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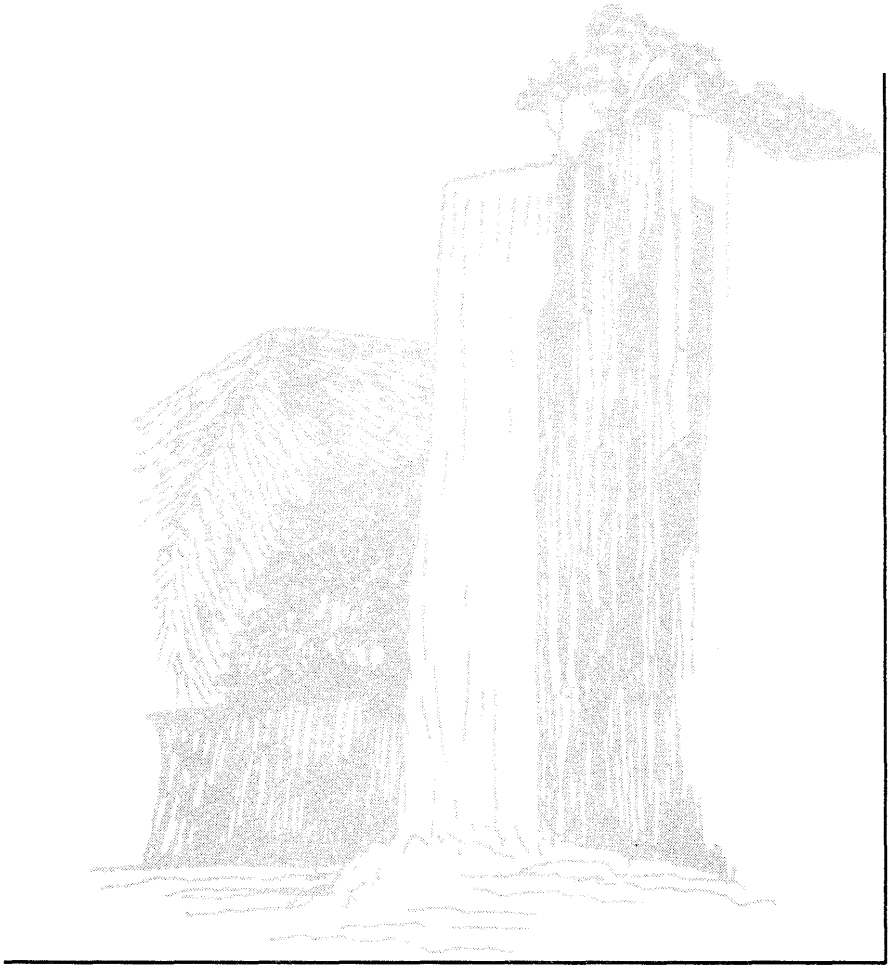
EXECUTIVE SUMMARY

UPTON WATER SUPPLY PROJECT

LEVEL II

MAY 30, 1991



EXECUTIVE SUMMARY

UPTON WATER SUPPLY PROJECT

LEVEL II

MAY 30, 1991

WSW #6 WELL STIMULATION AND TESTING, OPERATING PLAN AND PRECONSTRUCTION REPORT

PREPARED FOR

THE TOWN OF UPTON

AND

THE WYOMING WATER DEVELOPMENT COMMISSION

PREPARED BY

WESTON ENGINEERING, INC.

EXECUTIVE SUMMARY

Introduction

The Town of Upton receives its water supply from three deep Madison water supply wells. Two of these wells are "old" (35-45 years in age) and are believed to be nearing the end of their useful lives. Well No. 6 was drilled in 1983 as a supplemental water source for the Town of Upton. Due to the questionable structural integrity of Upton Well No. 2, located near Iron Creek, the decision was made to attempt a well stimulation project to enhance the well productivity of Upton Well No. 6. If successful, the well could then be used as a primary source of water for the Town of Upton. In 1989, the Town applied to the Wyoming Water Development Commission for funds to perform an enhancement procedure on the well and conduct a pre-design of the transmission pipeline from the well to the Town's storage facilities. Funding for the project was approved in the 1990 legislature, and the WWDC selected Weston Engineering, Inc. of Upton to conduct the engineering and supervision of the project.

Well Stimulation Activities

Well stimulation projects are not new, but there has been little formal documentation in the past regarding the changes in well characteristics, changes in water quality, or time requirements for well cleanup and development. The purpose of this project was to enhance the production of Well No. 6 through acidizing or hydraulically fracturing the open hole portion of the well in the Madison Limestone formation and monitor the changes as they occur.

Price proposals were solicited from Halliburton Services, Dowell Schlumberger, and BJ Services. All of the companies quoted prices for the hydraulic sand fracture procedure, but only BJ Services would submit a quote for the acid fracture procedure. BJ Services submitted the lowest price proposal for both options with costs of $46,865 and $35,321 for the hydraulic sand fracturing and acid fracturing procedures respectively. Due to the available funds for the project, and the general consensus that the acid would perform better in the Madison Limestone, the acid fracturing procedure was selected.

Environmental concerns for injecting a chemical or foreign substance into a potable drinking water aquifer were addressed in the application for injection permit filed with the Wyoming Department of Environmental Quality. The acid injection was authorized on DEQ permit number UIC-245, Class 5X27. The permit

authorized a short term acidizing project for the enhancement of the Upton No. 6 water supply well. The permit conditions dictated the initial slugs of water containing high total dissolved solids (TDS) to be disposed of at an authorized disposal well, the remaining water could be treated at the Town's waste water treatment facilities until the TDS fell below 5000 ppm, at which point the water could be discharged in the existing drainage located near the well site. PH and TDS were to be monitored until their values returned to their baseline parameters.

Pre-stimulation aquifer tests were performed to form baseline information for stimulation comparisons. Step testing commenced on July 10, 1990 with step of 200, 400, and 600 gpm. Constant discharge testing was performed on July 11 to 12, 1990 at a pumping rate of 600 gpm. The steps and constant rate were held at these rates for comparison to original testing data from 1983. The test data closely followed the original pump testing, indicating little if any changes in hydraulic conditions present in the well system.

Televideo logs were performed upon completion of the pre-stimulation testing. The well video logs were performed for a visual comparison of well bore hole changes resulting from the acid fracturing procedure.

A tension set packer was installed in the 9 5/8-inch casing at a depth of 1079 feet in preparation of the stimulation project. The packer was required to prevent the acid from coming in contact with the packer/liner hanger assembly placed at the casing changeover. The packer also prevented the treating pressures from coming in contact with the large diameter 13 3/8-inch casing located in the upper portion of the well.

On July 14, 1990, BJ Services rigged up on location with three large acid pumps and a blender. The 15% HCl solution was mixed in the steam cleaned frac tanks previously located on the well location. The approximately 20,000 gallons of HCl acid was then pumped into the well at an approximate 40 barrels per minute rate. A large pressure break took place, dropping from 1010 psi to 390 psi, indicating the acid fracturing procedure had opened the well to a more permeable zone.

Well clean up and development activities began immediately upon completion of the stimulation project. The initial slugs of poor quality water (1000 barrels, 42,000 gallons) were stored in the frac tanks for disposal. The remaining waste water was piped to the sanitary sewer for treatment at the Town's waste water treatment facility. Water with a TDS reading below 5000 ppm was discharged in the area's storm drainage system. PH and TDS were monitored throughout the development and testing phases.

Post-stimulation pump testing activities began on July 19, 1990 with a step test performed at steps of 100, 200, 400, 600, and 800 gpm. The subsequent constant rate test was performed July 20-21, 1990 at a pumping rate of 700 gpm. The post-stimulation tests indicate the specific capacity of the wells was improved more than two-fold at the higher rates.

Post-stimulation televideo logs indicate dramatically enhanced permeability features of the open hole section. High velocity acid etching enhanced the visibility of high angle fractures not previously observed throughout the borehole. If present prior to the well stimulation, the increased visibility is probably a result of the acid/limestone reaction opening the fractures as the acid solution passed through.

Water quality analysis comparisons of pre-stimulation and post-stimulation samples indicates minimal change in any EPA primary or secondary parameters. The small changes that are shown are most likely due to laboratory error or the water not yet reaching its baseline equilibrium. No harmful side effects can be noted in these tests.

Post-stimulation water tests indicated a bacterial contamination of coliform and iron bacteria. Standard chlorination attempts were unable to "clean" the well sufficiently to obtain an acceptable bacteria test. A well clean up and disinfection project was undertaken in April 1991. Water samples have been taken for analysis of coliform and iron bacteria, with no presence of either detected.

Conceptual Design

Inventory

The water supply for the Town of Upton is currently obtained through pumping three Madison water wells. Current storage facilities include a 200,000 gallon stand pipe, a 160,000 and a 300,000 gallon water storage tanks. All wells with the exception of Well No. 4 pump directly into the distribution system. There are no chlorination facilities located within the water system.

The Town of Upton's current population of 950 people utilize 478 service taps, including 21 commercial and 457 residential taps. Current annual consumption is approximately 58 million gallons per year of treated domestic water. Average yearly consumption is approximately 169 gpcd with a peak day consumption of nearly 950 gpcd.

Proposed Construction

To take advantage of the increased capabilities of Well No. 6, it is proposed to install a 600 gpm pump and related equipment in the well. Minor plumbing and electrical modifications would have to be performed at the Well No. 6 well house to accept the larger horsepower pump. A small addition will have to be built attached to the well house to contain a chlorination unit for disinfection purposes. Construction of an 8550 feet pipeline from the well to the storage facility is included in the cost estimates. Total cost of the project, including engineering is estimated at $353,795.

Economic Analysis

The total operating budget for the Town of Upton for the period July 1, 1990 through June 30, 1991 is $542,825.31. The portion of the budget set aside for the operation of the water system is $69,674.65. The water system is presently operated from revenues obtained directly from the sale of water to its citizens. The financial analysis assumed that the Town would continue to operate its water system under the separate enterprise fund accounting system and that all expenditures for non water-related items will be paid from the general fund.

The present average residential water bill is $12.15/month. The current average water bill appears to be mid-range when compared to the average water bill of similarly sized communities around the state.

For analysis purposes the current population of 950 people was projected to grow at an annual rate of 1.6% through the year 2000. This translates into a population growth from the present 950 to 1131. The population growth would add an approximate 5 additional service taps per year.

The current debt load consists of an amortized yearly payment of $20,086.73 for sewer lagoons and $4588.00 for a water tank. The economic analysis indicates that the water rates would need to be adjusted from the present average of $12.15/month to $14.00/ month immediately. Incremental increases to approximately $18.50/month by the year 2000 would be required to cover the loan obligation of this project.

Conclusion and Recommendations

The well stimulation project performed on the Upton Well No. 6 was a successful undertaking. The productivity of the well was improved more than two-fold. The well can now economically provide all the water required for the Town of Upton in the foreseeable future. The completion of the project, including building the pipeline from the well to the storage reservoirs, installation of larger pumping equipment and chlorination facilities should be undertaken. The project can be accomplished with minimal financial impact on the residents of the community. The completion of the project will allow the Town to comply with all EPA regulations that are currently in effect and those currently scheduled through 1995.