



The Acequia Institute

DRAFT TEN-YEAR PERMACULTURE AND RESTORATION ECOLOGY PLAN FOR ALMUNYAH DE LAS DOS ACEQUIAS, HOME OF THE ACEQUIA INSTITUTE

Prepared by Devon G. Peña, Ph.D. - President and Co-Founder

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INTRODUCTION

Background. The Acequia Institute was created in 2006 through a generous donation from the **Alfonso C. Peña Revocable Living Trust**. The donation included a gift of \$450,000 for the purchase of historic acequia farmlands in Viejo San Acacio, Colorado. These lands are the home and headquarters of the Institute and its non-profit research, education, and grassroots extension service station known as "**Almунyah de las Dos Acequias**." This name was chosen because two acequias (community irrigation ditches) transect the land. These farmlands are actively managed by **Peña Land Conservation and Restoration, L.L.C.**, which is committed to providing additional technical, management, and funding support for the operations at Almунyah de las Dos Acequias.

The A. C. Peña Revocable Living Trust purchased the 198-acre property in the historic "San Acacio Bottomlands" in 2006. This ranch property includes premiere irrigation rights (125 shares) on the **San Luis Peoples Ditch** (established in 1852) and additional rights on the **Robert Allen Ditch**. This is the fourth largest farm on the Peoples' Ditch and one of the thirty largest acequia farms in the Culebra watershed (according to local records from the Costilla County tax assessor). The acquisition included: a remarkable Territorial-style adobe home badly in need of restoration and remodeling work; livestock corrals suitable to running sheep or cattle and for working with horses; fairly large wood-frame barn with two separate compartments and pens with tin siding and roofing; equipment shed made of wood-frame and tin siding and roofing that holds 4-5 pieces of farm equipment; 1960s Polish-made tractor (sold in 2008); 1970s mechanical center-pivot sprinkler with diesel engine (sold in 2008); well-worn 1970s John Deere square-baler; and heavily-used 1972 Sperry New Holland "Speedrower" 1112 swather/windrower that is prone to mechanical breakdowns; this is a hay cutter that cuts a "swath" but leaves the cut hay behind in rows for easier baling.

"Promoting water democracy, resilient agriculture, and environmental justice."

The Acequia Institute • P.O. Box 178 • San Luis, CO 81152

www.acequiainstitute.org • dpena@acequiainstitute.org

206-228-4876 (mobile)

A few months after the purchase of the San Acacio riparian long-lot, the local District Court determined that the San Acacio property acquired for the Institute was entitled to successor use rights for grazing, wood gathering, and wild crafting on the 80,000-acre mountain tract known as La Sierra. This is the famous and historic commons of the **Sangre de Cristo Land Grant** of 1844. Also, in 2007, the Institute received title to the San Acacio farmland, water rights, buildings, and equipment through a quitclaim deed executed by Devon Peña, acting as Trustee of the A. C. Peña Revocable Living Trust.

Since 2007, Devon Peña has led the work to transform Almunyah de las Dos Acequias, as the home of The Acequia Institute, into a working farm and ranch operation, grassroots agricultural experiment station, and farm school for the benefit acequia farmers in Colorado and New Mexico, local community and businesses, visiting college and university students, and other faculty and researchers who share our vision for the preservation of the “acequia way of life” as a model of ecological sustainability, environmental and food justice, and community resilience.

Purpose and Organization of the Report. The purpose of this report is to provide the Board of Directors with information necessary to make decisions that will shape the Inaugural Capital Campaign discussed in a separate report. This permaculture and restoration ecology report is organized into four sections:

Part One is a brief environmental and agricultural history of the land in San Acacio that is the Institute’s headquarters and the home of our farm school and grassroots extension service station (*almunyah*).

Part Two provides an assessment of the ecological conditions of the property from about the time of purchase in 2006 through August 2010. This section identifies and discusses the critical problem areas that require attention in terms of investments in conservation and restoration of wildlife habitat and the adoption and promotion of sustainable acequia agroecological practices that will serve our aims of demonstrating the efficacy of restorative water and soil conservation and management practices in acequia agroecosystems.

Part Three summarizes the principle permaculture methods and restoration ecology planning and research activities that have been undertaken between the summer of 2007 and August 2010. Part Four presents the “rough draft” outline of a proposed ten-year plan for the application of the principles of permaculture and restoration ecology to the transformation of Almunyah de las Dos Acequias into a premiere example of sustainable and resilient acequia farming that is compatible with the regeneration and future protection of wildlife habitat and acequia agroecological values. This report is presented to the Board of Directors of the Acequia Institute for discussion, modification, and approval at our upcoming Board Meeting on August

27, 2010.

PART ONE

**ENVIRONMENTAL AND AGRICULTURAL HISTORY
OF ALMUNYAH DE LAS DOS ACEQUIAS**

The Environmental and Cultural Setting. The San Luis Valley (SLV) in south central Colorado is a high altitude “cold desert” environment with average rainfall that is approximately the same as California’s “Death Valley,” or about 7 inches a year. In Colorado, the SLV is defined as a “Mountain Park” because it is surrounded by mountains and has an average elevation of 7,800 feet above sea level. The SLV is surrounded by the 14,000-foot-high peaks of the Sangre De Cristo Mountain Range to the east and San Juan Mountain Ranges to the west. The SLV is the “Headwaters of the Rio Grande,” and is renowned for its ecology, diverse cultures, and deep history. Scientists note that a person can travel through every major ecological life zone in North America with a quick hike from the bottomlands in the Valley to the mountain peaks. Such a hike would take you from the Upper Sonoran or cold desert of the Valley floor through, in sequence, piñon-juniper foothill, Ponderosa-aspen and Douglas fir-aspen montane, mixed conifer-spruce subalpine, krummholz transition, and finally alpine tundra life zones.

The high mountain peaks of the San Juan and Sangre de Cristo ranges receive an enormous amount of snow over the course of a 7 to 8 month-long winter that characterizes the higher elevations. This snowpack is what makes acequia irrigated agriculture possible since the water rights decreed to the original Hispana/o settlers in the 1850s derive from the surface flow of the mountain spring snowmelt. The acequia system is snow-pack dependent and this implies that the system is also powered by the force of gravity, one of the qualities that has led social and natural science scholars across the world to recognize acequia technology as sustainable and low-impact. Moreover, acequia systems are recognized for the ecosystem and economic base services they provide. These include the creation of wildlife habitat and movement corridors, preservation of native heirloom land race cultivars, soil formation and conservation, maintenance of water quality and recharge of aquifers, returns to natural in-stream flows, and other qualities that are widely celebrated.

Beginnings of Acequia Agriculture in the San Luis Valley. The development of agriculture in the San Luis Valley occurred with the arrival of Spanish, Mexican (mestizo), Mesoamerican (Indian), and other people of diverse ethnic and national origin backgrounds including Sephardic Jews, Persians, Basques, and others.

Agricultural History of Almunyah de las Dos Acequias. Almunyah de las Dos Acequias was originally part of an extensive 2 mile-wide and 22 mile-long riparian long-lot deeded to the founder of La Plaza de San Luis de la Culebra, Dario Diego Gallegos. Mr. Gallegos settled this farm and ranch land in 1851 and a year later in 1852 led the locals in the construction of the San Luis Peoples Ditch, the oldest adjudicated water right in Colorado. Dario’s homestead

remained on a different section of this large estate in a locale that is now home to the Corpus A. Gallegos Ranches, owned and operated by one of our own Board Members, Joe C. Gallegos.

After Dario's death, the land that is home to the Institute remained within the extended Gallegos family through partible inheritance until the early 1950s when an Anglo cattle and lamb grower acquired the long-lot section of 198 acres that is now home to Almunyah de las Dos Acequias. It was during this period that the land was also used to grow commercial row crops in significant quantities. This included the production of cauliflower and lettuce for export markets. In the 1970s, another Anglo livestock producer bought the property. This owner was the one that installed the mechanical center-pivot sprinkler on one of the hay meadows in the northern one-third of the ranch that is more readily cultivated.

During the 1970s a second Anglo owner took possession of the ranch and focused on lamb and hay production. This owner was the one that installed the mechanical center-pivot sprinkler circle in one of the sections of the north-end hay fields. There is evidence of overgrazing dating back to this period with the meadows closest to the homestead south of the river showing signs of being overgrown with invasive grasses like the foxtail (a.k.a. broom grass), which is not good horse or cattle forage, and weeds like the Russian thistle. Both species were introduced in fairly recent decades (1950s-70s) and appear to thrive both in the seasonal wetland hummocks and overgrazed rangelands.

By the time a third family came into ownership of the land, it appears that conditions on the dry land grass meadows southeast of the homestead, the riparian area meadows, and the vegas north of the river and south of the Old Acequia Madre, had also suffered from either overgrazing or grazing during the wrong season. However, it is also the case that the 35-acre alfalfa fields at the north-end were crated at this time and the result is that these are in supremely good condition in terms of soil horizons because they have been unplowed for at least three decades.

PART TWO

ASSESSMENT OF ECOLOGICAL CONDITIONS AT ALMUNYAH DE LAS DOS ACEQUIAS

In 2007, Devon Peña, President and Founder of the Acequia Institute, decided to initiate a comprehensive assessment and study of the ecological conditions at Almunyah de las Dos Acequias. By ecological, it was understood that we needed to understand both the underlying “natural” and “anthropogenic” (human-modified) ecosystems of the Culebra watershed and the implications and expected effects of specific agroecological (farming) practices that we were starting to pursue on our land.

Ecological and Agroecological Conditions.

Water Quantity and Quality. Water quantity is secured in the form of a substantial share in the oldest adjudicated water rights in the state of Colorado, the historic San Luis Peoples Ditch (established in 1852), and the more junior rights on the Robert Allen Ditch. Water is our greatest asset and our rights are well secured and protected. Water quality is also excellent and the acequias generally are not affected by serious sedimentation in this part of the watershed with the possible exception of the old Acequia Madre and the Middle Ditch, which are in need of re-ditching along a cross-section of the long lots. Water quality in the river is also excellent as indicated by the “Blue Ribbon Trout Fishery” designation of this stretch of the Culebra by the Colorado Division of Wildlife (DOW).

Soil. Based on maps and consultations with the NRCS (Natural Resources Conservation Service), we have initiated soil augur surveys of Almunyah de las Dos Acequias, starting with a 30-acre hay meadow that was converted from acequia flood irrigation to a mechanical center-pivot sprinkler circle in the early 1970s. The cultivated fields (alfalfa, hay, and row crops) are underlain with sandy loams with moderate clay content and a fairly deep soil horizon of at least 6 feet. Slow deposition of new sediment through acequia flood-irrigated practices has kept the horizons replenished but there are always dangers of erosion on row crops and of compaction from too much plowing or repeated use of heavy equipment. The soil underlying the native wetland vegas is thin and the Alamosa clay strata appears to lie at 2-3 feet under sandy loams and more clay-infused soil types. We do not have a current USDA-NRCS soil map for the land but we are working with Western State College faculty and students on a GIS map of the ranch during the 2010-11 academic year.

Grazing Range. The rangeland capacity has not been formally established. Customary practices have greatly varied but when we acquired the ranch, the previous owner, Mr. David Ortiz, of New Mexico was running about 100 head of cattle (cow-calf pairs). A one-year lease in 2006-07 with Bobby Maestas of Chama, Colorado exposed the rangelands to some 60-70 cow-calf pairs, but the number was not verified. Joe Gallegos suggested that we shift to winter grazing cycles and limit our numbers to no more than 40 cow-calf pairs or no more than 9-12 bulls. Frankly, we do not know the carrying capacity of the vegas.

Native wild biodiversity. There is a great range of wildlife on the land and water at Almunyah de las Dos Acequias. With regard to fauna: We have confirmed sightings, by ornithology faculty and students, of the Southwestern willow flycatcher and the Yellow-throated warbler. Both of these birds are endangered or threatened and are indicator species of the presence of abundant habitat and food sources. We have to protect and extend this habitat by restricting both livestock access and human activity in the proximity of sites confirmed as habitat for these and other species. The flycatcher habitat appears to be a thicket of old growth willow on our neighbor's land (Clorindo Vialpando) although the thickets border and overlap with the fence line by the last of our river meanders. The ranch is located well within the historic range of the Gunnison sage grouse. With regard to flora: There are at least 35-60 native herbaceous plant species present and Dr. Enrique Salmon and other colleagues have previously identified that for similar neighboring long lots in the locale. These native plants have a normal and healthy distribution throughout their niches. There is a serious problem area related to the lack of regeneration of the cottonwood *bosque* (woodland) due to the impact of decades of livestock trampling or browsing on the saplings and juvenile trees. No renewal of the bosque is currently evident.

Native agro-biodiversity. The acequia farmers of the Rio Arriba bioregion are renowned as seed savers and plant breeders. The Institute has a significant seed collection going back to the late 1980s that includes land race varieties of corn (including *maíz de concho*), *bolita* beans, and *calabacitas* (squash, pumpkin). We have precious resources to protect as confirmed by the Organic Seed Alliance (OSA) in a visit to the farm last year (2009). There is a need to continue protecting these varieties from cross-pollination or introgression of hybrid or genetically-engineered crop varieties. This is especially a threat to our *maíz de concho* and *bolita* bean seed stocks. There are also some naturalized "exotics" like *habas* (Fava beans); these have been saved and adapted by local families for generations. With the advent of genetically-engineered alfalfa we will also now have to work to protect our organic alfalfa fields from the threats posed by transgenic drift.

Problem Areas Identified. As a result of this research, it was determined that there are six major sets of ecological problems at Almunyah de las Dos Acequias requiring our immediate attention and remediation:

1. Riparian Areas: We found fairly severe stream bank erosion and the associated decline of the native cottonwood *bosque* (forest or woodland) along a short fifty-yard stretch of the Culebra River closest to the bridge crossing. This appears to be a consequence both of natural flood events and years of over-grazing and neglect of the control of livestock access points on the river for their drinking water. The bosque was found to be in very poor condition with a population of perhaps two-dozen mature (50-75 year-old) trees and very few successional saplings or juvenile trees. The cottonwood bosque is threatened with collapse due to grazing pressures that have prevented natural regeneration along the root channels for several decades.

2. Native Wetland Meadows (Vegas): The native wetland meadows or *vegas* were found to be marked by extensive boggy hummocks caused by the grazing of livestock during the wet season from late Spring through early Fall instead of the dry season running from late Fall through early Spring. The high water levels in this area, caused by the sub-irrigated flow of water from the operation of the entire acequia system for about two miles above Almunyah de las Dos Acequias, make it unsustainable to graze livestock during the late spring through early fall seasons.
3. Prairie Dogs in the Center-Pivot Sprinkler Circle Hay Meadow: The next to the previous owner installed a mechanical center-pivot sprinkler in the early 1970s on a 30-acre hay meadow located in the southern half of the north end of the ranch above the Old Acequia Madre and below the uppermost flood-irrigated fields where most of our hay and row crop production occurs. The sprinkler irrigated field was found to be populated by an extensive prairie dog "town" that was reducing hay productivity and causing damage to the soil as a result of the tunneling that brings ancient riverbed gravels and even clays to the surface. The use of the mechanical sprinkler also involved a higher carbon footprint for the ranch since it has to be powered by a fuel-guzzling diesel engine.
4. Head Gates off the San Luis Peoples Ditch: Another problem area we identified involves soil erosion control problems on two of the four main head gates off the main stem San Luis Peoples' Ditch at the northern end of the ranch. The eastside lateral ditch or lindero is a principal problem in this regard and we found it was experiencing significant back-wall erosion from the tremendous hydrostatic pressure of the water leaving the Peoples' Ditch and entering into the lindero that delivers water to a large alfalfa-native grass meadow we use to produce a good portion of our hay.
5. Invasive Noxious Weeds: Like most other ranches in the area, our land also has invasive noxious weeds and the two principal problem species are Russian thistle and Russian Knapweed. The thistle is sporadically distributed, mainly in disturbed areas such as our row crop production fields and some wetland areas. It can be controlled with yearly manual removal, fire, or goat treatments. The Knapweed is a major threat because it has already reduced the value of our hay at least 50 percent according to one estimate. The Knapweed infestation is mostly limited to the northeast quadrant of the alfalfa hay fields, both above and below the San Luis Peoples' Ditch and some scattered patches along the eastside lindero that runs south from this point. This covers less than 1 percent of the surface area of the ranch, but this is a tough weed to beat. It reproduces and spreads quickly both through seed dispersal and rhizomes in the root structure. It produces its own allelopathic compound, a natural herbicide that discourages competing species including alfalfa and native grasses. It can be toxic to horses and cattle and this is the reason any given hay operation with the weed will suffer enormous economic losses to say nothing of the impact on the biodiversity of the farm.

6. Erosion Control on Row Crop Fields: Part of the challenge of our efforts to transform Almunyah de las Dos Acequias into an organic, sustainable, and resilient farm is the need to control soil erosion on our row crop fields. The soil profile in the upper half of the north fields that are used for hay and row crop production is excellent and highly fertile. The reason is that this section of the ranch has been in an alfalfa-native grass hay perennial prairie for at least 30-35 years and has not been disked or plowed. The soil horizon is deep – at least six feet of topsoil. It has very few rocks and is rich in the organic materials and nutrients produced by decades of alfalfa growth and nitrogen-fixing bacteria associated with this sort of agroecosystem. In a word, we have a lot to lose if we are careless with our row crop practices. In 2007, we plowed and disked a small half-acre section of this area (about 35 acres at the topmost irrigated fields). The corn plot consisted of all landrace and chimera varieties from Devon Peña's seed collection. Production results were good (except for the Oaxacan green dent from South Central Farm which produced tassels but no ears, although introgression into the other varieties was plainly visible in the coloration of the kernels). There was some erosion and an arroyo started to form along the edge of this small experimental milpa. The results were not encouraging and suggest that these rich fields are vulnerable to fairly rapid loss of topsoil when subject to conventional row crop practices. (For further discussion please see Part III).

PART THREE

PERMACULTURE AND RESTORATION ECOLOGY ACTIVITIES, 2007-2010

While waiting for the preparation and approval of a comprehensive ten-year plan for the restoration and long-term conservation of ecosystem resilience at Almunyah de las Dos Acequias, we have been busy consulting with numerous colleagues and engaging in low-cost experiments like subtle shifts in grazing range management and stocking rates, and a variety of modes of observation and data gathering. Part Three presents a discussion of the permaculture methods and restoration ecology planning and research activities that we have pursued and some of the actual shifts in management practices that have already been undertaken since 2007 and through August 2010.

1. Consultants. Since 2007, we have had several consultants visit us at the ranch to provide their views of the state of the land and water and to suggest best management practices to attain our goals of resilience and sustainability.

Reyes Garcia was the first to visit in the summer of 2007 and he agreed that the first thing we should be careful about is converting the alfalfa and hay fields into row crop operations since this usually causes soil erosion. Mr. Garcia and Devon Peña agreed that the Institute should: (1) never cultivate more than five acres for row crops; (2) follow wise crop and plot rotation schemes; and (3) periodically rest and rejuvenate the row crop sections with nitrogen-fixing plants like alfalfa, beans, or other legumes.

Estevan Arellano visited next in 2008 and his report is appended here as Appendix 1. Mr. Arellano's report supports the views of Devon Peña and especially the need to use some permaculture interventions to arrest the potential for soil erosion and to improve the flood irrigation of the fields. This will largely involve what we discuss in Part IV of this report (see pages 11-13 below).

Joe Gallegos has been a constant presence and advisor. His recommendations affect the daily, weekly, and monthly operations at the ranch and he is a vital and trusted authority on all matters related to ranch management and production practices. We expect Mr. Gallegos to play an active role in overseeing the implementation of the ten-year plan.

A soil conservation technician with the county NRCS office, has also visited twice and is a very capable, amiable, and smart young man. He has been a great help in an informal survey of the northern cultivated lands. We should work with him and other NRCS staff in the future although I disagree with a recommendation that we laser level the land around the center pivot to deal with a serious gradient that could result in erosion from our return to flood irrigated methods.

2. Experiments. We have developed two experimental strategies for dealing with soil erosion and habitat restoration and management challenges. On the soil erosion front, we have finally completed construction of a rock-lined compuerta structure on the problematic eastside lindero. We will observe how this works over the next two years and then decide an alternate

designs should this approach prove inadequate or inappropriate. On the habitat restoration front, we have reinforced cross-fencing and restricted livestock access to the riparian zone. Evidence of bosque regeneration is plentiful as can be seen in the Photographic addenda ([Appendix 2](#) below).

3. Management Changes. The principal management shift is our near total exclusion of livestock, and especially cattle and sheep, from the riparian zone where the problems of riverbank erosion and decline of the cottonwoods are critical concerns. Regeneration of the bosque and stabilization of riverbanks is readily apparent. We appear to be going in the right direction but will have to make sure that Jerry Gallegos, the current grazing leaseholder, manages the bull population for winter grazing in a manner that does not allow for intrusions into the bosque or excessive riverbank disturbances in areas deemed to be under recovery status.

4. Permaculture Methods. We have begun to apply the principles of permaculture to our routine management and ecological restoration activities by relying on the existing lay of the land (rather than laser-leveling or similar highly disruptive practices).

We are working with what we have and this, however, will involve considerable human modification of the landscape, but within the design elements already presented by the site topography, hydrology, biological, and geological qualities.

We are steadfastly committed to the exclusive use of local or regional heirloom land race cultivars (corn, bean, squash).

We have re-ditched or created new ditches in making a switch to flood irrigated practices on the former center-pivot sprinkler field with the most encouraging results this year (2010); i.e., we had good full hay production across all four sections of the northern alfalfa hay fields.

We have identified areas with steep contours or other erosive features (shallow soil horizons, prairie dog tunnels, etc.). These will be the target areas for terracing, tree lines, and the creation of an “edible landscape” of native fruit and berry trees (August apple, gooseberry, chokecherry, elderberry, etc.).

PART FOUR

DRAFT TEN-YEAR PERMACULTURE AND RESTORATION ECOLOGY PLAN

In Part Four, we present the “rough draft” outlines of a proposed ten-year plan involving the application of the principles of permaculture and restoration ecology to the transformation of Almunyah de las Dos Acequias into a premiere example of sustainable and resilient acequia farming that is compatible with the regeneration and future protection of wildlife habitat and acequia agroecological values. For the rationale underlying this plan, please read the Arellano Report. Here we offer a preliminary or draft outline of some of the strategies and practices we can adopt to deal with the six problem areas we identified in Part II above:

1. Riparian Zone: Maintain livestock restrictions in perpetuity. Plant native willows and encourage cottonwood sapling regeneration on eroded riverbanks and adjoining riparian areas. Build cross fencing north of the river, “paddock islands” around regenerating areas to protect saplings and juvenile trees, and re-build and repair cross fencing south of the river. Re-build and extend cross-fencing to protect meanders. Construct “rip-rap” structures on more severely eroded riverbanks and areas where the river is naturally exerting pressure on bank stability and add structures to create fish habitat and slow river flow impact on eroded and vulnerable banks. Plant aspen, chokecherry, gooseberry, and piñon trees to increase species and structural diversity of the bosque area.
2. Native Wetland Meadows (Vegas): Continue restricting livestock grazing to winter cycle with small number of bulls with current leaseholder and horse grazing year round. Hire contractor to repair hummocks (this will be expensive and requires specialized equipment).
3. Prairie Dogs in the Center-Pivot Sprinkler Circle Hay Meadow: Plant a new crop of alfalfa and native grasses by re-plowing, re-disking, planning, and re-seeding all the current fields in the northern topmost area of the ranch. Following sound flood irrigated practices, with new ditches (linderos and espinazos), should take care of the prairie dog problem. Build tree crescents and protective fencing to manage water flows and capture sediment to add to existing thin soil horizon. Use sequence of cover crops to add nutrients to soil before re-planting alfalfa-hay mixes.
4. Head Gates off the San Luis Peoples Ditch: Re-assess rock structures in two years (2012) before proceeding with possible EQIP (or other) grants with NRCS to install more complete metal structures on all four headgates off the San Luis Peoples’ Ditch. Re-ditch the eastside and westside linderos.

5. Invasive Noxious Weeds: Continue with annual goat and manual (fire and disking) removal treatments for the thistle and especially the knapweed. Plant a ten-yard wide buffer strip of perennial Flax around the entire edge surrounding the alfalfa and row crop fields. Flax should control invasive species and can also be used as a biodiesel crop to contribute to our long-term off-the-grid energy objectives.
6. Erosion Control on Row Crop Fields: This will be the most complicated and expensive part of our plan since it will involve a considerable amount of land shaping activities for the construction of the bank-and-terrace system (*bancal* and *banco* as Arellano calls these). This will require moving soil around; supplementing the soil; adding rocks and vegetation to stabilize the edges of the terraces; the planting of tree lines along linderos and espinazos; creation of a wide *cabecera* (front or head staging area) for irrigation purposes.

APPENDICES

Appendix 1: Report on The Acequia Institute Lands by Estevan Arellano. (Already emailed separately to the Board)

Appendix 2: Photographs.

Appendix 2

Photographs



Figure 1. New Holland tractor and round baler during baling operations in the north-end fields.



Figure 2. Cottonwood sapling in the bosque.



Figure 3. Newly completed rock structure on eastside lindero.



Figure 4. Eroded riverbank on Culebra River at Almunyah de las Dos Acequias.



Figure 5. Stable meander banks on Culebra River at Almunyah de las Dos Acequias.