Appendix J
Malpai Borderlands Group
Watershed Restoration Project

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By

Van Clothier

OVERVIEW AND SUMMARY

This watershed restoration project is unique in that it is a landscape scale effort, treating erosion problems in a natural and unobtrusive way, using native materials to help the watercourses achieve dynamic stability. Using deflectors and weirs made of sticks and stones, we intend to put the wiggle back into the long, straight gullies by harnessing the hydraulic power of a gully washer to carve meanders into the terraces, slowing the water down, allowing it to soak into the ground, and producing the needed sediment to aggrade the channel. For this to work properly, we must discern the harmonic spatial frequency of each reach of each arroyo. It's about going with the flow.

In other areas that are threatened but not yet gullied, we are attempting to protect the valley bottoms with cobble mulch placed along contour lines. The whole idea here is to create stability in the soil and to provide a seedbed to help native grass establish itself in key areas. By creating an episode of deposition in the valley bottoms, we are creating an ideal environment to germinate seed. Native grasses are living, self-repairing erosion control organisms. In order to get grass to take root in the valley bottoms we need to temporarily reverse the natural pattern of erosion and deposition with these man-made structures.

It's also about methodically working all of the first order, or headwater watercourses in the drainage network so that there will be a cumulative effect. We began work in the Astin Spring watershed that lies entirely within the boundaries of the Malpai Ranch and directly upstream of the San Bernardino Wildlife Refuge. The initial work in this drainage has now been completed and we are now working in the Hay Hollow Watershed that runs for several miles, through three ranches and roughly parallel with the Mexican Border. This is a long term project.

An important facet of the work is post-flood monitoring and maintenance. We need to go back to a treated area immediately after a flood event to see what happened. Did the structures really do what they were supposed to do? If not, why? We then need to correct any problems before the next runoff event. It is anticipated that, under ideal conditions it will take 5 years of follow-up and maintenance to insure that we are successful. In some cases promotion of healthy grass in the valley bottoms may require other management actions in addition to the gully restoration effort. These might include seeding of native grasses, use of fire or other brush control where possible, and/or changes in grazing management, to name a few.

I started the project on June 16, 2003 with a crew of 3 building arroyo erosion control structures in Sandy Arroyo. On July 3, I had 10 people working for me in Red Windmill Draw. On August 18 my crew went down to 5 or 6 for the remainder of this phase of the project. We finished the initial work in the Astin Draw drainage and moved to the Hay Hollow drainage on October 20. After the last day, which was February 6, 2004, my crew took a break from this project to complete a previously scheduled job for Larry Green at Sunglow. That project is scheduled to end on August 12, 2004 and they have committed to returning the crew to us at that time.

There have been two gully washers in watercourses treated by this project. The first time, I arrived at the project site an hour after a summer thunderstorm, and started making minor adjustments to some structures while the water was still flowing. We all excitedly walked in the arroyos the next morning to see how much of the work survived and, in most cases were pleasantly surprised to see that the structures had survived the flood, caused sediment to be deposited behind them, and raised the grade of the arroyo slightly. In the next few weeks we saw grass and annuals start to come up between the cracks in the rocks, and in the sediment collected behind the little dams. This is only the beginning. Given enough time, good management, and a whole lot of help from Mother Nature in the form of RAIN, well - well see.

THE GEOMORPHIC APPROACH

The philosophy behind this project is based on fluvial geomorphology, or naturally occurring landforms that have been formed by moving water. A lot of important work has been done in this field by David Rosgen, Wildland Hydrology, Inc. The Rosgen stream classification system has been adopted by the U.S. Forest Service, and most other federal and state land management agencies. It is based on factors that can be measured in the field such as floodplain accessibility, channel shape and other channel dimensions and patterns. It is important to understand what is governing the dynamic stability of the watercourse we are dealing with before going about making improvements. This way we hope that our influence on the watercourse will be appropriate, and coordinated with the natural forces that shape it.

Bill Zeedyk is a locally famous stream restoration practitioner from New Mexico who has developed the technique of Induced Meandering. This is a subtle approach that helps an ailing watercourse fix itself by governing the patterns of sediment erosion and deposition that are caused by the hydraulic power of floodwaters. For this to work we must anticipate the natural meander pattern appropriate for our particular stream type and size and build structures designed to influence the flow of floodwaters to do the work of reshaping the impaired channel into one that is stable. A key factor here is the Meander Wavelength, which is the valley distance taken up by a pair of opposite curves or bends.

I am a student of both Rosgen and Zeedyk.

TOTAL STRUCTURE INVENTORY FOR PROJECT TO DATE:

Brush Fill	24	
Post Baffle	1	
Brush Head Cut Structure	3	
Vanes	28	
Rock Baffles	179	
One Rock Dams	1247	
Wicker Weir	29	
Zuni Head Cut Structure	35	
Meander Cutoff Plug	8	
Contour Cobble Mulch	135,	total length: 664 yards
Cobble Channel Liner	198,	total length: 1439 yards
Tree Removal	39	
Rolling Dips	15	
Road Rut Fill	7	
Blocked 4-Wheeler Roads	2	
TOTAL STRUCTURES	**1950**	

TOTAL LENGTH OF TREATED REACHES: 37,870 feet, or 7.2 miles

Note: this is a conservative estimate because it is based on the straight line distances between the beginning and ending points of each treated reach. The number of structures is also conservative because I probably missed a few tributaries when I was counting.

TYPES OF STRUCTURES

All of the structures used in this project were built from native materials: sticks, stones, and earth collected locally, on site where available. The structures are designed to blend in to the landscape over time and become covered with natural sedimentation as the bed of the gully is raised by their influence. Two general types of in-stream structures were built, Weirs and Deflectors, in addition, we did some Tree Removal and Road Work:

Weirs are used to stabilize bed elevation and channel slope. There were many types used on this project:

One Rock Dams - These are only one rock high, at least five rows of rock long. One Rock Dams are built to extend across the channel bottom to collect a bit of sediment, grow grass in the cracks in the rocks, and stabilize the grade by protecting the channel bottom from down cutting.

Cobble Channel Liner - In essence, this is just a very long one rock dam, built to armor the channel bottom in certain reaches to stabilize the grade.

Contour Cobble Mulch - a curved application of cobble mulch about one yard wide and of varying length placed on the ground along a topographic contour line.

This structure is intended to provide a seed bed for grasses to grow where they are needed to stem sheet erosion.

Wicker Weir - Posts driven to within a foot or so of the ground in a row perpendicular to the flow and extending from gully wall to gully wall. Long thin branches are then woven between the posts, stomped down and wired to the posts. This will catch flood debris and sediment.

Brush Fill - Cut brush and branches interwoven and staked to the channel bottom to cause deposition.

Brush Head Cut Structure - brush laid down perpendicular to the flow, stomped down and packed with soil. This is used in very low flow velocity areas.

Zuni Head Cut Structure - Cobble liner on the surface of a head cut, followed by a slightly taller one rock dam which is placed downstream a distance at least four times the height of the head cut.

Deflectors are used to direct stream flow to meander, increasing the distance water has to travel to get down valley. Several types were used:

Post Baffle - built by pounding a matrix of posts into the channel bottom and cutting them off about a foot above the ground.

Rock Baffle - Hand placement of rocks which are set in shallow trenches so that only part of the rock is exposed to the force of the floodwaters.

Vane - This is a linear structure that points upstream at an angle protruding from the bank. Designed to capture sediment and redirect the flow towards the opposite bank.

Meander Cutoff Plug - rock fill to block where the flow has gone across a point bar.

Tree Removal - this is sometimes done in conjunction with a baffle or a vane to eliminate the bank protection where a structure has been built to intentionally erode a particular section of bank. This is to make it easier for the stream to erode its terrace to accelerate meander development.

Road Work was done primarily to address how the road influences the flow of water, concentrating it in some areas and producing gullies there while simultaneously drying out other areas. The applications were:

Rolling Dips - a very low water bar made of compacted earth that is angled to send water off the road and prevent it from causing ruts.

Road Rut Fill - using cobble and soil. This is done in conjunction with rolling dips.

Blocked 4-Wheeler Roads - This was done by piling thorny brush in key areas to stem the network of maverick roads.

DRAINAGES TREATED

Sandy Arroyo, Glenn's Malpai Ranch

This is a tributary of Red Windmill draw that enters from the North just below the windmill. This is a sand and gravel bed arroyo that is cutting through an alluvial fan. The arroyo was unstable with meander cutoffs near the head, and very little sinuosity in the middle reaches. There was very little grass cover in the arroyo bottom.

The strategy here was to try to stabilize the grade slightly higher than the present elevation in the arroyo and all tributaries, induce meandering where applicable, and try to cause an episode of deposition that could be colonized by grass.

We corrected four meander cutoffs near the top of the drainage. We built many one rock dams and baffles to stabilize this channel and raise the grade slightly.

<u>Structure Inventory</u>

Sandy Arroyo Tributary of Red Windmill Draw on Glenn's Malpai Ranch

UTM 0663054 / 3472592	Top of treated reach at Horse Pasture fence
Baffles	19
Cutoff Plugs	4
One Rock Dams	91
Cobble channel liner	4, total length: 15 yards
Zuni head cut str.	3
UTM 0663080 / 3472144	Confluence with Red Windmill Draw
Treated reach: 1200 feet	

This tributary had a gully washer last summer and the structures did quite well, filling in with sediment and, in places, grass. One rill we treated now has a very nice small stand of grass growing on the gully bottom. Now that they have filled in with sediment, we need to do maintenance on some of the one rock dams to secure the gains we have made. We should use cobble mined from the terraces instead of going up to the mesa for material, as we did during the initial construction.

Red Windmill Draw, Glenn's Malpai Ranch

There is a lot to say about this tributary because we did a lot of work here and experienced two gully washers in one season. This was the first large area treated during the project. It is a 1 1/4 square mile drainage basin at the Windmill. The valley is broad and gently sloping, fill is silt. The head of the valley is gently sloping and is not yet Bullied. About halfway from the windmill to the horse pasture fence, there is an extensive network of erosional rills and galloping gully head cuts. Below the confluence with Bale Draw there is a dirt tank that blew out through its spillway and created several hundred feet of gullying downstream, although the tank had been causing deposition during its life.

The valley floor was previously a swale, but now is cut by a gully that has reached bedrock throughout some reaches. The bedrock is a very erodable sandstone material that falls apart in slabs, and therefore isn't really protecting the gully from further down cutting, and also is an impossible material for seeding.

The design problem for repairing the incised channel was deciding what width to depth ratio to use for the transitional bankfull channel. I would like to induce a channel evolution back to a non-incised swale, a channel type that is not in the Rosgen classification system, but one that Zeedyk thinks was once common in parts of Arizona and New Mexico. The challenge is to pick a meander wavelength that will initially have the stream power to carve sediment out of the terraces and deposit it on the inside of developing point bars, creating a meandering stream that can absorb the hydraulic power of a large gully washer without degrading. The unique combination of this broad, gently sloping valley filled with silt and a robust stand of grass growing on the ephemeral channel bottom will then have the potential to aggrade back into a swale. Most of the sediment corning from sheet erosion during smaller runoff events will be captured by the lush grass in the channel bottom and eventually fill the entire channel up with sediment, restoring the historic swale morphology.

Upstream of the gullied portion of the valley, we built several cobble contour mulch structures to try to get more grass to grow on the valley bottom and protect it from future gullying. We built small one rock dams wherever there was the slightest incipient head cut, or channeling, no matter how small. Every single one of the many gully head cuts were treated with Zuni Head Cut structures and one rock dams.

For the incised channel, I used the meanders in the spillway as a reference reach and installed one rock dams and baffles to try to continue this pattern all the way to the confluence with the main stem. Quite a few trees were removed to promote lateral bank erosion in key places.

To address the troublesome bedrock channel bottom, I decided to try to get some deposition of sediment on top of this sandstone bedrock by means of one rock dams.

<u>Structure Inventory</u>

Red Windmill Draw on Glenn's Malpai Ranch

UTM 0662742 / 3472805 Top of treated reach in Horse Pasture

Baffles	54
Vanes	3
One Rock Dams	286
Contour Cobble Mulch	3, total length: 10 yards
Zuni head cut str.	17
Tree removal	15 (est.)

UTM 0664096 / 3471769 Confluence with Aston Draw

Treated reach: 5800 feet + 500 feet of tributaries, est. = 6300 feet

There were two gully washers in this tributary last summer, and all but 2 or 3 of the 360 structures in the mile long treated reach stayed put. The vast majority of the weirs have already collected quite a bit of sediment behind them which is now being colonized by grass and annuals. As time goes on, the sediment behind these weirs is expected to continue to aggrade the channel and provide an increasing seedbed area on the gully floor. The establishment of healthy stands of perennial native grass in the gully bottom is the key to successful restoration of these ephemeral watercourses. One structure a little way downstream from the spillway raised the grade a foot and grew in with lush grass in an incredibly short time. In another place a one rock dam that was too tall dug a hole in the channel bottom during the first runoff event. This was repaired. A one rock dam on the downstream side of a mesquite island in the channel caused a lot of deposition in this area.

Although the weirs seem to be doing their job of raising the grade in the gully bottom, I remain concerned that the deflectors are not causing as much lateral bank erosion as I had anticipated. Many of the baffles seem to be too close together to promote induced meandering effectively, especially considering the small scale of the system and limited stream power from the 0.8% valley slope. Maybe some of the baffles should be converted into one rock dams to extend the meander wavelength, giving the stream more drop between deflectors. This will put more power into lateral bank erosion which will increase the stream length and slow the floodwaters down. Some areas still need more tree removal opposite the baffles to increase their effectiveness. There is an over-extended meander at 900 feet that will need to be controlled with vanes in the future. We also need to do a bit of head cut repair on the main stem below the tank.

West Water, Glenn's Malpai Ranch

This tributary of Astin Draw is in a steep area at the base of the Southwest end of Steer Pasture Mountain dominated by fine grain valley fill and volcanic cobble of very low specific gravity. We treated numerous tributary arroyos that have cut to bedrock at the base of the mountain, extending our treated area all the way to West Water trough.

<u>Structure Inventory</u>

Aston Draw at West Water on Glenn's Malpai Ranch

UTM 0662296 / 3476821		Top of treated reach
	Baffles	7
	One Rock Dams	68
UTM 0662288 / 3476761		Found Metate on left terrace, marked location with PVC pipe
UTM 0662529 / 3476303		West Water Trough
	Treated reach: 1860 feet	

A thunderstorm last summer rained 2 inches in 45 minutes at this very spot and washed away 1/3 of the structures, but filled the rest of the structures with sediment. I think that the low specific gravity of the rocks we had to use had a lot to do with this. Most of the destroyed structures were subsequently replaced. At this time, there are many structures in good shape and filling up with sediment. Note: There are also a couple of dozen structures in the western most tributary that were marked with blue paint but were never constructed.

Aston Windmill Draw, Glenn's Malpai Ranch

This drainage has a deep gully through fine grained material, very little grass cover and a mesquite and acacia invasion happening. Valley slope ranges from 1.4% to 1.8%. This gully is discontinuous, starting at the road to Aston Windmill at station 0+00 with a four foot head cut. This incised channel goes along with little sinuosity for 1900 feet where it suddenly becomes a swale. This swale has multiple cobble bed low flow channels through a shrub thicket, and then the channels drop into a rapidly migrating head cut at 2400 feet. From this point, it becomes an incised channel again until the confluence with the South Fork of Astin Draw. There is an old channel to the North of the gully, as well as quite a few erosional rills in this area that flow into the main gully.

At the top of the treated reach, we built a large rock head cut structure to protect the road by preventing the head cut from migrating upstream. Continuing on for 1900 feet this was an induced meander project with a combination of one rock dams, baffles and vanes, removing trees where they were preventing lateral bank erosion opposite induced meander bends.

We treated all of the several tributary head cuts near the top of this treated reach, one of which was initiated where the road captured flow of a hill slope for 220 feet then cut straight down valley, causing a deep side gully to migrate up from the main stem. This was addressed by putting this water in an old channel that had the capacity for this flow.

Between 1900 and 2400 feet we built very low one rock dams in the cobble low flow channels to try to maintain the swale morphology.

The head cut at 2400 feet was treated with a series of baffles and one rock dams to try to prevent the gully from deepening in the straight down valley direction. From this point on, the incised channel was treated with a series of deflectors and weirs to attempt to induce meandering.

Structure Inventory

Astin Windmill Draw on Glenn's Malpai Ranch

UTM		Road crossing at Astin Windmill
	Vanes or Baffles	55 (est.)
	One Rock Dams	52 (est.)
	Tree Removal	12 (est.)
UTM		End of treated reach
	Treated reach: 4200 feet, not including numerous side channels.	

Last summer there was a medium sized gully washer that was photographed at the peak of the flood by Wendy Glenn. Amazingly, most of the structures survived the flood, and protected the gully from deepening during this event. A lot of sediment was collected behind the weirs and this was colonized by a moderate amount of annual vegetation, but there was a lot less lateral bank erosion than I was hoping for. In retrospect, I think that the project design had too short of a meander wavelength which made the structures a little bit too close together to optimize the performance of the baffles. (See discussion for Red Windmill Draw) There will be an ongoing process of monitoring and repair/adjustment to follow through on this. Unfortunately, the head cut' at 2400 feet migrated about 31 feet during that one gully washer. I would like to return to this site and install some riffle weirs with rock spillways, as well as some contour cobble mulch to try to stop this head cut and get some grass growing in the valley bottom in this area.

Boneyard Draw, Glenn's Malpai Ranch

Boneyard draw is not gullied except in the vicinity of the Glenn's driveway where two shallow gullies cross the road and continue as one gully all the way to the confluence with Astin Draw.

We treated both channels with a combination of baffles and one rock darns.

Structure Inventory

Boneyard Draw on Glenn's Malpai Ranch

UTM 0663298 / 3473526		Start of treated reach at road crossing: split channels	
	Baffles	13	
	One Rock Dams	20	
	Cobble channel liner	1	total length: 6 yards
UTM 0663203 / 3473438		Confluence of Boneyard Draw split channels	

UTM 0663205 / 3473356 Confluence with Aston Draw
Treated reach: 635 feet + 425 feet (tributary) = 1060 feet

To date there have been no channel forming flood events in this tributary, but the many rainstorms have had the effect of cementing the structures with soil as a mortar.

Aston Draw Main Stem below third crossing, Glenn's Malpai Ranch

The channel here has incised 2 to 3 feet and has low sinuosity. There is lots of sand and gravel in the bed, but the banks are composed of silt. There is thick mesquite and acacia lining the banks.

The plan here was to prevent this reach from down cutting to protect the road crossing

Structure Inventory

Astin Draw on Glenn's Malpai Ranch, below third crossing

UTM 0664144 / 3472521	Road Crossing	
Baffles	1	
One Rock Dams	4	
Cobble channel liner	1	total length: 7 yards
Vanes	1	
UTM 0664217 / 3472564	End of treated Reach	
UTM 0664425 / 3472431	Isolated Vane way downstream	

Treated reach: 230 feet

No flood events have occurred since construction, but the structures are starting to come in with a little bit of grass and annuals from the rains.

Aston Draw Main Stem above second crossing, Glenn's Malpai Ranch

This reach is an incised channel with low sinuosity. The channel is lined with well established mesquite and acacia trees that are protecting the banks from erosion and preventing the development of meanders.

This reach was treated with several baffles and some tree removal to help improve the sinuosity prior to the confluence of Red Windmill Draw.

Structure Inventory

Astin Draw on Glenn's Malpai Ranch, above second crossing

UTM 0664335 / 3472014	Upstream from crossing near Red Windmill Road
Baffles	4
One Rock Dams	1
Tree Removal	12 (est.)

UTM 0664096 3471769 Confluence with Red Windmill Draw
Treated reach: 1120 feet

No flood events have occurred since construction, but the structures are starting to come in with a little bit of grass and annuals from the rains.

Aston Draw Main Stem below first crossing, Glenn's Malpai Ranch

The valley has cut to volcanic bedrock in this reach and becomes a broad, stony channel. Below this crossing, the road is on valley right and within the flood prone area, capturing some of the stream for a few hundred feet before the water pours off the road in a small ditch. This area, between Geronimo Trail and the first crossing is where the cable and boulder check dam built by Warner Glenn in the summer of 1999 started the healing of this drainage by getting sediment to deposit on top of the lava bedrock and grow grass.

We built a few small one rock dams upstream of Warner's structure to help retain moisture in some of the over bank channels that have developed. We built one rock dams in the ditch to prevent it from head cutting and hopefully protecting the road from becoming rutted during the next big flood event.

Structure Inventory

Astin Draw on Glenn's Malpai Ranch, below first crossing

UTM 0664387 / 3471399	First Road Crossing of Astin Draw near Geronimo Trail
One Rock Dams	7
UTM 0664421 / 3471363	End of treated reach

Treated reach: 160 feet

This treated reach is still waiting to be tested by the next flood.

Thomas Tank; McDonald Ranch, Peterson Ranch

This is a broad, gently sloping valley dominated by very fine grained volcanically derived sediment. A half mile from the confluence with Hay Hollow the valley descends into a volcanic gorge. The lava flow and huge volcanic boulders appear to have prevented Thomas Tank Valley from becoming deeply gullied. The spillway from the tank has shifted the channel to the right of the valley bottom and caused gullying for a thousand feet as the channel was trying to find its way back to the valley bottom. Discontinuous gullying continues all the way except for the final reach where cobbles and boulders line the valley bottom near the boulder protected lip of the gorge.

The spillway was treated with a cobble head cut structure with wicker weirs and a rock spillway. The rest of the valley was treated with a combination of structures including

one rock dams, riffle weirs, baffles, contour cobble mulch, and cobble channel liners. All rock and cobble structures were seeded with native grass seed by February, 2004.

Structure Inventory

Thomas Tank Arroyo, starting at head cut spillway of tank. McDonald Ranch

UTM 0676970 / 3478760

Wicker Weir	4	
One Rock Dams	92	
Contour cobble mulch	2,	total length: 12 yards
Zuni head cut str.	1	

UTM 0676871 / 3478477 McDonald/Peterson fence

Treated reach: 830 feet + 320 feet of tributaries = 1150 feet

Thomas Tank Arroyo, starting at McDonald/Peterson fence. Peterson Ranch

UTM 0676871 / 3478477 McDonald/Peterson fence

Baffles	7	
Wicker Weir	11	
One Rock Dams	204	
Contour cobble mulch	86,	total length: 398 yards
Cobble channel liner	62,	total length: 419 yards
Zuni head cut str.	8	
Brush Fill	1,	total length: 5 yards

UTM 0676222 / 3476935 End of treated reach

Treated reach: 4630 feet (actual distance is slightly longer due to parallel channels)

As of March, 2004 this area is showing some positive response. There is lots of grass coming up between the spaces in the rocks and it is looking good so far.

Thomas Tank Tributaries, McDonald Ranch

There are several arroyos on the left side of the road 1/4 mile before you get to the tank, as well as numerous tributary arroyos that intersect downstream of the tank on valley left. These were treated with one rock dams, cobble liners in an effort to stabilize the gullies at their present depth, leaving the banks untreated to allow erosion to widen the gullies during flow events.

Structure Inventory

Gullies on the left side of the road into Thomas Tank 1/4 mile from tank, McDonald Ranch

UTM 0676966 / 3479264

One Rock Dams: 7
Cobble Channel Liner 6, total length: 55 yards

UTM 0676875 / 3479121
Treated reach: 470 feet + 150 feet of small rills = 620 feet

Gully on the left side of the road into Thomas Tank 1/8 mile from tank, McDonald Ranch
UTM
One Rock Dams: 3
Cobble Channel Liner 4, total length: 28 yards

UTM
Treated reach: 250 feet (est.)

Gully on the left side of road just past Thomas Tank, McDonald Ranch
UTM 0677266 / 3478754 Start of treated reach
One Rock Dams: 6
Cobble channel liner 9, total length: 42 yards

UTM 0677160 / 3478753 Arroyo crosses road
UTM 0677061 / 3478729 End of treated reach Treated reach: 570 feet

Gullies to right of road just past Thomas Tank, McDonald Ranch
UTM 0677185 / 3478689 Upslope end of treated area
Baffles 1
Wicker Weir 2
One Rock Dams 27
Cobble channel liner 20, total length: 187 yards

UTM 0676973 / 3478606 End of treated reach
Treated reach: 630 feet x 2 (to account for tributaries) = 1260 feet

To date there has been no channel forming event in this area, although generous spring rains have helped by watering in the structures, and grass is coming up in lots of places.

Thomas Tank Road, McDonald Ranch

We tried to fix erosion problems on this road in the bad places all the way from Geronimo Trail to the Pendleton Tank by filling in ruts and protecting the road from water damage with lead-out ditches and rolling dips. Several renegade 4-Wheeler roads were sealed off with large piles of thorny mesquite branches. Where the road crosses over the Catclaw Tank dam, we corrected a minor drainage problem that was starting to erode at the dam.

<u>Structure Inventory</u>

Road Work, Road to Thomas Tank, Catclaw Tank and Pendleton Tank, McDonald Ranch

Rolling Dips	15	(some with water harvesting cobble mulch)
Rut Fill	7,	total length: 70 yards
Blocked 4 wheel road:	2	(Blocked with brush piles)

The road is a lot smoother to drive on in places now, but will need periodic maintenance depending on the amount of traffic during muddy conditions.

Valle San Benito, McDonald Ranch, Peterson Ranch

This is a moderately sloping headwater valley of Hay Hollow to the east of Thomas Valley where the fine grained alluvium has been cut deeply to bedrock by two main gullies near the head of the valley. There are three meander cutoffs halfway up the valley from the road. The road has contributed to the erosion problem in this valley by capturing runoff in shallow ruts and carrying it down slope. Near the McDonald/Peterson fence there are a half dozen small arroyos that cross both the road and the fence. Not too far down the valley after you cross the cross the fence into Peterson's, this valley turns to a swale that connects to the Thomas Tank drainage on the Peterson Ranch. In the swale area there was lots of bare ground and sheet erosion with some incipient head cuts.

Near the top of the valley we treated several meander cutoffs to extend the channel length. Many structures were built in the gully bottoms from the top of the valley on down to where it becomes a swale.

Every single little gully in the whole area was treated with one rock dams. Road treatments such as rolling dips with water harvesting cobble mulch were constructed to get the water off the road at more frequent intervals and to prevent the road from channeling water. In the swale portion of the valley we treated all of the incipient erosion problems we could identify with one rock dams and extensive cobble mulch structures.

<u>Structure Inventory</u>

Valle San Benito on McDonald Ranch

UTM 0677753 / 3478638 Top of treated reach

Baffles	16	
Vanes	3	
Cutoff Plugs	3	
One Rock Dams	164	
Cobble channel liner	11,	total length: 68 yards

UTM 0677554 / 3478287 McDonald/Peterson fence

Treated reach: 1300 feet x 2 (to account for tributaries) = 2600 feet

Valle San Benito on Peterson Ranch

UTM 0677554 / 3478287 McDonald/Peterson fence

Baffles	11	
Vanes	1	
One Rock Dams	61	
Contour cobble mulch	28,	total length: 152 yards
Cobble channel liner	4,	total length: 16 yards
Zuni head cut str.	2	

UTM 0677405 / 3478124 Arroyo turns into a swale at this point
UTM End of treated reach
Treated reach: 3200 feet (est.)

To date there have been no channel forming events in this drainage.

Arroyo Hondo and Pendleton Tank Spillway, McDonald Ranch

Arroyo Hondo is a very narrow and deep v-bottom gully, over 6-8 feet deep in some places where you can touch both side walls with your hands. It is a tributary of the Pendleton Tank watershed and flows to a confluence with the Pendleton Tank spillway gully where it is now cutting through the left terrace of the Pendleton valley. Downstream of here, where the old valley bottom has been isolated by the dam from flows I found an abandoned channel 18" above the present channel. Walking up Arroyo Hondo, there are many places where you can spot a little piece of shelf 18" above grade. After doing a longitudinal profile of these channel segments, my conclusion is that when the Pendleton Tank was constructed, the spillway overloaded the much smaller Arroyo Hondo tributary and caused a meander cutoff downstream. This caused an 18" head cut to proceed up the already deeply gullied watercourse.

The Arroyo Hondo valley has a severe case of Galloping Gullies with several parallel deep gullies and rapidly migrating head cuts all over the landscape. We tried to treat this with one rock dams to at least stabilize the grade both down in the trench and throughout all of the many erosional gullies in the area to try to get some grass growing in the gully bottom. We also built some brush and fill head cut structures to protect a nice stand of Sacaton. The treated area extends from a pasture fence at the upstream end to five hundred feet downstream of the tank spillway gully confluence. This should control the grade at the present elevation for a long time.

<u>Structure Inventory</u>

Arroyo Hondo Above Pendleton Tank Spillway, McDonald Ranch
UTM 0679189 / 3477083 Fence at top of treated reach

One Rock Dams	71
Brush head cut str.	3

UTM 0678882 / 3477094 Confluence with Pendleton Tank Spillway
Treated reach: 1000 feet x 2 (to account for several parallel arroyos) = 2000 feet

Arroyo Hondo Below Pendleton Tank Spillway, McDonald Ranch

UTM 0678882 / 3477094 Confluence with Pendleton Tank Spillway

One Rock Dams	7
Baffles	3

UTM 0678753 / 3476995 End of treated reach

Treated reach: 530 feet

There has been one small gully washer in this drainage since we treated it. All of the structures survived and have retained sediment behind them.

Valle Buena Vista, Peterson Ranch

This is a minor headwater valley of the Hay Hollow drainage that has been cut steeply up into the mesa. The sediment here is sand and gravel with lots of cobblestones in places. The channel is only minimally gullied at the head of the valley, and then becomes deeply gullied towards the middle, with a series of head cuts and abandoned channels.

We concentrated our efforts where we thought it would do the most good at the top of the valley, building lots of structures out of cobblestones to increase grass cover. As there was lots of available cobble in the cut banks and valley slopes, it was relatively quick work and we tended to make the structures much longer than at other sites.

Several of the structures are very long cobble channel liners which were seeded with native grass, one of which is 140 feet long! We tried to slow the progress of the first few big head cuts with a series of rock drop structures and one rock dams at the bottom end of the treated reach.

<u>Structure Inventory</u>

Valle Buena Vista, starting at head of valley. Peterson Ranch

UTM 0676012 / 3477686

Baffles	2	
One Rock Dams	67	
Contour cobble mulch	13,	total length: 70 yards
Cobble channel liner	31,	total length: 336 yards

Glenn's Malpai Ranch
Red Windmill Draw

March 27, 2004

August 25, 2004

March 27, 2004

August 25, 2004

Glenn's Malpai Ranch
Red Windmill Draw

March 27, 2004

August 25, 2004

This contour cobble mulch structure worked pretty well.

Glenn's Malpai Ranch
Steer Pasture

March 27, 2004

September 14, 2004

Although this one-rock-dam survived a two-inch rain that fell in 45 minutes, over 25% of the structures in this reach were washed away and had to be replaced. Monitoring and maintenance are key.

McDonald Ranch
Thomas Tank

March 26, 2004

August 19, 2004

A cobble channel liner stopped this headcut from drying out this swale of grass

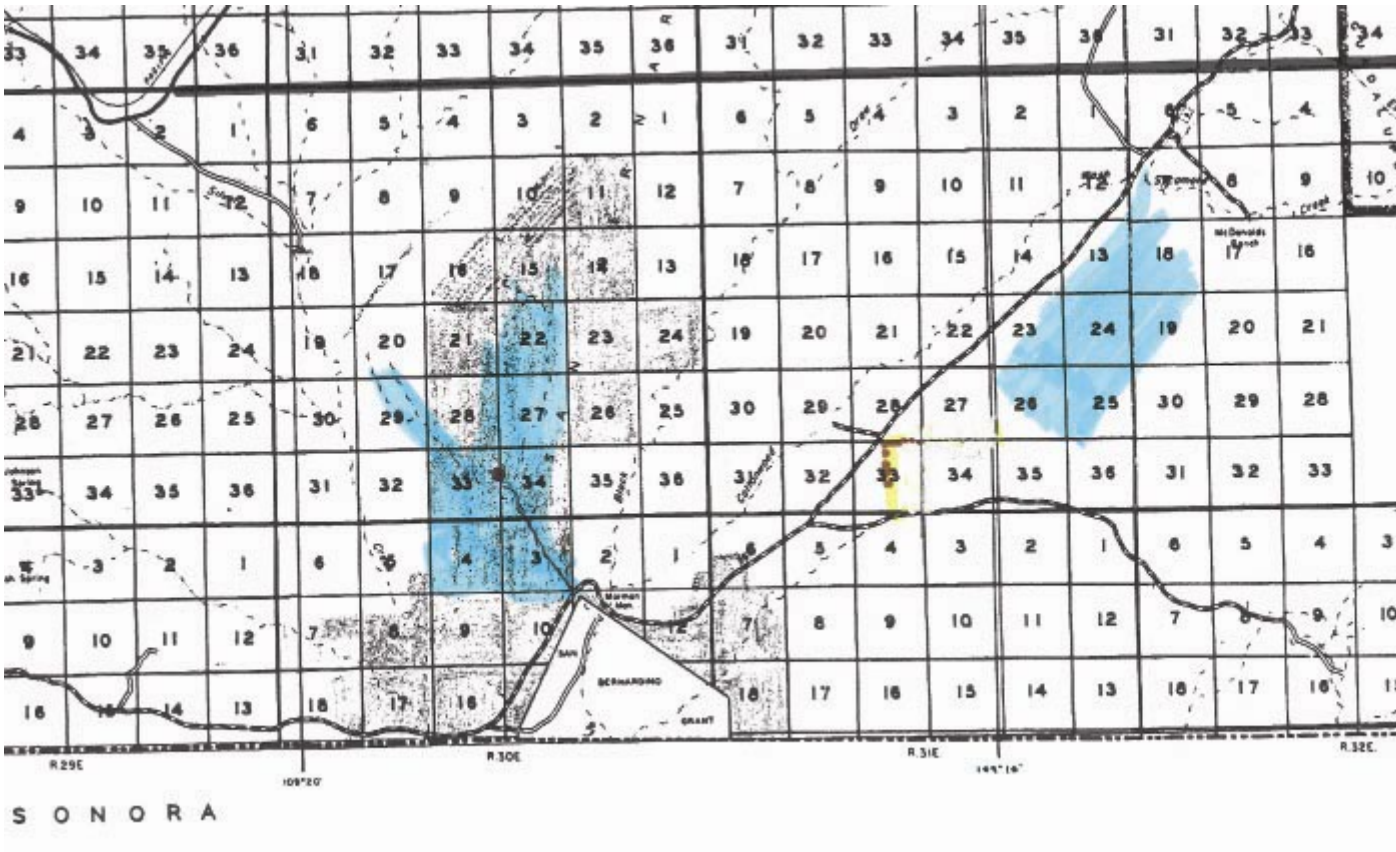
Peterson Ranch
Valle Buena Vista

August 19, 2004

September 15, 2004

The new grass facilitated by the contour cobble mulch has been shorn, but not uprooted

Map 1—Watershed Restoration and Fence Projects



Watershed restoration was done in all canyons and roads in blue areas
in T23S, R30 & 32 E; and T24S, R 30E.
New fence is shown with brown dots and yellow highlight in Section 33, T23S, R31E.