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Groundwater Recharge on Working Lands by Local Youth to Enhance

Ecosystem Services - Final Report

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Project Summary: Borderlands Restoration Network (BRN) in partnership with the Arizona Department of Water Resources (ADWR) implemented restoration activities at T4 Ranch – a privately owned working cattle ranch located approximately fifteen miles north of Nogales, AZ. Project goals were to 1) stabilize the headwaters of T4 Ranch; 2) stabilize the main drainages within the watershed; and 3) return vegetative cover to the watershed for the benefit of the landscape’s hydrologic cycle. These goals were accomplished through the construction of rock and wood erosion control structures (ECS), designed to slow water flow, trap sediment, mitigate erosion, and increase infiltration; the seeding of bare ground; and the engagement of local youth with the restoration of their home watershed through Borderlands Earth Care Youth (BECY), BRN’s paid internship program. Project effectiveness was evaluated through photo monitoring of baseline and end-of-project conditions and through modeling infiltration changes in response to ECS construction.



Figures 1 & 2. Erosion control structures, filled in with sediment after recent rains.

Project Deliverables:

Task 1 – Erosion Control: Install 400 ECS across 12 drainages on T4 Ranch with native materials. Photos and GPS points of each structure were reported back to ADWR staff.

Task 2 – Mulch and Seed: Apply native grass seed pellets across 40 acres of working grasslands. Photos and descriptions were reported back to ADWR staff.

Task 3 – Local Youth Engagement: Hire and train 10 local high school students in grassland and riparian restoration techniques. Supervise high school students to build 100 ECS and apply further seed and mulch to grassland uplands.

Task 4 – Effectiveness Evaluation: Measure ECS once completed. Calculate potential sediment capture. Take fixed point photo points of various structures over time. Report results back to ADWR staff.

Task 5 – Watershed Modeling: Following completion of restoration work, BRN will use a geospatial watershed assessment tool developed by USDA, EPA, and University of Arizona scientists to model infiltration increases due to erosion control structure installation.



Figure 3: Borderlands Earth Care Youth Interns and the Watershed Restoration Crew, Summer 2022

Work Summary:

Task 1: A total number of 699 ECS were installed at T4 Ranch by spring 2023 throughout 12 drainages, surpassing the deliverable of 500 (400 + 100 from youth restoration engagement). In some drainages, ECS filled in with sediment after multiple monsoons swept water downstream and dropped the sediment as the structure slowed the water flow. Additional ECS were built on top of these structures to continue raising the channel bed where it had been incised, and to further stabilize the banks. GPS points were taken for each structure and compiled into a shapefile.

Task 2: Mulching activities were halted in summer 2022 because of a lack of materials and feasibility. Funding for mulching was reallocated to building additional erosion control structures (Task 1). Wild seed was collected and seed was purchased to create 1,440 pounds of native seed pellets, which were spread throughout the ECS after installation. Species included grasses like Sideoats grama (*Bouteloua curtipendula*) and shrubs like rubber rabbitbrush (*Ericameria nauseosa*) that thrive in arid climates.

Task 3: High school youth work was completed in summer 2022 as part of the BECY program. A second week of high school youth work took place with leftover funding in summer, 2023, and more ECS were installed. This allowed new and returning students the opportunity to build ECS, as well as learn about field safety, plant identification, and how watershed restoration benefits the landscape.

Task 4: All ECS were measured after installation, and potential sediment capture was calculated using those measurements. In total, 196 tons of sediment can be collected behind ECS at T4 Ranch, which is

equivalent to 10 dump truck loads. Some ECS do not have measurements because the program switched from manual to digital data collection, and some information was not carried over. Fixed photo points at 11 structures were created following installation. These points include the baseline photos, along with four photos from the following year that documented the structure through each season, and then two additional photos following the 2024 winter and following summer monsoon season. Each point has 7 photos attached to document changes over time.

Task 5: Former BRN intern, Eden Santiago submitted a watershed model used as her capstone project for her Master's in GIS Administration, showing infiltration increases throughout the drainages at T4 Ranch after ECS were installed, with the highest infiltration rates being at the top of the watershed.

Challenges: Throughout the contract BRN experienced several leadership transitions that prompted reassessments of project deliverables and timelines. Adjustments were made to improve feasibility and ecological impact, including reallocating funding among tasks. For example, Task 2 was originally to mulch across 40 acres of bare soil; however, limited material made this impractical. Resources were then reallocated to increase the erosion control structure deliverable, which further contributed to the project's overall goals. Late in the project period, ranch ownership changed, and the new owner restricted drone use for aerial monitoring. ADWR was immediately notified and an amendment was made to focus solely on repeat photo monitoring to evaluate effectiveness.



Figures 4 & 5: Seed Pellets being spread throughout the project site.

Conclusions: This project was completed on time and successfully met the goals of stabilizing the headwaters and drainages at T4 Ranch by installing ECS and dispersing seed pellets to help mitigate erosion, increase infiltration, and revegetate the area. Funding was utilized to have the greatest impact on the landscape by increasing the amount of ECS installed, and by hosting an additional week of educational field work with local high school students to double the opportunity for community youth to learn about ecological systems and environmental careers. With help and flexibility from our partners at ADWR, we were able to amend deliverables to maximize on-the-ground restoration work, and foster more community connections.

Previously submitted data:

- Shapefile containing all ECS points
- Layer file containing 11 monitoring points and associated photos
- Spreadsheet containing ECS measurements and calculations for potential sediment capture
- Copy of Eden Santiago's final layout on Watershed Impact Analysis at T4 Ranch

Accompanying Data:

- Seed pellet data sheet