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Conclusions of Arch Hurley Conservancy District Irrigation Project--Summary

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Summary

The Arch Hurley Conservancy District (or AHCD) utilizes a system of canals and laterals to provide water for farmland around the Tucumcari area. While the system has served its purpose well since its creation in 1938, the long-term effectiveness of the project has suffered due to drought conditions, evaporation from the open-air Conchas Canal, and infiltration. This considerable drop in available water necessitates change for long-term sustainability.

This NMSBA project worked with AHCD to consider the feasibility of developing energy-generating technologies to raise funds for canal improvements. Renewable energy sources were screened for their feasibility. This involved an analysis of revenues, costs, and socio/political factors among other measures. After the pre-screening, AHCD chose Solar and Wind as the energy options for consideration. A conceptual development plan was devised to determine revenue from the project.

To begin this process, the LANL team looked at available siting options on land within AHCD control. Once a site with the best renewable energy potential was chosen, a plan that included three wind turbines with a total capacity of 7,500 kW coupled with 2,000 kW of capacity from photovoltaic (PV) solar cells was assessed. The feasibility analysis for the project estimated revenues for AHCD of between $1.2 and $3.9 million over 20 years. This revenue stream would only allow for minimal piping or lining of the main canal. Therefore, possible improvements to laterals within the AHCD are advised as a more cost effective use of revenue.

Pre-screening of Available Technologies

Four possible electricity producing technologies were considered for this project. These technologies were: Wind, Low-Head Hydro, Solar Photovoltaic, and Natural Gas Microturbine. Each of these technologies was defined based on a standard production capacity to allow ease of scaling and decision analysis scoring using the program Criterium Decision Plus. The weights used for the criteria and scoring of the alternatives were then combined to create the final results of the decision model. The decision score was found by computing the weighted sum of the scores of each alternative. The sum of an alternative's scores against all the sub-criteria multiplied by their appropriate weights was the total score.

Three different perspectives were used to set the weights. Results were then compared under the perspectives to see if the ranking of technologies differs. The results for the different energy technologies using each of the four weighting schemes for top-level criteria (Equal, LANL, AHCD, and Environmentalist) were compiled for AHCD to review. Two technologies, Gas Microturbines and Low-Head Hydro, violated rules within the model due to *Unsatisfactory* ratings regarding their viability. Upon consultation with AHCD, the project decided to move forward with Solar Photovoltaics and Wind Turbines as the preferred renewable energy sources.

Siting Options

When considering possible sites, the most important variables are the availability of the required resources, land topography, and any permitting or socio/political issues that could create "show-stoppers." Initially, a number of sites were considered on T4 Cattle Company land near the Conchas Canal. These areas were deemed insufficient after consulting with AHCD. Upon further discussion with Arch Hurley, three main siting locations were analyzed (see Figure 1).

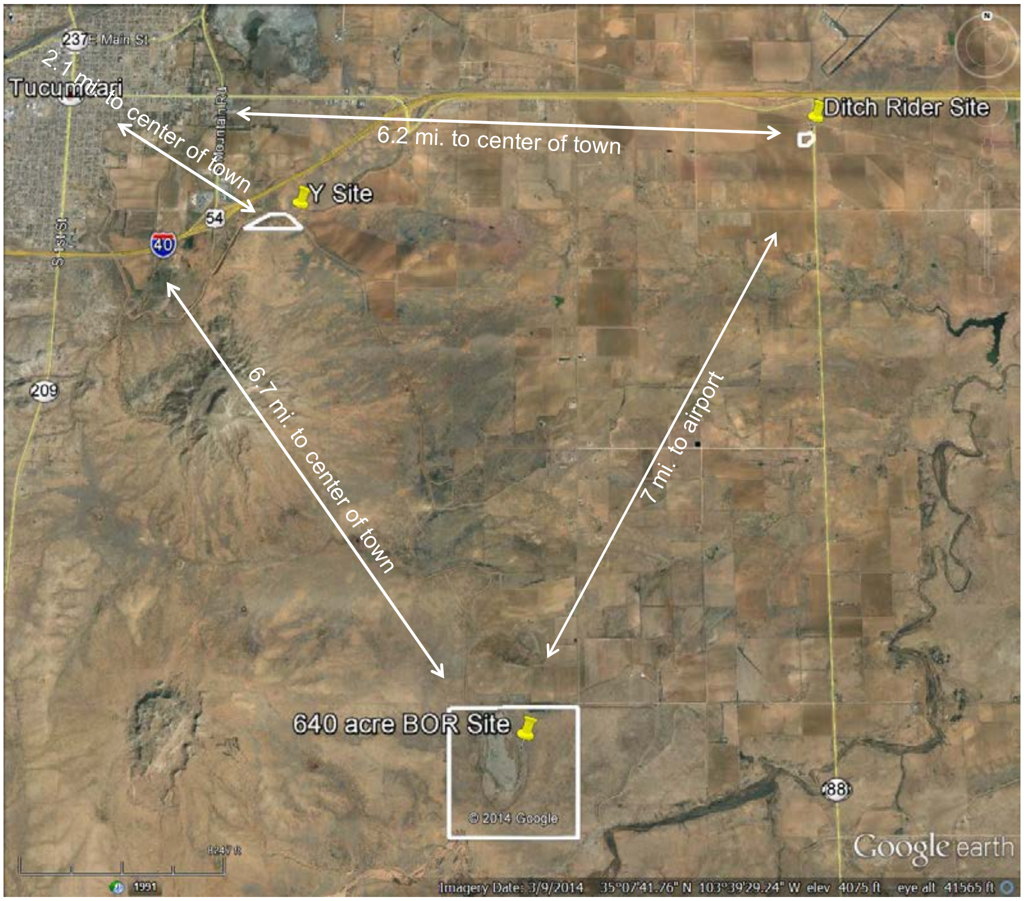

Figure 1: An overview of the three sites considered for potential energy development shows the positions relative to the town of Tucumcari.

The first is the "Y Site" on Bureau of Reclamation property near what is called the Y Substation. Located at a split in the Conchas Canal, this location is beneficial in that it is close to an electrical substation. However, this land does not have a consistent level and is below the floodplain. Considering the closeness of the land to the canal and its periodic flooding, this site is unsuitable.

The second siting option is known as the "Ditch Rider Site." It is a flat, ten-acre parcel of land with a 4.4 mile distance to the Y Substation. The biggest drawback for the Ditch Rider site is its proximity to I-40 and the Tucumcari Airport. Wind turbines are ruled out for this area and there are concerns about a solar array interfering with nearby flight patterns. Nevertheless, the site could be considered as a location for solar energy resources in the future.

The last location (the "BOR Site") is approximately seven miles south of the Tucumcari airport and consists of 640 acres of land. While this land is not directly under Arch Hurley's authority, the Bureau allows for usage and leasing of the land to other parties as with the other two sites. While there are 640 acres available, the presence of a depressed playa that is vulnerable to flooding towards the middle of the property leaves only half of land suitable for electricity generation purposes. This site was chosen as the optimal space for renewable energy development.

Analysis of Renewable Energy

Figure 2 provides an overview of the proposed wind and solar development. The entire developable area has over 200 acres in a northern direction, offering construction grade terrain with 2 percent slope or less. At full project build-out, six wind turbines and a 40 acre solar array could be installed. In the feasibility analysis it was assumed that Phase 1 would provide a maximum AC power rating of 7,500 kW using three wind turbines and Phase 2 would have a maximum AC power rating of 10,580 kW by adding solar PV. In the figure, turbines numbered 1 to 3 would be installed first, and then solar arrays numbered 4. Remaining items marked *F* are for possible future development. Grid connection consists of a 69 kV tie-in station *STA 1*, connecting to a 115-69 kV step up station located 2.7 miles west of the site.

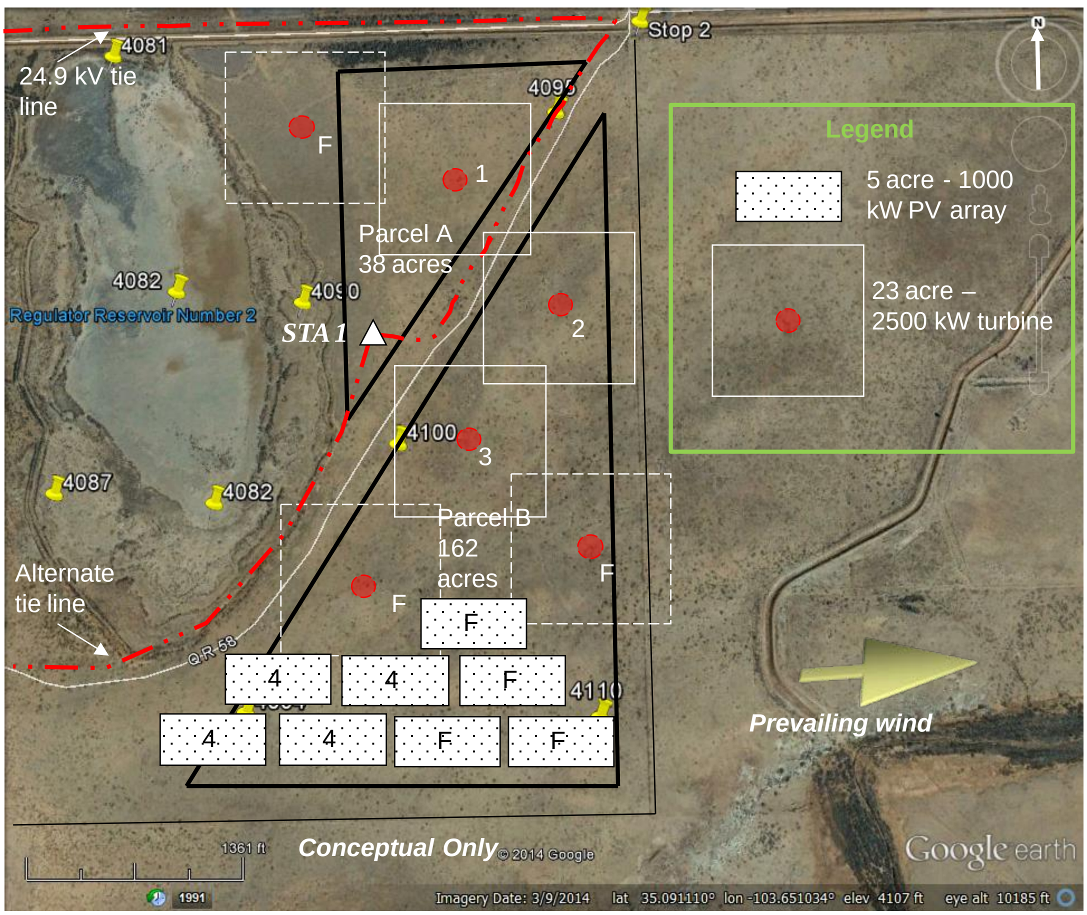

Figure 2: A conceptual plan to develop 10,580kW of electricity capacity using two phases is shown here. The red dots labeled "1, 2, and 3" in the squares show wind turbine locations built in phase 1, and rectangles labeled "4"are PV solar arrays for phase 2. Boxes labeled "F" are future activities.

A roll-up of key financial results from this analysis is shown in Table 1, tabulated as 20-year cumulative values. A possible interconnection within Farmers Electric Cooperative's (FEC's) system presents a potential hurdle, in terms of receiving a competitive buyback rate. The analysis assumes a $45 per MWh power purchase agreement is negotiated (4.5 cents per kWh). A developer can economically produce power assuming 4.5 percent cost-of-money, all State and Federal tax benefits accrued, and royalty payment of 3 percent to AHCD. About $1.3M is available to AHCD over twenty years, or about $65k per year on average.

TABLE 1
Financial Results for BOR Site Development, over 20 Years

Construction Cost	Operating Expense	PPA $/MWh	Net Tax Expense	Revenue	Net Revenue to AHCD
($18,554,000)	($16,172,820)	45	($4,011,480)	$35,085,180	$1,290,610

Significant unknowns are 1) FEC's ability to pay competitive buyback rates and 2) the near-term cost of solar cells which are dropping due to strong Chinese competition. If PV cell prices drop an additional 50 percent (which is possible in five to seven years), then the PPA required to achieve a 4.5 percent internal rate of return (IRR) drops to $40 per MWh. Royalty payment to AHCD also drops somewhat. Generally, utilities in New Mexico will be reluctant to pay more than retail energy rates for renewable power. FEC's current retail tariff rates are 8 cents per kWh for large "Power Service," 7.3 cents for Commercial service and 12 cents for Residential service. It is possible that more revenues could be generated for AHCD. A best-case value might be as high as $3.9M over twenty years if several key feasibility factors were improved. First, a more intensive use of the BOR Site with a tighter turbine layout might increase electricity capacity by up to 50 percent. Second, it is possible that the typical three percent energy royalty and $150 per acre lease fee could be doubled, although this is rare in New Mexico. If these favorable factors were applied, the revenue stream to AHCD would $3.9M ($1.3M × 1.5 × 2).

Canal Piping and Conclusions

The Los Alamos team conducted rough calculations to size a pipe adequate for 300 cubic feet per second (cfs) of flow in the 1-foot per 1000-foot gradient of the Main Canal. The model indicates an area of 129 square feet in a rectangular box would be needed to handle the flow. This translates to a 13-foot diameter pipe, or dual ten-foot pipes each having 150 cfs in flow. Such pipes are very expensive and generally not used in canal systems. A ten-foot pipe would be less expensive but comes at the expense of a much smaller flow. An alternative to the pipeline is to line the main canal with concrete to prevent infiltration. The cost per mile for lining the main canal would be $2.6M per mile and lining the laterals would cost $270k per mile.

The renewable energy project is estimated to return about $1.3M to AHCD over 20 years. This value is too small to finance a main canal lining or pipeline project, which would cost millions of dollars per mile. For a 20-year loan at seven percent interest, the $2.6M per mile canal lining cost would require payments of $242k per year. The $65k annual revenues would cover only about one-third of a mile of lining. In the unlikely event that the best case revenue stream of $3.9M could be obtained, the $195k/y available could support about one mile of main canal lining. In contrast, the revenue stream appears adequate to support improvements in the lateral canals, since the costs per section is the same order of magnitude as the average annual revenue stream, i.e., tens of thousands of dollars. Since the most cost-effective acre-foot savings is from lateral lining and such projects are tractable in terms of revenue flow, it is recommended that prioritized projects of lateral improvements be pursued, perhaps via the NMSBA program.