Coyote Creek
Watershed Improvement and Education Project

Final Report

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February 2014

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EXECUTIVE SUMMARY

This report provides information that has been used to assist planning and implementation of watershed improvements within the Coyote Creek Watershed. This report combines the earlier assessment report with details regarding design and implementation. This work has been funded by and Arizona Department of Environmental Quality Watershed Improvement and Education Grant awarded to the Little Colorado River Resource Conservation and Development (RC&D). Natural Channel Design, Inc. (NCD) has been the technical service provider to the RC&D for these projects.

The grant goals were to establish a Watershed Improvement Council (WIC), provide a rapid watershed assessment, develop and prioritize a list of Best Management Practices (BMPs), and rapidly move into the implementation of the BMP's with the WIC members. The goals of the implemented BMPs are to reduce the sediment yield of Coyote Creek and consequent sediment impairment of the Little Colorado River and Lyman Lake downstream of Coyote Creek. Due to the relatively short time frame and the relative abundance of existing data on the Coyote Creek watershed, a literature review and site visits to lands managed by WIC members were conducted. During site visits and through surveys, landowners were encouraged to express their concerns about sedimentation/erosion on their properties and suggest BMP's they felt would work or had worked in the past.

The suggested BMP's were analyzed for cost per acre protected, estimated time to load reduction, expected maintenance requirements, and sediment reduction potential due to placement within the watershed. The cost per acre of benefit was weighted by these four factors to provide a means of prioritizing BMP types and locations for implementation. This weighed cost benefit allows comparison of projects for sediment reduction. Other factors such as habitat enhancement, producers' requirements and other concerns of the WIC were considered in the prioritization process as well.

Results of the analysis indicate that specific areas of the Coyote Creek watershed produce relatively more sediment than others. Stream banks and roads are relatively high contributors for their total area. However, gully and rill erosion are prevalent through much of the watershed. This high sediment contribution has been noted for at least 40 years. Several phases of sediment control have been proposed and partially implemented in the past. Some practices have been successful but are nearing the end of their beneficial life span while others were not implemented due to lack of support from the producers or lack of adequate funding. It is hoped that strong initial landowner participation in the assessment phase as well as BMP selection will improve the chances for successful implementation and sediment reduction.

Analysis of practice cost efficiencies indicated that gully protection through sediment control basins and small grade control efforts were likely the most efficient use of funding to reduce sediment load. Bank sloping and road drainage efforts are worthwhile but did not rate high in efficiency due to the relatively high cost of these operations.

Support provided by the ADEQ through the Coyote Creek Watershed Education and Training grant has provided for rehabilitation of existing sediment control practices and the implementation of new practices, as well as the formation of a partnership between producers and state agencies. These actions should lead to further improvements to decrease sediment yield from the Coyote Creek Watershed, by providing a framework and momentum for future action.

Next steps include the further prioritization of landowner needs, in alignment with the suggested BMPs which have yet to be implemented, for further grant funding submittals.

PROJECT DESCRIPTION

Coyote Creek is a major tributary of the Little Colorado River in eastern Arizona. While the major portion of the channel is ephemeral, there is a significant yield of sediment from the watershed to the Little Colorado River. Sediment contributions are significant enough to influence the capacity of Lyman Lake, a major irrigation impoundment and recreational boating reservoir on the Little Colorado River, and enough to cause water quality impairment of the Little Colorado River. Arizona Department of Environmental Quality (ADEQ) has provided a Watershed Education and Training (WET) grant to the Little Colorado River RC&D with the objective of establishing a watershed council, identifying specific watershed concerns and best management practices (BMPs) to achieve sediment reduction. Finally, specific projects were funded and implemented under an ADEQ Nonpoint Source Grant. Natural Channel Design, Inc. has provided technical assistance to the RC&D in the development, prioritization, design, and implementation of BMPs.

This report describes the assessment process that was utilized to plan, estimates costs, prioritize, and fund watershed improvements that were focused on limiting the sediment contribution of Coyote Creek to the Little Colorado River. A review and synthesis of previous studies and programs to reduce sediment was conducted to provide insight into which practices work and which do not. Private landowners and grazing allotment managers within the basin were interviewed and site visits were conducted to discuss locations of specific problems. A descriptive list of BMP's and prioritization criteria were developed to assist the watershed group in deciding the best way to spend limited funding available for water quality improvement resulting in a list of recommended projects. Finally, several projects were chosen and implemented and are described in this report.

Coyote Creek has had recognized water quality issues related to sediment yield for several decades. Recommendations from several reports have generally agreed upon the source of sediment and types of practices required to alleviate sediment yield from the watershed. However, many recommendations have not been implemented due to lack of funding or support from public/private land managers. The project was to have direct input from land owners and managers as to the types of practices they believe would best benefit the land and their interests. This set of practices was evaluated to assess the potential impact on water quality improvement and a decision-making rubric was developed and utilized by the watershed improvement group. The Coyote Creek Watershed Council consists of local landowners and managers. It was anticipated that recommendations developed through this process would be fully supported and implemented by the participants. Consequently, the value of maintaining the projects will be high with a positive water quality response over the long-term.

PROJECT OBJECTIVES

The objectives of the ADEQ WET grant range from public education on watershed issues, formation of a watershed improvement council to development and implementation of BMPs focused on improving water quality by reducing sediment loads originating from the watershed. The objectives of the ADEQ Nonpoint Source Grant are to implement on-the-ground water quality improvement projects to control nonpoint source pollution.

This report contains:

- Assessment of existing resource conditions gathered from available sources and site visits.
- Landowner concerns and needs gathered from site visits and interviews
- Descriptions and costs for BMP's that are focused on sediment reduction and supported by landowners.
- A decision making rubric designed to assist the watershed council in choosing sites and practices which will have the greatest impact on sediment reduction.
- Descriptions of the objectives and design for every project implemented.

LOCATION

Coyote Creek is a 230 square mile sub watershed of the Little Colorado River located in Apache County, Arizona and Cantrell County, New Mexico (Figure 1). Approximately 50 square miles of the watershed are located in New Mexico with the remainder in Arizona. Elevations range from 7,900 feet in the eastern watershed to 6,000 near the confluence with the Little Colorado River. Flows are mostly ephemeral along the majority of the 41 miles of Coyote Creek channel.

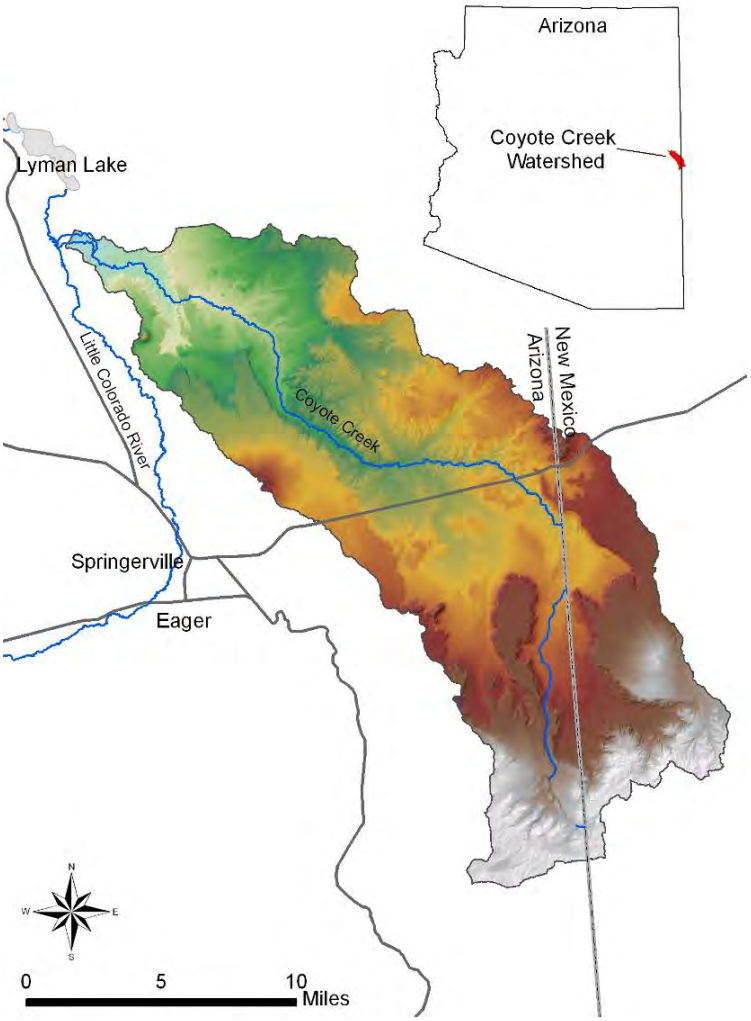

Figure 1. Location map.

EXISTING RESOURCE CONDITIONS AND CONCERNS

OWNERSHIP, CLIMATE, GEOGRAPHY AND SOILS

Background information on the Coyote Creek Watershed environment is covered in detail in a 1982 natural resource inventory conducted by the Arizona State Lands Department. This information is highlighted here.

The majority of land within the watershed is State Trust land that is leased for grazing (Table 1). It is important to note that most of the federal lands are in the upper portion of the watershed while state and private lands are in the lower two thirds of the watershed where most of the runoff and sediment yield are generated.

Table 1. Land ownership in Coyote Creek Watershed.

Acreages incorporate both Arizona and New Mexico portions of the watershed. Data from AZ State Lands (2009) D.L. Goerndt.

Ownership	Amount (mi^2)	Percentage of watershed
US Forest Service	65.5	28.4%
Bureau of Land Management	13.9	6.0%
Private Land	39.3	17.0%
State Trust	111.7	48.5%
Total	**230.4**	

Precipitation in the watershed ranges from 10 to 14 inches annually. Most precipitation occurs as rain during summer monsoon storms. Winter snows are characteristically light. The higher elevations in the southeastern portion of the watershed receive slightly more precipitation than the rest of the watershed.

The surface geology of the watershed consists of alluvial and sedimentary deposits interspersed with lava flows. The majority of soils on the watershed are loamy sands of the Clovis-Palma-Hubert association formed from eolian deposits on flat or undulating topography. Rudd (basaltic derivation) and Tours-Jocity soil associations are the next most prevalent. All soil associations are well drained.

The topography of the watershed is generally flat, or rolling with volcanic hills. Drainages can create incised canyons.

Vegetation on the watershed consists of mainly grassland savannas or grass mixed with pinyon /juniper.

ASSESSMENT

Assessment of existing conditions was conducted by a review of existing reports and data as well as site visits to see property and interview owners and managers. The goal of the assessment process was to gather information about the general resource condition and issues within the watershed as well as provide owners/managers with specific areas of concern and practices to address those concerns. Previous reports as well as landowner interviews provided valuable information about the resource conditions and practice needs on specific lands.

ANALYSIS OF EXISTING DATA

It has been recognized for at least 40 years that the Little Colorado River Basin and specifically the Coyote Creek watershed has high soil loss issues. The characteristic geology and soil type and typical land use of the watershed make it susceptible to rill and sheet erosion as well as gully and channel erosion. Six reports spanning 30 years of study related to the assessment of the Little Colorado River Basin or Coyote Creek specifically were reviewed.

These reports identify the likely sources of sediment impairment as, (1) the characteristic geology and soil of the watershed, (2) meteorological changes, causing an acceleration of stream channel erosion, sheet and rill erosion, and gullying, and (3) grazing.

A significant source of eroding sediment is from areas of the watershed made up of deep sandy loam soils. These soils lack cohesion and are easily eroded where there is a void in plant cover and along the banks of Coyote Creek and its tributaries. Sheet and rill erosion account for the largest amount of erosion in the basin with the highest rates occurring in area of badland topography like that found in the Coyote Creek watershed.

Plant cover and precipitation are well correlated within the watershed. The areas lower in the watershed, which are the focus of sediment reduction efforts, receive the least amount of rainfall and have the most severe erosion. It is also believed that recent rainfall events occur less often but with increased intensity. This results in an increase in erosion on the dry plains and desert grassland areas, which are most commonly grazed.

Widespread, heavy grazing decreases plant cover, thus increasing the erodibility of the soil. Runoff events mobilize soil which becomes suspended sediment in streams and increases turbidity. In the 2002 Little Colorado River TMDL report, ADEQ identified grazing practices as contributing 60% of the load for turbidly. This TMDL report is not specific to Coyote Creek alone but to the Little Colorado River and its tributaries. However, the recommendations by ADEQ for decreasing the loading are pertinent to Coyote Creek. ADEQ recommendations are to increase riparian vegetation, stream bank stabilization, the promotion of floodplain development and the minimization of impacts from cattle through improved grazing strategies and practices.

Common resource concerns in these reports are sheet and rill erosion, as well as gully and stream channel erosion. These concerns have historically been addressed with mixed success through the use of many conservation practices including the following. Many of these practices have reached the end of their service life (> 10 years) and need replacement or rehabilitation. Common practices recommended by the reports are:

- sediment detention basins
- water and sediment control basins
- dikes
- water development – springs, wells, pipeline, and pumps
- fencing

- improved grazing plans
- brush management
- water spreading
- rock and brush grade control

The primary documents reviewed were:

Little Colorado River Basin Summary Report, *USDA Soil Conservation Service, Economic Research Service and US Forest Service* (1981)
Coyote Creek Natural Resource Inventory, *Arizona State Land Department* (1982)
Lyman Lake Reservoir Capacity Survey, *USDA Soil Conservation Service* (1983)
Coyote Creek Erosion Control Demonstration Project, *Apache Natural Resource Conservation District* (1985)
Coyote Creek Critical Area Treatment RC&D Measure Plan, *Little Colorado River Plateau Resource Conservation and Development Area Inc.* (1988)
Coyote Creek Erosion Control Project, *Apache Natural Resource Conservation District* (1992)
ADEQ TMDL Study (2002)
Watershed Based Management and Action Plan, *Upper Little Colorado River Watershed Partnership* (2005)
Watershed Based Plan, Little Colorado River, *Arizona NEMO* (2006)
Little Colorado River Headwaters Watershed, Arizona Rapid Watershed Assessment, *USDA Natural Resource Conservation Service, Arizona and University of Arizona Water Resources Research Center* (2008)

Descriptions and major findings of the most pertinent documents are found below.

Little Colorado River Basin Summary Report (1981)
In December of 1981 a Cooperative River Basin Study of the Little Colorado River Basin was completed. The Soil Conservation Service, the Forest Service, and the Economic Research Service all participated. The Study was lead by the Arizona Department of Water Resources and the New Mexico State Engineer's Office. The study provides a description of the basin, the socio-economic base, irrigation practices, municipal and industrial water supply, rural domestic and livestock water supply, development of surface water resources, surface water budgets, erosion and sediment, flooding, recreation, fish and wildlife, and timber.

The report presents an analysis of resource data to offer solution to problems and assist decision makers in the development of water and related resource within the Little Colorado River Basin. It should be noted that this was not a basin-wide comprehensive plan. It did however, alternatives were developed which had a good possibility of being implemented with assistance from the USDA. These alternatives include: irrigation, recreation, erosion and sediment, and flooding.

One of the major land resource problems in the basin was identified as soil erosion within the alluvial valleys and on valley slopes. Erosion includes loss of land as a result of streambank and gully erosion, loss of soil nutrients, degradation of water quality by sediment, sediment deposition in streams channels and reservoirs, and the release of soluble salts by the erosion process. Approximately 5,300 miles of channel bank were experiencing moderate to severe erosion. Sheet and rill erosion accounts for the largest amount of erosion in the basin with the highest rates occurring in areas of badland topography, like that found in the Coyote Creek Watershed.

Recommendations to reduce soil erosion, protect water quality and improve productivity include:

- proper grazing use
- deferred grazing
- planned grazing systems
- fencing, water spreading

- brush management
- range seeding
- prescribed burning
- mechanical treatment
- stock water development

U.S. Department of Agriculture, Soil Conservation Service, Economic Research Service and US Forest Service 1981. Little Colorado River Basin, Arizona-New Mexico, Summary Report and Appendix I,II, III, and IV, Phoenix Arizona

Coyote Creek Natural Resource Inventory (1982)

A natural resource inventory of the Coyote Creek watershed was conducted by the Arizona State Land Department in 1981. Funding for this work was received from the Four Corners Regional Commission, Grant # 611-466-050-1. The subsequent report presents an analysis of natural resource data which provides a baseline of natural resource information and data, in an effort to assist in solving range resource management problems specific to the Coyote Creek watershed.

Soil erosion and soil loss studies were conducted focusing on two areas, sheet and rill erosion, and streambed and gully erosion. It was determined that through sheet and rill erosion, approximately 1.8 tons of sediment was being lost per year. Streambed and gully erosion, while more noticeable and damaging was estimated to be less than sheet and rill erosion. Of the 261 miles of tributaries to Coyote Creek it is reported that eighty-nine miles (34%) of the tributaries were experiencing moderate-to-severe bank erosion, with sluffing banks, limited vegetation, and headcutting. The study suggests that 934 erosion-control structures would be needed to stabilize tributary erosion. Treatments would include sloping, mulching, and seeding, gully walls and streambanks. It is also reports that a total of eighteen miles (75%) of Coyote Creek proper is in need of erosion-control measures. The U.S. Soil Conservation Service indentified a potential flood water and sediment-detention dam site on Coyote Creek which would be an effort to prolong the life of Lyman Lake.

The Arizona State Land Department identified the following may resource concerns, listed in the order of priority:

- erosion-control of eighty-nine mile of channels by means of fencing, bank sloping, seeding and mulching, and installing sediment retention structures.
- reduction of soil loss from sheet and rill erosion through the increase of rangeland cover.
- development of grazing systems, improvement of water distribution, long term monitoring, soil erosion studies
- pinyon-juniper invasion control
- Improvement of watering systems with the development of additional wells, pipelines, storage tanks and drinkers, lining ponds, and developing springs.
- development of more recreation activities to reduce impacts to the resource.

Arizona State Land Department, 1982. Coyote Creek Natural Resource Inventory, Phoenix Arizona

Lyman Lake Reservoir Capacity Survey (1983)

This study was conducted by the Soil Conservation Service to determine the capacity of Lyman Lake and the influx of sediment in its 63-year history. The survey concluded that the capacity of Lyman Lake had been reduced by 28% over that period with and annual influx of sediment at 165 acre feet per year from the watershed.

USDA Soil Conservation Service. 1983. Lyman Lake Apache County, Arizona Reservoir Capacity Survey

Coyote Creek Erosion Control Demonstration Project (1985)
This project was sponsored by the Apache Natural Resource Conservation District. Activities were directed at control of gully erosion through the installation of multiple small gully erosion control measures throughout the watershed. Labor was provided by the Northern Arizona Council of Governments (NACOG).

Apache Natural Resource Conservation District 1985. The Coyote Creek Erosion Control Demonstration Project.

Coyote Creek Critical Area Treatment RC&D Measure Plan (1988)

A Coyote Creek Watershed Critical Area Treatment Measure was undertaken in August of 1988. This "Measure" was an effort to develop a plan to address the severe soil erosion in the Coyote Creek watershed, a significant concern of the Apache Natural Resource Conservation District. Consistent with previous work, the plan identifies sheet, gully, and streambank erosion as the major contributors of sediment from the watershed.

The plan estimates that 40% of the erosion within the watershed is a result of streambank and gully erosion. It is reported that this type of soil erosion is particularly damaging to range lands due to runoff being rapidly conveyed from the area before it can infiltrate into the soil and promote vegetative cover. These gullies provide a conduit for the rapid transport of sediment to depositional areas such as Lyman Lake. Water quality is impaired by the suspended sediment.

Several alternatives were evaluated in an effort to meet the plans objects which include the protection, preservation and conservation of area water resources, and the improvement of range condition. The selected alternative includes grade control and sediment control structures, road stabilization, critical area planting, fencing, water development, and streambank protection. The estimated cost of these practices in 1988 is $1,780,300. It is believed that these practices would stop accelerating erosion losses, reduce erosion and sediment yield and maintain or improve productivity, land values, create jobs, and improve wildlife habitat and water quality.

Little Colorado River Plateau Resource Conservation and Development Area Inc., 1988. Coyote Creek Critical Area Treatment RC&D Measure Plan, Apache County, Arizona

Coyote Creek Erosion Control Project (1992)
The Coyote Creek Erosion Control Project was sponsored by the Apache Natural Resource Conservation District with cooperation from US EPA, Soil Conservation Service, Arizona State Lands Dept., Arizona Department of Environmental Quality, Cooperative Extension Service and Agricultural Stabilization and Conservation Service. It operated from 1992 through 1996. The focus of the project was the development of range management systems for Coyote Creek producers that would lead to greater ground cover on eight ranch units. Baseline and ongoing monitoring of vegetative cover and water quality were utilized to document the effectiveness of the BMPS. BMPs included both management and structural practices. Management BMPs were focused on grazing practices while structural BMPs focused on grade control, road stabilization, water development and streambank protection.

Upper Little Colorado River Watershed Partnership, Watershed Based Management and Action Plan (2005)

The Upper Little Colorado River Watershed Partnership was formed in 1998 through the assistance of the Arizona Department of Water Resources in an effort to protect, restore, and monitor natural resources of the upper Little Colorado River watershed to enhance quality of life. Participating agencies included the Arizona Department of Environmental Quality, The U.S. Fish and Wildlife Service, The U.S. Forest Services, local town managers, and irrigation users.

The partnership identified more than 20 objectives for the upper little Colorado River Watershed. Of note here is Objective 14 which relates to the feasibility of sediment storage on Coyote Creek in an effort to decrease the sediment yield from the Coyote Creek watershed. The concerning being that Coyote Creek is a major contributor of sediment to Lyman Lake. It was estimated that a large sediment storage structure could capture 85% of the sediment leaving the watershed.

It was also identified that sediment generation within the watershed is a result of bare ground. Grazing management as well as recreation and rock density would need to be managed in order to promote the recovery of ground cover. They suggest that Livestock grazing my need to be suspended, temporarily or even permanently if critical ground cover levels cannot be maintained. The reduction of pinyon and juniper was suggested as a way to increase ground cover in the Coyote Creek watershed.

As of the 2005 report no work had been completed within the Coyote Creek watershed, though it was still desired to evaluate the feasibility of developing sediment storage on Coyote Creek.

Upper Little Colorado River Watershed Partnership, 2005. Watershed Based Management and Action Plan, Rural Watershed Partnership Program, Arizona Department of Water Resources, Phoenix, Arizona.

Little Colorado River Headwaters Watershed, Arizona, Rapid Watershed Assessment (2008)
A Rapid Watershed Assessment was completed within the headwaters of the Little Colorado River, hydrologic unit 1502001 by the Natural Resources Conservation Service and the University of Arizona, Water Resources Research Center, in 2008. Coyote Creek is one of the subwatersheds within this study. The Rapid Watershed Assessment is a concise report containing natural resource information related to the condition and concerns with the study area. The assessment is primarily Geographic Information System Based, used to make decisions regarding the condition of the watershed and to help prioritize conservation efforts.

Resource concerns identified by this report include soil erosion, rangeland site stability, rangeland hydrologic cycle, excessive runoff, excessive suspended sediment and turbidity in surface water, threatened or endangered plant and animal species, noxious and invasive plants, wildfire hazard, inadequate water for fish and wildlife, habitat fragmentation, and inadequate stock water for domestic animals.

The report shares that most of the Little Colorado River from the West Fork of the Little Colorado River to Lyman Lake is listed as impaired by sediment. Lyman Lake is also listed as impaired due to mercury in fish tissue. Reaches of the Little Colorado River which Coyote Creek is a tributary of, contain eight species that are either listed, species of concern, or candidate species, under the U.S. Endangered Species Act.

Resource concerns for the watersheds of the Little Colorado River listed in this assessment include the following:

- soil erosion – sheet and rill erosion
- water quality – excessive nutrients and organics in surface water
- water quantity – inefficient water use on irrigated land
- plant condition – productivity, health and vigor
- domestic animals – inadequate quantities and quality of feed and forage

Recommended conservation practices include:

- water development in the form of pipelines and canals
- crop rotation
- pest management
- land leveling
- fencing
- prescribed grazing
- upland wildlife habitat management
- nutrient management

USDA Natural Resource Conservation Service, Arizona and University of Arizona Water Resources Research Center, 2008. Little Colorado River Headwaters Watershed, Arizona, Rapid Watershed Assessment.

Arizona NEMO Watershed based plan, Little Colorado Watershed (2006)

In partnership with the Arizona Departments of Environmental Quality and the University of Arizona Water Resources Research Center, the Arizona Cooperative Extension at the University of Arizona has initiated the Arizona Nonpoint Education for Municipal Officials (NEMO) Program. Arizona NEMO helps to develop watershed based plans to address nonpoint source pollution, such as sediment. In October of 2006 Arizona NEMO published the results of a watershed scale modeling using the Automated Geospatial Watershed Assessment tool. This hydrologic analysis system takes into account elevation, slope, soil type, land cover type, and precipitation data to ultimately determine water runoff and sediment yield.

Additionally NEMO provided recent model results that are useful for determining watershed condition at a coarse scale and identifying priority areas for further investigation and the implementation of conservation practices. Arizona NEMO applied the AGWA model to the Coyote Creek watershed. Results of the model are seen the Figures 2 and 3, note that the sediment yield tracks well with the spatial variation of water yield. This correlation indicates that sediment yield from the watershed could be mitigated through the implementation of conservation practices which increase infiltration and decrease runoff.

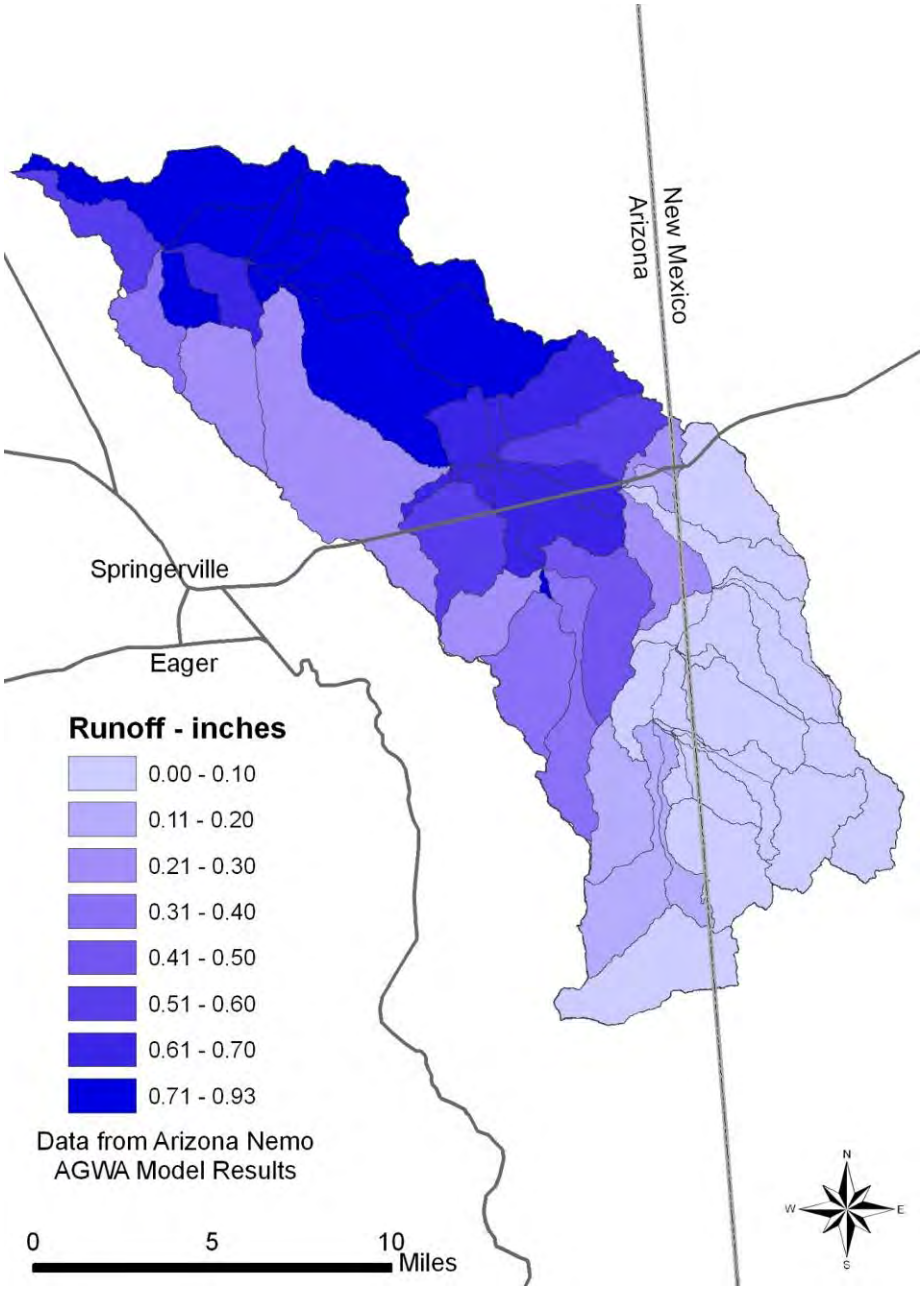

Figure 2. NEMO model results of runoff.

Model results of runoff from a 10-yr rainfall event – 1.3 inches of precipitation in 1 hour.

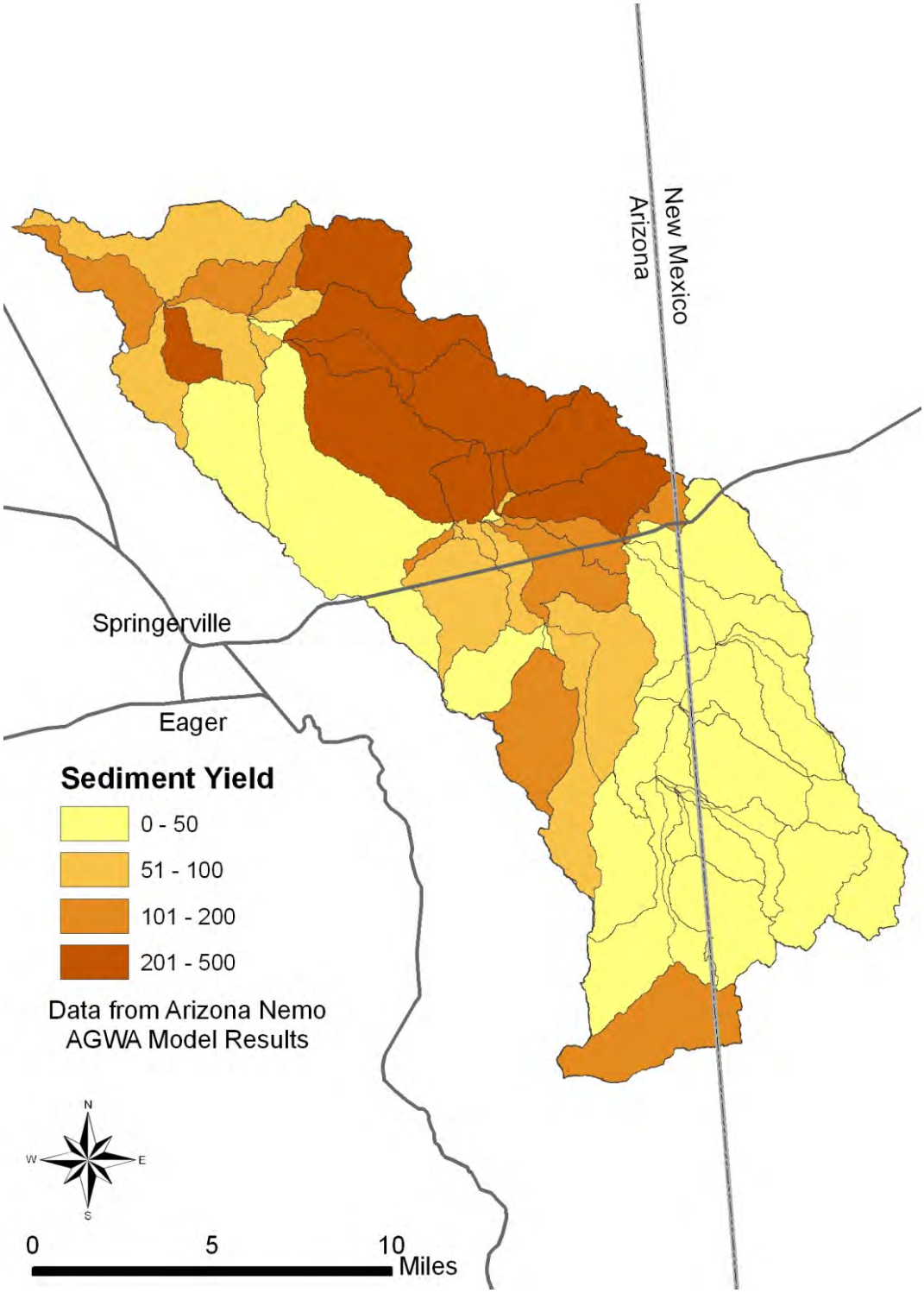

Figure 3. NEMO model results of sediment yield.

Note that the magnitude of sediment yield closely matches the map of runoff. Model results of runoff from a 10-yr rainfall event – 1.3 inches of precipitation in 1 hour.

WATER QUALITY

The Arizona Department of Environmental Quality (ADEQ) assesses surface water quality to identify which surface waters are impaired or exceed water quality standards. The current Watershed-scale Education and Training Grant was awarded to begin mitigation of Coyote Creek. Coyote Creek is a tributary to the impaired Little Colorado River and upstream of the impaired Lyman Lake. ADEQ monitors water quality at four sites at the mouth of Coyote Creek, near its confluence with the Little Colorado River. Through these monitoring efforts, ADEQ has identified Coyote Creek to be a major source of both turbidity and suspended sediment to impaired downstream waters, both impairments are considered to be caused by nonpoint source pollution.

The objectives of the Coyote Creek Watershed Improvement Council are to decrease suspended sediment and turbidity of Coyote Creek. Strategies include the use of BMPs to, increase plant cover through the improvement of grazing practices, such as fencing and water development, and to address streambank erosion, gully, and sheet or rill erosion. Continued monitoring by ADEQ will provide a means to measure the level of success of the BMPs implemented by the Coyote Creek producers. The monitoring scheme may need to be modified to obtain measurements during higher flows than have previously been sampled. Previous measurements taken during low flows are representative only of very local water quality and not representative of water quality of the Coyote Creek watershed.

SITE VISITS

The Coyote Creek Watershed Improvement and Education Project began with a kick off meeting September 18, 2010, in the Eagar Town Hall. During this and subsequent meetings producers which expressed interest in participating in the watershed improvement project were identified. Staff from Natural Channel Design scheduled site visits when possible with these producers to discuss resource concerns and solutions. Field notes were made and photographs taken. All data and photographs were organized and site maps were made indicating the location of Best Management Practices (BMPs). A list of participating producers is found in Table 2 and Figure 4 provides the location of their ranch. Summary information from site visits is found in Appendix A. Each summary includes a description of resource concerns, BMPs requested by the producer including typical costs, maps and photographs.

The BMPs listed in Appendix A represent what the producers desired, to solve specific resource concerns. A rubric is provided in Tables 5 and 6 to assist in the decision making based upon the producer proposed BMPs.

Table 2. List of producers requesting assistance from this project.

CLIFFORD JOHNSON
TRAVIS JOHNSON
GAYLYN KINGHT / DARIC KNIGHT
LANCE KNIGHT
SIDNEY MADDOCK
FRED MOORE/DARIC KNIGHT
BRIAN NICOLL
ELAINE ROGERS
JOHN THOMPSON

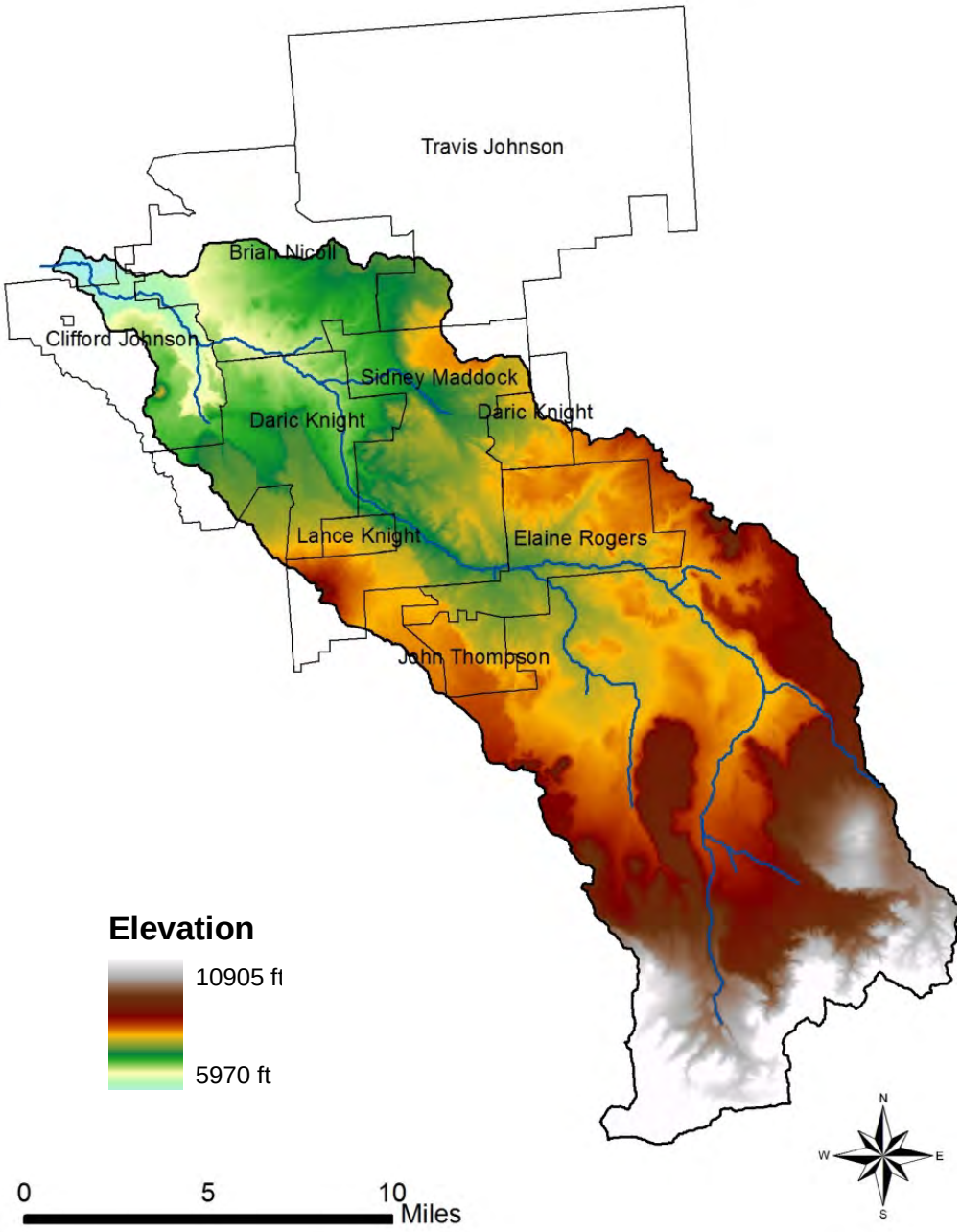

Figure 4. Location of ranches requesting assistance to implement conservation practices.

BEST MANAGEMENT PRACTICES

DEVELOPMENT OF BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) were developed to address nonpoint source pollution specific to land uses of the Coyote Creek Watershed. The sediment eroded from uplands and stream banks were identified as causing high turbidity and suspended sediment in Coyote Creek, the Little Colorado River, and ultimately Lyman Lake. The technical service provider (NCD) met with interested producers and compiled a list of desired BMPs. This list was broken into two broad categories, vegetative practices and structural practices (Table 3). Information organized by the Natural Resources Conservation Service and Arizona NEMO was used in the development of practices and in rating their effectiveness at meeting objectives.

Vegetative practices aim to improve plant cover through riparian and upland vegetation management thus decreasing the production of sediment from gullying, and sheet and rill erosion. Presently an invasion of pinyon and juniper has lead to a decrease in understory vegetation. Brush management or the removal of exotic species such as pinyon and juniper has been shown to increase understory abundance in Arizona (Clary and Jameson 1981). Once woody species are removed it is critical that the disturbed area be reclaimed through range seeding to help compete with the invasive species and improve the seed bank which has been alerted due to grazing.

Planting woody species, such as willows in areas of consistent stream flow or a high water table provides a natural sediment filter and stabilizes stream banks. In some reaches of Coyote Creek, willow and tamarisk are abundant and are often growing in the middle of the stream. This causes the channel to erode its banks as the stream widens because of the decreased channel capacity caused by the in-stream vegetation. Ideally the woody vegetation would be transplanted to the stream bank and the channel constructed to an appropriate width.

Fencing is an important tool for herd management. It allows for grazing rotation and stream protection. Resting grazed lands allows vegetation to renew energy reserves, rebuild shoot systems, and deepen root systems, with the end result being long-term maximum biomass production that benefits the producers and keeps the plant cover at a maximum.

Structural practices include those that directly stabilize or trap eroding soil and those that provide infrastructure for grazing management in the form of water development. Gully and grade control structures help to arrest headward migration of headcuts and stabilize local stream reaches. These headcuts and channel knick points are significant sources of sediment that contribute to the degradation of water quality. Using water spreading practices helps to redistribute the concentrated flow, allowing for more infiltration and decreasing the flow's energy.

Sediment basins are constructed to capture and detain sediment laden runoff. The basins are designed on an individual basis to meet site specific conditions. This practice also provides a means to remove sediment from stream flow, preserving the capacity of a downstream stock pond. Maintenance is required to remove accumulated sediments which decrease the capacity of the basin over time.

Stream bank stabilization in the form of rock and vegetation structures can help reduce the erosion brought upon by the erosive power of stream flood flows. The reconnection of a stream channel with its floodplain through bank sloping can also decrease erosion and promote proper stream channel and riparian function.

Sheet and rill erosion is caused by overland flow from rainfall events. Where vegetation cover is not sufficient to stabilize the soil structural practices can be implemented. Rock barriers and silt fences help to decrease runoff velocity and promote infiltration. The ultimate solution to sheet and rill erosion is the revegetation of bare soils.

Rainfall runoff commonly concentrates upon roads that run perpendicular to slope. This concentrated flow accelerates erosion of the unpaved dirt roads. By using water bars or rolling dips the water is directed off the road and spread onto adjacent fields.

Water development in the form of wells, springs and pipelines allows for better grazing rotation, which allows grazed lands to be rested. As described previously, resting grazed lands allows vegetation to renew energy reserves, rebuild shoot systems, and deepen root systems, with the end result being long-term maximum biomass production that benefits the produces and keeps the plant cover at a maximum.

Detail drawings of BMPs are located in Appendix B.

Table 3. List of potential BMP's identified by producers.

COYOTE CREEK – Best Management Practices
RANGE MANAGEMENT & VEGETATIVE PRACTICES
Brush Management (mechanical removal)
Fencing
Kangaroo Rat Control
Mulching
Range Seeding
Woody Plantings
STRUCTURAL PRACTICES
Bank Stabilization
Bank Sloping
Bank Sloping with Seeding and Mulching
Rock Protection (Toe Rock, Barb, Dart, Vane)
Gully Control Structures
Grade Control (Drop Spillway)
Grade Control (Rock & Brush, Rock & Wire Sausage, etc <300ac)
Headcut Treatment (Smooth-Seed-Mulch)
Sheet and Rill Erosion
Rock Barrier
Silt Fence
V-Mesh Spreader
Water Spreader/Dike
Sediment Basin
Sediment Basin
Water and Sediment Basin (WASCOB)
Road Stabilization
Culvert
Ditch Outlet
Rolling Dip
Water Bar
Water Development
Pipeline
Pond
Spring Development or Rehabilitation
Watering Facility (Tank, Trough)
Well Development or Rehabilitation

INSTITUTIONAL AND JURISDICTIONAL CONSIDERATIONS

Acquisition of required permits for implementation of BMP's may require considerable lead time and planning. Permitting requirements differ between practices and land ownership. Activities within the active channel of Coyote Creek likely require a Clean Water Act Section 404 permit for discharge into waters of the United States. This permit is administered by the Army Corps of Engineers. Application for a 404 permit also triggers the need for Clean Water Act Section 401 permits which are administered by Arizona Division of Environmental Quality (ADEQ), the need for a State Historical Preservation Office (SHPO) consultation, and a biological evaluation of effects to protected species. In upland areas, major ground disturbing activities may require SHPO consultation. Minor ground disturbing activities (fencing, gully treatments, etc.) likely do not require permitting. Landowners working directly with NRCS can likely utilize NRCS permitting programs and specialists to accomplish permitting tasks for work on their property. Grazing allotment leases may require review of specific management actions by the state or federal land management agency overseeing the lease. Well drilling requires permits from the Arizona Division of Water Resources (ADWR). Development or enhancement of existing stock ponds or retention basins may require water rights for development. Surface water rights are administered by ADWR.

Table 4. Permitting requirements for suggested BMPs.

Permitting is dependent on location and funding sources for each practice. This table provides general guidelines and specific permitting needs should be considered on an individual project basis. "?" indicates that practice may or may not fall within jurisdictional waters and field determinations will be required.

	ACOE 404	ADEQ 401	SHPO	Biological Evaluation	ADWR well	ADWR water rights
RANGE MANAGEMENT & VEGETATIVE PRACTICES						
Brush Management (mechanical removal)			X	X		
Fencing			X	X		
Kangaroo Rat Control						
Mulching						
Range Seeding						
Woody Plantings						
STRUCTURAL PRACTICES						
Bank Stabilization						
Bank Sloping	X	X	X	X		
Bank Sloping with Seeding and Mulching	X	X	X	X		
Rock Protection (Toe Rock, Barb, Dart, Vane)	X	X	X	X		
Gully Control Structures						
Grade Control (Drop Spillway)	X	X	X	X		
Grade Control (Rock & Brush, Rock & Wire Sausage, etc)	?	?	X	X		
Headcut Treatment (Smooth-Seed-Mulch)	?	?	X	X		
Sheet and Rill Erosion						
Rock Barrier			X	X		
Silt Fence						
V-Mesh Spreader						
Water Spreader/Dike			X	X		
Sediment Basin						
Sediment Basin	X	X	X	X		
Water and Sediment Basin (WASCOB)	X	X	X	X		
Road Stabilization						
Culvert						
Ditch Outlet						
Rolling Dip						
Water Bar						
Water Development						
Pipeline			X	X		
Pond	X	X	X	X		X
Spring Development or Rehabilitation			X	X		
Watering Facility (Tank, Trough)			X	X		
Well Development or Rehabilitation			X	X	X	

COST ANALYSIS

Based on site evaluations and discussions with producers, resource concerns were identified and BMPs were developed to address these concerns Estimated typical costs were refined using NRCS and ADEQ cost rates, NCD project experience, as well as other engineering cost estimators. Unit costs for specific practices are provided in Table 5.

Table 5. Unit costs for suggested BMP practices.

	Units	ADEQ-WIC 2011
Range Management & Vegetative Practices		
Brush Management	(ac)	$90.00
Fencing - Conventional	(ft)	$4.00
Fencing - Electrical	(ft)	$2.00
Kangaroo Rat Control	(ac)	$24.00
Mulching	(ac)	$800.00
Range Seeding	(ac)	$145.00
Woody Plantings	(ea)	$9.00
Structural Practices		
Bank Stabilization		
Bank Sloping	(cy)	$4.00
Bank Sloping with Seeding and Mulching	(ft)	$15.00
Rock Protection (Toe Rock, Barb, Dart, Vane)	(cy)	$75.00
Gully Control Structures		
Grade Control (Drop Spillway)	(cy)	$200.00
Grade Control (Rock & Brush, Rock & Wire Sausage, etc <300ac)	(cy)	$55.00
Headcut Treatment (Smooth-Seed-Mulch)	(ac)	$150.00
Sheet and Rill Erosion		
Dike and/or Water Spreader	(cy)	$4.00
V-Mesh Spreader	(ft)	$3.50
Silt Fence	(ft)	$1.00
Sediment Basins		
Sediment Basin (earthmoving)	(cy)	$4.00
Water and Sediment Control Basin (WASCOB)		
Earthwork	(cy)	$4.00
CMP	(ft dia-inch)	$1.80
Riser	(ea)	$350.00
Road Stabilization		
Culvert	(ea)	$500.00
Ditch Outlet	(ea)	$75.00
Rolling Dip	(ea)	$135.00
Waterbar	(ea)	$135.00
Water Development		
Pipeline (1-1/4 in.)	(ft)	$3.50
Pond	(cy)	$4.00
Spring Development or Rehabilitation	(ea)	$1,600.00
Tank	(gal)	$1.25
Trough	(gal)	$1.50
Well Development or Rehabilition		
Well	(ft)	$60.00
Windmill Pumping Plant	(ls)	$22,500.00
Solar Pumping Plant	(ls)	$12,500.00

PRIORITIZATION OF PROJECTS FOR FUNDING

The Watershed Improvement Council faces a challenging task of determining which practices and areas should be prioritized for implementation. While there is merit in all of the practices, limited funding availability necessitates that practices that will have the greatest impact on reducing sediment yield. Local landowners and managers with long experience in the watershed will ultimately provide the best guidance on choosing project areas and practices that best meet the needs of the watershed and stakeholders. However, a quantifiable method of organizing practice effectiveness and cost is a valuable tool for assisting and defending those prioritization decisions.

A prioritization rubric was developed to assist the WIC in planning. This rubric provides a weighted cost/acre-improved as a means of ranking practice effectiveness. The cost/acre is calculated by taking the cost of the practice and dividing by the acres protected or enhanced. For example a sediment basin can protect effectively reduce the sediment yield for the entire watershed upstream of it while fencing and stock management has an effect on the acreage within the fenced area. In some cases several practices are required for an impact on the same acreage, i.e. brush management and grassland seeding are both required to effectively treat the same acreage. In these cases the total cost of the treatment was divided by the acreage enhanced.

Weighting for four factors are applied to the cost/acre of each practice. The four weighting factors are:

Reduction Potential - The general potential sediment reduction of the practice. Three categories of reduction generally described by NEMO (2010).

High	= 1
Medium	= 2
Low	= 3

Estimated Time to Load Reduction - The amount of time required to realize full sediment control benefits. Three categories of reduction generally described by Amesbury et al., (2010).

Immediate	= 1
< 2 years	= 2
>2 years	= 3

Expected maintenance requirements – All practices are expected to have a useful life of at least 10 years. However, this weight factor estimates the amount of maintenance required to realize the full benefit of the practice over that 10-year life span. Three categories of reduction generally described by Amesbury et al., (2010).

Low	= 1
Medium	= 2
High	= 3

Watershed Placement Potential – This factor measures the potential sediment reduction due to the location of the practice within the watershed. This factor is weighted according to sediment yield data estimated by Arizona NEMO AGWA model (Figure 5). Ratings are in six categories:

0 - 50 tons acre	= 6
50 -100 tons/acre	= 5
100 - 200 tons/acre	= 4
200 – 300 tons/acre	= 3
300 – 400 tons/acre	= 2
400 – 500 tons/acre	=1
Bank sloping	= 1 (based on typical soil loss estimates for unstable banks during bankfull flows)

The first three factors are utilized to rank the effectiveness of the BMPs in general. The weights of the three factors are added together and multiplied by the cost per acre treated to provide a weighted unit cost for ranking purposes. The results are provided in Table 6. The fourth factor (Watershed Placement Potential) is multiplied by the weighted unit cost for proposed BMPs to provide a ranking of the treatment in a specific placement. These rankings are provided for each producer in the site visit results. Results are provided in Table 7. The most efficient BMPs have the lowest weighted area cost.

In general the ranking procedure is instructive. Small rock and brush grade control and sediment detention basins appear to be the most efficient means of controlling sediment throughout the basin. Cost intensive practices that only affect limited areas such as road stabilization and bank sloping are least efficient use of funding for sediment control.

Several steps could be taken to improve the ranking process. Typically, road runoff and bank erosion are high priority projects due to massive amounts of sediment produced by these areas. Our rankings likely underestimate the amount of sediment that could be controlled at these sites. Most estimates of sediment loss from these areas are based on an annual yield or common runoff event. The AGUA estimates for sediment yield from the basin are based on a 10-yr return frequency flood and do not incorporate roads or eroding banks within its estimates. The easiest way to compare the relative yields would be to rerun the model for a more frequent storm event (1.5 – 2 year). However it is doubtful that the relative ranks of bank sloping and road work would change since these practices are considerably more expensive than others.

Table 6. BMP's ranked by weighted unit cost.

Best Management Practice	Total Cost	Area Mitigated (ac)	Cost per Acre Mitigated	Reduction Potential	Time for Reduction	Expected Maintenance	Sum of NEMO Ratings	BMP Rating
Brush Management	$ 659,700.00	7330	90	2	3	1	6	540
Range Seeding	$ 265,785.00	1833	145	2	3	1	6	870
Fencing	$ 168,960.00	4300	39	2	3	2	7	275
Kangaroo Rat Control	$ 1,200.00	50	24	3	3	3	9	216
Bank Stabilization (Slope-Seed-Mulch)	$ 52,725.00	3	17,575	1	1	1	3	52,725
Channel and Bank Stabilization	$ 2,000.00	1	2,000	1	1	1	3	6,000
Gully Control (Grade Control Structure)	$ 89,375.00	8048	11	2	1	1	4	44
Sediment Basin	$ 31,600.00	4202	8	1	1	3	5	38
Sheet & Rill Water Spreading (Dike, V-Mesh)	$ 8,675.00	415	21	1	1	2	4	84
Road Stabilization	$ 3,375.00	2	1,688	2	1	3	6	10,125
Water Development (Watering Facility)	$ 97,855.00	5250	19	2	3	3	8	149
Water Development (Pond)	$ 9,600.00	4000	2	2	1	3	6	14
Water Development (Spring)	$ 20,045.00	4500	4	2	3	3	8	36
Water Development (Well, Pumping Plant)	$ 148,695.00	11250	13	2	3	3	8	106
	$ 1,559,590.00	**51,184**						

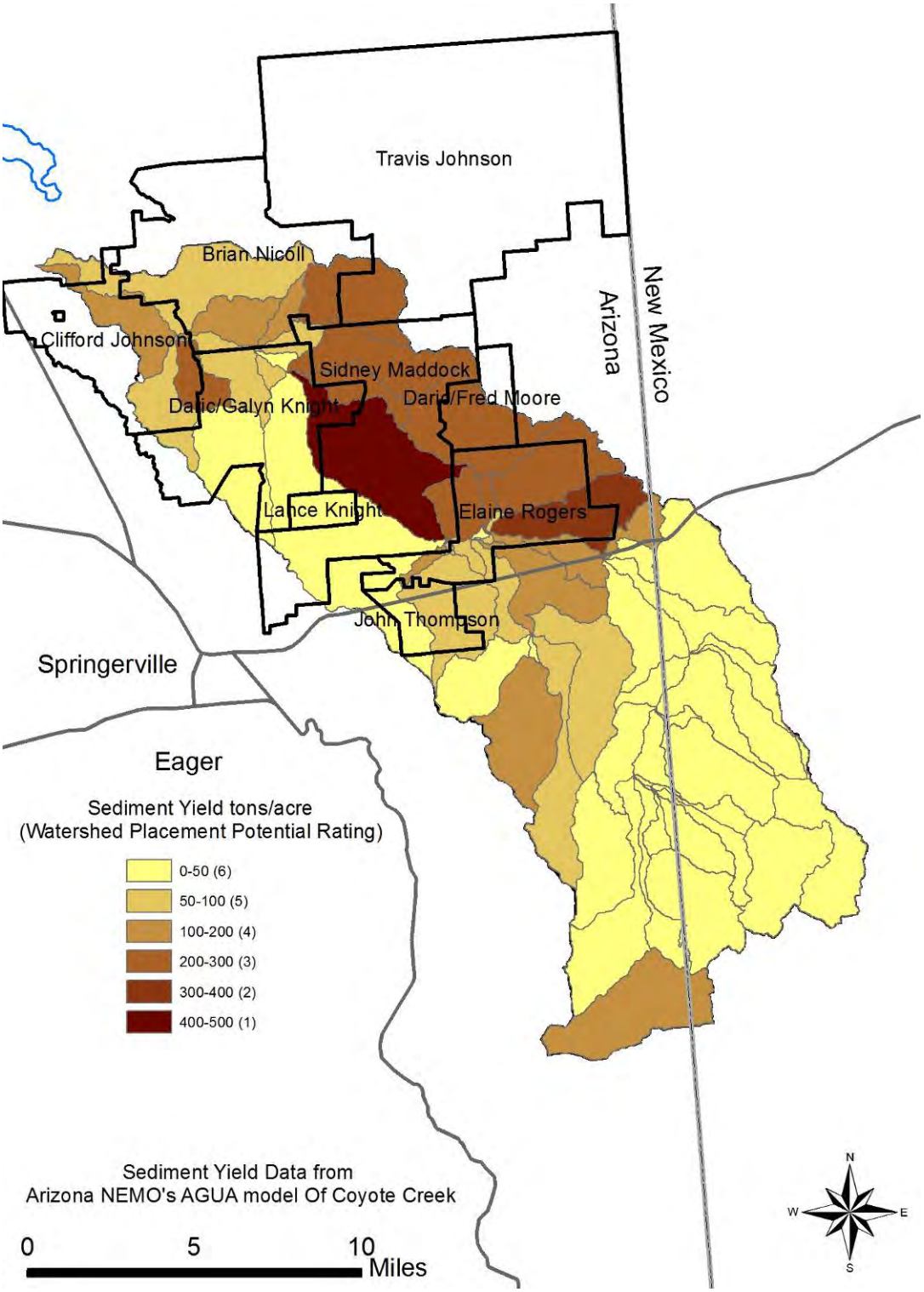

Figure 5. Land ownership and sediment yield in Coyote Creek.

Table 7. Results of BMP ranking by placement within the watershed.

Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
Clifford Johnson	Brush Management and Seeding	$126.25	5	3	1,894
Clifford Johnson	Bank Stabilization (Slope-Seed-Mulch)	$25,000.00	3	1	75,000
Clifford Johnson	Gully Control (Rock & Brush)	$11.92	4	2	95
Clifford Johnson	Water Development (Spring)	$1.28	6	3	23
Producer	**Best Management Practice**	**Cost per Acre Mitigated**	**Sum of NEMO Ratings**	**Location Rating**	**Area-Weighted BMP Rating**
Travis Johnson	Brush Management and Seeding	$126.25	6	3	2,273
Travis Johnson	Sheet and Rill Erosion (Dike, V-Mesh)	$20.90	6	1	125
Travis Johnson	Water Development NO. 1 (Pipe, Trough)	$28.18	8	3	676
Travis Johnson	Water Development NO 2. (Pond, Sed Basin)	$7.04	6	3	127
Travis Johnson	Water Development NO. 3 (Pond, Sed Basin)	$10.24	6	3	184
Producer	**Best Management Practice**	**Cost per Acre Mitigated**	**Sum of NEMO Ratings**	**Location Rating**	**Area-Weighted BMP Rating**
Galyn Knight (Daric Knight)	Gully Control ("V" Rock Weir)	$20.15	4	1	81
Galyn Knight (Daric Knight)	Gully Control (Rock & Brush)	$7.15	4	1	29
Galyn Knight (Daric Knight)	Water Development NO.1 (Solar, Pipe, Trough)	$17.60	8	5	704
Galyn Knight (Daric Knight)	Water Development NO. 2 (Well, Solar)	$12.38	8	6	594
Producer	**Best Management Practice**	**Cost per Acre Mitigated**	**Sum of NEMO Ratings**	**Location Rating**	**Area-Weighted BMP Rating**
Lance Knight	Brush Management and Seeding	$126.34	6	6	4,548
Lance Knight	Gully Control ("V" Rock Weir)	$10.23	4	1	40.9
Lance Knight	Water Development (Well, Solar, Pipe, Trough)	$16.04	5	6	481
Producer	**Best Management Practice**	**Cost per Acre Mitigated**	**Sum of NEMO Ratings**	**Location Rating**	**Area-Weighted BMP Rating**
Sidney Maddock	Gully Control (Rock & Brush)	$4.14	4	1	17
Sidney Maddock	Sediment Basin	$14.66	5	3	220
Sidney Maddock	Road Stabilization (Water Bars)	$2,160.00	6	3	38,880
Sidney Maddock	Water Development (Spring, Pipe, Trough)	$4.63	8	3	111
Producer	**Best Management Practice**	**Cost per Acre Mitigated**	**Sum of NEMO Ratings**	**Location Rating**	**Area-Weighted BMP Rating**
Fred Moore (Daric Knight)	Gully Control (Rock & Brush)	$11.92	4	1	48
Fred Moore (Daric Knight)	Sediment Basin	$5.05	5	3	76
Producer	**Best Management Practice**	**Cost per Acre Mitigated**	**Sum of NEMO Ratings**	**Location Rating**	**Area-Weighted BMP Rating**
Brian Nicoll	Fencing	$35.20	7	5	1,232
Brian Nicoll	Gully Control (Rock & Brush)	$10.83	4	4	173
Brian Nicoll	Water Development NO. 1 (Pipe, Trough)	$15.66	8	5	626
Brian Nicoll	Water Development NO. 2 (Pipe, Trough)	$15.66	8	5	626
Producer	**Best Management Practice**	**Cost per Acre Mitigated**	**Sum of NEMO Ratings**	**Location Rating**	**Area-Weighted BMP Rating**
Elaine Rogers	Bank Stabilization (Slope-Seed-Mulch) Becker Draw	$7,050.00	3	1	21,150
Elaine Rogers	Bank Stabilization (Slope-Seed-Mulch) Coyote Creek	$8,175.00	3	1	24,525
Elaine Rogers	Bank & Channel Stabilization (Earthwork)	$2,000.00	3	1	6,000
Elaine Rogers	Gully Control (Rock & Brush)	$1,191.67	4	1	4,767
Elaine Rogers	Road Stabilization (Water Bars)	$1,215.00	6	4	29,160
Producer	**Best Management Practice**	**Cost per Acre Mitigated**	**Sum of NEMO Ratings**	**Location Rating**	**Area-Weighted BMP Rating**
John Thompson	Brush Management and Seeding	$126.25	6	5	3,788
John Thompson	Fencing	$42.24	7	5	1,478
John Thompson	Kangaroo Rat Control	$24.00	9	5	1,080
John Thompson	Gully Control (Rock & Brush)	$11.92	4	1	48
John Thompson	Water Development NO. 1 (Well Renov, Windmill, Pipe)	$5.99	8	5	240
John Thompson	Water Development NO. 2 (Well Renov, Solar, Pipe)	$15.89	8	6	763
John Thompson	Water Development NO. 3 (Well, Solar, Pipe, Trough)	$11.38	8	6	546
John Thompson	Water Development NO. 4 (Spring, Pipe, Trough)	$7.35	8	5	294

FUNDED PROJECTS

Taking into account their resource concerns and priorities outlined in Phase 1 (assessment), landowners provided the RC&D with a list of projects prioritized by their specific needs and priorities, to be submitted for Phase 2 (implementation) funding. In July of 2011 ADEQ provided a grant extension and funding for the second phase of the Coyote Creek Watershed Education and Training grant. This provided funding for at least one project for each landowner as outlined in the grant extension submittal. Priority projects identified in Phase 1were not necessarily the projects landowners felt most compelled to implement, though Phase 2 funding was provided by ADEQ for these landowner desired projects. Table 8 lists the projects that have been constructed during Phase 2.

Table 8. Funded projects constructed during phase 2.

Travis Johnson	stock pond rehabilitation & headcut stabilization, V-mesh spreaders
Galyn Knight	livestock pipeline
Sidney Maddock	sediment basin rehabilitation, roadway drainage improvements
Fred Moore	sediment basin rehabilitation
Brian Nicoll	livestock pipelines
Elaine Rogers	headcut stabilization and miscellaneous drainage improvements.
John Thompson	livestock well and drinker

Where appropriate, NCD used the “natural channel” or geomorphic approach in the assessment and restoration design of practices. The approach uses reference conditions to assess the existing condition of the project area, determine the potential, and create a design to move toward the stream channel’s potential condition. Conservation practice standards developed by the USDA Natural Resources Conservation Service (NRCS) were also used to guide the design of other BMPs implemented within Phase 2.

A large portion of the constructed BMPs where aimed at the development or rehabilitation of watering facilities for the facilitation of balanced grazing within the uplands of the Coyote Creek Watershed. However, the headcut stabilization work completed by Elaine Rogers is having a very direct impact to the amount of sediment entering Coyote Creek proper, given the close proximity of the treated eroding areas to Coyote Creek.

A brief description and photographs of the completed projects are provided in Appendix C. The construction drawings with specifications and design information are found in Appendix D.

CONCLUSIONS

This report provides a review of previous studies, resource concerns, and producer requested BMPs and costs, to address nonpoint source pollution, specific to land uses of the Coyote Creek Watershed, as well as a description of the implementation of BMPs funded in Phase 2. A prioritization rubric is also provided to assist the WIC in future planning. This rubric provides a weighted cost/acre improved as a means of ranking practice effectiveness for decision making purposes.

Within the Coyote Creek watershed, stream banks and roads are relatively high contributors for their total area. However, gully and rill erosion are prevalent through much of the watershed. Some practices have been successful but are at the end of their service life

Analysis of practice cost efficiencies indicate that gully protection through sediment control basins and small grade control efforts were likely the most efficient use of funding to reduce sediment load. Bank sloping and road drainage efforts are worthwhile but did not rate high in efficiency due to the relatively high cost of these operations. Some refinement of the ranking process could be accomplished by refining the sediment yield model to more accurately include bank and roadway erosion. However, it is not believed that the ranks of the practices will change considerably. The more costly practices have important benefits to habitat, wildlife and channel stability but were not directly incorporated into the prioritization process. Ultimately it will be up to ADEQ, the WIC and each individual producer to decide what BMPs they are willing to implement upon their land, with matching funds.

Coyote Creek has historically been the focus of many studies. Several phases of implementation of recommend practices have resulted from these efforts. Support provided by the ADEQ through the Coyote Creek Watershed Education and Training grant has provided for maintenance of existing sediment control practices, implementation of new practices as well as the formation of a partnership between producers and state agencies. These actions should lead to further improvements to decrease sediment yield from the Coyote Creek Watershed, by providing a framework and momentum for future action.

Next steps include the further prioritization of landowner needs, in alignment with the suggested BMPs which have yet to be implemented, for further grant funding submittals.

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TECHNICAL APPENDICES

Appendix A - Summary of Site Visits
Appendix B – Best Management Practice Details
Appendix C – Description of Funded Projects
Appendix D – Construction Drawings with Specifications and Design Information

APPENDIX A - SUMMARY OF SITE VISITS

Clifford Johnson
Travis Johnson
Galyn Knight / Daric Knight
Lance Knight
Sidney Maddock
Fred Moore / Daric Knight
Brian Nicoll
Elaine Rogers
John Thompson

Coyote Creek Watershed Improvement and Education Project

Name: Clifford Johnson

Date of Visit: 11/10/2010

Ranch Name: Scraper Knoll Ranch

Email: cliffordjohnson@q.com

Mailing Address:

Phone Number: 602.920.1155

Site Description:
~3.5 miles of Coyote Creek meander through land owned or leased by the Johnson Cattle Company. Grazing is the primary land use on this ~11,120 acre ranch. Vegetation is typical of the lower Coyote Creek Watershed.

This reach of stream contains numerous tall (> 6 feet) vertical banks. The stream banks consist of weak alluvial soils that are easily eroded. The entire stream appears to be adjusting to a downstream change in base level, evident by the headcuts in tributaries and a narrow stream channel with little to no floodplain.

This ranch contains old dikes (>30 years) on Coyote Creek tributaries that are utilized for erosion control. These structures have largely failed due to overtopping or other problems. Several of the dikes have gullies dissecting them; an old sediment detention basin has a severely eroding downstream channel due to an undersized outlet pipe and lack of spillway provisions. Other drainages contain relatively recent headcuts and gullies. Additionally, the rancher is concerned about decreased capacity of a 4 acre pond due to sedimentation. One particular pasture lacks adequate water due to sedimentation of the existing tank within the pasture. Reduced use of this pasture has increased grazing pressure in other pastures.

Ranch Objectives and Resource Concerns:
Mr. Johnson would like to decrease sediment runoff by restoring grasslands via the removal of junipers and replanting with grasses. He would like to address relatively recent head-cutting and gullies with grade control structures and by rehabilitation the failed dikes.

For herd management he would like help developing or rehabilitating a spring which would allow for better grazing rotation which would increase vegetative cover and decrease sediment runoff.

Mr. Johnson would also like to treat the tall vertical banks of Coyote Creek, which are actively eroding and are a significant source of sediment to the stream.

Proposed Best Management Practices (BMPs) to Achieve Ranch Objectives:

Structural Practices
- Bank Stabilization
- Gully Control
- Water Development

Vegetative Practices
- Brush Management
- Range Seeding

Coyote Creek Watershed Improvement and Education Project

Name: Clifford Johnson **Ranch Name:** Scraper Knoll Ranch

Estimated BMP Cost – Range Management

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Brush Management	ac	2000	$90.00	$180,000	
Range Seeding	ac	500	145.00	$72,500	
			Total Estimated Cost:	$252,500	2000 ac

Estimated BMP Cost - Bank Stabilization

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Bank Sloping-Seeding-Mulching	ft	2500	$15.00	$37,500	
			Total Estimated Cost:	$37,500	1.5 ac

Estimated BMP Cost – Gully Control

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Rock and Brush Grade Control Structure (4 each)	cy	260	$55.00	$14,300	
			Total Estimated Cost:	$14,300	1200 ac

Estimated BMP Cost – Water Development

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Spring Development	ea	1	$1,600.00	$1,600	
			Total Estimated Cost:	$1,600	1250 ac

Total: $305,900

Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
Clifford Johnson	Range Management (Brush & Seed)	$126.25	6	3	2,273
Clifford Johnson	Bank Stabilization (Slope-Seed-Mulch)	$25,000	3	1	75,000
Clifford Johnson	Gully Control (Grade Structure)	$11.92	4	2	95
Clifford Johnson	Water Development (Spring)	$1.28	8	3	31

Coyote Creek Watershed Improvement and Education Project

Site Photos

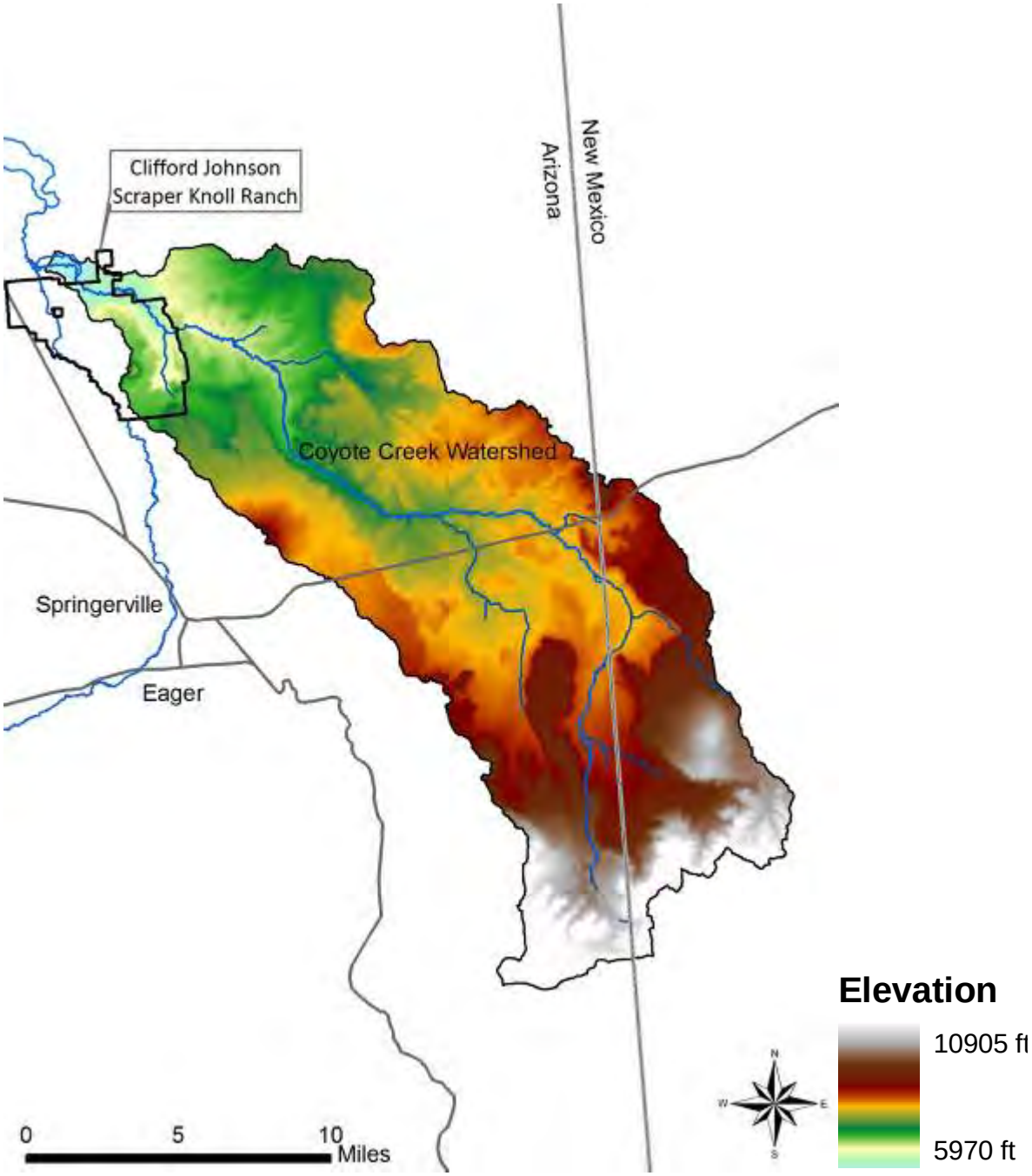
Overview photograph of the Scraper Knoll Ranch, showing a typical dry meander of Coyote Creek with eroding banks and sparse vegetation.

Photograph of an outside meander of Coyote Creek. These eroding vertical banks are a significant source of sediment polluting downstream waters.

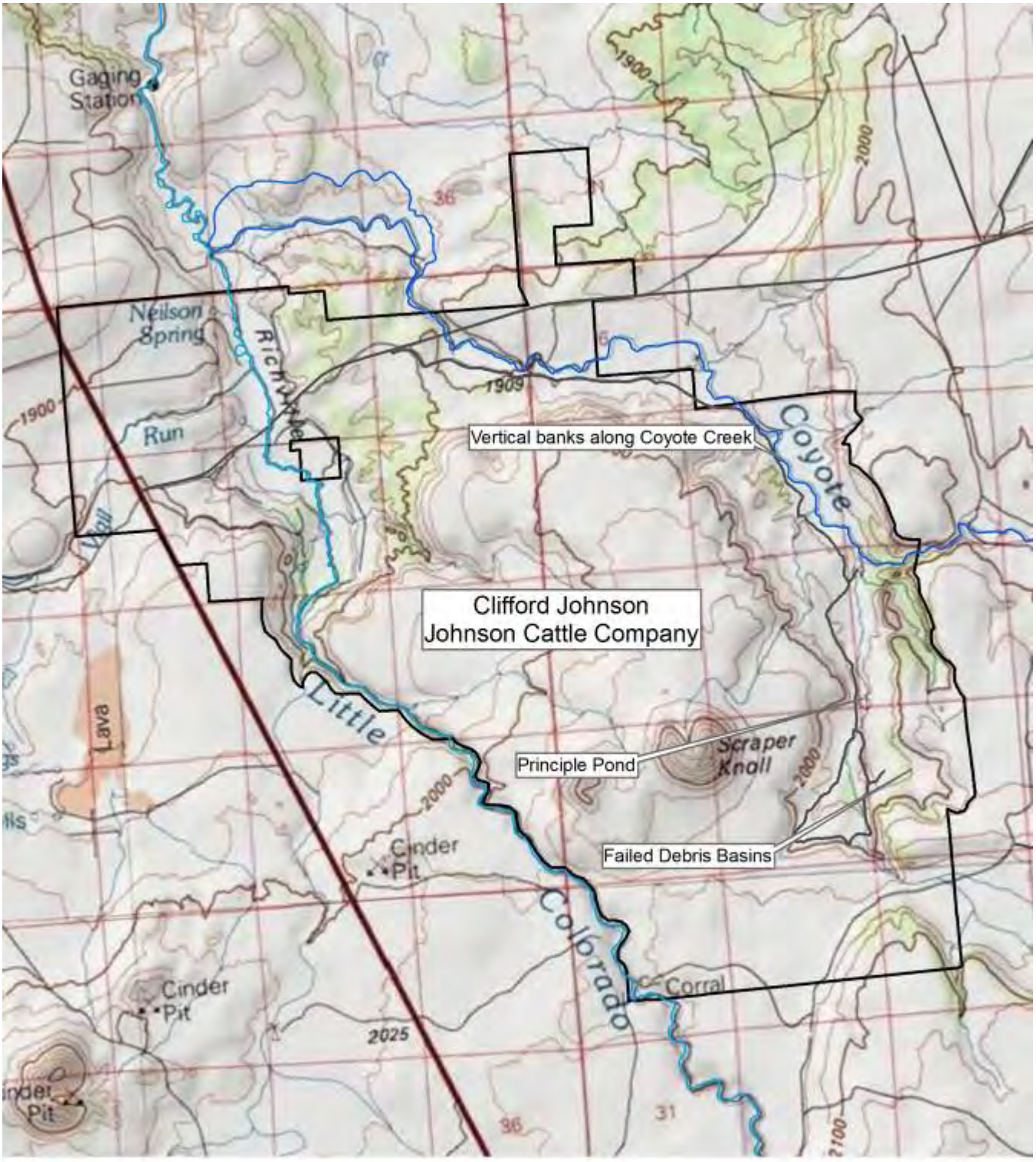
Downstream view of a detention basin; the outlet pipe is undersized and causing severe erosion.

Severe gully erosion within the Alfredo pasture of the Scraper Knoll Ranch.

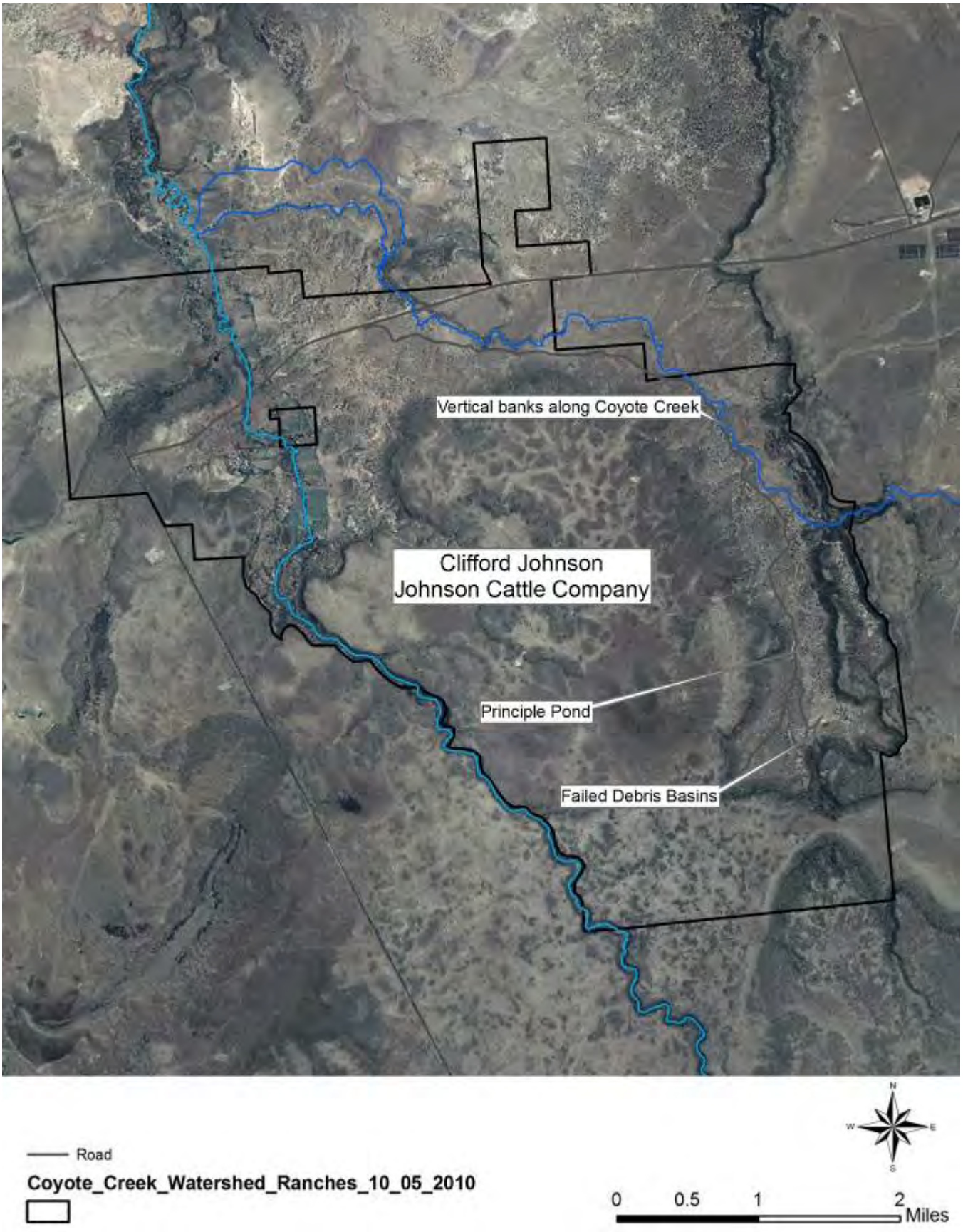
Site Maps


Clifford Johnson
Scraper Knoll Ranch
New Mexico
Arizona
Coyote Creek Watershed
Springerville
Eager
0
5
10
Miles
Elevation
10905 ft
5970 ft

Coyote Creek Watershed Improvement and Education Project



Coyote Creek Watershed Improvement and Education Project



Coyote Creek Watershed Improvement and Education Project

Name: Travis Johnson

Date of Visit: 04/14/2011

Ranch Name: Johnson Livestock Inc.

Email: tjohnsonlivestock@yahoo.com

Mailing Address: P.O. Box 1655, St. Johns, AZ 85936

Phone Number: 928.245.3383

Site Description

A portion of this ~35,000 acre ranch is located within the uplands of Coyote Creek. Changes in herd management have led to improvements in vegetative cover and a decrease in gullies and other erosion throughout this portion of the ranch. Many of the active gullies and headcuts have restored and are now covered in grasses and forbs.

Previous conservation practices include sediment basins (dikes) which have been successful at trapping sediment.

Ranch Objectives and Resource Concerns:

A lack of adequate watering sites leads to concentrated grazing and lost opportunities for rotation of stock across the ranch. Existing grazing practices have increased the risk of concentrated runoff and erosion. Development of water lines from existing pumps and stock ponds will enable distribution of livestock across a wider area of the ranch and reduce grazing pressure to improve vegetative cover and reduce soil loss. The combination of sediment basins and stock ponds would be an effective solution for sediment reduction.

Mr. Johnson would like to decrease sediment runoff through the removal of junipers and establishment of grasses. He would like to address headcutting and gullies with a dike and V-mesh spreaders.

Suggested Best Management Practices (BMPs) to Achieve Ranch Objectives:

Structural Practices

- Sediment Basin
- Sheet and Rill Erosion Control
- Water Development

Vegetative Practices

- Brush Management
- Range Seeding

Coyote Creek Watershed Improvement and Education Project

Name: Travis Johnson **Ranch Name:** Johnson Livestock Inc.

Estimated BMP Cost – Range Management

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Brush Management	ac	2560	$90.00	$230,400	
Range Seeding	ac	640	$145.00	$92,800	
			Total Estimated Cost:	$323,200	2560 ac

Estimated BMP Cost – Sheet and Rill Erosion

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Dike	cy	1600	$4.00	$6,400	
V-Mesh Spreaders	ft	650	$3.50	$2,275	
			Total Estimated Cost:	$8,675	415 ac

Estimated BMP Cost – Water Development and Sediment Basins

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
NO. 1 Pipeline (1 ¼" diameter)	ft	7920	$3.50	$27,720	
Trough	gal	5000	$1.50	$7,500	
				($35,220)	1250 ac
NO. 2 Stock Pond Rehabilitatn	cy	1200	$4.00	$4,800	
Sediment Basin Rehabilitation	cy	1000	$4.00	$4,000	
				($8,800)	1250 ac
NO. 3 Stock Pond	cy	1200	$4.00	$4,800	
Sediment Basin	cy	2000	$4.00	$8,000	
				($12,800)	1250 ac
			Total Estimated Cost:	$56,820	

Total : $388,695

Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
Travis Johnson	Range Management (Brush & Seed)	$126.25	6	3	2,273
Travis Johnson	Sheet and Rill Erosion (Dike, V-Mesh)	$20.90	6	1	125
Travis Johnson	Water Development (NO. 1)	$28.18	8	3	676
Travis Johnson	Water Development (NO. 2)	$7.04	6	3	127
Travis Johnson	Water Development (NO. 3)	$10.24	6	3	184

Coyote Creek Watershed Improvement and Education Project

Site Photos

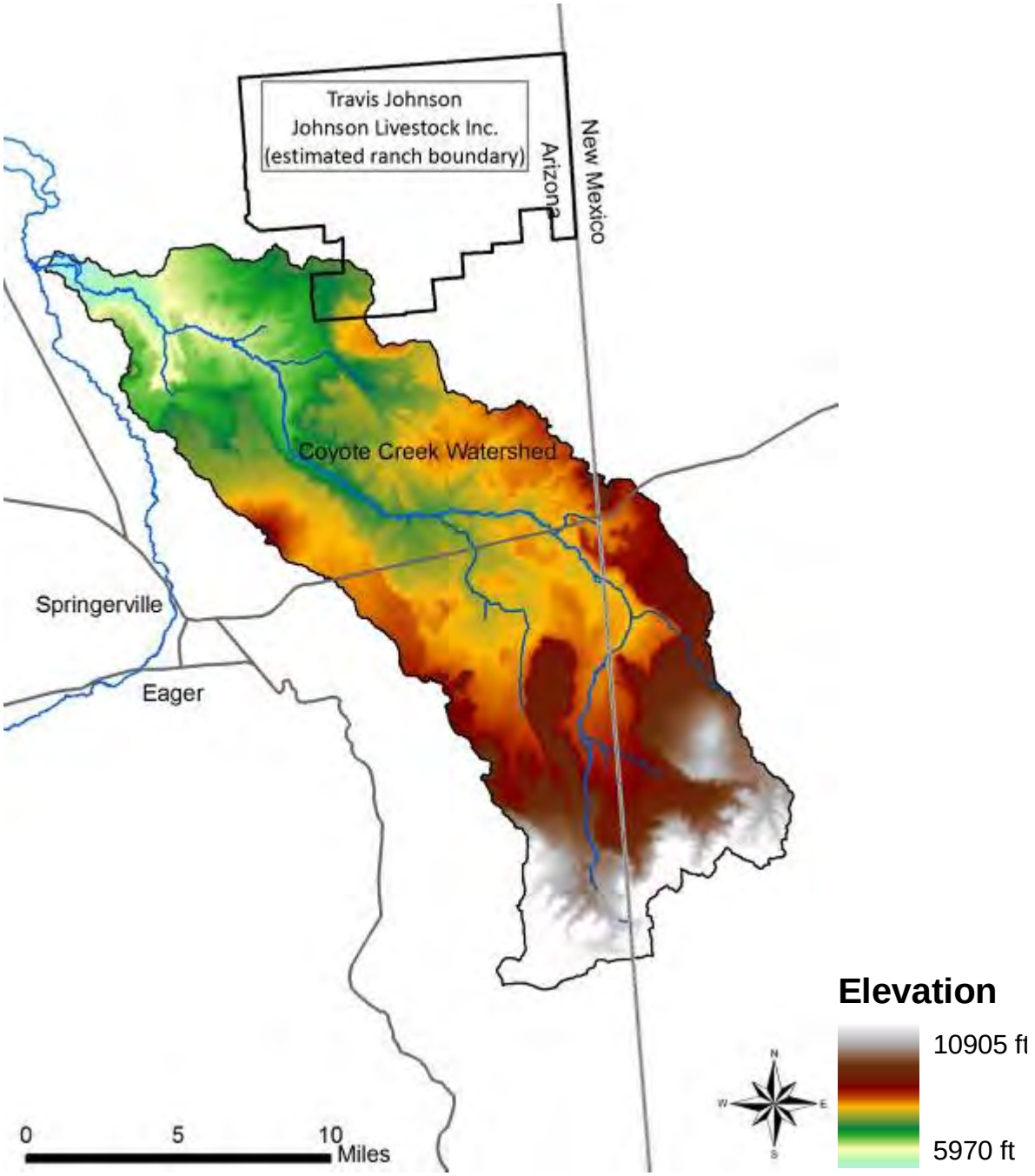
A typical sediment basin found on this ranch. This one in particular has been in service for over 20 years and is still functioning, though it needs some rehabilitation to restore its historic capacity.

View of the area needing brush management and range seeding.

An active gully where Mr. Johnson would like to install a dike and V-mesh spreaders.

Another view of an active gully, and areas in need of brush management and range seeding.

Site Maps


Travis Johnson
Johnson Livestock Inc.
(estimated ranch boundary)
Arizona
New Mexico
Coyote Creek Watershed
Springerville
Eager
0
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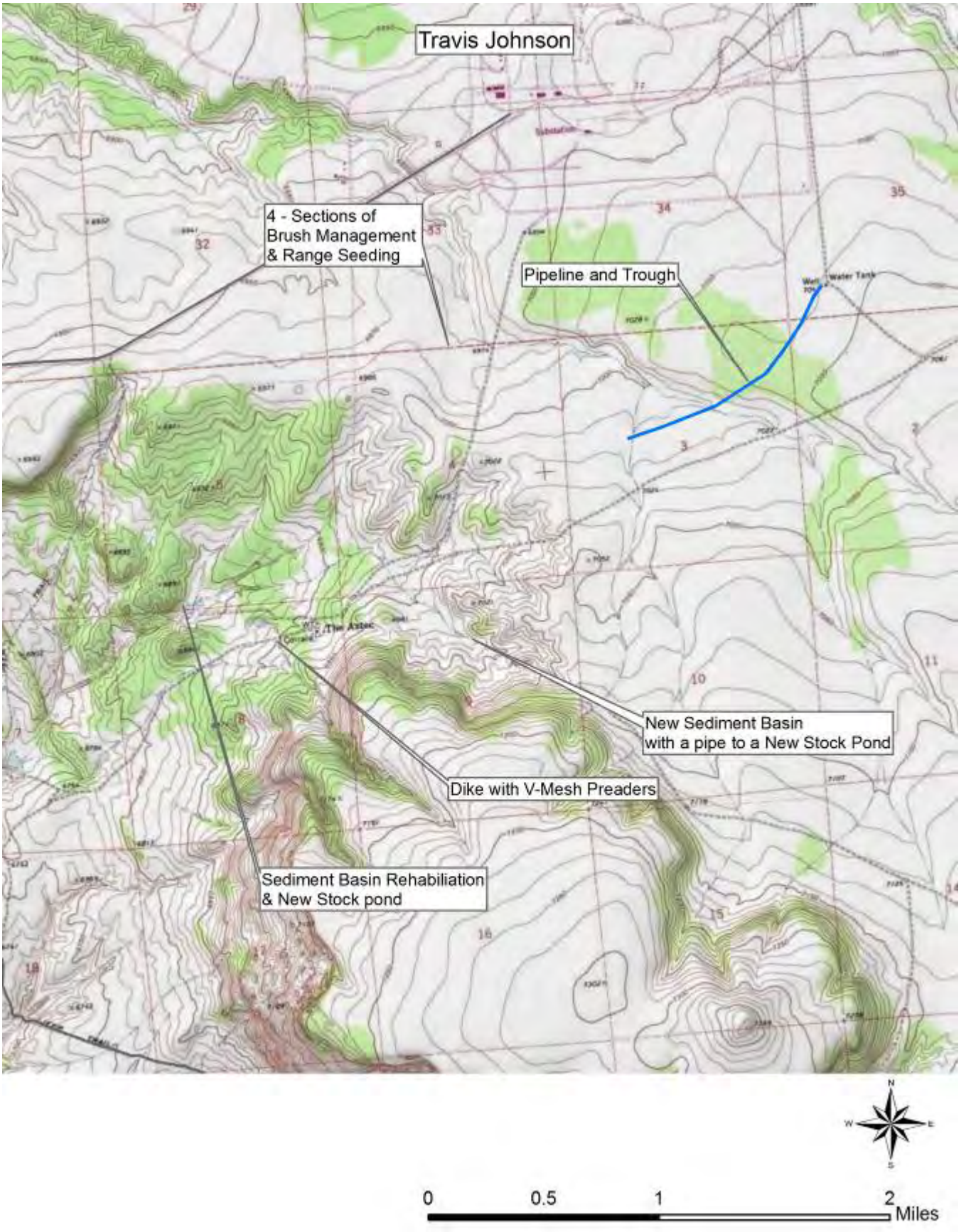
10
Miles
Elevation
10905 ft
5970 ft

Coyote Creek Watershed Improvement and Education Project




Travis Johnson
4 - Sections of
Brush Management
& Range Seeding
Pipeline and Trough
New Sediment Basin
with a pipe to a New Stock Pond
Dike with V-Mesh Preaders
Sediment Basin Rehabiliation
& New Stock pond
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Coyote Creek Watershed Improvement and Education Project

Name: Galyn Knight (Daric Knight)

Date of Visit: 01/27/2010

Ranch Name: Knight Ranch

Email: dknight100@hotmail.com

Mailing Address:

Phone Number: 928.521.9897

Site Description

The Knight Ranch contains ~5.5 miles of Coyote Creek. These reaches of the stream and its tributaries are located in weak alluvial soils that are easily eroded. Grazing is the primary land use on this ~12,965 acre ranch. Vegetation is typical of the lower Coyote Creek watershed.

The entire stream appears to be adjusting to a change in base level, evident by the headcuts in tributaries and the narrow channel with little to no floodplain. Attempts to construct low-water road crossings have had mixed success.

Several pastures lack adequate water due to the failure of wells or the lack a local water source within the pasture. Reduced use of these pastures has increased grazing pressure in other pastures.

Ranch Objectives and Resource Concerns:

The Knights would like to address relatively recent headcutting and gullies with grade control structures. A long-term solution to the eroding banks and stream crossings is desired.

Rehabilitation of a well and addition of a pipeline would allow greater dispersal of grazing that would increase vegetative cover and decrease sediment runoff.

Proposed Best Management Practices (BMPs) to Achieve Ranch Objectives:

Structural Practices

- Rock and Brush Grade Control
- Water Development

Coyote Creek Watershed Improvement and Education Project

Name: Galyn Knight (Daric Knight) **Ranch Name:** Knight Ranch

Estimated BMP Cost – Gully Control

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
"V" Rock Weir Grade Control	cy	45	$55.00	$2,475	390 ac
Rock and Brush Grade Control Structure	cy	500	$55.00	$27,500	2100 ac
			Total Estimated Cost:	$29,975	

Estimated BMP Cost – Water Development

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Pipeline	ft	5800	$3.50	$20,300	
Trough	gal	5000	$1.50	$7,500	
Well Power Plant - Solar	ea	1	$12,500	$12,500	
				($40,300)	2000 ac
Well Rehabilitation	ft	30	$60.00	$1,800	
Well Power Plant - Solar	ea	1	$12,500	$12,500	
				($14,300)	2000 ac
			Total Estimated Cost:	$49,500	

Total: $79,475

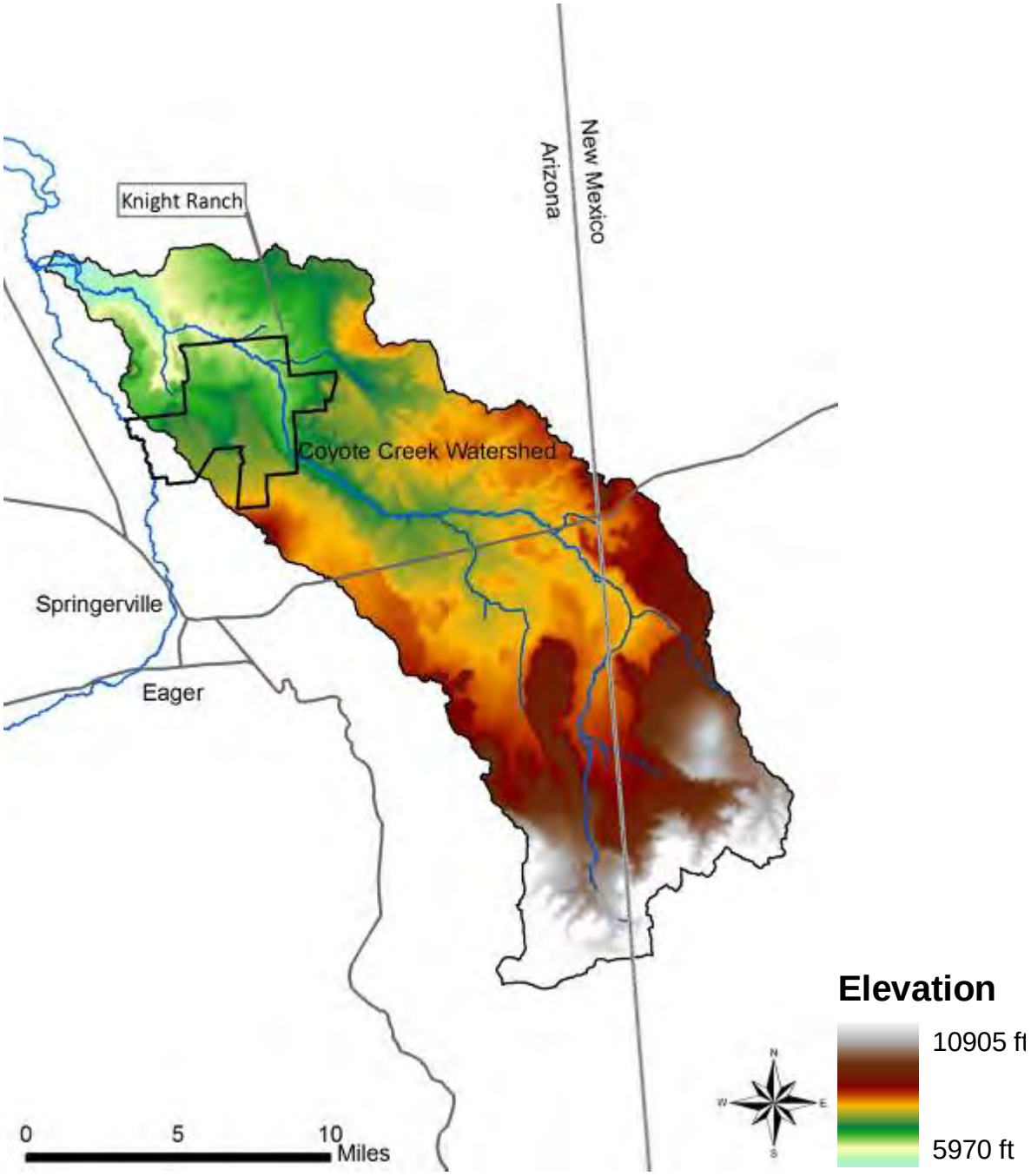
Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
Galyn Knight	Gully Control (V Rock Grade Control)	$20.15	4	1	81
Galyn Knight	Gully Control (Rock & Brush Grd Cntrl)	$7.15	4	1	29
Travis Johnson	Water Development (NO. 1)	$17.60	8	5	704
Travis Johnson	Water Development (NO. 2)	$7.15	8	6	594

Site Photos

Overview of a portion of the Knight Ranch

View of a failed grade-control structure made of T-posts and tires.

Site Maps


Knight Ranch
Arizona
New Mexico
Coyote Creek Watershed
Springerville
Eager
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5
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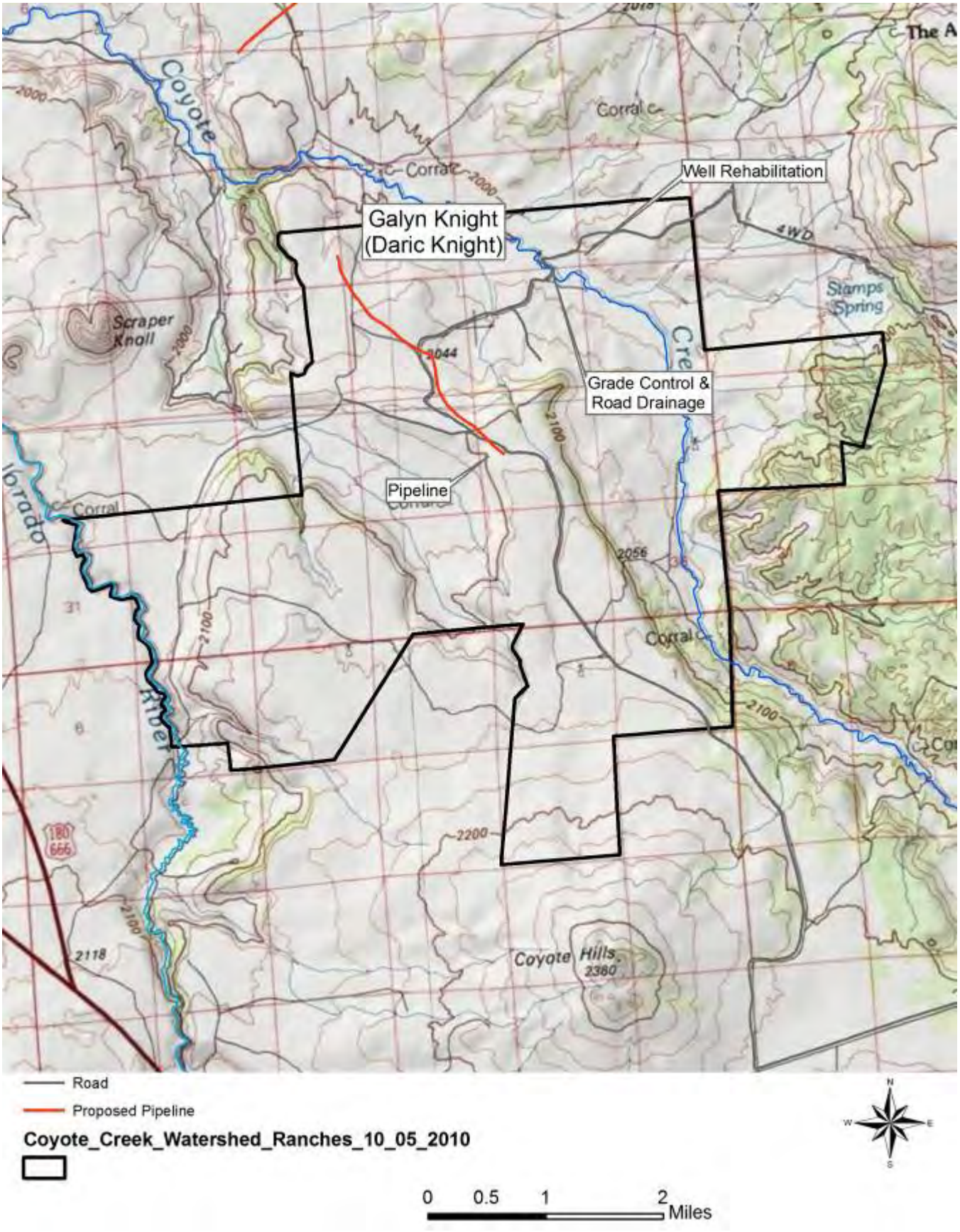
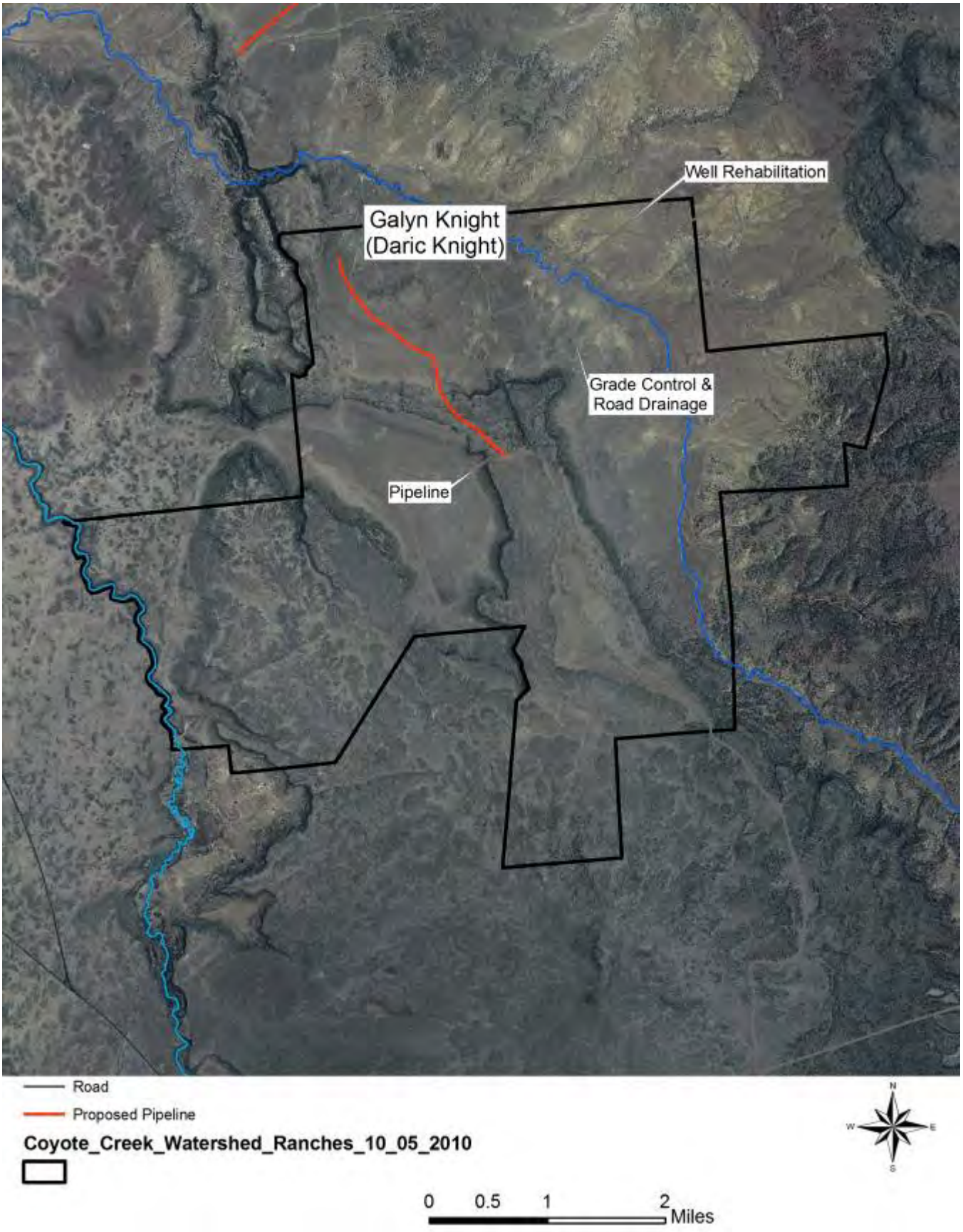
Miles
Elevation
10905 ft
5970 ft


Galyn Knight
(Daric Knight)
Well Rehabilitation
Grade Control &
Road Drainage
Pipeline
Coyote
Corral
Scraper
Knoll
Stamps
Spring
4WD
Coyote Hills
2380
Road
Proposed Pipeline
Coyote_Creek_Watershed_Ranches_10_05_2010
0 0.5 1 2 Miles


Well Rehabilitation
Galyn Knight
(Daric Knight)
Grade Control &
Road Drainage
Pipeline
Road
Proposed Pipeline
Coyote_Creek_Watershed_Ranches_10_05_2010
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Miles

Coyote Creek Watershed Improvement and Education Project

Name: Lance Knight

Date of Visit: 01/27/2011

Ranch Name: Lance Knight Ranch

Email:

Mailing Address:

Phone Number: 928.521.3353

Site Description

This ~1275 acre ranch is mainly comprised of tributary drainages of Coyote Creek, with ~0.25 miles of Coyote Creek proper, meandering through it. The bulk of the ranch sits atop a mesa above Coyote Creek where there is a high density of Junipers and little water.

Ranch Objectives and Resource Concerns:

Mr. Knight would like to decrease sediment runoff through the removal of juniper trees and establishment of grasses. He would like to address headcutting and gullies with grade control structures.

For herd management he would like help developing a well. This water development would allow for better grazing rotation which would lead to an increase in vegetative cover and decrease sediment runoff.

Proposed Best Management Practices (BMPs) to Achieve Ranch Objectives:

Structural Practices

- Gully Control
- Water Development

Vegetative Practices

- Brush Management
- Range Seeding

Coyote Creek Watershed Improvement and Education Project

Name: Lance Knight **Ranch Name:** Lance Knight Ranch

Estimated BMP Cost – Range Management

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Brush Management	ac	850	$90.00	$76,500	
Range Seeding	ac	213	$145.00	$30,885	
			Total Estimated Cost:	$107,385	850 ac

Estimated BMP Cost – Gully Control

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
"V" Rock Weir	cy	80	$55.00	$4,400	
			Total Estimated Cost:	$4,400	430 ac

Estimated BMP Cost – Water Development

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Well Development	ft	200	$60.00	$12,000	
Well Power Plant – Solar	ea	1	$12,500	$12,500	
Pipeline	ft	20	$3.50	$70	
Trough	gal	5000	$1.50	$7,500	
			Total Estimated Cost:	$32,070	2000 ac

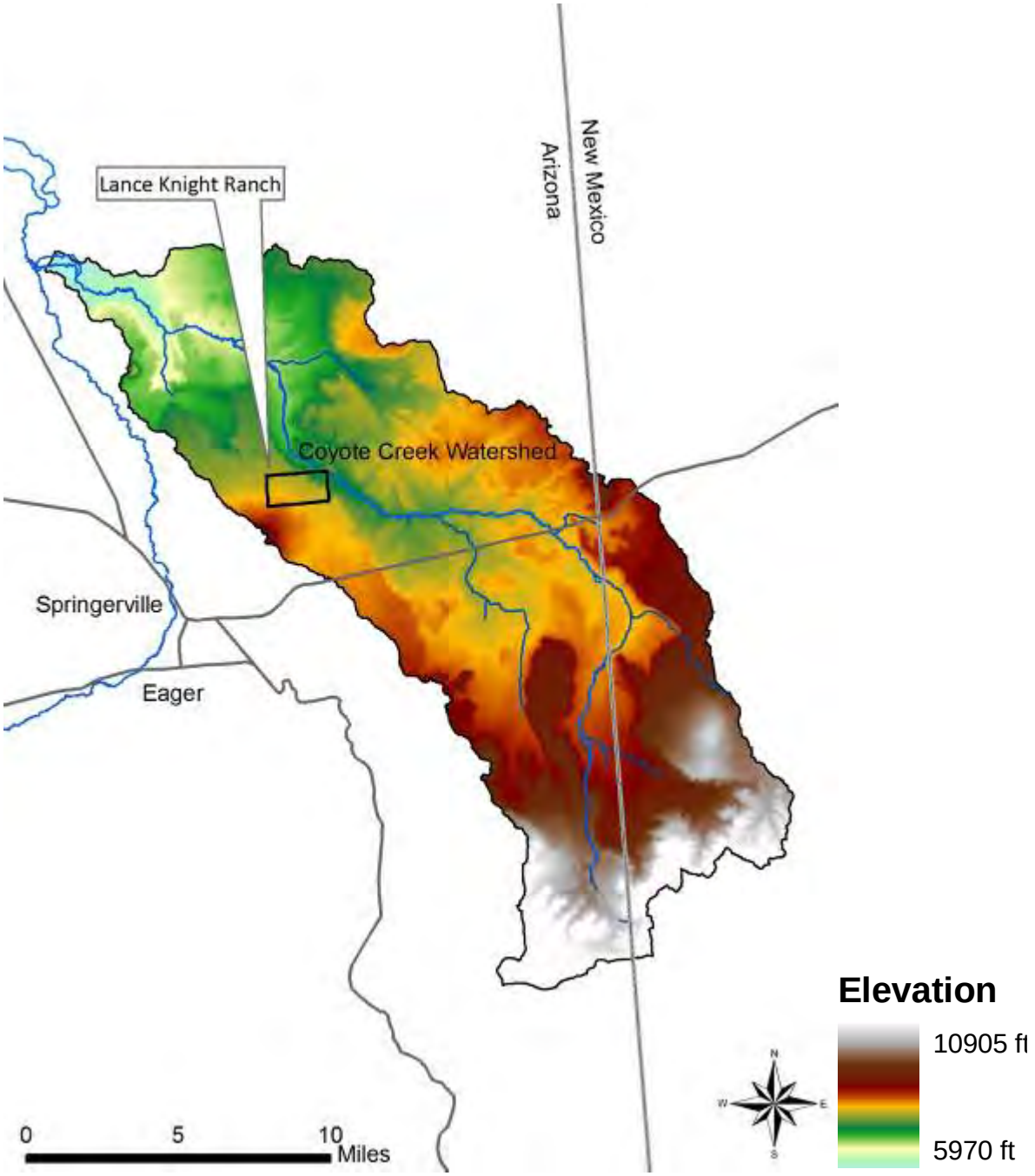
Total: $143,855

Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
Galyn Knight	Range Management (Brush & Seed)	126.34	6	6	4,548
Galyn Knight	Gully Control (V Rock Grade Control)	$10.23	4	1	41
Galyn Knight	Water Development	$16.04	5	6	481

Site Photos

No Photos available

Site Maps


Lance Knight Ranch
New Mexico
Arizona
Coyote Creek Watershed
Springerville
Eager
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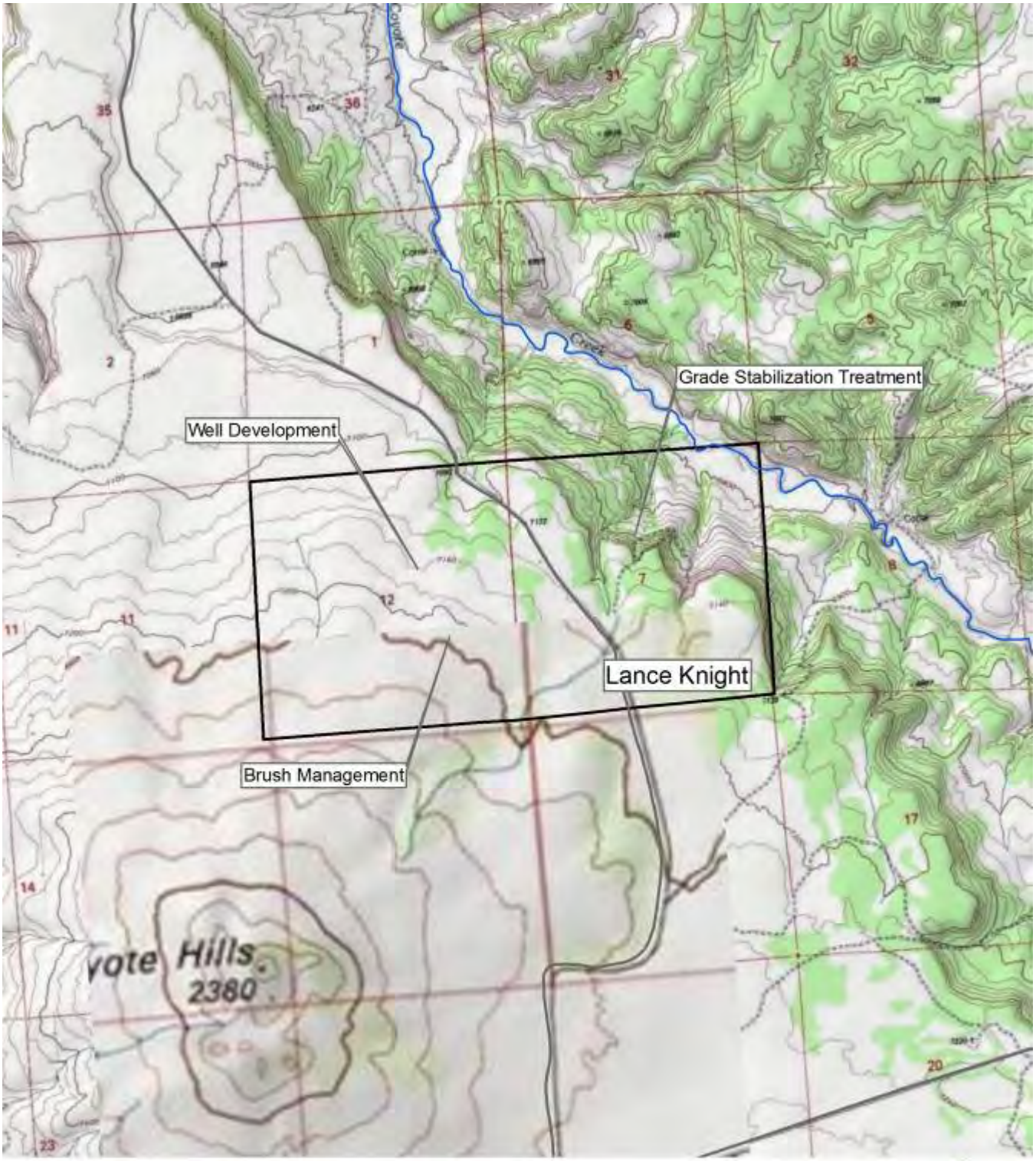
Miles
Elevation
10905 ft
5970 ft


Grade Stabilization Treatment
Well Development
Lance Knight
Brush Management
Road
Coyote Creek
Name
Lance Knight
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Miles


Grade Stabilization Treatment
Well Development
Lance Knight
Brush Management
Road
Coyote Creek
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Miles

Coyote Creek Watershed Improvement and Education Project

Name: Sidney Maddock

Date of Visit: 01/06/2011

Ranch Name: The Maddock Ranch

Email: sporandomcattle@hotmail.com

Mailing Address:

Phone Number: 602.686.1590

Site Description

This ranch contains ~5.8 miles of Coyote Creek. Grazing is the primary land use on this ~20,400 acre ranch. Historically, conservation work on this ranch has included sediment/debris basins that are currently silted in or are in danger of being flanked. As these structures fail, base level changes in Coyote Creek may lead to channel incision in both the stream and its tributaries.

Road drainage and stream crossings are associated with numerous gullies and headcuts.

Brush management is being undertaken by the USFWS on portions of this ranch.

Ranch Objectives and Resource Concerns:

There are several breeched, or nearly breeched, sediment basins and water and sediment control basins (WASCOB) on this ranch. Rehabilitation of the sediment basins, which would restore the historic capacity and function, could be an effective solution for sediment reduction. The design standard for a WASCOB states that they must be built on watersheds with less than 1 square mile of drainage area. Many of these WASCOBs exceed this standard and rehabilitation is not recommended.

For herd management, Ms. Maddock would like help developing a spring to allow better grazing rotation which would increase vegetative cover and decrease sediment runoff.

The road network on this ranch is paralleled by gullies and headcuts. The installation of waterbars would reduce erosion and thus the amount of sediment reaching downstream waters. Grade stabilization of actively incising channels through the use of rock and brush structures could reduce the amount of sediment reaching the downstream waters by reduce.

Proposed Best Management Practices (BMPs) to Achieve Ranch Objectives:

Structural Practices

- Gully Control
- Sediment Basin
- Road Stabilization
- Water Development

Coyote Creek Watershed Improvement and Education Project

Name: Sidney Maddock **Ranch Name:** The Maddock Ranch

Estimated BMP Cost – Gully Control

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
"V" Rock Weir	cy	90	$55.00	$4,950	
			Total Estimated Cost:	$4,950	1195 ac

Estimated BMP Cost – Sediment Basin

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Sediment Basin Rehabilitation	cy	2500	$4.00	$10,000	
			Total Estimated Cost:	$10,000	682 ac

Estimated BMP Cost - Road Stabilization

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Road Water Bars	ea	16	$135.00	$2,160	
			Total Estimated Cost:	$2,160	1 ac

Estimated BMP Cost - Water Development

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Spring	ea	1	$1,600.00	$1,600	
Pipeline	ft	45	$3.50	$158	
Trough	gal	5000	$1.5	$7,500	
			Total Estimated Cost:	$9,258	2000 ac

Total: $26,368

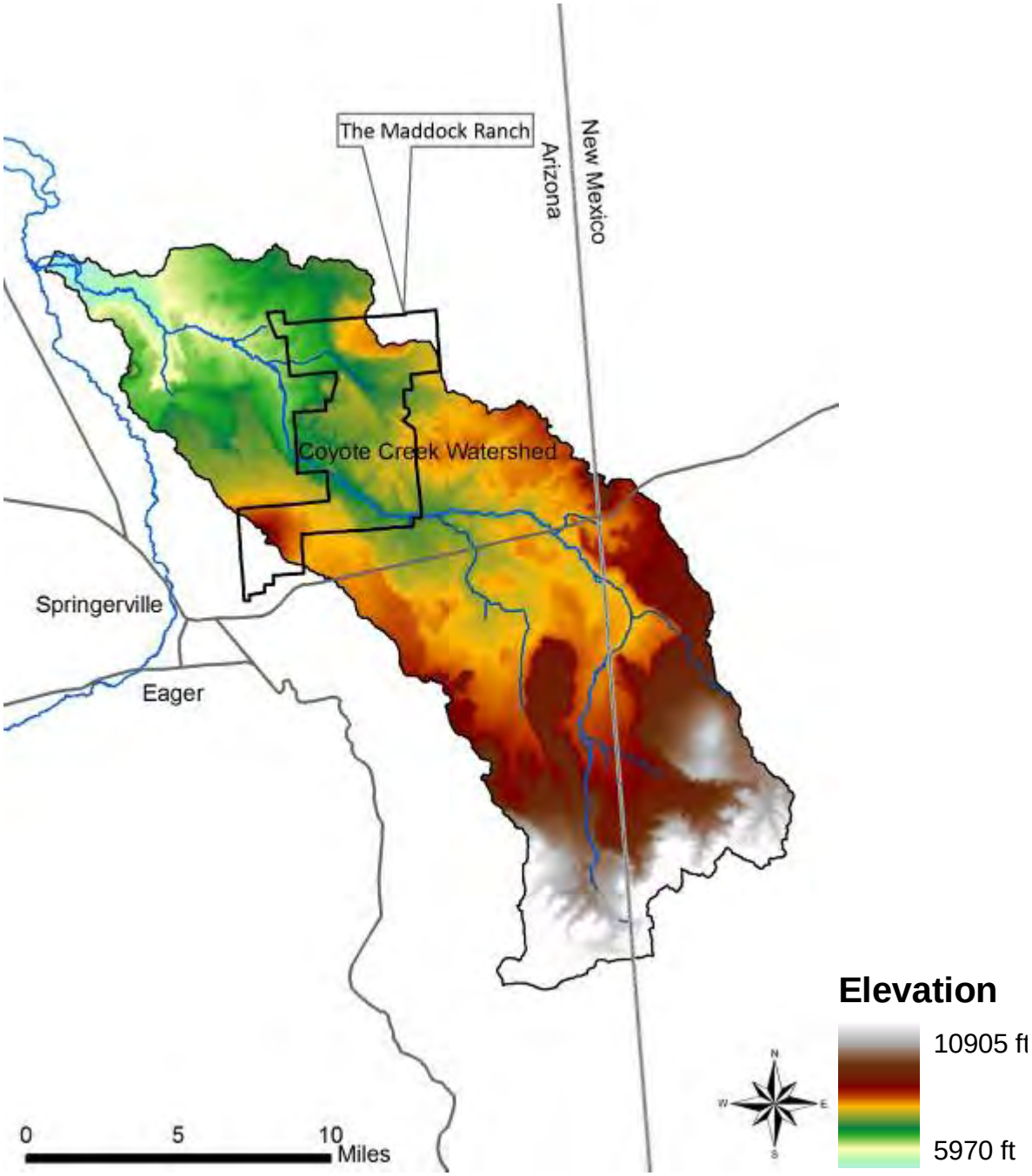
Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
Sidney Maddock	Gully Control (V Rock Weir)	$4.14	4	1	17
Sidney Maddock	Sediment Basin	$14.66	5	3	220
Sidney Maddock	Road Stabilization (Waterbars)	$2,160	6	3	38,880
Sidney Maddock	Water Development (Spring)	$4.63	8	3	111

Site Photos

A failing grade-control structure at a road crossing on a tributary to Coyote Creek.

A typical road on this ranch with an actively eroding parallel gully.

Site Maps


The Maddock Ranch
Arizona
New Mexico
Coyote Creek Watershed
Springerville
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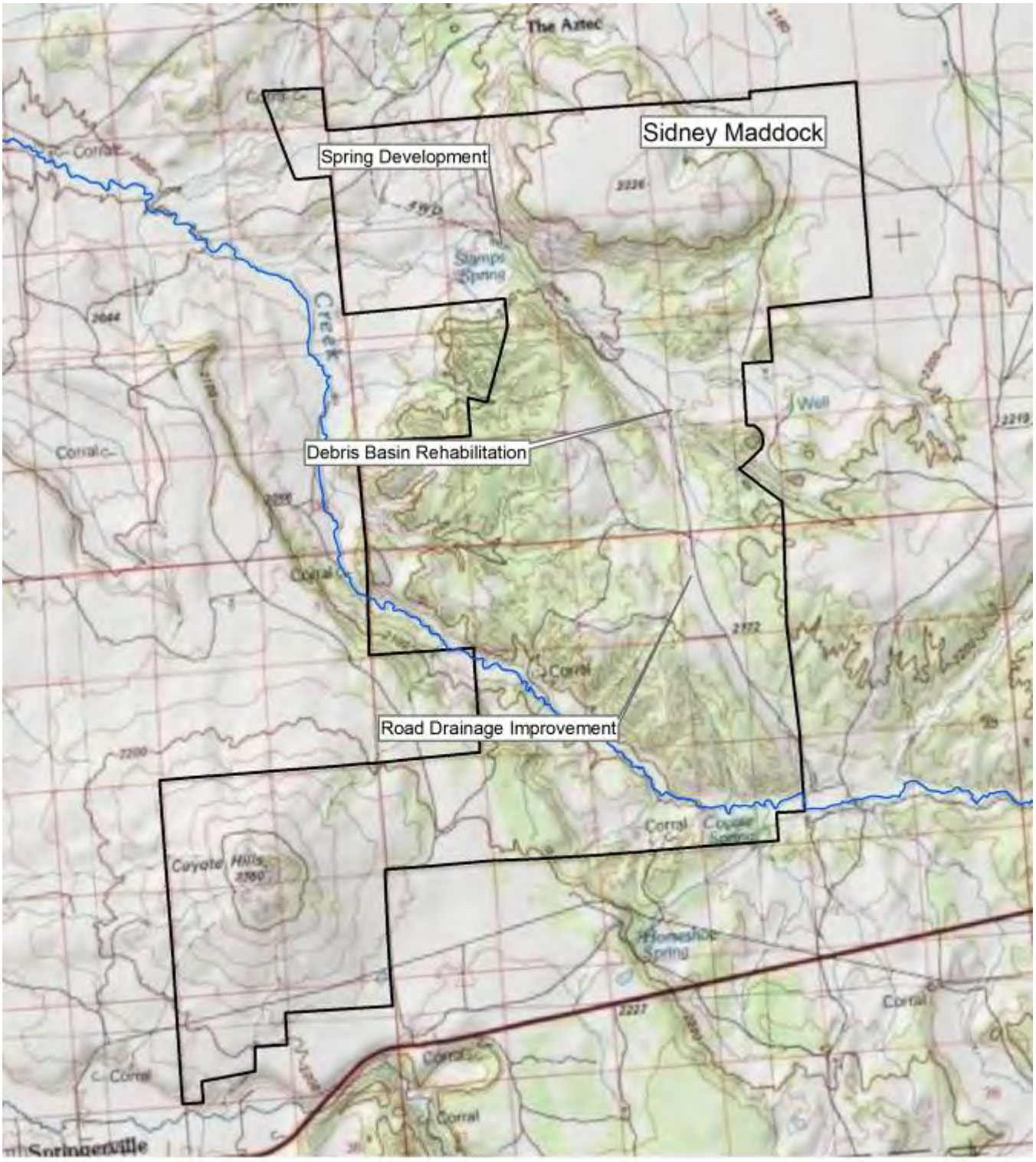
Miles
Elevation
10905 ft
5970 ft


Sidney Maddock
Spring Development
Debris Basin Rehabilitation
Road Drainage Improvement
Coyote Creek
Coyote_Creek_Watershed_Ranches_10_05_2010
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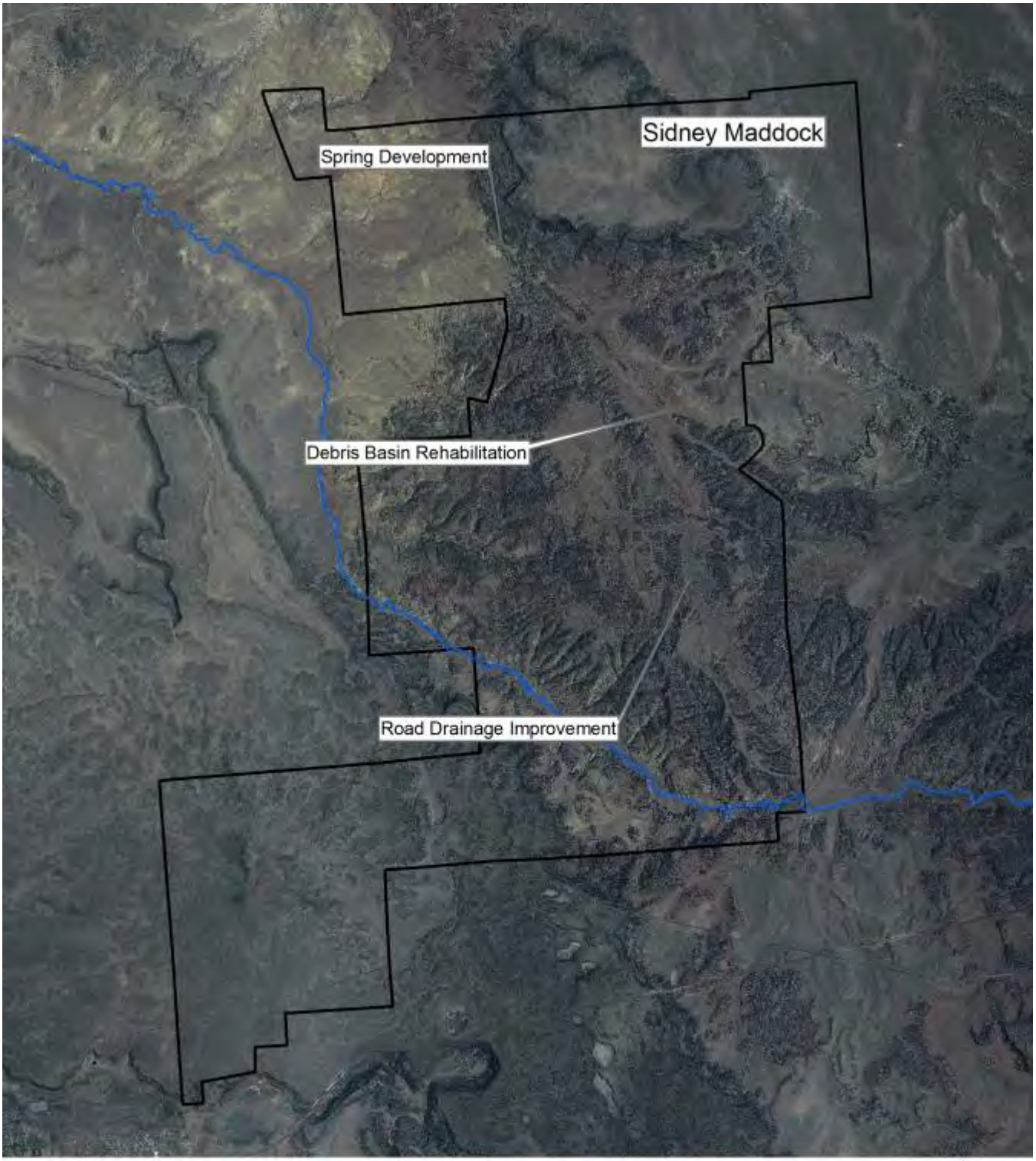
Sidney Maddock
Spring Development
Debris Basin Rehabilitation
Road Drainage Improvement
Coyote Creek
Coyote_Creek_Watershed_Ranches_10_05_2010
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Coyote Creek Watershed Improvement and Education Project

Name: Fred Moore (Daric Knight)

Date of Visit: 01/27/2011

Ranch Name:

Email: dknight100@hotmail.com

Mailing Address:

Phone Number: 928.521.9897

Site Description

The drainage network across this ranch represents tributaries of Coyote Creek. Historically conservation work on this ranch has included water and sediment control basins (WASCOBs) and Sediment Detention basins to trap sediment and arrest channel incision. Head-cutting and rill erosion continue to be active.

There are breeched sediment/debris basins; it is unclear whether its rehabilitation is an effective solution both with regard to cost and benefit. One sediment basin located in the north-central portion of the ranch does show promise for rehabilitation.

Grazing is the primary land use on this ~3,370 acre ranch.

Ranch Objectives and Resource Concerns:

There are several breached or nearly breached sediment basins and WASCOBs on this ranch. Rehabilitation of the sediment basins would restore the historic capacity and function could be an effective solution for sediment reduction. The design standard for a WASCOB states that they must be built on watersheds with less than 1 square mile of drainage area. Many of these WASCOBs exceed this standard and rehabilitation is not recommended.

Mr. Moore would like to address relatively recent head-cutting and gullies with grade/gully control structures.

Proposed Best Management Practices (BMPs) to Achieve Ranch Objectives:

Structural Practices

- Gully Control
- Sediment Basin

Name: Fred Moore (Daric Knight) **Ranch Name:**

Estimated BMP Cost – Rock and Brush Grade Control

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Rock and Brush Grade Control Structure	cy	260	$55.00	$14,300	
			Total Estimated Cost:	$14,300	1200 ac

Estimated BMP Cost – Sediment Basin

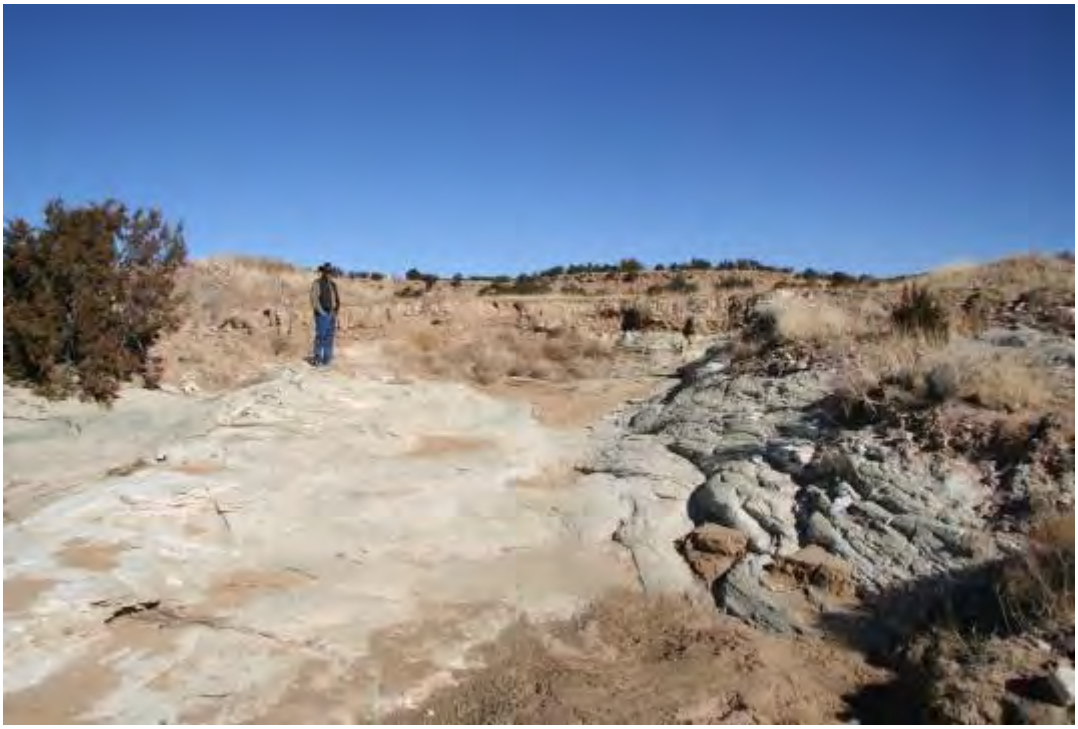
Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Sediment Basin Rehabilitation	cy	2,400	$4.00	$9,600	
			Total Estimated Cost:	$9,600	1900 ac

Total: $23,900

Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
Fred Moore	Gully Control (Rock & Brush Grd Cntrl)	$11.92	4	1	48
Fred Moore	Sediment Basin Rehabilitation	$5.05	5	3	76

Site Photos

Shows actively eroding headcuts.

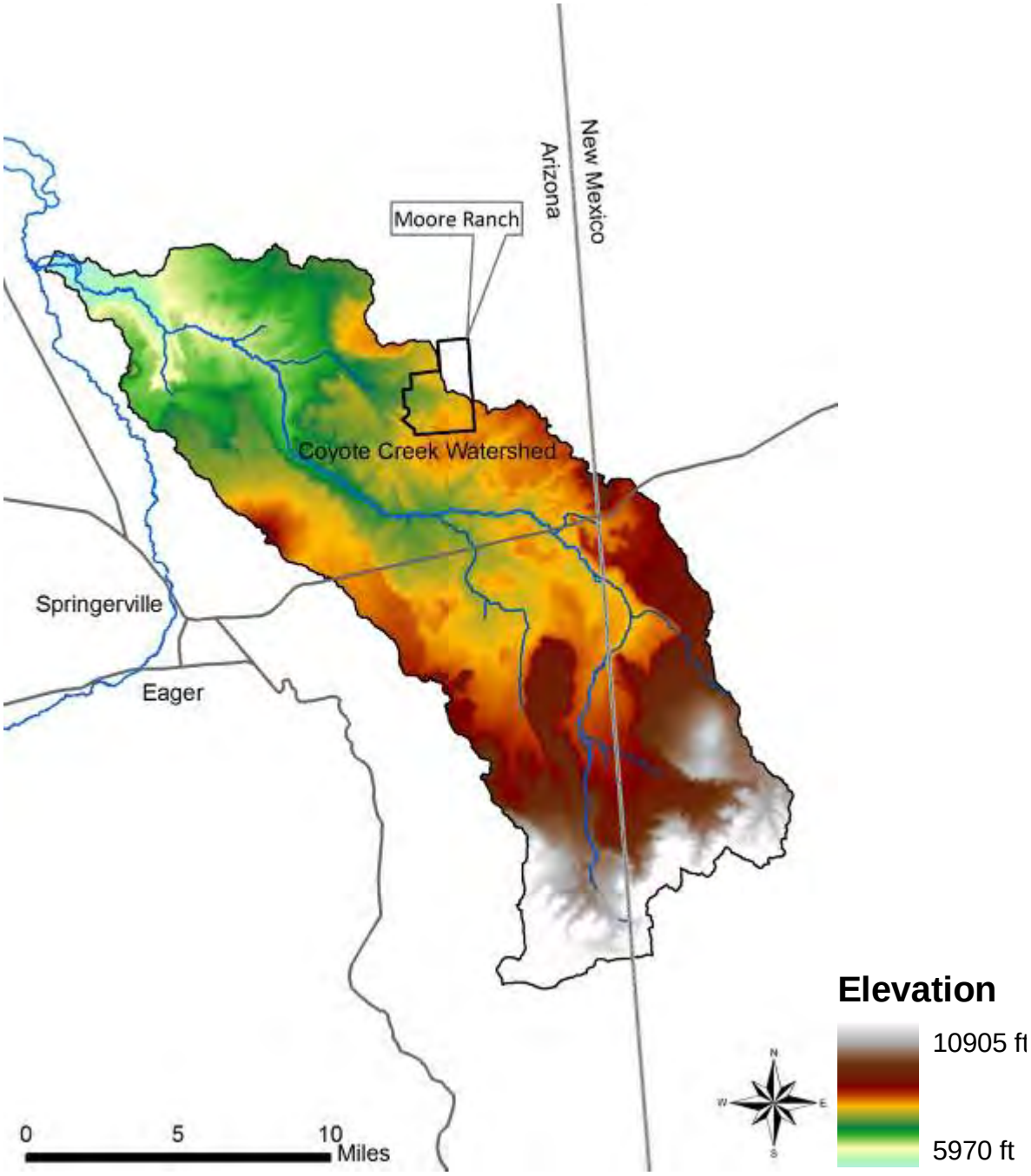


Shows an area of an actively eroding headcut.

Shows another actively eroding headcut.

Shows a failed WASCOB that has reached the end of its service life and is potentially built in a location that has too large of a contributing watershed.

Site Maps


New Mexico
Arizona
Moore Ranch
Coyote Creek Watershed
Springerville
Eager
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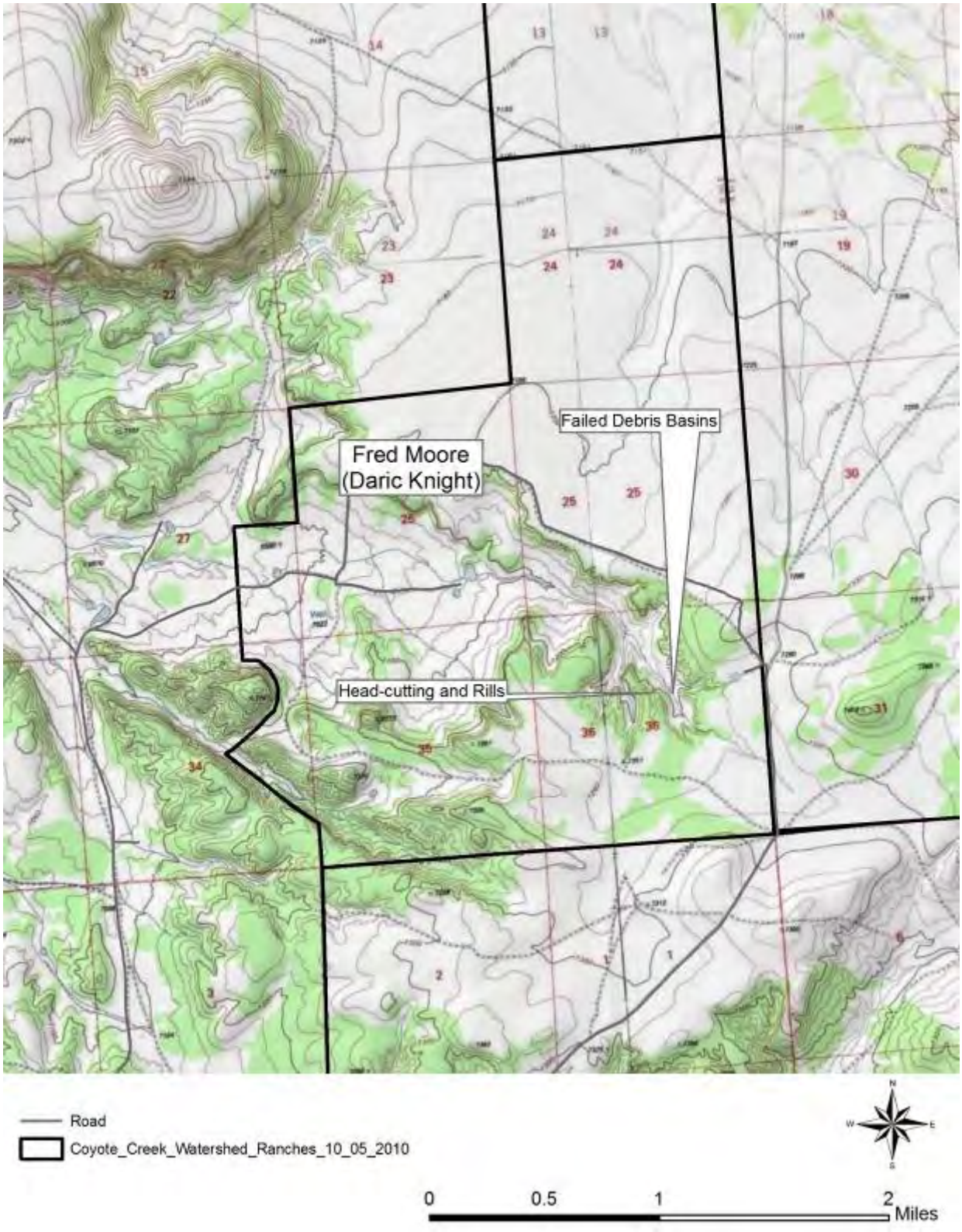
Miles
Elevation
10905 ft
5970 ft


Fred Moore
(Daric Knight)
Failed Debris Basins
Head-cutting and Rills
Road
Coyote_Creek_Watershed_Ranches_10_05_2010
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0.5
1
2
Miles

Coyote Creek Watershed Improvement and Education Project

Name: Brian Nicoll

Date of Visit: 02/04/2011

Ranch Name: Coyote Creek Ranch

Email: bnicoll01@msn.com

Mailing Address:

Phone Number: 928.245.7353

Site Description:
About 2.2 miles of Coyote Creek meanders through the southeast corner of this ranch; however, approximately half of the ranch drains to the north and directly into the Little Colorado River. The Ranch has extensive groundwater development as part of the Tucson Electric Power operations. These wells can be utilized for ranch management activities. Grazing is the primary land use on this ~18,470 acre ranch. Vegetation cover is typical of the lower Coyote Creek watershed.

Brian Nicoll recently purchased this ranch from Mike Udall. Mr. Udall historically participated in NRCS conservation programs and implemented many conservation practices related to vegetation and stabilization treatments (water bars, water spreaders and revegetation along water courses), as well as grazing management practices aimed at decreasing erosion. These practices are intact and maintained by the new owner and have been effective at reducing erosion from specific areas; however, additional areas need protection.

Headcutting and gully erosion are present on steeper slopes and along reaches of Coyote Creek.

Ranch Objectives and Resource Concerns:
Lack of adequate watering sites has led to concentrated grazing and lost opportunities for rotation of stock across the ranch. Existing grazing practices have increased the risk of concentrated runoff and erosion. Development of water lines from existing pumps and additional fencing will enable distribution of livestock across a wider area of the ranch and reduce grazing pressure to improve vegetative cover and decrease soil loss.

Headcuts and gully erosion are also concerns that could be addressed through grade stabilization treatments. Grade stabilization is required on a wide range of watershed sizes both along the banks of Coyote Creek and along hillslopes.

Proposed Best Management Practices (BMPs) to Achieve Ranch Objectives:

Structural Practices
- Gully Control
- Water Development

Range Management and Vegetative Practices
- Fencing

Coyote Creek Watershed Improvement and Education Project

Name: Brian Nicoll **Ranch Name:** Coyote Creek Ranch

Estimated BMP Cost – Range Management

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Standard 4-Strand Barbed Wire Fence	ft	15,840	$4.00	$63,360	
			Total Estimated Cost:	$63,360	1800 ac

Estimated BMP Cost – Gully Control

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Rock & Brush Grade Control Structure	cy	65	$55.00	$3,575	
			Total Estimated Cost:	$3,575	330 ac

Estimated BMP Cost – Water Development

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
NO. 1 Pipeline (1 ¼" diameter)	ft	6805	$3.50	$23,818	
Trough	gal	5000	$1.50	$7,500	
				($31,318)	2000 ac
NO. 2 Pipeline (1 ¼" diameter)	ft	6805	$3.50	$23,818	
Trough	gal	5000	$1.50	$7,500	
				($31,318)	2000 ac
			Total Estimated Cost:	$62,636	

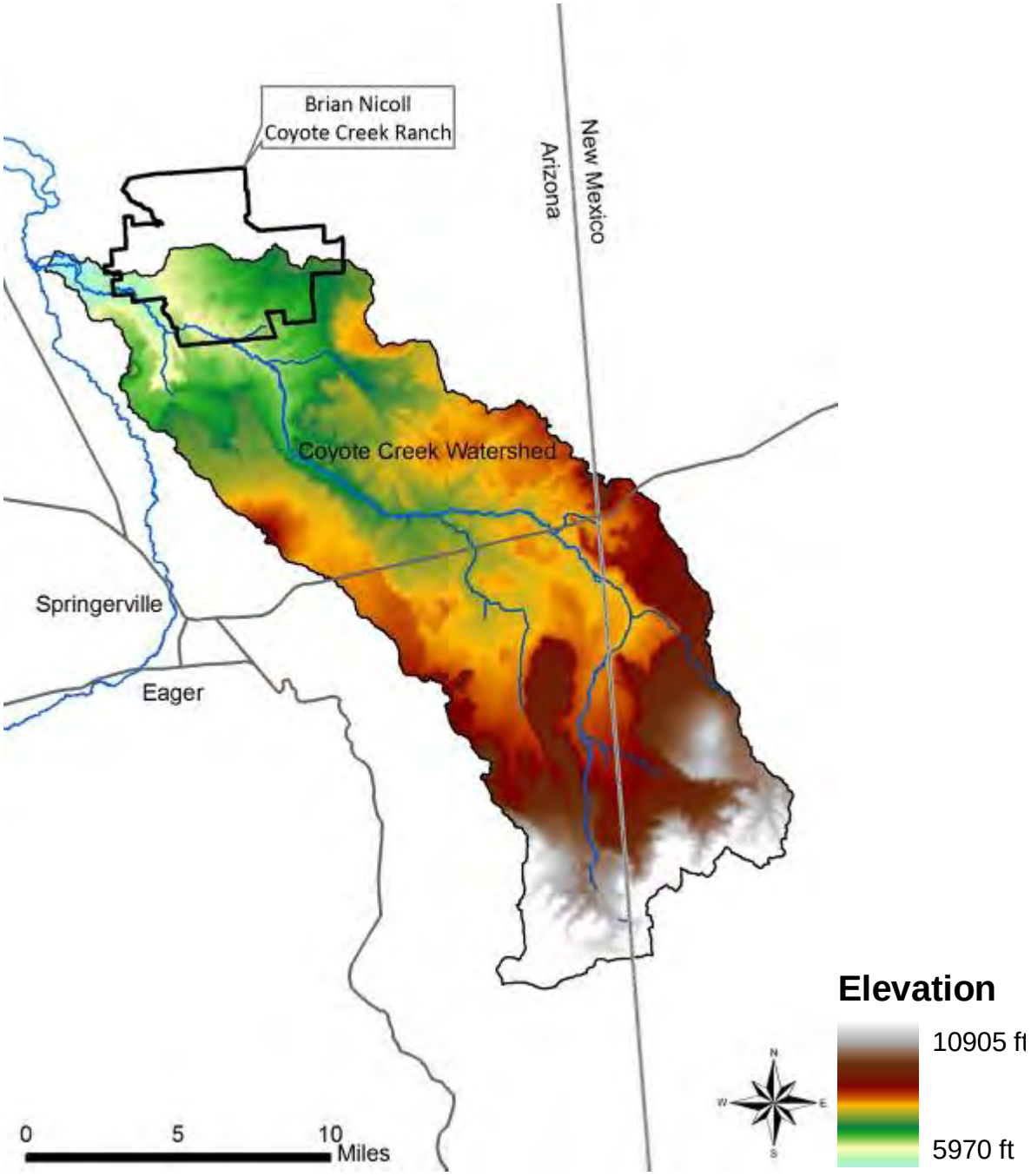
Total: $129,570

Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
Brian Nicoll	Range Management (Fencing)	$35.20	7	5	1,232
Brian Nicoll	Gully Control (Rock & Brush Grd Cntrl)	$10.83	4	4	173
Brian Nicoll	Water Development (NO. 1)	$15.66	8	5	626
Brian Nicoll	Water Development (NO. 2)	$15.66	8	5	626

Site Photos

Not Available

Site Maps


Brian Nicoll
Coyote Creek Ranch
New Mexico
Arizona
Coyote Creek Watershed
Springerville
Eager
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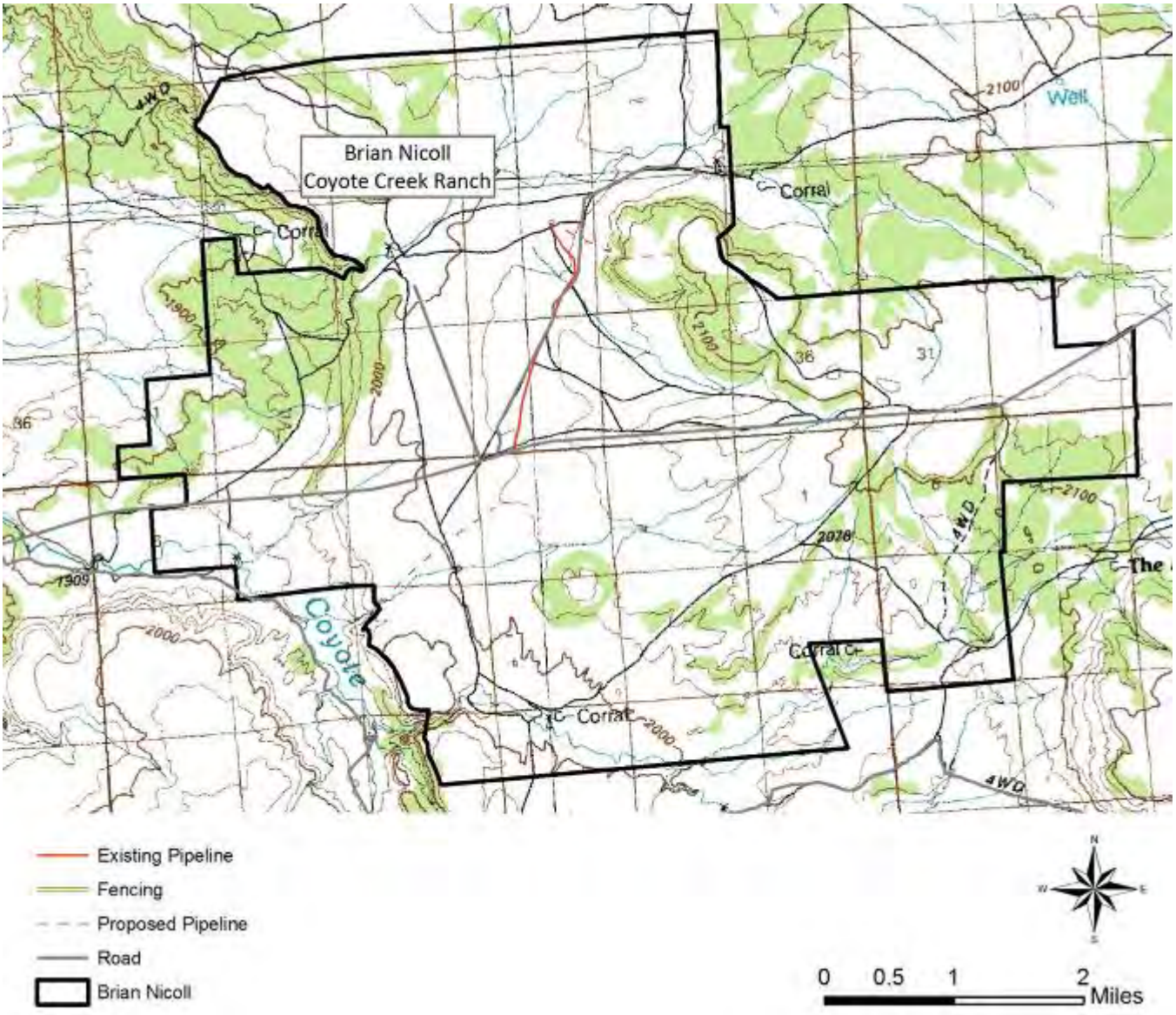
Miles
Elevation
10905 ft
5970 ft


Brian Nicoll
Coyote Creek Ranch
Corral
Corral
Corral
Corral
Well
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2000
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1909
2078
36
31
36
Coyote
Existing Pipeline
Fencing
Proposed Pipeline
Road
Brian Nicoll
N
W
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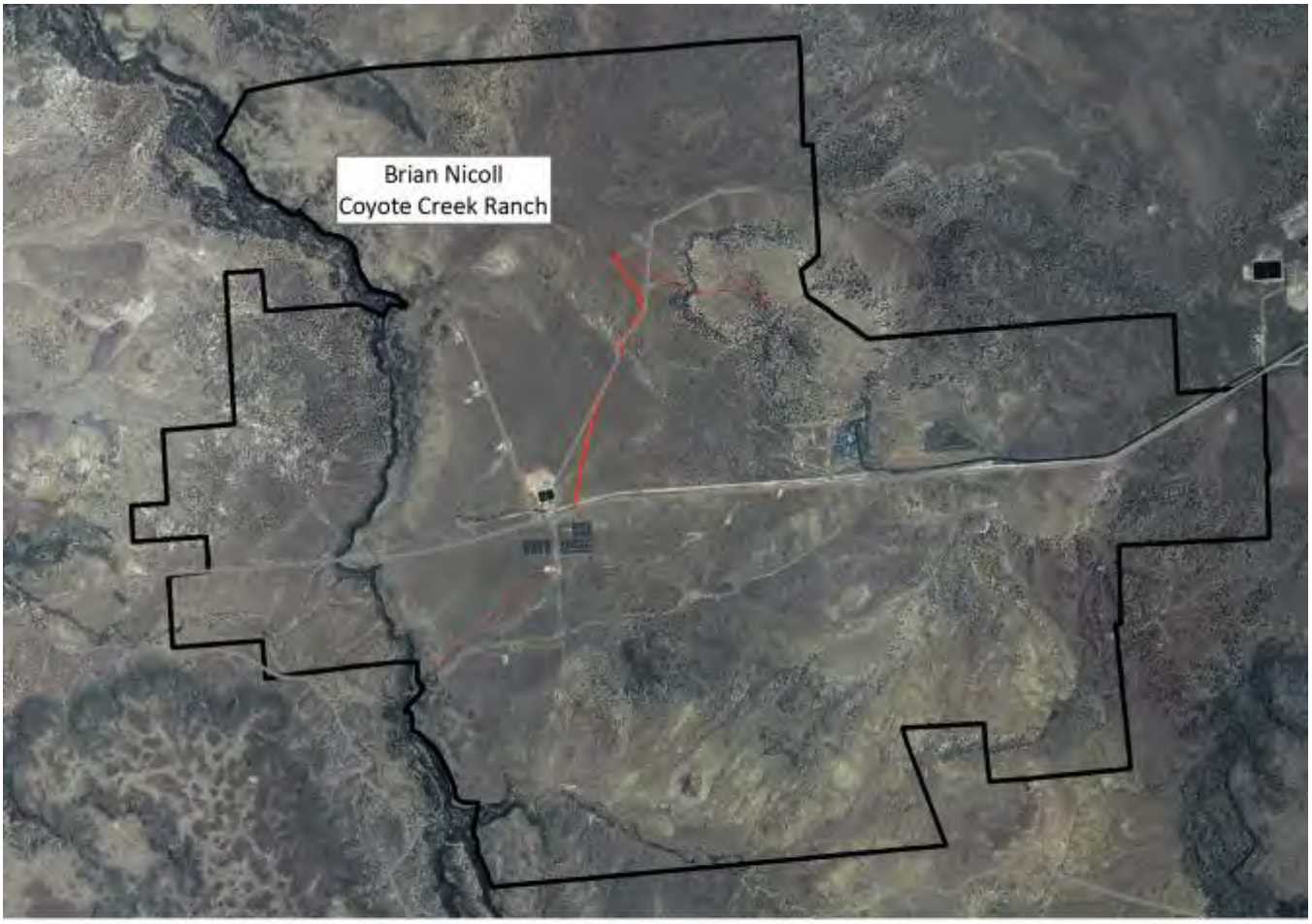
0.5
1
2
Miles


Brian Nicoll
Coyote Creek Ranch
Existing Pipeline
Fencing
Proposed Pipeline
Road
Brian Nicoll
N
W
E
S
0 0.5 1 2
Miles

Coyote Creek Watershed Improvement and Education Project

Name: Elaine Rogers

Date of Visit: 01/19/2011 & 04/13/2011

Ranch Name: Rogers Ranch

Email: elainer.64@gmail.com

Mailing Address: Po Box 1640, Springerville, AZ 85938

Phone Number: 928.245.1572

Site Description

This ranch contains ~4.3 miles of Coyote Creek. These reaches of the stream contain tall (> 6 feet), vertical banks which consist of weak alluvial soils that are easily eroded. The entire stream appears to be adjusting to a change in base level, evident by the headcuts in tributaries and a narrow stream channel with little to no floodplain. Base level change is likely stabilized upstream of a major grade control structure, but the channel and tributary morphology is still adjusting.

A concrete sill has been in place for over 30 years and has effectively controlled the local gradient of Coyote Creek just downstream of a main road used to access several ranches. Lateral movement of Coyote Creek threatens to flank this grade control structure.

Grazing is the primary land use on this ~40,650 acre ranch. Vegetation is typical of the lower Coyote Creek watershed.

Ranch Objectives and Resource Concerns:

Ms. Rogers is concerned that the recent lateral migration of Coyote Creek could flank the Grade-Control Sill, causing the structure to fail. Failure of the structure would lead to incision and headward migration of a large head-cut. This would increase the sediment loading of Coyote Creek from main channel substrate and from tributaries as the base level change migrates throughout the drainage network. There has been a campaign to remove tamarisk (salt cedar) from the channel in an attempt to restore its historic capacity. Further tamarisk removal and bank stabilization would advance these efforts and decrease the production of sediment from streambanks.

Becker Draw has partially adjusted to the base level change and would benefit from bank stabilization to decrease the production of sediment from its banks.

Ms. Rogers would also like to treat a large gully migrating out of Coyote Creek, which is actively eroding and a significant source of sediment to the stream. Other places of active erosion are roads which need water bars to decrease erosion and spread out the water.

Proposed Best Management Practices (BMPs) to Achieve Ranch Objectives:

Structural Practices

- Bank Stabilization (Becker Draw)
- Bank Stabilization (Coyote Creek)
- Channel and Bank Stabilization (Near grade-control sill)
- Gully Control (Rock and Brush Grade Control)
- Road Stabilization (Water Bars)

Coyote Creek Watershed Improvement and Education Project

Name: Elaine Rogers **Ranch Name:** Rogers Ranch

Estimated BMP Cost – Bank Stabilization

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Slope-Seed-Mulch (Becker Draw)	ft	470	$15.00	$7,050	1 ac
Slope-Seed-Mulch (Coyote Creek)	ft	545	$15.00	$8,175	1 ac
			Total Estimated Cost:	$15,225	

Estimated BMP Cost – Channel and Bank Stabilization (Near grade-control sill)

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Earthwork	cy	500	$4.00	$2,000	
			Total Estimated Cost:	$2,000	1 ac

Estimated BMP Cost – Gully Control

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Rock & Brush Grade Control Structure	cy	65	$55.00	$3,575	
			Total Estimated Cost:	$3,575	3 ac

Estimated BMP Cost – Road Stabilization

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Water Bars	ea	9	$135.00	$1,215	
			Total Estimated Cost:	$1,215	1 ac

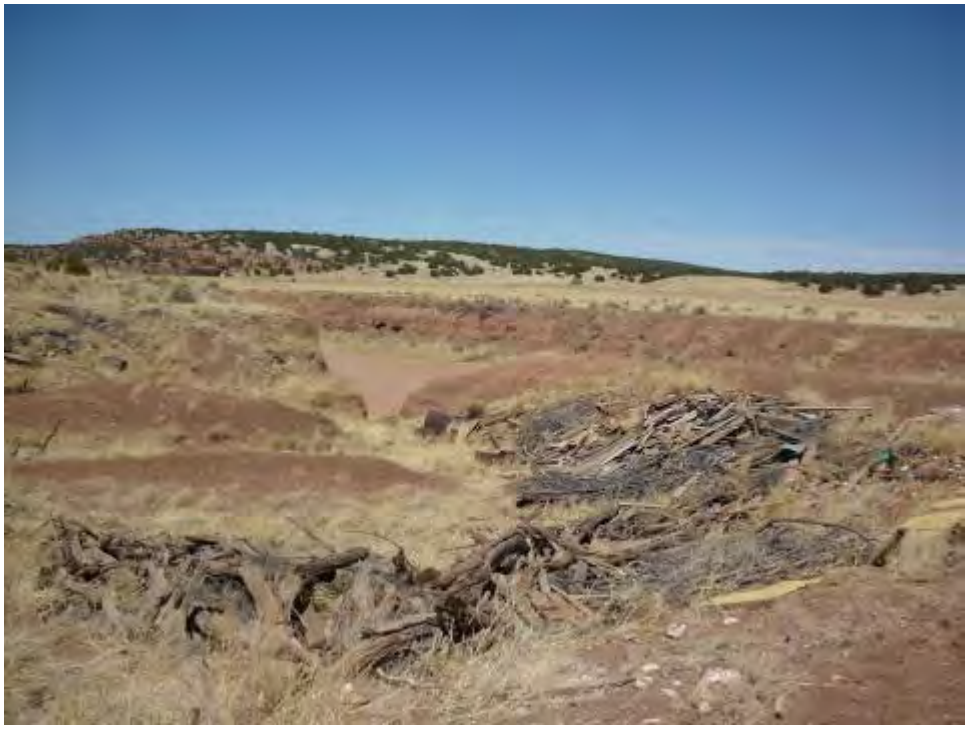
Total: $22,015

Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
Elaine Rogers	Bank Stabilization (Becker Draw)	$7,050	3	1	21,150
Elaine Rogers	Bank Stabilization (Coyote Creek)	$8,175	3	1	24,525
Elaine Rogers	Channel & Bank Stabilization (Sill)	$2,000	3	1	6000
Elaine Rogers	Gully Control (Rock & Brush)	$1,192	4	1	4,767
Elaine Rogers	Road Stabilization (Water Bars)	$1,215	6	4	29,160

Site Photos

Grade-control sill has effectively controlled the course of Coyote Creek and maintained the local grade.

Vertical banks of Coyote Creek, downstream of the grade-control sill. The grade-control sill has been constructed upon the natural bedrock rock seen in the foreground.

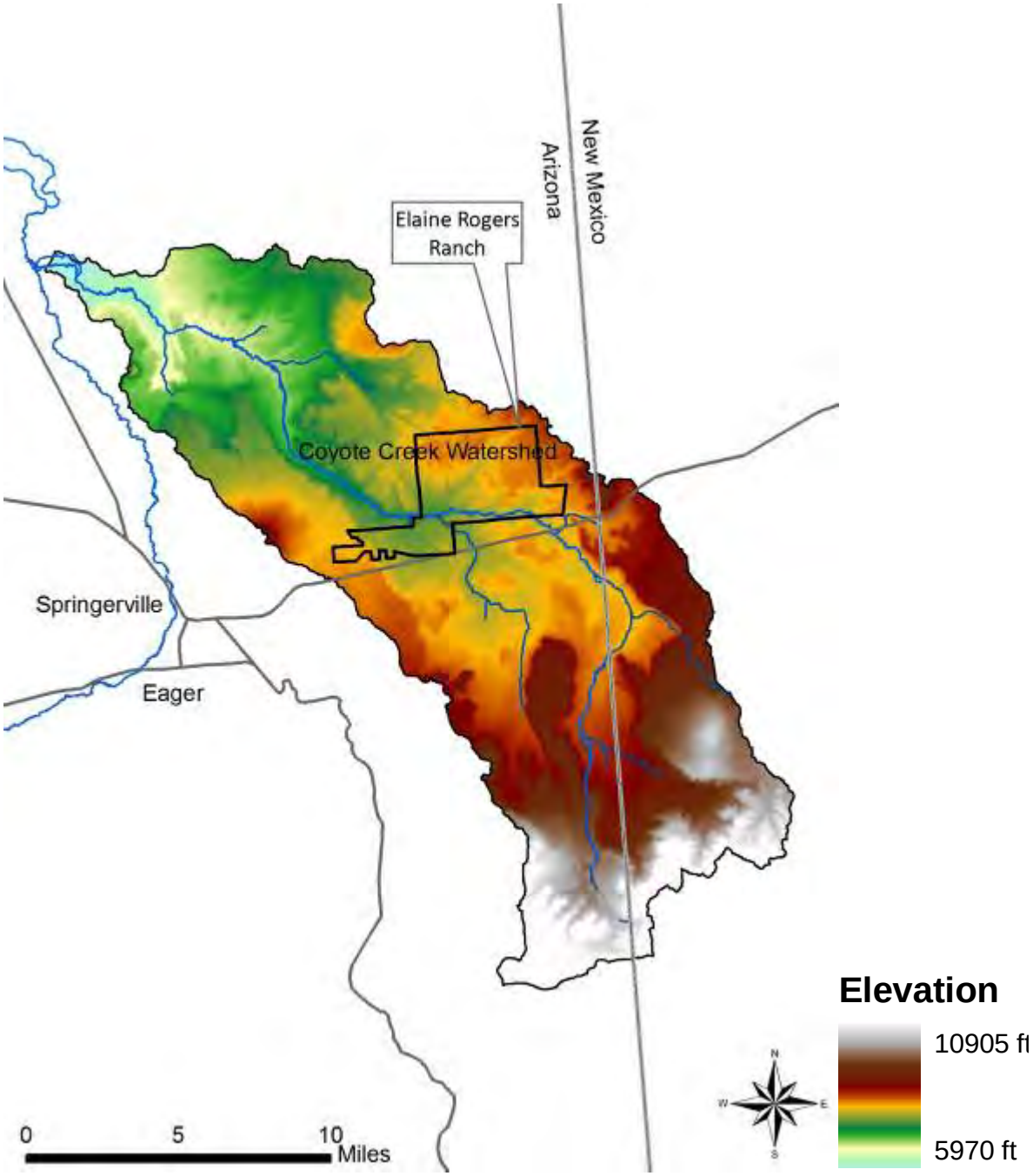


Gully migrating out of Coyote Creek with unsuccessful mitigation in the form of brush.

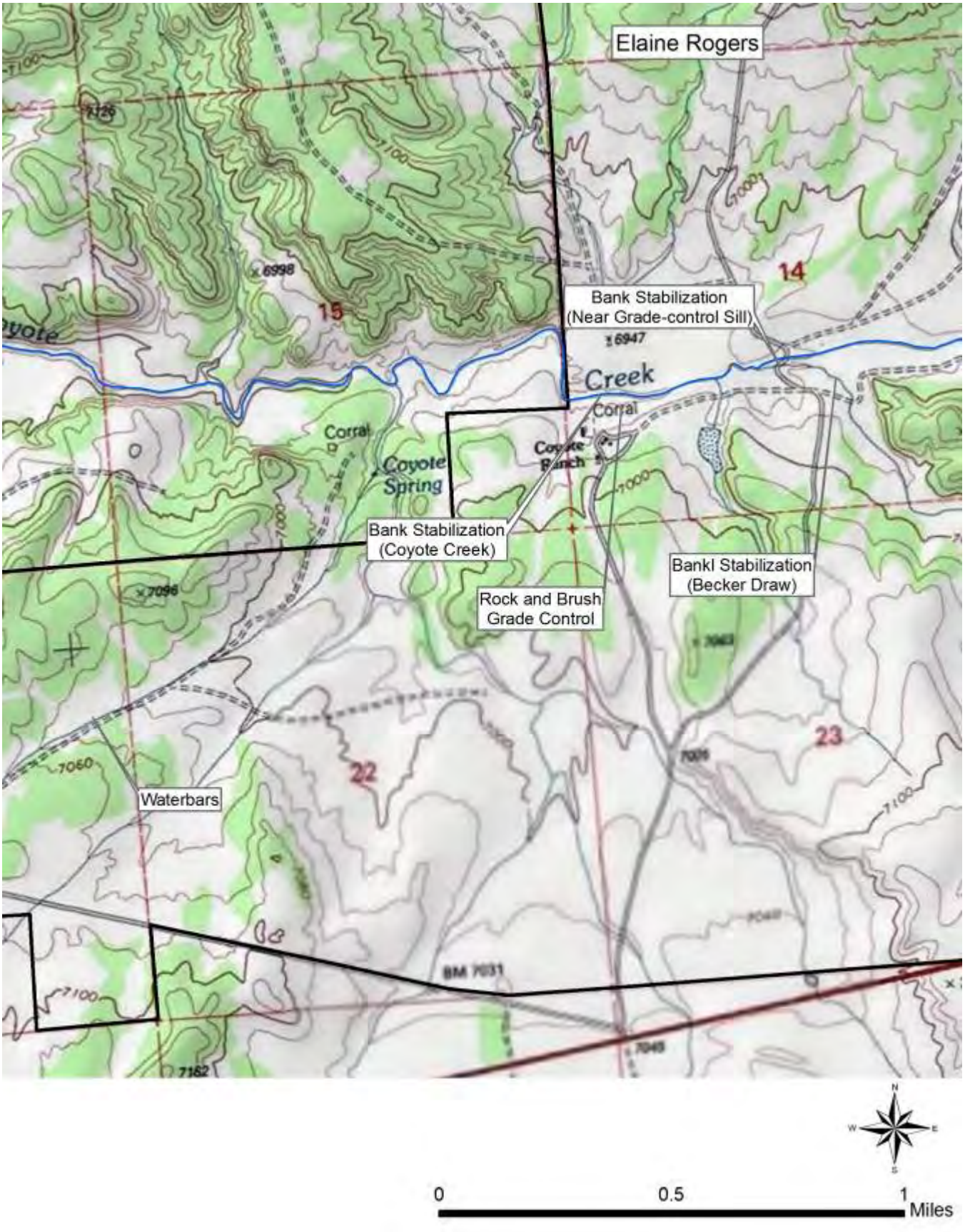
This reach of Coyote Creek has undergone tamarisk removal in an attempt to restore the hydraulic capacity of the channel.

The lower reach of Becker Draw is actively eroding. This reach is evolving toward a stable condition and is a good candidate for bank stabilization.

Site Maps


New Mexico
Arizona
Elaine Rogers Ranch
Coyote Creek Watershed
Springerville
Eager
0
5
10
Miles
Elevation
10905 ft
5970 ft

Coyote Creek Watershed Improvement and Education Project




Elaine Rogers
Bank Stabilization
(Near Grade-control Sill)
Bank Stabilization
(Coyote Creek)
Bankl Stabilization
(Becker Draw)
Rock and Brush
Grade Control
Waterbars
N
W
E
S
0
0.5
1
Miles

Coyote Creek Watershed Improvement and Education Project

Name: John Thompson

Date of Visit: 12/12/2010

Ranch Name: Horseshoe Springs

Email:

Mailing Address: 985 W. School Bus Road, Eagar

Phone Number: 928.245.2162

Site Description:
This property contains tributaries of Coyote Creek. Grazing is the primary land use on this ~3,000 acre ranch. Historically, conservation work on this ranch has included sediment/debris basins, V-mesh fencing spreaders to retard sheet erosion and rill development. These practices have been at least partially successful; however, head-cutting and rill erosion are still active on the ranch.

Dispersal of grazing pressure is limited by water sources on the property. Wells on the property need new pumps and a sustainable source of power (i.e. solar or windmill). The upper well needs a storage tank, pipe, and drinkers. Pasture fences are in need of repair to effectively manage grazing pressure and vegetation density. Grassland cover is limited by both juniper tree encroachment and wind erosion. Wind erosion has been a persistent problem leading to the denudation of fertile soil from some pastures.

Sediment retention on one tributary is limited by a breached water and sediment control basin (WASCOB); however, the effectiveness of this structure is questionable.

Dense populations of kangaroo rats are a perceived barrier to reestablishment of grasslands and other vegetative cover.

Ranch Objectives and Resource Concerns:
Mr. Thompson would like to decrease sediment runoff through the removal of junipers and reestablishment of grass ground cover. He would like to address relatively recent head-cutting and gullies with grade control structures. Establishment of vegetation and stabilization of wind-eroded pasture is also a goal.

Grazing and vegetation management would be enhanced by developing a new well and rehabilitating two wells. These water developments and additional fencing would allow for better grazing rotation which would increase vegetative cover and decrease sediment runoff.

Proposed Best Management Practices (BMPs) to Achieve Ranch Objectives:

Structural Practices
- Gully Control
- Water Development

Vegetative Practices
- Fencing
- Brush Management
- Range Seeding
- Kangaroo Rat Control

Coyote Creek Watershed Improvement and Education Project

Name: John Thompson **Ranch Name:** Horseshoe Springs

Estimated BMP Cost – Range Management & Vegetative

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Brush Management	ac	1920	$90.00	$172,800	
Range Seeding	ac	480	$145.00	$69,600	
				($242,400)	1920 ac
Fencing	ft	26,400	$4.00	$105,600	2500 ac
Kangaroo Rat Control	ac	50	$24.00	$1,200	50 ac
			Total Estimated Cost:	$349,200	

Estimated BMP Cost – Gully Control

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigated
Rock & Brush Grade Control Structure	cy	260	$55.00	$14,300	
			Total Estimated Cost:	$14,300	1200 ac

Estimated BMP Cost – Water Development

Description	Unit	Quantity	Typical Unit Cost	Estimated Cost	Area Mitigation
NO. 1 Well Renovation	ft	40	$60.00	$2,400	1250 ac
Windmill w/o Tower	ea	1	$5000.00	$5,000	
Pipeline	ft	25	$3.50	$88	
NO. 2 Well Renovation	ft	320	$60	$19,200	2000 ac
Well Power Plant (Solar)	ea	1	$12,500	$12,500	
Pipeline	ft	25	$3.50	$88	
NO. 3 Well Devel (North Mesa)	ft	40	$60	$2,400	2000 ac
Well Power Plant (Solar)	ea	1	$12,500	$12,500	
Pipeline	ft	100	$3.50	$350	
Trough	gal	5,000	$1.50	$7,500	
NO. 3 Spring Development	ea	1	$1,600.00	$1,600	1250 ac
Pipeline	ft	25	$3.50	$88	
Trough	gal	5000	$1.50	$7,500	
			Total Estimated Cost:	$71,214	

Total: $434,713

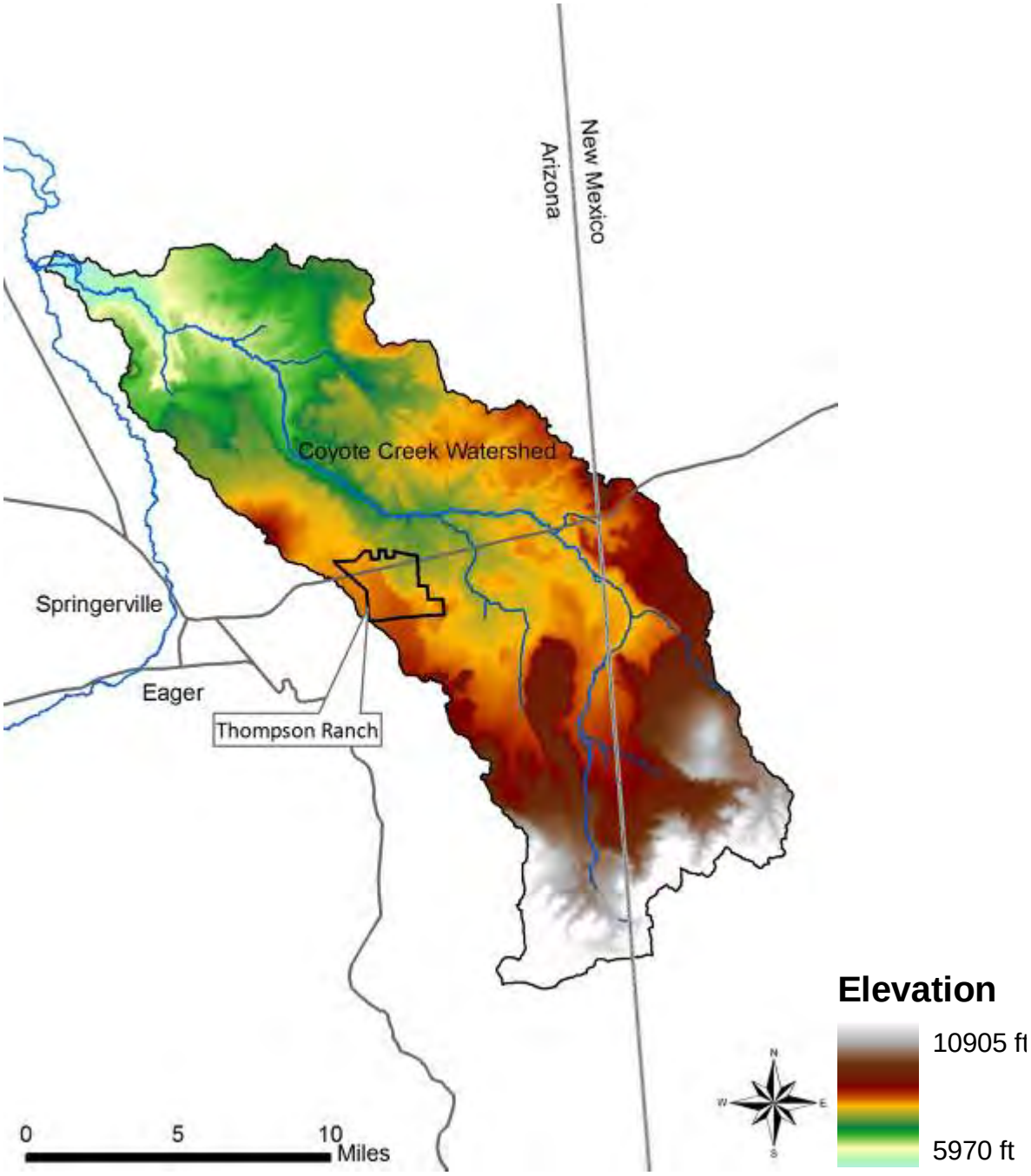
Producer	Best Management Practice	Cost per Acre Mitigated	Sum of NEMO Ratings	Location Rating	Area-Weighted BMP Rating
John Thompson	Range Management (Brush & Seed)	$126.25	6	5	3,788
John Thompson	Fencing	$42.24	7	5	1,478
John Thompson	Kangaroo Rat	$24.00	9	5	1,080
John Thompson	Gully Control (Rock & Brush Grd Cntrl)	$11.92	4	1	48
John Thompson	Water Development (NO. 1)	$6.00	8	5	240
John Thompson	Water Development (NO. 2)	$15.89	8	6	763
John Thompson	Water Development (NO. 3)	$11.38	8	6	546
John Thompson	Water Development (NO. 4)	$7.35	8	5	294

Site Photos

View of an area in need of brush management and wind erosion treatment.

Picture of a damaged windmill and well in need of rehabilitation.

Site Maps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Arizona
Coyote Creek Watershed
Springerville
Eager
Thompson Ranch
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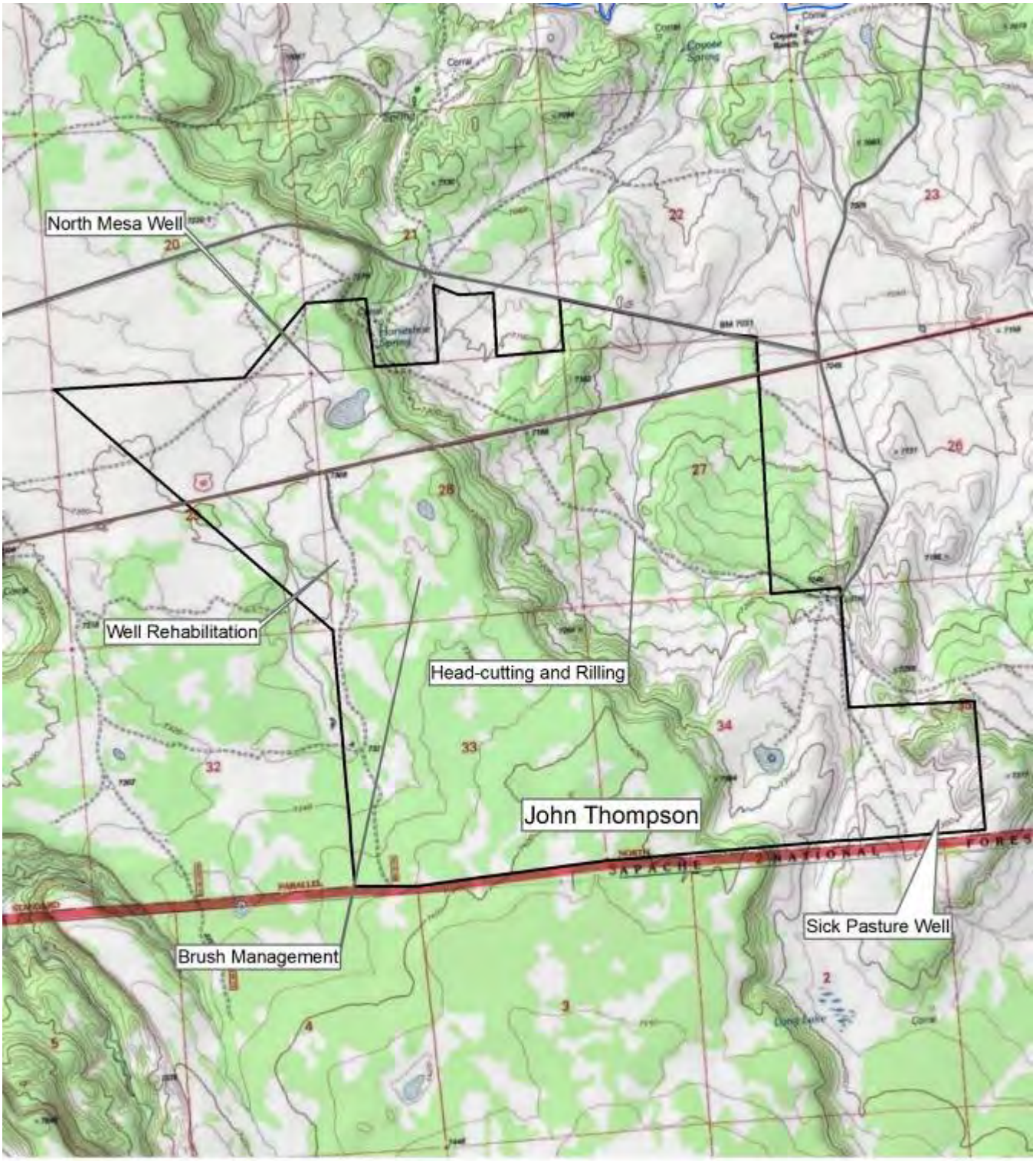
Miles
Elevation
10905 ft
5970 ft


North Mesa Well
Well Rehabilitation
Head-cutting and Rilling
John Thompson
Brush Management
Sick Pasture Well
Road
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0
0.5
1
2
Miles


North Mesa Well
Well Rehabilitation
Head-cutting and Rilling
John Thompson
Sick Pasture Well
Brush Management
Road
Coyote_Creek_Watershed_Ranches_10_05_2010
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Miles

APPENDIX B - BEST MANAGEMENT PRACTICE DETAILS

Cover – Index of Drawings
BMP 1A – DETAIL: Fencing - Access Gate & Line Post Assembly
BMP 1B – DETAIL: Fencing - End/Corner Post & Grade Change Assembly
BMP 2 – DETAIL: Fencing - Electrical
BMP 3 – DETAIL: Willow Pole Plantings
BMP 4 – DETAIL: Vertical Willow Bundles
BMP 5 – DETAIL: Headcut Treatment (Smooth - Seed - Fabric/Mulch)
BMP 6 – DETAIL: Rock and Brush Grade Control Structure
BMP 7 – DETAIL: Rock Wire Sausage Grade Control Structure
BMP 8 – DETAIL: Modified Heede Grade Control Structure
BMP 9 – DETAIL: 'V' Rock Weir Grade Control Structure
BMP 10 – DETAIL: Rock Wire Crib Grade Control Structure
BMP 11 – DETAIL: Cross Vane Weir
BMP 12 – DETAIL: Media Luna
BMP 13 – DETAIL: Sediment Basin
BMP 14 – DETAIL: Water and Sediment Control Basin (WASCOB)
BMP 15 – DETAIL: Bank Sloping - Seeding - Fabric/Mulch
BMP 16 – DETAIL: Rock Stream barb
BMP 17 – DETAIL: Boulder Dart
BMP 18 – DETAIL: Rock Vane
BMP 19 – DETAIL: Post Vane
BMP 20 – DETAIL: Vegetated Toe Extension
BMP 21 – DETAIL: Toe Rock with Willow Trench (optional)
BMP 22 – DETAIL: Dike
BMP 23 – DETAIL: V-Mesh Water Spreader
BMP 24 – DETAIL: Sediment Fence
BMP 25 – DETAIL: Road Water bar
BMP 26 – DETAIL: Road Rolling Drain Dip
BMP 27 – DETAIL: Road Cross Drain Culvert
BMP 28 – DETAIL: Road Cross Drain with Downspout
BMP 29 – DETAIL: Road Ditch Outlet
BMP 30 – DETAIL: Pond
BMP 31 – DETAIL: Spring Development or Rehabilitation
BMP 32 – DETAIL: Pipeline and Trough
BMP 33 – DETAIL: Well Development or Rehabilitation

COYOTE CREEK
Best Management Practice DETAILS

INDEX OF DRAWINGS

BMP NO.	TITLE
1A	DETAIL: Fencing – Access Gate & Line Post Assembly
1B	DETAIL: Fencing – End/Corner Post & Grade Change Assembly
2	DETAIL: Fencing – Electrical
3	DETAIL: Willow Pole Plantings
4	DETAIL: Vertical Willow Bundles
5	DETAIL: Headcut Treatment (Smooth – Seed – Fabric/Mulch)
6	DETAIL: Rock and Brush Grade Control Structure
7	DETAIL: Rock Wire Sausage Grade Control Structure
8	DETAIL: Modified Heede Grade Control Structure
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11	DETAIL: Cross Vane Weir
12	DETAIL: Media Luna
13	DETAIL: Sediment Basin
14	DETAIL: Water and Sediment Control Basin (WASCOB)
15	DETAIL: Bank Sloping – Seeding – Fabric/Mulch
16	DETAIL: Rock Streambarb
17	DETAIL: Boulder Dart
18	DETAIL: Rock Vane
19	DETAIL: Post Vane
20	DETAIL: Vegetated Toe Extension
21	DETAIL: Toe Rock with Willow Trench (optional)
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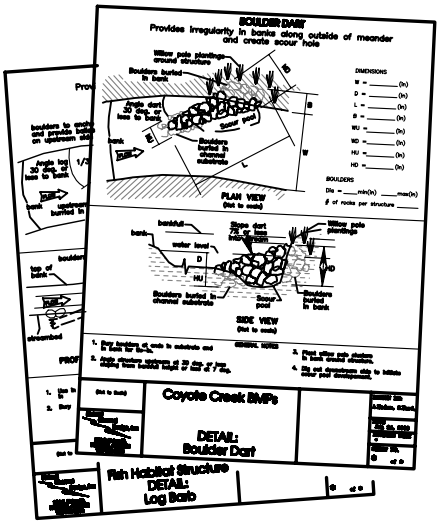
32	DETAIL: Pipeline and Trough
33	DETAIL: Well Development or Rehabilitation



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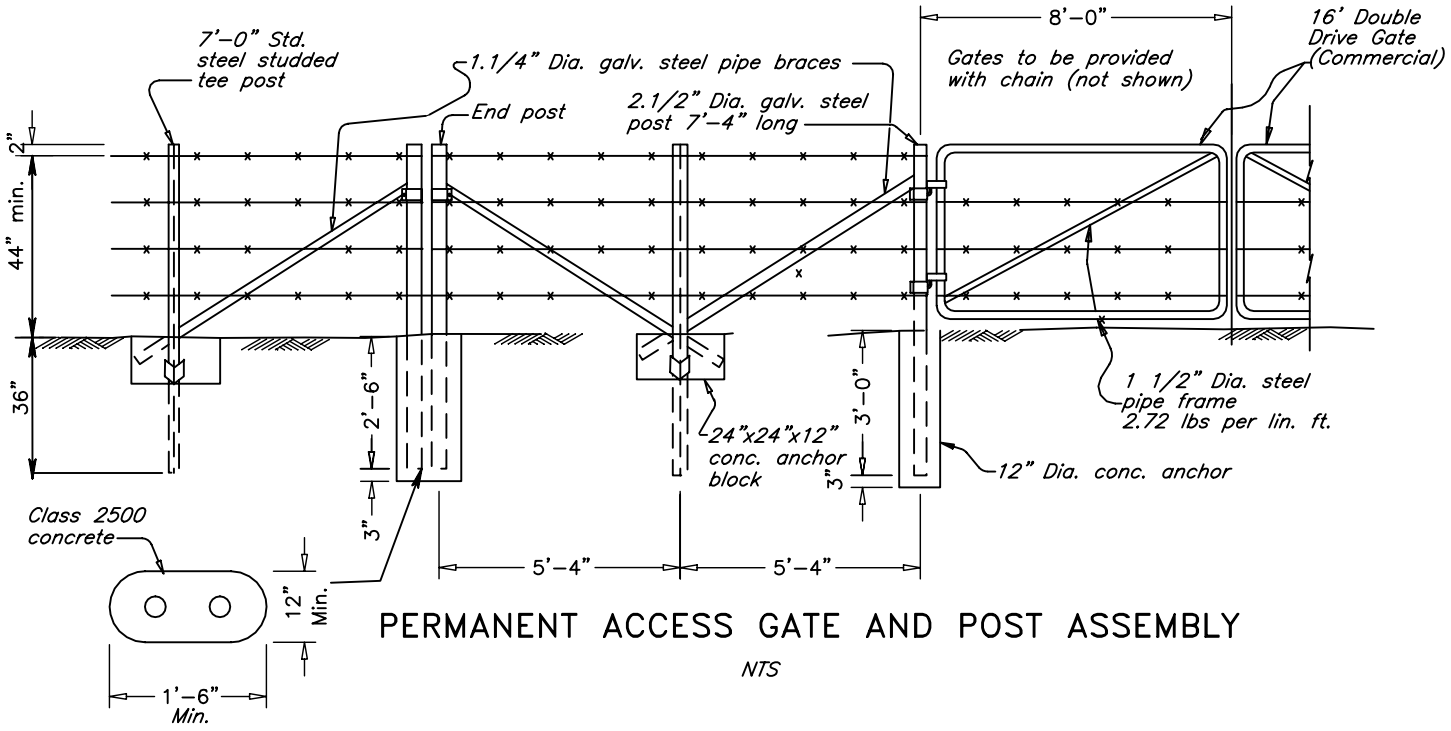
8–1/2 in x 11 in. Sheet Size

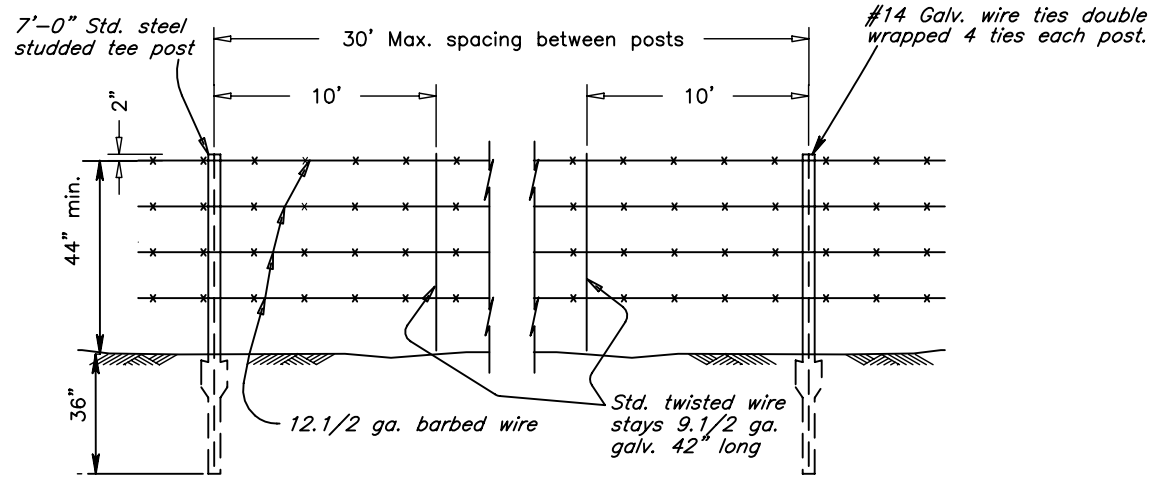
	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	Cover Sheet		DATE April 2011 REVISION DATE
			Cover

Fencing Management



PERMANENT ACCESS GATE AND POST ASSEMBLY

NTS

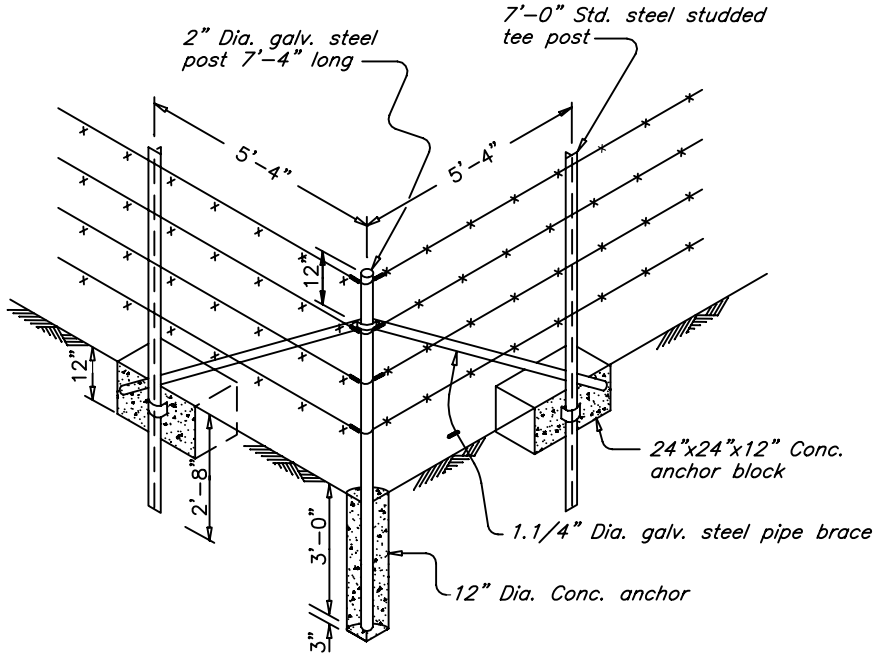


LINE POST ASSEMBLY

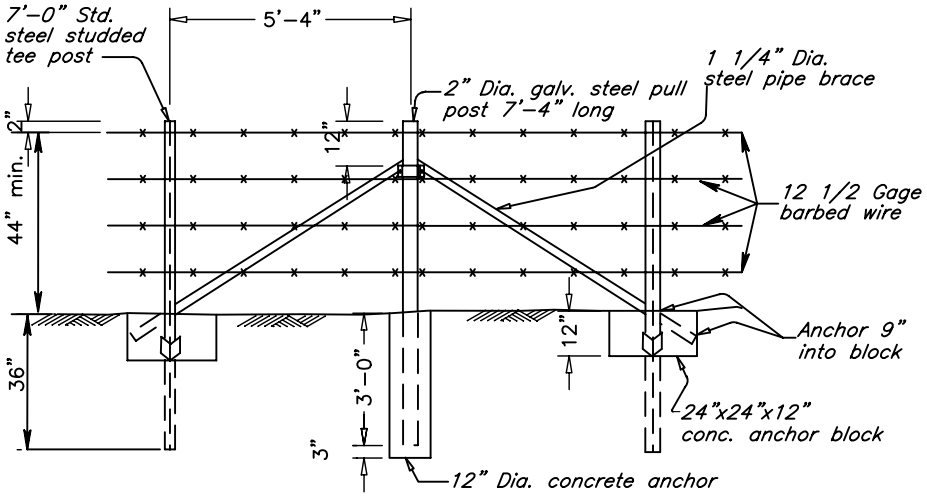
NTS

(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard DATE April 2011 REVISION DATE
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Fencing - Access Gate & Line Post Assembly		BMP NO. 1A

FENCING MANAGEMENT (continued)



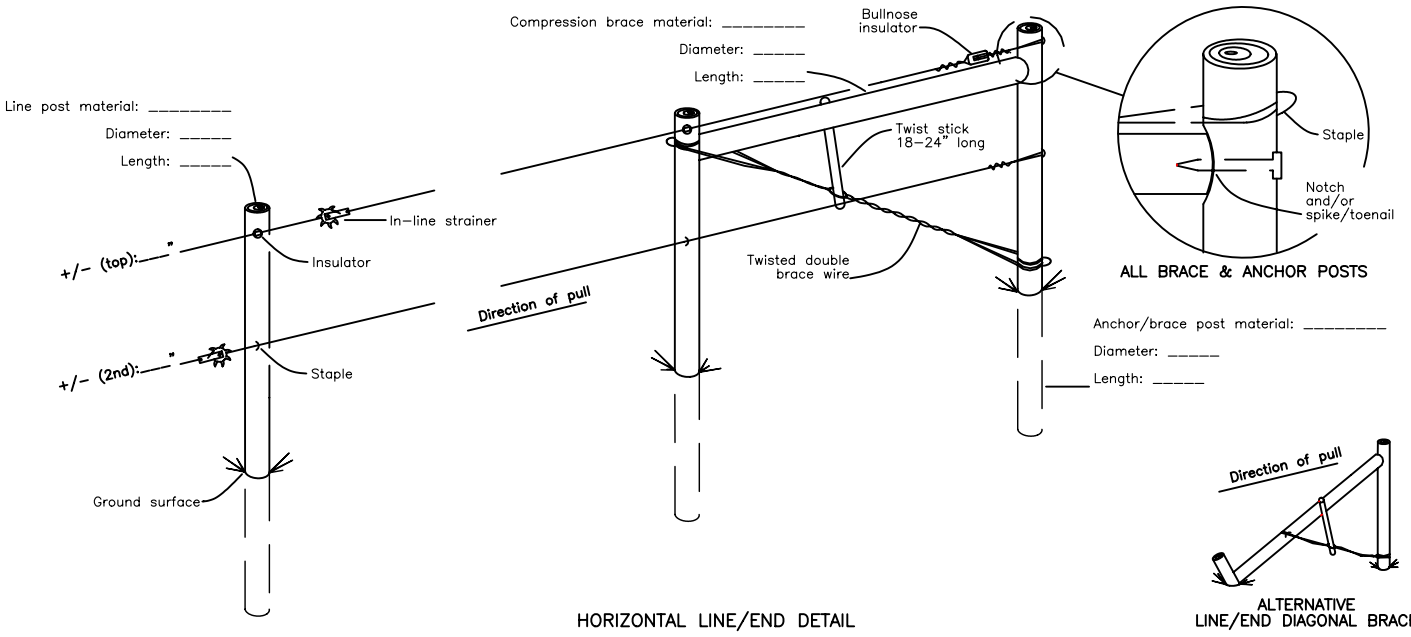
END OR CORNER POST ASSEMBLY



PULL POST OR CHANGE IN GRADE ASSEMBLY

(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Fencing - End or Corner Post & Grade Change Assembly		DATE April 2011 REVISION DATE BMP NO. 1B

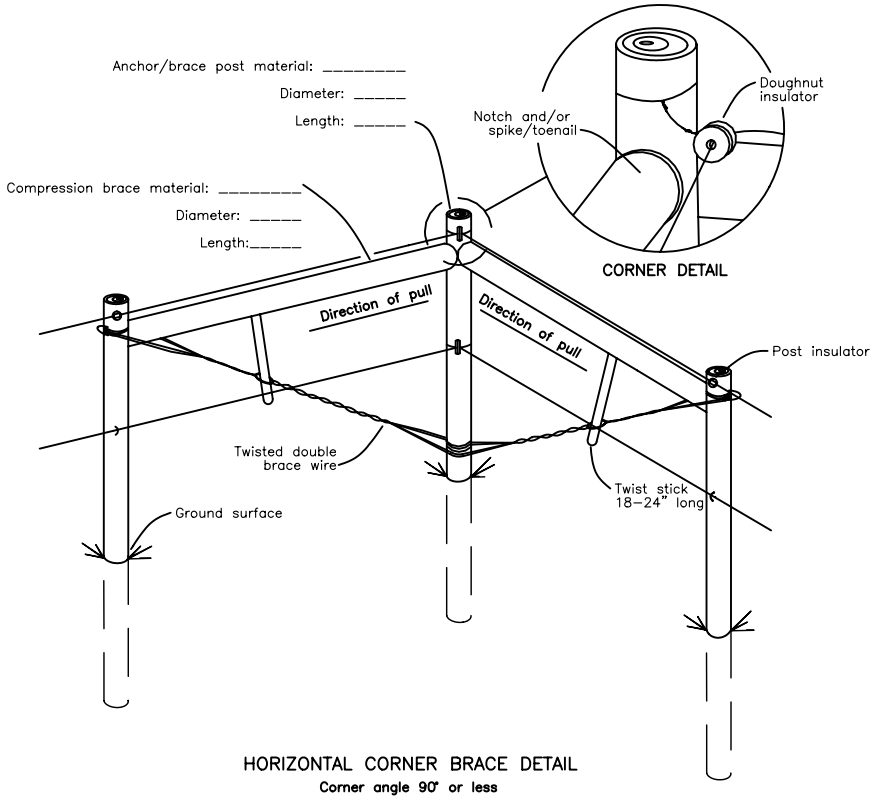
ELECTRICAL FENCING



HORIZONTAL LINE/END DETAIL

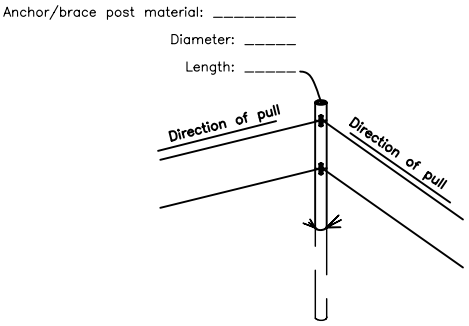
ALL BRACE & ANCHOR POSTS

ALTERNATIVE
LINE/END DIAGONAL BRACE

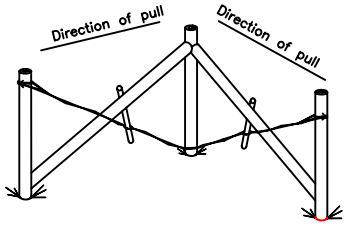


CORNER DETAIL

HORIZONTAL CORNER BRACE DETAIL
Corner angle 90° or less



ALTERNATIVE
SINGLE POST CORNER BRACE
Corner angle 90° or less



ALTERNATIVE
DIAGONAL CORNER BRACE
Corner angle 90° or less

(Not to Scale)
Adapted From NRCS Drawings

Coyote Creek Best Management Practices

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

DETAIL:
Fencing - Electrical

Preliminary
Not For
Construction

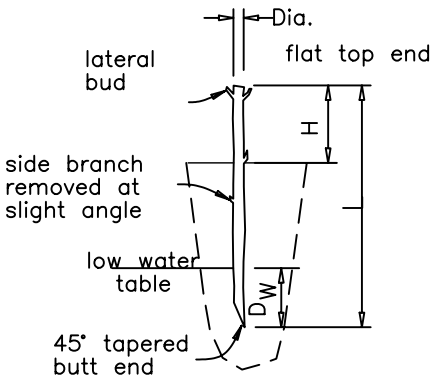
DESIGN BY:
S.Yard

DATE
April 2011

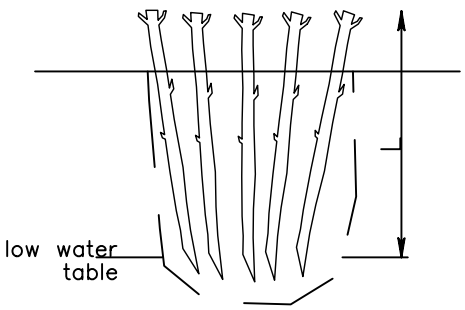
REVISION DATE

BMP NO.
2

WILLOW POLE PLANTINGS



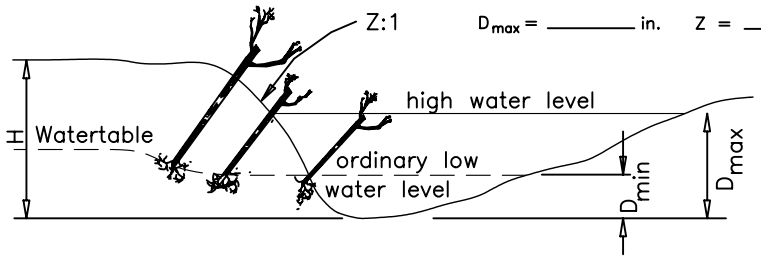
POLE PLANTING DETAIL
(Not to scale)



POLE CLUSTER DETAIL
(Not to scale)

DIMENSIONS

WATER DEPTH		BANK	
D_{min} = _____	in.	H = _____	ft.
D_{max} = _____	in.	Z = _____	



SECTION VIEW
(Not to scale)

GENERAL NOTES

PLANT MATERIAL PROCUREMENT and HANDLING

All woody species shall be native and collected from designated local sources.

Dormant unrooted hardwood cuttings can be taken after leaf fall and before bud burst in the spring. Never remove more than 1/3 of any single donor plant during harvesting. The best rooting success is from cuttings that are disease–free, green plants that are 2–10 years old. The best diameters for pole planting, vertical bundles, and trenches are 1/2 to 1 inch and 2 to 3 inches for post plantings. Cutting length varies depending on the application. It shall be long enough to reach 6 to 8 inches into the lowest water level of the year and high enough to expose at least two to three buds.

Cuts shall be made with clean, sharp tools. The bottom end of the stem cutting shall be cut to a 45–degree angle and the top end shall be cut square across or horizontal to the stem. Trim off all side branches and the terminal bud (bud at the growing tip) so energy will be rerouted to the lateral buds for more efficient root and stem sprouting. Do not trim terminal bud from cuttings for vertical bundles and willow trench until after planted. Trimmed tip ends shall be sealed by dipping in light–colored latex, water–based paint.

Submerge cuttings in water for 3 to 7 days prior to planting to maximize water retention. Do not allow the roots to emerge from the bark.

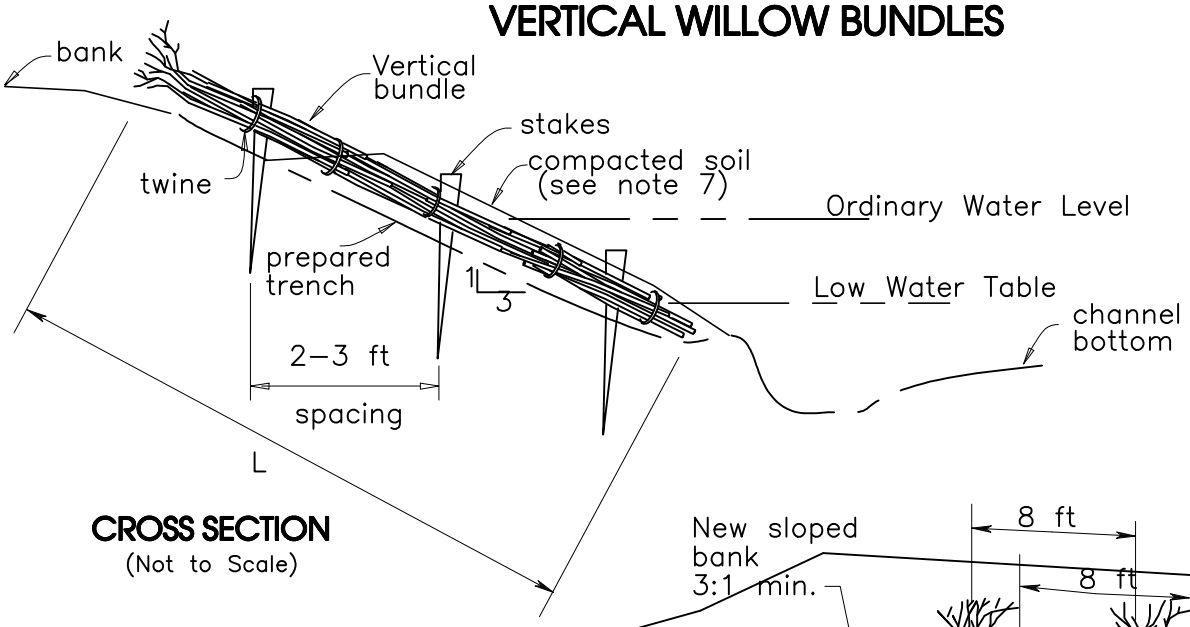
POLE PLANTINGS and POLE CLUSTERS:

Pole cuttings are placed in the ground deep enough to reach the lowest water table of the year and high enough to expose at least two to three buds. Root primordia will develop when good soil–to–stem contact is made and exposed sections of the cutting will sprout stems and leaves. Dormant cuttings can be planted with a digging bar, auger, water–jet, or if the soil is saturated, they may be pushed into the soil. Pole Plantingsare planted in the Bank and Overbank Zone and shall be spaced 2–4 feet apart in the row. In multiple row plantings, spacing between rows shall be staggered with respect to those in adjacent rows.

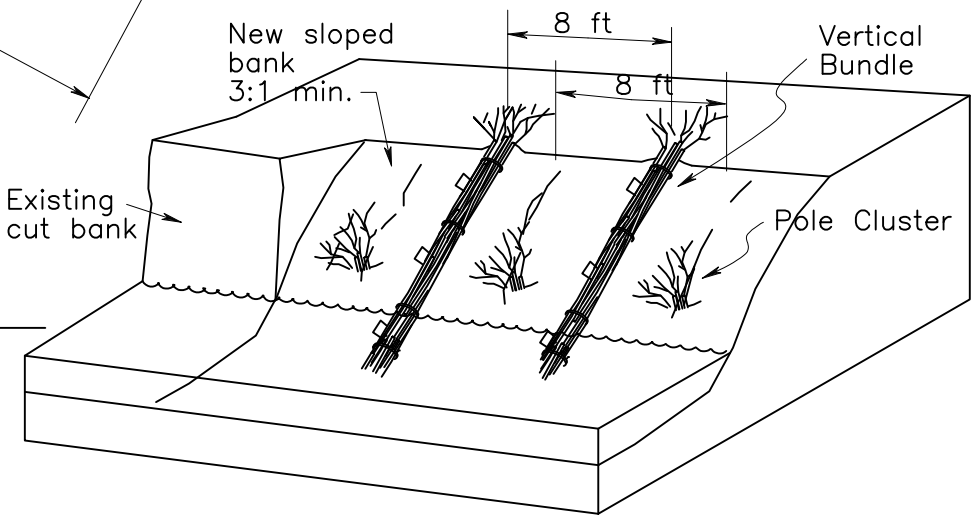
Pole Clusters require four to six inch holes augered into the bank, down to the water table with the use of a hydraulic auger attached to an excavator or tractor. Four willow poles are placed into the hole, backfilled and watered in. A Willow Trench uses pole clusters at 1 foot spacings behind the toe rock that creates a "fence" to filter runoff before it enters the stream and provide dense vegetation to stabilize the eroding bank.

(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Willow Pole Plantings		DATE April 2011
			REVISION DATE
			BMP NO. 3

VERTICAL WILLOW BUNDLES



CROSS SECTION
(Not to Scale)



ISOMETRIC VIEW
(Not to Scale)

VERTICAL BUNDLES

Dormant native poles placed in shallow trenches at 8 ft spacings with clusters in between.

Species _____

Dia _____ in.

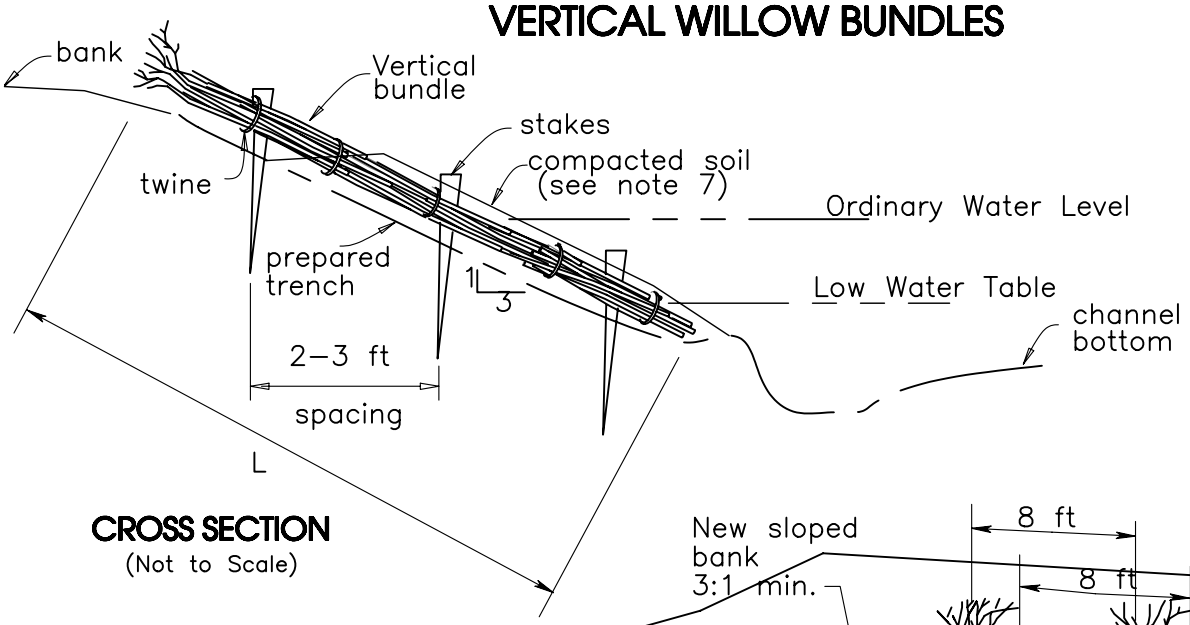
Length _____ ft.

VERTICAL BUNDLE NOTES

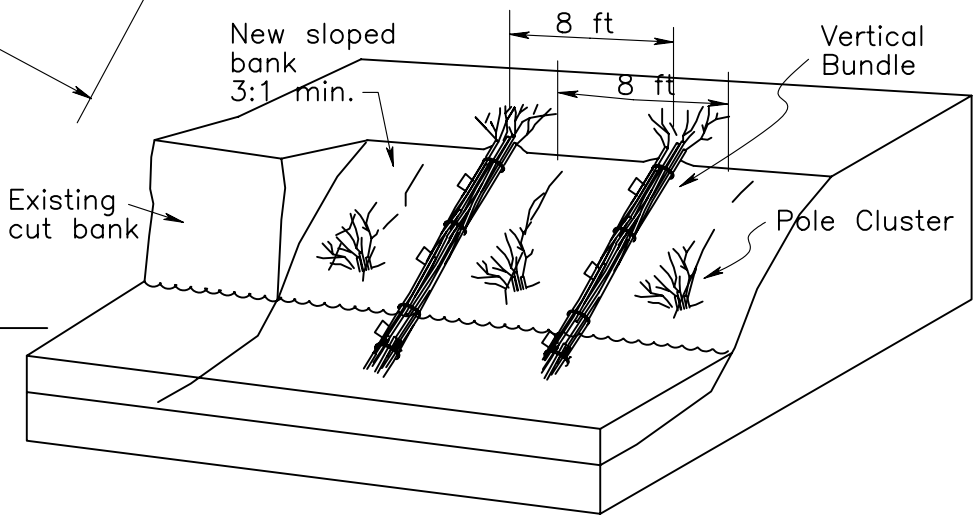
1. Cuttings shall be dormant, stripped of side branches, and soaked 3 to 7 days.
2. Cuttings shall be 3/4 to 2 inches in diameter and typically 3 stems per bundle or cluster.
3. Bundles shall be tied with untreated twine about every 2 feet.
4. Excavate a vertical trench with a slope of 2:1 or more in the streambank.
5. Make sure the bottom of the trench will still be under water during low flows.
6. The trenches should be excavated on 4 foot centers alternating with willow clusters to ensure adequate protection and to encourage rapid growth to fill in the bank.
7. Place bundle in the trench with the cut ends in the water.
8. Secure bundles to back of trench with wooden stakes at about 3 foot spacings.
9. "Muddy" in bundles with water and soil (covering the bundles 1 to 2 inches deep)
10. Leave approximately 30 percent of upper branches exposed.
11. Tops of cuttings are cut off after placement.

(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Vertical Willow Bundles		DATE April 2011
			REVISION DATE
			BMP NO. 4

VERTICAL WILLOW BUNDLES



CROSS SECTION
(Not to Scale)



ISOMETRIC VIEW
(Not to Scale)

VERTICAL BUNDLES

Dormant native poles placed in shallow trenches at 8 ft spacings with clusters in between.

Species _____

Dia _____ in.

Length _____ ft.

VERTICAL BUNDLE NOTES

1. Cuttings shall be dormant, stripped of side branches, and soaked 3 to 7 days.
2. Cuttings shall be 3/4 to 2 inches in diameter and typically 3 stems per bundle or cluster.
3. Bundles shall be tied with untreated twine about every 2 feet.
4. Excavate a vertical trench with a slope of 2:1 or more in the streambank.
5. Make sure the bottom of the trench will still be under water during low flows.
6. The trenches should be excavated on 4 foot centers alternating with willow clusters to ensure adequate protection and to encourage rapid growth to fill in the bank.
7. Place bundle in the trench with the cut ends in the water.
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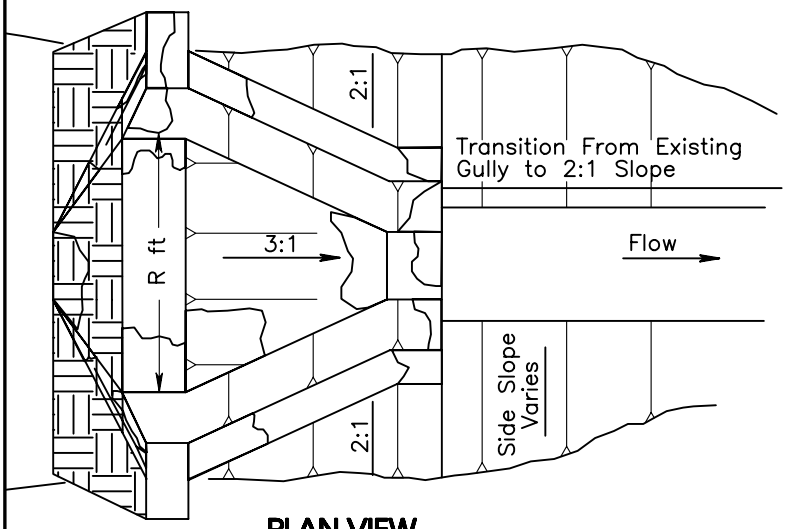
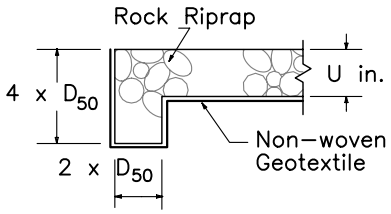
9. "Muddy" in bundles with water and soil (covering the bundles 1 to 2 inches deep)
10. Leave approximately 30 percent of upper branches exposed.
11. Tops of cuttings are cut off after placement.

(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Vertical Willow Bundles		DATE April 2011
			REVISION DATE
			BMP NO. 4

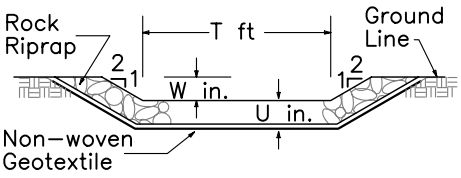
ROCK and BRUSH GRADE CONTROL STRUCTURE



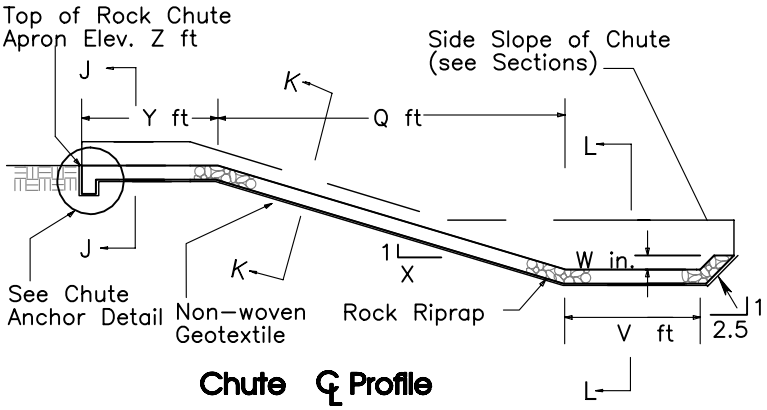
PLAN VIEW



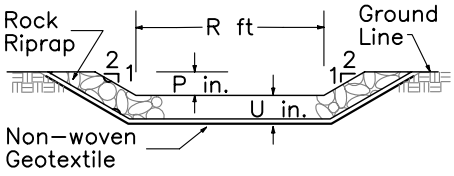
Chute Anchor Detail



Typical Section L-L



Chute $\mathcal{C}_L$ Profile



Typical Section J-J & K-K

Dimensions

Z _____ ft
Y _____ ft
X _____
W _____ in.
V _____ ft
U _____ in.
T _____ ft
R _____ ft
Q _____ ft
P _____ in.
D_{50} _____ in.

NOTES

1. Site Preparation: the surface between the channel and the structure shall be prepared by excavating vertical or overhanging banks, sloping and shaping to provide a uniform surface.
2. Geotextile shall be non–woven fabric with a minimum grab tensile strength of 90 lb, greater than 50% elongation at failure, a minimum of 40 lb puncture strength, and UV resistance of 70% strength retained. Geotextile shall be joined by overlapping a minimum of 18 inches and secured against the underlying foundation material.
3. Structure to be built of either rock or alternate layers of rock and brush (first layer shall be brush) or atop geotextile.
4. Rock and/or brush shall not be dropped more than 3 ft onto geotextile to prevent puncture of material.
5. The brush shall be from fresh cut, live conifers juniper is preferred). The maximum diameter of the stem shall be 1–1/2 in., placed on top of geotextile, not exceeding 4 inch compressed thickness, and completely covering the structure base. The butt ends shall be placed upstream, the brush will be repositioned within the keyways as needed to minimize voids.
6. Rock shall be blocky or angular in shape, durable, and well–graded according to the Rock Gradation table. If rounded stones must be used, increase the size by 40%.
7. Rock shall be selected and hand–placed in horizontal layers, beginning at the bottom, to form a dense, interlocking mass.
8. The minimum depth of keyway shall be 2 feet into the channel bank and 1 foot into the channel bottom.
9. All structures shall be finished in a workmanlike manner.

(Not to Scale)
Adapted From NRCS Drawings

Coyote Creek Best Management Practices

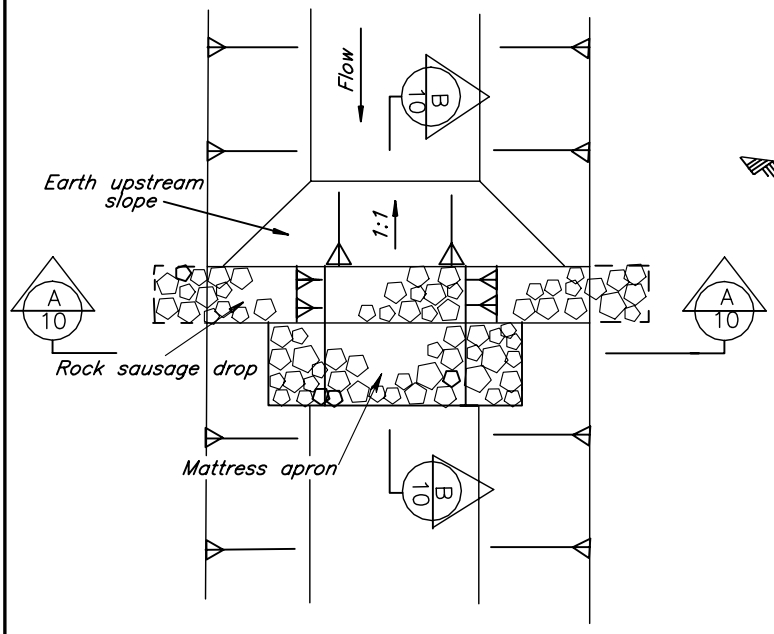
Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

DETAIL:
Rock and Brush Structure

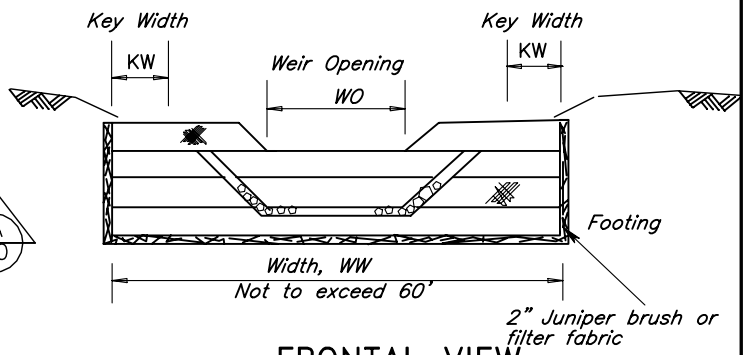
Preliminary
Not For
Construction

DESIGN BY: S.Yard
DATE April 2011
REVISION DATE
BMP NO. 6

ROCK WIRE SAUSAGE GRADE CONTROL STRUCTURE

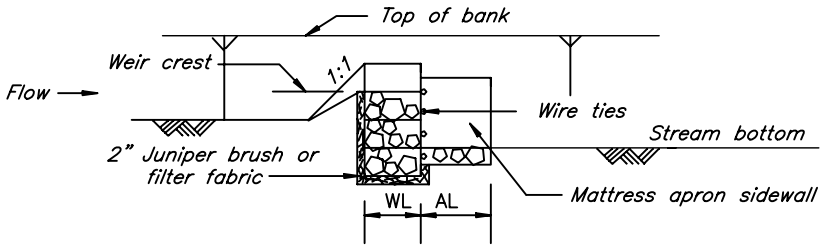


PLAN VIEW



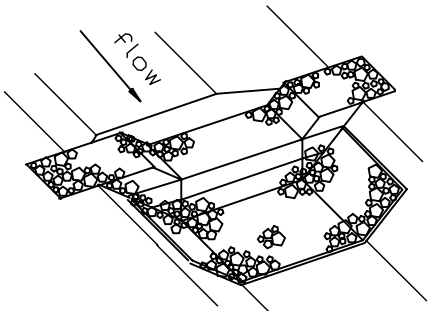
FRONTAL VIEW

Section A 10



SIDE VIEW

SECTION B 10



ISOMETRIC VIEW

DIMENSIONS

KW _____ ft

WO _____ ft

WW _____ ft

WL _____ ft

AL _____ ft

NOTES

1. Spillway width (w) to be based on Q for 10 year 24 hour storm.
2. Wire mesh shall be welded 2 in. by 4 in. and 14 gauge minimum with a width not less than 72 in.
3. Rock shall be sound and no smaller than 2 in. in size.
4. Tie wire shall be galvanized 14 gauge minimum.
5. Seams shall be overlapped 4 in. minimum and be tied by tie wire at 6 in. maximum width. Seams shall be placed upstream.
6. Rock wire sausages shall be connected together at all edges and down the centerline of the rock sausage drop at 1 ft by 1 ft spacing maximum.
7. Mattress apron shall be seamed and doubled wire tied at 6 in. widths to the sausage drop structure.
8. A single sausage drop structure can be used up to 1 ft drop max. Multiple sausage drops can be used up to 2 ft drop max.

(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Rock Wire Sausage Structure		DATE April 2011
			REVISION DATE
			BMP NO. 7

MODIFIED HEEDE GRADE CONTROL STRUCTURE

DIMENSIONS

___ CW = Channel Width

___ L_U = Length Upstream

___ L_D = Length Downstream

___ L_A = Length Apron

___ L_F = Length Fence

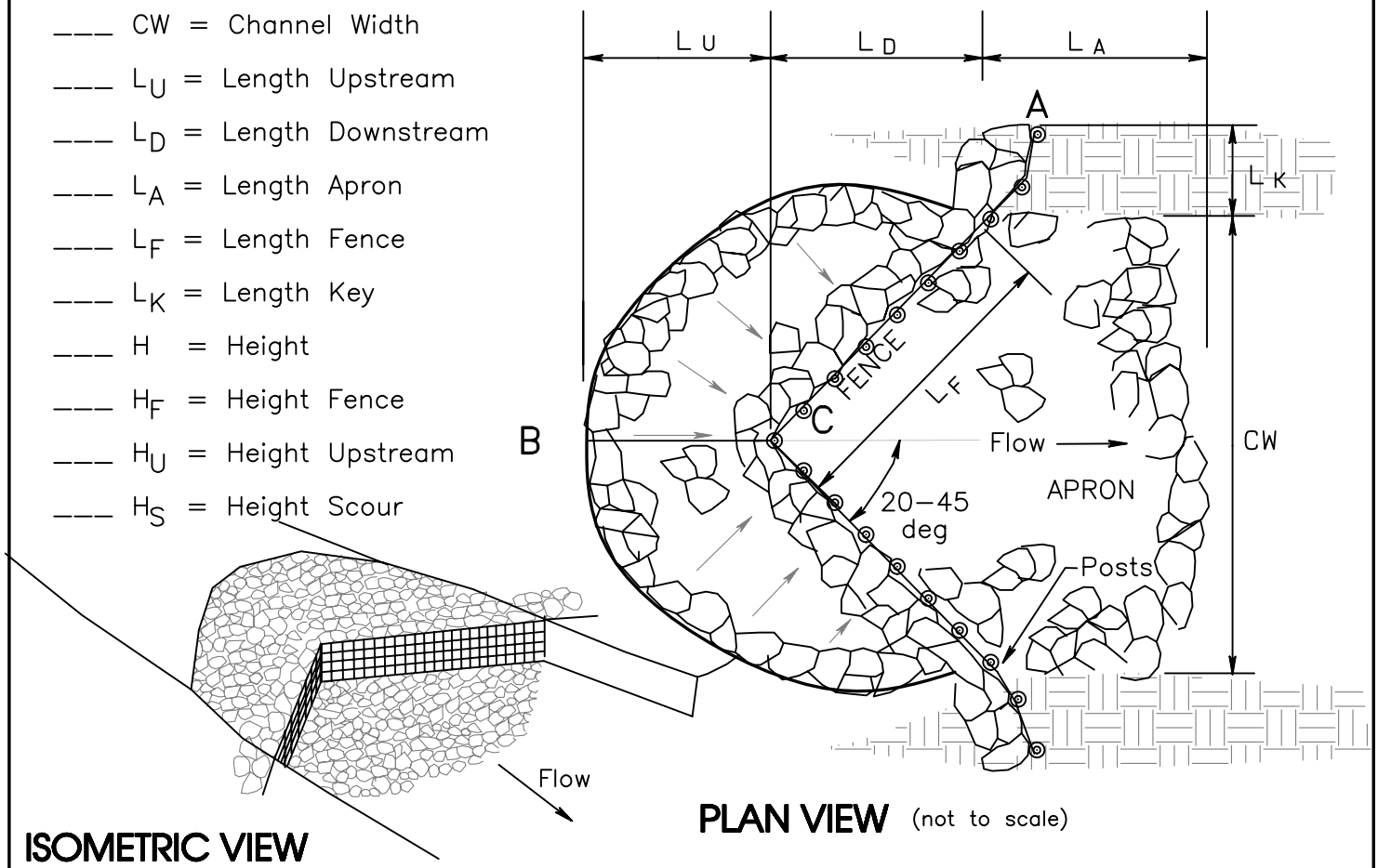
___ L_K = Length Key

___ H = Height

___ H_F = Height Fence

___ H_U = Height Upstream

___ H_S = Height Scour



ISOMETRIC VIEW

(not to scale)

PLAN VIEW (not to scale)

MIN. ROCK THICKNESS

A = D_{50} = __ in.

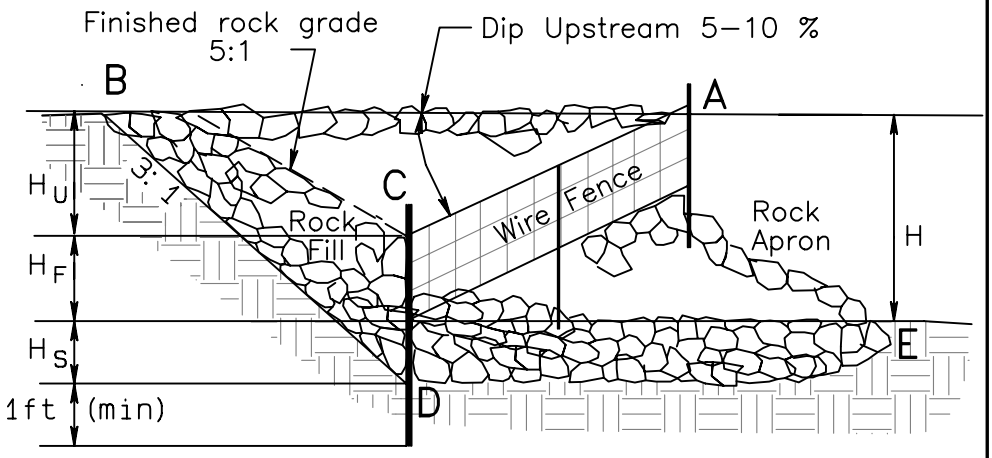
C–D = $4D_{50}$ = __ in.

E = $2D_{50}$ = __ in.

ROCK GRADATION *1

	Angular Rock (inches)	Rounded Rock (inches)
D_{max}	_____	_____
D_{50}	_____	_____
D_{min}	_____	_____

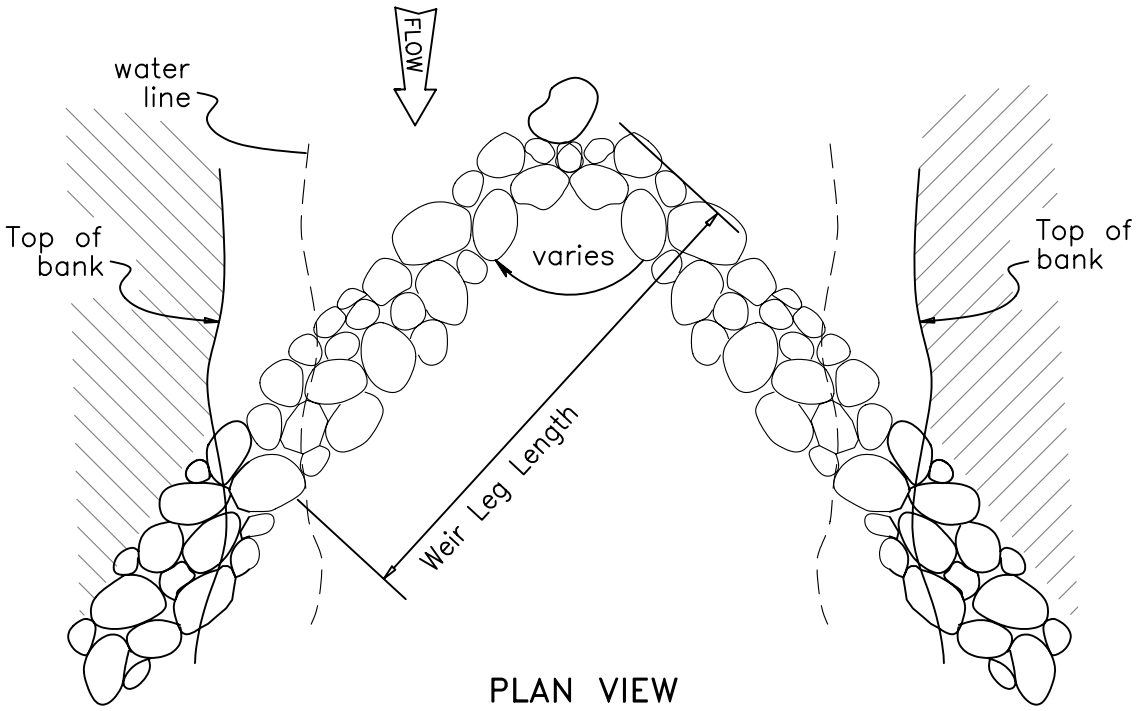
*1 Design Storm, Q10 = ___ cfs



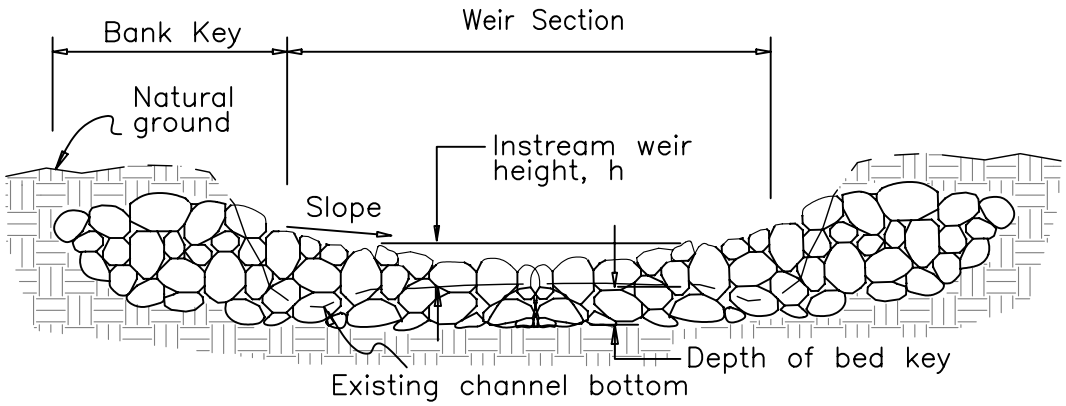
PROFILE VIEW (not to scale)

(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Modified Heede Structure		DATE April 2011 REVISION DATE BMP NO. 8

V ROCK WEIR GRADE CONTROL STRUCTURE



PLAN VIEW
(Not to scale)



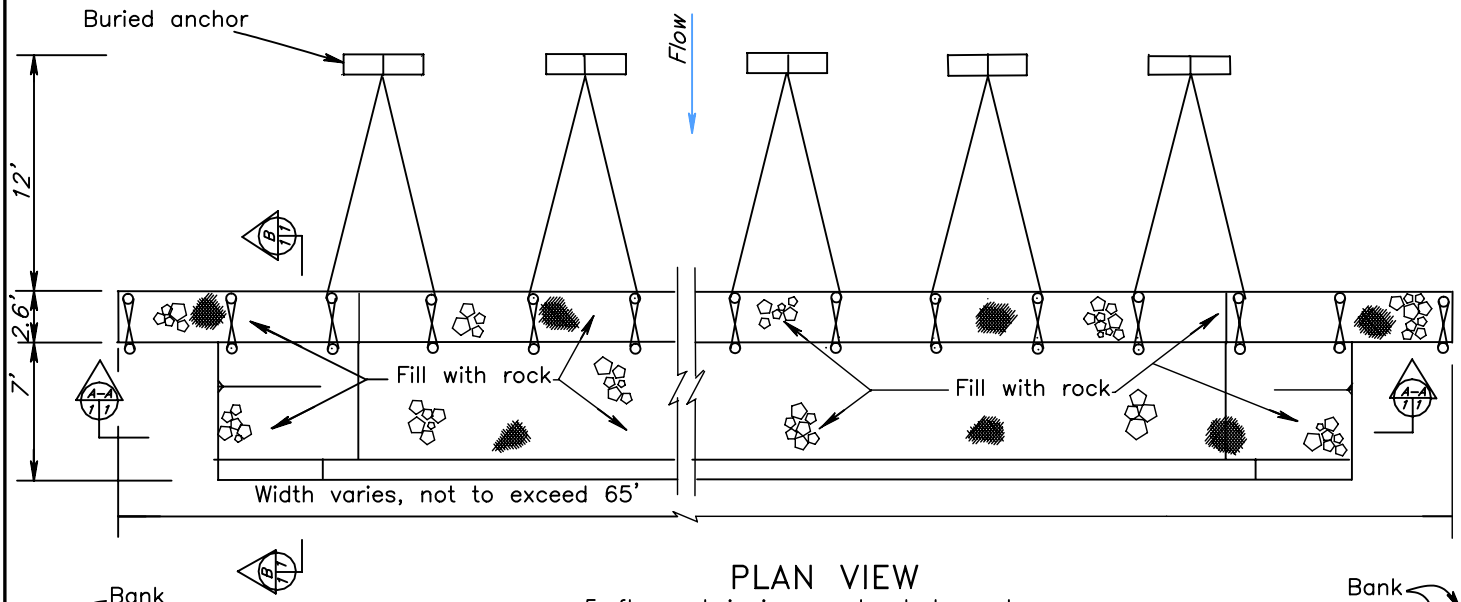
SIDE VIEW
(Not to scale)

GENERAL NOTES

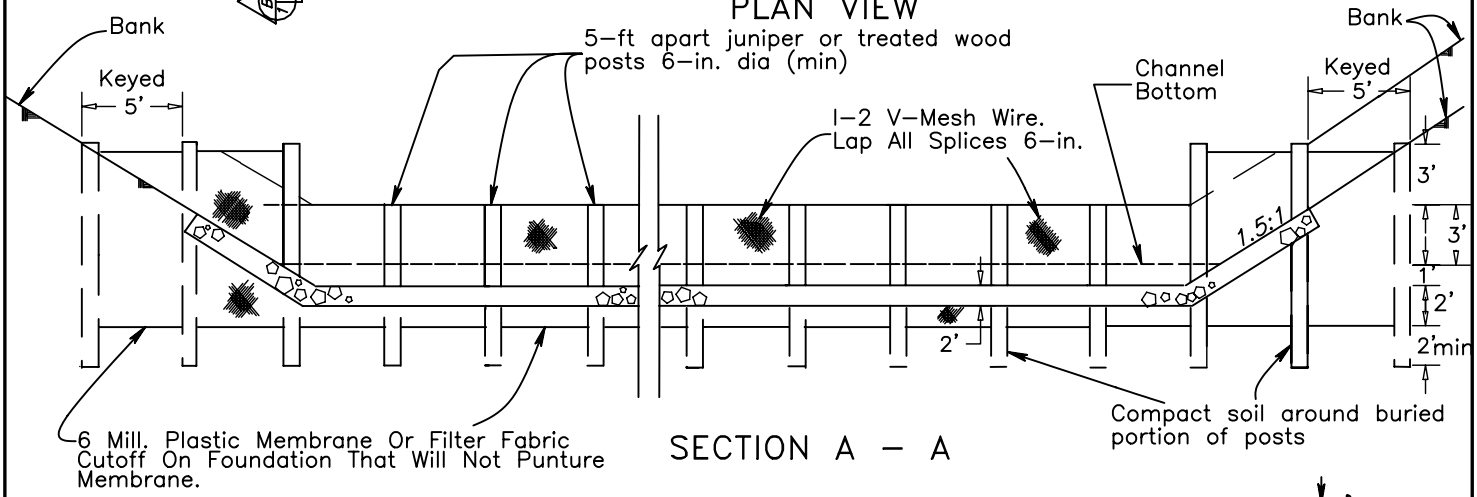
1. Feature provides backwater to increase localized water table for hydric vegetation recovery on floodplain.
2. Weir crest invert set at ordinary high water elevation.
3. Constructed of rock & gravels, providing both fish passage and habitat.
4. This standard drawing requires supporting technical documentation prior to use and must be adapted to the specific site.

(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: V Weir Structure		DATE April 2011 REVISION DATE BMP NO. 9

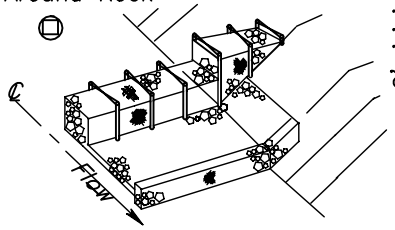
ROCK WIRE CRIB GRADE CONTROL STRUCTURE



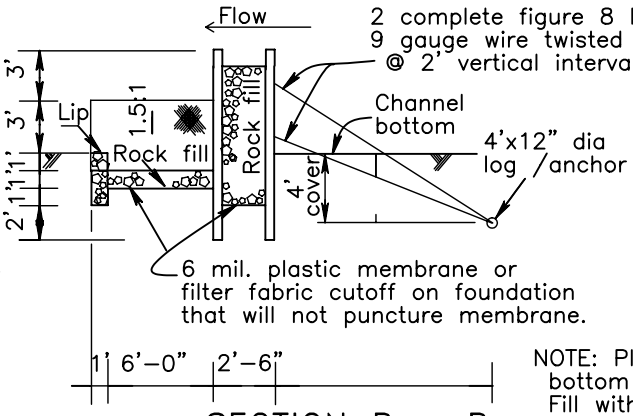
PLAN VIEW



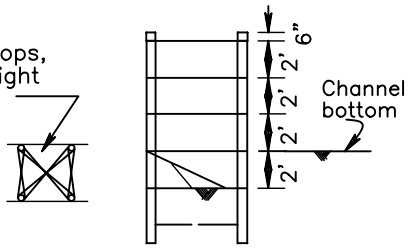
SECTION A – A



ISOMETRIC HALF SECTION



SECTION B – B



PLAN ELEVATION

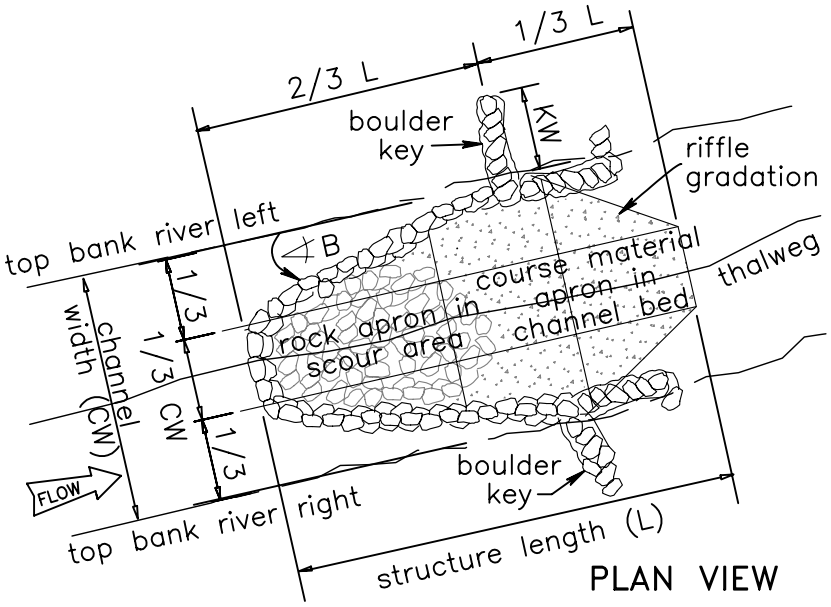
BRACE DETAIL

NOTE: Place woven wire so that top and bottom wrap under and behind brace wire Fill with rock in layers before attaching brace wire

(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Rock Wire Crib		DATE April 2011
			REVISION DATE
			BMP NO. 10

CROSS-VANE WEIR GRADE CONTROL STRUCTURE

Channel pool conversion, grade control, floodplain backwatering and fish habitat enhancement.



PLAN VIEW (Not to scale)

DIMENSIONS

CW = _____ (ft) H = _____ (ft)

W = _____ (ft) HA = _____ (ft)

KW = _____ (ft) HW = _____ (ft)

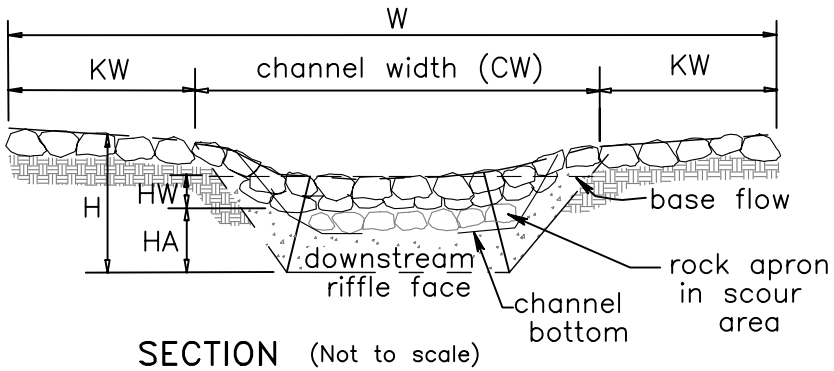
L = _____ (ft) ∠B = _____ (deg)

∠H = _____ (deg)

BOULDERS

Dia = _____ min(in) _____ max(in)

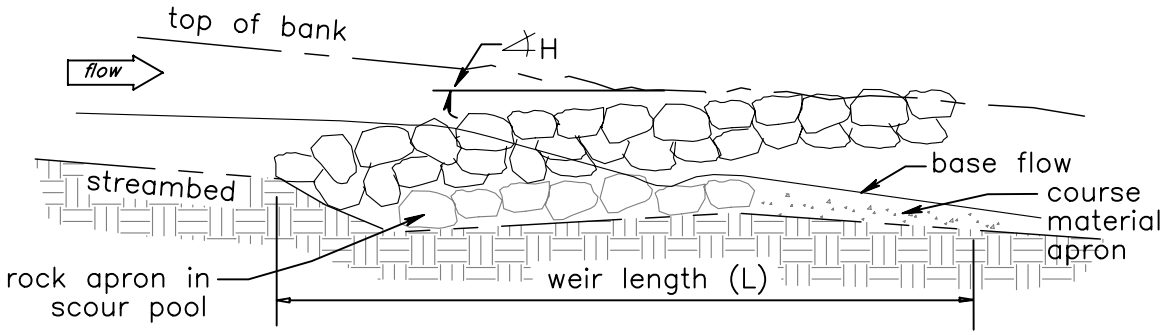
# of rocks per structure _____



SECTION (Not to scale)

GENERAL NOTES

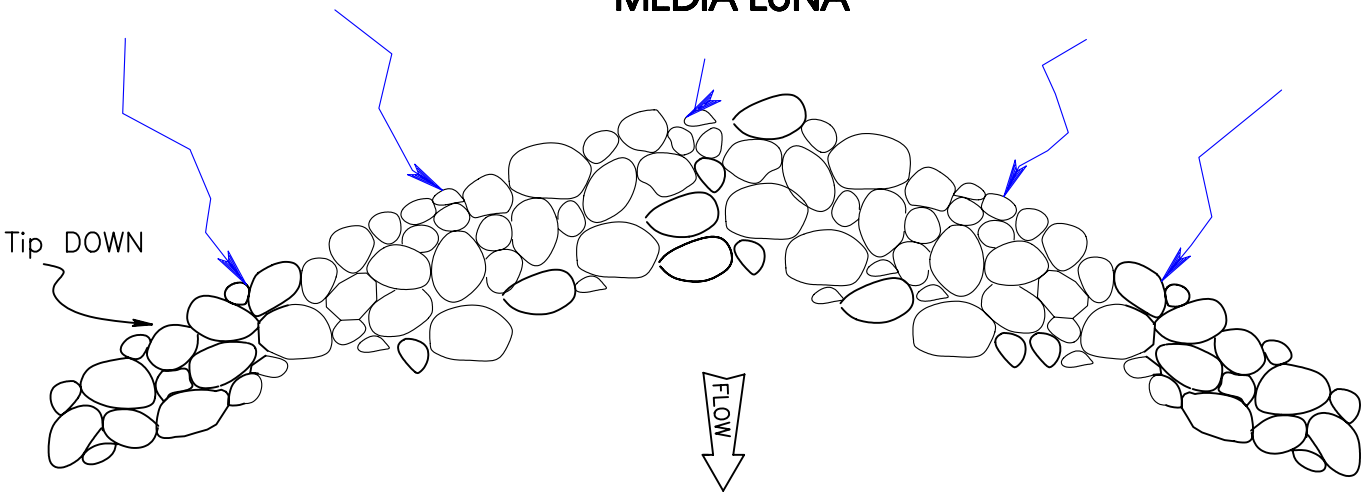
1. Feature provides backwater to increase localized water table for hydric vegetation recovery on floodplain.
2. Weir crest invert set at ordinary high water elevation.
3. Constructed of rock & gravels, providing both fish passage and habitat.
4. This standard drawing requires supporting technical documentation prior to use and must be adapted to the specific site.



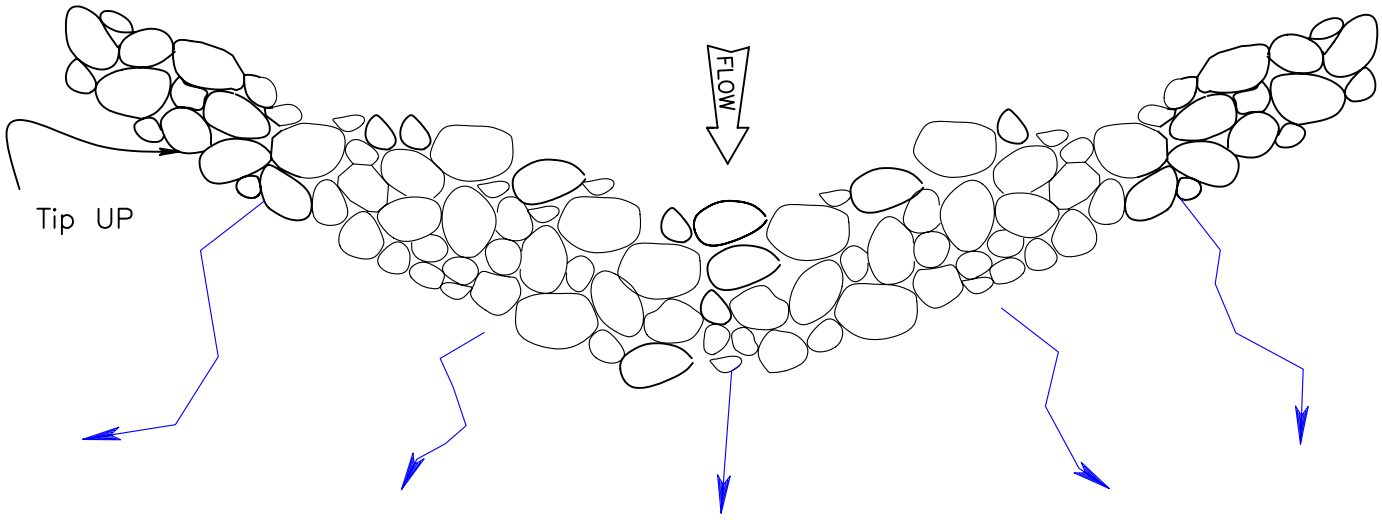
PROFILE VIEW (Not to scale)

(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Cross-Vane Weir		DATE April 2011
			REVISION DATE
			BMP NO. 11

MEDIA LUNA



SHEET FLOW COLLECTOR PLAN VIEW



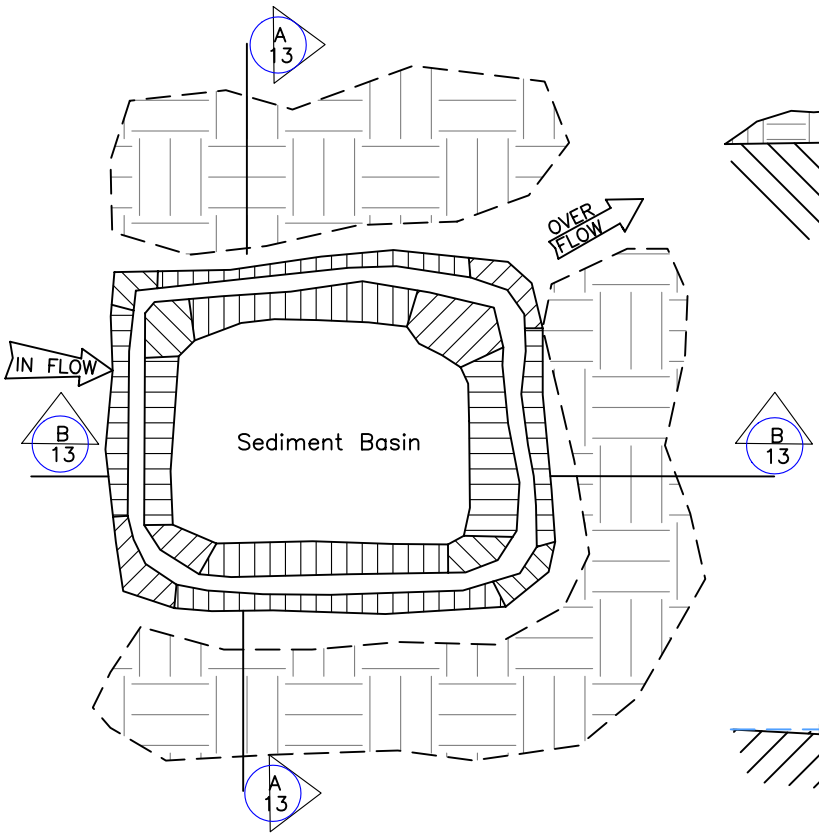
SHEET FLOW SPREADER PLAN VIEW

GENERAL NOTES

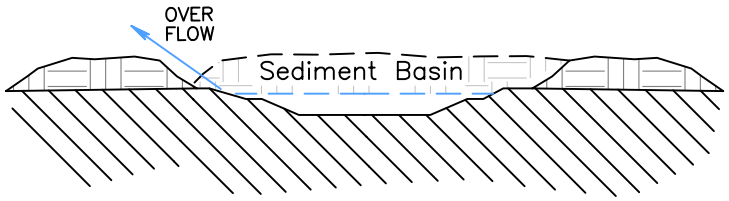
1. Identify which type of Media Luna (ie 'tips UP' or 'tips DOWN') is appropriate for the treatment site.
2. If the treatment site is at the collection point of a network of rills or small gullies, then use a Sheet Flow Collector (tips DOWN). Select two points 6 in. above the bed on each bank of the main channel immediately downslope of where the rills collect. Lay out an arc from bank to bank so that the tips point downslope.
3. If the treatment site is located where runoff from a shallow channel (<1 ft deep) can easily be spread across relatively flat ground, then use a Sheet Flow Spreader (tips UP). Lay out an arc across the flat area with the tips at the same elevation (ie use a leveling tool) and the center slightly lower.
4. Lay out the upslope edge of the structure by tracing an arc parallel to the lower edge to create a band that is at least 4 ft wide. Media Lunas composed of wider bands of cobble mulch offer more protection from erosion, improved infiltration, and increased plant recruitment.
5. Start by digging a shallow trench from tip to tip along the downslope side. Fill the trench with 1 or 2 rows of rock so that no rock protrudes more than 2 in. above ground level. This will serve as the Splash Apron.
6. Scatter native grass and wildflower seed in the area where the Media Luna is to be built.
7. For both types of Media Luna, cover the ground with a single layer of cobble mulch to form a band at least 4 ft wide.

(Not to Scale) Adapted From Dryland Solutions	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
			DATE April 2011
			REVISION DATE
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Media Luna		BMP NO. 12

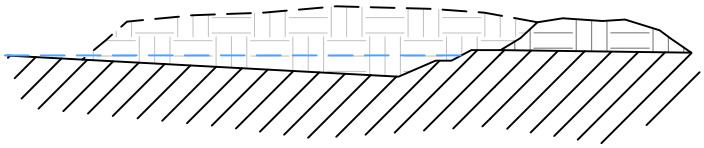
SEDIMENT BASIN



SEDIMENT BASIN PLAN VIEW



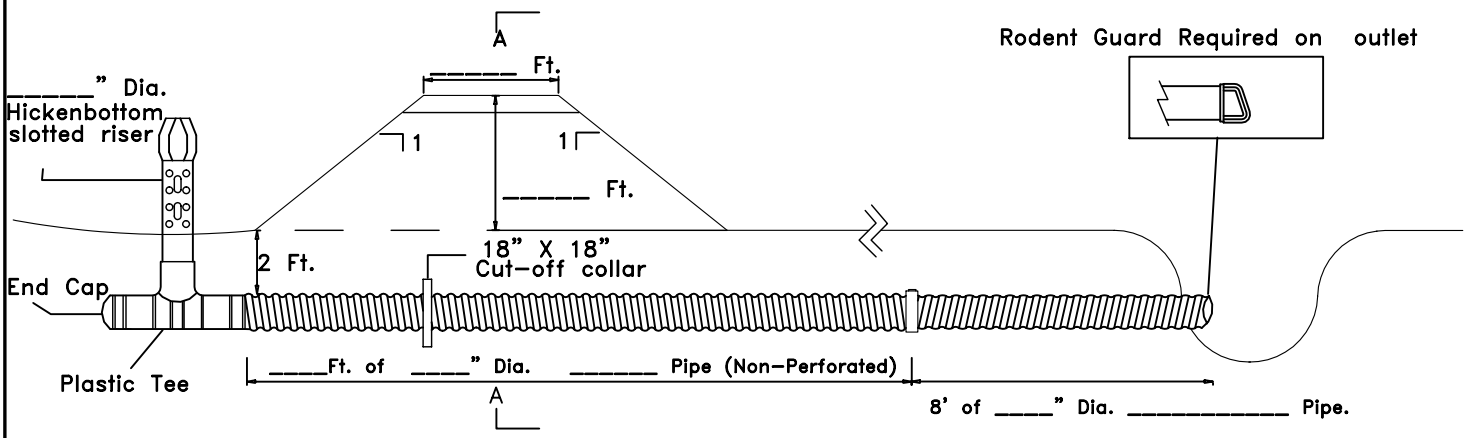
SECTION A 13



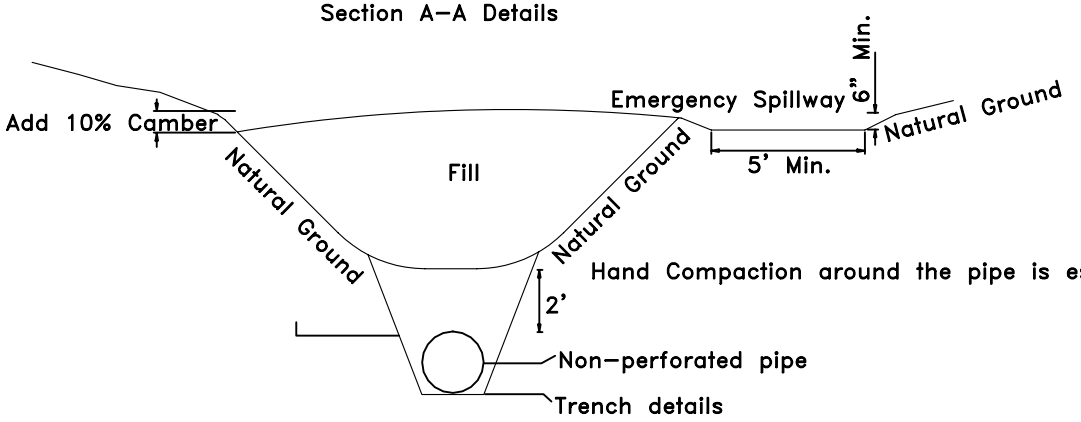
SECTION B 13

(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Sediment Basin		DATE April 2011
			REVISION DATE
			BMP NO. 13

WATER & SEDIMENT CONTROL BASIN (WASCOB)



Section A–A Details

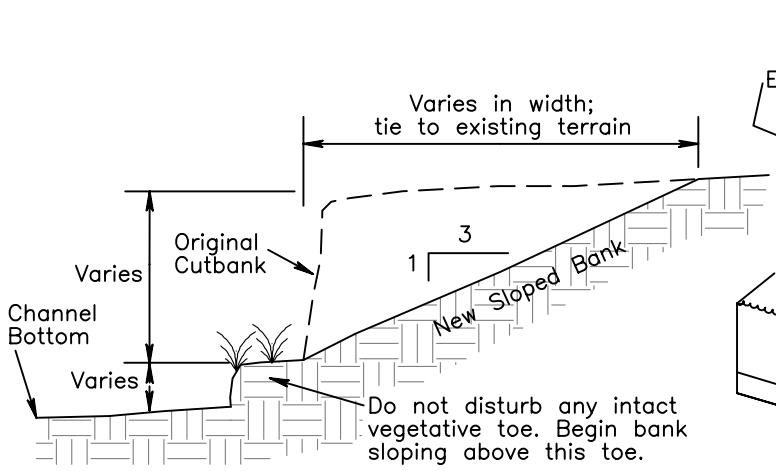


Hand Compaction around the pipe is essential through the fill.

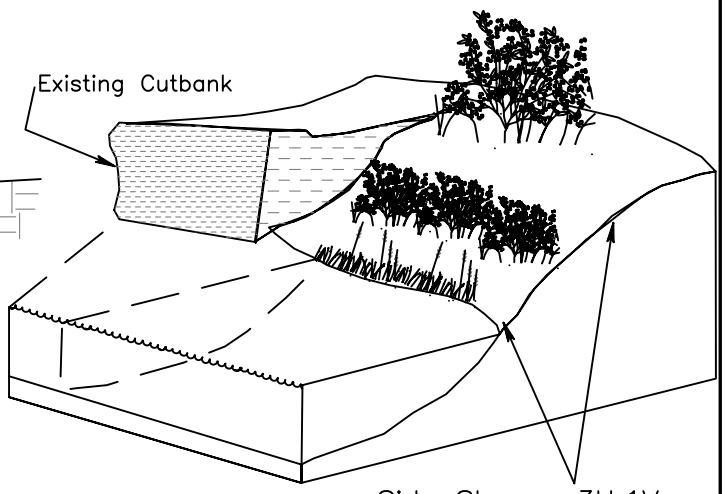
Required Storage Volume: _____ Cu. Ft.

(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: WASCOB		DATE April 2011 REVISION DATE BMP NO. 14

BANK SLOPING - SEEDING - FABRIC OR MULCH

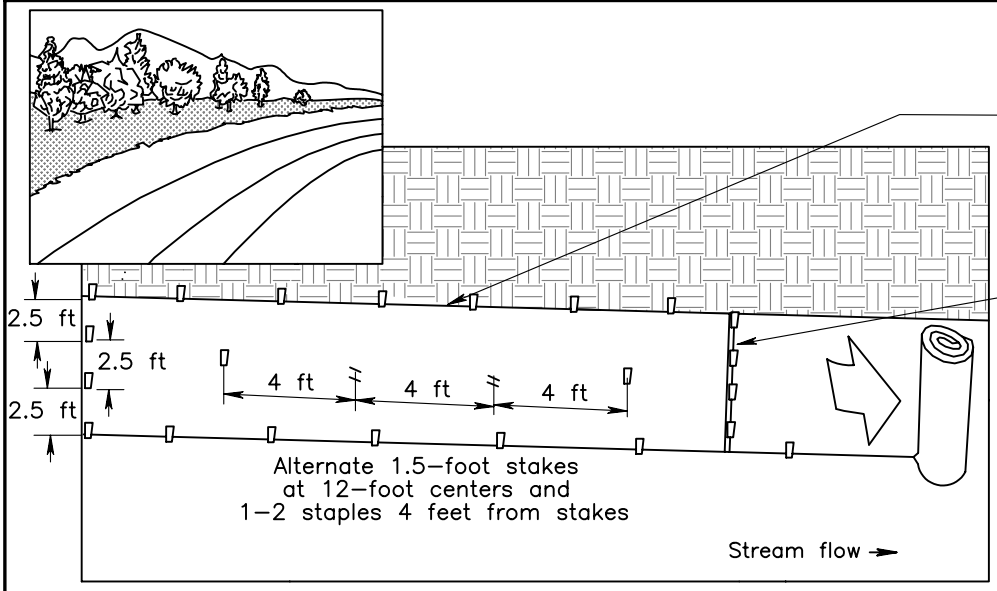


SECTION VIEW OF TOE
(Not to Scale)

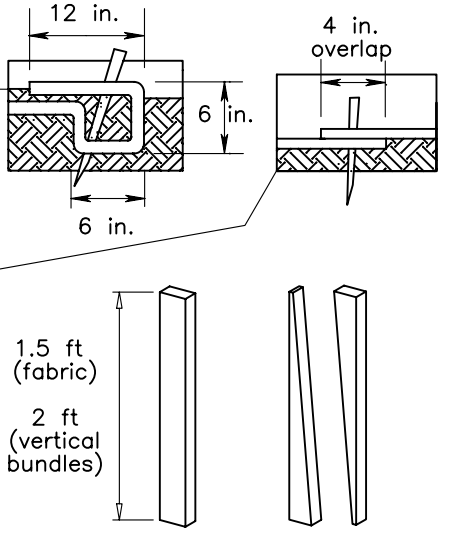


ISOMETRIC VIEW
(Not to Scale)

Side Slopes: 3H:1V
(Optimim slope angle
for vegetative growth:
2H:1V to 10H:1V)



EROSION CONTROL FABRIC: SLOPE INSTALLATION DETAIL
(NOT TO SCALE)



DEAD STOUT STAKES

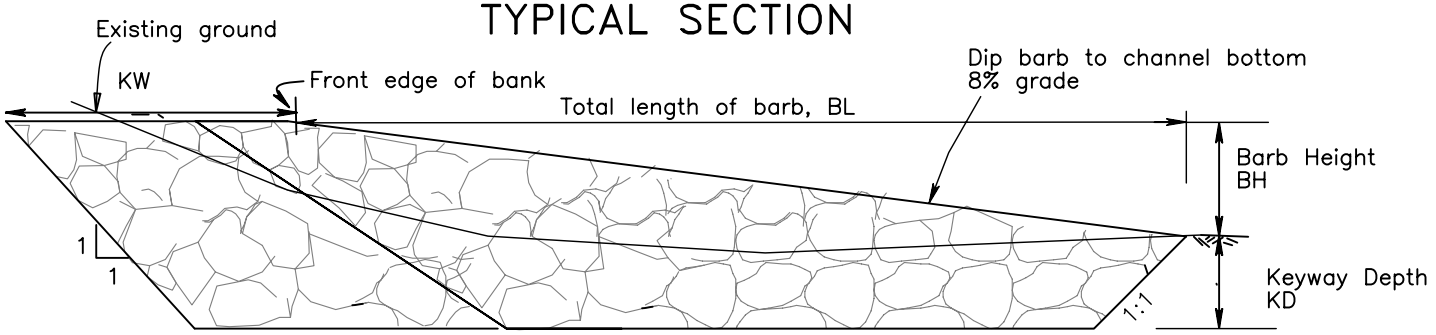
BANK SLOPING NOTES

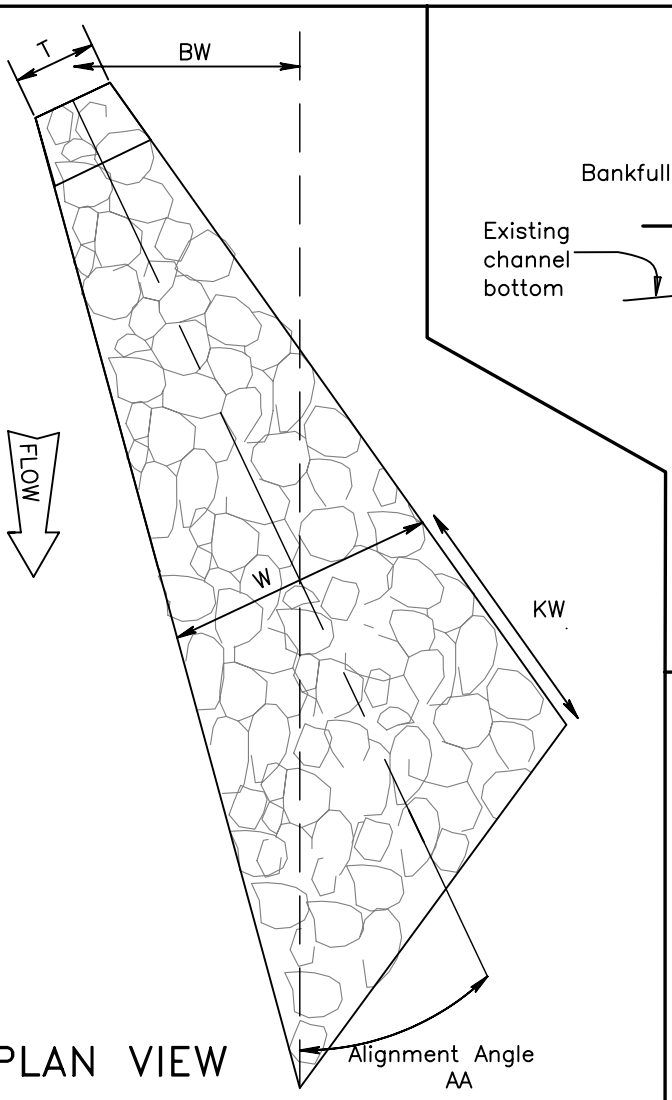
- Slope bank to angle between 2:1 and 10:1 to optimize vegetative growth.
- Do not disturb any intact vegetation at toe of bank.
- Install plantings.
- Install erosion control fabric, opening holes for plantings where neccessary.
- Secure edges and ends with stakes.

(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Bank Sloping - Seeding - Fabric/Mulch		DATE April 2011 REVISION DATE BMP NO. 15

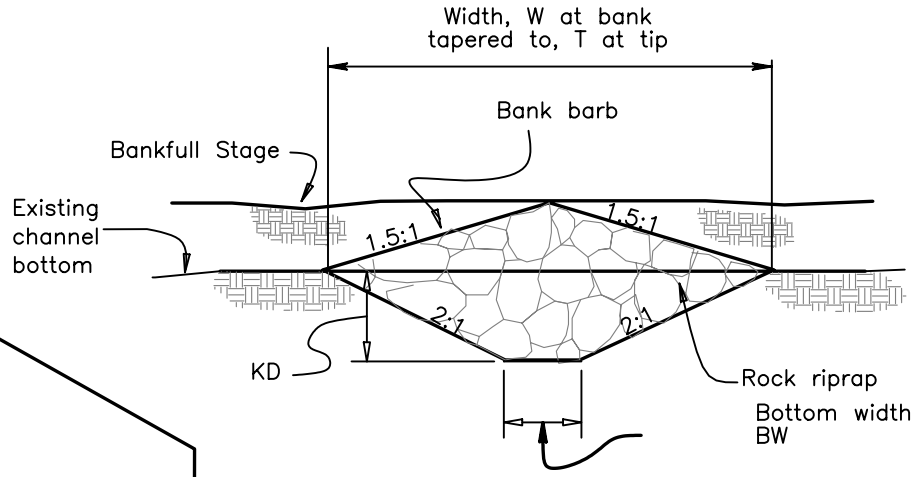
ROCK STREAMBARB

TYPICAL SECTION





PLAN VIEW



CROSS–SECTION
AT BANK
(Not to Scale)

NOTES

1. Use well–graded, angular rock with bulk specific gravity greater than 1.7
2. Rock riprap shall conform to the following gradation:

% Passing Dry Wt. Basis	Size Opening (inches)
100	_____
50	_____
min	_____

DIMENSIONS

KW _____ ft
BL ____ ft
BH _____ ft
KD _____ ft
BL _____ ft
W _____ ft
T _____ ft
AA _____ ft

(Not to Scale)

Coyote Creek Best Management Practices

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

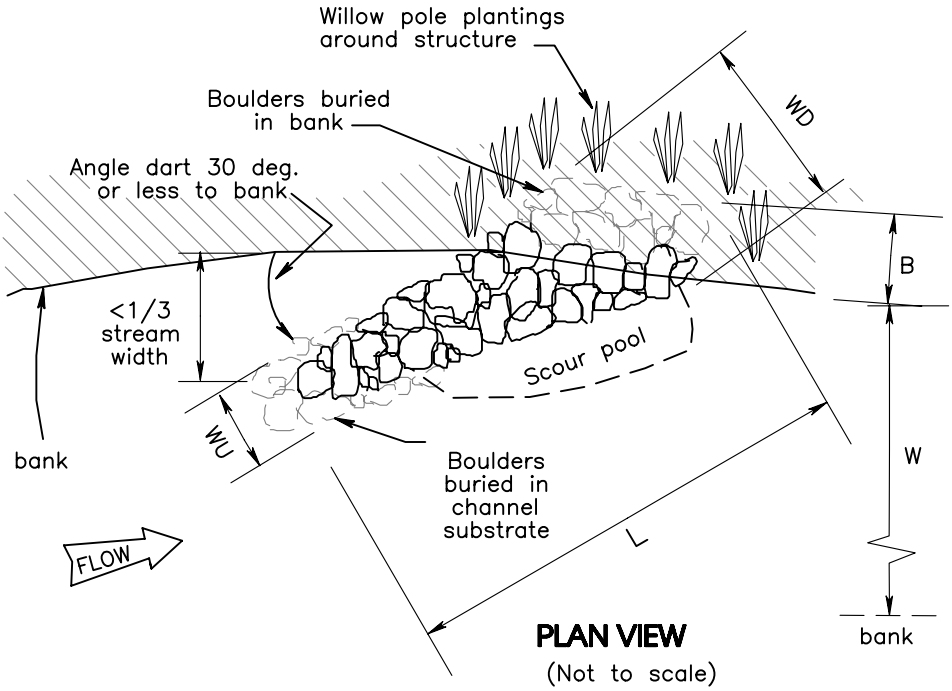
DETAIL: Rock Streambarb

Preliminary Not For Construction

DESIGN BY: S.Yard
DATE April 2011
REVISION DATE
BMP NO. 16

BOULDER DART

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



PLAN VIEW
(Not to scale)

DIMENSIONS

D = _____ (ft)

L = _____ (ft)

B = _____ (ft)

W = _____ (ft)

WU = _____ (ft)

WD = _____ (ft)

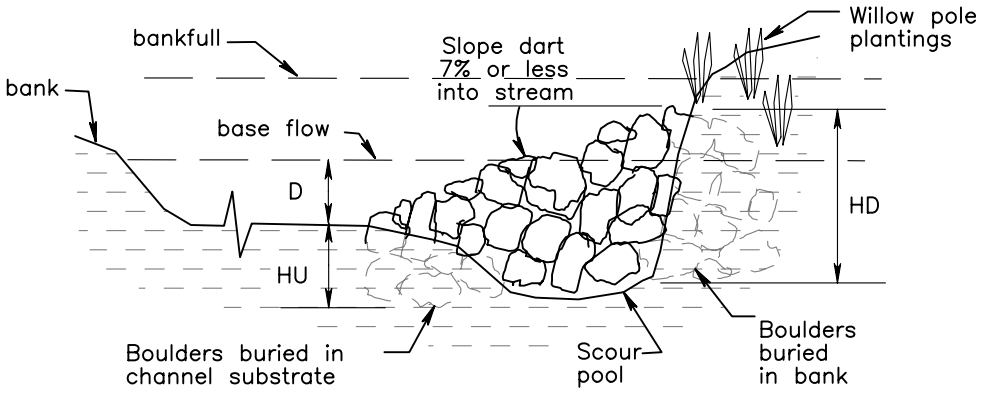
HU = _____ (ft)

HD = _____ (ft)

BOULDERS

Dia = _____min(in) _____max(in)

# of rocks per structure _____



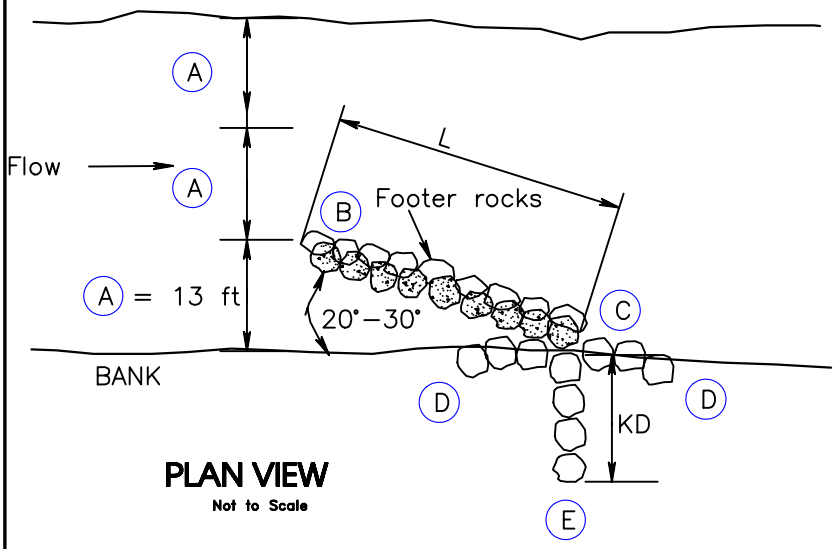
SIDE VIEW
(Not to scale)

GENERAL NOTES

1. Bury boulders at ends in substrate and in bank for tie–in.
2. Angle structure upstream at 30 deg. or less sloping from bankfull height or less at 7 deg.
3. Plant willow pole clusters in bank around structure.
4. Dig out downstream side to initiate scour pool developement.
5. This standard drawing requires supporting technical documentation prior to use and must be adapted to the specific site.

(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Boulder Dart		DATE April 2011
			REVISION DATE
			BMP NO. 17

ROCK VANE

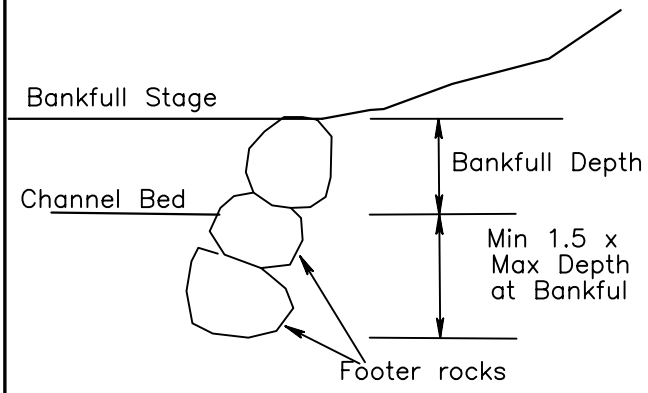


PLAN VIEW
Not to Scale

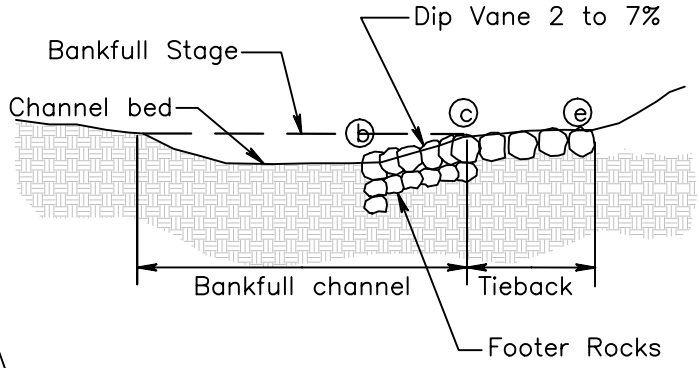
(A) 1/3 Bankfull Channel Width (max)
(B) Top Rock at Bed Elev
(C) Top Rock at Bankfull Elev
(D) Optional Toe Rock – Length Varies
(E) Tieback at Floodplain Elev

VANE DIMENSIONS
Bankfull Channel Width = _____ ft
Bankfull Depth = _____ ft
Floodplain Elevation = _____ ft
A _____ ft
B _____ ft
C _____ ft
D _____ ft
E _____ ft
L _____ft
KD _____ft

TOE ROCK
at Rock Vane or Cross-Vane Weir



CROSS-SECTION
Not to Scale



CROSS-SECTION
Not to Scale

SPECIFICATIONS FOR ROCK VANE & TOE ROCK

Rock Vane: min. dia. _____ ft
Footer Rocks: min. dia. _____ ft

Angular rock with specific gravity > 1.7

NOTE: Toe rock shall be tied a minimum of one rock diameter into bank at upstream and downstream ends.

(Not to Scale)

Coyote Creek Best Management Practices

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

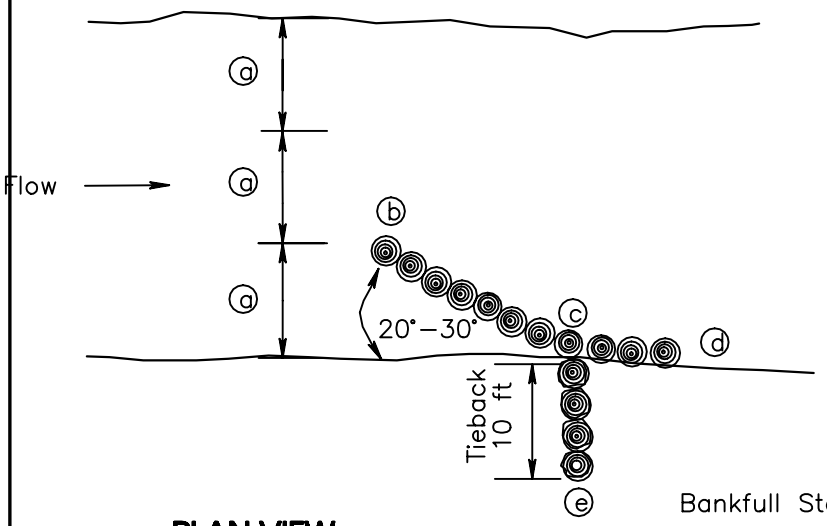
DETAIL: Rock Vane

Preliminary Not For Construction

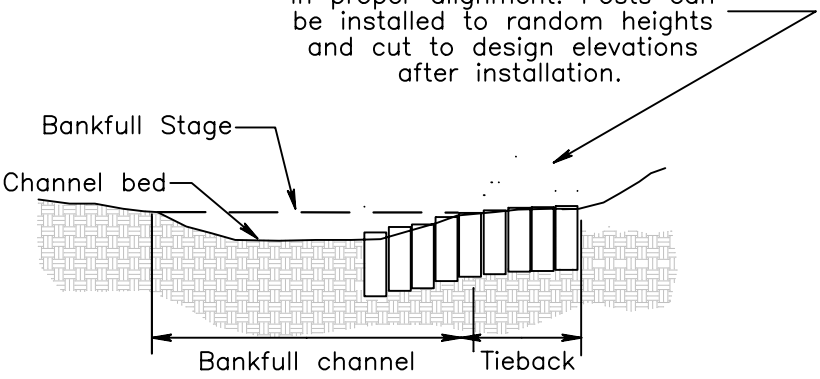
DESIGN BY: S.Yard
DATE April 2011
REVISION DATE
BMP NO. 18

POST VANE

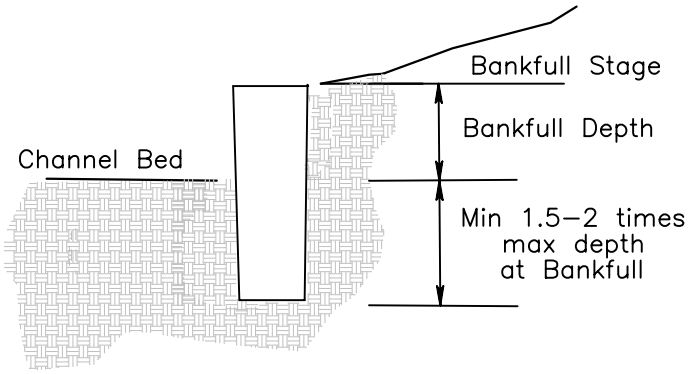
ⓐ 1/3 Bankfull Channel Width (max)
ⓑ Top Post at Channel Bed Elev
ⓒ Top Post at Bankfull Elev
ⓓ Optional Toe Posts or Toe Rock
ⓔ Tieback at Floodplain Elev



PLAN VIEW
Not to Scale



CROSS-SECTION
Not to Scale



TOE POST CROSS-SECTION
Not to Scale

SPECIFICATIONS FOR POST VANE

Minimum diameter 6–inch post set in trench

Post Material is Locally Available Tree Species
Prefereably a Decay Resistant Species

Minimum Diameter 6 inches
(Depending on Size of Stream)
Posts extend below Stream Bed 2X Max Depth at bankfull

Posts installed upside down to prevent resprouting if using invasive, non–native species

(Not to Scale)
Adapted From Zeedyk

Coyote Creek Best Management Practices

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

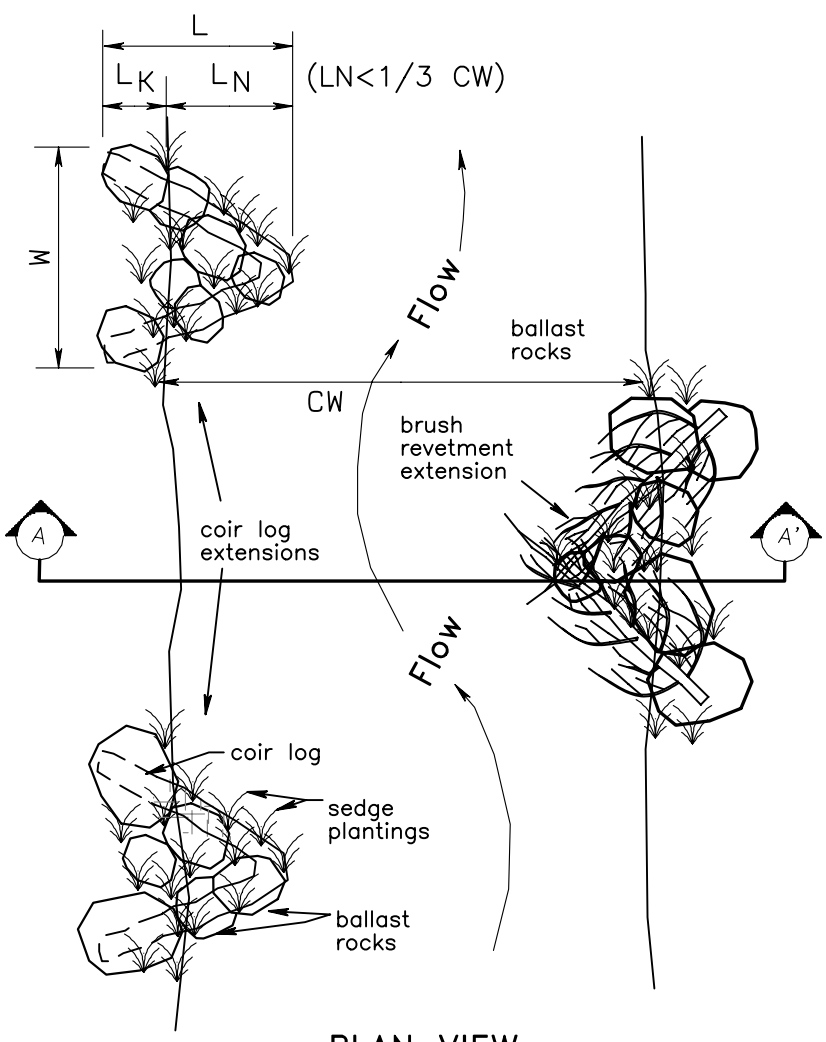
DETAIL: Post Vane

Preliminary Not For Construction

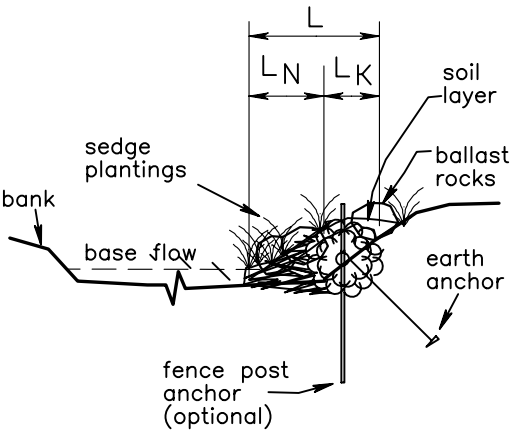
DESIGN BY: S.Yard
DATE April 2011
REVISION DATE
BMP NO. 19

VEGETATED TOE EXTENSION

Provides low water depth and cover



PLAN VIEW
(Not to scale)



SECTION A–A' VIEW
Brush Revetment Extension
(Not to scale)

NOTE: Same layering applys for coir log extension: Anchored coir log, ballast rock, soil, sedge plantings

DIMENSIONS

CW _____ (ft) L _____ (ft)

W _____ (ft) (<1/3 CW) L_N _____ (ft)

L_K _____ (ft)

BOULDERS

Dia = _____min(in) _____max(in)

# of rocks per structure _____

COIR LOGS

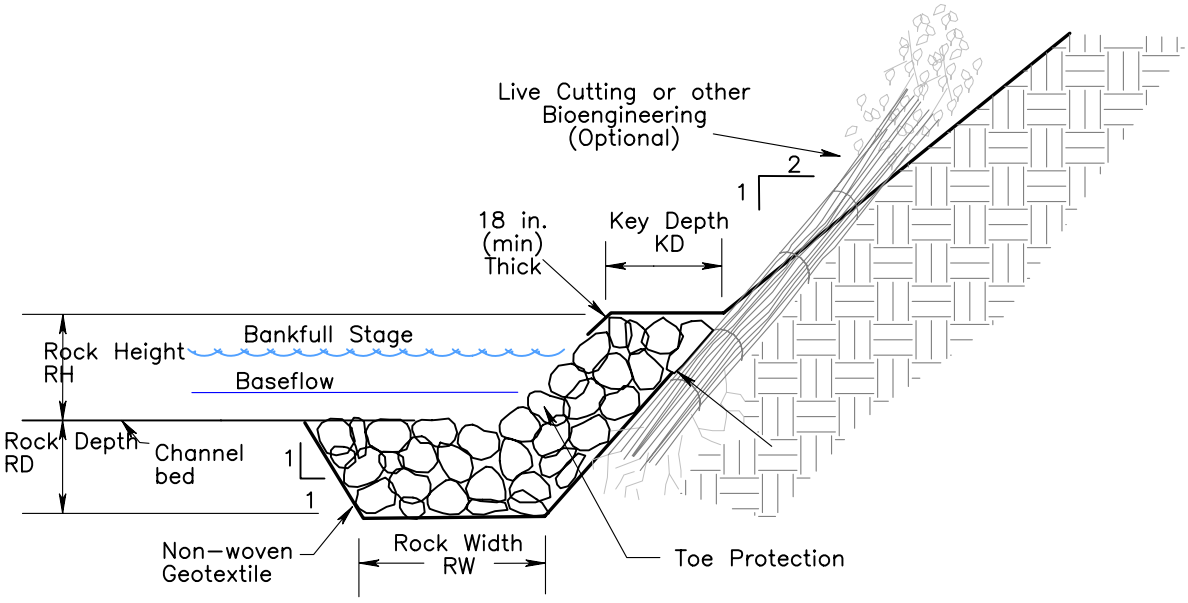
Diameter _____(in) Length _____ (ft)

GENERAL NOTES

- Used to constrict low water flow which would ordinarily spread over bar in a thinner sheet, unusable by adult fish.
- Captures fine sediments and builds out toe of bank.
- Install in alternating pattern in low slope riffles or runs which are wide and shallow.
- Install brush revetment or coir log, anchored with buried boulders.
- May require additonal earth anchor or fence posts to secure brush or coir log.
- Plant with sedges and/or deer grass.
- May need to add some starter material to plant in, or let revetment catch sediment, then plant during next season.
- This standard drawing requires supporting technical documentation prior to use and must be adapted to the specific site.

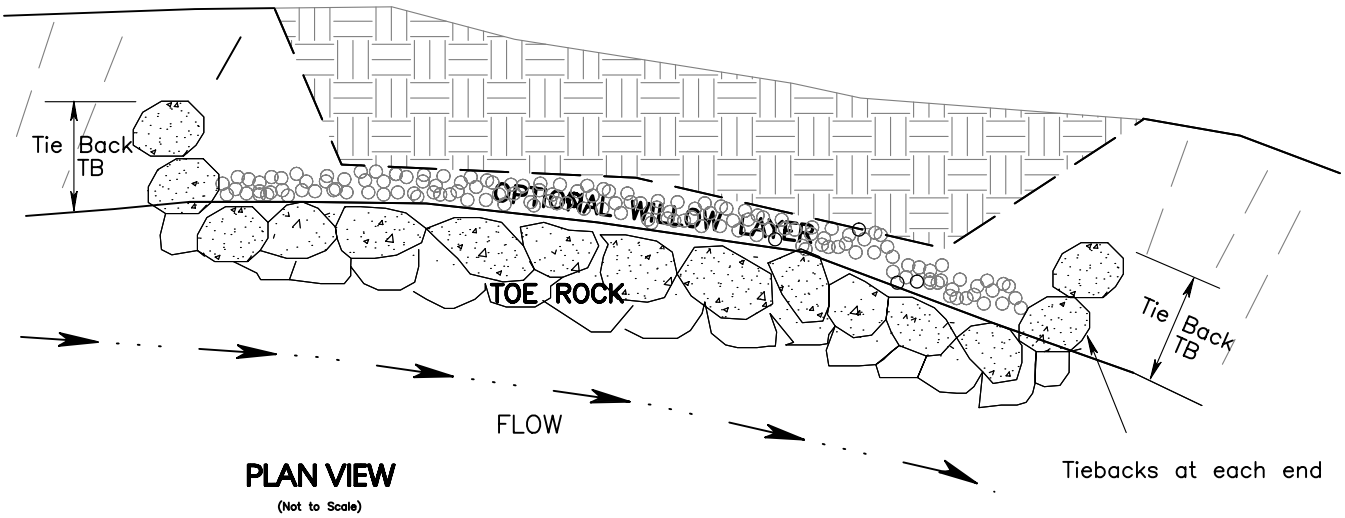
(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Vegetated Toe Extension		DATE April 2011 REVISION DATE BMP NO. 20

TOE ROCK WITH OPTIONAL BRUSH TRENCH



TYPICAL TOE ROCK SECTION

(Not to Scale)



PLAN VIEW

(Not to Scale)

Note:
Rooted/leafed condition of the living plant material is not representative of the time of installation. See SHEET 8 for willow bundle installation detail.

DIMENSIONS

RH _____ ft

RD ____ ft

RW _____ ft

KD _____ ft

TB _____ ft

ROCK SPECIFICATIONS

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

Rock Riprap Rocks: Dmin = 3 in.
D50 = 9 in.
Dmax =15 in.

(Not to Scale)

Coyote Creek Best Management Practices

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

DETAIL: Toe Rock with Willow Trench (optional)

Preliminary Not For Construction

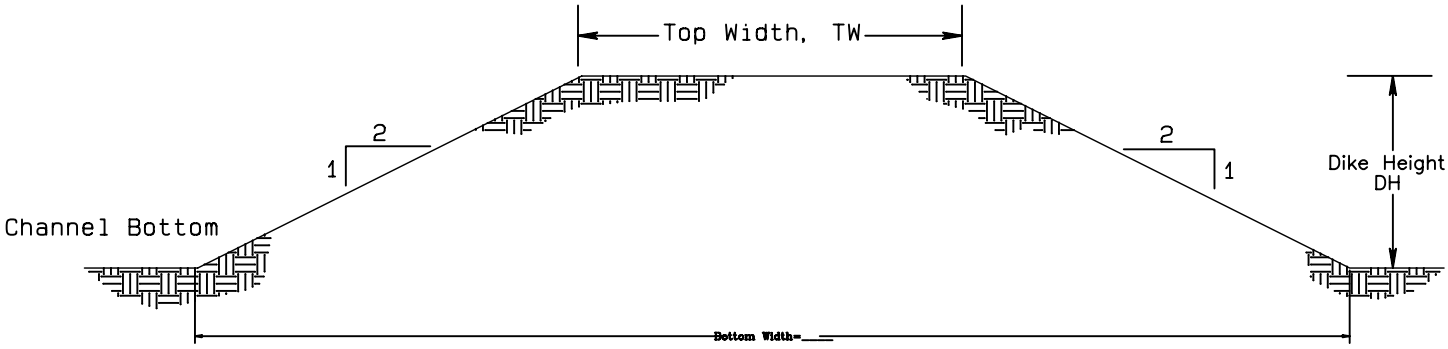
DESIGN BY: S.Yard

DATE April 2011

REVISION DATE

BMP NO. 21

DIKE

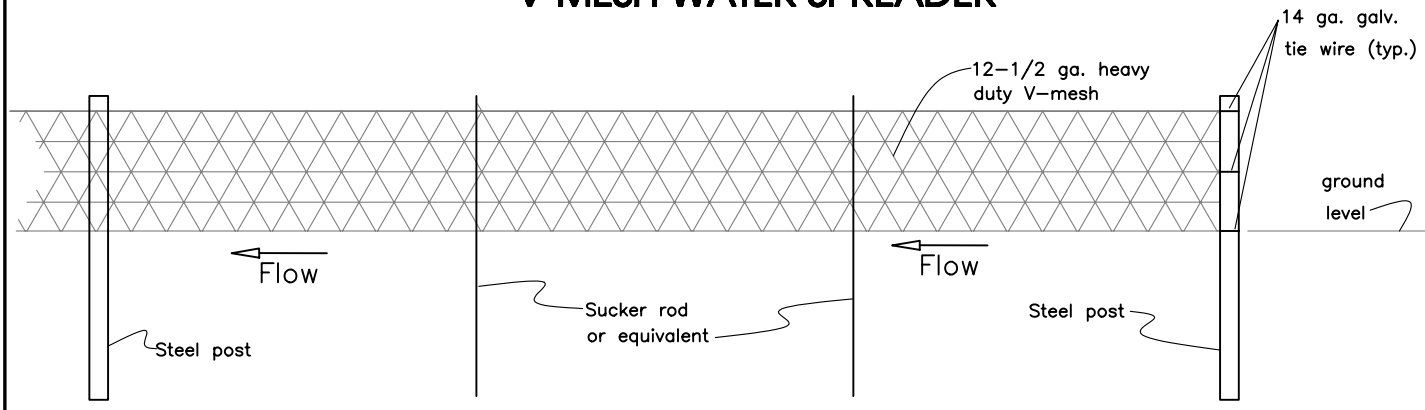


DIKE CROSS–SECTION

NOTES:
1. Embankment material shall be placed in lifts no greater than 4 in. thickness before compaction if a tracked vehicle is used for compaction.
2. Maximum layer thickness shall be 6" prior to compaction if a rubber–tired vehicle is used for compaction.
3. Equipment shall pass over entire surface of lift before next lift is placed.
4. The stream side of dike shall be protected with rock barbs and vegetation
5. If necessary top soil shall be spread over dike in order to establish the required vegetation.

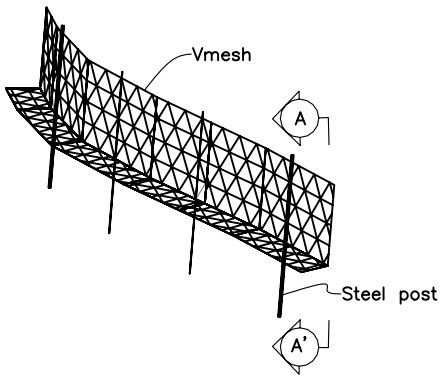
(Not to Scale)	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Dike		DATE April 2011 REVISION DATE BMP NO. 22

V-MESH WATER SPREADER

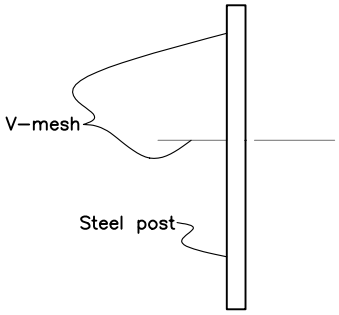


TYPICAL V–MESH SPREADER

Not to Scale



ISOMETRIC VIEW



SECTION A–A'

DESIGN AND INSTALLATION GUIDELINES

1. The purpose of V Mesh Spreaders is to prevent concentration of runoff from causing rills, gullies, and headcuts. The spreader acts to slow the runoff, at a slower, non–erosive rate. Spreaders can be used to:
   - ––Stabilize the flow from emergency spillways
   - ––Stabilize headcuts by rerouting flow
   - ––Prevent concentration and channeling of runoff from roads, kickouts, etc.
   - ––Prevent concentration of flow on rangelands and forestlands
2. Spreaders induce vegetative growth by increasing the infiltration of runoff into the ground.
3. Height of wire can vary from 1–2 ft.
4. Selection of the proper grade is the critical design parameter. The grade along the alignment can vary from 0–4% (0–4 ft per 100 ft)
   - A. When crossing the draw, the alignment grade is at least 1/2 of draw slope.
   - B. When the cross slope is 2% or greater, the grade shall not exceed 1/2 of the cross slope, once the alignment is out of the draw.
   - C. When picking up water from emergency spillways, diversions, grassy draws, or swales, the grade must be sufficient to prevent silt buildup but catches trash. It is critical to have an accurate staked alignment.
   - D. For the first 50 to 100 ft of spreader, it is common in the mountain areas to begin with a grade of 2–3 ft. per 100 ft, then 0.5 ft per 100 ft, then end with 0 ft per 100 ft.
5. When used for emergency spillways, the top of the spreader shall be 0.5 ft lower than the crest of the spillway.
6. Spreaders shall not be installed on sandy soils which produce a lot of sediment or are subject to wind erosion.
7. Errors in staking and/or construction can usually be corrected by pulling up the spreader intact and changing the grade.
8. When crossing a dip, rill, or concentrated flow area, the spreader needs to the "away" grade, and/or increase the height of spreader wire and posts through the low area in order to keep the top of the spreader level.

(Not to Scale)
Adapted From NRCS Drawings

Coyote Creek Best Management Practices

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

DETAIL: V-Mesh Water Spreader

Preliminary Not For Construction

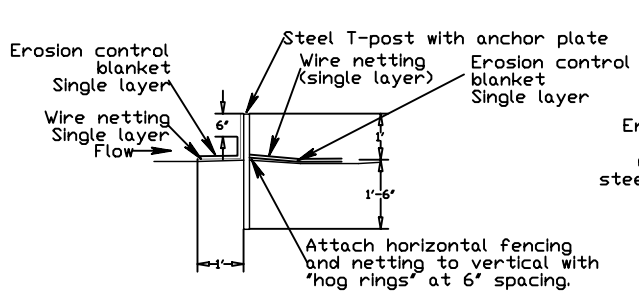
DESIGN BY: S.Yard

DATE April 2011

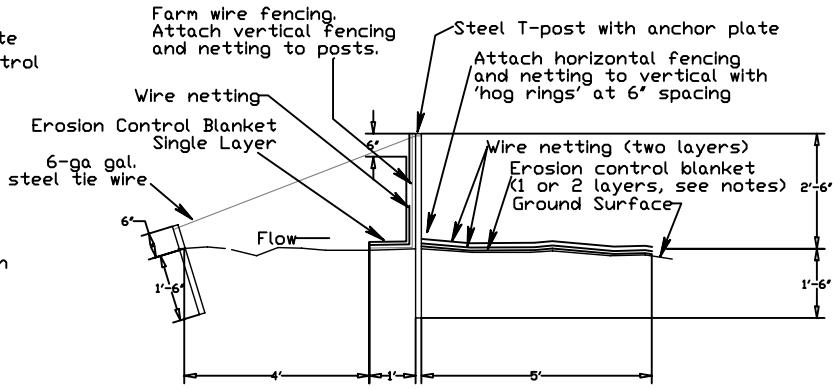
REVISION DATE

BMP NO. 23

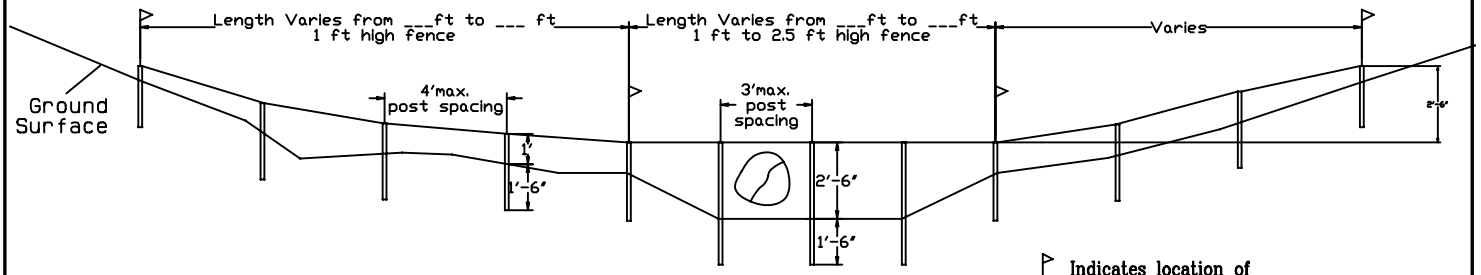
SEDIMENT FENCE



1 ft fence
Typical Cross-Section

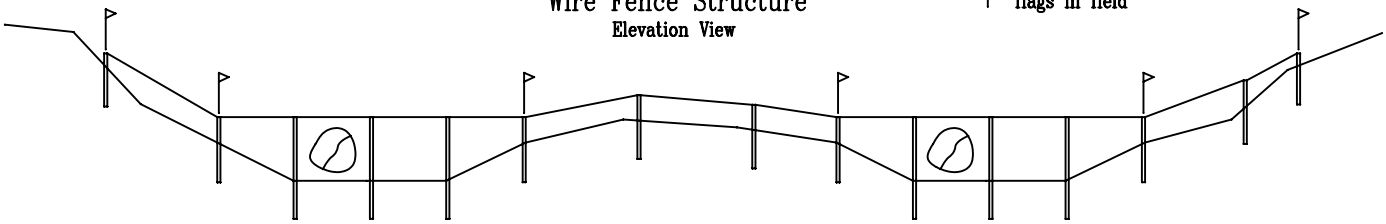


1 ft to 2.5 ft fence
Typical Cross-Section



Indicates location of flags in field

Wire Fence Structure
Elevation View



Wire Fence Structure Multiple Gully
Elevation View

Materials Used

1. Erosion Control Blanket
   North American Green Product
   C-125 Coconut fiber blanket or
   P-300 Nylon Blanket
2. Type 1, T-section steel posts, 5 feet long shall be used.
3. Fencing shall be galvanized steel, meeting requirements of ASTM Standard A-116. Vertical fencing shall be woven Wire, design No. 939-6-12.5 (Farm Fence) with a minimum of 9 line wires and is 39" in height. Maximum spacing of stay wires is 6". Intermediate line wires and stay wires shall be 12.5 gage or heavier.
4. Wire netting shall be galvanized steel mesh. The wire shall be 0.0475 inch diameter or larger. The maximum opening shall be 1.5 inches.

Construction Notes

1. Steel posts shall be driven so anchor plates are below ground and to the depth specified. Posts shall be trimmed to the height shown on drawings.
2. Wire fencing shall be tied together with wire ties at 2 foot intervals.
3. Erosion control blanket shall be tied to fencing at 2 foot spacing along the edges.
4. Erosion control blanket shall be a double layer of C-125 or a single layer of P-300.
5. Anchor fencing and netting to ground using 1/8" dia, 9" long staples at 4' maximum spacing. Use #3 rebar bent into a hook at corners and overlaps.
6. Splices in the erosion control blanket shall have a minimum overlap of 6".

(Not to Scale)
Adapted From NRCS Drawings

Coyote Creek Best Management Practices

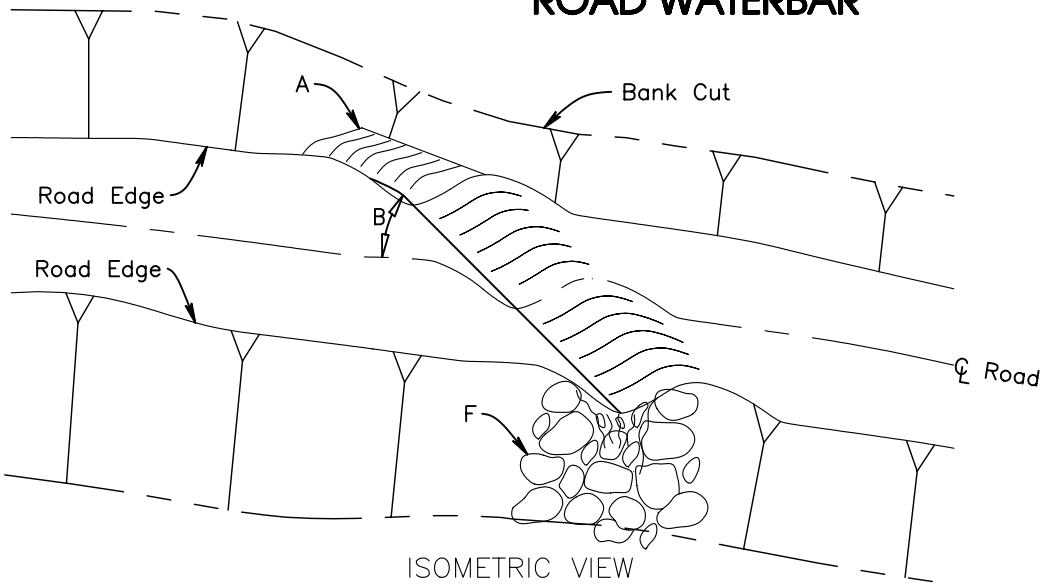
Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

DETAIL: Sediment Fence

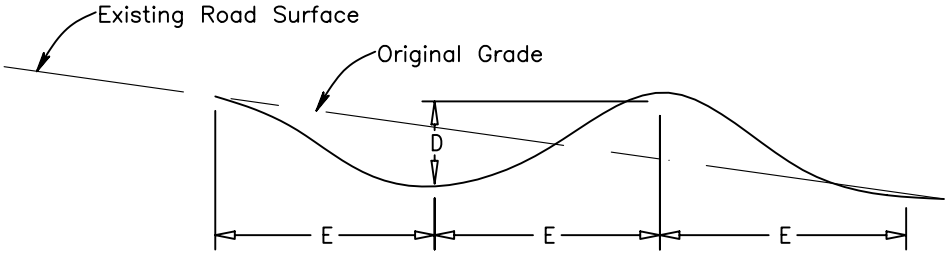
Preliminary Not For Construction

DESIGN BY: S.Yard
DATE April 2011
REVISION DATE
BMP NO. 24

ROAD WATERBAR



ISOMETRIC VIEW



WATER SECTION VIEW

Road Slope (%)	D–(ft)	F–(ft)
2–3	1.3	1.0
4	2.0	1.4
5	2.3	1.8
6	2.7	2.0
7	3.0	2.3
8	3.5	2.8

Water bar construction for forest or ranch roads, firebreaks, stocktrail and walkways. Specifications are typical, adjust to site conditions.

A: Bar fill extends to Bank Cut slope

B: Angle drain 30° degrees from U+2104 of road

D: Depth 1 ft maximum

E: 3 ft to 4 ft minimum

F: Erosion protected constructed outlet.

_____ Yes _____ No

Outlet Material

Materials _____

Thickness _____

Design length _____

Constructed angle _____

Constructed depth _____

1. Water Bars to be spaced at maximum of 10 ft of elevation change between each one.
2. Specifications are typical, adjust to site conditions.

NOTES:

. This standard drawing requires supporting technical documentation prior to use and must be adapted to the specific site.

. Outlets will be free of woody debris, dams, or any obstructions that prohibit drainage from the lower end of the waterbar.

. Use 3" angular rock riprap where necessary for outlet.

. Disturbed areas and slopes shall be seeded and mulched to grass upon completion.

Seeding Species _____

Seeding Rate_____Lbs. PLS/AC

(Not to Scale)
Adapted From NRCS Drawings

Coyote Creek Best Management Practices

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

DETAIL: Road Waterbar

Preliminary Not For Construction

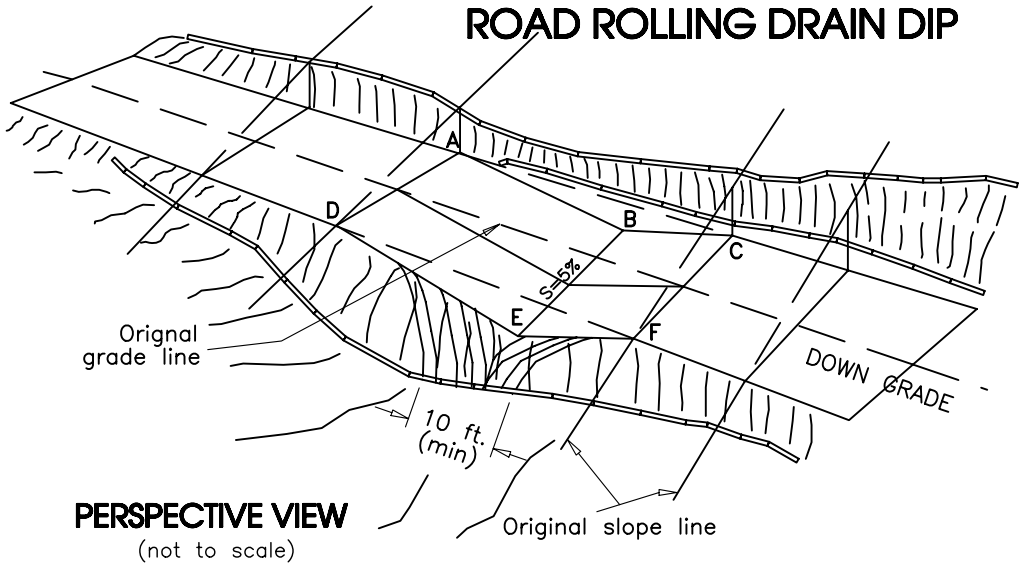
DESIGN BY:

DATE

REVISION DATE

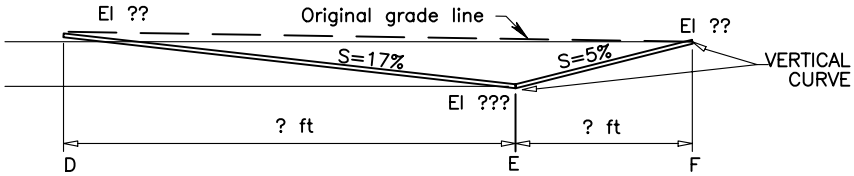
BMP NO. 25

ROAD ROLLING DRAIN DIP

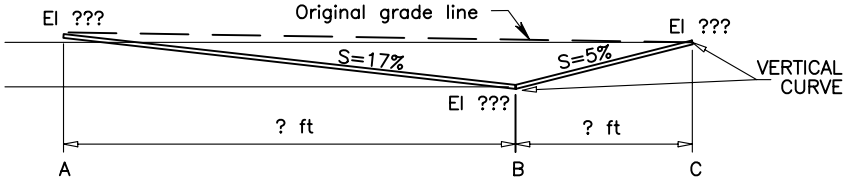


PERSPECTIVE VIEW
(not to scale)

Road Slope (%)	D–(ft)	F–(ft)
2–3	1.3	1.0
4	2.0	1.4
5	2.3	1.8
6	2.7	2.0
7	3.0	2.3
8	3.5	2.8

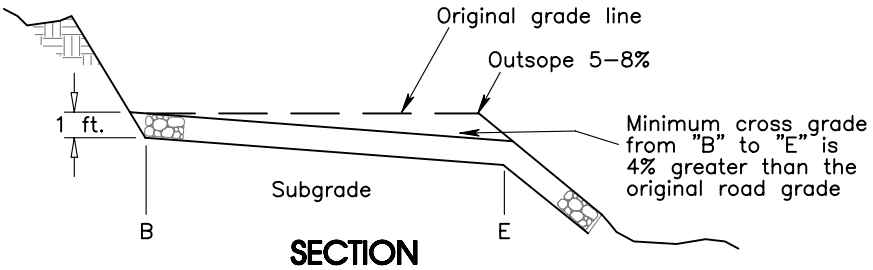


Road Profile Along D–E–F of Draing Dip



Road Profile Along A–B–C of Drain Dip

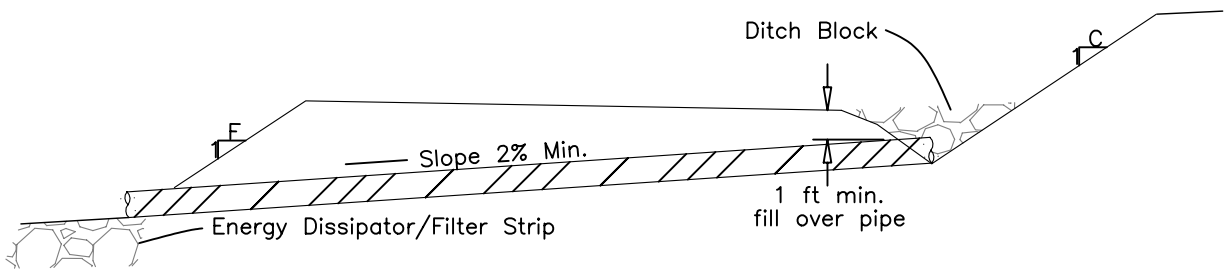
PROFILES
(not to scale)



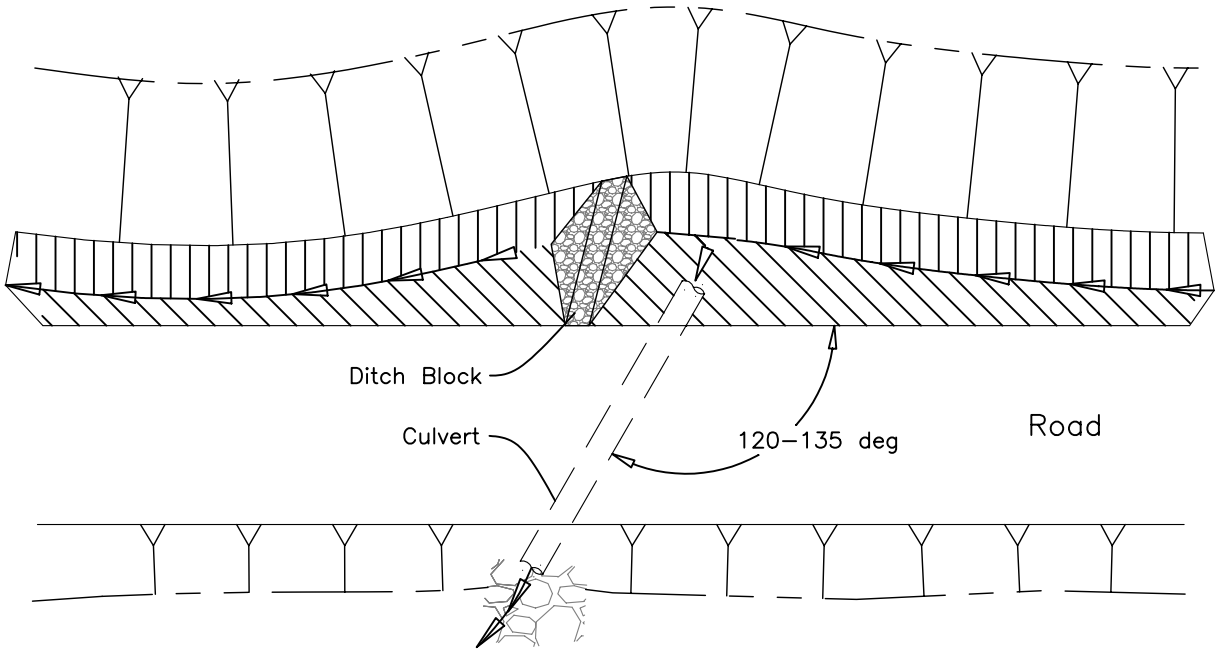
SECTION
(not to scale)

(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard DATE April 2011 REVISION DATE
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Road Rolling Drain Dip		BMP NO. 26

ROAD CROSS DRAIN/CULVERT



CROSS SECTION



PLAN VIEW

NOTES:

1) Minimum cover over culvert is 1 ft.
2) Spacing and size of relief culverts to be based on local conditions
3) Disturbed areas and slopes shall be seeded and mulched to grass upon completion.
4) Culvert outlet to be directed across a vegetated area for filtering out sediment and away from wetlands and streams.
5) Use rock riprap where necessary for erosion protection at outlet.
6) Minimum culvert diameter 18" in Western WA 15" in Eastern WA.

Culvert Diameter _____ (in.)
Culvert Length _____ (ft)
Culvert Material _____

Cut Side Slope(C) ___ :1
Fill Side Slope (F) ___ :1

Seeding Species _____

Seeding Rate _____ Lbs. PLS/AC

Outlet Rip Rap
Rip Rap Diameter _____
Depth _____

(Not to Scale)
Adapted From NRCS Drawings

Coyote Creek Best Management Practices

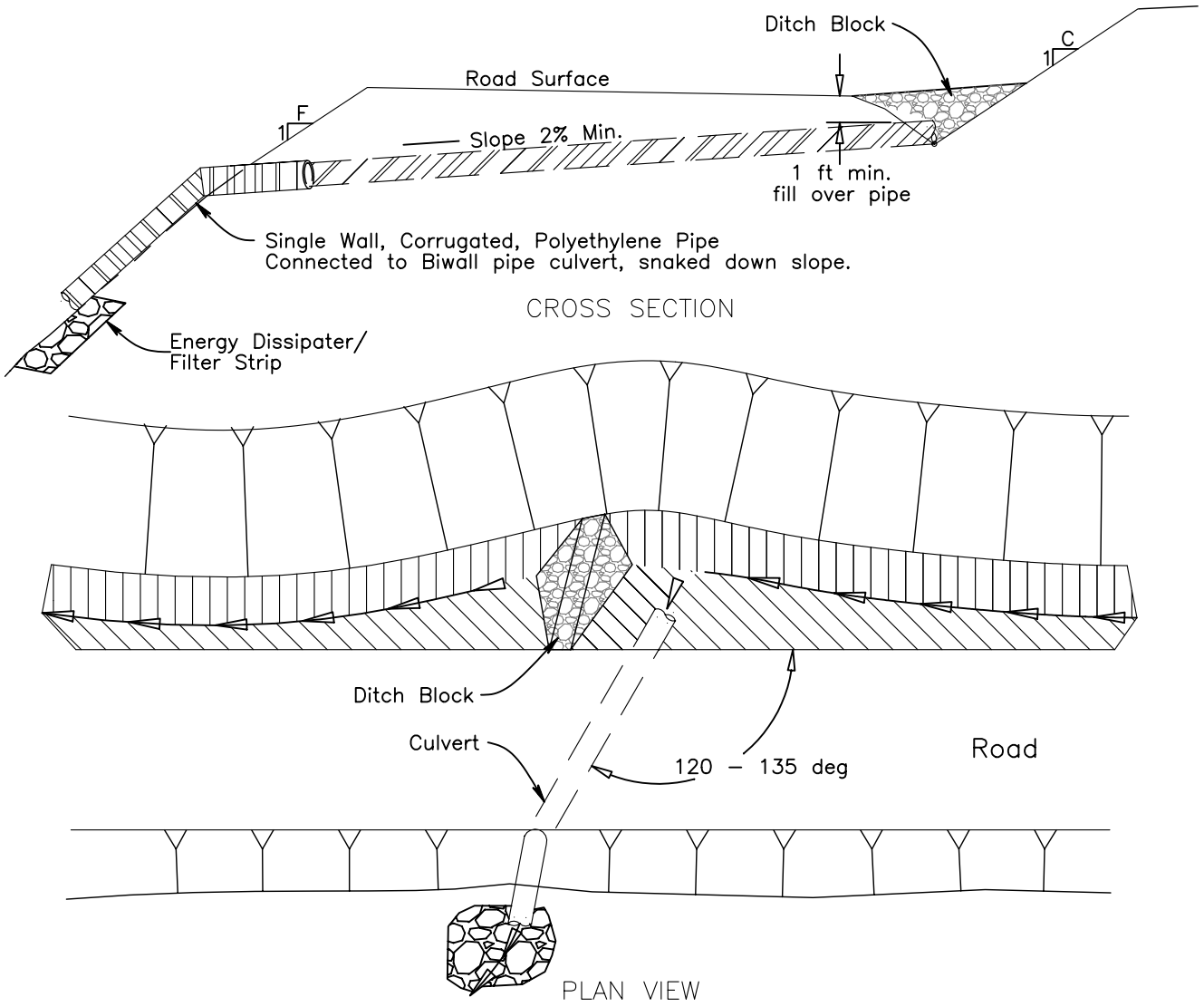
Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

DETAIL:
Road Cross Drain Culvert

Preliminary Not For Construction

DESIGN BY: S.Yard
DATE April 2011
REVISION DATE
BMP NO. 27

ROAD CROSS DRAIN WITH DOWNSPOUT



NOTES:

1) Minimum cover over culvert is 1 ft.
2) Spacing and size of relief culverts to be based on local conditions
3) Disturbed areas and slopes shall be seeded and mulched to grass upon completion.
4) Culvert outlet to be directed away from direct discharge into wetlands and streams.
5) Use rock riprap where necessary for energy dissipater at outlet
6) Anchor downspout where stability is necessary using rock or treated posts.

Culvert Diameter _____ (in)
Culvert Length _____ (ft)
Culvert Material _____

Downspout Length _____ (ft)
Downspout Material _____

Cut Side Slope(C) ___ :1
Fill Side Slope (F) ___ :1

Seeding Species _____
Seeding Rate _____ Lbs. PLS/AC

Energy Dissipater Rip Rap
Rip Rap Diameter _____ (ft)
Depth _____ (ft)

(Not to Scale)
Adapted From NRCS Drawings

Coyote Creek Best Management Practices

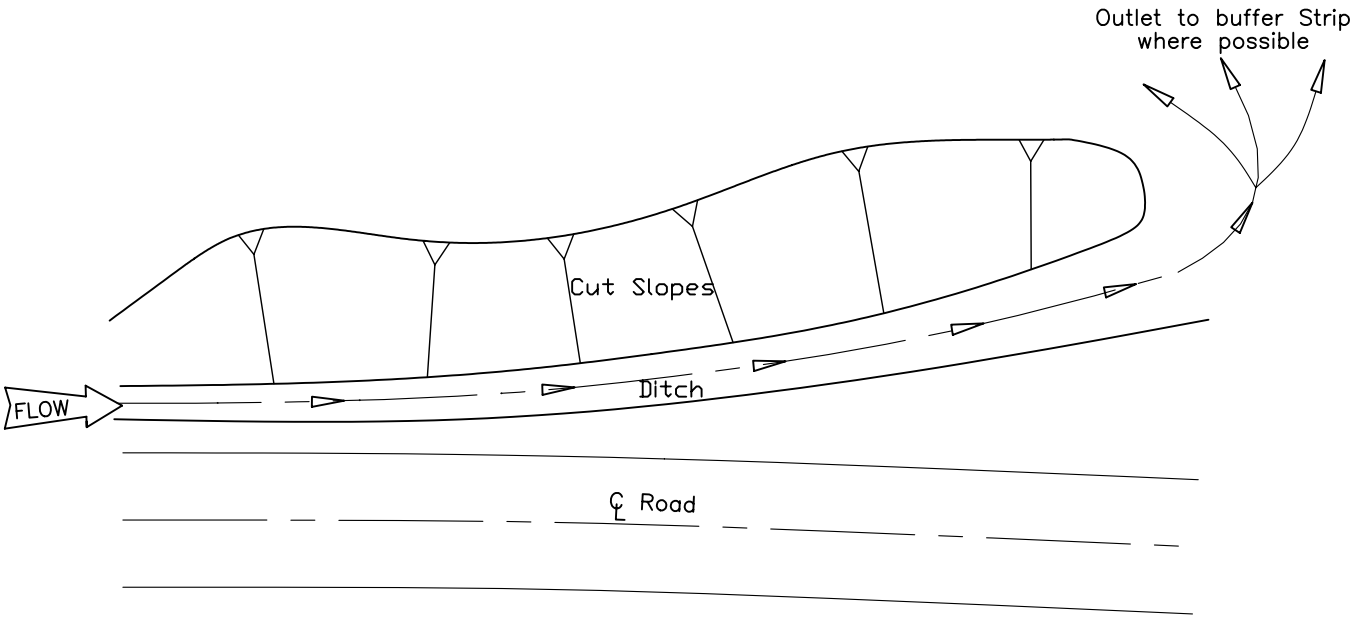
Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

DETAIL: Road Cross Drain with Downspout

Preliminary Not For Construction

DESIGN BY: S.Yard
DATE April 2011
REVISION DATE
BMP NO. 28

ROAD DITCH OUTLET



PLAN VIEW

Length _____ (ft) Spacing (maximum) _____ (ft) Slope (maximum) _____ (%)

NOTES:

. This standard drawing requires supporting technical documentation prior to use and must be adapted to the specific site.

. Locate Ditch Out off of road prism where terrain allows ditch water to be drained away from road on same side the ditch is on.

. Ditch Outs should not be used where water will drain toward fill or sidecast material, unstable slopes or directly into a stream or wetland.

. Slope and length of Ditch Out to be based on local conditions and site. Energy dissipater may be necessary if a stable outlet is not available.

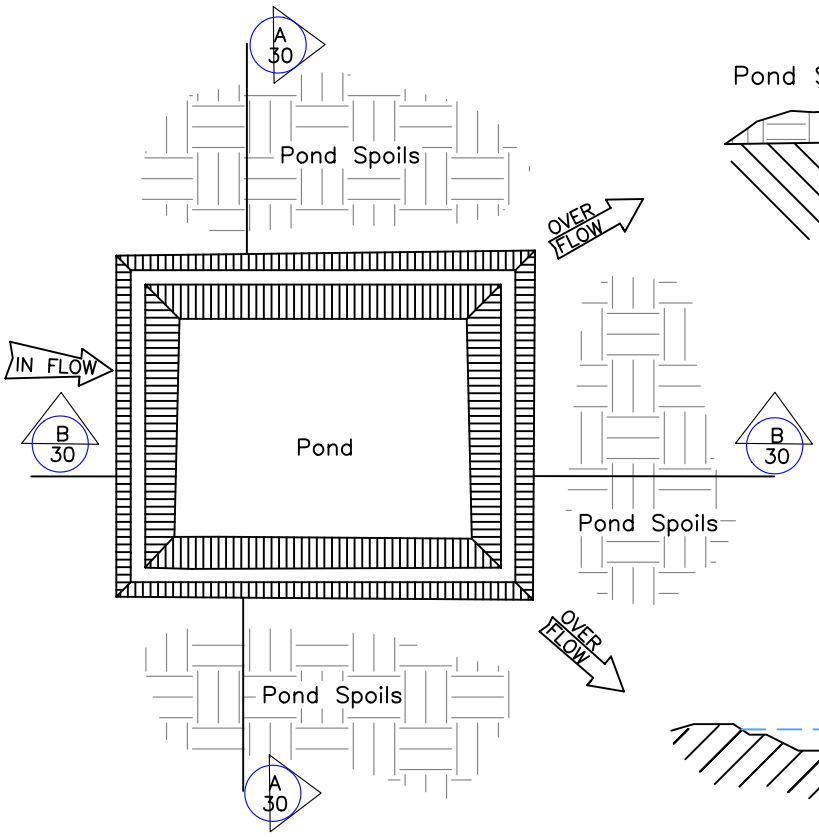
. Disturbed areas and slopes shall be seeded and mulched to grass upon completion.

Seeding Species _____

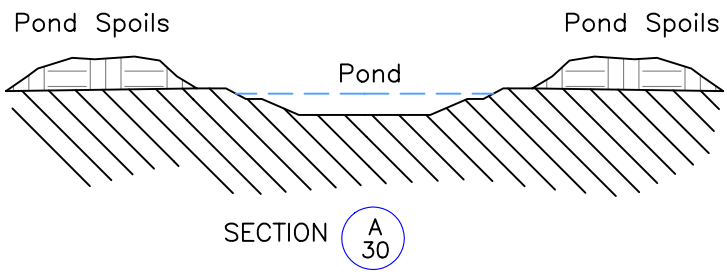
Seeding Rate _____ Lbs. PLS/AC

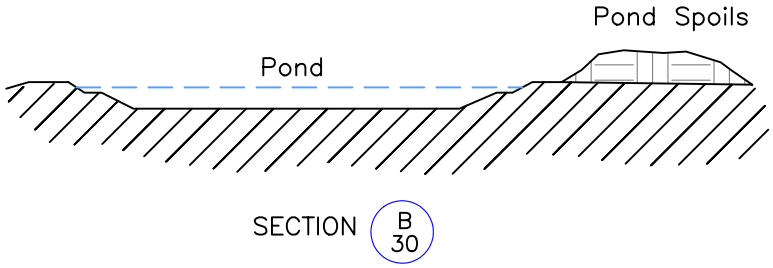
(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Road Ditch Outlet		DATE April 2011
			REVISION DATE
			BMP NO. 29

POND



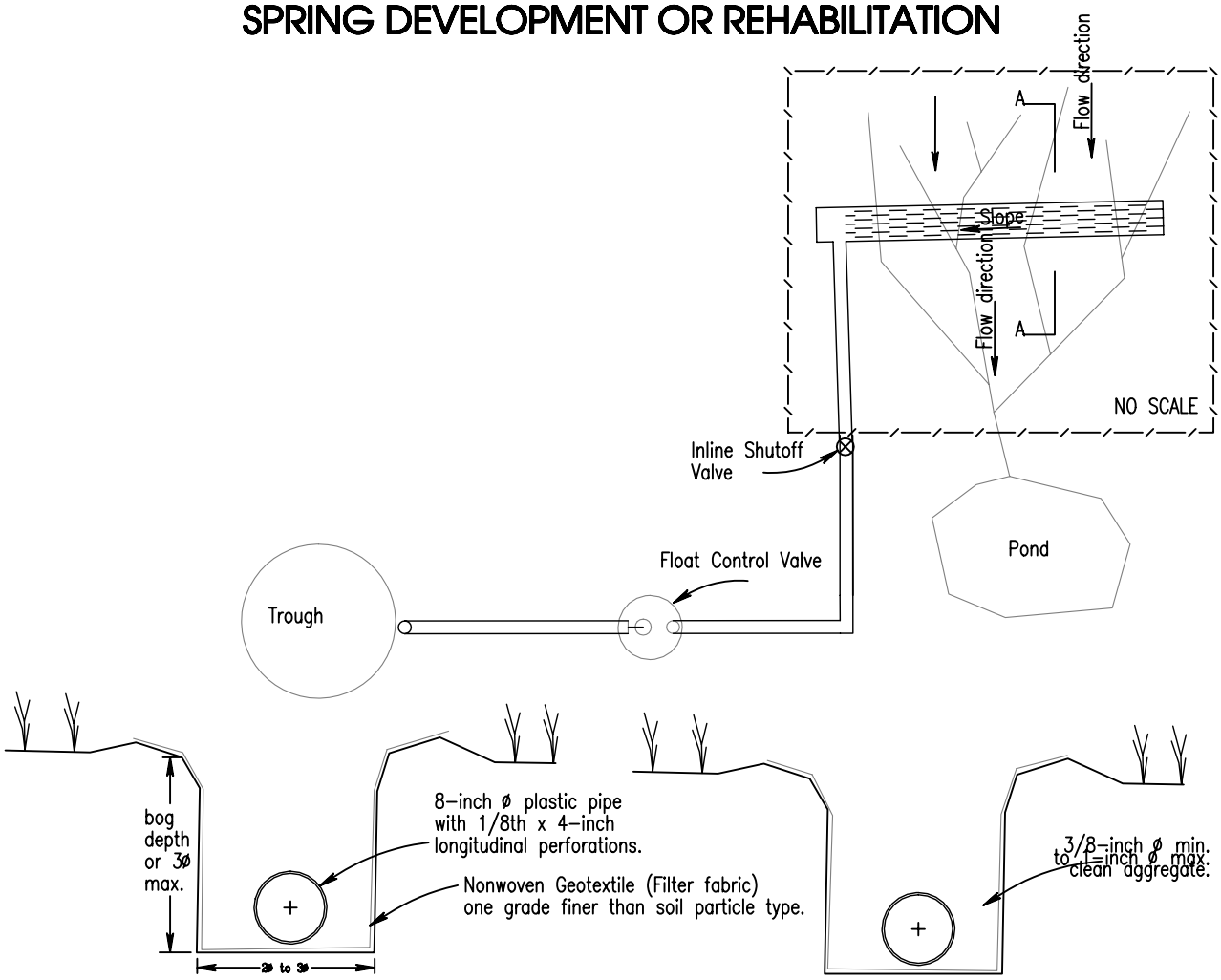
POND PLAN VIEW





(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Pond		DATE April 2011
			REVISION DATE
			BMP NO. 30

SPRING DEVELOPMENT OR REHABILITATION

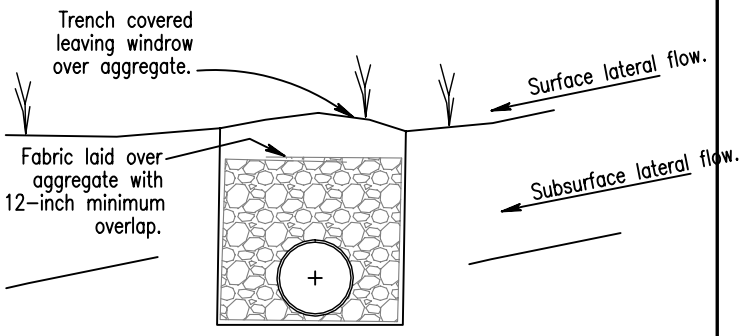


Step 1

Step 2

DESIGN NOTES:

1. Oversized perforated inlet pipe increases the area in contact with the subsurface lateral flow of water.
2. Coarse aggregate and oversized pipe provide the least resistant course for subsurface water flow through the trench.
3. Filter fabric is required to eliminate the migration of soil particles into the aggregate while allowing water to pass to the pipe.
4. The aggregate filled trench and oversized pipe act as a temporary storage reservoir.
5. The porous trench and perforated pipe allow non-intercepted water to continue through the wet soil profile in the wetland.
6. The only water removed from the wetland is the quantity needed to sustain a full watering facility.
7. Because there is no impervious cutoff wall in the wet spring area the damage to the integrity of the wetland is minimized.
8. Replace components as necessary for rehabilitation.

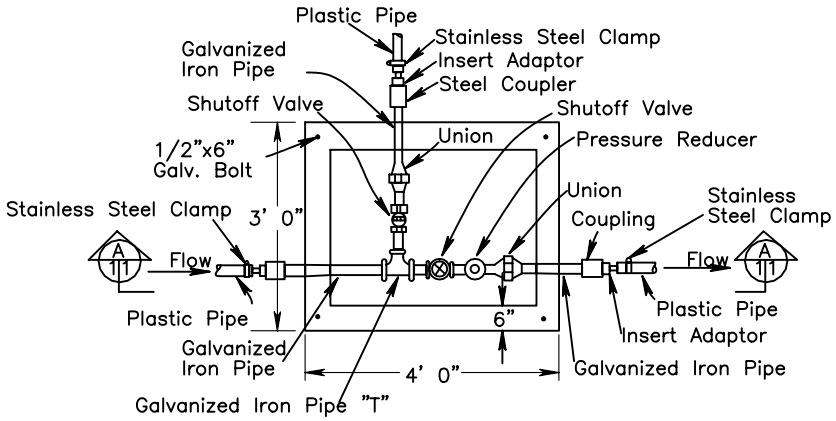


Step 3

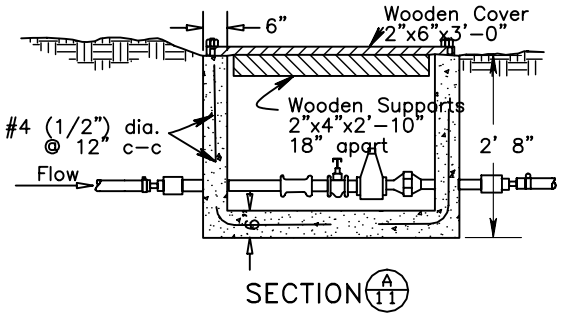
SECTION A-A

(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard DATE April 2011 REVISION DATE
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Spring Development or Rehabilitation		BMP NO. 31

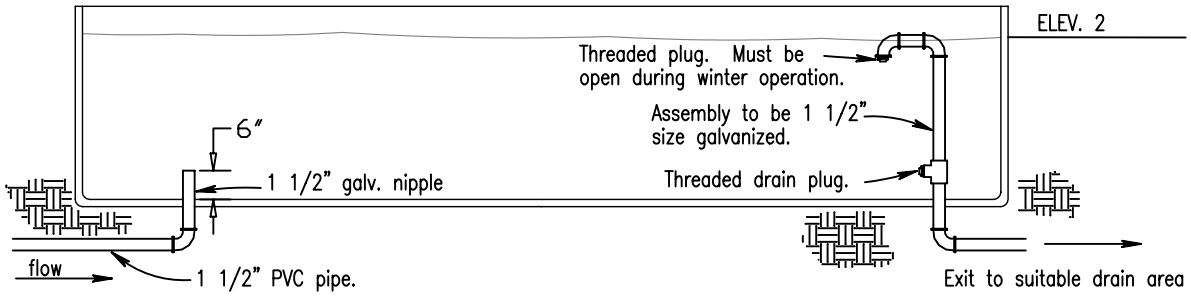
PIPELINE AND TROUGH



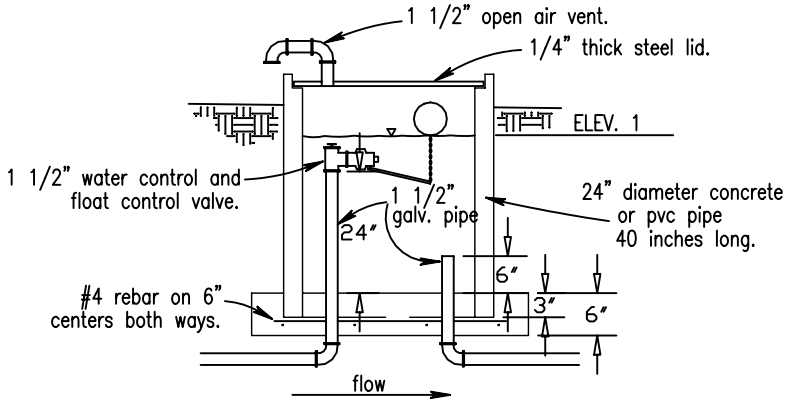
PRESSURE REDUCING STATION
WITH LATERAL LINE



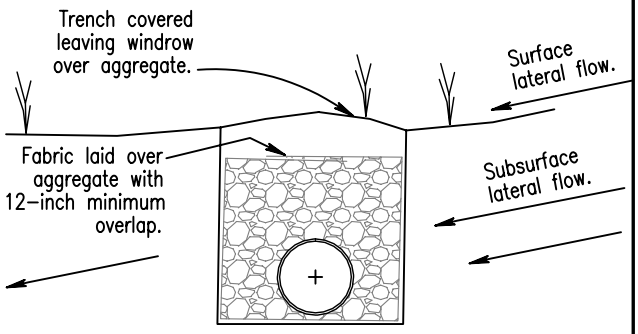
SECTION A/T1



TROUGH



WATER LEVEL CONTROL BOX

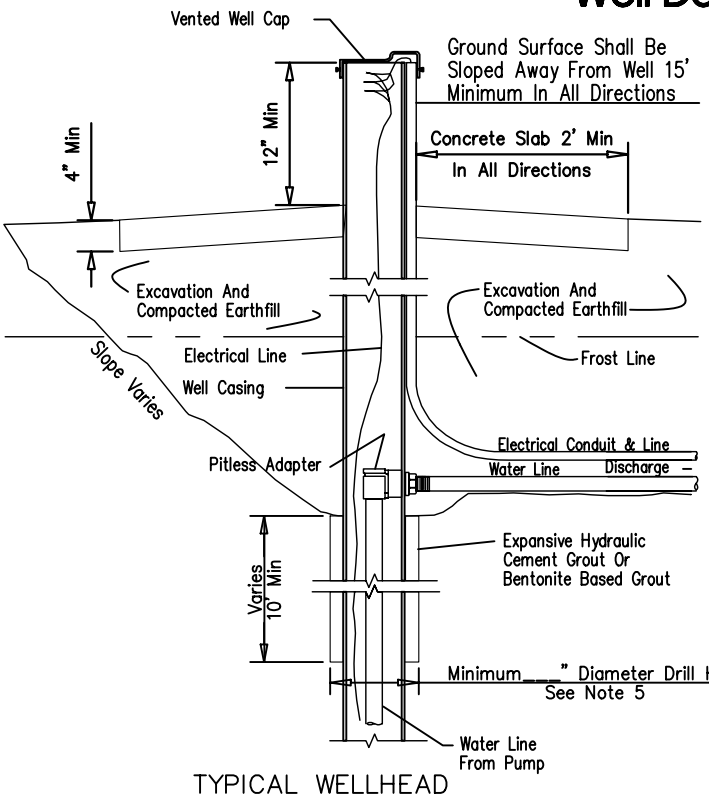


TRENCH DETAIL

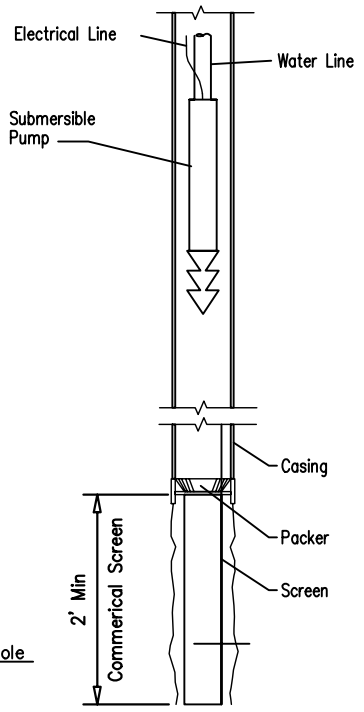
NOTE:
Elevation 1 in the Water Level Control Box and Elevation 2 in the Trough must be the same.

(Not to Scale) Adapted From NRCS Drawings	Coyote Creek Best Management Practices	Preliminary Not For Construction	DESIGN BY: S.Yard
Natural Channel Design, Inc 206 S. Elden St. Flagstaff, AZ 86001 928-774-2336	DETAIL: Pipeline and Trough		DATE April 2011
			REVISION DATE
			BMP NO. 32

Well Development



TYPICAL WELLHEAD
Not To Scale



TYPICAL WATER WELL
Not To Scale

NOTES:

1. Water well and pump installation shall comply with all applicable local and state regulations.
2. Excavations and all other work shall conform to OSHA regulations.
3. Electrical wiring must comply with local codes and manufacturers requirements.
4. Pitless Adapter and waterline may be installed above the frost line only when the well is used seasonally.
5. When an oversized drill hole is constructed for the installation of the casing, the diameter of the drill hole shall be a minimum of 3 inches greater than the outer diameter of the casing or coupling, whichever is greater.
6. Casing diameter shall be sized so that the uphole velocity is less than 5 ft/sec.
7. Only steel casing shall be used for driven wells.
8. Minimum casing strength shall be determined as described in IL Practice Standard 642, Water Well.
9. The screen shall be sized to permit water entrance at no greater than 0.7 ft/sec.
10. Pump intake shall not be placed inside a well screen.
11. An airline shall be installed where water level lies more than 250 feet below the ground surface. This airline can be copper, polyethylene, or galvanized tubing and shall have Presta valve installed to allow the connection of an air compressor. Airline must be airtight and its exact length must be documented.
12. The well capo shall be removable to allow for measurement of depth to water surface or pressure.
13. After construction is complete, the well shall be disinfected pre local or state requirements.

DESIGN DIMENSIONS

Estimated Well Depth = _____(ft)

Required Production = _____(gpm) min

Casing Materials: ☐ Plastic ☐ Steel

Casing Diameter =_____(in)

Wall Thickness = _____(in)

SDR = _____

Pitless Adapter = ☐ Yes ☐ No

RECORD OF WELL INSTALLATION (As Built)

Name Of Landowner _____
Date Of Completion _____

Name Of Person Performing Well Construction _____

Company _____

Address _____

_____

Was a Water Well Construction Permit Obtained From The IL Dept Of Health or Approved Local Health Department Prior to Construction? (Attach A Copy Of The Permit.) ☐ Yes ☐ No

Were the Water Well Construction and Pump Installation Reports Submitted to the appropriate Health Department? ☐ Yes ☐ No (Attach A Copy Each Report)

Was An Airline Installed? ☐ Yes____Ft. Length ☐ No

Actual Well Depth_____ft
Depth Pump Set_____ft
Pumping Capacity_____gpm

I certify that this practice has been completed In accordance with this plan and specifications and the above record of well installation.

Well Driller _____ _____
Sign Here Date

As Built Practice Meets the ENGINEER'S Specifications

_____ _____
ENGINEER'S Certification Date

(Not to Scale)
Adapted From NRCS Drawings

Coyote Creek Best Management Practices

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, AZ 86001
928-774-2336

DETAIL: Well Development or Rehabilitation

Preliminary Not For Construction

DESIGN BY: S.Yard

DATE April 2011

REVISION DATE

BMP NO. 33

APPENDIX C - DESCRIPTION OF FUNDED PROJECTS

Travis Johnson	stock pond rehabilitation & headcut stabilization, V-mesh spreaders
Galyn Knight	livestock pipeline
Sidney Maddock	sediment basin rehabilitation, roadway drainage improvements
Fred Moore	sediment basin rehabilitation
Brian Nicoll	livestock pipelines
Elaine Rogers	headcut stabilization and miscellaneous drainage improvements.
John Thompson	livestock well and drinker

TRAVIS JOHNSON, STOCK POND REHABILITATION & HEADCUT STABILIZATION

The objective of this project was to rehabilitate a stock pond and stabilize several headcuts within the Coyote Creek watershed. This work promotes sheet flow and infiltration for an increase in sediment and water storage, while decreasing sediment migration from these upland areas.

The project area is located upon State-owned land, leased by the Travis Johnson within Apache County, 11 miles northeast of Springerville, Arizona, 34.2850° Latitude, -109.1944° Longitude.

Project tasks included: 1) The excavation of sediment from a stock pond to restore the ponds capacity to hold water and sediment. Enough sediment was removed to ensure a 10 year minimum service life of the stock pond. 2) Active headcuts upstream of the pond have been sloped, seeded, and covered with erosion control fabric to accelerate their progression to a stable form and aid in revegetation. 3) V-Mesh spreaders have been installed to spread water, promoting infiltration and discouraging concentration and the subsequent erosion that channelized water causes.

Engineers estimated project cost: $70,436

Figure 1. Completed V-Mesh spreader.

Figure 2. Preconstruction photograph of headcuts.

Figure 3. Post construction photograph of headcuts with treatment of disturbed areas.

Figure 4. Excavation of sediment from the stock pond.

GALYN KNIGHT & DARIC KNIGHT, LIVESTOCK PIPELINE

The objective of this work was to construct a pipeline to supply water to under-utilized pasture land which would help facilitate balanced grazing for livestock.

The proposed pipeline is located on State-owned land leased by Galyn Knight in Apache County, 11 miles northeast of Springerville, Arizona, 34.2340° Latitude, -109.2473° Longitude.

The 12,410 ft pipeline has been tied into an existing well and storage tank and gravity feeds into a new storage tank and 2 troughs. With proper management, this watering facility will reduce grazing pressure in pastures nearest to current watering facilities which will increase upland vegetation and decrease erosion. These efforts will lead to an increase in clean water runoff within the Coyote Creek watershed.

Engineers estimated project cost: $70,292.

Figure 5. Large rock that was encounter during pipeline installation.

Figure 6. Lower trough fed by the new pipeline.

Figure 7. Trough and storage tank at the end of the pipeline.

SIDNEY MADDOCK, DRAINAGE IMPROVEMENTS

The objective of this work was to complete a design for berm rehabilitation that has brought a sediment basin back into service. In addition, a series of drain dips have been installed to address a severely eroding road and roadside ditches

The berm repair is located on private land within Apache County, 9 miles northeast of Springerville, Arizona, 34.2281° Latitude, -109.1647° Longitude.

The repaired berm will allow the sediment basin to arrest sediment on-site, keeping it from migrating downstream. Material used to repair the berm was excavated from the on-site sediment basin which reduced haul costs and restored the basins sediment storage capacity. These efforts will lead to improvements in water quality within the Coyote Creek watershed and provide the land owner with a proper functioning stock tank as well. The roadway drain dips are similar to water bars and will direct overland flow off of the road and onto surrounding pasture lands.

Engineers estimated project cost: $19,806.

Figure 8. Surveying the failed berm prior to construction.

Figure 9. Post construction photograph of the repaired berm with rock protection.

Figure 10. Construction of a roadway drain dip.

FRED MOORE, SEDIMENT BASIN REHABILITATION

The objectives of this project were to stabilize the eroding spillway and to rehabilitate the sediment basin to restore sediment storage capacity.

The sediment basin is located on private land owned by Fred Moore in Apache County, 11 miles northeast of Springerville, Arizona, 34.2297° Latitude, -109.1350° Longitude.

The sediment basin was initially designed to reduce sediment loading to a stock tank. The sediment basin had lost all storage capacity and the spillway had failed and a headcut had formed and was eroding into the sediment basin. The headcut threatened to mobilize the great deal of sediment the basin had stored during its functional life. The failing spillway has been mitigated by the construction of a large linear vegetated spillway, Figure 1. The service life of the basin, between maintenance activities, is estimated to be between 2-3 years.

Engineers estimated project cost: $32,995.

Figure 11. Eroding sediment basin spillway.

Figure 12. Post construction photograph of the sediment basin with linear spillway.

BRIAN NICOLL, 2 LIVESTOCK PIPELINES

The objective of this work was to construct 2 livestock pipelines and watering facilities that tie into existing TEP wells to supply water to under-utilized pastures for improved grazing management. The development of these new livestock watering facilities provides for balanced grazing within nearby pastures, which will help in the conservation of upland vegetation and subsequently decrease runoff.

The constructed 8,500 ft and 450 ft pipelines are located on State-owned land leased by Brian Nicoll in Apache County, 13 miles north of Springerville, Arizona, 34.3071° Latitude, -109.2172° Longitude, and 34.2861° Latitude, -109.2737° Longitude

The pipelines are buried within trenches (Figure 16) and connected to troughs made of large recycled tires, Figures 17 and 18.

Engineers estimated project cost: $44,958 (8,500 ft pipeline and watering facility), and $5,457 (450 ft pipeline and watering facility).

Figure 13. Buried pipeline with spoil mounded above trench.

Figure 14. Newly constructed watering facility at the end of the new 450 ft pipeling.

Figure 15. Newly constructed watering facility at the end of the new 8,500 ft pipeline.

ELAINE ROGERS, HEADCUT STABILIZATION

The objectives of this project were to stabilize several headcuts just upslope of Coyote Creek and, where possible, promote sheet flow across the field leading into the headcuts. The project has stabilized several headcuts, reducing erosion and increasing clean water runoff and sediment sourcing within the Coyote Creek watershed

The project area is located on private property and State-owned land leased by Elaine Rogers in Apache County, 10 miles east of Springerville, Arizona, 34.1739° Latitude, -109.1466° Longitude.

These best management practices have all been constructed on and around pasture land adjacent to Coyote Creek. The constructed rock-lined chute provides a hardened exit for overland flow from the pasture land. An earthen berm and swale along the edge of the creek direct flow from the field into the rock chute to keep new headcuts from forming and the banks of other headcuts have been sloped to a more stable form and seeded.

Water bars have been constructed to address road erosion at the northern edge of the pasture. Debris deposited along fence line has been removed. Both of these practices help direct flow onto the field and reduce concentrated flow along road and fence line. Several kangaroo rat colonies exist along the northern edge of the field which has significantly reduced vegetation in this area. We have recommended placing rat traps where water flows off the hillside toward the field and then seeding this area, though the traps have not be utilized at the time of this report.

Engineers estimated project cost: $22,255.

Figure 16. Headcuts at the edge of pasture land adjacent to Coyote Creek.

Figure 17. Post-construction photograph of treated and seeded headcut.

JOHN THOMPSON, LIVESTOCK WELL AND DRINKER

The objective of this work was to develop a well and watering facilities to supply water to under-utilized pastures for improved grazing management. The development of this new livestock watering facility provides for balanced grazing, which will help in the conservation of upland vegetation and subsequently decrease runoff.

The constructed well is located on State-owned land leased by John Thompson in Apache County, 6 miles east of Springerville, Arizona, 34.1558° Latitude, -109.1852° Longitude

Engineers estimated project cost: $22,750

Figure 18. Solar powered livestock well with drinker.

APPENDIX D - CONSTRUCTION DRAWINGS WITH SPECIFICATIONS AND DESIGN INFORMATION

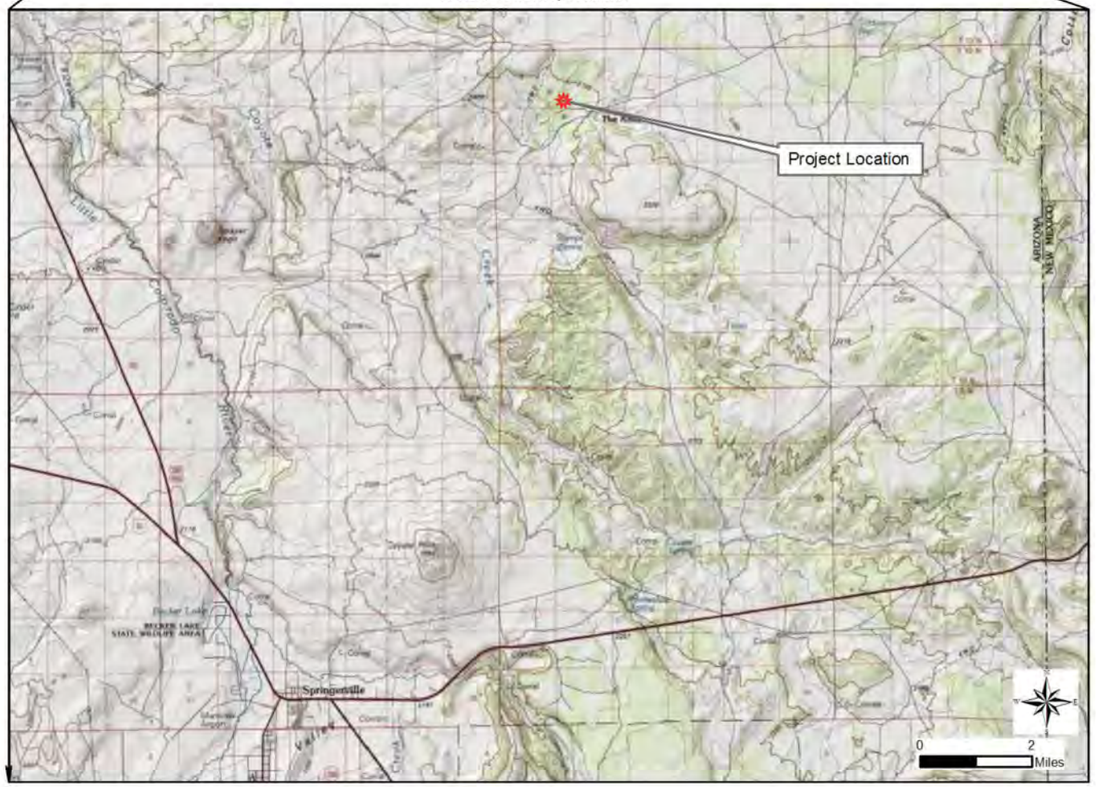
COYOTE CREEK
Watershed - Scale Education and Training Grant

PREPARED FOR: Travis Johnson, Johnson Livestock

FUNDED BY:
Arizona Department of Environmental Quality (ADEQ)
Water Quality Division
Contract EV10-0051 (Project #12-002)

LOCATION MAP

ARIZONA, GILA & SALT RIVER MERIDIAN
T10N, R30E, SEC. 5
APACHE COUNTY, ARIZONA



INDEX OF DRAWINGS

LANDOWNER:
Travis Johnson
P.O. Box 1655
St. Johns, AZ 85936
Phone: (928) 245-3383

PROJECT MANAGER:
Little Colorado River
Plateau RC&D
David Newlin
153 W. Vista, Suite 2
Holbrook, AZ 86025
Phone: (928) 524-2912

TECHNICAL CONSULTANT:
Natural Channel Design, Inc.
206 S. Elden Street
Flagstaff, AZ 86001
Phone: (928) 774-2336

FUNDING AGENCY:
Arizona Department of
Environmental Quality
1110 W. Washington St.
Phoenix, AZ 85007
Phone: (602) 771-4635

MATERIAL LIST

Basin Earthwork:	4000 cy
Headcut Sloping:	5,040 cy
Grass Seed Mix:	1.8 ac
V-Mesh Spreader:	970 ft
Double Net Erosion Control Fabric:	15 rolls

DESIGN INFORMATION

Watershed Area: 2.7 sq mi (1730 ac)
Sediment Yield: 690 cy per year
Stock Pond Capacity: 8970 cy
Expected Life of Stock Pond: 13 yrs

Hydrology	Est. Peak Flows (NFF – USGS)
Q2	38 cfs
Q5	168 cfs
Q10	251 cfs
Q25	424 cfs
Q50	607 cfs
Q100	711 cfs

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774-2336

DRAWN BY:	C.Tressler		
DESIGNED BY:	S.Yard & C.Tressler		
REVIEWED BY:	S.Yard		
REV	DATE	BY	REVISION

COVER SHEET:
Location, Index & Quantities

COYOTE CREEK
Watershed-Scale Education and Training Grant
Travis Johnson, Johnson Livestock

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 8-21-13 ARIZONA, U.S.A.
Expires 3-31-2014

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.

CALL TWO WORKING DAYS BEFORE YOU DIG 263-1100 1-800-STAKE-IT (OUTSIDE MARICOPA COUNTY)

DATE: AUG 21, 2013
DRAWING NO: CVR01
NCD PROJECT NO: 10-183-AZ
SHEET NO: 1 OF 6

PROJECT DESCRIPTION

The purpose of this project is to rehabilitate a stock pond and treat eroding areas of watershed to improve range condition, and reduce sediment production from these upland areas.

Improvement plan includes:
1. Rehabilitating an existing stock pond to provide additional water and sediment storage.
2. Seed disturbed areas and spillway with native grass seed.
3. Sloping, seeding, and the installation of erosion control fabric of 6 headcuts.
4. Installation of V–mesh spreaders to decrease channelization and promote infiltration.

GENERAL NOTES

1. Site survey data was collected by NCD in October of 2012.
2. All stationing refers to baseline of construction and is measured horizontal distance.
3. All existing conditions are to be verified in the field prior to construction.
4. 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 no utilities are present. The existence, location and depth of any utility must be determined by the contractor prior to any excavation. Call before you dig, 1–800–STAKE–IT
5. No construction shall begin until all necessary permits, easements, and funding authorizations are obtained.
6. Construction activities will be conducted in a manner consistent with all safety regulations, and other permitting required by Arizona State Land Department, Arizona Department of Environmental Quality, and others.
7. Installation shall be constructed to the lines and grades as shown on the drawings or as staked in the field by the ENGINEER or authorized representative, recognizing there is variation in nature.
8. Construction activities shall be performed in a manner that minimizes soil, water and air pollution.

CONSTRUCTION SPECIFICATIONS

EARTHWORK

The earthwork activities shall consist of the Stock Pond and Headcut Sloping at locations shown on SHEET 3.

Excavation

Excavation shall be limited to Stock Pond and Headcuts as shown on the drawings or as staked in the field. No excavation shall take place within any jurisdictional areas.
Disturbance of existing native vegetation shall be minimized to the greatest extent possible during excavation.

Excavated material shall be spoiled on site. All finished surfaces shall be generally smooth, seeded, and pleasing in appearance and blend into surrounding terrain.

Earthfill

Materials: All fill materials shall be obtained from the required excavations and approved borrow sources. Fill materials shall not contain sod, brush, roots, perishable or frozen materials.

Placement: The placement of fill materials shall follow these guidelines:
> Any vertical bank shall be sloped before placement of fill material.
> The placing and spreading of fill material shall be started at the lowest point and the fill brought up and compacted to obtain a density similar to the surrounding bank material.
> Material when placed shall contain sufficient moisture so that a sample taken in the hand and squeezed shall remain intact when released.
> The placing and spreading of fill material shall be started at the lowest point and the fill brought up in horizontal layers not to exceed: six (6) inches of loose fill for wheel compaction and four (4) inches of loose fill for dozer compaction. Construction equipment shall be operated over the areas of each layer of fill to insure that the required compaction is obtained.
> Fill shall not be placed on frozen soil, snow or ice.
> Headcuts and gullies designated for filling and re–contouring shall be filled as close as possible to the historic natural ground surface, and smoothed and shaped to blend with the surrounding landscape.
> All finished surfaces shall be generally smooth and pleasing in appearance and blend into surrounding terrain.

V–MESH SPREADER

Four V–Mesh Spreader shall be installed at locations shown on SHEET 3. See SHEET 5 for installation Details.

RANGELAND SEEDING

Disturbed areas will be seeded with native grasses. Seeding activities include the following:
> Prepare seedbed where needed.
> Seed can be drilled or broadcast by hand.
> Seed shall be incorporated into the soil, but not more than 1–inch deep.

Seeding dates vary for different grasses, legumes, and forbs. Seed shall be purchased from a reliable supplier. The grass seed mix will consist of the following species as available. The seeding rates below are for planting by hand broadcasting. Grass seed mix will be applied at a rate of 10.5 pounds to the acre. Estimated area of disturbance is 2 acres.

Species	Scientific Name	% of Mix	lb PLS/ac	lb PLS for 2 acres
Western Wheatgrass	(Pascopyrum smithii)	50%	9.00 lb/ac PLS	18.0 lb PLS
Blue Grama	(Bouteloua gracilis)	50%	1.50 lb/ac PLS	3.0 lb PLS
		100%	10.5 lb/ac PLS	21.0 lb PLS

EROSION CONTROL FABRIC

Biodegradable erosion control fabric made of Jute, Coir, Straw, Coconut or other natural material shall be placed over the seed as shown for protection. Fabric is laid and anchored over seeding to reduce soil erosion and provide a good environment for vegetative regrowth. Two types of fabric will be installed. See SHEET 6 for fabric installation details.

Double Net Straw/Coconut
Erosion Control Blanket (ECB) containing a matrix fiber blend of 30% coconut and 70% straw by weight with double net biodegradable jute/scrim netting and biodegradable thread (Western Excelsior CS–3 Coconut Straw Erosion Blankets – All Natural Netting or comparable) for extended–term erosion control. This fabric shall be placed and staked over seed on the sloped portion of the headcut(s).

Bristle Coir Mat
Erosion Control Blanket (ECB) woven from biodegradable machine–spun bristle coir twine with minimum twine count of 39MD x 18CD per foot (RoLanka BioD–Mat 90 semi permanent woven bristle coir mat or comparable) for erosion control. This fabric shall be placed on the downstream end of the headcut sloping, in locations shown on SHEET 3, at the throat of the feature where flows concentrate.

Double Net Straw/Coconut ECB shall meet the following minimum properties:

Property	Test Method	Value	Unit
Tensile Strength	ASTM D6818	12.5 (MD), 12.5 (TD)	lb/in
Elongation	ASTM D6818	5.0 (MD), 5.0 (TD)	%
Mass per Unit Area	ASTM D6566	9.5	oz/yd^2
Thickness	ASTM D1777	8.5	mm
Light Penetration	ECTC TASC 00197	10	% open
Water Absorption	ASTM D1117	325	%

Bristle Coir Mat ECB shall meet the following minimum properties:

Property	Test Method	Value	Unit
Dry Tensile Strength	ASTM D4595	2024 (MD), 1160 (CD)	lb/ft
Wet Tensile Strength	ASTM D4595	1776 (MD), 936 (CD)	lb/ft
Elongation @ Wet Failure	ASTM D4595	52 (MD), 24 (CD)	%
Weight	ASTM D3776	29.0	oz/yd^2
Thickness	ASTM D1777	9.0	mm
Recommended Flow		16	ft/s
Recommended Slope		>1:1	
Recommended Shear Stress		5	lb/ft^2

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774–2336

DRAWN BY:	C.Tressler		
DESIGNED BY:	C.Tressler		
REVIEWED BY:	S. Yard		
REV	DATE	BY	REVISION

GENERAL NOTES & CONSTRUCTION SPECIFICATIONS

COYOTE CREEK
Watershed-Scale Education and Training Grant
Travis Johnson, Johnson Livestock

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 8-21-13 ARIZONA, U.S.A.

Expires 3-31-2014

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DATE: Aug 21, 2013
DRAWING NO: GEN01
NCD PROJECT NO: 10–183–AZ
SHEET NO: 2 OF 6

N
W E
S

HORIZ SCALE: 1" = 300'

0 300 600

Natural Channel Design, Inc

206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774–2336

DRAWN BY:	C. Tressler		
DESIGNED BY:	S. Yard, C. Tressler		
REVIEWED BY:	S. Yard		
REV	DATE	BY	REVISION

PLAN VIEW
Project Overview

COYOTE CREEK
Watershed-Scale Education and Training Grant
Travis Johnson, Johnson Livestock

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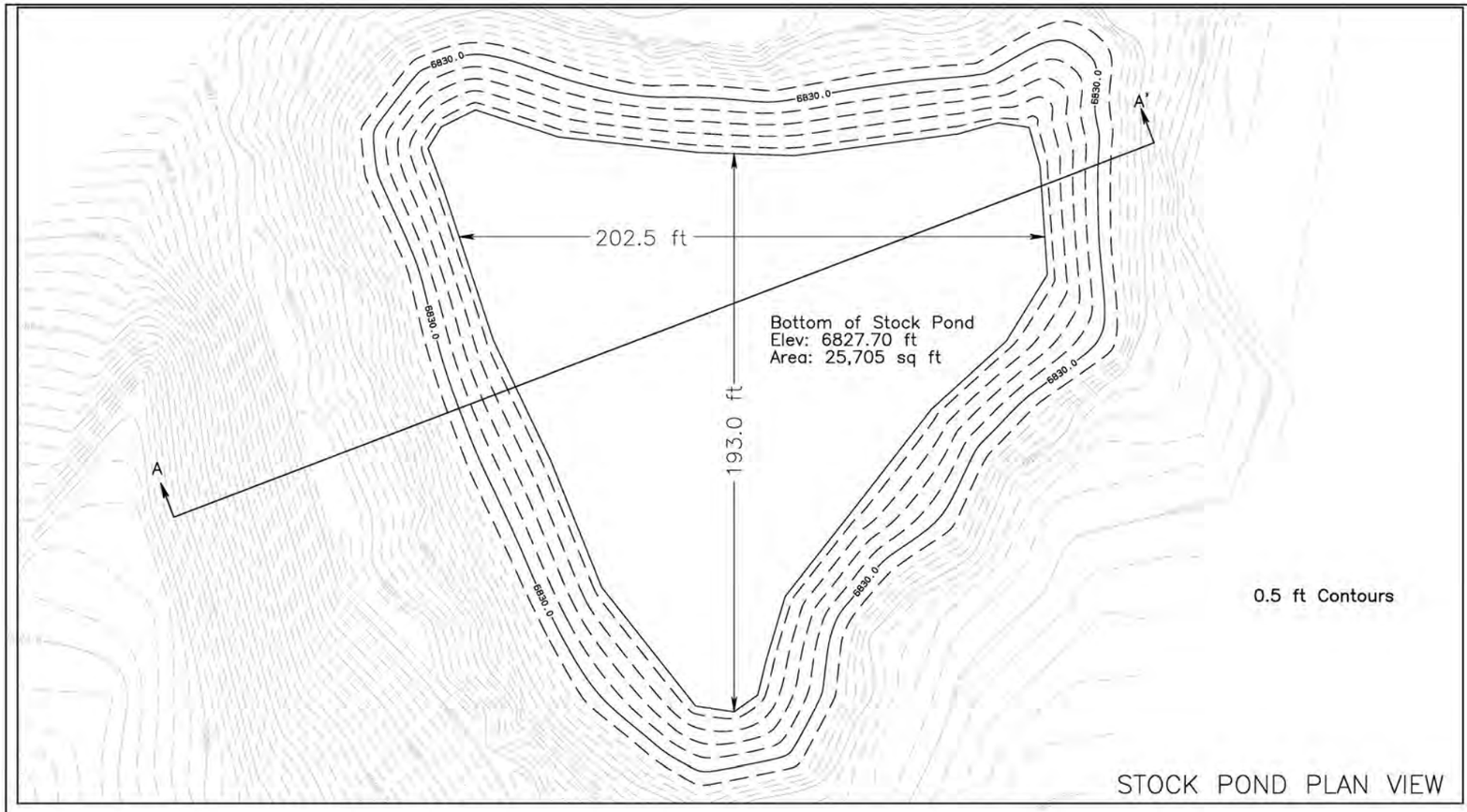
(OUTSIDE MARICOPA COUNTY)

DATE: Aug 21, 2013

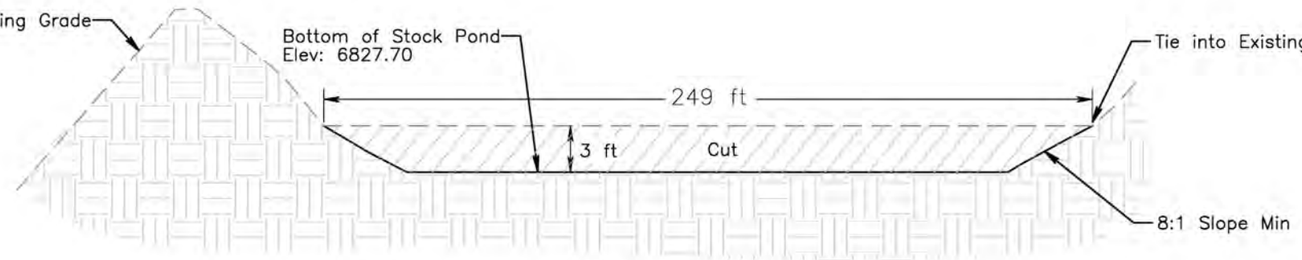
DRAWING NO: PLN01

NCD PROJECT NO: 10–183–AZ

SHEET NO: 3 OF 6



STOCK POND PLAN VIEW



STOCK POND CROSS–SECTION A–A'

LEGEND:

- Fill
- MAJOR CONTOUR – DESIGN
- MINOR CONTOUR – DESIGN
- MAJOR CONTOUR – EXISTING
- MINOR CONTOUR – EXISTING

CONSTRUCTION NOTES

1.) Apply grass seed mix to all disturbed areas (see sheet 2)

2.) Excavated materials shall be spoiled on site and seeded.

N W E S

VERT SCALE: 1" = 10'

0 10 10

HORIZ SCALE: 1" = 50'

0 50 100

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774–2336

DRAWN BY: Christopher Tressler
DESIGNED BY: S. Yard & C. Tressler
REVIEWED BY: S. Yard

REV	DATE	BY	REVISION

GRADING PLAN AND CROSS-SECTION
Stock Pond Rehabilitation

COYOTE CREEK
Watershed-Scale Education and Training Grant
Travis Johnson, Johnson Livestock

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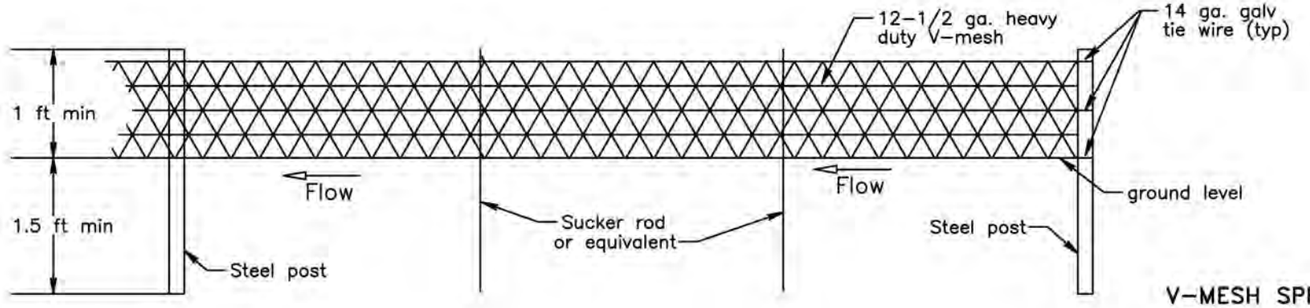
DATE: Aug 21, 2013

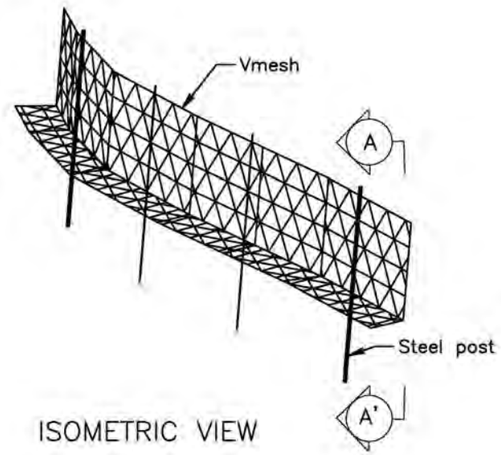
DRAWING NO: PLN02

NCD PROJECT NO: 10–183–AZ

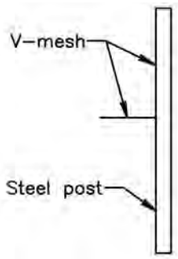
SHEET NO: 4 OF 6



TYPICAL V–MESH SPREADER
Not to Scale



ISOMETRIC VIEW



SECTION A–A'

V–MESH SPREADER

Purpose

The purpose of V Mesh Spreaders is to prevent concentration of runoff from causing rills, gullies, and headcuts. The spreader acts to slow the runoff, spread it over a larger area, and release it through the wire mesh openings at a slower, non–erosive rate. Spreaders can be used to:

- –Stabilize the flow from emergency spillways
- –Stabilize headcuts by rerouting flow
- –Prevent concentration and channeling of runoff from roads, kickouts, etc.
- –Prevent concentration of flow on rangelands and forestlands

Spreaders induce vegetative growth by increasing the infiltration of runoff into the ground.

Design & Installation

1. Height of wire can vary from 1–2 ft.
2. Selection of the proper grade is the critical design parameter. The grade along the alignment can vary from 0–4% (0–4 ft. per 100 ft.)
   - A. When crossing the draw, the alignment grade is at least 1/2 of draw slope.
   - B. When the cross slope is 2% or greater, the grade shall not exceed 1/2 of the cross slope, once the alignment is out of the draw.
   - C. When picking up water from emergency spillways, diversions, grassy draws, or swales, the grade must be sufficient to prevent silt buildup but catches trash. It is critical to have an accurate staked alignment.
   - D. For the first 50 to 100 feet of spreader, it is common in the mountain areas to begin with a grade of 2–3 ft. per 100 ft., then 0.5 ft. per 100 ft., then end with 0 ft. per 100 ft.
3. When used for emergency spillways, the top of the spreader shall be 0.5 ft. lower than the crest of the spillway.
4. Spreaders shall not be installed on sandy soils which produce a lot of sediment or are subject to wind erosion.
5. Errors in staking and/or construction can usually be corrected by pulling up the spreader intact and changing the grade.
6. When crossing a dip, rill, or concentrated flow area, the spreader needs to be strengthened by rocks (or equivalent) on the downslope side, by increasing the "away" grade, and/or increase the height of spreader wire and posts.

Natural Channel Design, Inc
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(928) 774–2336

DRAWN BY: C.Tressler			
DESIGNED BY: S.Yard & C.Tressler			
REVIEWED BY: S.Yard			
REV	DATE	BY	REVISION

DETAIL:
V-Mesh Spreader

COYOTE CREEK
Watershed-Scale Education and Training Grant
Travis Johnson, Johnson Livestock

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 8-21-13 ARIZONA, U.S.A.

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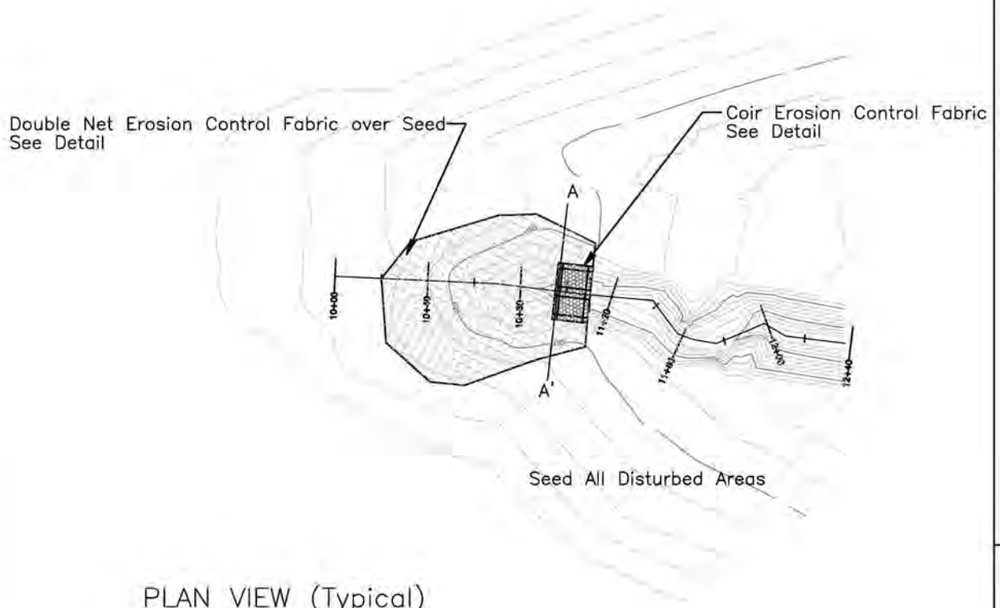
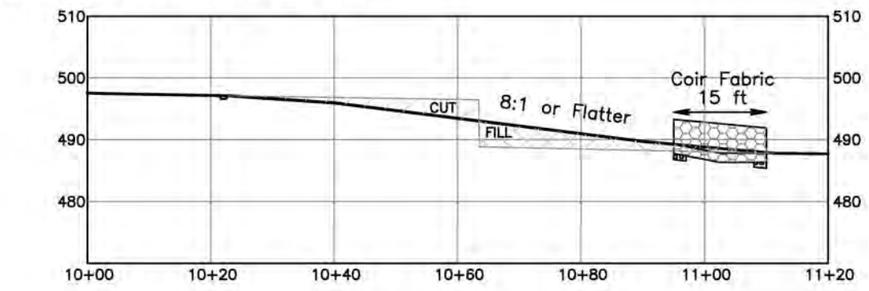
DATE: Aug 21, 2013
NCD PROJECT NO: 10–183–AZ
DRAWING NO: DTL01
SHEET NO: 5 OF 6



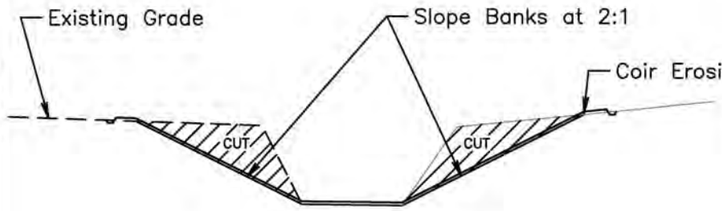
PLAN VIEW (Typical)

Not to Scale



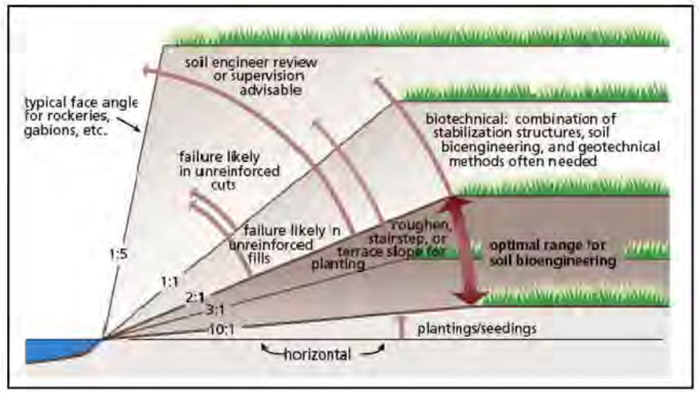
PROFILE (Typical)

Not to Scale

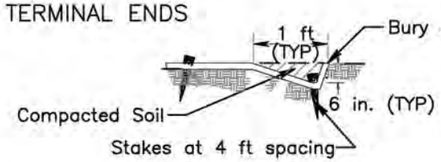


THROAT CROSS–SECTION A–A'
(Typical)

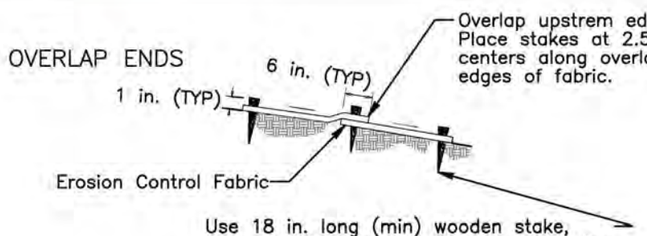
Not to Scale



TERMINAL ENDS

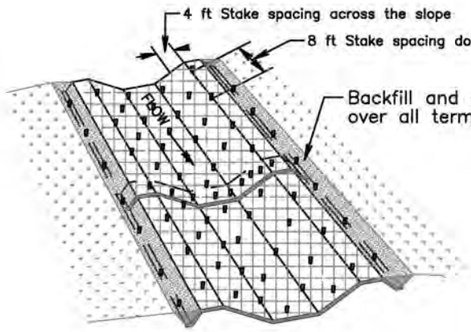


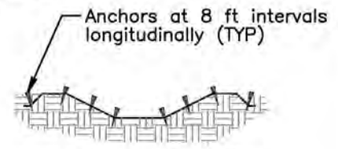
OVERLAP ENDS



Notes:

1. Where used in combination with live posts, cut erosion control fabric as necessary to fit around the posts & place extra stakes at the cut corners.
2. Align fabric parallel to streambank.
3. Overlap of the bristle coir mat & the double net shall match the overlap specifications as outlined by this detail.
4. Loose, sandy, rocky, or other problematic soil conditions may require longer or different fasteners.





CHANNEL FABRIC ANCHOR PATTERN
SECTION VIEW

EROSION CONTROL FABRIC
INSTALLATION DETAIL

Not to Scale

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774–2336

DRAWN BY: C.Tressler			
DESIGNED BY: S.Yard, C.Tressler			
REVIEWED BY: S. Yard			
REV	DATE	BY	REVISION

DETAIL:
Headcut Stabilization

COYOTE CREEK
Watershed-Scale Education and Training Grant
Travis Johnson, Johnson Livestock

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO. 26889
STEPHANIE N. YARD
Date Signed 8-21-13
ARIZONA, U.S.A.

Expires 3-31-2014

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DATE: Aug 21, 2013

DRAWING NO: DTL02

NCD PROJECT NO: 10–183–AZ

SHEET NO: 6 OF 6

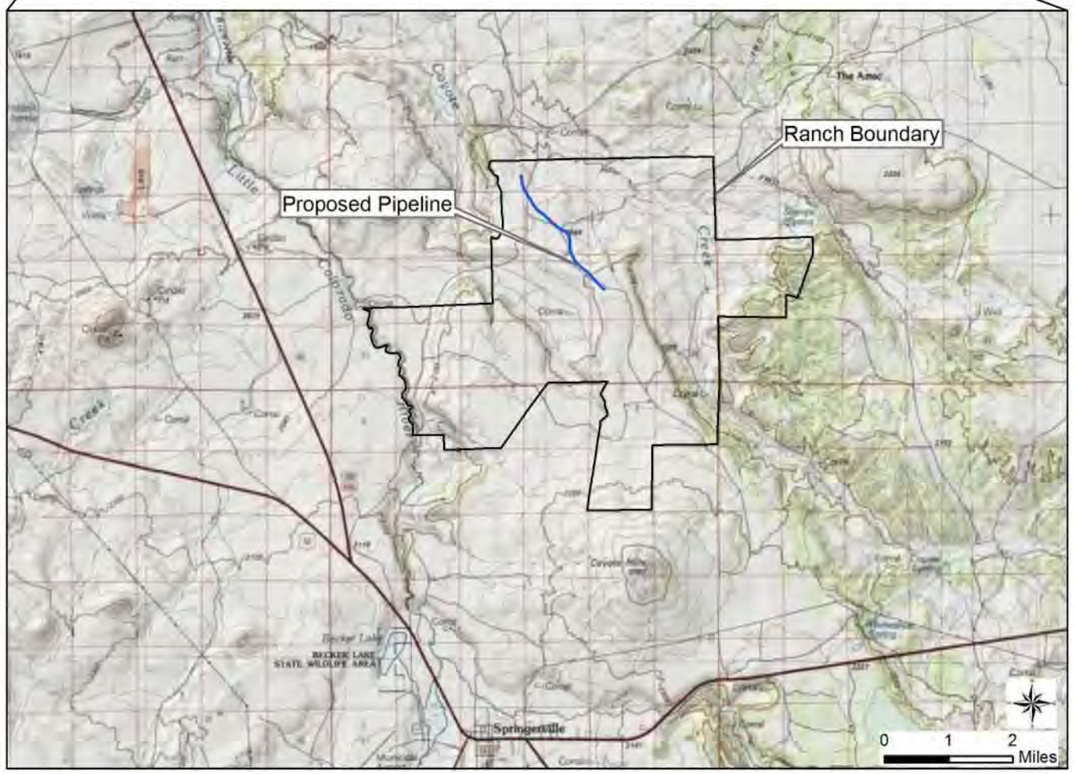
COYOTE CREEK
Watershed -Scale Education and Training Grant

PREPARED FOR: Galyn Knight - Cinco Noches Ranch

FUNDED BY:
Arizona Department of Environmental Quality (ADEQ)
Water Quality Division
Contract EV10-0051 (Project #12-002)

LOCATION MAP

Coyote Creek Watershed
Arizona, Gila & Salt River Meridian
Sec15,16,22,26,27, T10N, R29E



LANDOWNER:
Galyn Knight
PO Box 240
Springerville, AZ 85938
Phone: (928)521-9897

PROJECT MANAGER:
Little Colorado River
Plateau RC&D
David Newlin
153 W. Vista, Suite 2
Holbrook, AZ 86025
Phone: (928)524-2912

TECHNICAL CONSULTANT:
Natural Channel Design, Inc.
206 So. Elden Street
Flagstaff, AZ 86001
Phone: (928)774-2336

FUNDING AGENCY:
Arizona Department of Environmental Quality
1110 West Washington St.
Phoenix, AZ 85007
Phone: (602)771-4635

INDEX OF DRAWINGS

MATERIAL LIST

PIPELINE		
HDPE (160 psi – SDR 11)	1-1/4 in. Dia	12,410 LF
FITTINGS		
Shutoff Valve (MIN: 2ea 25 psi, 2ea 125 psi, 150 psi)	1-1/4 in. Dia	5 EA
Air Release Valve (AR) (MIN: 40 psi, 85 psi, 135 psi)	1-1/4 in. Dia	3 EA
Air-Vac/Air Release Valve (AVAR) (MIN: 25 psi, 125 psi)	1-1/4 in. Dia	2 EA
Pressure Reducer (INLET: 125 psi min) (OUTLET 10-30 psi)	1-1/4 in. Dia	1 EA
Float Valve (25 psi)		1 EA
WATER STORAGE		
Storage Tank	2,250 Gal	1 EA
Trough	350 Gal	1 EA

NOTES
Pressure rating is 25% above working pressure.
Miscelaneous appurtenances (tees, elbows, etc) not listed.

Natural Channel Design, Inc
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Flagstaff, Arizona 86001
(928) 774-2336

DRAWN BY:	C. Tressler & C. Moody		
DESIGNED BY:	S. Yard & C. Tressler		
REVIEWED BY:	S. Yard		
REV	DATE	BY	REVISION

COVER SHEET: Location, Index, Materials

Coyote Creek Watershed-Scale Education and Trainaing Grant
Galyn Knight - Livestock Pipeline

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DATE: 05/15/2012
DRAWING NO: CVR01
NCD PROJECT NO: 10-183-AZ
SHEET NO: 1 OF 6

PROJECT DESCRIPTION

The purpose of this pipeline and watering facilty is to provide adequate water for livestock and wildlife for improved grazing management. Water will be conveyed through a 1-1/4 inch HDPE pipeline from an existing 2,250 gallon storage tank to a new 2,250 gallon storage tank. The new storage tank will supply water to a 350 gallon trough. The pipeline will also tie to an existing 1-1/4 inch pipeline and 350 gallon trough.

GENERAL NOTES

1. Profile elevation data was taken from USGS topographic maps, with a contour interval of 20 ft.
2. All stationing refers to baseline of construction and is measured horizontal distance.
3. All existing conditions are to be verified in the field prior to construction.
4. 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 no utilities are present. The existence, location and depth of any utility must be determined by the contractor prior to any excavation. Call before you dig, 1-800-STAKE-IT
5. No construction shall begin until all necessary permits and easements are obtained.
6. Construction activities will be conducted in a manner consistent with all safety regulations, and other permitting required by Arizona State Land Department, Arizona Department of Environmental Quality, and others.
7. Installation shall be constructed to the lines and grades as shown on the drawings or as staked in the field by the ENGINEER or authorized representative, recognizing there is variation in nature.
8. Construction activities shall be performed in a manner that minimizes soil, water and air pollution.

CONSTRUCTION SPECIFICATIONS

PIPELINE

The work shall cover the supply of all labor, materials, and equipment required for furnishing and installing a livestock pipeline, including any appurtenances required for proper operation. See SHEET 4 for location and SHEETS 5 and 6 for Details.

PIPE AND FITTING MATERIALS

Plastic pipe shall conform to the requirements of the following specifications listed below or as shown on the drawings.

MATERIAL	ASTM Specification	AWWA Specification
ACrylonitrile-Butadiene-Styrene (ABS)	D1527, D2282	
Polyethylene (PE)	D2104, D2239, D2447, D2737, D3035	C901
Polyvinyl Chloride (PVC)	D1785, D2241, D2672	C900

All joints, connections, and appurtenances shall be capable of withstanding the designated design working pressure for the respective pipe. All appurtenant components including air/vacuum relief valves, control valves, pressure regulators, et cetera, shall conform to the type identified on the drawings.

Markings on the plastic pipe shall include the following:
- Nominal pipe size (e.g., 2 inches)
- Type of plastic pipe material, by designation code (e.g., PE3408)
- Pressure rating in psi for water at 23°C (73.4° F) (e.g., 160 psi)
- ASTM specification with which the pipe complies (e.g., D3035)
- Manufacturer's name (or trademark) and code
- The seal of approval of the National Sanitation Foundation (NSF), or approved equal

PLACEMENT

- Any grading, shaping, or ripping of the pipeline right-of-way, as deemed necessary by the design shall be done prior to the layout or installation of the pipe material.
- Pipelines shall be placed so they are protected against hazards imposed by traffic, farm operations, freezing temperatures, fire, or soil cracking.
- Trenches for plastic or coated pipelines shall be free of rocks and other sharp materials, and the pipe shall be carefully placed to prevent damage. Flexible plastic pipe may be placed by plow-in equipment if soils are suitable and rocks and boulders will not damage the pipe.
- Pipeline installation equipment shall be capable of installing the pipeline without causing immediate or long-term damage to the pipe or pipe couplers.
- Appurtenant structures shall be installed per manufacture recommendations and at the location shown on the drawings.
- Thrust blocks shall be installed per manufacture recommendations and at the location shown on the drawings.

TESTING

Pipelines placed in open excavated trenches will be tested before total backfill is completed. Backfill may be placed between the joints if needed to prevent movement of the pipe during testing. The pipe shall be filled with water and tested at the design working-head or at a minimum head of 10 feet, whichever is greater. All leaks shall be repaired and the test repeated.

DEPTH OF COVER

The pipe shall be placed to the minimum depth shown on the drawings. The pipe shall be placed below the frost line, and not less than 18 inches in range land and 30 inches when crossing cultivated fields. The minimum depth may be obtained by mounding soil over the pipeline on range land where site conditions such as shallow soils or rock make it impractical to attain the minimum depth of cover by usual means. If mounding is anticipated to be used to achieve the minimum depth, the contractor shall obtain approval of this option from the designer in writing. Surface pipelines shall be installed as shown on the drawings.

BACKFILLING

All backfilling shall be completed before the line is placed in service. For plastic or coated pipelines, the initial backfill shall be of selected material, free from rocks or other sharp material that would damage the pipe. Deformation or displacement of the pipe must not be allowed to occur during backfilling and compaction.

Natural Channel Design, Inc
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Flagstaff, Arizona 86001
(928) 774-2336

DRAWN BY: C. Tressler & C. Moody
DESIGNED BY: S. Yard & C. Tressler
REVIEWED BY: S. Yard

REV	DATE	BY	REVISION

GENERAL NOTES and CONSTRUCTION SPECIFICATIONS

Coyote Creek Watershed-Scale Education and Trainaing Grant
Galyn Knight - Livestock Pipeline

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DATE: 05/15/2012
DRAWING NO: GEN01
NCD PROJECT NO: 10-183-AZ
SHEET NO: 2 OF 6

WATERING FACILITY (Tank and Trough)

The work shall cover the supply of all labor, materials, and equipment required for furnishing and installing the materials necessary to construct a tank, trough, or other watertight container.
See SHEET 4 for location and SHEETS 5 and 6 for Details.

MATERIALS

Approved construction materials for water facilities are: reinforced concrete, galvanized and black sheet metal steel, and used heavy equipment tires. All piping for inlet, outlet and overflow fittings of the tank shall be new. Automatic water level control and/or overflow facilities shall be provided as appropriate.

INSTALLATION

Site Preparation/Foundation Work

The area immediately surrounding the tank or trough shall be smoothed and graded to permit free drainage of the surface water without erosion. The foundation shall be leveled, scarified, and compacted, before any material is placed.

If a tank or trough is to be constructed on a relatively impermeable soil, at least 4 inches of sand, gravel, or other porous material shall be placed on the foundation. When on-site materials exist, or can be reworked to provide a well-drained base, imported drain materials will not be required. The surface of the base material shall be smooth and without sharp protruding rocks to prevent damage to the bottom of the tank or trough.

The base material shall surround the outside of trough for a minimum of 4 feet. The bottom of the trough or tank shall be at least 2 inches above the surrounding ground surface.

Anchoring

Troughs and tanks shall be permanently installed and adequately anchored to prevent movement at all times by wind and livestock and prevent entry by livestock in accordance with details shown in the drawing. In the absence of details, anchoring may be done by, but is not limited to, the following:

- Concrete ballast at least 4 inches thick placed inside the tank or trough,
- Three or more equally spaced posts welded or bolted to facility and anchored in concrete or buried at least 30 inches into soil,
- Three or more equally spaced .-inch diameter guy wires secured to the facility with bolts or welded and anchored, or
- Two cross members of 1½-inch diameter steel pipes bolted to four equally spaced posts. The posts shall be standard steel posts or a minimum 4-inch-diameter juniper, piñon, or treated pine, and shall be set at least 30 inches deep.

Escape Ramps

Escape ramps will be of corrosion resistant materials. Escape ramps will be installed flush to the trough or tank wall in a manner that prevents animals from passing between the wall and the ramp.

Steel Reinforcement Requirements and Concrete Floor Thickness

Diameter of Tank (ft)	Floor Area(sf)	Floor Thickness (inches)	Min. Steel Reinforcement
0 to 20	0 to 315	4	6"x6", 10 gage welded wire fabric
20 to 30	315 to 706	6	6"x6", 6 gage welded wire fabric
30 to 40	706 to 1,256	6	#4 rebar, 12" center-to-center, both ways
> 40	> 1,256	8	#4 rebar, 9" center-to-center, both ways

TANK INSTALLATION

Reinforced Conrete

All concrete shall be proportioned, mixed, placed and cured as required to produce a 28-day strength of at least 3,000 pounds per square inch. Steel Reinforcement Requirements and Concrete Floor Thickness table lists minimum size and spacing. All reinforced concrete walls, if any, shall have a minimum thickness of 6 inches. Reinforcing steel bars shall be no. 4 or larger, spaced on 12-inch centers both ways. Reinforcing mesh (6"x6") made with 6-gage steel may be used in walls up to 4 feet in height.

The cement shall be Portland cement, Type II, II A or V, or as shown on drawings. If Type II or Type V is used, an airentraining agent shall be added to the mixing water in the amount needed to produce an air content of 5% to 7%.

Reinforcing steel in floors shall be covered by at least 2 inches of concrete. All splices shall be lapped a length of at least 30 times the diameter of the reinforcing steel and be tied in place with acceptable annealed steel wire. Reinforcing mesh shall be lapped at least 6 inches. Vertical reinforcement shall have an 18-inch leg projecting horizontally into the floor for joining into floor reinforcement and extend to within 3 inches of the top of the wall.

Footers shall be used on floors where erosion around the tank and/or undermining of the floor is anticipated. Minimum dimensions for footers shall be 12in deep by 10in thick. The concrete for the entire floor and foundation shall be placed continuously and as one unit. A construction joint shall be formed between the floor and the wall as shown on the drawings. Construction joint between wall and floor shall also be water tight.

Steel

Steel tanks shall meet the minimum requirements as described in the Steel Rim Tanks and Troughs table. Seams and joints may be bolted, riveted, or butt-welded. The ends of the steel may also be lapped and welded with a fillet weld on both sides. All joints must be of good quality and be watertight. Joints that are crimped or soldered are not acceptable.

For field fabricated tanks, bolted or riveted joints shall be lapped at least 2.0 inches. Holes shall be drilled or punched for 3/8-inch diameter bolts or rivets spaced at 1-1/2 inch on center, or holes may be drilled or punched for 1/2 inch diameter bolts or rivets spaced at 2 inches on center.

Corrugated steel shall be bolted or riveted per the manufacturer or commercial fabricating plant. The minimum thickness for prefabricated troughs made of corrugated steel is 20 gauge.

All welded joints shall be continuously welded in accordance with good welding procedures.

For steel structures with a concrete floor: prior to placement of concrete, the bottom 8.0 inches of the steel wall may be painted with asphalt. Prior to concrete placement, the assembled steel rim shall be leveled and temporarily held at the designed elevation with blocking. The walls shall be embedded a minimum of 4 inches into the reinforced concrete footing.

Refurbished Steel Tanks

Refurbished steel tanks shall meet the minimum requirements as new steel tanks and as described in the Steel Rim Tanks and Troughs table. Tanks shall be refurbished at a commercial tank refurbishing facility. They shall be cleaned to bare metal and coated with a material that meets NSF/ANSI Standard 61 for potable water.

Large Rubber Tire

Large clean, used tires may be used as troughs. Tires shall be cleaned and free of chemicals and free of any aftermarket chemical puncture sealer. Only tires without aftermarket chemical puncture sealer shall be installed.

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774-2336

DRAWN BY: C. Tressler & C. Moody
DESIGNED BY: S. Yard & C. Tressler
REVIEWED BY: S. Yard

REV	DATE	BY	REVISION

CONSTRUCTION SPECIFICATIONS

Coyote Creek Watershed-Scale Education and Trainaing Grant
Galyn Knight - Livestock Pipeline

REGISTERED PROFESSIONAL ENGINEER CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 5/15/2012 ARIZONA, U.S.A.
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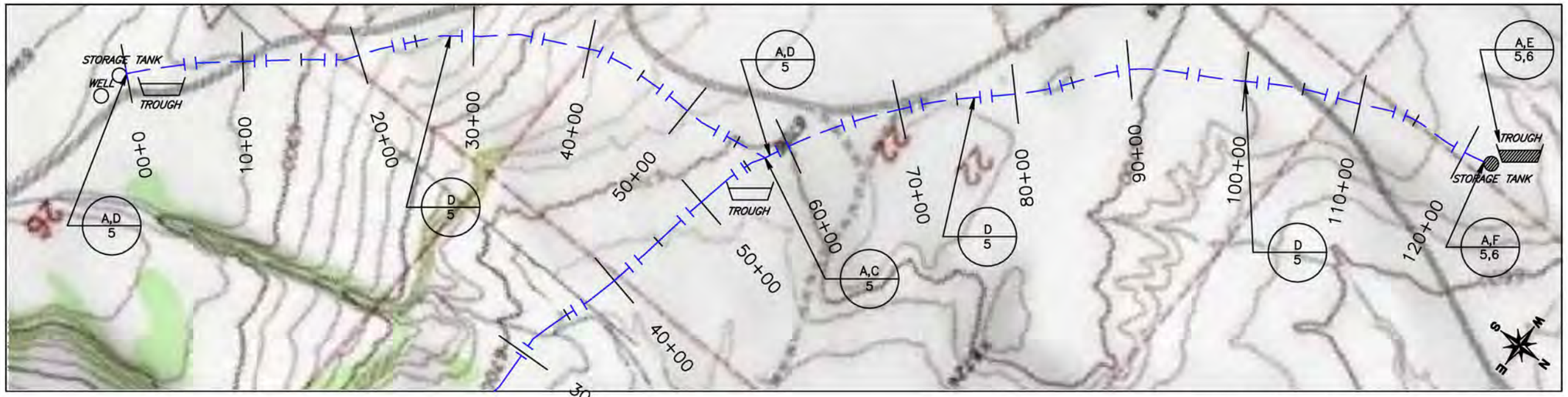
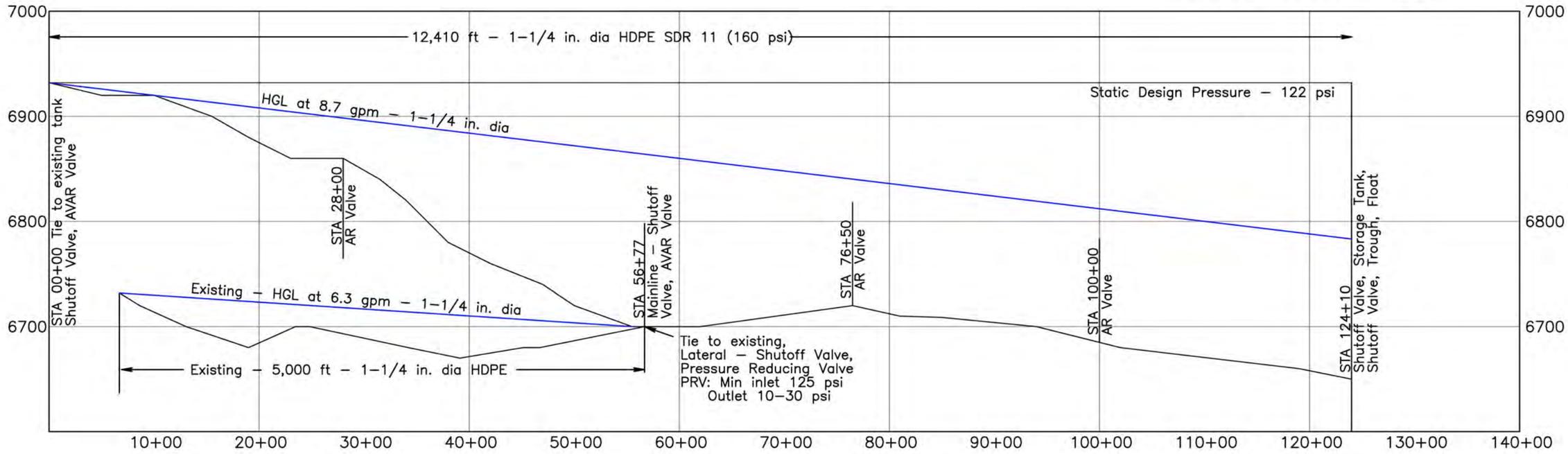
DATE: 05/15/2012
NCD PROJECT NO: 10-183-AZ
DRAWING NO: GEN02
SHEET NO: 3 OF 6



HORIZ SCALE: 1" = 1,000'
VERT SCALE: 1" = 100'

1,000 0 1,000



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DRAWN BY: C. Tressler & C. Moody			
DESIGNED BY: S. Yard & C. Tressler			
REVIEWED BY: S. Yard			
REV	DATE	BY	REVISION

PLAN AND PROFILE VIEW

Coyote Creek Watershed–Scale Education and Trainaing Grant
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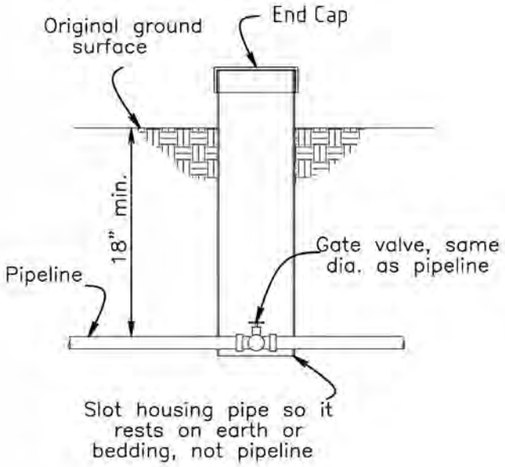
(OUTSIDE MARICOPA COUNTY)

DATE: 05/15/2012

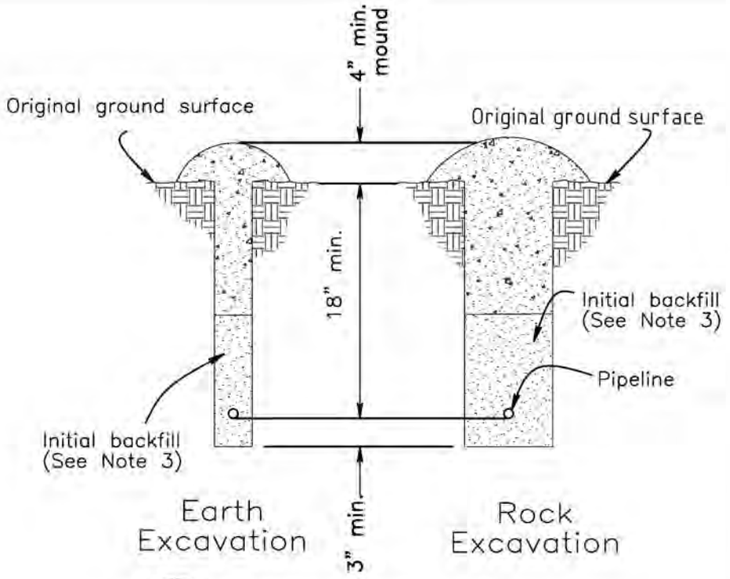
DRAWING NO: PP01

NCD PROJECT NO: 10–183–AZ

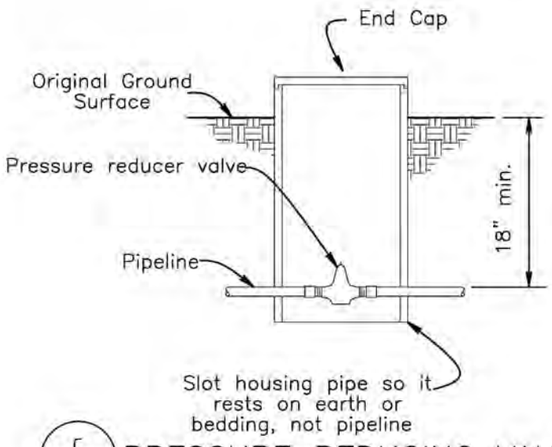
SHEET NO: 4 OF 6



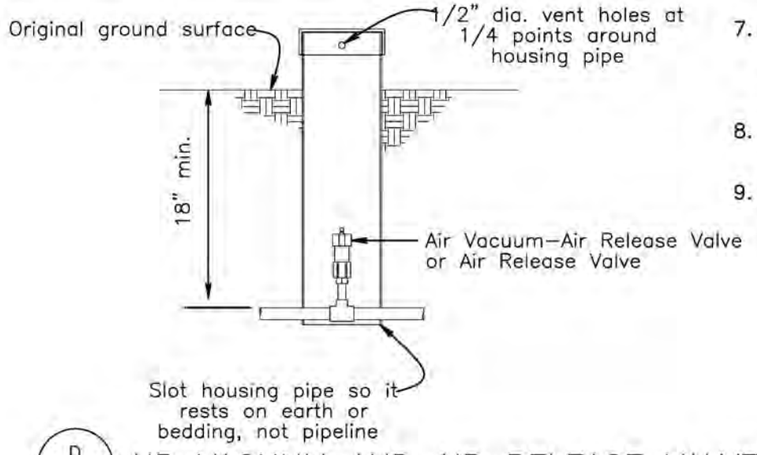
A/4 SHUTOFF VALVE



B/4 TRENCH DETAILS



C/4 PRESSURE REDUCING VALVE (PRV)



D/4 AIR VACUUM AND AIR RELEASE VALVE (AVAR) OR AIR RELEASE VALVE (AR)

GENERAL NOTES

1. Where bedding is required, the minimum trench width shall be fourteen (14) inches. The maximum trench width shall be twenty–four (24) inches.
2. Where the bottom of the trench is not free from rock, hard un–weathered shale, or boulders, bedding shall be provided. The trench shall be over excavated a minimum of three (3) inches below grade. The bedding material used to establish the final grade shall be sand or fine graded stable soil finer than 1/2 inche.
3. Initial backfill materials placed six (6) inches over the pipeline shall be finer than 1/2 inche. Remaining backfill shall be placed in layers not exceeding six (6) inches. The backfill shall be mounded for four (4) inches above the natural ground line.
4. Earthen water bars shall be provided where necessary to divert excess water runoff away from the trench.
5. Areas disturbed by construction activity shall be revegetated.
6. Vents for removing air should be located at all summits. An air release valve shall be located at the first summit from the water source. Special care shall be taken during the layout of the pipeline to eliminate grade changes that cause minor high points between the air vents. In no case shall the air vents be more than one (1) mile apart.
7. Automatic vacuum relief valves shall be designed for pipelines subject to extreme surge flow conditions such as pumping, fluctuating flow, or high velocity flow. Air vacuum release valves shall pe placed downstream of shutoff valves to allow air to return to pipe.
8. Guard posts shall be installed at all appurtenances which have above ground housing pipes.
9. See SHEET 2 for Pipeline construction specifications

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DESIGNED BY: S. Yard & C. Tressler			
REVIEWED BY: S. Yard			
REV	DATE	BY	REVISION

DETAILS: Trench and Valves

Coyote Creek Watershed–Scale Education and Trainaing Grant
Galyn Knight – Livestock Pipeline

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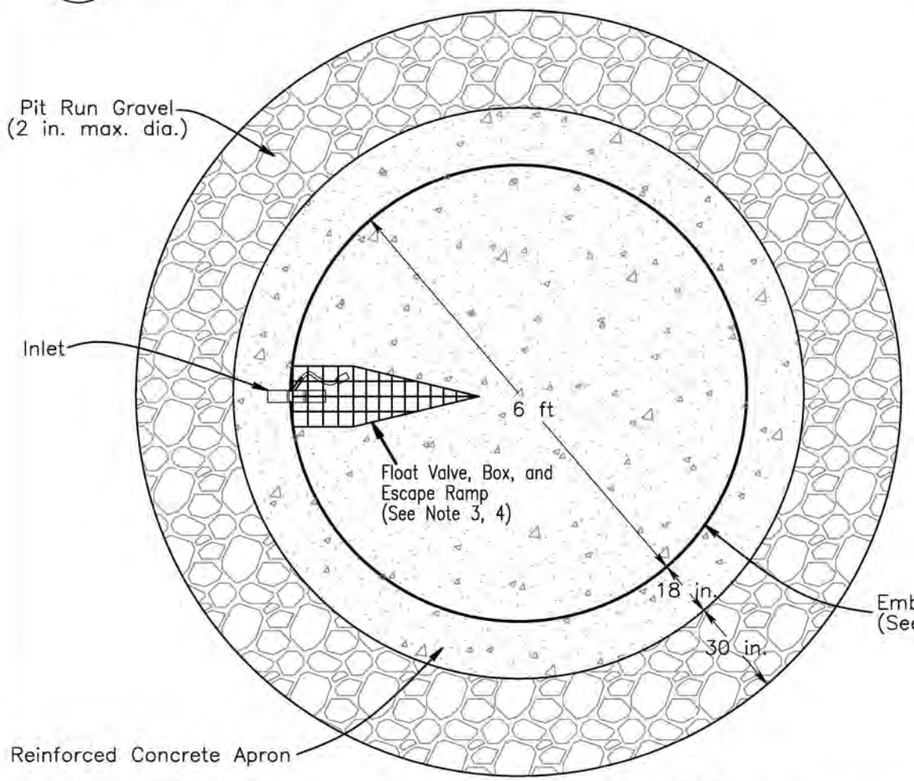
DATE: 05/15/2012

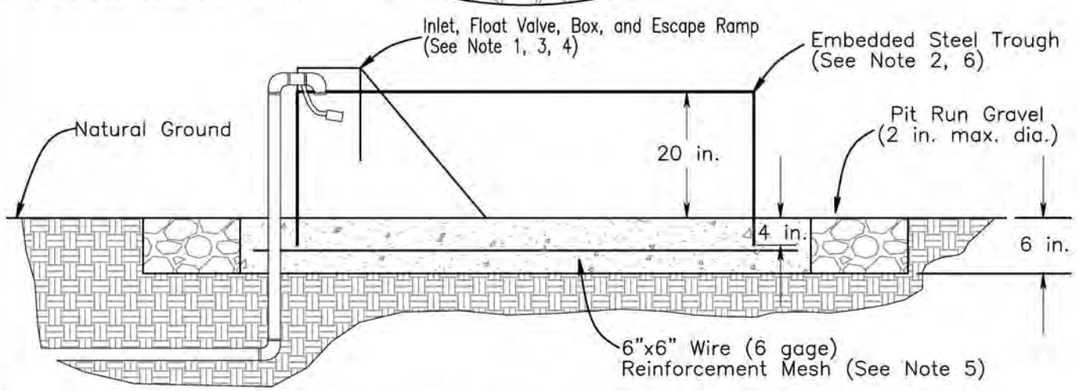
DRAWING NO: DT01

NCD PROJECT NO: 10–183–AZ

SHEET NO: 5 OF 6

E/4 Trough and Float

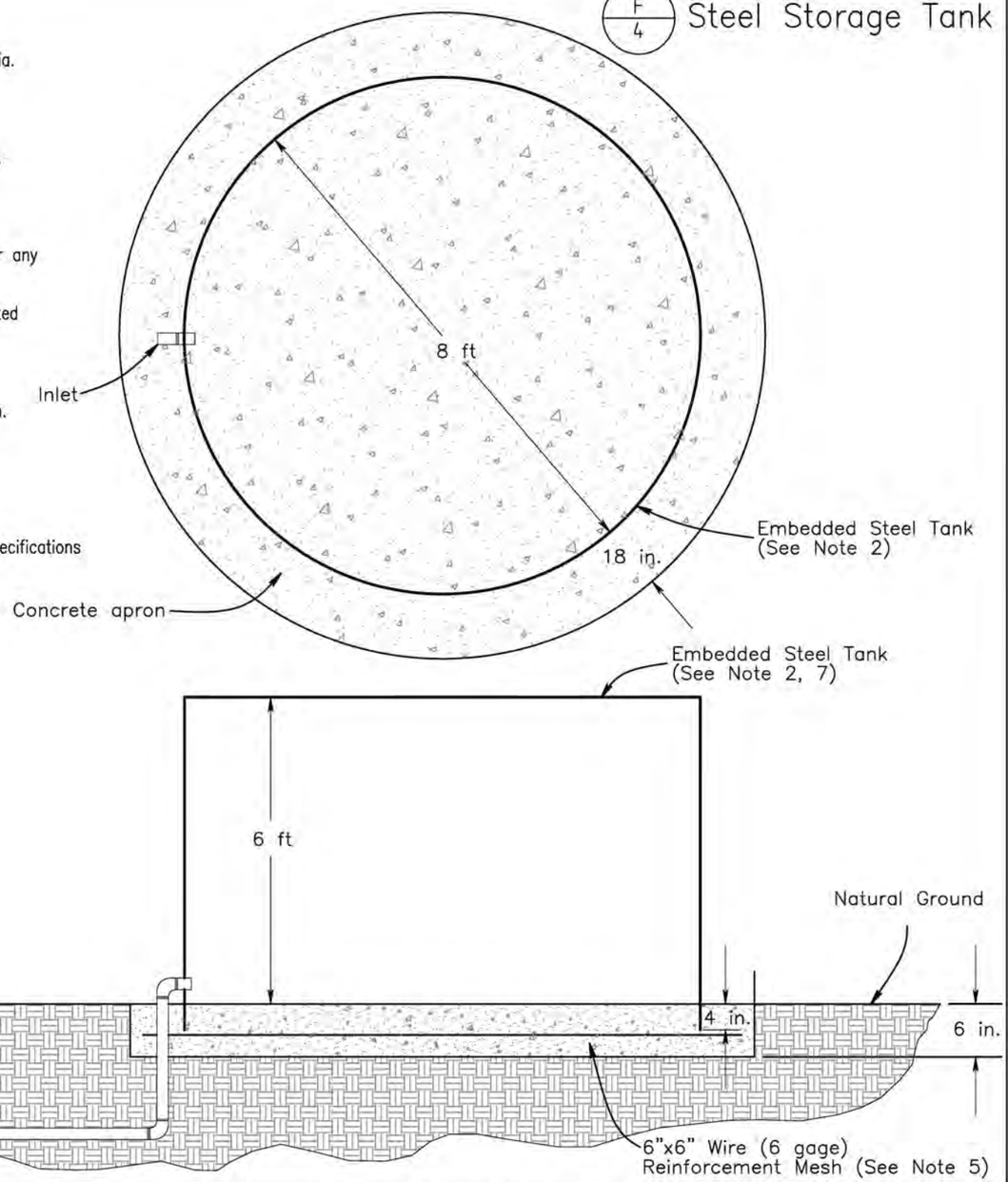




GENERAL NOTES

1. An overflow & drain pipe with a minimum 2 in. dia. must be installed if the water level in the tank is not controlled with a float. The drain pipe shall be installed to properly drain. Protect drain pipe at outlet end by backfilling over pipe with field stone, minimum 1 1/2 in. dia.
2. 3/16 inches wall thickness.
3. Trough shall contain a ~45 degree escape ramp installed to provide a positive means of escape for any bird or animal.
4. Trough Inlet and float or overflow must be protected by the shown protection system or an approved alternate. All fasteners shall be galvanized or stainless steel.
5. Reinforcing steel shall be covered by at least 2 in. of concrete and shall not contact steel walls.
6. Trough storage at 20 in. is ~ 350 gallons.
7. Tank storage at 6 ft is ~ 2,250 gallons.
8. See SHEET 3 for Tank and Trough construction specifications

F/4 Steel Storage Tank



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DRAWN BY: C. Tressler & C. Moody			
DESIGNED BY: S. Yard & C. Tressler			
REVIEWED BY: S. Yard			
REV	DATE	BY	REVISION

DETAILS: Trough and Float, Steel Storage Tank

Coyote Creek Watershed-Scale
Education and Trainaing Grant
Galyn Knight - Livestock Pipeline

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DATE: 05/15/2012

DRAWING NO: DT02

NCD PROJECT NO: 10-183-AZ

SHEET NO: 6 OF 6

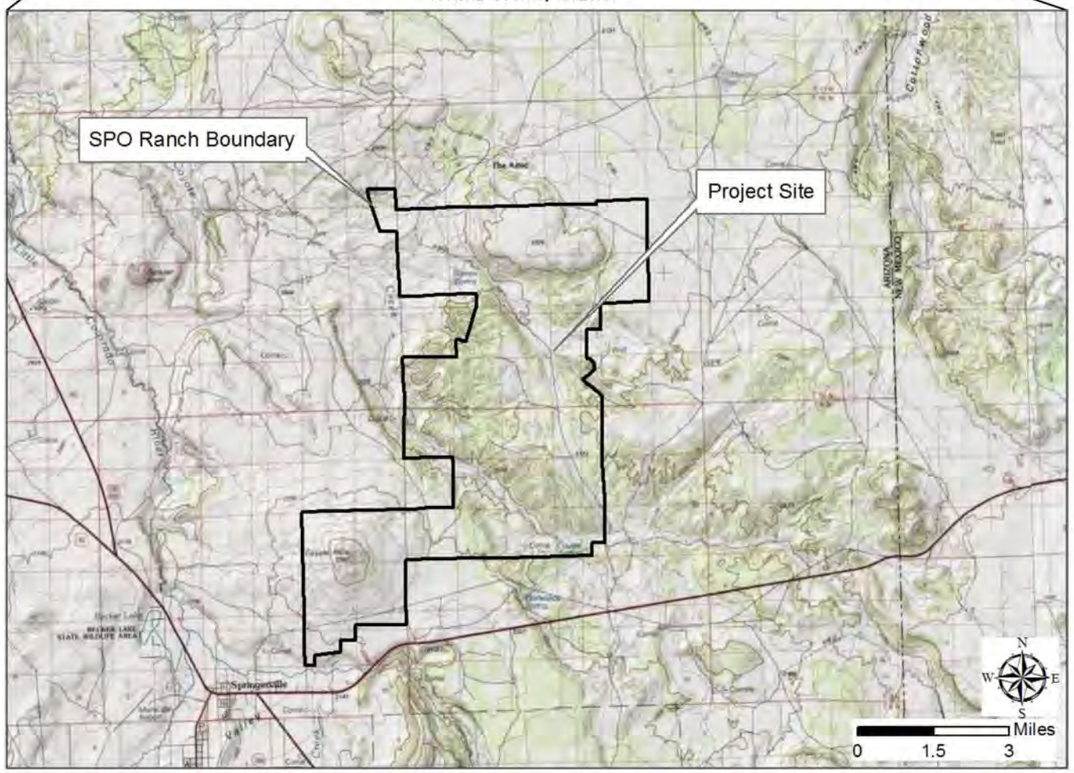
COYOTE CREEK
Watershed - Scale Education and Training Grant

PREPARED FOR: Sidney Maddock of the SPO Land and Cattle Company

FUNDED BY:
Arizona Department of Environmental Quality (ADEQ)
Water Quality Division
Contract EV10-0051 (Project #12-002)

LOCATION MAP

ARIZONA, GILA & SALT RIVER MERIDIAN
SW1/4 of the S/W 1/4 of
T10N, R30E, SEC. 27
APACHE COUNTY, ARIZONA



INDEX OF DRAWINGS

LANDOWNER:
Sidney Maddock
Phone: (602) 686-1590

PROJECT MANAGER:
Little Colorado River
Plateau RC&D
David Newlin
153 W. Vista, Suite 2
Holbrook, AZ 86025
Phone: (928) 524-2912

TECHNICAL CONSULTANT:
Natural Channel Design, Inc.
206 S. Elden Street
Flagstaff, AZ 86001
Phone: (928) 774-2336

FUNDING AGENCY:
Arizona Department of
Environmental Quality
1110 W. Washington St.
Phoenix, AZ 85007
Phone: (602) 771-4635

MATERIAL LIST

Berm Reconstruction Earthwork:		
CUT	20	CY
FILL	355	CY
Non-Woven Geotextile	230	SY
Rock Riprap	70	CY
Grass Seed Mix	0.25	AC
Drain Dip	7	EA

DESIGN INFORMATION

WATERSHED AREA: 1.1 SQ MI

HYDROLOGY: Est. Peak Flows

Q2	16 cfs
Q5	69 cfs
Q10	107 cfs*
Q25	180 cfs
Q50	252 cfs
Q100	286 cfs

* Design based 10-year flow

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DRAWN BY:	C. Tressler		
DESIGNED BY:	C. Tressler		
REVIEWED BY:	S. Yard		
REV	DATE	BY	REVISION

COVER SHEET:
Location, Index & Quantities

Coyote Creek
Watershed-Scale Education and Training Grant
Sidney Maddock - SPO Land and Cattle

REGISTERED PROFESSIONAL ENGINEER CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 10/28/2013 ARIZONA, U.S.A.

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(OUTSIDE MARICOPA COUNTY)

DATE: 10/28/2013

DRAWING NO: CVR01

NCD PROJECT NO: 10-183-AZ

SHEET NO: 1 OF 4

PROJECT DESCRIPTION

The purpose of this project is to repair a failed berm which directs runoff into a sediment basin, and to construct drain dips which will reduce concentrated flow and erosion from roads and roadside ditches. Improvement plan includes:

1) Reconstructing an eroded/breeched portion of a berm with fill and toe rock
2) Constructing 7 roadway drain dips on a severely eroding road
3) Seeding of all disturbed areas

GENERAL NOTES

1. Site survey data was collected by NCD on October, 2012.
2. All stationing refers to baseline of construction and is measured horizontal distance.
3. All existing conditions are to be verified in the field prior to construction.
4. 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 no utilities are present. The existence, location and depth of any utility must be determined by the contractor prior to any excavation. Call before you dig, 1-800-STAKE-IT
5. No construction shall begin until all necessary permits and easements are obtained.
6. Construction activities will be conducted in a manner consistent with all safety regulations, and other permitting required by Arizona State Land Department, Arizona Department of Environmental Quality, and others.
7. Installation shall be constructed to the lines and grades as shown on the drawings or as staked in the field by the ENGINEER or authorized representative, recognizing there is variation in nature.
8. Construction activities shall be performed in a manner that minimizes soil, water and air pollution.

CONSTRUCTION SPECIFICATIONS
EARTHWORK

The earthwork activities shall consist of berms, swales, bank sloping, drain dips, and debris removal.

Excavation

Excavation shall be limited to berm building, swale creation, water bars, and any necessary borrow to construct the berm as shown on the drawings or as staked in the field.
No excavation shall take place within any jurisdictional areas. Disturbance of existing native vegetation shall be minimized to the greatest extent possible during excavation.

Excavated material shall be placed in the specified berm location as shown on the drawings or as staked in the field. All finished surfaces shall be generally smooth and pleasing in appearance.

Earthfill

Materials: All fill materials shall be obtained from the required excavations and approved borrow sources. Fill materials shall not contain sod, brush, roots, perishable or frozen materials.

Placement: The placement of fill materials shall follow these guidelines:

- Any vertical bank shall be sloped before placement of fill material.
- The placing and spreading of fill material shall be started at the lowest point and the fill brought up and compacted to obtain a density similar to the surrounding bank material.
- Material when placed shall contain sufficient moisture so that a sample taken in the hand and squeezed shall remain intact when released.
- The placing and spreading of fill material shall be started at the lowest point and the fill brought up in horizontal layers not to exceed: six (6) inches of loose fill for wheel compaction and four (4) inches of loose fill for dozer compaction. Construction equipment shall be operated over the areas of each layer of fill to insure that the required compaction is obtained.
- Fill shall not be placed on frozen soil, snow or ice.
- Channels designated for filling and re-contouring shall be filled as close as possible to the historic natural ground surface, and smoothed and shaped to blend with the surrounding landscape.
- All finished surfaces shall be generally smooth and pleasing in appearance and blend into surrounding terrain.

BERM STABILIZATION

The berm stabilization work shall consist of furnishing and installing loose rock including placement of filter fabric. See SHEET 3 for Details.

> Non-woven geotextile shall be placed behind the rock. Fabric shall have a minimum grab tensile strength of 90 lb, greater than 50% elongation at failure, a minimum of 40 lb puncture strength, and UV resistance of 70% strength retained. The geotextile shall be joined by overlapping a minimum of 18 inches and secured against the underlying foundation material. Securing pins shall be installed as necessary to prevent undue slippage or movement of the geotextile. Recommend 3/16-inch steel bars pointed on one end and fabricated with a head to retain a steel washer. (1.5-inch diameter). Pin length shall be not less than 18 inches. U-shaped pins are acceptable.
> Rock shall be angular, dense, sound and free from cracks, seams, or other defects conducive to accelerated weathering. 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 or authorized representative and have a bulk specific gravity of not less that 2.0 per ASTM C127. Rock shall be well graded as follows:

Diameter, in.	Percent Passing
18	Dmax
15	D75
12	D50
6	Dmin

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

> Rock placement shall begin at the bottom of slope. Rock shall not be dropped more than 3 feet onto geotextile.
> Sloped banks shall be seeded with native grass.

RANGELAND SEEDING

Disturbed areas will be seeded with native grasses. Seeding activities include the following:
> Prepare seedbed where needed.
> Seed can be drilled or broadcast by hand.
> Seed shall be incorporated into the soil, but not more than 1-inch deep.

Seeding dates vary for different grasses, legumes, and forbs. Seed shall be purchased from a reliable supplier. The grass seed mix will consist of the following species as available. The seeding rates below are for planting by hand broadcasting.

Seed Mix	
Western Wheatgrass (Pascopyrum smithii)	9.00 lb/ac PLS
Blue Grama (Bouteloua gracilis)	1.50 lb/ac PLS
	10.50 lb/ac PLS

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DESIGNED BY:	C. Tressler		
REVIEWED BY:	S. Yard		
REV	DATE	BY	REVISION

GENERAL NOTES & CONSTRUCTION SPECIFICATIONS

Coyote Creek
Watershed-Scale Education and Training Grant
Sidney Maddock - SPO Land and Cattle

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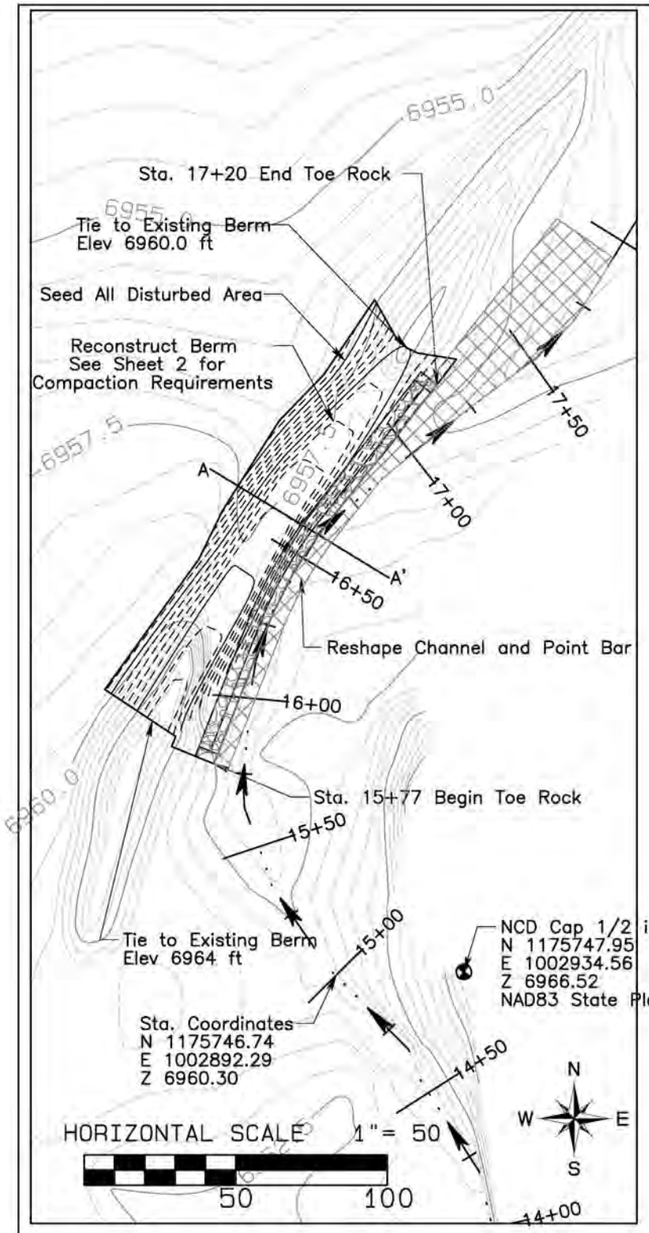
DATE: 10/28/2013

DRAWING NO: GEN01

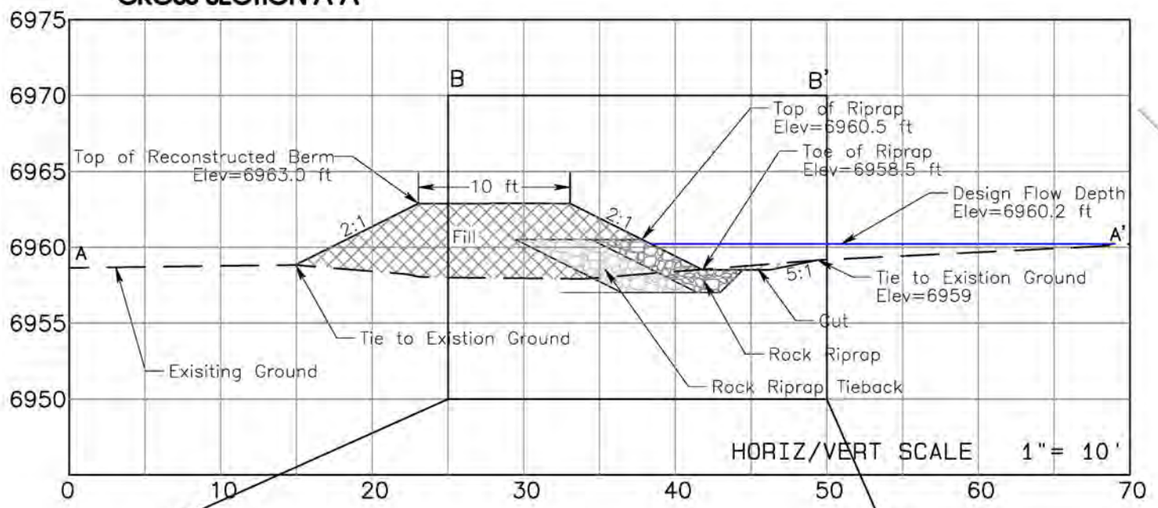
NCD PROJECT NO: 10-183-AZ

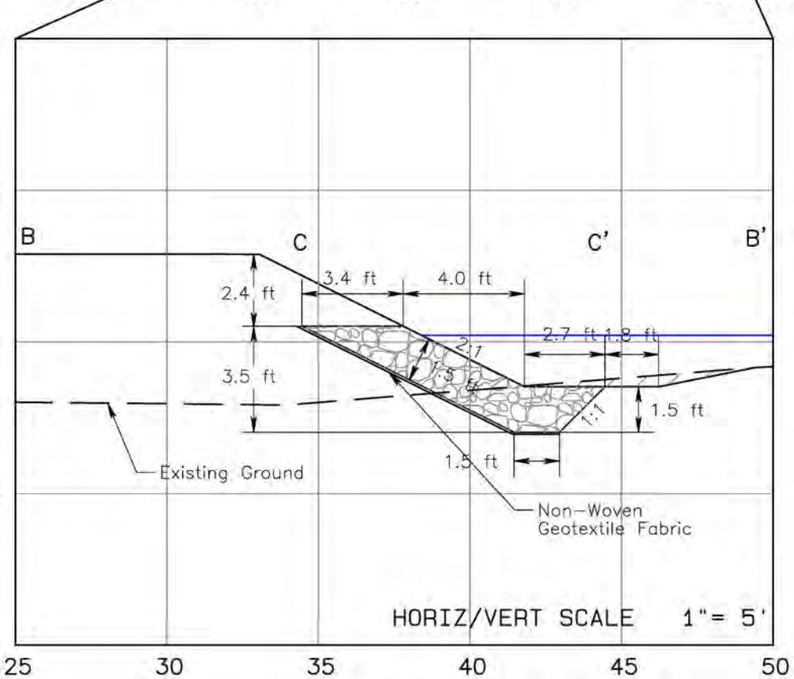
SHEET NO: 2 OF 4



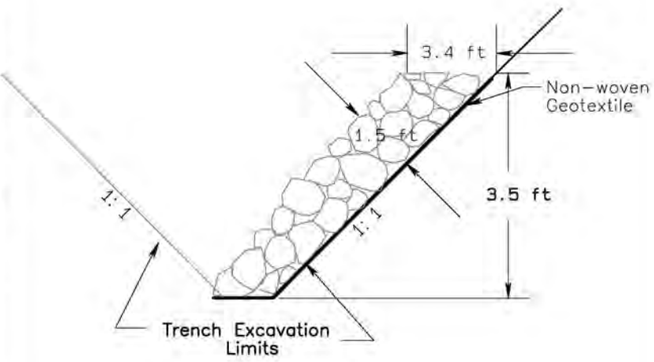
PLAN VIEW

CROSS-SECTION A-A'

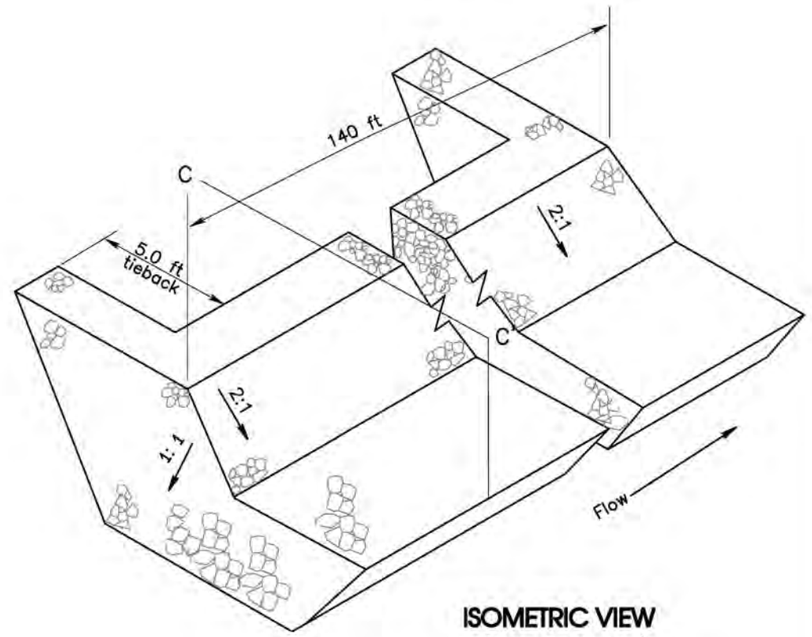




CROSS-SECTION B-B'



TYPICAL TIE BACK SECTION
(Not to Scale)



ISOMETRIC VIEW
(Not to Scale)

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DRAWN BY:	C. Tressler		
DESIGNED BY:	C. Tressler		
REVIEWED BY:	S. Yard		
REV	DATE	BY	REVISION

PLAN AND PROFILE

Coyote Creek
Watershed-Scale Education and Training Grant
Sidney Maddock - SPO Land and Cattle

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
26889
STEPHANIE N. YARD
Date Signed 10/28/2013
ARIZONA, U.S.A.

Expires 3-31-2014

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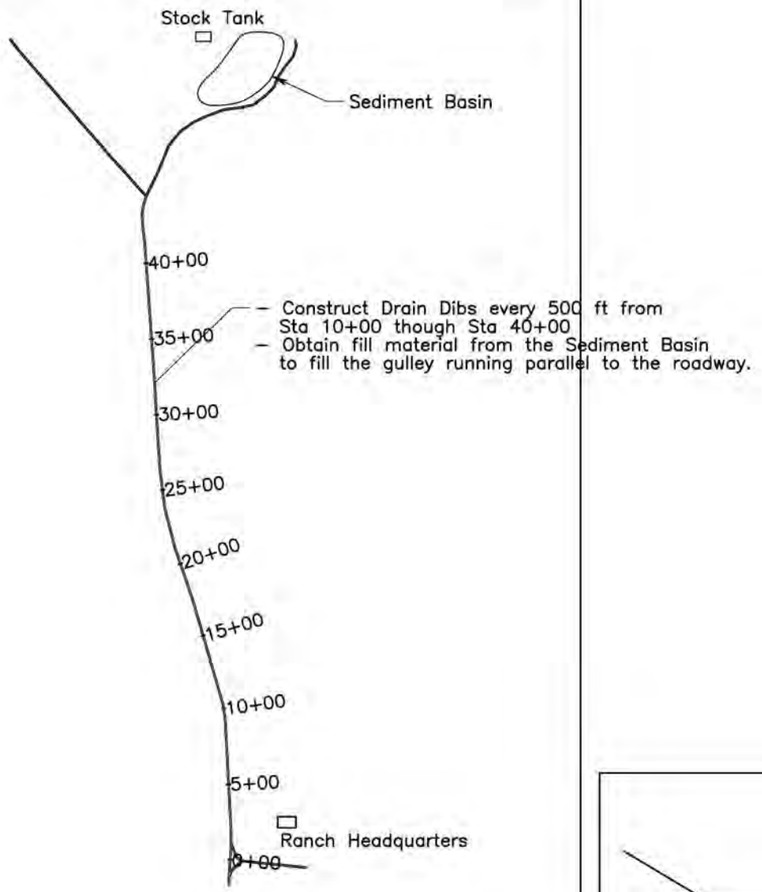
263-1100
1-800-STAKE-IT
(OUTSIDE MARICOPA COUNTY)

DATE: 10/28/2013

DRAWING NO: PP01

NCD PROJECT NO: 10-183-AZ

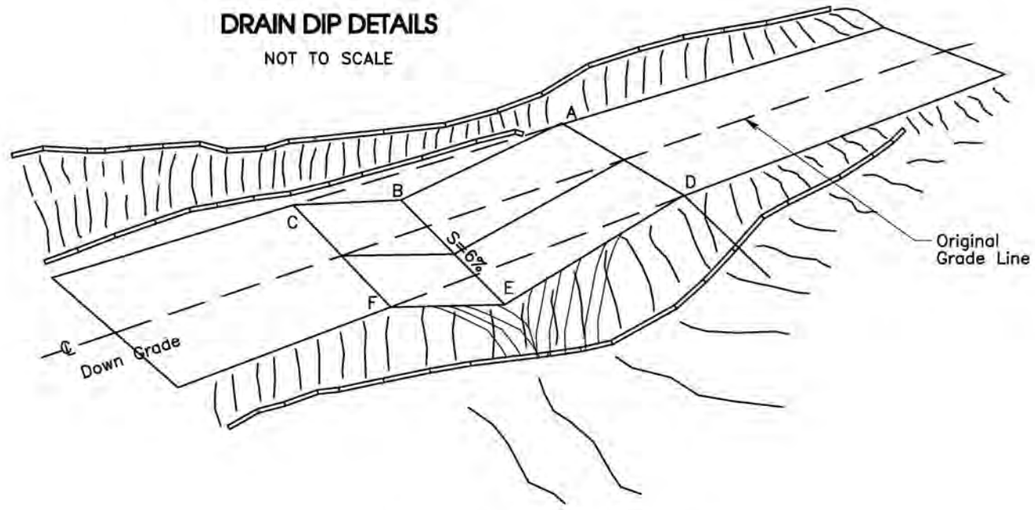
SHEET NO: 3 OF 4



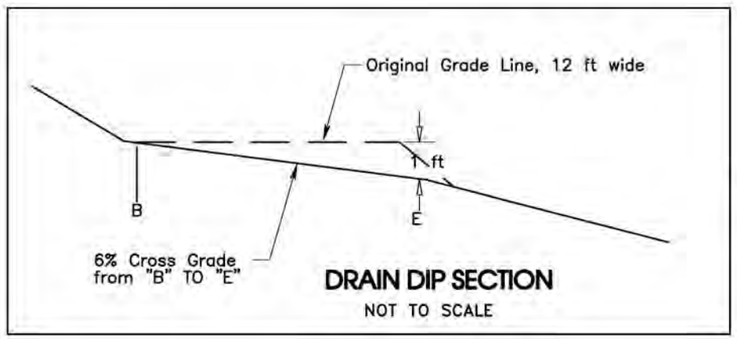
PLAN VIEW WATERBAR LOCATIONS

DRAIN DIP DETAILS

NOT TO SCALE

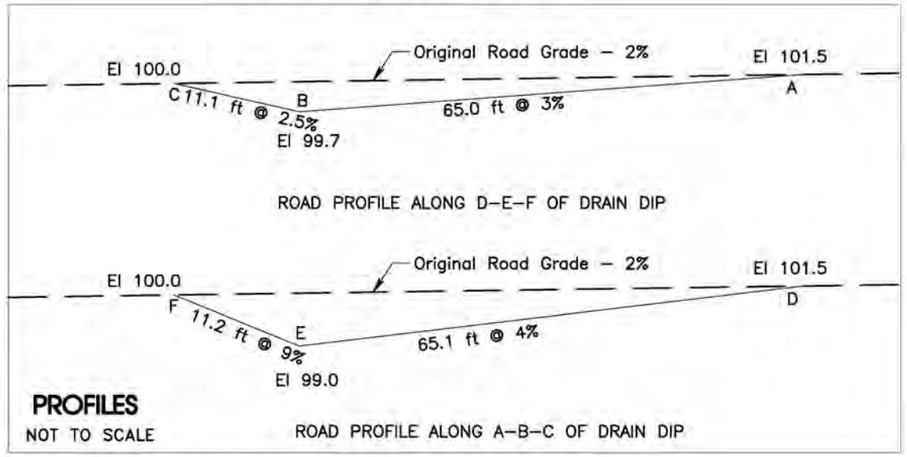


CROSS-SECTIONAL VIEW



DRAIN DIP SECTION

NOT TO SCALE



PROFILES

NOT TO SCALE

Natural Channel Design, Inc

206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774–2336

DRAWN BY:	C. Tressler		
DESIGNED BY:	C. Tressler		
REVIEWED BY:	S. Yard		
REV	DATE	BY	REVISION

DRAIN DIP DETAIL AND PLAN

Coyote Creek
Watershed-Scale Education and Training Grant
Sidney Maddock - SPO Land and Cattle

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 10/28/2013 ARIZONA, U.S.A.

Expires 3-31-2014

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CALL TWO WORKING DAYS BEFORE YOU DIG 263-1100 1-800-STAKE-IT (OUTSIDE MARICOPA COUNTY)

DATE: 10/28/2013

DRAWING NO: DTL 01

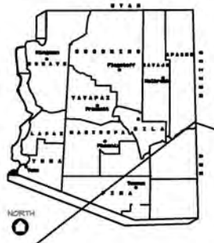
NCD PROJECT NO: 10–183–AZ

SHEET NO: 4 OF 4

COYOTE CREEK
Watershed - Scale Education and Training Grant

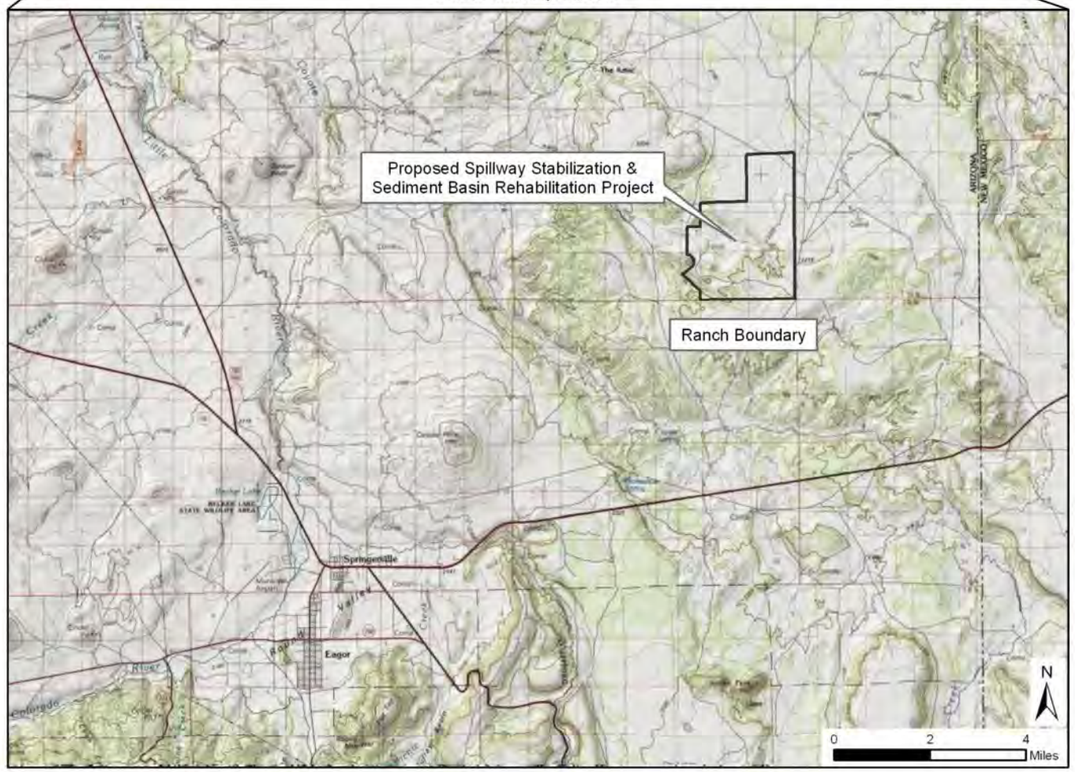
PREPARED FOR: Fred Moore

FUNDED BY:
Arizona Department of Environmental Quality (ADEQ)
Water Quality Division
Contract EV10-0051 (Project #12-002)



LOCATION MAP

ARIZONA, GILA & SALT RIVER MERIDIAN
T10N, R30E, SEC. 26
APACHE COUNTY, ARIZONA



LANDOWNER:
Fred Moore
(contact: Daric Knight)
Phone: (928) 521–9897

PROJECT MANAGER:
Little Colorado River
Plateau RC&D
David Newlin
153 W. Vista, Suite 2
Holbrook, AZ 86025
Phone: (928) 524–2912

TECHNICAL CONSULTANT:
Natural Channel Design, Inc.
206 S. Elden Street
Flagstaff, AZ 86001
Phone: (928) 774–2336

FUNDING AGENCY:
Arizona Department of
Environmental Quality
1110 W. Washington St.
Phoenix, AZ 85007
Phone: (602) 771–4635

INDEX OF DRAWINGS

WORK QUANTITIES

EARTHWORK:	
CUT	5450 CU YD
FILL	1155 CU YD
GRASS SEED MIX	2.75 AC

Natural Channel Design, Inc
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(928) 774–2336

DRAWN BY: C. SCUDIERI			
DESIGNED BY: C. SCUDIERI, S. YARD			
REVIEWED BY: S. YARD, G. CATHEY			
REV	DATE	BY	REVISION

COVER SHEET:
Location, Index & Quantities

COYOTE CREEK
Watershed-Scale Education and Training Grant
Fred Moore

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 2/28/12 ARIZONA, U.S.A.

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DATE: AUGUST 28, 2012

DRAWING NO: CVR01

NCD PROJECT NO: 10–183–AZ

SHEET NO: 1 OF 6

PROJECT DESCRIPTION

The purpose of this project is to stabilize the eroding spillway and rehabilitate the associated sediment basin. Improvement plan includes:

1) Construct new stable 200 ft spillway and apron by excavating along southern edge of basin.
2) Stabilize headcut in existing spillway with fill material from basin/spillway excavation.
3) Rehabilitate existing sediment basin to provide additional sediment storage.
4) Extend existing berm across top of eroding spillway with fill material from basin/spillway excavation.
5) Seed disturbed areas and spillway with native grass seed.

GENERAL NOTES

1. Site survey data was collected by NCD on March 29, 2012.
2. All stationing refers to baseline of construction and is measured horizontal distance.
3. All existing conditions are to be verified in the field prior to construction.
4. 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 no utilities are present. The existence, location and depth of any utility must be determined by the contractor prior to any excavation. Call before you dig, 1-800-STAKE-IT
5. No construction shall begin until all necessary permits, easements, and funding authorizations are obtained.
6. Construction activities will be conducted in a manner consistent with all safety regulations, and other permitting required by Arizona State Land Department, Arizona Department of Environmental Quality, and others.
7. Installation shall be constructed to the lines and grades as shown on the drawings or as staked in the field by the ENGINEER or authorized representative, recognizing there is variation in nature.
8. Construction activities shall be performed in a manner that minimizes soil, water and air pollution.

CONSTRUCTION SPECIFICATIONS

EARTHWORK

The earthwork activities shall consist of sediment basin and spillway rehabilitation and berm.

Excavation

Excavation shall be limited to sediment basin and spillway construction as shown on the drawings or as staked in the field. No excavation shall take place within any jurisdictional areas.
Disturbance of existing native vegetation shall be minimized to the greatest extent possible during excavation.

Excavated material shall be placed in the specified berm and headcut locations as shown on the drawings or as staked in the field. All finished surfaces shall be generally smooth and pleasing in appearance and blend into surrounding terrain.

Earthfill

Materials: All fill materials shall be obtained from the required excavations and approved borrow sources. Fill materials shall not contain sod, brush, roots, perishable or frozen materials.

Placement: The placement of fill materials shall follow these guidelines:

- Any vertical bank shall be sloped before placement of fill material.
- The placing and spreading of fill material shall be started at the lowest point and the fill brought up and compacted to obtain a density similar to the surrounding bank material.
- Material when placed shall contain sufficient moisture so that a sample taken in the hand and squeezed shall remain intact when released.
- The placing and spreading of fill material shall be started at the lowest point and the fill brought up in horizontal layers not to exceed: six (6) inches of loose fill for wheel compaction and four (4) inches of loose fill for dozer compaction. Construction equipment shall be operated over the areas of each layer of fill to insure that the required compaction is obtained.
- Fill shall not be placed on frozen soil, snow or ice.
- Headcuts and gullies designated for filling and re-contouring shall be filled as close as possible to the historic natural ground surface, and smoothed and shaped to blend with the surrounding landscape.
- All finished surfaces shall be generally smooth and pleasing in appearance and blend into surrounding terrain.

RANGELAND SEEDING

Disturbed areas will be seeded with native grasses. Seeding activities include the following:

> Prepare seedbed where needed.
> Seed can be drilled or broadcast by hand.
> Seed shall be incorporated into the soil, but not more than 1-inch deep.

Seeding dates vary for different grasses, legumes, and forbs. Seed shall be purchased from a reliable supplier. The grass seed mix will consist of the following species as available. The seeding rates below are for planting by hand broadcasting.

Seed Mix	
Western Wheatgrass (Pascopyrum smithii)	9.00 lb/ac PLS
Blue Grama (Bouteloua gracilis)	1.50 lb/ac PLS
	10.5 lb/ac PLS

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774-2336

DRAWN BY: C. SCUDIERI
DESIGNED BY: C. SCUDIERI & S. YARD
REVIEWED BY: S. YARD, G. CATHEY

REV	DATE	BY	REVISION

GENERAL NOTES & CONSTRUCTION SPECIFICATIONS

COYOTE CREEK
Watershed-Scale Education and Training Grant
Moore Ranch

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 8/28/12 ARIZONA, U.S.A.
Expires 3-31-2014

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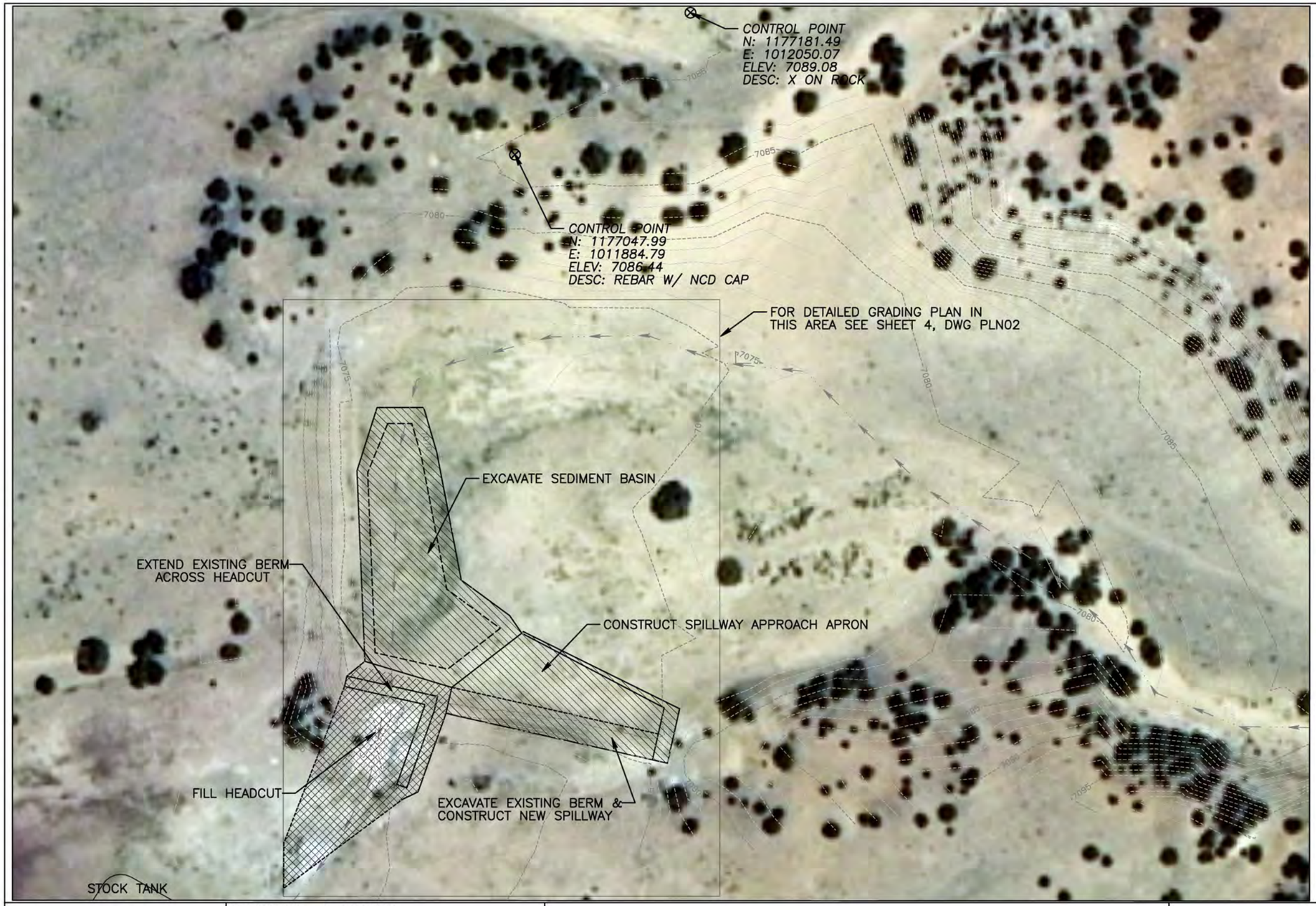
CALL TWO WORKING DAYS BEFORE YOU DIG 263-1100 1-800-STAKE-IT (OUTSIDE MARICOPA COUNTY)

DATE: AUGUST 28, 2012
DRAWING NO: GEN01
NCD PROJECT NO: 10-183-AZ
SHEET NO: 2 OF 6



LEGEND:

- CUT
- FILL
- EXISTING FLOWLINE
- ⊗ CONTROL POINT
- MAJOR CONTOUR – EXISTING
- MINOR CONTOUR – EXISTING

HYDROLOGY SUMMARY:

WATERSHED AREA: 2003 AC (3.1 SQ MI)

METHOD:	Q10 (CFS)	Q25 (CFS)
TR–55	78	182
NFF Weighted	144	239
LCR Regional Curve	105	151
Average of 3 Methods (used for design)	109	191

SEDIMENT YIELD:

ANNUAL VOLUME (PSIAC): 1.5 AC–FT (2500 CU YD) PER YEAR

N W E S

HORIZ SCALE: 1" = 100'

100 0 100

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(928) 774–2336

DRAWN BY: C. SCUDIERI
DESIGNED BY: C. SCUDIERI & S. YARD
REVIEWED BY: S. YARD, G. CATHEY

REV	DATE	BY	REVISION

PLAN VIEW:
Project Overview

COYOTE CREEK
Watershed-Scale Education and Training Grant
Moore Ranch

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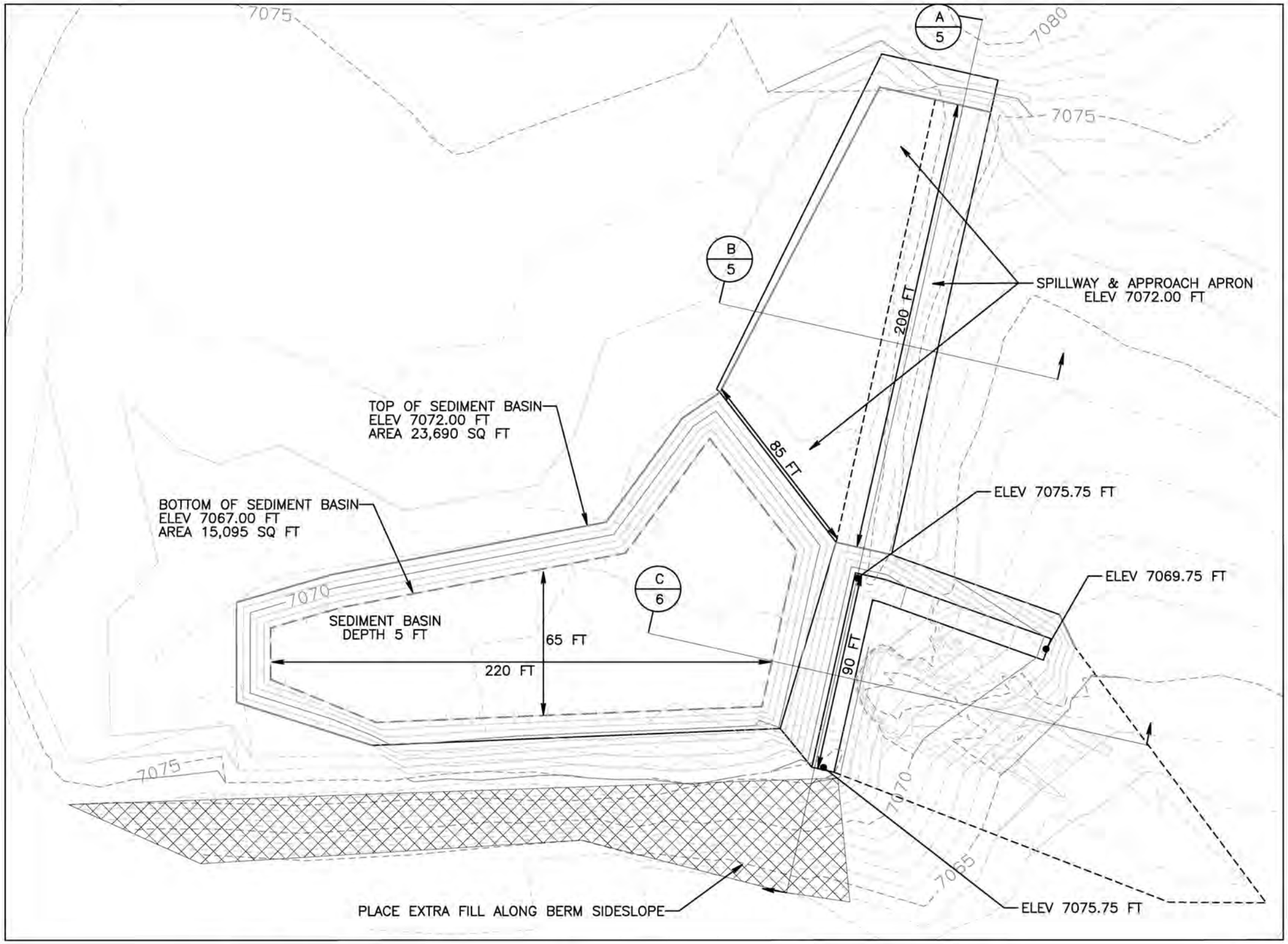
DATE: AUGUST 28, 2012

DRAWING NO: PLN01

NCD PROJECT NO: 10–183–AZ

SHEET NO: 3 OF 6



LEGEND:

- FILL
- MAJOR CONTOUR – DESIGN
- MINOR CONTOUR – DESIGN
- MAJOR CONTOUR – EXISTING
- MINOR CONTOUR – EXISTING
- DETAIL LOCATION (B / 5 — SHEET REFERENCE; DETAIL IDENTIFIER)

CONSTRUCTION NOTES

1.) ARMOR EXIT CHANNEL DOWNSTREAM OF LEVEL SPILLWAY W/ SORTED COURSE MATERIAL FROM EXCAVATION ACTIVITIES

2.) IMPORTANT THAT THE APPROACH APRON & SPILLWAY BE LEVEL AT AN ELEV OF 7072.00 FT

3.) APPLY GRASS SEED MIX TO ALL DISTURBED AREAS (SEE SHEET 2)

HORIZ SCALE: 1" = 50'

50 0 50

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Flagstaff, Arizona 86001
(928) 774–2336

DRAWN BY: C. SCUDIERI
DESIGNED BY: C. SCUDIERI, S. YARD
REVIEWED BY: S. YARD, G. CATHEY

REV	DATE	BY	REVISION

GRADING PLAN:
Spillway Stabilization & Sediment Basin Rehabilitation

COYOTE CREEK
Watershed-Scale Education and Training Grant
Moore Ranch

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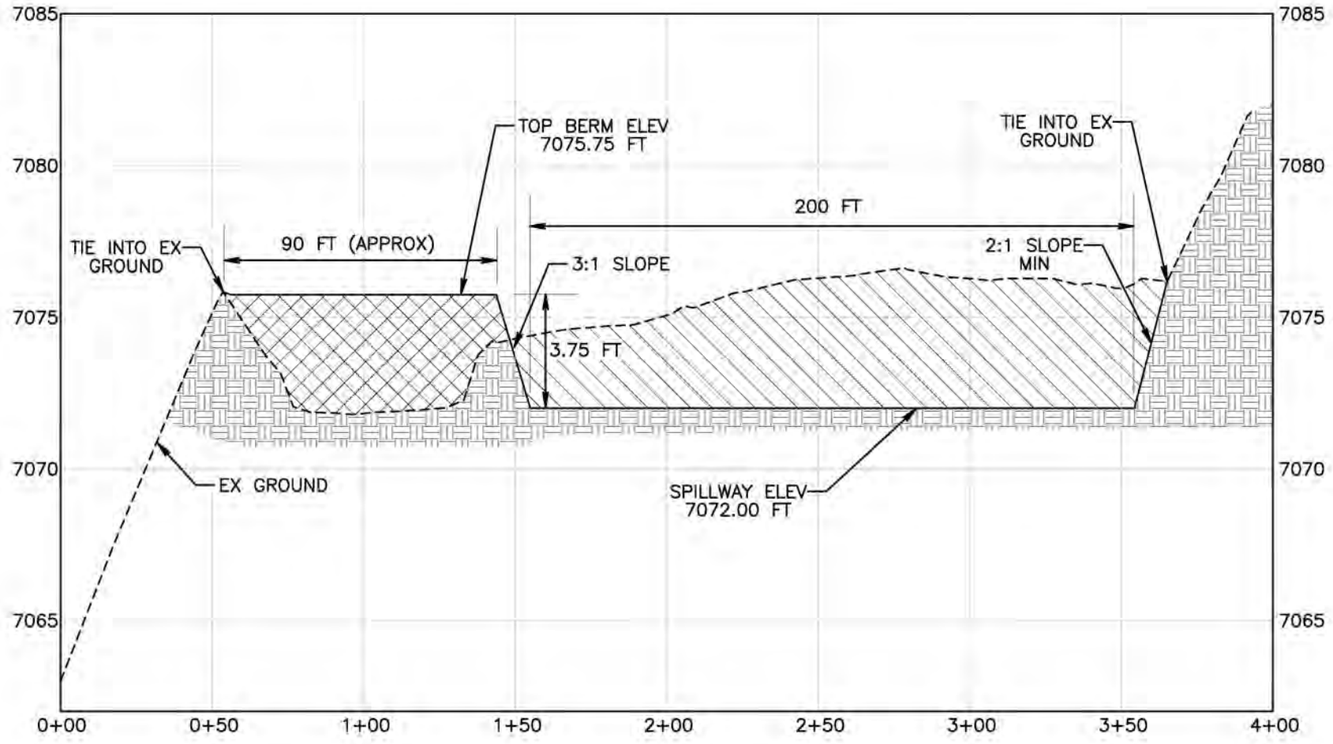
DATE: AUGUST 28, 2012

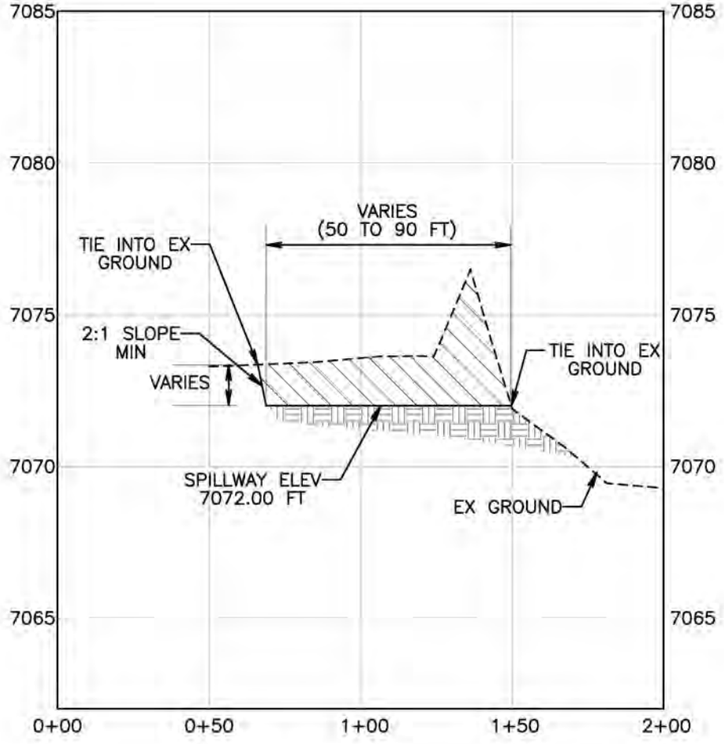
DRAWING NO: PLN02

NCD PROJECT NO: 10–183–AZ

SHEET NO: 4 OF 6



A/4 SPILLWAY & BERM CROSS-SECTION



B/4 SPILLWAY & APPROACH APRON CROSS-SECTION

HORIZ SCALE: 1" = 50'
VERT SCALE: 1" = 5'

50 0 50

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Flagstaff, Arizona 86001
(928) 774-2336

DRAWN BY: C. SCUDIERI
DESIGNED BY: C. SCUDIERI, S. YARD
REVIEWED BY: S. YARD, G. CATHEY

REV	DATE	BY	REVISION

DETAILS: Spillway, Headcut, & Sediment Basin Cross-Sections

COYOTE CREEK
Watershed-Scale Education and Training Grant
Moore Ranch

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Expires 3-31-2014

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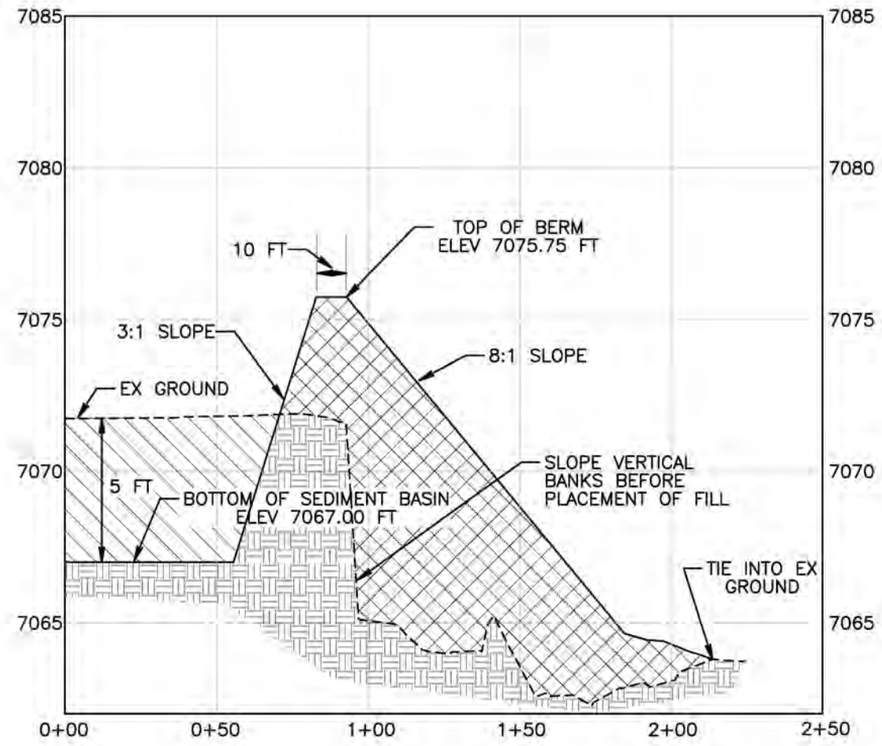
(OUTSIDE MARICOPA COUNTY)

DATE: AUGUST 28, 2012

DRAWING NO: DET01

NCD PROJECT NO: 10-183-AZ

SHEET NO: 5 OF 6



C/4 SEDIMENT BASIN & BERM CROSS-SECTION

HORIZ SCALE: 1" = 50'
VERT SCALE: 1" = 5'

50 0 50

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206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774-2336

DRAWN BY: C. SCUDIERI
DESIGNED BY: C. SCUDIERI & S. YARD
REVIEWED BY: S. YARD, G. CATHEY

REV	DATE	BY	REVISION

DETAILS: Headcut & Sediment Basin Cross-Section

COYOTE CREEK
Watershed-Scale Education and Training Grant
Moore Ranch

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 8/28/12 ARIZONA, U.S.A.

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(OUTSIDE MARICOPA COUNTY)

DATE: AUGUST 28, 2012

DRAWING NO: DET02

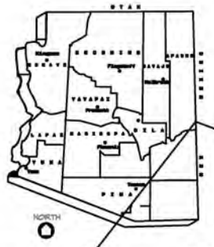
NCD PROJECT NO: 10-183-AZ

SHEET NO: 6 OF 6

COYOTE CREEK
Watershed -Scale Education and Training Grant

PREPARED FOR: Brian Nicoll - Coyote Creek Ranch

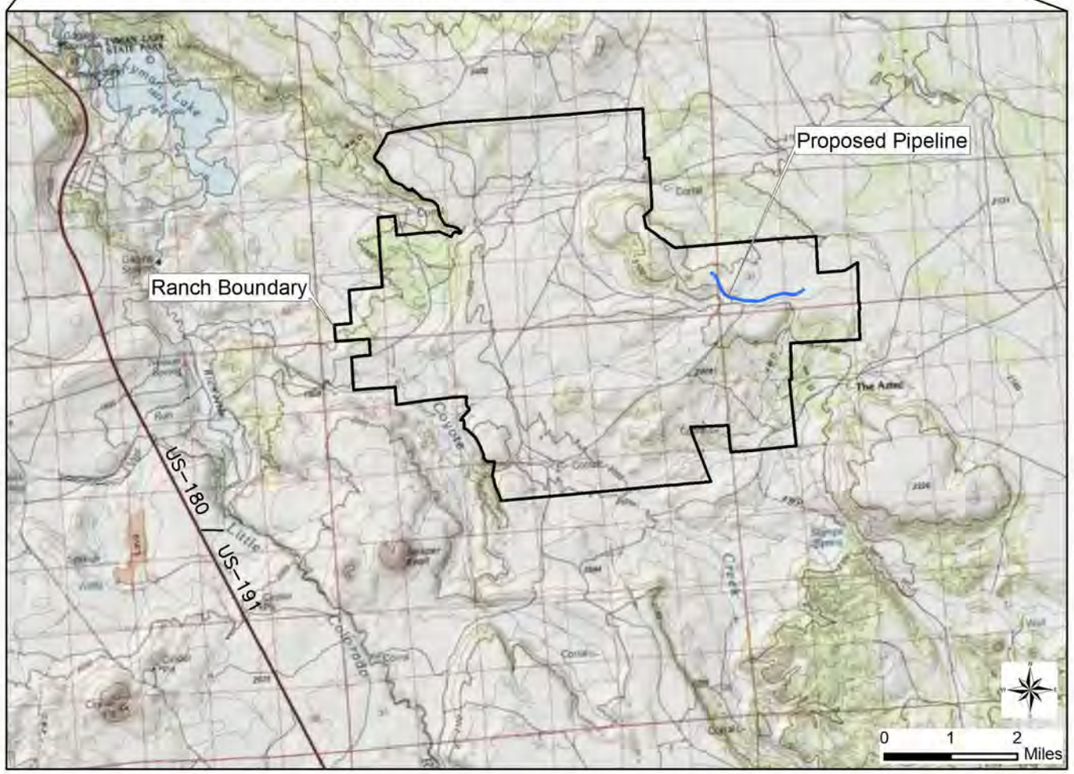
FUNDED BY:
Arizona Department of Environmental Quality (ADEQ)
Water Quality Division
Contract EV10-0051 (Project #12-002)



LOCATION MAP

Coyote Creek Ranch

Arizona, Gila & Salt River Meridian
Sec 36, T11N, R29E
Sec 31 & 32, T11N, R30E



LANDOWNER:
Brian Nicoll
PO Box 1144
Eager, AZ 85925
Phone: (928) 245-7353

PROJECT MANAGER:
Little Colorado River
Plateau RC&D
David Newlin
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Phone: (928)524-2912

TECHNICAL CONSULTANT:
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Phone: (928)774-2336

FUNDING AGENCY:
Arizona Department of Environmental Quality
1110 West Washington St.
Phoenix, AZ 85007
Phone: (602)771-4635

INDEX OF DRAWINGS

MATERIAL LIST

PIPELINE		
HDPE Pipe (80 psi – SDR 19)	1-1/4 in. Dia	8,500 LF
FITTINGS		
Shutoff Valve (Min: 30 psi)	1-1/4 in. Dia	2 EA
Air Release Valve (AR) (Min: 30 psi)	1-1/4 in. Dia	3 EA
Air-Vac/Air Release Valve (AVAR) (Min: 30 psi)	1-1/4 in. Dia	1 EA
Pressure Reducer (Min inlet: 120 psi, Outlet 30 – 50 psi)	1-1/4 in. Dia	1 EA
Float Valve (30 psi)		1 EA
Drain		2 EA
WATER STORAGE		
Trough	350 Gal	1 EA

NOTES
Pressure rating of pipe and appurtenances is 25% above working pressure.
Miscellaneous appurtenances (tees, elbows, etc) not listed.

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DRAWN BY: C. Tressler & C. Moody			
DESIGNED BY: S. Yard & C. Tressler			
REVIEWED BY: S. Yard			
REV	DATE	BY	REVISION

COVER SHEET: Location, Index, Materials

Coyote Creek
Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed ARIZONA, U.S.A.
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(OUTSIDE MARICOPA COUNTY)

DATE: 08/29/2012
NCD PROJECT NO: 10-183-AZ
DRAWING NO: CVR01
SHEET NO: 1 OF 6

PROJECT DESCRIPTION

The purpose of this pipeline and watering facility is to provide adequate water for livestock and wildlife for improved grazing management. Water will be conveyed through a 1-1/4 inch HDPE pipeline from an existing Tucson Electric Power water pipeline to a new 350 gallon trough.

GENERAL NOTES

1. Profile elevation data was taken from USGS topographic maps, with a contour interval of 20 ft.
2. All stationing refers to baseline of construction and is measured horizontal distance.
3. All existing conditions are to be verified in the field prior to construction.
4. 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 no utilities are present. The existence, location and depth of any utility must be determined by the contractor prior to any excavation. Call before you dig, 1-800-STAKE-IT
5. No construction shall begin until all necessary permits and easements are obtained.
6. Construction activities will be conducted in a manner consistent with all safety regulations, and other permitting required by Arizona State Land Department, Arizona Department of Environmental Quality, and others.
7. Installation shall be constructed to the lines and grades as shown on the drawings or as staked in the field by the ENGINEER or authorized representative, recognizing there is variation in nature.
8. Construction activities shall be performed in a manner that minimizes soil, water and air pollution.

CONSTRUCTION SPECIFICATIONS

PIPELINE

The work shall cover the supply of all labor, materials, and equipment required for furnishing and installing a livestock pipeline, including any appurtenances required for proper operation. See SHEET 4 for location and SHEETS 5 and 6 for Details.

PIPE AND FITTING MATERIALS

Plastic pipe shall conform to the requirements of the following specifications listed below or as shown on the drawings.

MATERIAL	ASTM Specification	AWWA Specification
ACrylonitrile-Butadiene-Styrene (ABS)	D1527, D2282	
Polyethylene (PE)	D2104, D2239, D2447, D2737, D3035	C901
Polyvinyl Chloride (PVC)	D1785, D2241, D2672	C900

All joints, connections, and appurtenances shall be capable of withstanding the designated design working pressure for the respective pipe. All appurtenant components including air/vacuum relief valves, control valves, pressure regulators, et cetera, shall conform to the type identified on the drawings.

Markings on the plastic pipe shall include the following:
- Nominal pipe size (e.g., 2 inches)
- Type of plastic pipe material, by designation code (e.g., PE3408)
- Pressure rating in psi for water at 23°C (73.4° F) (e.g., 160 psi)
- ASTM specification with which the pipe complies (e.g., D3035)
- Manufacturer's name (or trademark) and code
- The seal of approval of the National Sanitation Foundation (NSF), or approved equal

PLACEMENT

- Any grading, shaping, or ripping of the pipeline right-of-way, as deemed necessary by the design shall be done prior to the layout or installation of the pipe material.
- Pipelines shall be placed so they are protected against hazards imposed by traffic, farm operations, freezing temperatures, fire, or soil cracking.
- Trenches for plastic or coated pipelines shall be free of rocks and other sharp materials, and the pipe shall be carefully placed to prevent damage. Flexible plastic pipe may be placed by plow-in equipment if soils are suitable and rocks and boulders will not damage the pipe.
- Pipeline installation equipment shall be capable of installing the pipeline without causing immediate or long-term damage to the pipe or pipe couplers.
- Appurtenant structures shall be installed per manufacture recommendations and at the location shown on the drawings.
- Thrust blocks shall be installed per manufacture recommendations and at the location shown on the drawings.

TESTING

Pipelines placed in open excavated trenches will be tested before total backfill is completed. Backfill may be placed between the joints if needed to prevent movement of the pipe during testing. The pipe shall be filled with water and tested at the design working-head or at a minimum head of 10 feet, whichever is greater. All leaks shall be repaired and the test repeated.

DEPTH OF COVER

The pipe shall be placed to the minimum depth shown on the drawings. The pipe shall be placed below the frost line, and not less than 18 inches in range land and 30 inches when crossing cultivated fields. The minimum depth may be obtained by mounding soil over the pipeline on range land where site conditions such as shallow soils or rock make it impractical to attain the minimum depth of cover by usual means. If mounding is anticipated to be used to achieve the minimum depth, the contractor shall obtain approval of this option from the designer in writing. Surface pipelines shall be installed as shown on the drawings.

BACKFILLING

All backfilling shall be completed before the line is placed in service. For plastic or coated pipelines, the initial backfill shall be of selected material, free from rocks or other sharp material that would damage the pipe. Deformation or displacement of the pipe must not be allowed to occur during backfilling and compaction.

Natural Channel Design, Inc
206 S. Elden St.
Flagstaff, Arizona 86001
(928) 774-2336

DRAWN BY: C. Tressler & C. Moody
DESIGNED BY: S. Yard & C. Tressler
REVIEWED BY: S. Yard

REV	DATE	BY	REVISION

GENERAL NOTES and CONSTRUCTION SPECIFICATIONS

Coyote Creek Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch

REGISTERED PROFESSIONAL ENGINEER CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed ARIZONA, U.S.A.

Expires 3-31-2014

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DATE: 08/29/2012

DRAWING NO: GEN01

NCD PROJECT NO: 10-183-AZ

SHEET NO: 2 OF 6

WATERING FACILITY (Trough)

The work shall cover the supply of all labor, materials, and equipment required for furnishing and installing the materials necessary to construct a tank, trough, or other watertight container.
See SHEET 4 for location and SHEETS 5 and 6 for Details.

MATERIALS

Approved construction materials for water facilities are: reinforced concrete, galvanized and black sheet metal steel, and used heavy equipment tires. All piping for inlet, outlet and overflow fittings of the tank shall be new. Automatic water level control and/or overflow facilities shall be provided as appropriate.

INSTALLATION

Site Preparation/Foundation Work

The area immediately surrounding the trough shall be smoothed and graded to permit free drainage of the surface water without erosion. The foundation shall be leveled, scarified, and compacted, before any material is placed.

If a trough is to be constructed on a relatively impermeable soil, at least 4 inches of sand, gravel, or other porous material shall be placed on the foundation. When on-site materials exist, or can be reworked to provide a well-drained base, imported drain materials will not be required. The surface of the base material shall be smooth and without sharp protruding rocks to prevent damage to the bottom of the trough.

The base material shall surround the outside of trough for a minimum of 4 feet. The bottom of the trough shall be at least 2 inches above the surrounding ground surface.

Anchoring

Troughs shall be permanently installed and adequately anchored to prevent movement at all times by wind and livestock and prevent entry by livestock in accordance with details shown in the drawing. In the absence of details, anchoring may be done by, but is not limited to, the following:

- Concrete ballast at least 4 inches thick placed inside the trough,
- Three or more equally spaced posts welded or bolted to facility and anchored in concrete or buried at least 30 inches into soil,
- Three or more equally spaced .-inch diameter guy wires secured to the facility with bolts or welded and anchored, or
- Two cross members of 1½-inch diameter steel pipes bolted to four equally spaced posts. The posts shall be standard steel posts or a minimum 4-inch-diameter juniper, piñon, or treated pine, and shall be set at least 30 inches deep.

Escape Ramps

Escape ramps will be of corrosion resistant materials. Escape ramps will be installed flush to the trough wall in a manner that prevents animals from passing between the wall and the ramp.

Steel Reinforcement Requirements and Concrete Floor Thickness

Diameter of Tank (ft)	Floor Area(sf)	Floor Thickness (inches)	Min. Steel Reinforcement
0 to 20	0 to 315	4	6"x6", 10 gage welded wire fabric
20 to 30	315 to 706	8	6"X6", 6 gage welded wire fabric
30 to 40	706 to 1,256	0	#4 rebar, 12" center-to-center, both ways
> 40	> 1,256	8	#4 rebar, 8" center-to-center, both ways

TROUGH INSTALLATION

Reinforced Conrete

All concrete shall be proportioned, mixed, placed and cured as required to produce a 28-day strength of at least 3,000 pounds per square inch. Steel Reinforcement Requirements and Concrete Floor Thickness table lists minimum size and spacing. All reinforced concrete walls, if any, shall have a minimum thickness of 6 inches. Reinforcing steel bars shall be no. 4 or larger, spaced on 12-inch centers both ways. Reinforcing mesh (6"x6") made with 6-gage steel may be used in walls up to 4 feet in height.

The cement shall be Portland cement, Type II, II A or V, or as shown on drawings. If Type II or Type V is used, an airentraining agent shall be added to the mixing water in the amount needed to produce an air content of 5% to 7%.

Reinforcing steel in floors shall be covered by at least 2 inches of concrete. All splices shall be lapped a length of at least 30 times the diameter of the reinforcing steel and be tied in place with acceptable annealed steel wire. Reinforcing mesh shall be lapped at least 6 inches. Vertical reinforcement shall have an 18-inch leg projecting horizontally into the floor for joining into floor reinforcement and extend to within 3 inches of the top of the wall.

Footers shall be used on floors where erosion around the trough and/or undermining of the floor is anticipated. Minimum dimensions for footers shall be 12in deep by 10in thick. The concrete for the entire floor and foundation shall be placed continuously and as one unit. A construction joint shall be formed between the floor and the wall as shown on the drawings. Construction joint between wall and floor shall also be water tight.

Steel

Steel troughs shall meet the minimum requirements as described in the Steel Rim Tanks and Troughs table. Seams and joints may be bolted, riveted, or butt-welded. The ends of the steel may also be lapped and welded with a fillet weld on both sides. All joints must be of good quality and be watertight. Joints that are crimped or soldered are not acceptable.

For field fabricated troughs, bolted or riveted joints shall be lapped at least 2.0 inches. Holes shall be drilled or punched for 3/8-inch diameter bolts or rivets spaced at 1-1/2 inch on center, or holes may be drilled or punched for 1/2 inch diameter bolts or rivets spaced at 2 inches on center.

Corrugated steel shall be bolted or riveted per the manufacturer or commercial fabricating plant. The minimum thickness for prefabricated troughs made of corrugated steel is 20 gauge.

All welded joints shall be continuously welded in accordance with good welding procedures.

For steel structures with a concrete floor: prior to placement of concrete, the bottom 8.0 inches of the steel wall may be painted with asphalt. Prior to concrete placement, the assembled steel rim shall be leveled and temporarily held at the designed elevation with blocking. The walls shall be embedded a minimum of 4 inches into the reinforced concrete footing.

Large Rubber Tire

Large clean, used tires may be used as troughs. Tires shall be cleaned and free of chemicals and free of any aftermarket chemical puncture sealer. Only tires without aftermarket chemical puncture sealer shall be installed.

Natural Channel Design, Inc
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(928) 774-2336

DRAWN BY: C. Tressler & C. Moody			
DESIGNED BY: S. Yard & C. Tressler			
REVIEWED BY: S. Yard			
REV	DATE	BY	REVISION

CONSTRUCTION SPECIFICATIONS

Coyote Creek
Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch

REGISTERED PROFESSIONAL ENGINEER CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed ARIZONA, U.S.A.
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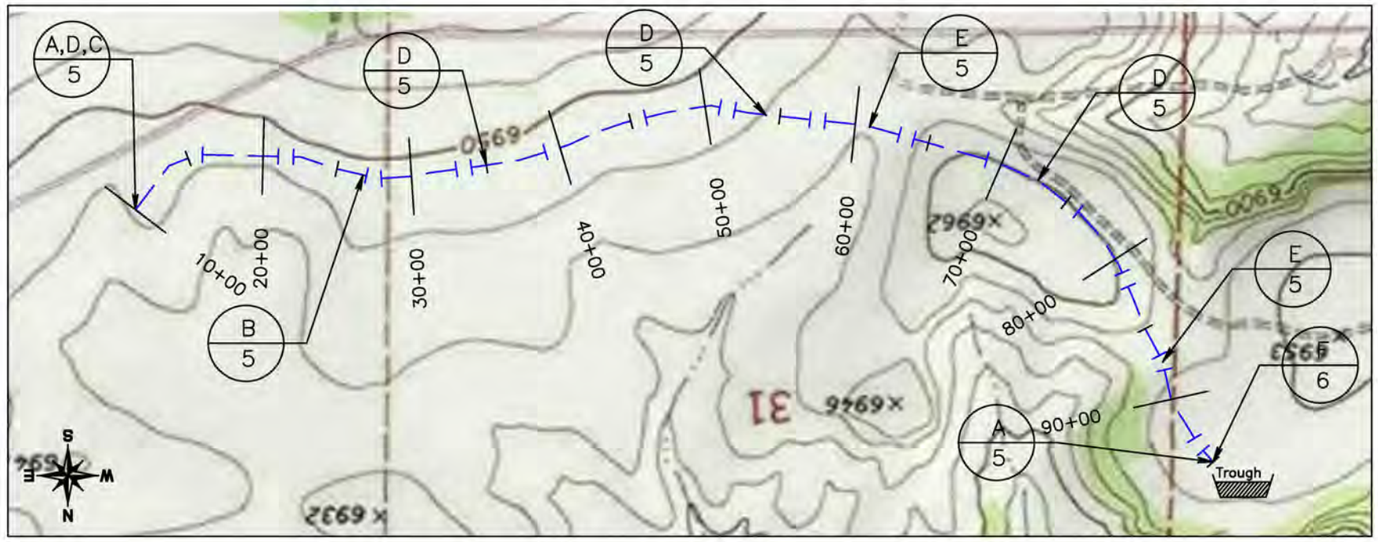
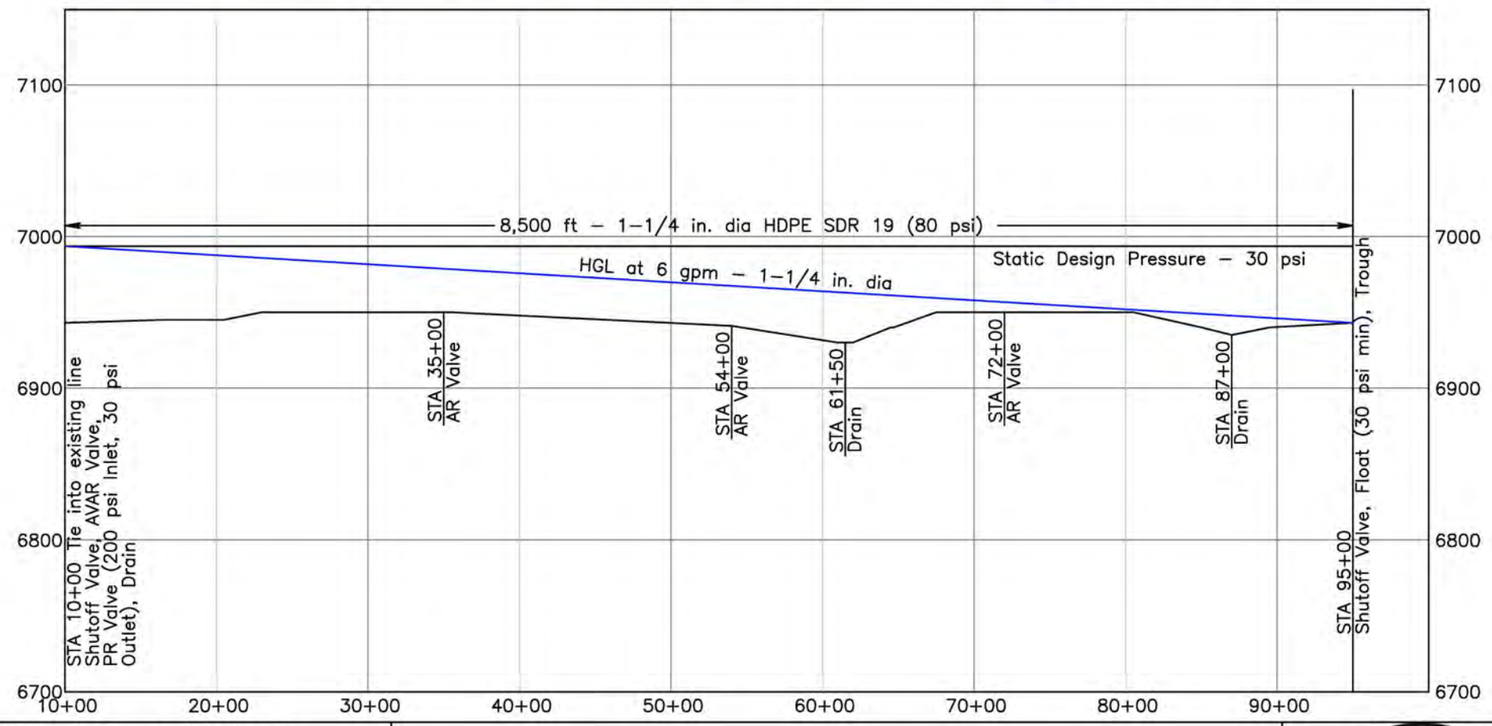
DATE: 08/29/2012
NCD PROJECT NO: 10-183-AZ
DRAWING NO: GEN02
SHEET NO: 3 OF 6





HORIZ SCALE: 1" = 1,000'
VERT SCALE: 1" = 100'

1,000 0 1,000

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DRAWN BY:	C. Tressler & C. Moody		
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REV	DATE	BY	REVISION

PLAN AND PROFILE VIEW

Coyote Creek
Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch

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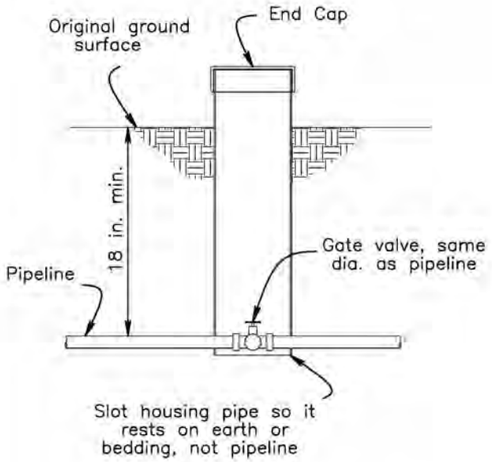
DATE: 08/29/2012

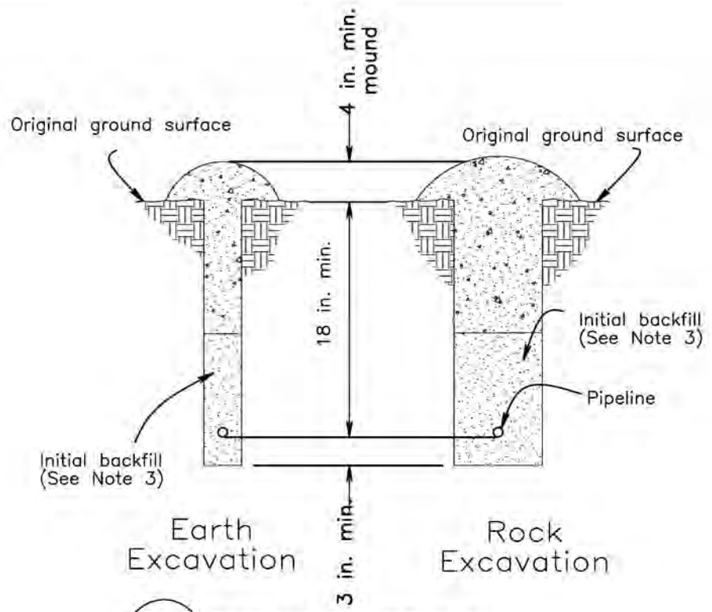
DRAWING NO: PP01

NCD PROJECT NO: 10–183–AZ

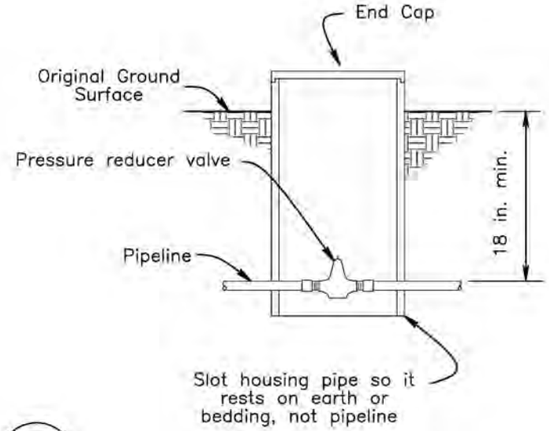
SHEET NO: 4 OF 6



A/4 SHUTOFF VALVE



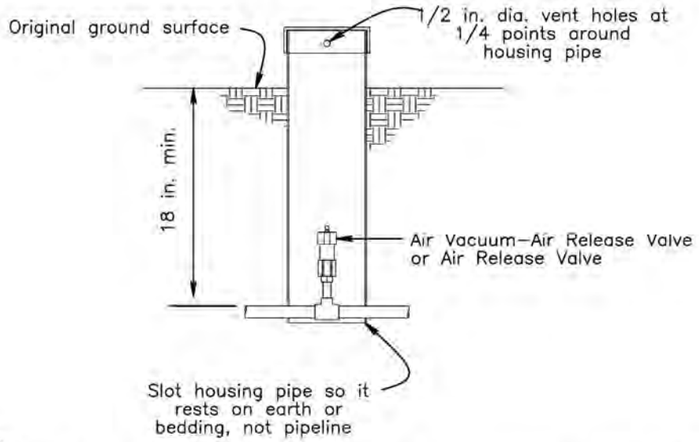
B/4 TRENCH DETAILS



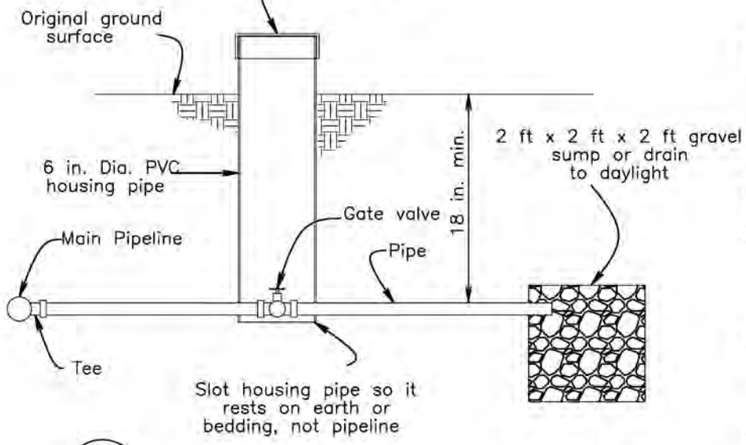
C/4 PRESSURE REDUCING VALVE (PRV)

GENERAL NOTES

1. Where bedding is required, the minimum trench width shall be fourteen (14) inches. The maximum trench width shall be twenty–four (24) inches.
2. Where the bottom of the trench is not free from rock, hard un–weathered shale, or boulders, bedding shall be provided. The trench shall be over excavated a minimum of three (3) inches below grade. The bedding material used to establish the final grade shall be sand or fine graded stable soil finer than 1/2 inche.
3. Initial backfill materials placed six (6) inches over the pipeline shall be finer than 1/2 inche. Remaining backfill shall be placed in layers not exceeding six (6) inches. The backfill shall be mounded for four (4) inches above the natural ground line.
4. Earthen water bars shall be provided where necessary to divert excess water runoff away from the trench.
5. Areas disturbed by construction activity shall be revegetated.
6. Vents for removing air should be located at all summits. An air release valve shall be located at the first summit from the water source. Special care shall be taken during the layout of the pipeline to eliminate grade changes that cause minor high points between the air vents. In no case shall the air vents be more than one (1) mile apart.
7. Automatic vacuum relief valves shall be designed for pipelines subject to extreme surge flow conditions such as pumping, fluctuating flow, or high velocity flow. Air vacuum release valves shall pe placed downstream of shutoff valves to allow air to return to pipe.
8. Guard posts shall be installed at all appurtenances which have above ground housing pipes.
9. See SHEET 2 for Pipeline construction specifications



D/4 AIR VACUUM AND AIR RELEASE VALVE (AVAR) OR AIR RELEASE VALVE (AR)



E/4 DRAIN DETAIL

Natural Channel Design, Inc

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DRAWN BY: C. Tressler & C. Moody			
DESIGNED BY: S. Yard & C. Tressler			
REVIEWED BY: S. Yard			
REV	DATE	BY	REVISION

DETAILS: Trench and Valves

Coyote Creek
Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch

REGISTERED PROFESSIONAL ENGINEER CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed ARIZONA, U.S.A.

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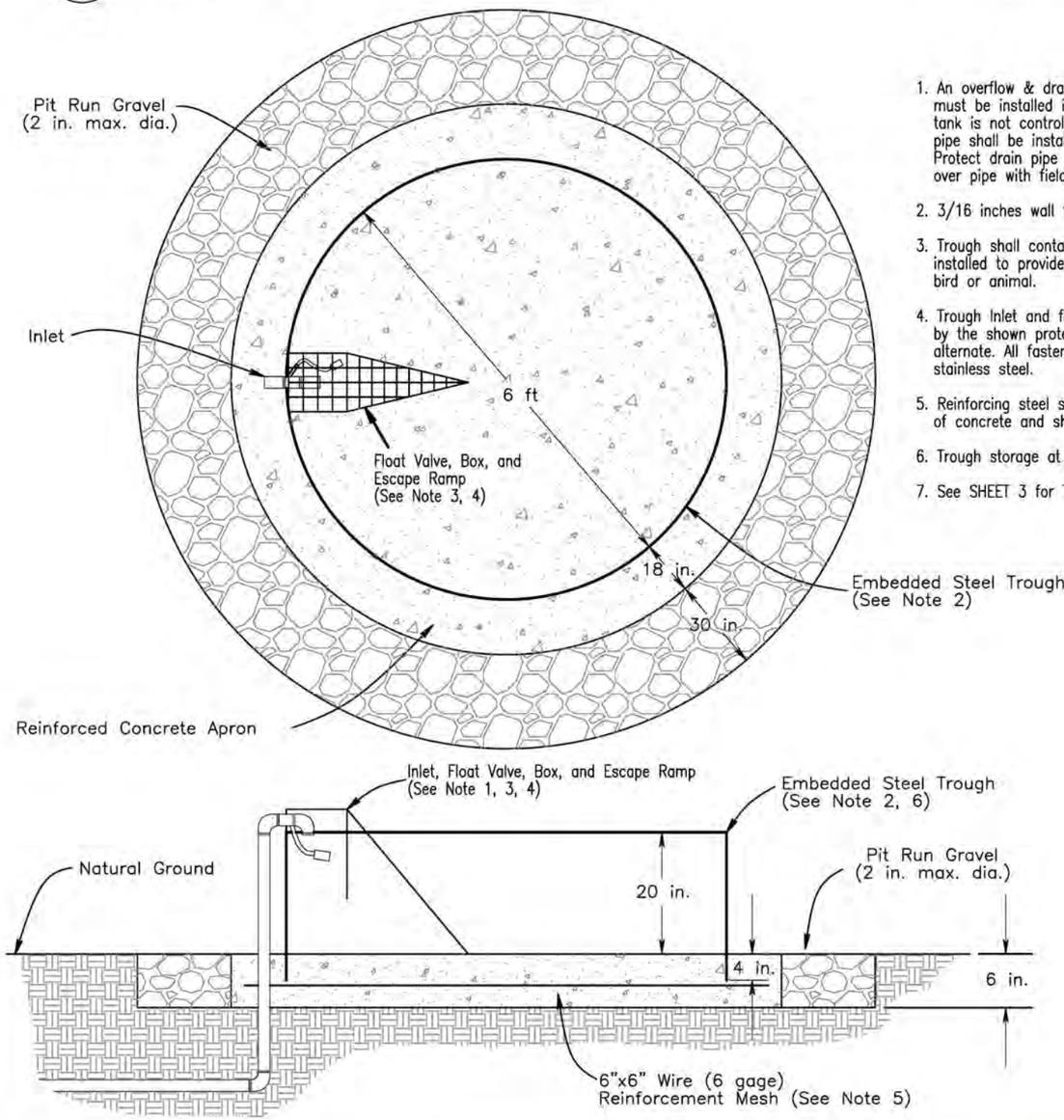
DATE: 08/29/2012

DRAWING NO: DTL01

NCD PROJECT NO: 10–183–AZ

SHEET NO: 5 OF 6

F/4 Trough and Float



GENERAL NOTES

1. An overflow & drain pipe with a minimum 2 in. dia. must be installed if the water level in the tank is not controlled with a float. The drain pipe shall be installed to properly drain. Protect drain pipe at outlet end by backfilling over pipe with field stone, minimum 1 1/2 in. dia.
2. 3/16 inches wall thickness.
3. Trough shall contain a ~45 degree escape ramp installed to provide a positive means of escape for any bird or animal.
4. Trough Inlet and float or overflow must be protected by the shown protection system or an approved alternate. All fasteners shall be galvanized or stainless steel.
5. Reinforcing steel shall be covered by at least 2 in. of concrete and shall not contact steel walls.
6. Trough storage at 20 in. is ~ 350 gallons.
7. See SHEET 3 for Trough construction specifications

Natural Channel Design, Inc
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DESIGNED BY:	S. Yard & C. Tressler		
REVIEWED BY:	S. Yard		
REV	DATE	BY	REVISION

DETAILS: Trough and Float

Coyote Creek
Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch

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DATE: 08/29/2012

DRAWING NO: DTL02

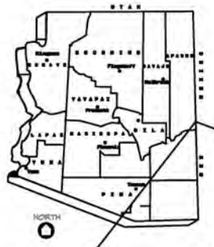
NCD PROJECT NO: 10-183-AZ

SHEET NO: 6 OF 6

COYOTE CREEK
Watershed -Scale Education and Training Grant

PREPARED FOR: Brian Nicoll - Coyote Creek Ranch Project #2

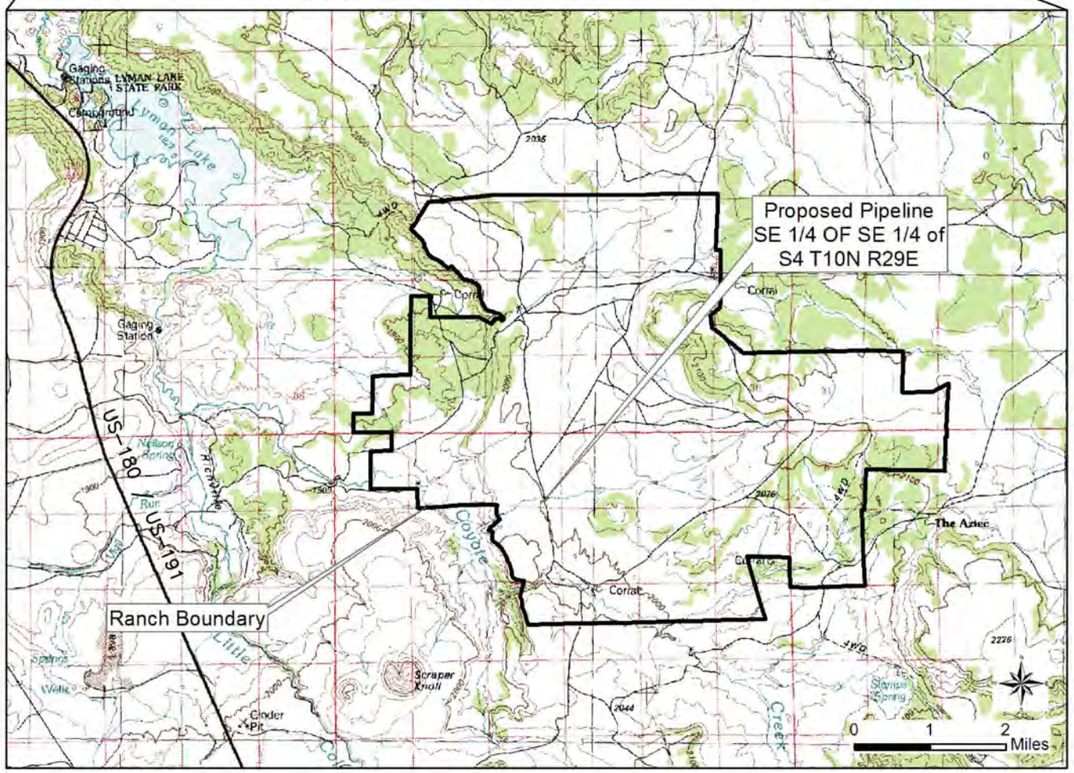
FUNDED BY:
Arizona Department of Environmental Quality (ADEQ)
Water Quality Division
Contract EV10-0051 (Project #12-002)



LOCATION MAP

Coyote Creek Ranch

Arizona, Gila & Salt River Meridian
Sec 36, T11N, R29E
Sec 31 & 32, T11N, R30E



LANDOWNER:
Brian Nicoll
PO Box 1144
Eager, AZ 85925
Phone: (928) 245-7353

PROJECT MANAGER:
Little Colorado River
Plateau RC&D
David Newlin
153 W. Vista, Suite 2
Holbrook, AZ 86025
Phone: (928)524-2912

TECHNICAL CONSULTANT:
Natural Channel Design, Inc.
206 So. Elden Street
Flagstaff, AZ 86001
Phone: (928)774-2336

FUNDING AGENCY:
Arizona Department of
Environmental Quality
1110 West Washington St.
Phoenix, AZ 85007
Phone: (602)771-4635

INDEX OF DRAWINGS

MATERIAL LIST

PIPELINE		
PVC Pipe (Sch 40)	1-1/4 in. Dia	450 LF
FITTINGS		
Shutoff Valve (1 Min Rating: 250 psi, 1 Min Rating: 40 psi)	1-1/4 in. Dia	2 EA
Air-Vac/Air Release Valve (AVAR) (Min Rating: 40 psi)	1-1/4 in. Dia	1 EA
Air Release Valve (AR) (Min Rating: 40 psi)	1-1/4 in. Dia	1 EA
Pressure Reducer (Min Inlet Rating: 200 psi, Outlet 15 - 50 psi)	1-1/4 in. Dia	1 EA
Float Valve (Min Rating: 40 psi)		1 EA
Drain		1 EA
WATER STORAGE		
Trough	350 Gal	1 EA

NOTES
Pressure rating of pipe is set to the pressure of the TEP supply line. The pressure rating of the appurtenances is at least 25% above working pressure. Miscellaneous appurtenances (tees, elbows, etc) not listed.

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DRAWN BY:	C. Tressler		
DESIGNED BY:	C. Tressler		
REVIEWED BY:	S. Yard		
REV	DATE	BY	REVISION

COVER SHEET: Location, Index, Materials

Coyote Creek
Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch Project #2

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
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STEPHANIE N. YARD
Date Signed 10/10/2013
ARIZONA, U.S.A.
Expires 3-31-2014

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(OUTSIDE MARICOPA COUNTY)

DATE: 10/10/2013
NCD PROJECT NO: 10-183-AZ
DRAWING NO: CVR01
SHEET NO: 1 OF 6

PROJECT DESCRIPTION

The purpose of this pipeline and watering facility is to provide adequate water for livestock and wildlife for improved grazing management. Water will be conveyed through a 1-1/4 inch SCH 40 PVC pipeline from an existing Tucson Electric Power water pipeline to a new 350 gallon trough.

GENERAL NOTES

1. Profile elevation data was taken from USGS topographic maps, with a contour interval of 20 ft.
2. All stationing refers to baseline of construction and is measured horizontal distance.
3. All existing conditions are to be verified in the field prior to construction.
4. 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 no utilities are present. The existence, location and depth of any utility must be determined by the contractor prior to any excavation. Call before you dig, 1-800-STAKE-IT
5. No construction shall begin until all necessary permits and easements are obtained.
6. Construction activities will be conducted in a manner consistent with all safety regulations, and other permitting required by Arizona State Land Department, Arizona Department of Environmental Quality, and others.
7. Installation shall be constructed to the lines and grades as shown on the drawings or as staked in the field by the ENGINEER or authorized representative, recognizing there is variation in nature.
8. Construction activities shall be performed in a manner that minimizes soil, water and air pollution.

CONSTRUCTION SPECIFICATIONS

PIPELINE

The work shall cover the supply of all labor, materials, and equipment required for furnishing and installing a livestock pipeline, including any appurtenances required for proper operation. See SHEET 4 for location and SHEETS 5 and 6 for Details.

PIPE AND FITTING MATERIALS

Plastic pipe shall conform to the requirements of the following specifications listed below or as shown on the drawings.

MATERIAL	ASTM Specification	AWWA Specification
ACrylonitrile-Butadiene-Styrene (ABS)	D1527, D2282	
Polyethylene (PE)	D2104, D2239, D2447, D2737, D3035	C901
Polyvinyl Chloride (PVC)	D1785, D2241, D2672	C900

All joints, connections, and appurtenances shall be capable of withstanding the designated design working pressure for the respective pipe. All appurtenant components including air/vacuum relief valves, control valves, pressure regulators, et cetera, shall conform to the type identified on the drawings.

Markings on the plastic pipe shall include the following:
- Nominal pipe size (e.g., 2 inches)
- Type of plastic pipe material, by designation code (e.g., PE3408)
- Pressure rating in psi for water at 23°C (73.4° F) (e.g., 160 psi)
- ASTM specification with which the pipe complies (e.g., D3035)
- Manufacturer's name (or trademark) and code
- The seal of approval of the National Sanitation Foundation (NSF), or approved equal

PLACEMENT

- Any grading, shaping, or ripping of the pipeline right-of-way, as deemed necessary by the design shall be done prior to the layout or installation of the pipe material.
- Pipelines shall be placed so they are protected against hazards imposed by traffic, farm operations, freezing temperatures, fire, or soil cracking.
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DRAWN BY: C. Tressler
DESIGNED BY: C. Tressler
REVIEWED BY: S. Yard

REV	DATE	BY	REVISION

GENERAL NOTES and CONSTRUCTION SPECIFICATIONS

Coyote Creek Watershed-Scale Education and Trainaing Grant Brian Nicoll - Coyote Creek Ranch Project #2

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DATE: 10/10/2013
NCD PROJECT NO: 10-183-AZ
DRAWING NO: GEN01
SHEET NO: 2 OF 6

WATERING FACILITY (Trough)

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Approved construction materials for water facilities are: reinforced concrete, galvanized and black sheet metal steel, and used heavy equipment tires. All piping for inlet, outlet and overflow fittings of the tank shall be new. Automatic water level control and/or overflow facilities shall be provided as appropriate.

INSTALLATION

Site Preparation/Foundation Work

The area immediately surrounding the trough shall be smoothed and graded to permit free drainage of the surface water without erosion. The foundation shall be leveled, scarified, and compacted, before any material is placed.

If a trough is to be constructed on a relatively impermeable soil, at least 4 inches of sand, gravel, or other porous material shall be placed on the foundation. When on-site materials exist, or can be reworked to provide a well-drained base, imported drain materials will not be required. The surface of the base material shall be smooth and without sharp protruding rocks to prevent damage to the bottom of the trough.

The base material shall surround the outside of trough for a minimum of 4 feet. The bottom of the trough shall be at least 2 inches above the surrounding ground surface.

Anchoring

Troughs shall be permanently installed and adequately anchored to prevent movement at all times by wind and livestock and prevent entry by livestock in accordance with details shown in the drawing. In the absence of details, anchoring may be done by, but is not limited to, the following:

- Concrete ballast at least 4 inches thick placed inside the trough,
- Three or more equally spaced posts welded or bolted to facility and anchored in concrete or buried at least 30 inches into soil,
- Three or more equally spaced .-inch diameter guy wires secured to the facility with bolts or welded and anchored, or
- Two cross members of 1½-inch diameter steel pipes bolted to four equally spaced posts. The posts shall be standard steel posts or a minimum 4-inch-diameter juniper, piñon, or treated pine, and shall be set at least 30 inches deep.

Escape Ramps

Escape ramps will be of corrosion resistant materials. Escape ramps will be installed flush to the trough wall in a manner that prevents animals from passing between the wall and the ramp.

Steel Reinforcement Requirements and Concrete Floor Thickness

Diameter of Tank (ft)	Floor Area(sf)	Floor Thickness (inches)	Min. Steel Reinforcement
0 to 20	0 to 315	4	6"x6", 10 gage welded wire fabric
20 to 30	315 to 706	6	6"x6", 6 gage welded wire fabric
30 to 40	706 to 1,256	0	#4 rebar, 12" center-to-center, both ways
> 40	> 1,256	8	#4 rebar, 9" center-to-center, both ways

TROUGH INSTALLATION

Reinforced Conrete

All concrete shall be proportioned, mixed, placed and cured as required to produce a 28-day strength of at least 3,000 pounds per square inch. Steel Reinforcement Requirements and Concrete Floor Thickness table lists minimum size and spacing. All reinforced concrete walls, if any, shall have a minimum thickness of 6 inches. Reinforcing steel bars shall be no. 4 or larger, spaced on 12-inch centers both ways. Reinforcing mesh (6"x6") made with 6-gage steel may be used in walls up to 4 feet in height.

The cement shall be Portland cement, Type II, II A or V, or as shown on drawings. If Type II or Type V is used, an airentraining agent shall be added to the mixing water in the amount needed to produce an air content of 5% to 7%.

Reinforcing steel in floors shall be covered by at least 2 inches of concrete. All splices shall be lapped a length of at least 30 times the diameter of the reinforcing steel and be tied in place with acceptable annealed steel wire. Reinforcing mesh shall be lapped at least 6 inches. Vertical reinforcement shall have an 18-inch leg projecting horizontally into the floor for joining into floor reinforcement and extend to within 3 inches of the top of the wall.

Footers shall be used on floors where erosion around the trough and/or undermining of the floor is anticipated. Minimum dimensions for footers shall be 12in deep by 10in thick. The concrete for the entire floor and foundation shall be placed continuously and as one unit. A construction joint shall be formed between the floor and the wall as shown on the drawings. Construction joint between wall and floor shall also be water tight.

Steel

Steel troughs shall meet the minimum requirements as described in the Steel Rim Tanks and Troughs table. Seams and joints may be bolted, riveted, or butt-welded. The ends of the steel may also be lapped and welded with a fillet weld on both sides. All joints must be of good quality and be watertight. Joints that are crimped or soldered are not acceptable.

For field fabricated troughs, bolted or riveted joints shall be lapped at least 2.0 inches. Holes shall be drilled or punched for 3/8-inch diameter bolts or rivets spaced at 1-1/2 inch on center, or holes may be drilled or punched for 1/2 inch diameter bolts or rivets spaced at 2 inches on center.

Corrugated steel shall be bolted or riveted per the manufacturer or commercial fabricating plant. The minimum thickness for prefabricated troughs made of corrugated steel is 20 gauge.

All welded joints shall be continuously welded in accordance with good welding procedures.

For steel structures with a concrete floor: prior to placement of concrete, the bottom 8.0 inches of the steel wall may be painted with asphalt. Prior to concrete placement, the assembled steel rim shall be leveled and temporarily held at the designed elevation with blocking. The walls shall be embedded a minimum of 4 inches into the reinforced concrete footing.

Large Rubber Tire

Large clean, used tires may be used as troughs. Tires shall be cleaned and free of chemicals and free of any aftermarket chemical puncture sealer. Only tires without aftermarket chemical puncture sealer shall be installed.

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DESIGNED BY: C. Tressler
REVIEWED BY: S. Yard

REV	DATE	BY	REVISION

CONSTRUCTION SPECIFICATIONS

Coyote Creek
Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch Project #2

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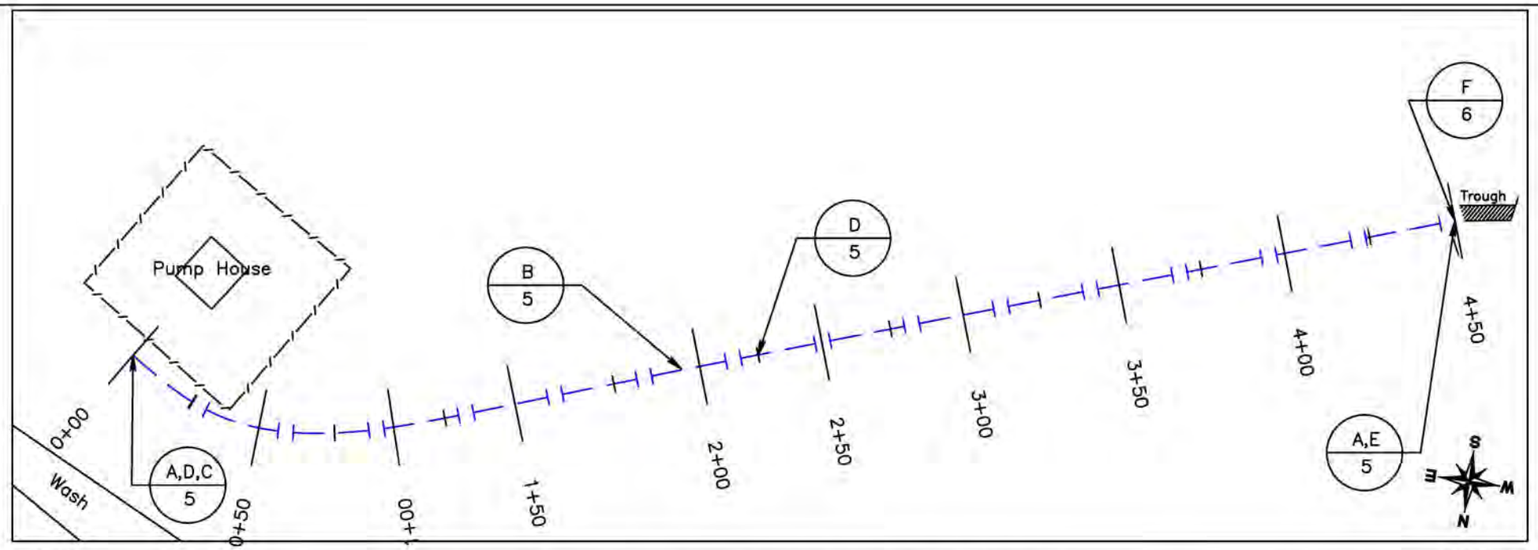
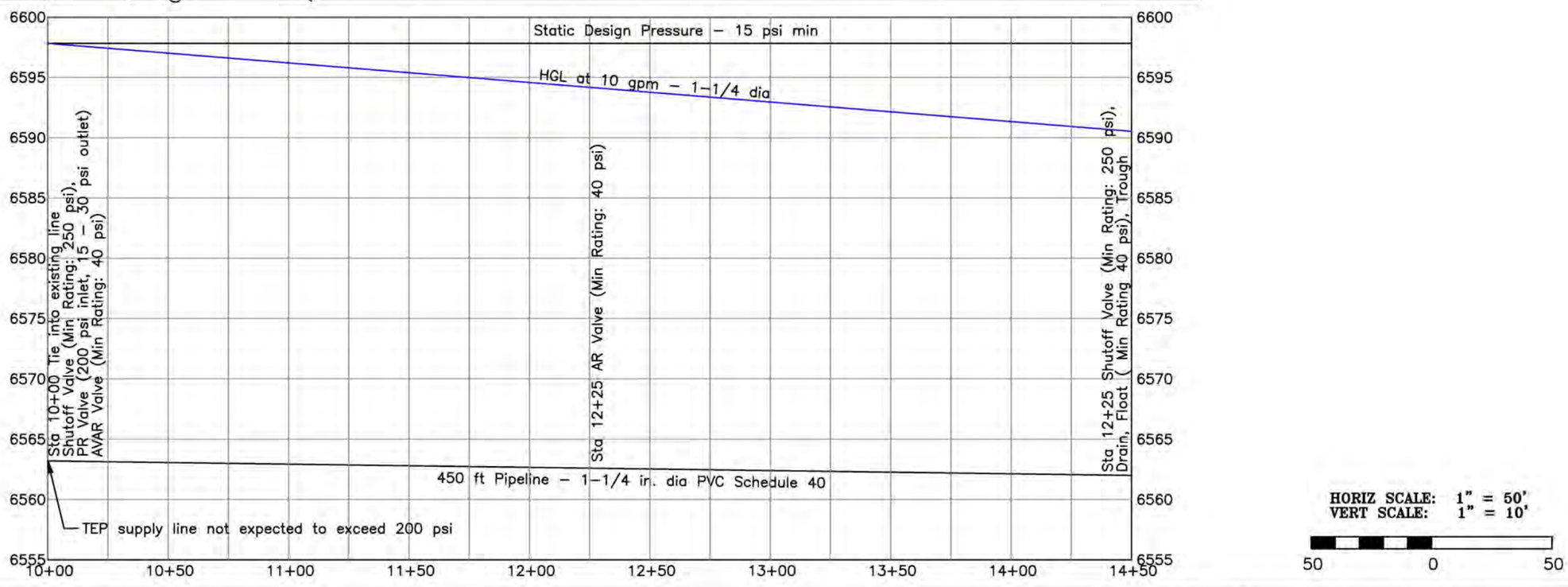
DATE: 10/10/2013
NCD PROJECT NO: 10-183-AZ
DRAWING NO: GEN02
SHEET NO: 3 OF 6





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

50 0 50

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PLAN AND PROFILE VIEW

Coyote Creek
Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch Project #2

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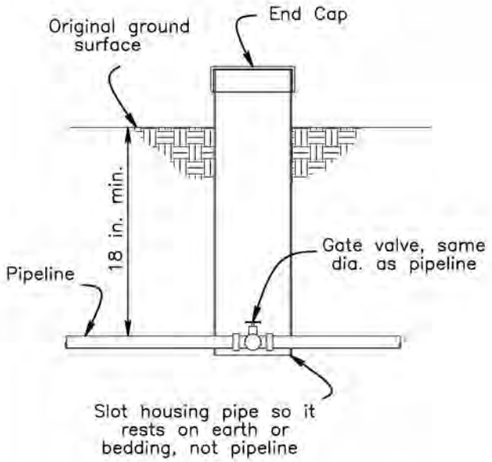
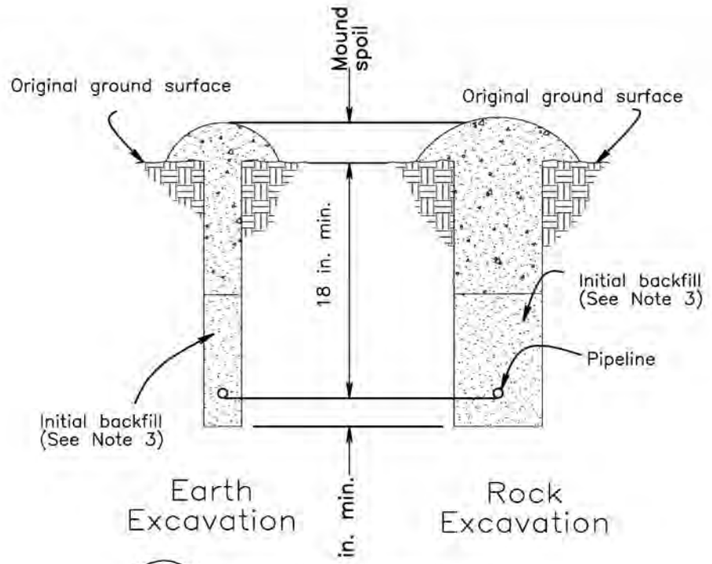
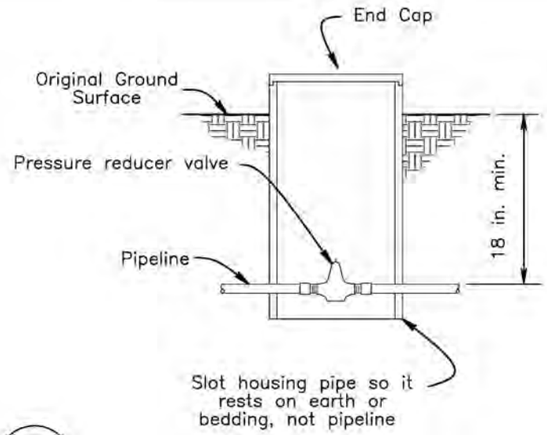
DRAWING NO: PP01
NCD PROJECT NO: 10–183–AZ
SHEET NO: 4 OF 6



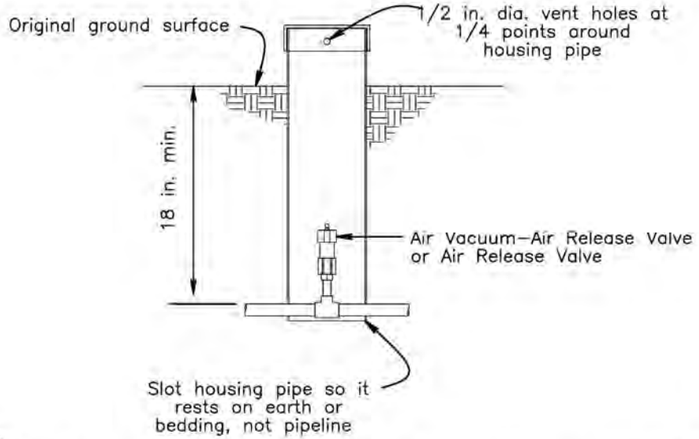
A/4 SHUTOFF VALVE



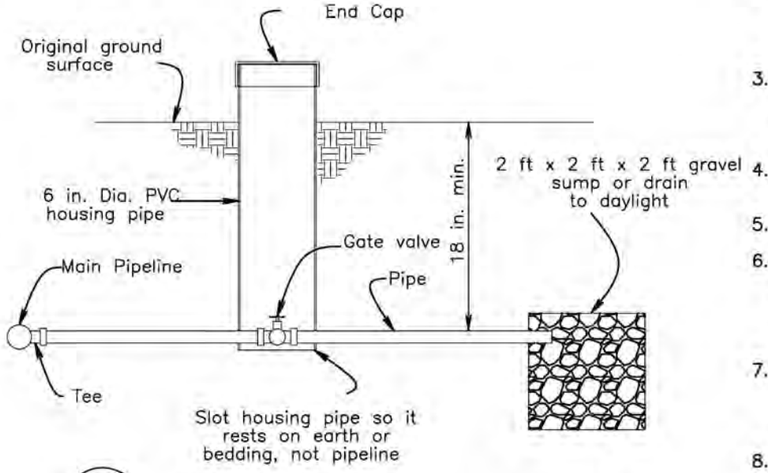
B/4 TRENCH DETAILS



C/4 PRESSURE REDUCING VALVE (PRV)



D/4 AIR VACUUM AND AIR RELEASE VALVE (AVAR) OR AIR RELEASE VALVE (AR)



E/4 DRAIN DETAIL

GENERAL NOTES

1. Where bedding is required, the minimum trench width shall be fourteen (14) inches. The maximum trench width shall be twenty–four (24) inches.
2. Where the bottom of the trench is not free from rock, hard un–weathered shale, or boulders, bedding shall be provided. The trench shall be over excavated a minimum of three (3) inches below grade. The bedding material used to establish the final grade shall be sand or fine graded stable soil finer than 1/2 inche.
3. Initial backfill materials placed six (6) inches over the pipeline shall be finer than 1/2 inch. Remaining backfill shall be placed in layers not exceeding six (6) inches. The backfill shall be mounded for four (4) inches above the natural ground line.
4. Earthen water bars shall be provided where necessary to divert excess water runoff away from the trench.
5. Areas disturbed by construction activity shall be revegetated.
6. Vents for removing air should be located at all summits. An air release valve shall be located at the first summit from the water source. Special care shall be taken during the layout of the pipeline to eliminate grade changes that cause minor high points between the air vents. In no case shall the air vents be more than one 1,000 ft apart.
7. Automatic vacuum relief valves shall be designed for pipelines subject to extreme surge flow conditions such as pumping, fluctuating flow, or high velocity flow. Air vacuum release valves shall be placed downstream of shutoff valves to allow air to return to pipe.
8. Guard posts shall be installed at all appurtenances which have above ground housing pipes.
9. See SHEET 2 for Pipeline construction specifications

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REV	DATE	BY	REVISION

DETAILS: Trench and Valves

Coyote Creek Watershed-Scale Education and Trainaing Grant Brian Nicoll - Coyote Creek Ranch Project #2

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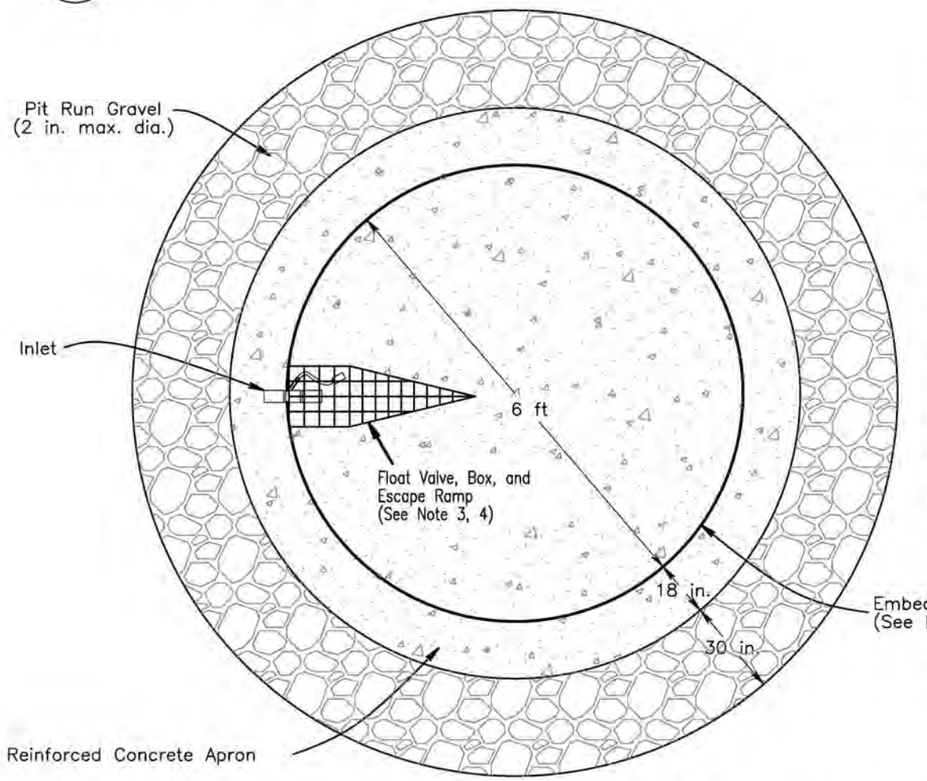
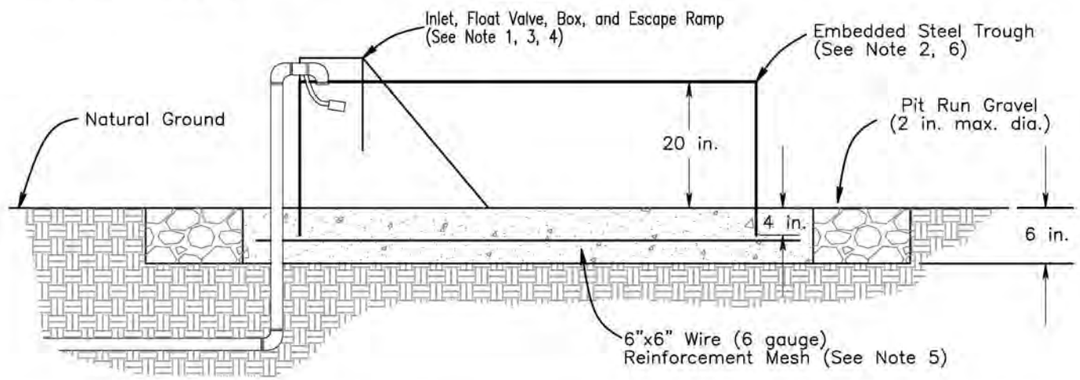
NCD PROJECT NO: 10–183–AZ
SHEET NO: 5 OF 6

F/4 Trough and Float





GENERAL NOTES

1. An overflow & drain pipe with a minimum 2 in. dia. must be installed if the water level in the tank is not controlled with a float. The drain pipe shall be installed to properly drain. Protect drain pipe at outlet end by backfilling over pipe with field stone, minimum 1 1/2 in. dia.
2. 3/16 inches wall thickness.
3. Trough shall contain a ~45 degree escape ramp installed to provide a positive means of escape for any bird or animal.
4. Trough Inlet and float or overflow must be protected by the shown protection system or an approved alternate. All fasteners shall be galvanized or stainless steel.
5. Reinforcing steel shall be covered by at least 2 in. of concrete and shall not contact steel walls.
6. Trough storage at 20 in. is ~ 350 gallons.
7. See SHEET 3 for Trough construction specifications

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DETAILS: Trough and Float

Coyote Creek
Watershed-Scale Education and Trainaing Grant
Brian Nicoll - Coyote Creek Ranch Project #2

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SHEET NO: 6 OF 6

COYOTE CREEK
Watershed - Scale Education and Training Grant

PREPARED FOR: Elaine Rogers - E< Ranch

FUNDED BY:
Arizona Department of Environmental Quality (ADEQ)
Water Quality Division
Contract EV10-0051 (Project #12-002)

LOCATION MAP
E< Ranch

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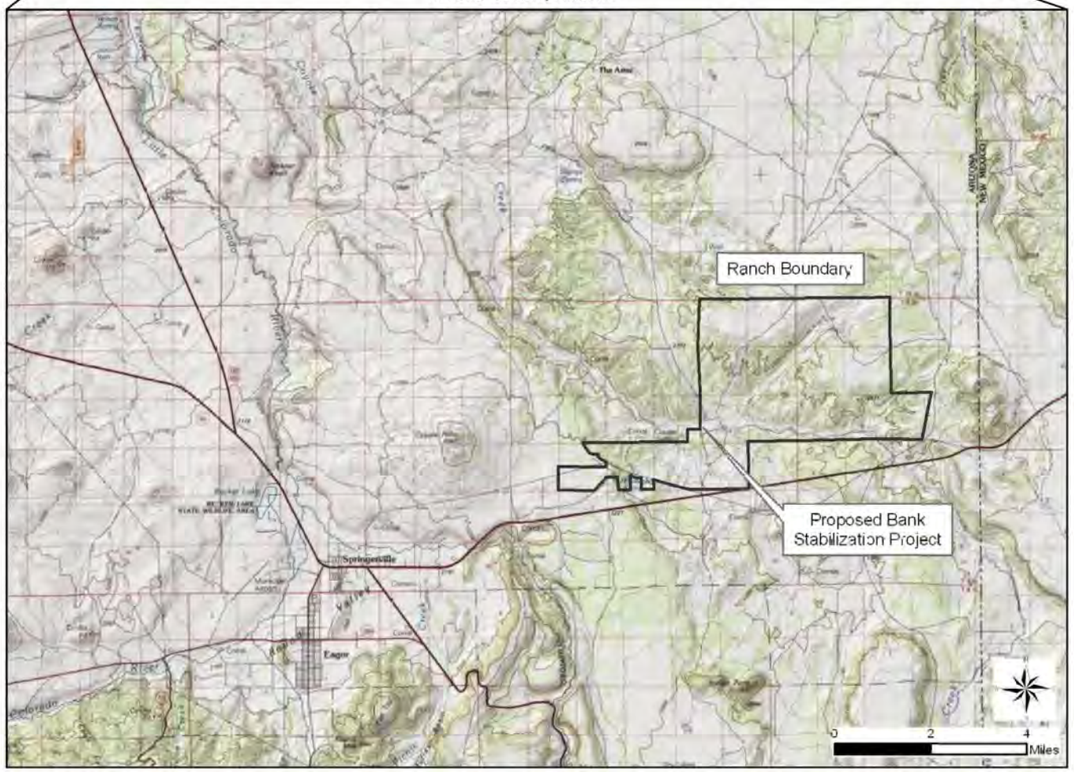
APACHE COUNTY, ARIZONA



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PROJECT MANAGER:
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TECHNICAL CONSULTANT:
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Flagstaff, AZ 86001
Phone: (928) 774-2336

FUNDING AGENCY:
Arizona Department of
Environmental Quality
1110 W. Washington St.
Phoenix, AZ 85007
Phone: (602) 771-4635

INDEX OF DRAWINGS

WORK QUANTITIES

EARTHWORK:	
CUT	777 CU YD
FILL	663 CU YD
ROCK	75 CU YD
GEOTEXTILE	150 SQ YD
GRASS SEED MIX	4 AC
RAT SNAP TRAPS	48 EA

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REVIEWED BY: S. YARD			
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COVER SHEET:
Location, Index & Quantities

COYOTE CREEK
Watershed-Scale Education and Training Grant
Rogers Ranch

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DATE: JULY 19, 2012
NCD PROJECT NO: 10-183-AZ
DRAWING NO: CVR01
SHEET NO: 1 OF 7

PROJECT DESCRIPTION

The purpose of this project is to reduce concentrated flow and erosion. Several headcuts are actively eroding and need repair. The rancher would like to optimize sheet flow across the pasture to improve forage. Improvement plan includes:

1) Stabilize banks near headcuts by resloping and seeding
2) Stablize headcut by constructing a stable outlet using rock-lined chute
3) Reduce overbank erosion by constructing earthen berm and swale to direct runoff to stable outlet
4) Prevent concentrated flow along road by installing water bars
5) Prevent concentrated flow along fenceline by raising the bottom wire and removing debris
6) Redirect runoff towards field by constructing small berms in two locations
7) Control Kangaroo Rat population

GENERAL NOTES

1. Site survey data was collected by NCD on December 13, 2011.
2. All stationing refers to baseline of construction and is measured horizontal distance.
3. All existing conditions are to be verified in the field prior to construction.
4. 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 no utilities are present. The existence, location and depth of any utility must be determined by the contractor prior to any excavation. Call before you dig, 1-800-STAKE-IT
5. No construction shall begin until all necessary permits and easements are obtained.
6. Construction activities will be conducted in a manner consistent with all safety regulations, and other permitting required by Arizona State Land Department, Arizona Department of Environmental Quality, and others.
7. Installation shall be constructed to the lines and grades as shown on the drawings or as staked in the field by the ENGINEER or authorized representative, recognizing there is variation in nature.
8. Construction activities shall be performed in a manner that minimizes soil, water and air pollution.

CONSTRUCTION SPECIFICATIONS

EARTHWORK

The earthwork activities shall consist of berms, swales, bank sloping, water bars, and debris removal. See this SHEET for descriptions of drainage provisions.

Excavation

Excavation shall be limited to bank sloping, swale creation, debris removal, water bars, and any necessary borrow to construct berms as shown on the drawings or as staked in the field.
No excavation shall take place within any jurisdictional areas. Disturbance of existing native vegetation shall be minimized to the greatest extent possible during excavation.

Excavated material shall be placed in the specified berm locations as shown on the drawings or as staked in the field. All finished surfaces shall be generally smooth and pleasing in appearance.

Earthfill

Materials: All fill materials shall be obtained from the required excavations and approved borrow sources. Fill materials shall not contain sod, brush, roots, perishable or frozen materials.

Placement: The placement of fill materials shall follow these guidelines:

- Any vertical bank shall be sloped before placement of fill material.
- The placing and spreading of fill material shall be started at the lowest point and the fill brought up and compacted to obtain a density similar to the surrounding bank material.
- Material when placed shall contain sufficient moisture so that a sample taken in the hand and squeezed shall remain intact when released.
- The placing and spreading of fill material shall be started at the lowest point and the fill brought up in horizontal layers not to exceed: six (6) inches of loose fill for wheel compaction and four (4) inches of loose fill for dozer compaction. Construction equipment shall be operated over the areas of each layer of fill to insure that the required compaction is obtained.
- Fill shall not be placed on frozen soil, snow or ice.
- Channels designated for filling and re-contouring shall be filled as close as possible to the historic natural ground surface, and smoothed and shaped to blend with the surrounding landscape.
- All finished surfaces shall be generally smooth and pleasing in appearance and blend into surrounding terrain.

DRAINAGE PROVISIONS

See SHEETS 4, 5, 6, & 7 for locations and details. Swales, berms, and other disturbed areas shall be seeded with native grass, see SHEET 3 for Grass Seed Mix

Berm and Swale: Excavate shallow swale offset from bank of Coyote Creek to redirect runoff to stable outlet. Place spoil material in berm along edge of bank.

Berm: Construct berm to redirect runoff towards pasture.

Water Bars: Construct two waterbars along road to disperse concentrated flows.

Fencing Debris Removal: Remove debris along fenceline to disperse concentrated flows and raise bottom wire of fence to prevent future deposition.

HEADCUT STABILIZATION

The headcut stabilization work shall consist of headcut excavation and bank sloping; furnishing and installing loose rock including placement of filter fabric. See SHEET 4 for location and SHEET 5 for Details.

> The site shall be excavated and backfilled to the grades shown on drawings. Excavation shall be limited to the headcut remediation area as shown on the drawings or as staked in the field. Any fill material shall be compacted to the density of surrounding undisturbed areas. Additional spoils shall be spread outside the channel and sloped in such a way as to direct flows toward rock-lined chute. Disturbance of existing native vegetation shall be minimized.
> Non-woven geotextile shall be placed behind the rock. Fabric shall have a minimum grab tensile strength of 90 lb, greater than 50% elongation at failure, a minimum of 40 lb puncture strength, and UV resistance of 70% strength retained. The geotextile shall be joined by overlapping a minimum of 18 inches and secured against the underlying foundation material. Securing pins shall be installed as necessary to prevent undue slippage or movement of the geotextile. Recommend 3/16-inch steel bars pointed on one end and fabricated with a head to retain a steel washer. (1.5-inch diameter). Pin length shall be not less than 18 inches. U-shaped pins are acceptable.
> Rock shall be angular, dense, sound and free from cracks, seams, or other defects conducive to accelerated weathering. The least dimension of an individual rock shall not be less than one-half the greatest dimension. Rock source shall be approved by the ENGINEER or authorized representative and have a bulk specific gravity of not less that 2.5 per ASTM C127. Rock shall be well graded as follows:

Diameter, in.	Percent Passing
15-20	D100
13-18	D85
10-15	D50
8-13	D10

> Rock placement shall begin at the bottom of slope. Rock shall not be dropped more than 3 feet onto geotextile.
> Sloped banks shall be seeded with native grass, see SHEET 3 for Grass Seed Mix

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REVIEWED BY: S. YARD

REV	DATE	BY	REVISION

GENERAL NOTES & CONSTRUCTION SPECIFICATIONS

COYOTE CREEK
Watershed-Scale Education and Training Grant
Rogers Ranch

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DRAWING NO: GEN01
NCD PROJECT NO: 10-183-AZ
SHEET NO: 2 OF 7

DAMAGE PREVENTION AND CONTROL – KANGAROO RAT

Kangaroo rats can over populate rangeland preventing areas from being restored. Both changes in grazing management and control programs may be needed for successful damage prevention. Kangaroo rats tend not to be abundant in areas with good grass cover. However, if populated they will restrict grass reestablishment. Reducing the population size must occur first followed by rangeland seeding. The most efficient and humane control method is the use of snap traps. "Museum Special" traps are very useful and economic trap and are easy to fix and transport. The larger Victor rat trap is more powerful and heavier. Common baits include whole kernel corn, peanut butter and oatmeal, and oatmeal paste which are placed on the trigger plate. (Do not use whole kernel corn when large numbers of seed–eating songbirds are in the area.) Place traps near, but not inside, the burrow entrances or along runways between mounds. Check traps each day to remove dead kangaroo rats. Reset tripped traps and replace baits that may have been removed by ants or other insects. (REFERENCE: Internet Center for Wildlife Damage Management – Kangaroo Rats, http://icwdm.org/handbook/rodents/KangarooRats.asp)

RANGELAND SEEDING

Disturbed areas will be seeded with native grasses. Seeding activities include the following:
> Prepare seedbed where needed.
> Seed can be drilled or broadcast by hand.
> Seed shall be incorporated into the soil, but not more than 1–inch deep.

Seeding dates vary for different grasses, legumes, and forbs. Seed shall be purchased from a reliable supplier. The grass seed mix will consist of the following species as available. The seeding rates below are for planting by hand broadcasting.

Seed Mix	
Western Wheatgrass (Pascopyrum smithii)	9.00 lb/ac PLS
Blue Grama (Bouteloua gracilis)	1.50 lb/ac PLS
	10.50 lb/ac PLS

FENCING

Prevent concentrated flow along fenceline by raising the bottom wire and removing accumulated debris. If the condition of the bottom wire is poor, then replace with smooth double strand wire (12–1/2 gauge). Minimum protective coating – Class 1 galvanized per ASTM–121
Strand breaking strength of 950 foot–pounds or 70,000 psi

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CONSTRUCTION SPECIFICATIONS

COYOTE CREEK
Watershed-Scale Education and Training Grant
Rogers Ranch

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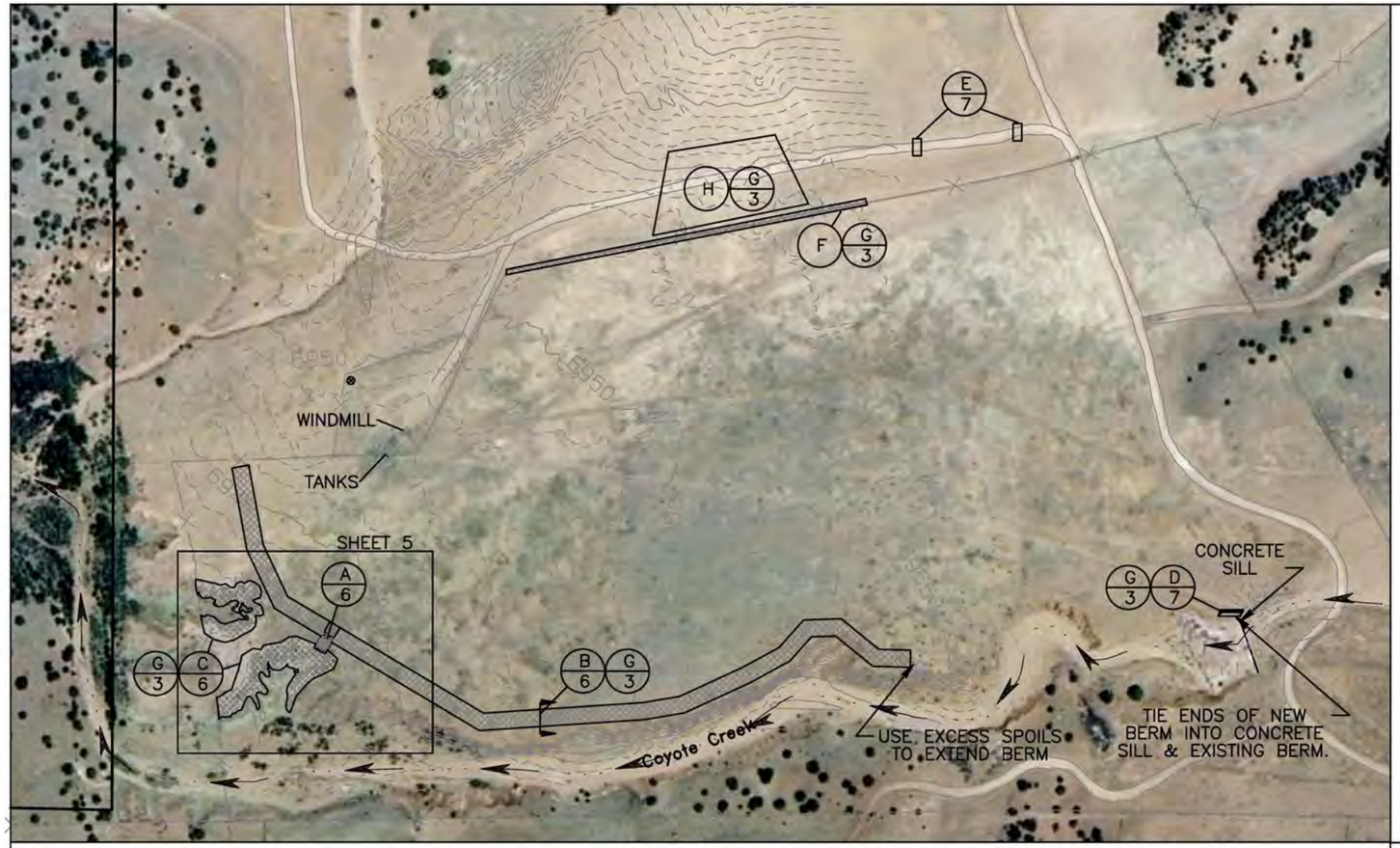
SHEET NO: 3 OF 7



CONSTRUCTION NOTES

		EARTHWORK QUANTITES: CUT	FILL
(A)	CONSTRUCT ROCK–LINED CHUTE	(A) 125 CY	–
(B)	CONSTRUCT EARTHEN BERM AND COLLECTOR SWALE. USE SPOILS FROM SWALE TO CONSTRUCT BERM	(B) 530 CY	550 CY
(C)	RESLOPE BANKS OF HEADCUTS TO 2:1 SLOPE	(C) 70 CY	–
(D)	CONSTRUCT EARTHEN BERM BETWEEN WING WALL OF CONCRETE SILL AND EXISTING BERM	(D) –	110 CY
(E)	CONSTRUCT WATER BARS	(E) 3 CY	3 CY
(F)	REMOVE DEBRIS PILE THAT HAS FORMED ALONG FENCELINE. RAISE BOTTOM WIRE ON FENCE TO 16 IN. TO ENSURE IT DOES NOT CATCH DEBRIS	(F) 50 CY	–
(G)	SUPPLY AND APPLY GRASS SEED MIX	(G) –	–
(H)	SUPPLY AND PLACE KANGAROO RAT TRAPS	(H) –	–

LEGEND:

- EARTHWORK
- ROCK
- FENCELINE
- ROAD
- FLOWLINE
- BENCHMARK
- MAJOR CONTOUR
- MINOR CONTOUR
- PROPERTY BOUNDARY
- B/6 DETAIL LOCATION
  - SHEET REFERENCE
  - DETAIL IDENTIFIER

HORIZONTAL SCALE: 1" = 300'

300 0 300

N W E S

HYDROLOGY SUMMARY

AT HEADCUT:
WATERSHED AREA: 350 AC (0.5 SQ MI)

FLOWS: (DETERMINED USING EFH2)

Q2 = 10 CFS
Q5 = 32 CFS
Q10 = 57 CFS
Q25 = 112 CFS

COYOTE CREEK (AT SILL):
WATERSHED AREA: 133 SQ MI

FLOWS: (DETERMINED USING LCR REGIONAL CURVE)

Q2 = 377 CFS
Q5 = 930 CFS
Q10 = 1550 CFS
Q25 = 2729 CFS

Natural Channel Design, Inc
206 S. Elden St.
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DESIGNED BY: C. SCUDIERI, S. YARD
REVIEWED BY: S. YARD

REV	DATE	BY	REVISION

PLAN VIEW: Bank Stabilization

COYOTE CREEK
Watershed-Scale Education and Training Grant
Rogers Ranch

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 26889 STEPHANIE N. YARD Date Signed 7/19/12 ARIZONA, U.S.A.

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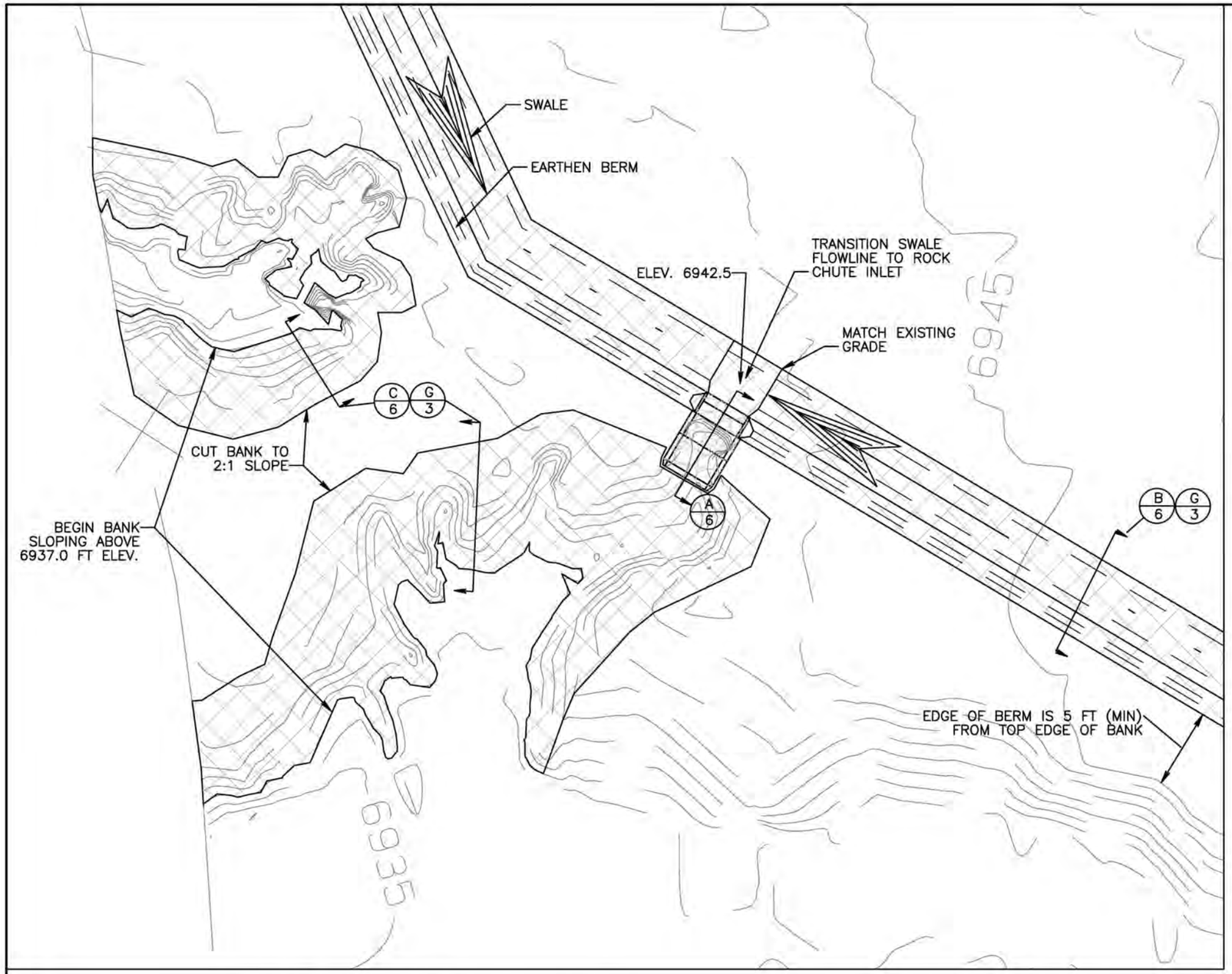

CONSTRUCTION NOTES

(A) CONSTRUCT ROCK–LINED CHUTE. EXTEND CHUTE APRON TO EDGE OF BERM. MATCH THICKNESS ON CHUTE SIDE & NARROW TO 1 FT ON SWALE SIDE.

(B) CONSTRUCT EARTHEN BERM AND COLLECTOR SWALE. USE SPOILS FROM SWALE TO CONSTRUCT BERM.

(C) RESLOPE BANKS OF HEADCUTS TO 2:1 SLOPE.

(G) SUPPLY AND APPLY GRASS SEED MIX.

SEE SHEETS 2 & 3 FOR GENERAL NOTES & CONSTRUCTION SPECIFICATIONS

HORIZONTAL SCALE: 1" = 50'

50 0 50

N W E S

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REVIEWED BY: S. YARD

REV	DATE	BY	REVISION

PLAN VIEW: Headcut Detail

COYOTE CREEK
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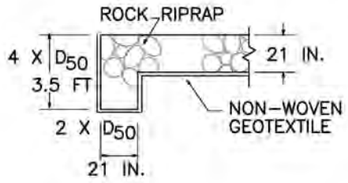
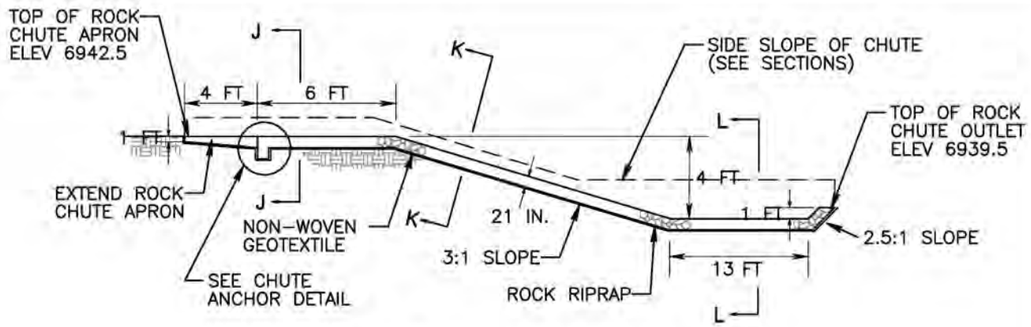
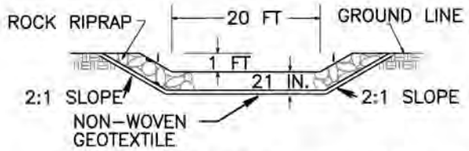


CHUTE ANCHOR DETAIL

(NOT TO SCALE)

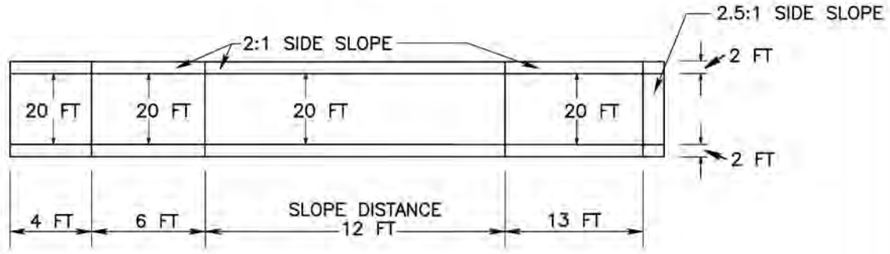


CHUTE ℄ PROFILE



TYPICAL SECTION J-J, K-K & L-L

(NOT TO SCALE)



CHUTE PLAN VIEW

A/4 ROCK-LINED CHUTE PLAN & PROFILE VIEW NOT TO SCALE

Rock Specifications

DIAMETER, IN.	% PASSING
15 – 20	D100
13 – 18	D85
10 – 15	D50
8 – 13	D10

Material Quantities

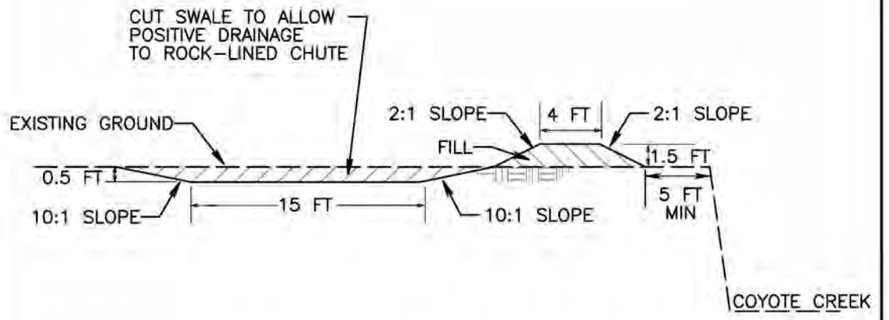
QUANTITY	UNIT	ITEM
150	SQ YD	GEOTEXTILE
75	CU YD	ROCK RIPRAP

D_{50} = 10 in

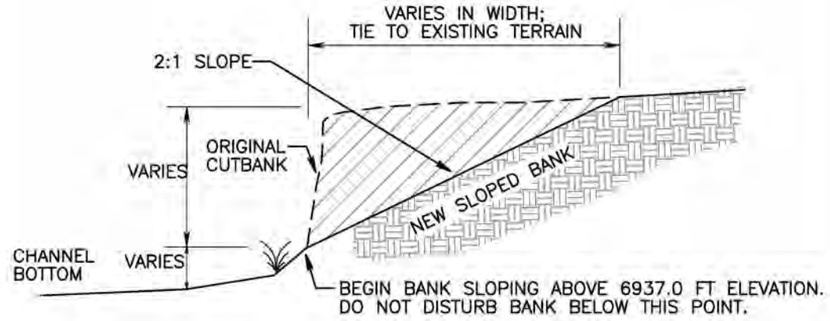
NOTES

SEE SHEET 2 FOR GENERAL NOTES & CONSTRUCTION SPECIFICATIONS

1. THE SITE SHALL BE EXCAVATED AND BACKFILLED TO THE GRADES SHOWN ON DRAWING. THE FILL MATERIAL SHALL BE COMPACTED TO THE DENSITY OF SURROUNDING UNDISTURBED AREAS.
2. GEOTEXTILE SHALL BE NON-WOVEN FABRIC WITH A MINIMUM GRAB TENSILE STRENGTH OF 90 LB, GREATER THAN 50% ELONGATION AT FAILURE, A MINIMUM OF 40 LB PUNCTURE STRENGTH, AND UV RESISTANCE OF 70% STRENGTH RETAINED. GEOTEXTILE SHALL BE JOINED BY OVERLAPPING A MINIMUM OF 18 INCHES AND SECURED AGAINST THE UNDERLYING FOUNDATION MATERIAL.
2. ROCK SHALL BE DENSE AND ANGULAR TO SUB-ROUNDED IN SHAPE. THE LEAST DIMENSION OF AN INDIVIDUAL ROCK SHALL NOT BE LESS THAN ONE-THIRD THE GREATEST DIMENSION. SOURCE OF ROCK WILL BE APPROVED PRIOR TO PLACEMENT. ROCK SHALL BE WELL GRADED AS SHOWN IN TABLE.
3. ROCK PLACEMENT SHALL BEGIN AT THE BOTTOM OF SLOPE.
4. ROCK SHALL NOT BE DROPPED MORE THAN 3 FT ONTO GEOTEXTILE.
5. A SUFFICIENT AMOUNT OF ROCK SHALL BE HAND PLACED TO SECURE CONTACT BETWEEN STONES AND INSURE A NEAT, UNIFORM SURFACE.



B/4 BERM & COLLECTOR SWALE TYPICAL SECTION NOT TO SCALE



C/4 BANK SLOPING TYPICAL SECTION NOT TO SCALE

SEE SHEETS 2 & 3 FOR GENERAL NOTES & CONSTRUCTION SPECIFICATIONS

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DESIGNED BY: C. SCUDIERI, S. YARD			
REVIEWED BY: S. YARD			
REV	DATE	BY	REVISION

DETAILS:
Rock-Lined Chute, Berm & Swale, Bank Sloping

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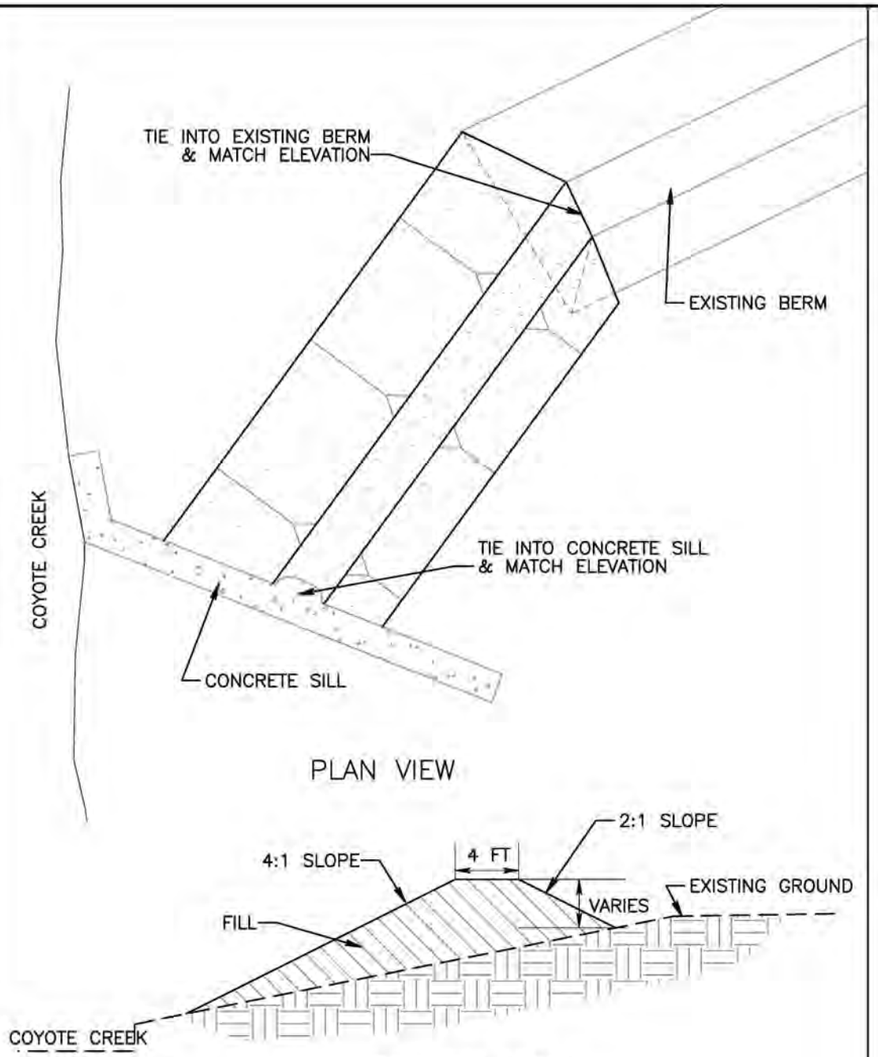
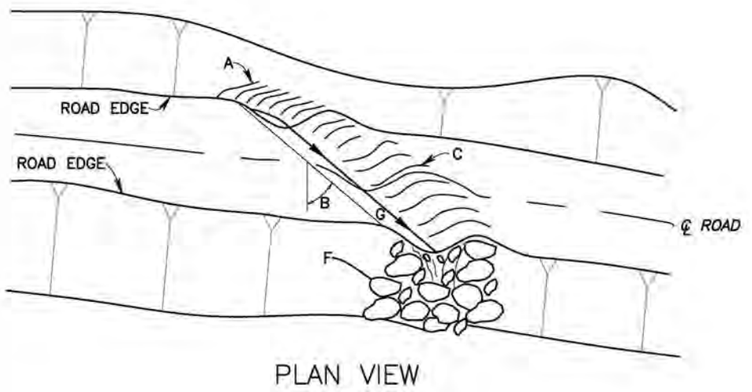
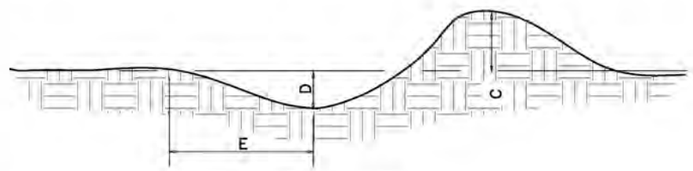


D/4 BERM AT SILL TYPICAL — NOT TO SCALE

SEE SHEET 2 FOR GENERAL NOTES & CONSTRUCTION SPECIFICATIONS



PLAN VIEW



SECTION VIEW

E/4 EARTHEN WATER BAR TYPICAL — NOT TO SCALE

SEE SHEET 2 FOR GENERAL NOTES & CONSTRUCTION SPECIFICATIONS

DESIGN AND INSTALLATION GUIDELINES

1. A WATER BAR CONSISTS OF A SHALLOW TRENCH WITH A PARALLEL BERM OR RIDGE ON THE DOWNSLOPE SIDE AND IS ANGLED DOWN ACROSS THE ROAD. WATER BARS CAN BE CONSTRUCTED WITH A BACKHOE AND ARE USUALLY MADE OF COMPACTED SOIL.

2. WATER BAR CONSTRUCTION FOR FOREST OR RANCH ROADS, FIREBREAKS, STOCKTRAILS, AND WALKWAYS WITH LITTLE OR NO TRAFFIC. SPECIFICATIONS ARE AVERAGE, AND MAY BE ADJUSTED TO CONDITIONS.

   A: BANKCUT TIE IN POINT.

   B: ANGLE DRAIN 30° TO 45° DEGREES DOWNGRADE WITH ROAD CL.

   C: CROSS–DRAIN BERM HEIGHT 1 TO 2 FT ABOVE THE ROADBED. (OPTIMUM IS 1 FT)

   D: CUT DEPTH 6 IN. TO 12 IN. INTO ROADBED. (OPTIMUM IS 6 IN.) PILE EXCAVATED MATERIAL ON DOWNHILL SIDE TO DIVERT WATER OFF ROAD.

   E: 3 FT TO 4 FT MINIMUM.

   F: ENERGY ABSORBER IS NEEDED ON THE DOWNSLOPE OUT–FALL SUCH AS STONE, RIPRAP OR BRUSH, TO SLOW AND DISSIPATE WATER.

   G: PROVIDE A CROSS–DRAINAGE GRADE OF 1 TO 2 PERCENT.

MAXIMUM CROSS DRAIN SPACING (FEET)
(GENERAL GUIDELINES)

SOIL TYPE	ROAD GRADIENT (%) 1%–4%	5%–9%	10%–15%
HIGHLY EROSIVE GRANITIC OR SANDY	300 ft	200 ft	150 ft
MODERATE EROSIVE CLAY OR LOAM	350 ft	250 ft	175 ft
LOW EROSIVE SHALE OR GRAVEL	400 ft	300 ft	200 ft

NOTES:

FREQUENCY OF CROSS–DRAIN STRUCTURES DEPENDS UPON CLIMATE, SOILS, ROAD LOCATION, AND ROAD GRADIENT. NEED ENOUGH TO MOVE WATER OFF ROAD BEFORE THE AMOUNT OF WATER ACCUMULATED CAN CAUSE CHANNELING AND RUTS, OBSERVE EXISTING PATTERNS. INSTALL WHENEVER A NATURAL DRAINAGE FEATURE IS CROSSED.

Drawings and Construction Specifications: Adapted from USDA NRCS and USFS Drawings

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REVIEWED BY: S. YARD

REV	DATE	BY	REVISION

DETAILS:
Berm at Sill & Water Bar

COYOTE CREEK
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