bankfull height or less at 7%.
8. Plant willow pole clusters in bank around structure.
9. Dig out downstream side to initiate scour pool developement.

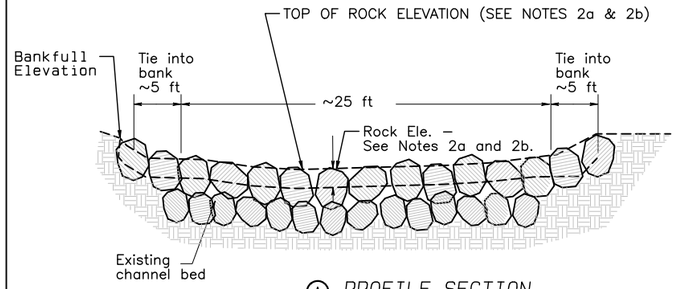
## 4 ROCK SILL DETAILS




PLAN VIEW
(Not to Scale)




B CROSS SECTION
Not to Scale




A PROFILE SECTION
Not to Scale

### NOTES:

1. Excavate channel bed and banks in preparation for rock placement. Take care to minimize disturbance of existing vegetation. Spoils (larger materials) will be used as fill on downstream side of structure.

2a. STA 16+23 – Install rock so that the top of sill matches existing channel bed elevation.

2b. STA 21+87 – Install rock to extend 1.0 ft above existing channel bed elevation.

3. Use well–graded, angular rock of size indicated in Rock Specifications below.

4. Backfill downstream side of rock structure with spoils from excevation. Select larger material for backfill.

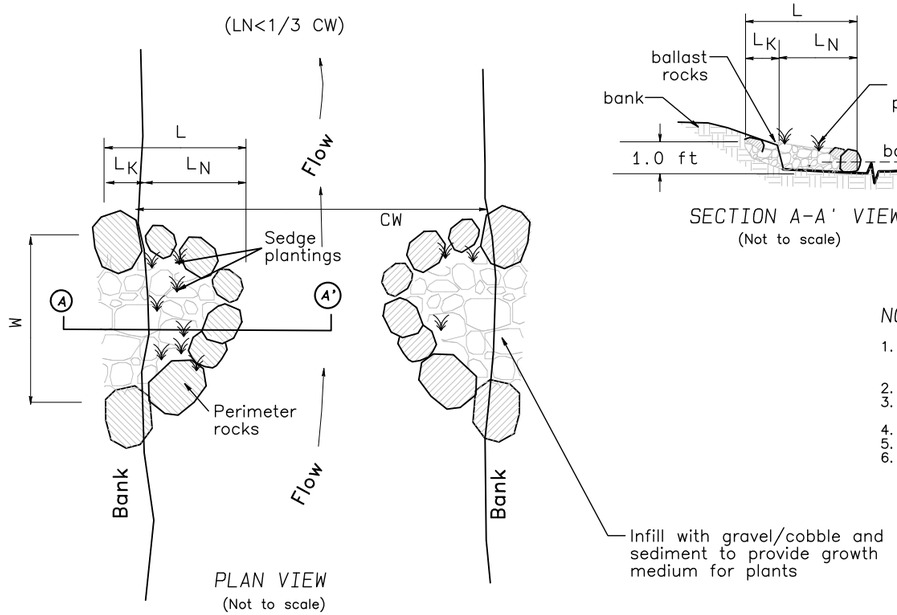
### ROCK SPECIFICATIONS

Use well–graded, angular rock with bulk specific gravity greater than 2.5

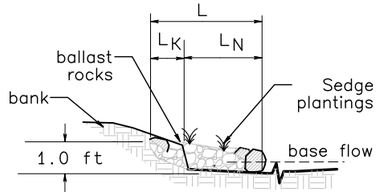
Rock Gradation: Dmin = 18 in.
D50 = 24 in.
Dmax = 36 in.

## 3 INNER BERM DART DETAILS

Provides low water depth and cover




PLAN VIEW
(Not to scale)




SECTION A–A' VIEW
(Not to scale)

**DIMENSIONS**

CW 34 (ft) L 12 (ft)
W 34 (ft) $L_N$ 10 (ft)
$L_K$ 2 (ft)

**BOULDERS**

Dia = 18 min(in) 24 max(in)
# of rocks per structure 20–30

### NOTES:

1. Used to constrict low water flow which would ordinarily spread over bar in a thinner sheet and unusable by adult fish.
2. Captures fine sediments and builds out toe of bank.
3. Install in pairs in low slope riffles or runs which are wide and shallow.
4. Perimeter rock is 18–24 inches
5. Infill is river gravels/cobbles.
6. Plant with sedges.

ALL DRAWINGS 8½ x 11 ANSI A

UNAUTHORIZED CHANGES & USES: THE ENGINEER PREPARING THESE PLANS, AND THE ENGINEER'S EMPLOYER, SHALL NOT BE LIABLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS BY ANY PERSON OTHER THAN THE ENGINEER OF RECORD FOR THESE PLANS.

DRAWING NUMBER: DTL–02
SHEET NUMBER: 8 of 11
DATE: 17 Dec 2020
NGD PROJECT NUMBER:

PRELIMINARY NOT FOR CONSTRUCTION

ROCK BARB, ROCK SILL & INNER BERM DART DETAILS

POND & STREAM IMPROVEMENTS
CHRISTOPHER CREEK AT R–C SCOUT RANCH
GILA COUNTY, AZ

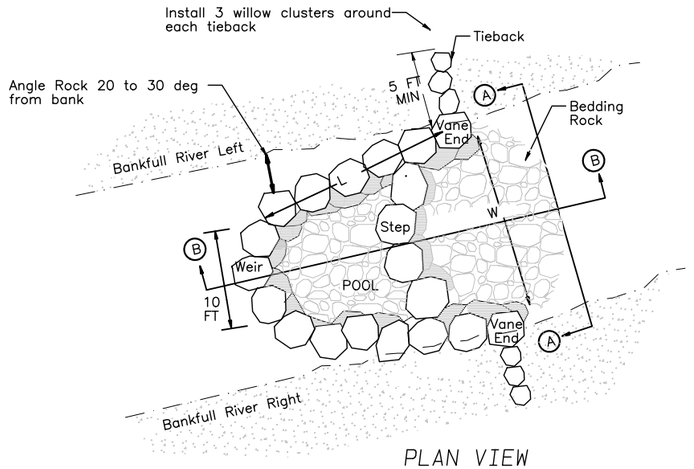
DRAWN BY: MW
DESIGNED BY: MW, AH
REVIEWED BY:

| NO. | DATE | BY | REVISION |
|---|---|---|---|

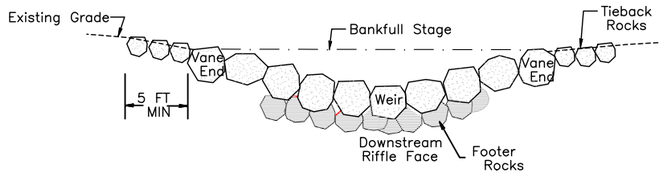
Natural Channel Design


2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774–2336

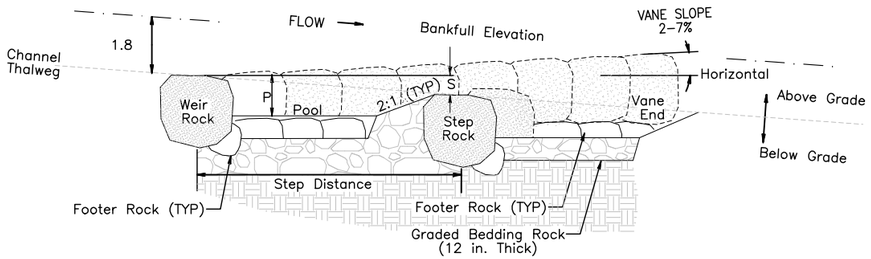
## 5 CROSS VANE WEIR DETAILS (MORE DETAILED SITE SPECIFIC SURVEYS NEED TO BE CONDUCTED FOR FINAL DESIGN PRIOR TO INSTALLATION)




PLAN VIEW
(Not to Scale)




A FRONT ELEVATION
(STEP NOT SHOWN)
(Not to Scale)




B PROFILE
(Not to Scale)

### ROCK SPECIFICATIONS (estimated per structure)

| | SIZE | | QUANTITY | |
|---|---|---|---|---|
| Top Rock | 36 | in. | 25 | ea. |
| Footer Rock | 24 | in. | 32 | ea. |
| Tieback Rock | 18 | in. | 8 | ea. |

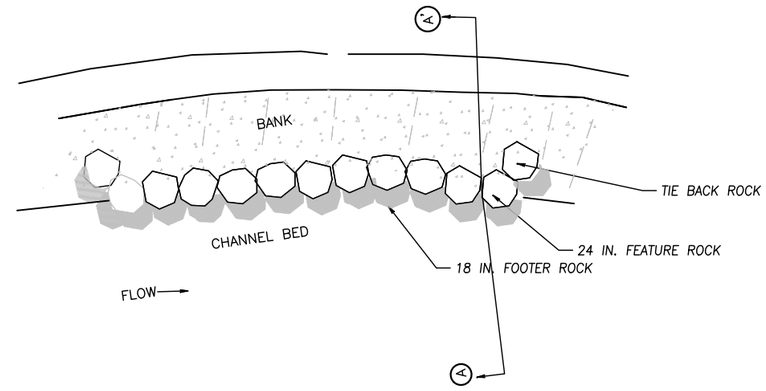
### ROCK CROSS VANE NOTES

1. This structure decreases near-bank stress and provides grade control by preventing downcutting of stream channels and providing floodplain connectivity.
2. Vane arms are constructed by forming a u-shaped weir across the stream with appropriately sized boulders.
3. Use dense, sound, well-graded angular rock that is free of cracks and is approved by the engineer or representative.
4. The weir is lower in the center than on the sides and helps to center the flow of the channel and pass sediment.
5. The sides of the weir are tied into the banks with tie-back wings constructed of boulders that prevent the channel from cutting around the grade control.

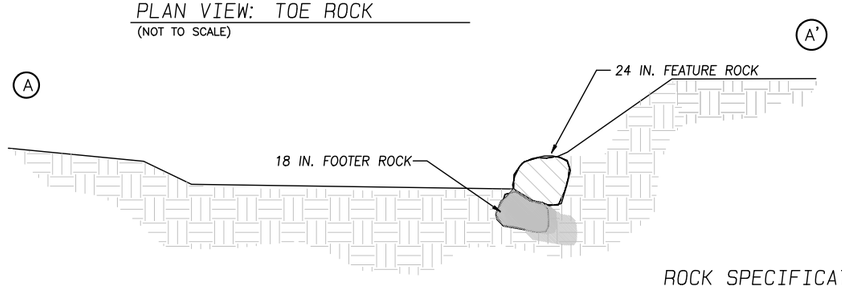
### TYPICAL STRUCTURE DIMENSIONS (TO BE DETERMINED AT FINAL DESIGN)

| LOCATION | WEIR THROAT WIDTH (FT) | POOL DEPTH (P) (FT) | STEP DISTANCE (FT) | STEP DEPTH (S) (FT) | VANE % SLOPE | VANE END STATION | VANE LENGTHS L (FT) | WEIR OUTLET WIDTH (W) (FT) | BANKFULL MAX DEPTH (FT) | MIN TOP ROCK SIZE (IN.) | MIN FOOTER ROCK SIZE (IN.) | MIN TIEBACK ROCK SIZE (IN.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TBD | 10–13 | 2.5 | 14 | 0.8 | 4–7% | TBD | 20–30 | 30–39 | 1.8–2.0 | 36 | 24 | 18 |

## 7 TOE ROCK DETAILS




PLAN VIEW: TOE ROCK
(NOT TO SCALE)




SECTION A-A': TOE ROCK
(NOT TO SCALE)

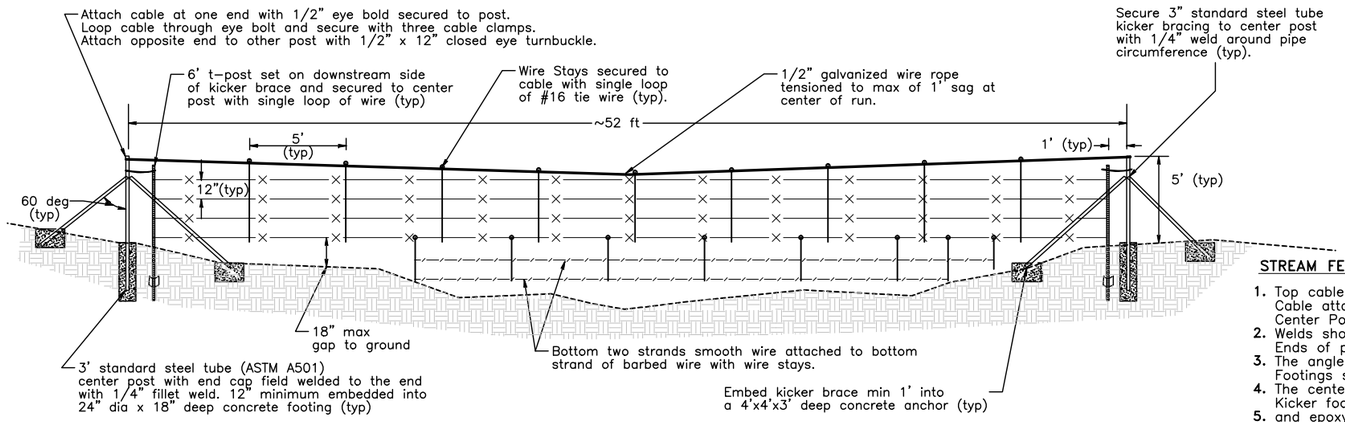
### ROCK SPECIFICATIONS

| | SIZE | | QUANTITY | |
|---|---|---|---|---|
| Top Rock | 24 | in. | 27 | ea. |
| Footer Rock | 18 | in. | 35 | ea. |

### TOE ROCK NOTES

1. Toe rock to be installed at base of existing bank as specified by Engineer or Representative.
2. Feature rocks to be installed so top of rock is at bankfull elevation.
3. Feature rocks are placed on top of footer rocks and locked together to minimize gaps and to have a generally smooth face.

## 9 BARBED WIRE STREAM CROSSING DETAIL
(NTS)

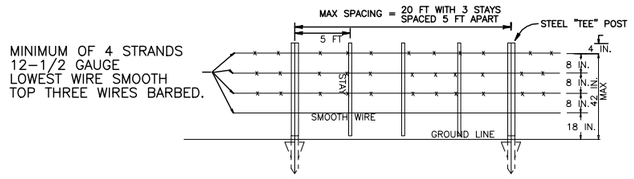



### STREAM FENCE CROSSING NOTES

1. Top cable to be 1/2", 6x19 IWRC Galvanized Wire Rope
   Cable attached to posts with 1/2" eye bolt and 1/2"x12" Eye & Eye Galvanized Turnbuckle
   Center Post and Bracing are 3" diameter standard steel pipe, meeting ASTM A501, Fy=36 ksi
2. Welds should be 1/4" fillet, all around (O) pipe circumference.
   Ends of pipe shall be capped and welded with 1/4" fillet all around.
3. The angle between center posts and kickers shall be 60 deg.
   Footings should be standard weight (150 lb/ft.) concrete, 3,000 psi.
4. The center post pipe shall extend a minimum of 12" into a 24" dia x 18" deep concrete footing
   Kicker footings are 4'x4'x3' deep. If bedrock is encountered at 18" deep or less, drill
5. and epoxy four (4) #4 rebar, 12" deep into rock leaving 12" exposed and embedded into concrete footing. Space rebar 3' apart.

### TYPICAL BARBED WIRE FENCE DETAILS

STEEL "TEE" POST & WIRE SPACING FOR BARBED WIRE FENCE




MINIMUM OF 4 STRANDS
12-1/2 GAUGE
LOWEST WIRE SMOOTH
TOP THREE WIRES BARBED.

| DRAWING NUMBER: | DTL-03 |
|---|---|
| SHEET NUMBER: | 9 of 11 |
| DATE: | 17 Dec 2020 |
| NGD PROJECT NUMBER: | |

UNAUTHORIZED CHANGES & USES: THE ENGINEER PREPARING THESE PLANS SHALL NOT BE RESPONSIBLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES MUST BE IN WRITING AND MUST BE APPROVED BY THE ENGINEER PRIOR TO THE CHANGE BEING MADE.

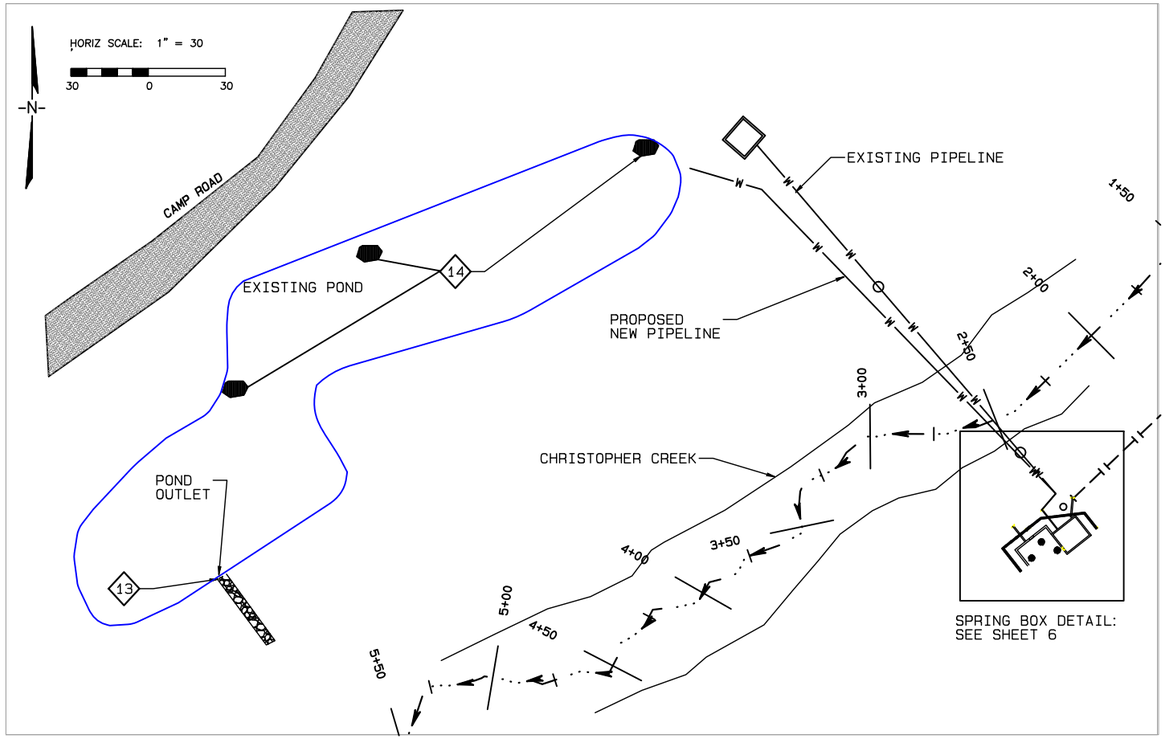
PRELIMINARY NOT FOR CONSTRUCTION

CROSS-VANE WEIR, TOE ROCK & BARBED WIRE CROSSING DETAILS

POND & STREAM IMPROVEMENTS
CHRISTOPHER CREEK AT R-C SCOUT RANCH
GILA COUNTY, AZ

| DRAWN BY: MW | | | |
|---|---|---|---|
| DESIGNED BY: MW, AH, JE | | | |
| REVIEWED BY: | | | |
| NO. | DATE | BY | REVISION |


Natural Channel Design
2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774-2336

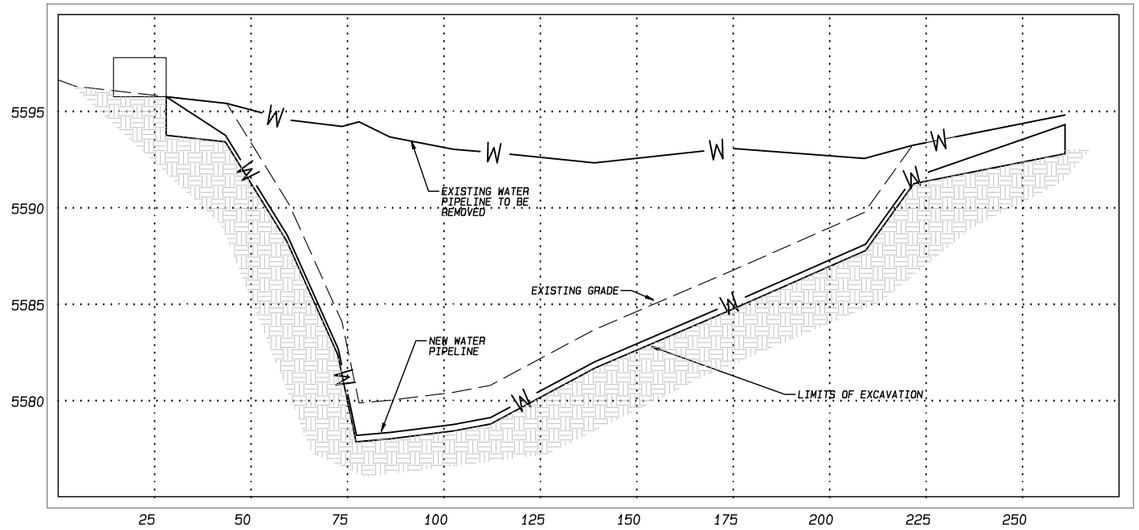



## NOTES:

1. Pipeline is expected to be 4 inch schedule 40 PVC. Final size, type and alignment to be determined in Formal Design.
2. When exposed, concrete ductbank shall conform to the existing bedrock surface

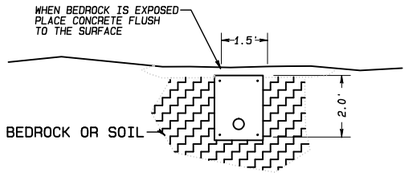
## PLAN VIEW: SPRINGBOX, POND PIPELINE AND POND OUTLET

(Not to Scale)



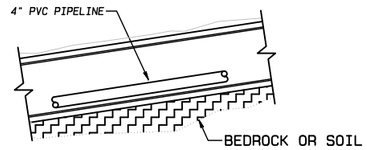

## PROFILE VIEW POND PIPELINE

(Not to Scale)




## TRENCHING ELEVATION

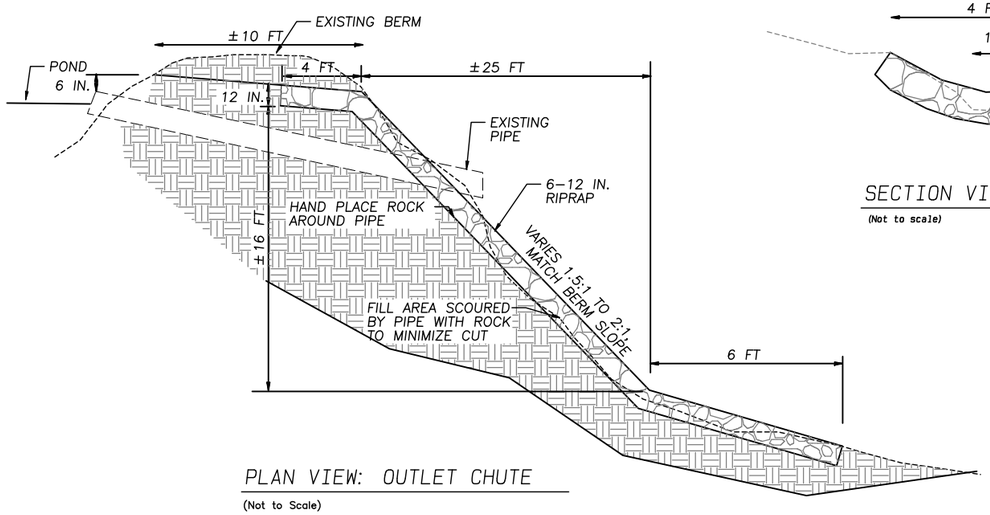
(Not to Scale)




## TRENCHING PROFILE

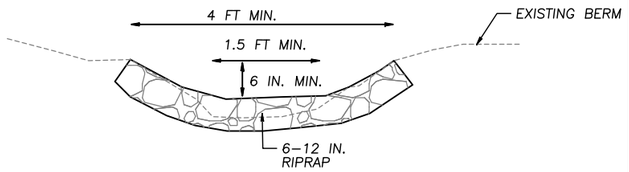
(Not to Scale)

## 13 POND OUTLET CHUTE




## PLAN VIEW: OUTLET CHUTE

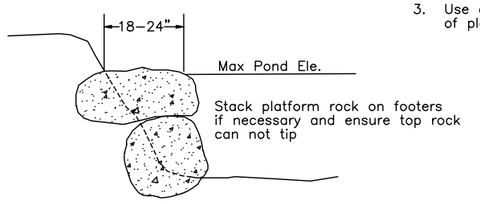
(Not to Scale)




## SECTION VIEW: OUTLET CHUTE

(Not to scale)

## 14 POND PLATFORM ROCK




## SECTION VIEW

(Not to Scale)

## NOTES:

1. The pond platform rocks allow for a stable standing area on the pond bank just above the water surface.
2. The platform rock needs to be large enough with a flat surface to provide stable footing. Top of rock needs to be above the high water level.
3. Use a footer rock if depth of pool greater than height of platform rock.

811 BLUE STAKE, INC. 811 or 1-800-STAKE-IT

UNAUTHORIZED CHANGES & USES: THE ENGINEER PREPARING THESE PLANS AND SPECIFICATIONS CANNOT BE RESPONSIBLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS AND SPECIFICATIONS. ALL CHANGES MUST BE IN WRITING AND MUST BE APPROVED BY THE ENGINEER OF RECORD PRIOR TO CONSTRUCTION.

DRAWING NUMBER: T-02
SHEET NUMBER: 10 OF 11
DATE: 17 Dec 2020
NGD PROJECT NUMBER:

PRELIMINARY
NOT FOR
CONSTRUCTION

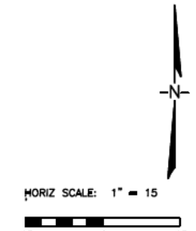
POND OUTLET CHUTE, PLATFORM ROCK & CONCEPTUAL POND PIPELINE

POND & STREAM IMPROVEMENTS
CHRISTOPHER CREEK AT R-C SCOUT RANCH
GILA COUNTY, AZ

| NO. | DATE | BY | REVISION |
|---|---|---|---|

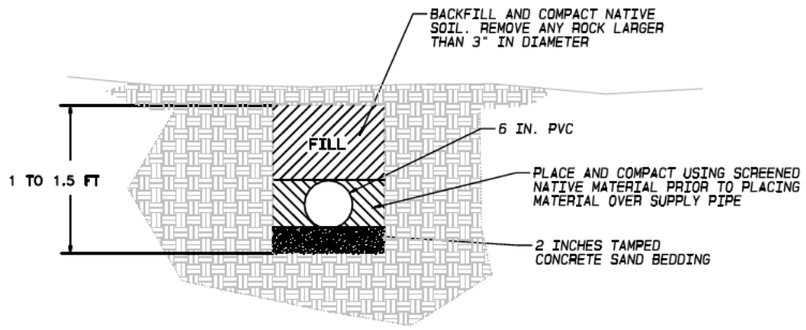
DRAWN BY: WW, JE
DESIGNED BY: WW, AH, JE
REVIEWED BY:

Natural Channel Design
2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774-2336

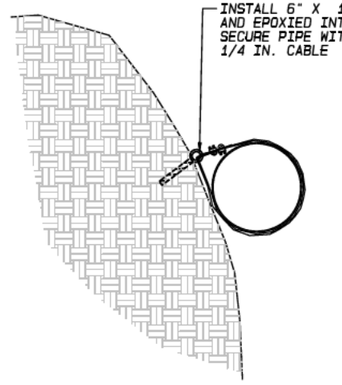




*STREAM POOL PIPELINE NOTES*

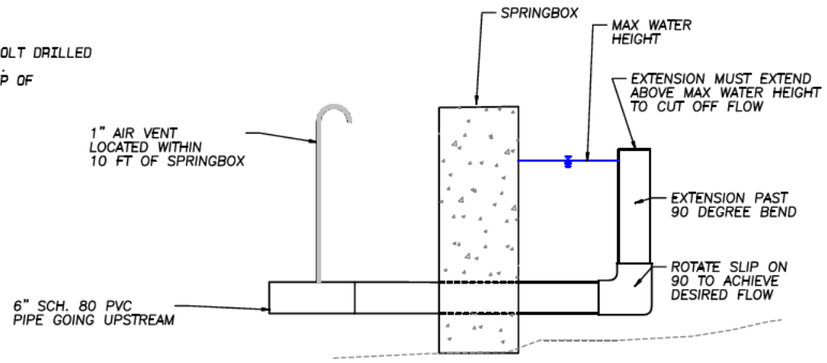
1. Pipeline to be constructed with 6" schedule 80 pvc.
2. Pipe outlet to be located above bedrock pool, preferably at a location where water can cascade down bedrock to pool.
3. Minimum elevation of outlet is 7 ft above elevation of the riffle at pool outlet which is approximately the 10 year flow. This will result in approximately 4 ft of drop from springbox outlet.
4. Location of pipeline to be field fit in the most direct path which avoids trees and larger rocks.
5. Maintain constant pipe grade to avoid dips in pipeline which could result in airlocks.
6. Bury pipe in a trench with a minimum of 6 inches of cover. Pipe to be placed on 4–inches of tamped concrete sand bedding. Where trenching is prohibited by bedrock, route pipeline around bedrock and anchor with 1/4 inch wire rope to 6–inch eyebolts drilled and epoxied into bedrock. Ensure a minimum of two anchors per 10 ft section of pipe.
7. All joints to be securely glued with pvc cement.
8. When backfilling pipeline trench, take care to carefully place first layer of backfill to just above the springline on each side of the pipe before placing additional fill to just below the top of the pipe and compacting through the use of hand tools. Be careful to avoid damaging the pipe.
9. Native material can be used to backfull the pipe as long as all rock larger than 3" in diameter is removed from the backfull material.
10. Any rock material can be placed over the trench after compaction.




*TRENCHING SECTION VIEW*
(Not to scale)




*EXPOSED PIPE ON BEDROCK SECTION VIEW*
(Not to scale)




*FLOW CONTROL SYSTEM AT SPRINGBOX PROFILE VIEW*
(Not to scale)

DRAWING NUMBER: DTL-02
SHEET NUMBER: 11 of 11
DATE: 17 Dec 2020
NCD PROJECT NUMBER:

PRELIMINARY NOT FOR CONSTRUCTION

DRAWN BY: MW, JF
DESIGNED BY: MW, JF, AH, JE
REVISED BY:

| NO. | DATE | BY | REVISION |
|---|---|---|---|

NEW PIPELINE UPSTREAM
CONCEPTUAL PLAN AND DETAILS

POND & STREAM IMPROVEMENTS
CHRISTOPHER CREEK AT R–C SCOUT RANCH
GILA COUNTY, AZ

Natural Channel Design
2900 N. WEST ST. #5
Flagstaff, Arizona 86004
(928) 774–2336

N
W E
S

SCALE 0 100 200 300 FEET

CONTOURS - 40 FEET

## LEGEND

- PROPERTY BOUNDARIES
- ROAD - MAIN
- ROAD - SECONDARY
- ROAD - SERVICE
- FOOTPATH
- CONTOUR - MAIN
- CONTOUR - SECONDARY
- CAMPSITE BOUNDARIES
- WOODED AREA
- INTERMITTENT STREAM
- BRIDGE
- GATE
- STRUCTURES: EXISTING
  - PROPOSED
  - DEMOLITION
- CAMPFIRE CIRCLE
- CHAPEL
- BB RANGE
- ARCHERY
- SPORTS COURT

PROPERTY LINE

STATE ROUTE 260

MAIN ENTRANCE

VAN NESS LODGE

PROPOSED SHOWER & TOILET FACILITY

FAMILY CABINS

RAMADA

SHOWER

DINING HALL

KEVIN'S LODGE

CAMPFIRE CIRCLE

FLAGPOLES

DIRECTOR'S CABIN

STORAGE BARN

AMERICAN CANCER SOCIETY STORAGE

PAINT LOCKER

MAINTE-NANCE SHOP

RANGER RESIDENCE

STORAGE TANK

PUMP/WELL HOUSE

WRANGLERS

ARCHERY

SPORTS COURT

POND

BB RANGE

KIWANIS LODGE

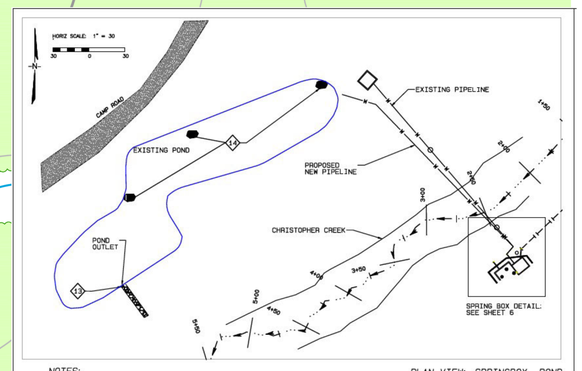
CAMPSITE #1
CAMPSITE #2
CAMPSITE #3
CAMPSITE #4
CAMPSITE #5
CAMPSITE #6
CAMPSITE #7
CAMPSITE #8
CAMPSITE #9
CAMPSITE #10
CAMPSITE #11

LATRINE

5600

5800

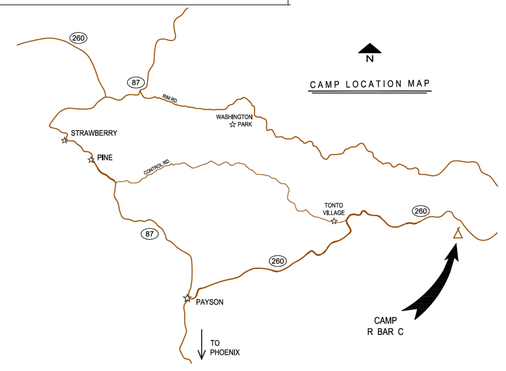
CHRISTOPHER CREEK




NOTES:

1. Pipeline is expected to be 4 inch schedule 40 PVC. Final size, type and alignment to be determined in Formal Design.
2. When exposed, concrete ductbank shall conform to the existing bedrock surface

PLAN VIEW: SPRINGBOX, POND PIPELINE AND POND OUTLET
(Not to Scale)




REVISION DATES:

ENGINEERING SERVICE
BOY SCOUTS OF AMERICA
1325 W. WALNUT HILL LN
IRVING, TX. 75015-2079

ORIGINATOR: TH
DRAWN: MP
PLOTTED: 11/6/07

SCOUTS OF AMERICA ★ ENGINEERING SERVICE ★ BOY

DRAWING NUMBER: 010E 06-26-07

SITE DEVELOPMENT PLAN

# R BAR C SCOUT RANCH

GRAND CANYON COUNCIL

PHOENIX, ARIZONA

010E R Bar C Scout Ranch 6-26-07.dwg

# Applications: Christopher Creek Restoration Project

**Profile**
cha r@az-tu.org

**Project Title**
Chr stopher Creek Restorat on Project

**Organization Name**
Ar zona Counc of Trout Un m ted

**Application Cover Page**
Chr stopher Creek App cat onCoverPageForm_AWPF_FY2024.doc

**Executive Summary**
R-C Chr stopher Creek Restorat on Execut veSummary_AWPF_FY2024.docx

**Project Overview**
Chr stopher Creek Project Overv ew Temp ate_AWPF_FY2024.doc

**Project Location and Environmental Contaminant Information**
Chr stopher Creek ProjectLocat on_Env ronmenta Contam nantInformat onForm_AWPF_FY2024.doc

**Scope of Work**
Chr stopher Creek ScopeOfWorkTemp ate_AWPF_FY2024.docx

**AWPF Detailed Budget**
AWPF Chr stopher Creek App cat on Deta ed Budget Aug'23.pdf

**Matching / Cost Share Budget**
R-C Chr stopher Creek Match ng Funds.pdf

**Arizona Watershed Map**
Ar zonaWatershedMapForm_AWPF_FY2024.pdf

**Project Location: Schematic Maps**
NCD Dwgs.pdf

**Project Location: Schematic Maps (cont.)**

**Project Location: Ownership Maps**
R Bar C Scout Ranch 11-6-07 Rev s ons Property L ne.pdf

**Project Location: Ownership Maps (cont.)**

**State Historic Preservation Office (SHPO) Review Forms**
2021-1256 R-C Camp_updated_NHPA_Concurrence.pdf

**State Historic Preservation Office (SHPO) Review Forms (cont.)**

**State Historic Preservation Office (SHPO) Review Forms (cont.)**

**State Historic Preservation Office (SHPO) Review Forms (cont.)**

**State Historic Preservation Office (SHPO) Review Forms (cont.)**

**Key Personnel**
A an Dav s - Cha r AZTU
Doy e Ga nes - Treasurer AZTU
Rod Buchanan - Conservat on Cha r, Project Coord nator
Josh Cr swe - Project Manager, Project Coord nator

**Key Personnel (cont.)**

**Project Site Photographs**
R-C Pond & Chr stopher Creek Photos.pdf

**Project Implementation Plans**
We ve d v ded the project nto three phases:
• Phase One eng neer ng eva uat on and n t a pond restorat on work. Comp ete
• Phase Two roadway repa r and eros on contro measures, spr ng box and supp y p pe ne rep acement and repa r; coup ed w th the ntroduct on of nat ve Roundta Chub and Longf n Dace; -- Fa /W nter 2023-24
• Phase three restorat on of adjacent Chr stopher Creek nto a b ue-r bbon f shery and the re ntroduct on of recreat ona nat ve G a trout. Fa /W nter 2024-25

**Existing Plans / Reports / Information**
NCD Chr stopher Ck Des gn 12172020.pdf

**Existing Plans / Reports / Information (cont.)**
NCD Draw ngs Statement.docx

**Existing Plans / Reports / Information (cont.)**

**Letters of Community Support**
Zach Beard AWPF FY2024 support etter.docx

**Letters from Entities Pledging Matching Funds**
GCC Harmon 2023 Support Letter.pdf

**Evidence of Control and Tenure of Land**
GCC Harmon 2023 Support Letter.pdf

**Evidence of Control and Tenure of Land (cont.)**
RC Acessor Map.pdf

**Project Site Access / Permission to Conduct Work**
AZTU has worked c ose y w th property owner Grand Canyon Counc (GCC), Boy Scouts of Amer ca s nce beg nn ng th s program. GCC and AZTU have consu ted w th Ar zona Game and F sh Department (AZGD), U.S. F sh and W d fe Serv ce (USFWS), and env ronmenta consu t ng f rm Natura Channe Des gn (NCD). GCC has who ehearted y supported AZTU's efforts. GCC has accommodated, supported, and contr buted both n-k nd serv ces as we as some f nanc a ass stance.

**Evidence of Physical and Legal Availability of Water**
GCC Harmon 2023 Support Letter.pdf

**Evidence of Physical and Legal Availability of Water (cont.)**
R-C G a Count Assessor deta s.pdf

**OPTIONAL: Additional Project Information**

**OPTIONAL: Additional Project Information**

**OPTIONAL: Additional Project Information**

**OPTIONAL: Additional Project Information**

**OPTIONAL: Additional Project Information**

**OPTIONAL: Additional Project Information**

**View Budget Worksheet**

**View Application Goals**
https://porta .ec v s.com/#/peerGoa s/6866CE18-4145-4CA2-B5F8-8CCA6D0D36D4

## Applications: File Attachments

**Application Cover Page**
Chr stopher Creek App cat onCoverPageForm_AWPF_FY2024.doc

**Executive Summary**
R-C Chr stopher Creek Restorat on Execut veSummary_AWPF_FY2024.docx

**Project Overview**
Chr stopher Creek Project Overv ew Temp ate_AWPF_FY2024.doc

**Project Location and Environmental Contaminant Information**
Chr stopher Creek ProjectLocat on_Env ronmenta Contam nantInformat onForm_AWPF_FY2024.doc

**Scope of Work**
Chr stopher Creek ScopeOfWorkTemp ate_AWPF_FY2024.docx

**AWPF Detailed Budget**
AWPF Chr stopher Creek App cat on Deta ed Budget Aug'23.pdf

**Matching / Cost Share Budget**
R-C Chr stopher Creek Match ng Funds.pdf

**Arizona Watershed Map**
Ar zonaWatershedMapForm_AWPF_FY2024.pdf

**Project Location: Schematic Maps**
NCD Dwgs.pdf

**Project Location: Ownership Maps**
R Bar C Scout Ranch 11-6-07 Rev s ons Property L ne.pdf

**State Historic Preservation Office (SHPO) Review Forms**
2021-1256 R-C Camp_updated_NHPA_Concurrence.pdf

**Project Site Photographs**
R-C Pond & Chr stopher Creek Photos.pdf

**Existing Plans / Reports / Information**
NCD Chr stopher Ck Des gn 12172020.pdf

**Existing Plans / Reports / Information (cont.)**

NCD Draw ngs Statement.docx

**Letters of Community Support**
Zach Beard AWPF FY2024 support  etter.docx

**Letters from Entities Pledging Matching Funds**
GCC Harmon 2023 Support Letter.pdf

**Evidence of Control and Tenure of Land**
GCC Harmon 2023 Support Letter.pdf

**Evidence of Control and Tenure of Land (cont.)**
RC Acessor Map.pdf

**Evidence of Physical and Legal Availability of Water**
GCC Harmon 2023 Support Letter.pdf

**Evidence of Physical and Legal Availability of Water (cont.)**
R-C G  a Count Assessor deta  s.pdf

SHPO-2021-1256 (163117) Rec: 03-15-22

U.S. Fish and Wildlife Service
Arizona Partners for Fish and Wildlife
Arizona Ecological Services Field Office
9828 North 31st Avenue #C3
Phoenix, Arizona 85051-2517
602-242-0210 602-242-2513 Fax

March 15, 2022

Ms. Kasey Miller, M.A.
State Historic Preservation Office
Arizona State Parks
1100 West Washington Street
Phoenix, AZ 85007

Attn: Ms. Mary-Ellen Walsh, MA, RPA
Compliance Specialist/Archeologist

RE: R-C Scout Ranch Pond and Spring Enhancement Project for a model native fish system and refuge habitat

Dear Ms. Miller:

In compliance with Section 106 of the National Historic Preservation Act, I want to notify you of a proposed federal undertaking in Gila County, Arizona. The U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program proposes to fund a project to repair an eroding spring box and water delivery system to maintain a pond that will serve as both a refuge habitat and an educational fishery. The proposed project will be funded under the authority of the Partners for Fish and Wildlife Act (Public Law: 109-294).

The Area of Potential Effects (APE) for the R-C Scout Ranch Spring Box and Creek Renovations for a model native fish system and refuge habitat Project is a 3.32-acre parcel located in Section 26, Township 11 North, Range 12 East. We contracted BRIC, LLC to conduct a Class III cultural resources survey in and around the project area. A 3.32-acre areas was surveyed that included the project area. The document, *A Class III Cultural Resource Survey of 3.32 Acres for the R-C Scout Camp Pond and Spring Enhancement Project at R-C Scout Ranch in Gila County, Arizona*, prepared by Matthew Johnson, Richard Goddard, and Tim Goddard of BRIC, LLC, dated September 2021 found no archaeological or historic sites. Per SHPO guidelines, a complex of structures and features were recorded as In-Use structures and isolated features and were considered as they contribute to larger landscapes. A copy of the draft report is enclosed for your convenience. If you do not have any comments, we will ask BRIC, LLC to finalize the report. We will send you the final version for your files.

A letter describing the project was sent to the following tribal contacts: Pueblo of Zuni, Navajo Nation, Tonto Apache Tribe, Salt River Pima Maricopa Indian Community, Yavapai Apache Nation, Yavapai Prescott Indian Tribe, White Mountain Apache Tribe, San Carlos Apache Tribe, and Hopi Tribe. We have asked if they have any properties of cultural or religious significance within the project area as well as if they have any concerns with the project. We intend to notify the affected tribes should any cultural features or deposits be encountered during project activities.

**Project Name**: A Class III Cultural Resource Survey of 3.32 Acres for the R-C Scout Camp Pond and Spring Enhancement Project at R-C Scout Ranch in Gila County, Arizona

**County:** Gila

**Geographic Location**: R-C Scout Ranch -- Portion of Township 11N, Range 12E, Section 26

**USGS 7.5 Minute Map Name**: Promontory Butte, Arizona

**Project Description**:
R-C Scout Camp has the potential to provide recreational and educational opportunities centered around fishing in both a pond and stream. This project will improve the spring box, water delivery infrastructure, and potential sediment contributions to the pond to improve the habitat quality and sustainability of the resources for native species. Base flow in Christopher Creek in this reach is entirely supplied by the spring across the stream from the pond. Spring discharge enters the stream channel as spill over from the spring box and overflow from the pond. The developed spring box is in poor condition and is leaking at several points despite previous attempts to repair it.

The developed spring box is not in good condition (Photograph 1). The apparent original spring box does not appear to have much inflow as the spring outlet has migrated away from the box over time. A new box was built from concrete adjacent to the old box to capture the new outlet(s). This newer structure has been undermined and flow passes below the walls in several areas. Sandbags have been utilized to patch the spring box and create enough head to push water into the outlet pipe delivering water to the pond. This has had some limited success, but it does not appear that water has overflowed the outlet weir of the spring box in quite some time.

The pipeline extending from the spring across Christopher Creek to the pond is likewise in poor condition (Photograph 2). The current pipe is suspended over the streambed via suspension cable held up by steel support towers on either side of the creek. Gravity flow delivers water to the pond. The original pipe was thin walled metal and has rusted through extensively. Repairs using smaller diameter PVC and HDPE pipe pushed through the original have been attempted. However, the pipeline was found to be leaking in several places and the supporting cables have been twisted by either high winds or high flows in the stream.

The new spring box will encompass all of the existing structures within a single structure. The most important piece of this structure will be to key the foundation down a minimum of 12 inches into the existing grade. In some locations this will be into cobbly soil and in others this will be keyed into bedrock. Where possible the structure should key into bedrock as this will capture the most water, force it to the surface, and make it available for the diversion pipe. Adjustable valves are recommended for the outflow to both the pond and stream in addition to an overflow weir. These valves can be constructed of pipe elbow with an extension that can be rotated above the elevation of the outflow weir to turn flow off. The elbow can be rotated to any elevation to adjust head pressure and volume. Maximum outflow to the pond is recommended to be 40 to 60 gallons per minute to maintain pond flow and allow for stream flow. The elbow valve configurations are less expensive and less apt to damage during freezing temperatures.

There are two options to rebuild the spring box. One option is to build the spring box from reinforced concrete and the second is to build it from reinforced concrete masonry unit blocks. Both structures will follow the same height and alignment regardless of type of wall built. Spring outlets should be identified prior to construction. This may require diverting the spring from some areas of the existing box to determine if there is additional inflow. All work on the spring box will be done with hand tools. Heavy equipment will not cross Christopher Creek or be used to construct the new spring box.

The water delivery pipeline from the spring box should feed both the stream and the pond. The stream pipeline should extend upstream along the same shore as the spring to deliver water to the stream channel near the pipeline. This pipe should be able to carry the full discharge of the spring if necessary and the outflow should be delivered to the channel in a manner that can fill the pool upstream of the property line if possible.

The pipeline to the pond will need to cross Christopher Creek. The preferred alternative for both price and maintenance is to chisel a shallow trench across the bedrock of the stream channel and bury the pipe in a concrete slurry poured into the trench. This alternative is relatively inexpensive, provides less visual obtrusion, and can be easily maintained because it is close to ground level.

Additional work may occur along the banks of the pond. This work may include planting native pollinator plants, adding logs to the water edge for habitat complexity, and installing new signage about native fishes and fishing rules at the pond. All work would be done with hand tools.

**Photograph 1:** Photograph of the existing spring box. The spring box leaks in multiple locations.

**Photograph 2:** Photograph of current piping that delivers water from the spring box to the pond. The pipe is elevated above Christopher Creek.

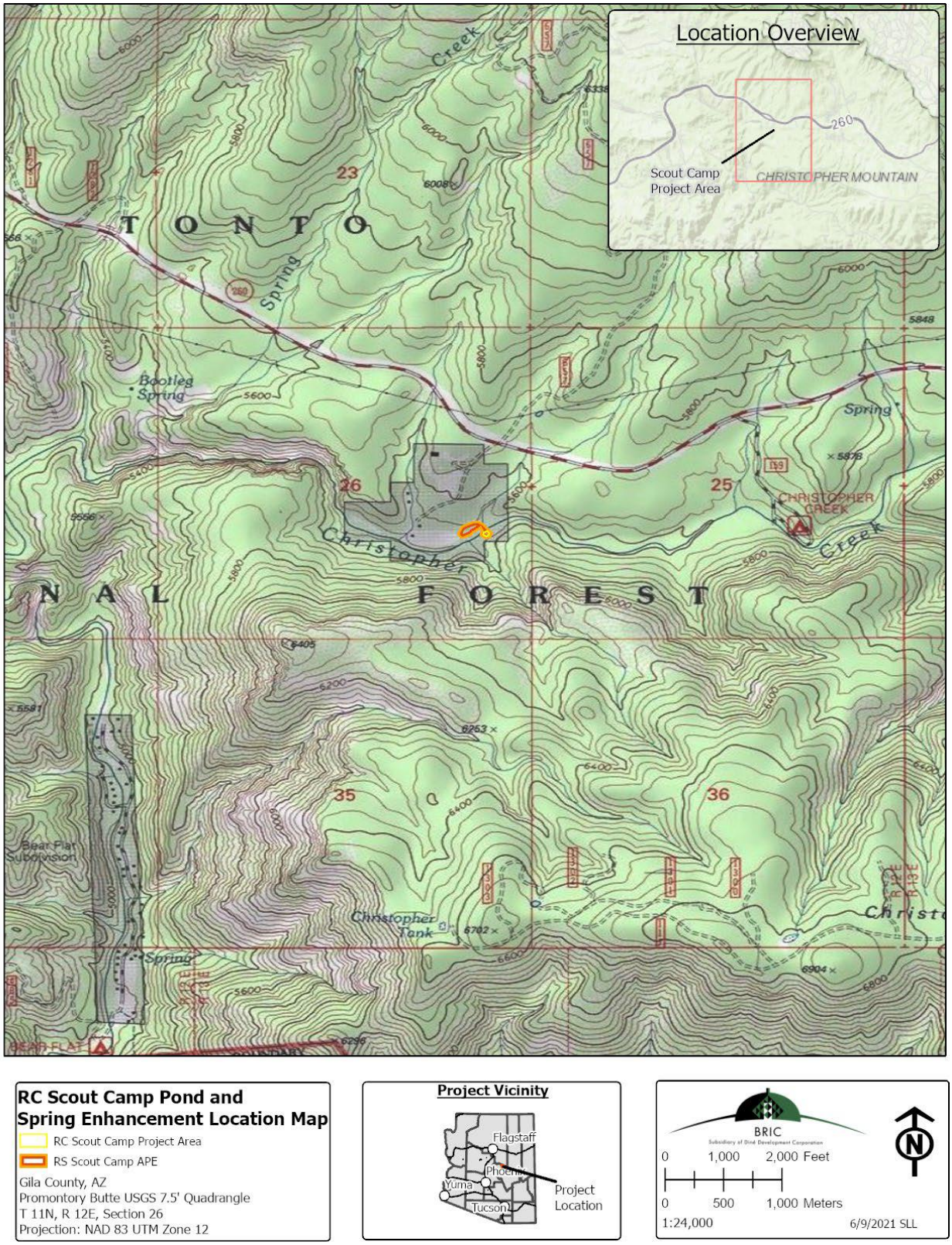



**Figure 1.** Location of project area depicted on the USGS 7.5-minute topographic quadrangle Promontory Butte, AZ.

**Mitigation Plan:**
In the APE, three In Use Structures (Spring box, Barn, and Cabin Foundation) and five Isolated in-use Features (Culturally Modified trees, Pipeline, Pond, Christopher Creek crossing, and Retaining wall) were identified. Individually, all the in-use structures and features are not considered eligible for the NRHP. However, some could be considered as contributing elements to larger landscapes, of which two were identified: the David Martin in holdings and the RC Scout Camp. BRIC, LLC recommended no further action was necessary for any of the in-use structures or features.

Based on archival research and survey results provided by the BRIC, LLC report, we request your concurrence of the finding "**No Historic Properties"** by this project. Should cultural deposits be discovered during ground-disturbing activities, all work in the vicinity will stop until cultural resource items can be evaluated by a professional archaeologist and consultation with the State Historic Preservation Office occurs.

Please concur with this determination. If you have questions, please contact Jennifer Graves, Partners Biologist, at jennifer_m_graves@fws.gov or 928-338-4288 x26185.

Sincerely,

JESS NEWTON

Digitally signed by JESS NEWTON
Date: 2022.03.15 14:02:41 -07'00'

Jess Newton
Project Leader
Arizona Fish and Wildlife Conservation Office

16 MAR 2022

Concurrence Date
Arizona State Historic Preservation Office

Enclosures

Christopher Creek
Google

# Conceptual Design Assessment

## Christopher Creek at R-C Scout Ranch

Natural Channel Design, Inc.
2900 N. West Street, STE 5
Flagstaff, AZ 86004

Natural Channel Design, Inc.

**November 2020**

# Conceptual Design Assessment

## Christopher Creek at R-C Scout Ranch

**Submitted to:**
Alan Davis
Zane Grey Chapter, Trout Unlimited
Paradise Valley, Arizona

Greg Harmon
Grand Canyon Council
8840 E Chaparral Rd., STE 200
Scottsdale, AZ 85250

**December 2020**

**Prepared by:**
Natural Channel Design, Inc.
2900 N. West St., STE 5
Flagstaff, AZ 86004

# TABLE OF CONTENTS



## LIST OF FIGURES



## LIST OF TABLES

# EXECUTIVE SUMMARY

This report provides and assessment of enhancement opportunities for Christopher Creek and the adjacent pond on R-C Scout Ranch. The pond is fed by flows from a spring on the opposite side of Christopher Creek. The spring box and pipeline infrastructure is in poor condition and in need of repair. The pond has recently been excavated to remove accumulated sediment and there is a need to reroute runoff from the campground road to alleviate erosion from the roadway. Additionally, there are opportunities to utilize the flow from the springs to improve habitat quality in Christopher Creek.

Spring discharge was measured in November 2020 after a prolonged dry spell of low winter and monsoon moisture. Spring flow was ~180 gallons per minute, considerably less than the last known measurement in 1952 of 800 gpm. It is not known if this flow is due to chronic discharge decline or more acute weather patterns. However, at the time of measurement it was the only flow into this portion of the creek. The flow is more than sufficient to keep the pond full and support a fishery. It is recommended that spring discharge be monitored on a more regular basis in the future.

The most significant stream habitat deficiency is the lack of perennial flow through the entire reach. There are several pools in the lower portion of the reach which have been shaped by previous large discharges and appeared unstable. The loss of these pools would severely diminish the existing habitat quality.

Several enhancements are proposed for the area: These include:

New concrete spring box
New supply line to pond placed under creek bed
New supply line to upstream end of reach to create perennial flow for habitat
Gravel paved trail around pond to prevent erosion
Rock lined chute for pond outflow
Road cross drains to direct water away from pond and limit ditch erosion
Fish habitat features in stream to stabilize pools and create additional habitat
Fence crossings over stream that can minimize maintenance efforts and keep livestock off riparian area

A conceptual level cost estimate for material and labor on each task is provided. Several tasks can be completed with out further engineering effort if a knowledgeable contractor is hired (roadway, pond improvements). Other projects will require additional engineering design and oversight (stream and pipeline improvements).

Stream habitat improvements are expected to require a Clean Water Act Section 404 permit. Rerouting spring flows to different areas of the stream or off the property to improve habitat will require additional knowledge of the water rights and may require changes to the point of diversion within the water right.

# PROJECT DESCRIPTION

Camp R – C is operated by the Boy Scouts of America as a summer camp. It is located in Gila County along Christopher Creek. Infrastructure at the camp includes a pond utilized for fishing, a spring head diversion and pipe works that carry water across the creek to the pond as well as roads, campgrounds, buildings and utilities to support the scout camp. The spring and pond infrastructure are near the end of their useable lifespan and are deteriorating. The scout camp in cooperation with Trout Unlimited has already undertaken several aspects of the project, including the treatment of cattails and removal of sediment from the pond. However, the road is still considered a source of sediment to the pond and the spring box, pipeline and support structure for the pipeline are leaking and in need of frequent repair. Additionally, there is a desire to utilize the spring water, to enhance the habitat for aquatic species in Christopher Creek within the property.

The Boy Scouts in cooperation with Trout Unlimited and others seek to develop an implementable plan for repair of infrastructure and implementation of sustainable habitat improvements. It is recognized that there is a desire for much of this work will be paid via grant funding and implemented with volunteer labor.

This project focuses on assessing the springs, water delivery infrastructure, potential sediment contributions to the pond, as well as the Christopher Creek channel through the property to determine appropriate repairs and enhancements that will improve the habitat quality and sustainability of the resources. Recommendations for enhancements are provided along with conceptual level costs for the various projects so that grant funding and partnerships for implementation can be sought. These recommendations will form a master plan for the project that can be implemented in parts as funding opportunities become available.

## LOCATION

The project is located in Gila County, Arizona between Payson and Odegarrd along SR 260 (Figure 1). The property is along either side of Christopher Creek, just downstream from the Christopher Creek Campground. While the camp is owned and operated by the Boy Scouts of America the surrounding property is Tonto National Forest.

This reach of Christopher Creek is at an elevation of approximately 5500 ft along the Mogollon Rim. Vegetation is varied in the property, with south facing hill slopes dominated by juniper and grasses and north facing slopes a mix of ponderosa pine and other conifers. The riparian zone along the creek is typical of the area and composed of sycamore, cottonwood, and willows as well as evergreens.

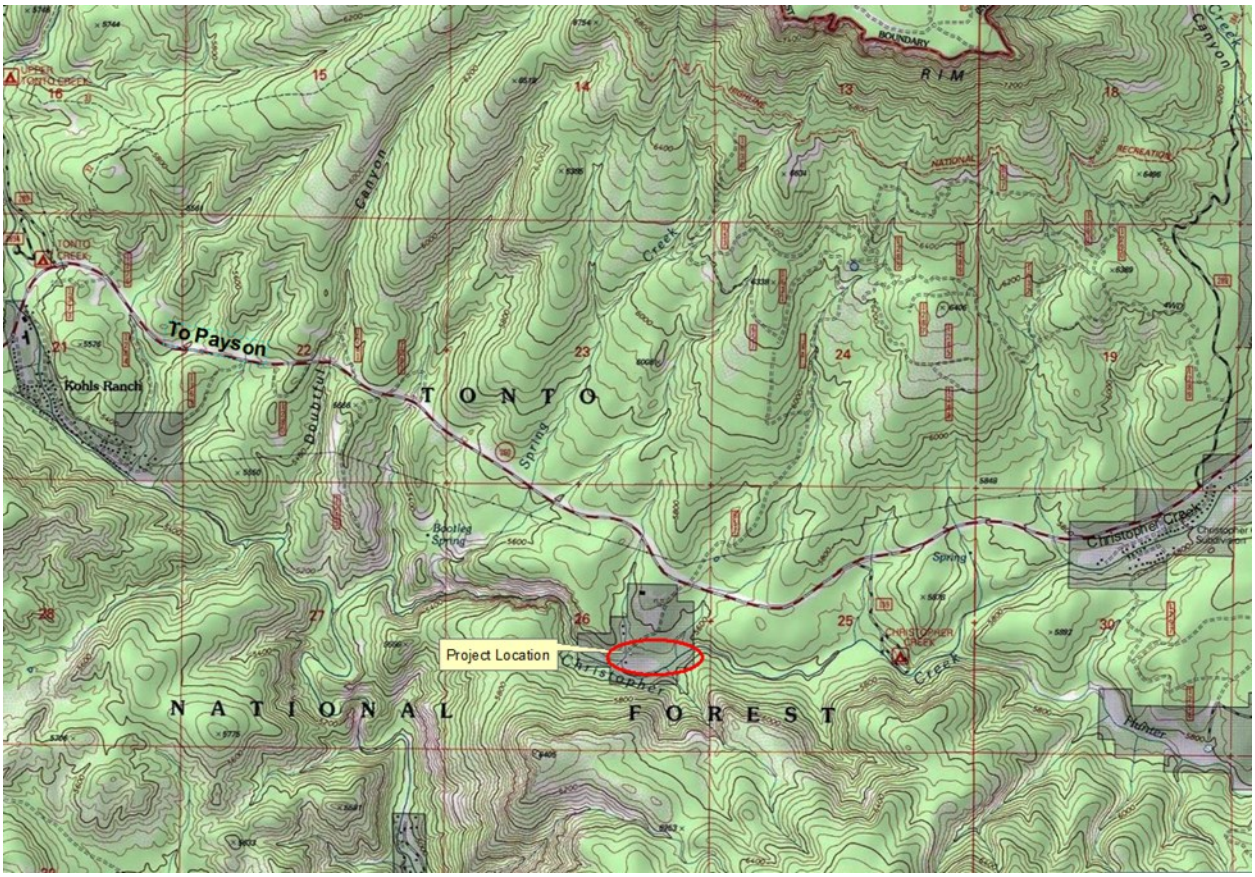



**Figure 1 Location map.**

*The project is located along SR 260 north of Payson, AZ. T11N, R12E, S26, N1/2 SE1/4.*

## PROJECT OBJECTIVES

R-C Scout Camp has the potential to provide recreational and educational opportunities centered around fishing in both the pond and stream. The focus of the assessment is on this aspect of the property, especially the objectives listed below.

The assessment and design will focus on several separate areas listed below.

- Improvement of the spring box to limit leakage and allow control over flow into pipeline or creek
- Provide recommendations for road grading and surfacing to limit erosion and sediment transport to pond.
- Determine need for enhancement of spring overflow area to improve spring habitat
- Provide a geomorphic/habitat assessment of Christopher Creek through the property. Provide design for habitat enhancements that will create 'blue ribbon' fishery for this reach.
- Determine habitat effects (temperature, depth, velocity) of additional spring flows into creek.

- Provide summary of findings and recommendations on best course of action to achieve goals
- Provide concept plan and conceptual level costs for implementation of preferred course of action.

# EXISTING CONDITIONS

## HYDROLOGY

The Christopher Creek watershed extends to the top of the Mogollon Rim. At the upstream boundary of the property the watershed area is approximately 25.5 square miles (Figure 2). A smaller subwatershed is included in this area. It runs through the property from the north and joins Christopher Creek just at the upstream boundary of the project. This small watershed is approximately 1.2 square miles with the potential to generate significant discharge that flows through the property.

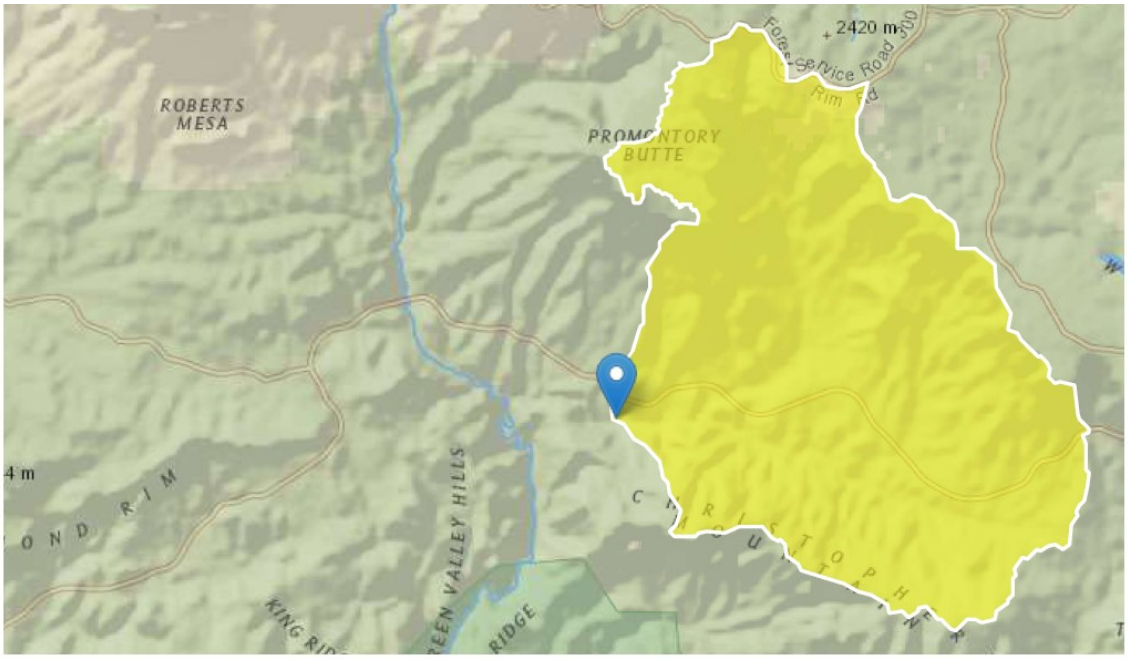



**Figure 2. Watershed Area**

Peak flood discharges were estimated from the main watershed as well as the smaller northern watershed using USGS StreamStats program. Bankfull or channel forming discharges are approximately the 1.5-year return interval flood (Table 1). Less frequent floods rapidly increase in magnitude and have the potential to have large impacts on the channel and floodplain.

Base flow in the stream in this reach is entirely supplied by the spring on river left across the stream from the pond. There was no discharge in Christopher Creek flowing into the study reach. Discussions with Trout Unlimited and BSA personnel indicated that this is a normal condition during dry periods of the

year. Spring discharge enters the stream channel as spill over from the spring box and overflow from the pond. The developed spring box is in poor condition and is leaking at several points despite previous attempts to repair it. Flows were measured at two points to determine spring outflow. Flows were measured in late October 2020 after a long dry period and are assumed to represent 'low' spring discharge but it is not known if discharge varies seasonally.

| | |
|---|---|
| Flow into the pond at outlet pipe | 17.5 gallon per minute (gpm) |
| Weir flow measurement on bedrock in channel | 166.0 gpm |
| | |
| Total estimated spring flow | 183.5 gpm* |

* *(perhaps as low as 140 gpm given variation in results from different measurement methods)*

This measured flow is considerably lower than the only know previous flow estimate. Discharge for R_C spring was estimated at 800 gpm on 5/14/1952 *(http://www.azwater.gov/AzDWR/Statewideplanning/wateratals/centralhighlands/documents/volume_5ton_final.pdf).* Discharges have not been estimated on a regular schedule and it is unknown if the current conditions are due to longterm, chronic depletion of flow or if they are the result of an extremely dry winter/summer condition in 2020. Given these observations, it appears that we can assume that this volume of flow or more will be available from the spring for the foreseeable future. However, it is recommended that spring discharge be estimated on a more regular schedule in the future and that the inlet structure for the pipelines be built with as much flexibility as possible to allow for longterm variation in discharge.

Given the pond acreage of 0.34 acres at max pool evaporation losses are minimal and well below the ability of the spring to deliver water. Using estimated evaporation losses from the White River pan evaporation station maximum losses are in June with an average of 11.7 inches per month (http://www.patagoniaalliance.org/wp-content/uploads/2014/06/ARIZONA-MONTHLY-AVERAGE-PAN-EVAPORATION.pdf ). This equates to a loss of approximately 2.5 gpm from the pond surface during the hottest portions of the year. Inflow in excess of this amount will be require to keep the pond full. Additional flow will help maintain temperature and water quality. Temperature of the spring outflow was approximately 12°C and should be relatively constant throughout the year.

**Table 1. Flood discharge analysis.**

*Discharges are estimated using USGS StreamStats program ((https://streamstats.usgs.gov/ss/). Peak Region 4, Central Highlands curve. Estimates provided in cubic feet per second (cfs).*

| | WS AREA ($mi^2$) | Q1.5 | Q2 | Q5 | Q10 | Q25 | Q50 | Q100 |
|---|---|---|---|---|---|---|---|---|
| *Christopher Creek at RC Camp* | 25.5 | 263 | 470 | 1420 | 2660 | 5230 | 8210 | 11800 |
| *N. Trib above Pond* | 1.2 | 34 | 62 | 206 | 408 | 865 | 1370 | 2030 |
| *Christopher Ck above trib* | 24.3 | 245 | 455 | 1370 | 2570 | 5150 | 7960 | 11500 |

## GEOMORPHOLOGY

The project reach, begins at the outlet of a large bedrock bounded pool and bedrock dominated riffle/pool sequence extending for over half the property. The upper reach is vertically and laterally stable given the bedrock dominated bed and generally good riparian vegetation. The downstream section has an alluvial

bed overlying the bedrock and extends downstream to the property boundary and the waterfall. However, flood flows have moved considerable sediment and created transverse bars of cobble sized sediment. The bars have become colonized by vegetation but tend to route flows and shear stress towards banks, causing some lateral erosion. This erosion is limited to two specific areas and both banks are relatively low. Excess sediment is not considered a widespread problem. However, the steepness of the riffles in the transverse bars can create headcuts which would potentially eliminate pool habitat upstream.
Pools were generally long with base flow depths of 2.5 to 3.5 feet. The base of the pool was often to bedrock and provided little cover for habitat other than the depth.

A longitudinal profile and cross section data at several riffles and pools were collected to determine bankfull cross section dimensions, flood plain dimensions and channel slope. Regional curve prediction for the 25.5 square mile drainage area indicates that riffle cross sectional area should be approximately 68 $ft^2$ at bankfull stage (Moody et al 2003). Typical cross section measurements from riffles in the project area are near this estimate, indicating that bankfull dimensions are typical of the greater region (Table 2). The relatively high entrenchment rations indicate that the main channel generally has good access to the floodplain for high flows.

**Table 2. Geomorphic Dimensions and Ratios**

| Description | ID | Cross-Sectional Area (ft) | Bankfull Width (ft) | Floodprone Width (ft) | Mean Depth (ft) | Max Depth (ft) |
|---|---|---|---|---|---|---|
| Riffle | XS 1 | 60 | 34 | 63 | 1.8 | 2.6 |
| Good Pool | XS 2 | 92 | 39 | 70 | 2.4 | 4.5 |
| Wide Pool | XS 3 | 154 | 52 | 150 | 3 | 5.4 |
| Good Pool | XS 4 | 152 | 46 | 115 | 3.3 | 5.9 |
| Poor Pool | XS 5 | 57 | 26 | 67 | 2.2 | 3.2 |
| Riffle | XS 6 | 57 | 36 | 100 | 1.6 | 2.4 |
| | | | | | | |
| Description | ID | W/D Ratio | Entrenchment Ratio | Slope (ft/ft) | D50 (mm) | Type |
| Riffle | XS 1 | 18.9 | 1.9 | 0.005 | 70.0 | B3c |
| Good Pool | XS 2 | 16.3 | 1.8 | 0.005 | NA | NA |
| Wide Pool | XS 3 | 17.3 | 2.9 | 0.005 | NA | NA |
| Good Pool | XS 4 | 13.9 | 2.5 | 0.007 | na | NA |
| Poor Pool | XS 5 | 11.8 | 2.6 | 0.003 | 60.00 | NA |
| Riffle | XS 6 | 22.5 | 2.8 | 0.001 | 65.00 | C3 |

The geomorphic data indicate that the general dimension of the stream are within the range of stable streams elsewhere in the region. Bank erosion is minimal and further large scale incision of the channel is limited by the bedrock underlying the stream bed. In short, the stream channel and floodplain are generally functioning as expected.

Previous, large flood events have created several debris piles of large trees and brush in the channel. These blockages have created transverse bars (sediment deposition that directs flow towards the edges of

the channel rather than downstream). These bars have created some limited bank erosion as well as some split channel conditions at base flow. More problematic is that the bars consist of very steep, short riffle sections that can headcut. Head cutting through the bar structure would cause the loss of pool habitat upstream. Both length and depth of the pools would be affected.

### SPRING BOX AND PIPELINE

The developed springbox is not in good condition. The apparent original spring box does not appear to have much inflow as the spring outlet migrated away from the box over time. A new box was built from concrete adjacent to the old box to capture the new outlet(s). This newer structure has been undermined and flow passes below the walls in several areas. Sandbags have been utilized to patch the springbox and create enough head to push water into the outlet pipe delivering water to the pond. This has had some limited success, but it does not appear that water has overflowed the outlet weir of the springbox in quite some time. During the assessment period, flows escaping through the spring box leak and down the hillside to the creekbed were the majority of the spring flow with a minimum flow reaching the pond. The spring outlet into the box is ill defined. We found several areas of inflow into the springbox but there may be others with less obvious flow or located around the periphery of the box. Additional inflow areas are best identified when the springbox has been emptied.

The pipeline extending from the spring across the Christopher Creek to the pond is likewise in poor condition. The current pipe is suspended over the streambed via suspension cable held up by steel support towers on either side of the creek. Gravity flow delivers water to the pond. The original pipe was thin walled metal and has rusted through extensively. Repairs using smaller diameter PVC and HDPE pipe pushed through the original have been attempted. However, the pipeline was found to be leaking in several places and the supporting cables have been twisted by either high winds or high flows in the stream.

### POND

The pond has recently been dredged to clean out accumulated sediment and to control cattail infestation. We measured pond inflow and outflow to determine if there was any leakage. The first measurement indicated in inflow of ~17 gpm and there was no outflow with the pond elevation 12-18 inches below the outflow pipe. A subsequent measurement was taken a week later. Discharge into the pond was estimated at 55 gpm with outflow the same. This indicated that there were no significant leaks in the pond. Throughflow should be adequate to maintain temperature and keep the pond flushed. No measurement of dissolved oxygen was made because there have been no indications of inadequate oxygenation, even when the pond was infested with emergent vegetation.

The banks of the pond are relatively bare of vegetation with a heavily utilized trail along the edge. The vegetated buffer between bare dirt and the pond surface is only one or two feet in many areas. There are still some small patches of cattail in the shallow end of the pond.

The outflow of the pond is a buried, horizontal, 4-inch PVC pipe. This pipe is working relatively well but is likely susceptible to blockage with subsequent over flow. The outflow is in an eroded cut through the bond embankment. Larger rocks have been exposed to slow further erosion but overtopping flow from the pond could be problematic.

## FISH HABITAT IN CHRISTOPHER CREEK

The greatest limiting factor for fish and aquatic habitat through the reach is lack of perennial flow through the entire reach. Spring flows entering the reach do provide a base flow that appears adequate to carry fish populations through the year at reasonable temperatures. However, those flows only enter downstream of the spring and pond inlet, leaving a 240-foot section of riffle on the upstream side of the property dry, along with the extensive bedrock pool upstream of the property boundary. If watered, these areas would greatly increase the size of available habitat during dry periods when Christopher Creek does not have flow.

Other considerations for fish habitat include making sure that the limited spring discharge can provide adequate depth and cover for fish throughout the reach. Because of the low base discharge and the amount of bedrock through the reach, the discharge can spread across the channel bottom and not provide adequate depth through riffles and some of the pools. This is most evident in the upper half of the project area where bedrock is the dominant channel bed.

Unstable bars are the main issue in the lower half of the project area. The transverse bars are forming several high value pools upstream of the bar. If the bar should erode the desired pool depth could be lost. As large floods formed the bars, they filled in several areas which could provide good pool habitat which would normally be maintained by smaller frequent flood events. These areas can be stabilized and deepened to preserve the existing habitat conditions.

Formation of the bars has helped to form several split channel areas which are high value, off channel rearing sites for small fish. These side channels should be preserved and managed to hold a small amount of flow perennially. In at least one case, a headcut is threatening to drain the side channel and degrade the habitat.

The low base discharge and bedrock combine to create pool habitat that often has adequate depth requirements but does not often have adequate hiding cover. Boulder cover and overhang cover that provide hiding and loafing areas for fish are not as frequent as needed to maintain fish populations.

## RIPARIAN VEGETATION AND FENCING

Vegetation along the riparian zone is of appropriate species for the region and elevation. Tree crown cover is adequate to shade the stream and provide an allochthonous source of food to the stream. There does seem to be regeneration of all species along the banks. However, many of the wetland and willow species were heavily browsed. Cattle were noted on the property during the assessment and the water crossing of the fence is not in place on the downstream end of the property. Appropriate fencing and maintenance would help prevent grazing pressure from domestic livestock and ensure that the riparian system remains in healthy condition.

## ROAD DRAINAGE

The road servicing the campground is the major source of sediment to the pond. The pond was recently dredged to provide the original volume and needs to be protected from further sediment deposition and degradation. The existing road drainage does not allow for water gather on the western (uphill) side to cross the road at regular intervals. This leads to increased erosion in the roadside ditch and to the road itself (Figure 3). Additionally, the road has sections which drain into the pond, adding sediment to the pond.

**Figure 3. Existing road drainage**

## ALTERNATIVES CONSIDERED

The habitat potential for this reach of Christopher Creek is very high because of the relatively large spring flow available for both the pond and stream channel. Pond water quality can be kept quite high with only a portion of the spring output and the remainder can be provided to the channel to maintain it in a perennial condition, keeping aquatic life alive through low flow periods.

It is recommended that the spring box and pipeline be repaired to provide efficient water transfer and control to both the channel and pond. Importantly the delivery system should be fitted with simple valves that will allow throttling discharge to the pond or channel and work under varying head conditions at the springbox.

Additionally, it is recommended that the outflow of the springbox towards the channel be directed upstream to near the property line in order to wet up and additional 240 feet of riffle habitat and potentially a large bedrock pool just upstream of the property line. This would provide a larger habitat area with a relatively small investment in infrastructure.

The pond can be enhanced by encouraging vegetation growth (grasses) around the embankment to limit sediment runoff into the pond. Foot traffic could be better managed in the area by formalization of a gravel path with several rock casting platforms around the pond edges to provide anglers with a focused access site to the pond edge. The outflow area can be strengthened with a rock rundown below the pipe outlet to prevent erosion and a designated overflow channel in case the pipe becomes blocked with debris.

Once perennial flow to the channel is secured, there are habitat structures and channel modifications that can be utilized to help stabilize existing good habitat in the stream and improve depth and cover under low discharge conditions.

All of the stream channel enhancements are focused on low discharge habitat improvements. It does not appear that the bankfull channel or adjacent floodplain require any additional work to achieve habitat improvements or stream stability goals.

Road improvements to reduce erosion and sedimentation in the pond are also recommended. Maintenance of a vegetated buffer around the pond will be helpful and will likely require some formal trail creation around the pond as well as fishing platform areas with larger stones to promote vegetation along the shoreline.

# DESIGN COMPONENTS

The following are short descriptions of the components to the improvement plan. Details are provided in the accompanying sheets

### ROAD DRAINAGE

The road design will be to drain the road surface away from important infrastructure and to install road dips to allow water to cross the road. The rolling dips are a low point in the road with a raised section of road downstream of the dip. This pushes water across the road and allows it to spread out before it becomes too concentrated. The road dip design and spacing is based upon a NRCS specification from Apache county, Arizona. Each dip is spaced from 95 to 115 feet apart based on the slope of the road (6-11.4%). At the outlet onto the hillside from the dips, a small rock spreader structure will be installed to spread water and minimize erosion.

**Figure 4. Rolling dip installed on dirt road in Apache County**

The road ditch on the uphill side of the road is sized using the rational method. The storm intensity was determined to be 10.6 inches/hour during the 5-minute, 100-year event. The curve number C is 50 and the area was 0.23 acres. Model results estimate that each dip and connecting channel must be able to pass 1.25 cfs during the 100-year storm event. The lowest dip and channel below the pond has to handle a watershed area of 2.64 acres and 14 cfs.

## SPRING BOX

The new spring box will encompass all of the existing structures within a single structure. The most important piece of this structure will be to key the foundation down a minimum of 12 inches into the existing grade. In some locations this will be into cobbly soil and in others this will be keyed into bedrock. Where possible the structure should key into bedrock as this will capture the most water and force it to the surface and make it available for the diversion pipe. Adjustable valves are recommended for the outflow to both the pond and stream in addition to an overflow weir. These valves can be constructed of pipe elbow with and extension that can be rotated above the elevation of the outflow weir to turn flow off. The elbow can be rotated to any elevation to adjust head pressure and volume. Maximum outflow to the pond is recommended to be 40 to 60 gpm to maintain pond flow and allow for stream flow. The elbow valve configurations are less expensive and less apt to damage during freezing temperatures.

There are two options to rebuild the spring box. One option is to build the spring box from reinforced concrete and the second to build it from reinforced cmu blocks. Both structures will follow the same height and alignment regardless of type of wall built. Spring outlets should be identified prior to construction. This may require diverting the spring from some areas of the existing box to determine if there is additional inflow.

## PIPELINE

The water delivery pipeline from the spring box should feed both the stream and the pond. The stream pipeline should extend upstream along the same shore as the spring to deliver water to the stream channel near the pipeline. This pipe should be able to carry the full discharge of the spring if necessary and the outflow should be delivered to the channel in a manner that can fill the pool upstream of the property line if possible.

The pipeline to the pond will need to cross Christopher Creek. We have provided three options for this crossing. Two options are aerial crossings similar to the current configuration. They utilize cable or metal channels suspended from metal towers to support the pipe above the stream bed and call for essentially rebuilding the entire system. The preferred alternative for both price and maintenance is to chisel a shallow trench across the bedrock of the stream channel and bury the pipe in a concrete slurry poured into the trench. This alternative is relatively inexpensive, provides less visual obtrusion and can be easily maintained because it is close to ground level.

## POND

The outflow of the pond should be armored with a rock line chute and a low swale through the pond bank to allow over flow across the berm if the overflow pipe should clog. Areas around the top of the shore line that are only bare ground should be planted in grasses to provide a vegetated buffer and protect the pond from sediment laden runoff. The shoreline can be further protected by creating specific access points along the shoreline for angling. These areas can be created with larger rocks protruding into the water to provide a casting platform.

## STREAM HABITAT

All stream structures are proposed for providing hiding habitat at low discharge or preserving current habitat by stabilizing in place. All structures utilize native rock or logs. Some larger rocks may need to be imported. Detail drawings of the various structures are provided in the drawings.

## VEGETATION

Little revegetation will be required at the site other than vegetation associated with building new structures or covering construction related ground disturbance. Seeding and biodegradable erosion cloth to cover the seeding are recommended in traveled areas around the pond.

It is recommended that the current property fence be maintained and that the fence stream crossing at the downstream end of the property be rebuilt to keep domestic livestock off the property.

## OTHER COMPONENTS AS REQUIRED

A fish cleaning station has been recommended and priced out for placement near the pond. This will require the bench and sink to be installed as well as extension of a water line from the nearby existing line.

# INSTITUTIONAL AND JURISDICTIONAL CONSIDERATIONS

A Clean Water Act Section 404 permit will be required for the habitat work in the stream. This will include an archaeological study and biological evaluation of the site for that application. It is assumed that the permit will be issued under a Nationwide 27 permit for aquatic habitat enhancement. The application should be made at least six months prior to scheduled construction.

Routing the pipeline under the channel should not require a 404 permit since dredge and fill volumes or disturbed acreage within jurisdictional water will not be large enough to trigger a permit.

Rerouting of the spring flows upstream to the property boundary may require some adjustment to the point of diversion portion of the water rights to the spring. We are unaware of the stipulations of the water right at this point, but this should be investigated prior to implementation of that phase of the plan.

# CONSTRUCTION ACTIVITIES

### CONSTRUCTION SEQUENCE

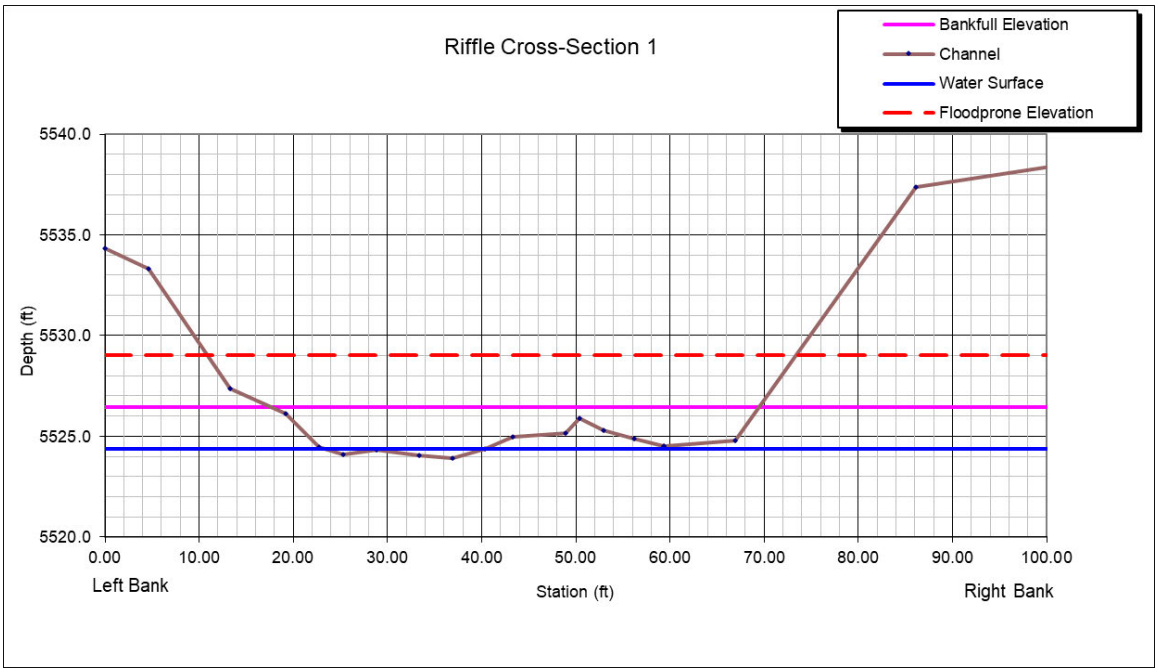
The various tasks outlined recommended in this study could take place in any order. However, the logical progression would be to first repair the spring box and pipeline. Accommodations for the upstream line could be built in but not used until the diversion is approved. Work on the pipeline in the creek should be scheduled for a period when no stream flow is expected.

Once water is available to the creek. Habitat work can begin. However, the habitat work should take place during low flows preferably in the winter months when birds and amphibians are least active.

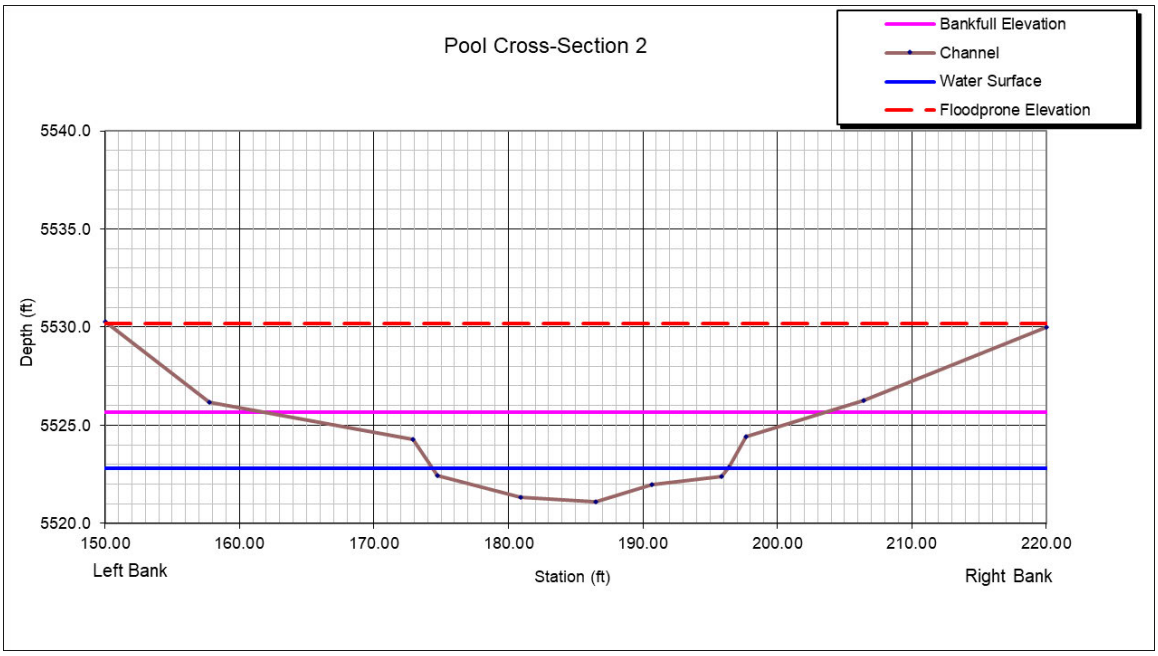
# REFERENCES

*Moody, T., S. Yard, M. Wirtanen. 2003. Regiona Relationships for Banfull Stage in Natural Channels of the Arid Southwest. Natural Channel Design, Inc. Flagstaff, AZ*

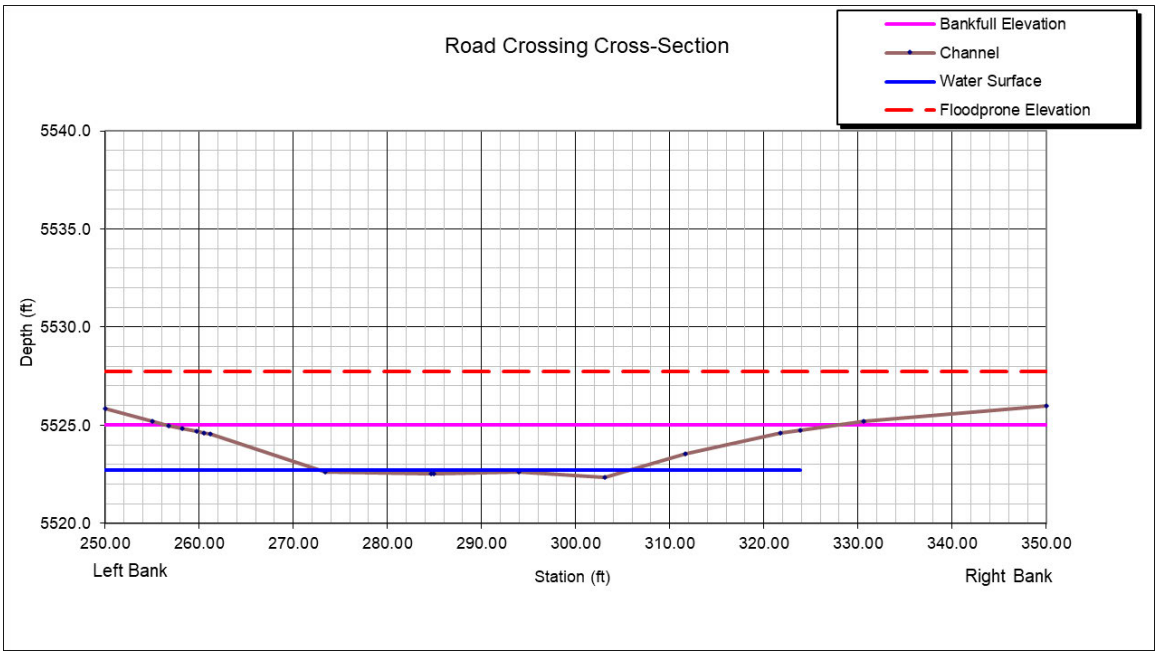
# APPENDIX A – GEOMORPHIC DATA



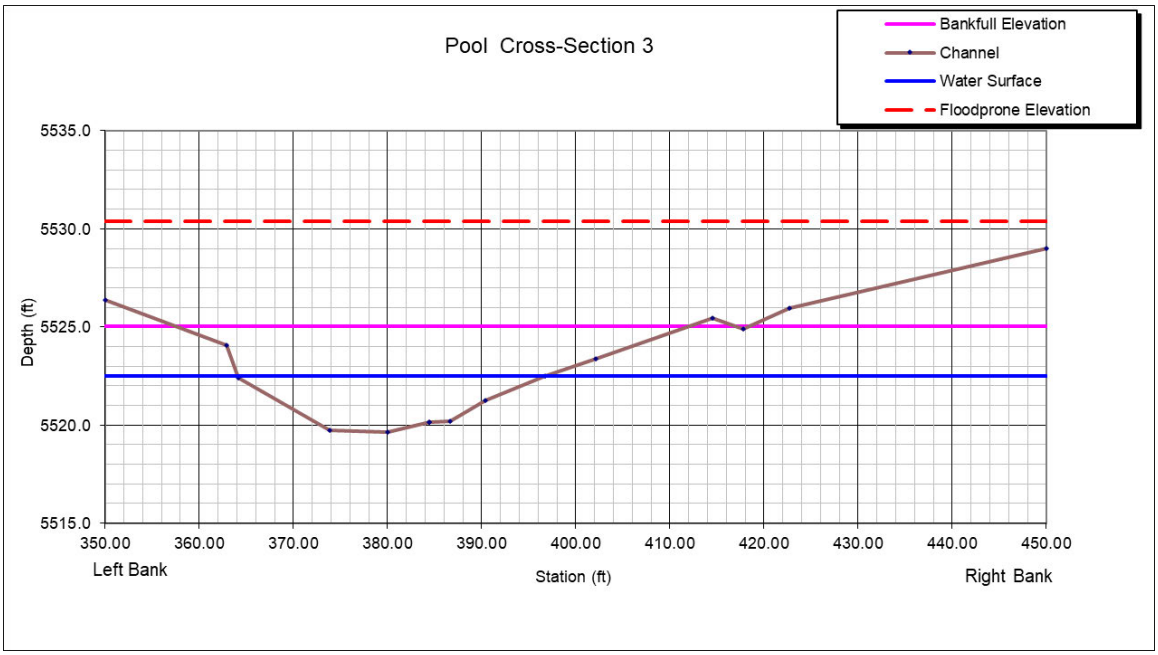

Riffle 1 at low water(base flow)



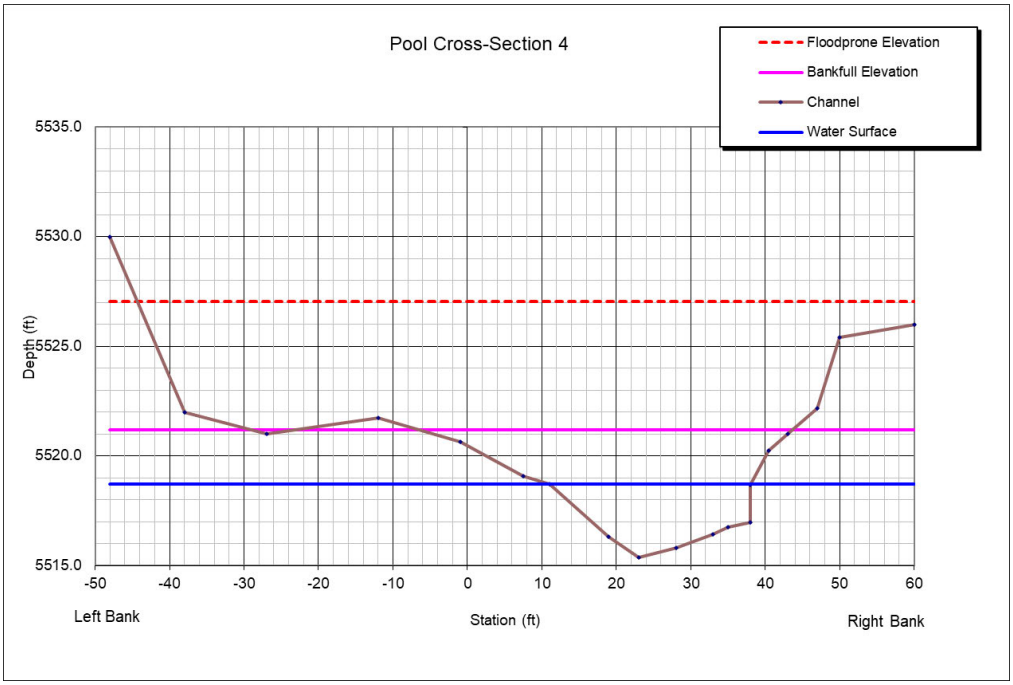

Shallow, bedrock dominated pool at low water



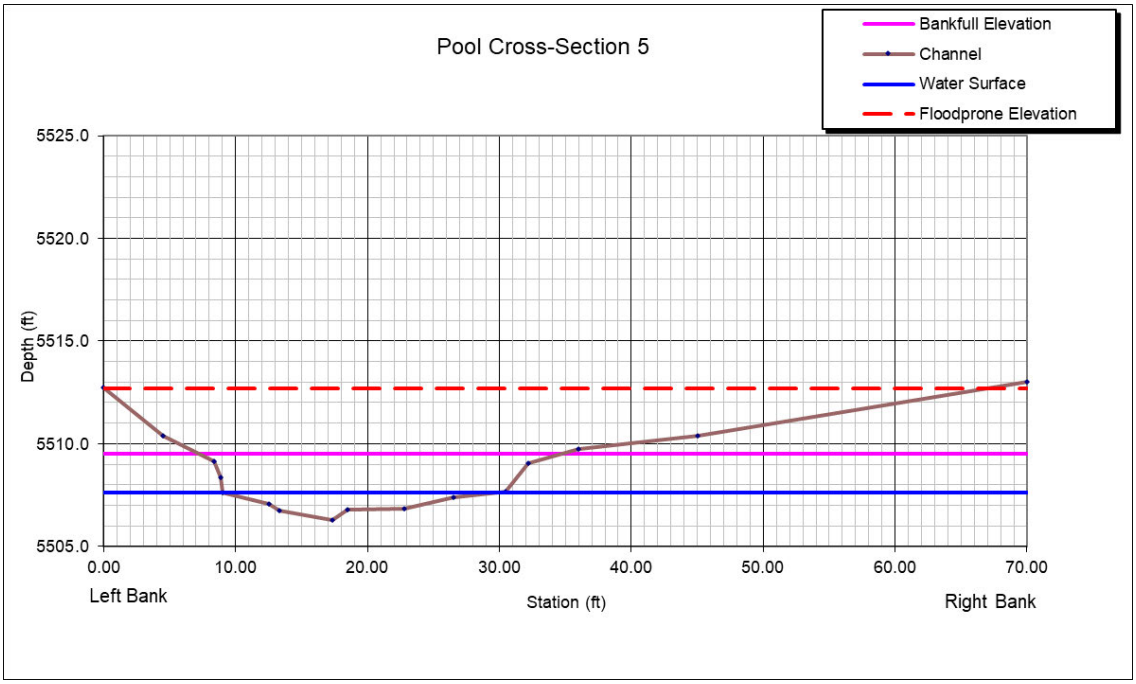

Bedrock dominated riffle utilized for stream crossing. Wide shallow flows likely prohibit fish movement between reaches at low water.



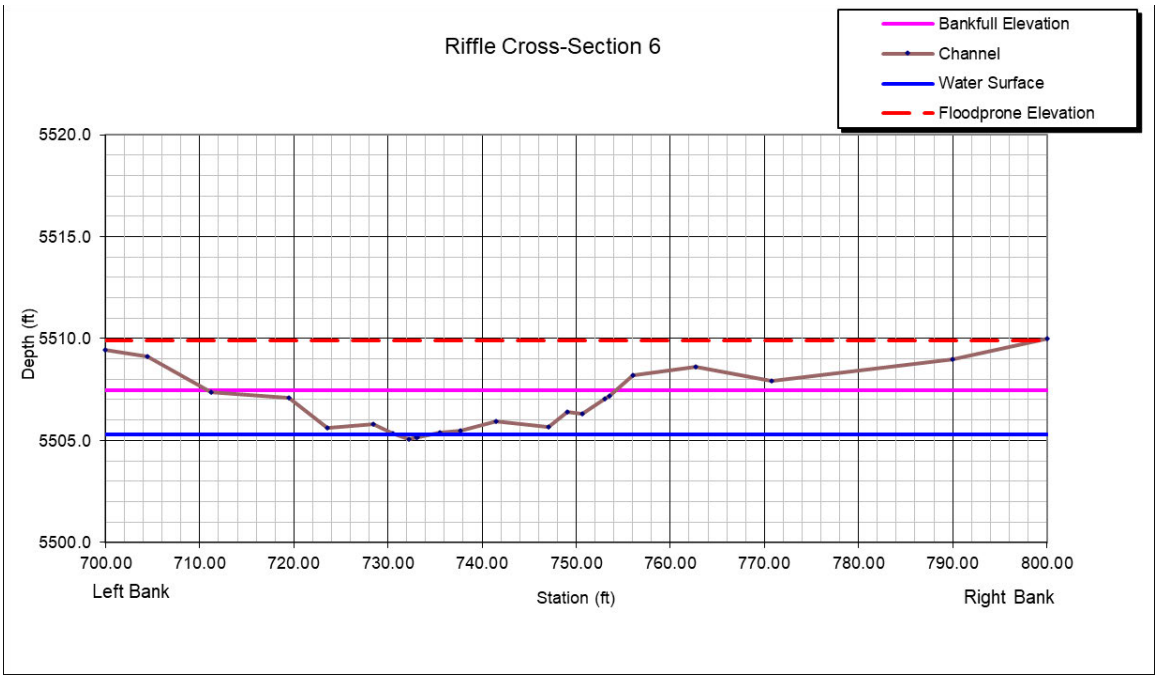

Pool with adequate depth but lacking hiding cover for larger fish.



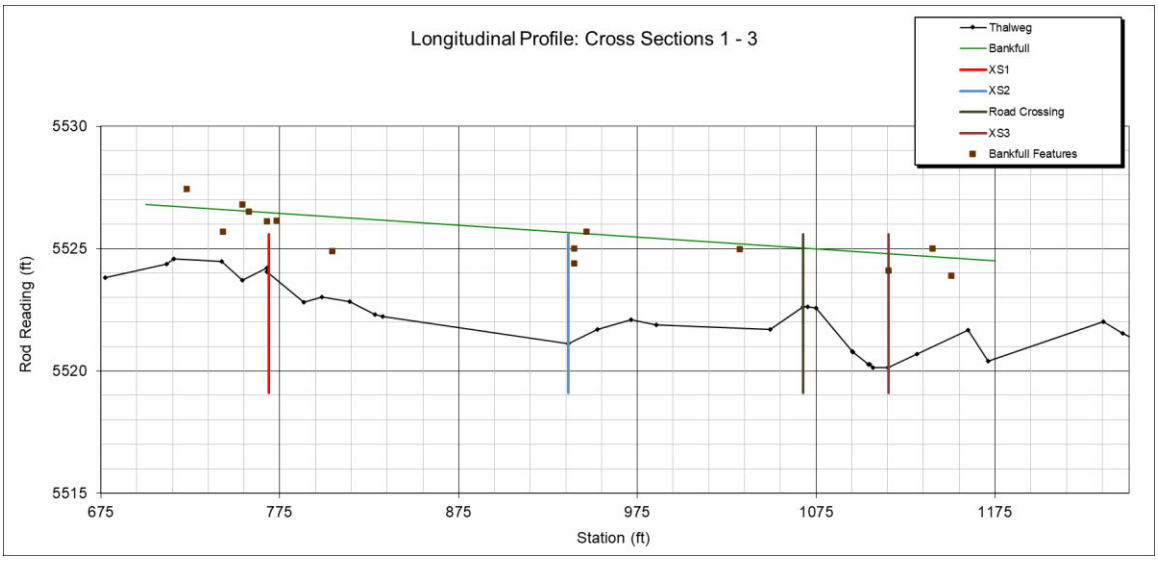

Good condition pool

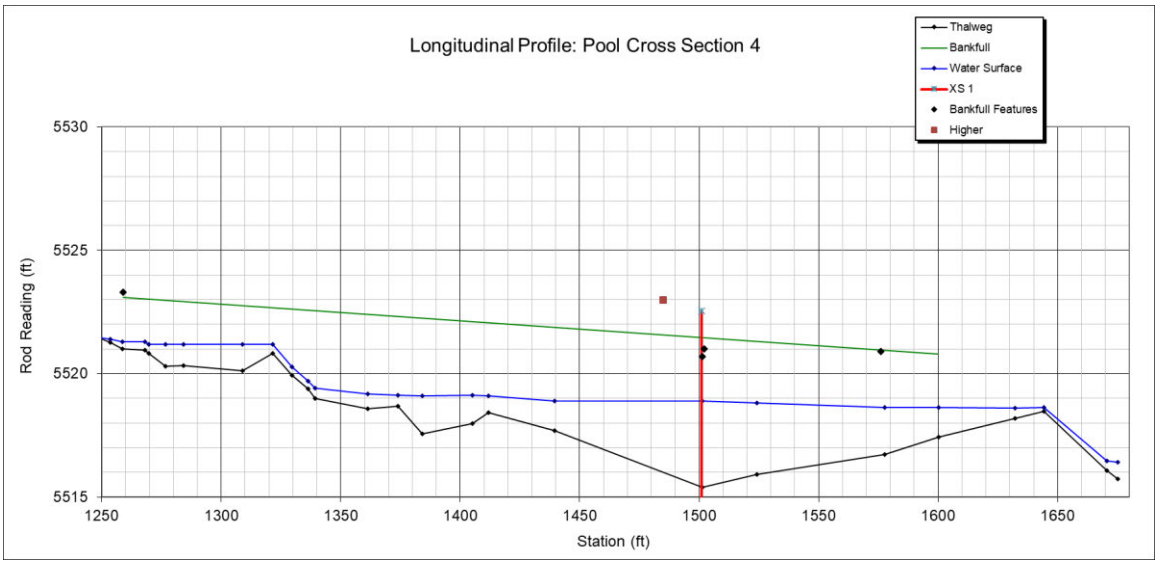



Shallow pool with relatively good alluvial and vegetative cover.




Typical riffle in lower reach.


Longitudinal Profile: Cross Sections 1 - 3
Thalweg
Bankfull
XS1
XS2
Road Crossing
XS3
Bankfull Features
Rod Reading (ft)
5530
5525
5520
5515
675
775
875
975
1075
1175
Station (ft)


Longitudinal Profile: Pool Cross Section 4
Thalweg
Bankfull
Water Surface
XS 1
Bankfull Features
Higher
Rod Reading (ft)
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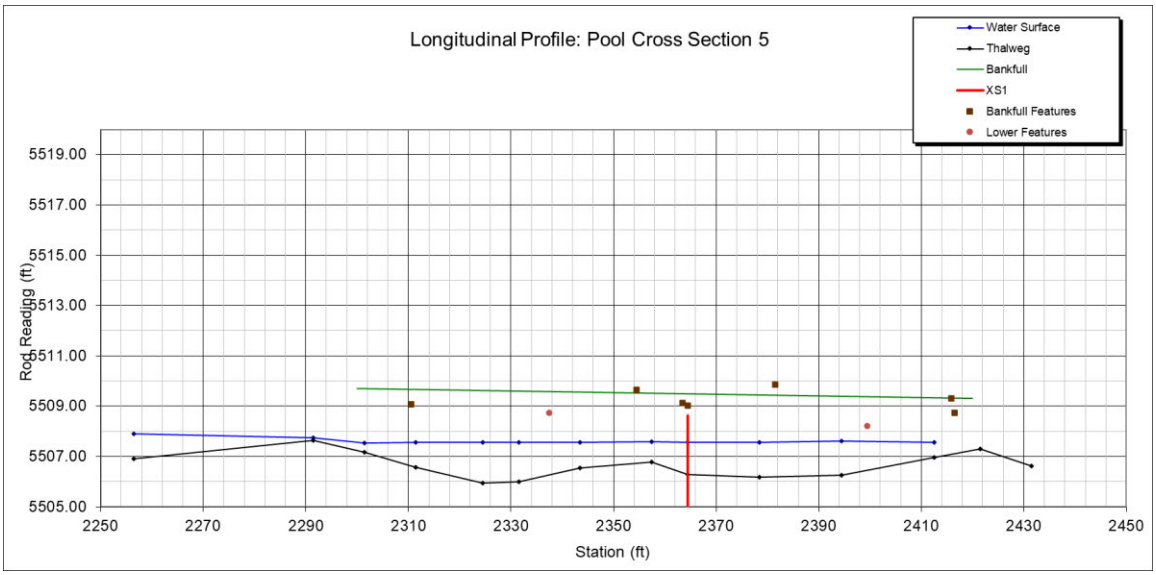
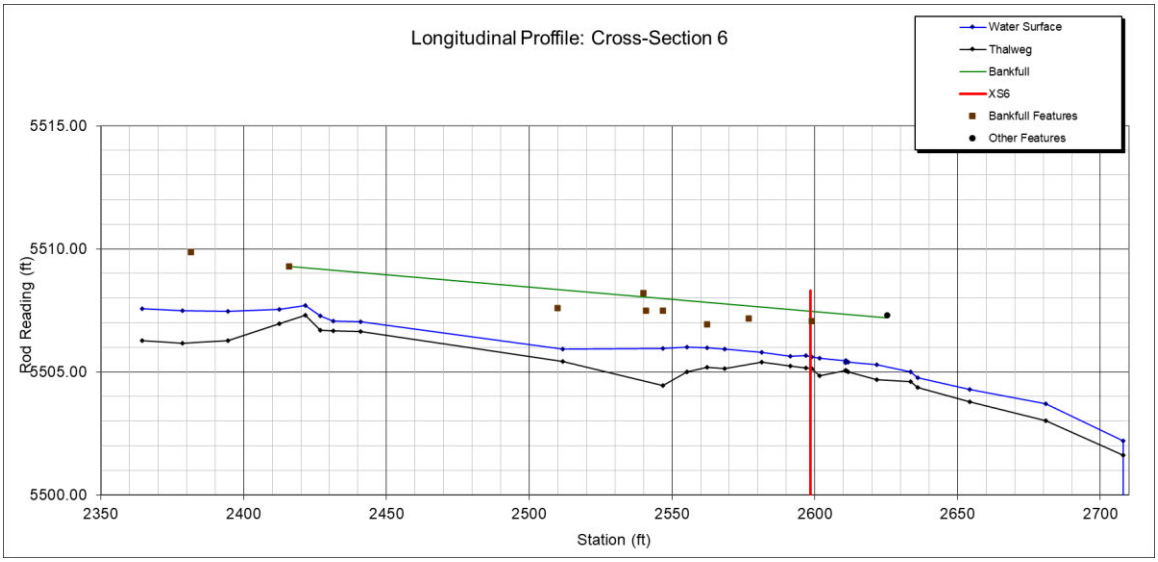
5525
5520
5515
1250
1300
1350
1400
1450
1500
1550
1600
1650
Station (ft)


Longitudinal Profile: Pool Cross Section 5
Water Surface
Thalweg
Bankfull
XS1
Bankfull Features
Lower Features
Rod Reading (ft)
5519.00
5517.00
5515.00
5513.00
5511.00
5509.00
5507.00
5505.00
2250
2270
2290
2310
2330
2350
2370
2390
2410
2430
2450
Station (ft)


Longitudinal Proffile: Cross-Section 6
Water Surface
Thalweg
Bankfull
XS6
Bankfull Features
Other Features
Rod Reading (ft)
5515.00
5510.00
5505.00
5500.00
2350
2400
2450
2500
2550
2600
2650
2700
Station (ft)

# DRAWINGS AND SPECIFICATIONS

*Under separate cover*

NCD Drawings Statement

Natural Channel Design Maps accompanying the NCD Christopher Ck Design 12172020 are uploaded in **Project Location: Schematic Maps** section. File name: NCD Dwgs.pdf.

# ARIZONA GAME & FISH LETTERHEAD

August 22, 2023

Reuben Teran
Executive Director, Arizona Water Protection Fund
Arizona Department of Water Resources
1802 W. Jackson St. Box #79
Phoenix, AZ 85007

**Subject: AZTU FY 2024 Arizona Water Protection Fund (AWPF) application**

Dear Executive Director Teran:

This letter supports the Arizona Council of Trout Unlimited (AZTU) and landowner Grand Canyon Council BSA (GCC) application for FY2024 Arizona Water Protection Fund funding for the Christopher Creek restoration project. The creek restoration is the third and final phase of a three-phase project currently underway.

Arizona Council of Trout Unlimited and Grand Canyon Council BSA (GCC), as the landowner, have partnered to create a model desert fish habitat and refuge populations of native roundtail chub and longfin dace, to restore youth fishing to the R-C Scout Ranch pond, and to restore a .53-mile reach of Christopher Creek to a perennial trout habitat.

The camp has an existing spring head diversion and an aging pipeline that AZTU and GCC are replacing as part of an earlier phase of this project. Once the work is completed the pond will be a valuable outreach tool for AZTU, GCC, school, and other youth groups in educating youth about the importance of native fish conservation. Additionally, the pond will create a refuge for roundtail chub and longfin dace in the Tonto Creek watershed. We are delighted to have an additional refuge for these native fish.

The next phase of this project, and subject of this grant application, is a pipeline extension to create a perennial flow into 240-foot riffle section upstream of the spring and restoration and conservation work to Christopher Creek. The creek is generally very shallow on a solid rock base. Consequently, the creek generally does not have significant habitat for holdover water. The pipeline extension and habitat restoration proposal will help mitigate the intermittent reach by directing water upstream into a pool ideal for sustaining a year-round trout population.

AZTU has regularly sought AZGFD guidance and suggestions for restoring the R-C pond and a portion of Christopher Creek. Among our suggestions and guidance, we suggested once the pond was drained, dredged, and refilled, the parties do the following:

- Lay 2-3 cubic yards of pea gravel for spawning beds
- Stock native roundtail chub and longfin dace.

# ARIZONA GAME & FISH LETTERHEAD



Once the work is completed the pond will be a valuable outreach tool for AZTU and GCC in educating scouts and other youth about the importance of native fish conservation. Additionally, the pond will create a refuge for roundtail chub and longfin dace in the Tonto Creek watershed.

This extensive, multi-year project is restoring youth education and recreational fishing, and includes:

- restoration of an existing, over-grown fishing pond;
- road grading and pond bank erosion control measures;
- replacing and repairing an aging pipeline and spring box; and
- restoration and conservation work of .53-mile reach of Christopher Creek supporting a sustainable, year-round trout population

We have helped guide AZTU in their activities, and endorse their general plan. AZTU, GCC,), and their consultant Natural Channel Design promise to continue working with AZGFD in improving this important habitat, and restoring desert fish habitat.

We endorse the AZTU-GCC plan and recommend their application be considered for the FY2024 Arizona Water Protection Fund.

Sincerely yours,

Zach Beard
Native Trout and Chub Coordinator

**Grand Canyon Council BSA**
8840 E Chaparral Rd Suite 200 | Scottsdale, Arizona 85250
www.grandcanyonbsa.org | 602-955-7747

August 24, 2023

Reuben Teran
Executive Director, Arizona Protection Fund
Arizona Department of Water Resources
1802 W. Jackson St. Box #79
Phoenix, AZ 85007

**Subject: AZTU FY 2024 Arizona Water Protection Fund (AWPF) application**

Dear Executive Director Teran:

This letter is in support of the Arizona Council of Trout Unlimited (AZTU) application for FY2024 Arizona Water Protection Fund funding for Christopher Creek restoration project.

R-C Scout Ranch is a camping facility operated by the Grand Canyon Council, Boy Scouts of America in Gila County, Arizona. For millions of years, water has flowed from a spring on this property sculpting the rose-tinted box canyon and providing ecologically important habitat in the rim country. This water source has been negatively impacted by fires, floods, human impact, and livestock. Grand Canyon Council BSA (GCC), as the landowner, has partnered with Arizona Council of Trout Unlimited to address these issues and restore the headwater sections of Christopher Creek to a healthy aquatic habitat. Specific goals include:

- Develop a model desert fish habitat for refuge populations of native roundtail chub and longfin dace.
- Restore youth fishing to the R-C Scout Ranch pond and stream.
- Exclude livestock that wander onto the property and damage fragile riparian species and contaminate the water with fecal coliform.
- Restore the .53-mile section of stream above the box canyon by installing soil pockets and planting native species.
- Mitigate future damage by installing erosion controls that will reduce runoff and associated turbidity while hardening access points for trout stocking and other recreational use.

GCC is working closely with AZTU and consulting with Arizona Game and Fish Department (AZGFD), U.S. Fish and Wildlife Service (USFWS), and environmental consulting from Natural Channel Design (NCD). This project will reverse years of human abuse and recommend their application be accepted for the FY2024 Arizona Water Protection Fund.

Sincerely yours,

Gregory Harmon
Director of Support Services

**Grand Canyon Council BSA**
8840 E Chaparral Rd Suite 200 | Scottsdale, Arizona 85250
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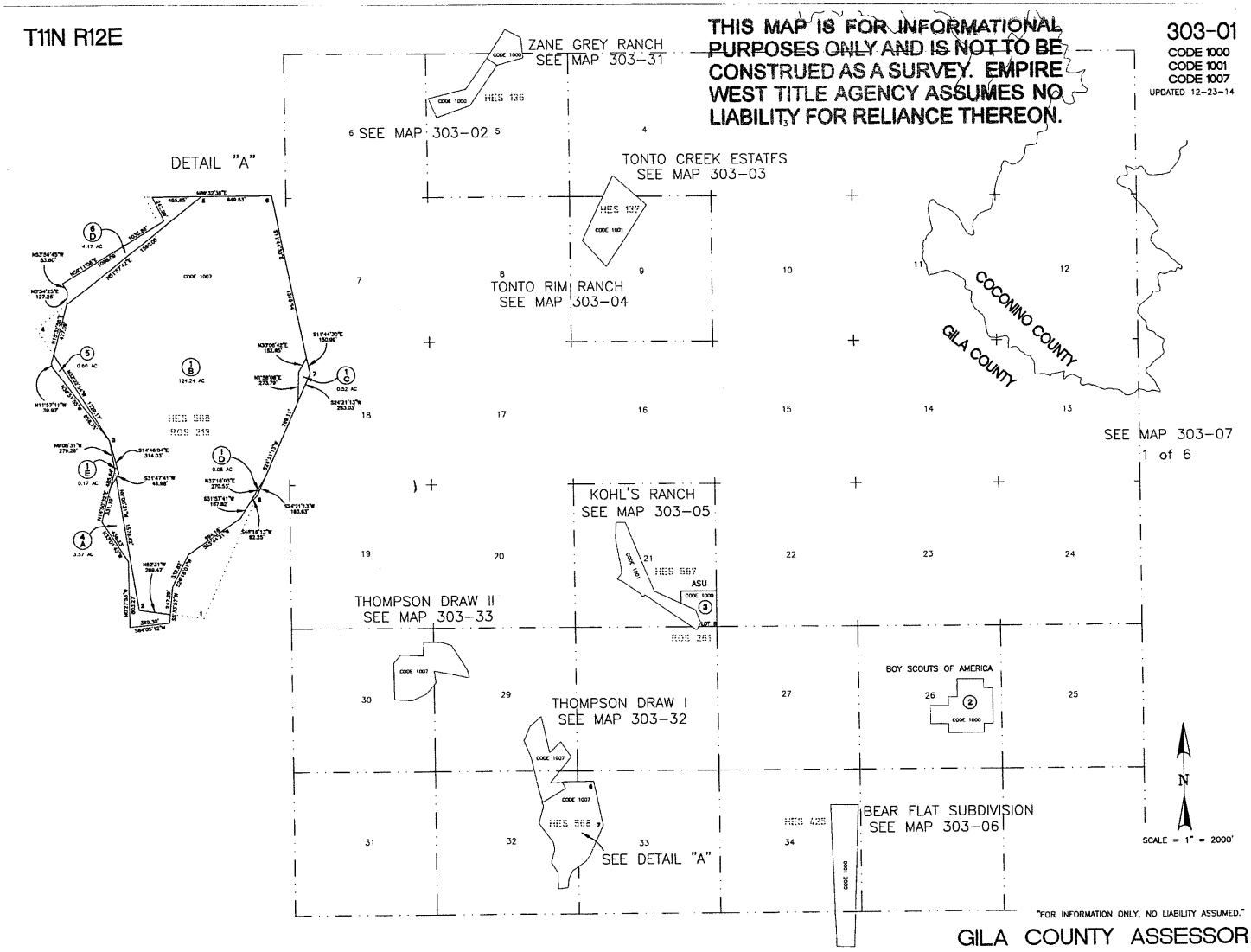
Director of Support Services


T11N R12E
303-01
CODE 1000
CODE 1001
CODE 1007
UPDATED 12-23-14
THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY AND IS NOT TO BE CONSTRUED AS A SURVEY. EMPIRE WEST TITLE AGENCY ASSUMES NO LIABILITY FOR RELIANCE THEREON.
ZANE GREY RANCH
SEE MAP 303-31
HES 136
SEE MAP 303-02
DETAIL "A"
TONTO CREEK ESTATES
SEE MAP 303-03
HES 137
TONTO RIM RANCH
SEE MAP 303-04
COCONINO COUNTY
GILA COUNTY
SEE MAP 303-07
1 of 6
HES 568
ROS 313
KOHL'S RANCH
SEE MAP 303-05
HES 567
ASU
ROS 361
THOMPSON DRAW II
SEE MAP 303-33
BOY SCOUTS OF AMERICA
THOMPSON DRAW I
SEE MAP 303-32
HES 568
SEE DETAIL "A"
BEAR FLAT SUBDIVISION
SEE MAP 303-06
HES 425
N
SCALE = 1" = 2000'
"FOR INFORMATION ONLY. NO LIABILITY ASSUMED."
GILA COUNTY ASSESSOR

**Grand Canyon Council BSA**
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August 24, 2023

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Sincerely yours,

Gregory Harmon
Director of Support Services

# Account: R028002

## Location

**Parcel Number** 30301002

**Tax Area** 1000 District 1000

**Situs Address** 19887 260 (Mp 271.6) HWY

**Legal Summary** Section: 26 Township: 11N Range: 12E PT #1154933, BEING THE SW1/4SE1/4SE1/4NE1/4, W1/4SE1/4NE1/4, E1/2SE1/4SW1/4NE1/4, W1/2NE1/4NE1/4SE1/4, NW1/4NE1/4S1/4, NE1/4NW1/4SE1/4, S1/2NW1/4NW1/4SE1/4, NW1/4SE1/4NE1/4SE1/4, SW1/4NE1/4SE1/4, SE1/4NW1/4SE1/4 & N1/2SW1/4NW1/4SE1/4 SEC 26 T11N R12E = 75.0 AC

## Owner Information

**Owner Name** BOY SCOUTS OF AMERICA, GRAND CANYON COUNCIL INC FKA

**Owner Address** 2969 N GREENFIELD RD PHOENIX, AZ 85016

## Assessment History

| | |
|---|---|
| **Full Cash Value (FCV)** | $2,488,892 |
| **Limited Property Value (LPV)** | $2,377,632 |
| **Primary Assessed** | $356,645 |
| **Exempt** | ($356,645) |
| **Net Primary Assessed** | $0 |
| **Secondary Assessed** | $373,334 |
| **Exempt** | ($373,334) |
| **Net Secondary Assessed** | $0 |

**Tax Area:** 1000 **Primary Rate:** 0.094496
**Secondary Rate:** 0.0204150

| Legal Class | FCV | LPV | Primary Assessed | Secondary Assessed |
|---|---|---|---|---|
| 02.R | $2,488,892 | $2,377,632 | $356,645 | $373,334 |

## Transfers

**No Transfer Documents**

## Images

- Sketch
- GIS