JOHNSON-FERMELIA Co. Inc.
CONSULTING ENGINEERS, ARCHITECTS AND SURVEYORS

PHASE I REPORT

OAKLEY
WATER SUPPLY PROJECT
LEVEL II - FEASIBILITY STUDY

FOR

WYOMING WATER DEVELOPMENT COMMISSION

1515 Ninth Street
Rock Springs, Wyoming 82901
Phone (307) 362-7519

AUGUST 1989
August 23, 1989

Wyoming Water Development Commission  
Herschler Building  
122 West 25th Street  
Cheyenne, WY 82002  

Attention: Mr. Patrick Erger  

Re: Phase I Report  
Oakley Water Supply Project  

Dear Mr. Erger:

We are transmitting herewith ten copies of the above report together with accompanying drawings that are bound separately. This report is not as complete or thorough as we would like it to be due to the compressed time schedule that you asked us to comply with.

The report is slanted toward answering the concerns of the Oakley water users and does not comply with some aspects of our Contract relative to assessing the potential for future growth.

However, a considerably larger demand than the present needs of Oakley can be satisfied from Alternate "A" of the project due to the fact that DEQ regulations require a minimum 8 inch diameter pipeline where there is only one supply line. Also, DEQ requires a minimum 6 inch diameter pipeline to serve fire hydrants, etc.

The profile of the hydraulic gradient clearly demonstrates that a flow of at least 500 gallons per minute can be delivered to Oakley.
The report states that work is continuing on the appraisal of the existing domestic wells and a "Supplement" to the report will be submitted at an early date. We hope to have most of the data and information that will be included in the "Supplement" complete for the presentation on August 23, 1989.

Please call me or Bob Johnson of my staff if you have questions or require additional information.

Sincerely,

JOHNSON-FERMELIA CO. INC.

Wayne L. Johnson, P.E. and L.S.
Project Manager

WLJ:bw

Enc.
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INTRODUCTION


The Oakley Project area is located about two miles south of Kemmerer, Wyoming. It consists of homes and development in the Quarry and Oakley Subdivisions and three other homes situated on individual lots outside of the subdivisions, as shown on Sheet 3 of the Drawings. There is a total of 20 lots in the area considered for water service.

The homes in the study area presently obtain their water from shallow private wells. The quantity and quality of these groundwater supplies varies greatly and for the most part, the quality is very poor. Consequently, the homeowners are intent on obtaining a better supply. Additionally, water is not available for fire protection and there has been one instance where property has been lost to fire because of this deficiency.

The objectives of the study were to evaluate the feasibility of importing water from either the City of Kemmerer or the Town of Diamondville; developing a groundwater supply from the Nugget Formation; and evaluating the possibilities of treating the water from existing private wells.
The alternatives to be considered for importing a supply from Kemmerer involved studying:

1. Connecting to an existing 12" diameter pipeline supplying a fire hydrant at the intersection of Highways 30 and 189.

2. Connecting to a 10" diameter pipeline that feeds Diamondville at the intersection of Canyon Road and the Highway 30-189 Business Loop.

Two points of connection to the Diamondville water system were to be evaluated:

1. Connecting at the Diamondville tankage.
2. Connecting to the system in the Southland Addition.

In addition to conducting a study of the Nugget Formation, an assessment was to be undertaken for the individual landowner water wells.

During the early phases of the study effort, several of these options were dropped or deleted from the program. The connection to the Kemmerer System at the Canyon Road/Highway 30-189 Business Loop was removed from consideration because it was felt that the higher head available at the Highway 30-189 intersection was more desirable and its location would allow easy and good access to a pipeline alignment in the Highway 30 right-of-way. (See Sheets 1 and 2 of the Drawings.)

Both Diamondville alternatives were abandoned because they would involve dealing with a third party - Diamondville. Regardless of which alternative for a surface supply was considered, it would be mandatory to deal with the City of Kemmerer because Kemmerer treats and supplies water to Diamondville. Therefore, a direct connection to the Kemmerer System was considered to avoid a three-party agreement if a surface water supply proved to be feasible.
The Nugget Formation as a source for a groundwater supply was evaluated up to a point before opting for a plan to evaluate a supply from the Frontier Formation. This change in plan was undertaken because of the possibility of developing a supply from the Frontier at much less cost. Costs would be reduced by a factor greater than ten.

Therefore this Report focuses on: Connecting to the Kemmerer System at the 12 inch diameter pipeline on the northeast corner of the intersection of Highways 30 and 189. Two options are considered under this scheme:

Option 1 - Obtain water and operations, meter reading, and billing services from the City of Kemmerer.

Option 2 - Obtain water only from the City of Kemmerer. All other services would be provided by the Oakley District.

A groundwater source was evaluated from the Frontier Formation, however, this evaluation is not complete because a test well would have to be completed to confirm the assumptions made herein relative to this option. Also, considerable information is presented in the groundwater section (Alternate "B") of this Report.

The results of quality analysis of water from the private domestic wells is presented herein, together with a scheme and their related costs to treat each domestic supply by installing filters, water softeners, and reverse osmosis units. This alternate would only treat the well water to a limited extent and would not provide volumes of water necessary for fire protection.
The three alternates described above are referenced in this Report as follows:

Alternate "A" - Connecting to the Kemmerer Water Supply - Options 1 and 2.

Alternate "B" - Development of Groundwater.

Alternate "C" - Reverse Osmosis and Softening Units for Existing Well Water.

The relative monthly costs per home for these three alternates are estimated as follows:

<table>
<thead>
<tr>
<th>ALTERNATE</th>
<th>ESTIMATED MONTHLY WATER COST PER RESIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 G/C/D</td>
</tr>
<tr>
<td>A. Connect to Kemmerer System - Option 1</td>
<td></td>
</tr>
<tr>
<td>Kemmerer Provides All Services</td>
<td>$ 71.89</td>
</tr>
<tr>
<td>Option 2 - Oakley Reads Meters and Bills Users</td>
<td>$ 74.88</td>
</tr>
<tr>
<td>B. Develop Water Well</td>
<td></td>
</tr>
<tr>
<td>C. Individual In-House Water Treatment Units*</td>
<td></td>
</tr>
</tbody>
</table>

* Provides no Fire Protection and quantity per capita per day is not given.
A project Scoping Meeting was held in Kemmerer on June 23, 1989. The following persons were in attendance at this meeting:

- George Zebre, Commissioner, Wyoming Water Development Commission
- John Jackson, Wyo. Water Dev. Commission Staff
- Patrick Erger, " "
- Jon Wade, " 
- Dick Stockdale, State Engineer's Office
- Bill Wilson, Oakley Water Association
- Tom Lozier, " 
- Andy Kasenhagen, Lincoln County Planner
- Joe Bluemel, Lincoln County Attorney
- Kent Smith, Director of Public Works, Kemmerer
- Wayne L. Johnson, Johnson-Fermelia Co. Inc. (JFCo)
- Robert E. Johnson, " 
- George (Pete) Dana, " 

Another meeting was held on June 30, 1989 with representatives of Kemmerer and the South Lincoln Fire District. The following were in attendance:

- Marty Gunder, Mayor of Kemmerer
- Steve Golnar, Kemmerer City Administrator
- Tim Gaughan, Fire Chief and Kemmerer Councilman
- Kent Smith, Kemmerer Director of Public Works
- Robert E. Johnson, Johnson-Fermelia Co. Inc.

Kent Smith left his position with the City of Kemmerer shortly after this meeting. Subsequently, the Consultant was advised that Vean Taylor would serve as the staff contact person with the City of Kemmerer.
A third meeting was held in the Kemmerer City Hall on July 25, 1989 attended by:

Patrick Erger  Wyoming Water Development Commission
Steve Golnar   Kemmerer City Administrator
Vean Taylor    City of Kemmerer
Robert E. Johnson  Johnson-Fermelia Co. Inc.

Several other meetings and discussions were held with Oakley people, Lincoln County personnel, and City of Kemmerer staff during the course of the work and all representations made herein have been discussed to some degree with the parties involved.

III ALTERNATE "A" - CONNECTION TO KEMMERER SYSTEM

This alternate involves evaluation of connecting to an existing 12 inch diameter pipeline on the northeast corner of the intersection of U.S. Highways 30 and 189, as shown on Sheet 1 of the Drawings. An 8 inch diameter pipeline would be installed from this point to the Oakley area, inside the Highway 30 right-of-way fence. Wyoming DEQ regulations mandate a minimum pipeline diameter of 8 inches in cases where a single source supply pipeline serves a public water system.

Connecting to an existing pipeline at the intersection of Highway 30-189 Business Loop and Canyon Road was also considered early in the study. However, this idea was dropped because the higher available head and better access to the U.S. Highway 30 right-of-way alignment from the connecting point at the Highway 30-189 intersection. Although slightly more pipeline is required, there is less need to obtain right-of-way across lands between the Canyon Road connecting point and the Highway 30 right-of-way.
A limited analysis of the impact on the Kemmerer water system from connecting at the Highway 30-189 intersection was performed at the request of Vean Taylor of the City of Kemmerer. This analysis evaluated pressure loss from the demands to supply Oakley and the impact of storage at Kemmerer's Green Hill Reservoir. The analysis indicated that the reduction in pipeline pressure would be minimal in delivering water to Oakley to meet all domestic needs and fire flows. Storage capacity in the Green Hill Reservoir would be adequate to meet the requirements of Oakley. DEQ regulations stipulate that storage would have to be available to supply the average daily demands. Fire storage is not required by Oakley because average daily demands are less than 50,000 gallons. Average daily demands for Oakley are estimated at about 35,000 gallons in applying an average daily per capita demand of 500 gallons and assuming 3.5 persons per residence. Five hundred gallons per day per capita is conservative.

However, additional storage requirements may have to be provided to satisfy future growth in Kemmerer. Construction of a storage facility in Oakley may therefore be necessary at some future date if growth occurs in Kemmerer.

A transmission pipeline and distribution system, as shown on the Drawings, would have to be built to supply Kemmerer water to the residents of Oakley.

The distribution system would consist of a 6 inch diameter pipeline as required by DEQ regulations and would include fire hydrants positioned pursuant to the South Lincoln Fire District's recommendations. Fire flows are assumed at two-250 gallons per minute fire streams (total 500 gpm) which can easily be met with the 6 inch diameter pipeline.
Storage is required equal to the average daily demands -- about 35,000 gallons. This storage is assumed to be satisfied by available storage in Kemmerer's Green Hill Reservoir.

The Capital Cost for these facilities are estimated at:

<table>
<thead>
<tr>
<th>Facility</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Pipeline</td>
<td>$371,900.00</td>
</tr>
<tr>
<td>Distribution System</td>
<td>$69,125.00</td>
</tr>
<tr>
<td><strong>Total Capital Cost</strong></td>
<td><strong>$441,025.00</strong></td>
</tr>
</tbody>
</table>

The above figures include 10% for engineering design costs, 15% for contingencies, and a $25,000.00 connection charge by the City of Kemmerer. A detailed breakdown is presented in the Appendix to this Report.

Two options were evaluated under this Alternate:

Option 1 - considers obtaining water from the City of Kemmerer and having them provide maintenance, operations, meter reading and billing services.

Option 2 - considered only obtaining the water from the City of Kemmerer and Oakley would perform all maintenance, operation, meter reading and billing services.

The following cost components were estimated for Alternate "A" - Option 1:

3. Costs Payable to City of Kemmerer.
4. Total Monthly Costs.
A detailed breakdown of these costs is provided in the Appendix, however their characteristics and features are described below.

1. **Capital Costs - Transmission Pipeline**

These costs include the $25,000 connection charge to Kemmerer, pipeline appurtenances, highway and railroad boring and a river crossing, together with 10% for engineering and 15% for contingencies.

Thirty-three percent (33%) of the capital costs is assumed to be in the form of a loan to be paid back to the State over 30 years at 4% interest. The loan portion is therefore amortized which computes to a cost per lot or residence of $29.60 per month.

2. **Capital Costs - Distribution System**

These costs include the construction of a 6 inch diameter distribution system with appurtenances and fire hydrants, as shown in the Drawings. They also include 10% for engineering and 15% for contingencies.

The distribution system, however, is assumed to be funded by the Wyoming Farm Loan Board which requires a 50% grant and 50% loan. The loan portion must be amortized at 8.5% interest over an assumed repayment term of 30 years to correspond with the term of the Transmission Pipeline.

The capital costs were therefore apportioned accordingly and a cost per residence of $13.40 per month was calculated to repay the loan as described above.
3. Costs Payable to the City of Kemmerer Under Option 1

As stated earlier, Option 1 assumes that the City of Kemmerer forces would operate and maintain the transmission pipeline and distribution system, read meters and provide billing services. The City of Kemmerer provides water to the Town of Diamondville under the following cost structure:

| Base Rate | $ 4.26/single meter/month |
| Water Charge | $ 1.75/1000 gallons |

The following assumptions were made in calculating charges by Kemmerer under Option 1.

a. The meter charge would be increased by $1.00 per meter -- from $4.26 to $5.26 to cover added costs to read the meters in Oakley.

b. The water charge would be increased by calculating the added charges based on available cost data and increased demand on the applicable service. These costs and services were drawn from Water, Wastewater, Sanitation Rate Study, prepared by Kent R. Smith, Kemmerer Director of Public Works, dated April 25, 1988 and revised May 1, 1988.

The services and costs that would be impacted by the increased water demands by Oakley are:
<table>
<thead>
<tr>
<th>Item</th>
<th>Affected Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Plant Operation and Maintenance</td>
<td>$106,049.00</td>
</tr>
<tr>
<td>Water Meter Maintenance</td>
<td>$8,130.00</td>
</tr>
<tr>
<td>Total</td>
<td>$114,179.00/year</td>
</tr>
</tbody>
</table>

Average annual water quantity delivered in Kemmerer is 220,000,000 gallons.

Estimated total annual water use in Oakley equals 7,665,000 gallons (assuming 300 gal/capita/day) or a 3.5% increase in Kemmerer water deliveries.

Applying the 3.5% increase to the affected amounts (3.5 of $114,179.00) = $3,996.00 per year.

Applying this amount to Oakley water deliveries would compute to $0.50/1000 gal. This would then be added to the water charge levied by Kemmerer: $1.75 + $0.50 = $2.25. The water charge to Oakley users would then be $2.25/1000 gallons. Monthly water costs per residence would be:

- Use of 100 gal/capita/day $28.89
- Use of 300 gal/capita/day $76.14
Total monthly water costs to Oakley residents under Alternate "A" - Option 1 are therefore estimated as follows:

CAPITAL COSTS

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Line</td>
<td>$ 29.60</td>
</tr>
<tr>
<td>Distribution System</td>
<td>$ 13.40</td>
</tr>
</tbody>
</table>

VARIABLE COSTS TO KEMMERER/MONTH

<table>
<thead>
<tr>
<th>Volume</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 G/C/D</td>
<td>$ 28.89</td>
</tr>
<tr>
<td>300 G/C/D</td>
<td>$ 76.14</td>
</tr>
</tbody>
</table>

TOTAL COSTS PER MONTH - ALTERNATE "A" - OPTION 1

<table>
<thead>
<tr>
<th>Volume</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 G/C/D</td>
<td>$ 71.89</td>
</tr>
<tr>
<td>300 G/C/D</td>
<td>$ 119.14</td>
</tr>
</tbody>
</table>

The following cost components were estimated for Alternate "A" - Option 2:

3. Meter Reading and Billing Costs.
4. Variable Costs Payable to Kemmerer.
5. Total Monthly Costs.
Costs for Items 1 and 2 are the same for Option 2 as for Option 1. Item 3. "Meter Reading and Billing Costs", assumes that Oakley hires a part time person to read meters and prepare billing to work a total of 12 hours per month at $15.00 per hour. Vehicle costs were estimated at 8 hours per month at $10.00 per hour; and supplies at $10.00 per month. The total monthly expense for this effort would total $270.00 or $13.50 per residence per month.

Item 4, "Variable Costs Payable to Kemmerer", would be based on the $1.75 rate per 1000 gallons billed by Kemmerer, which equals $8.38 per residence per month for 100 gallons per capita per day; and $55.13 per month for 300 gallons per capita per day.

Again, 3.5 persons per residence are assumed in making these calculations.

Total monthly costs per residence for Alternate "A" - Option 2 are summarized as follows:

<table>
<thead>
<tr>
<th>CAPITAL COSTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Line</td>
<td>$ 29.60</td>
</tr>
<tr>
<td>Distribution System</td>
<td>$ 13.40</td>
</tr>
<tr>
<td>METER READING AND BILLING</td>
<td></td>
</tr>
<tr>
<td>Sub Total</td>
<td>$ 13.50</td>
</tr>
<tr>
<td></td>
<td>$ 56.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VARIABLE COSTS PAYABLE TO KEMMERER/MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 G/C/D @ $1.75/1000 gal</td>
</tr>
<tr>
<td>300 G/C/D @ $1.75/1000 gal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOTAL COSTS PER MONTH - ALTERNATE &quot;A&quot; - OPTION 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 G/C/D</td>
</tr>
<tr>
<td>300 G/C/D</td>
</tr>
</tbody>
</table>
The Nugget Formation was investigated as a potential source of groundwater, however it was dropped from consideration when it became apparent that drilling into the Frontier Formation may be a more attractive approach. The Nugget is from 6,000 to 7,000 feet deep at Oakley, whereas the Frontier is at a depth of about 250 feet under the Hams Fork River just west of the Oakley Project area. The Frontier also has good potential for recharge in the area so it was targeted as a potential source for groundwater development.

Although the groundwater investigation has determined that the Frontier Formation is more attractive for potential development than the Nugget Formation, the geological aspects of each are presented herein.

Nugget Formation:

The Nugget Formation of Upper Triassic Age consists principally of massive, cross-bedded aeolian sandstones and minor quartzites. It ranges in thickness from 600 to 1100 feet in the Kemmerer region. In the Oakley area, the Nugget is projected to be 800-900 feet thick and buried to a depth of 6,000-7,000 feet (Plate 2, MSM, ref. 3). The dip of formations at the surface is 20 degrees W-NW and the strike is N-S to slightly NE-SW.

The existence of a low angle thrust fault from the west, called the Darby Thrust Fault, is found in the area and its surface expression is located 2-3 miles east of Oakley. Because it is a low angle fault, it has no structural effect on deeply lying strata such as the Nugget.
A single outcrop of Nugget is found in Sections 30 and 31, Township 20 North, Range 115 West. The outcrop, located by photogeology, is 5 miles south and 3.5 miles east of the Oakley Project Area. Here the strike is N-S and the dip is approximately 25 degrees to the West.

Over the balance of the area east of Oakley, the Nugget subcrops against the Tertiary deposits of the western Green River Basin. Studies of the outcrops of the Nugget Formation in areas from 12 to 35 miles north of Oakley indicate good porosities and permeabilities but subsurface porosities obtained from drill stem tests find ranges of from 10-20 percent. Studies of cores of the Nugget from the Davis Oil Co., Oyster Gap No. 1 Well in T 32 N, R 115 W, show the Nugget sand to be well cemented and have no visible porosity.

Transmissivities at depth are considerably less in drill stem tests than those in near surface zones due to depth of burial and lesser fracture potential with such depth. Near surface fracturing accounts for the comparatively high yields (75-2000 gpm) of the springs from the Nugget Formation in Townships 30 and 31 North, Range 116 West.

Water quality data from the Nugget in the Oakley area is nonexistent. However, in areas 12 to 30 miles north of Oakley, the Nugget water quality is good, ranging from 150-300 Mg/L of calcium bicarbonate type water. In the Oakley area higher dissolved solid content is expected because of inactive recharge at depth.

Recharge of the Nugget in the Oakley area is principally from subsurface sources because the Nugget is not exposed at the surface within a radius of several miles
in any direction from Oakley. The nearest known Nugget outcrop is the only surface area where the formation recharge can occur. That outcrop (located earlier in the text) is only one mile long and one-half mile wide, providing very little areal extent for rainfall recharge. Although the possibility of recharge from the overlying Twin Creek Limestone exists, it cannot be depended upon to provide quantities or qualities of water to saturate or at least recharge the Nugget Formation at depths.

Conclusions
The potential for development of a Nugget Formation water well is low because of the following:

a) The formation is buried to a depth of 6,000+ feet and possibly to a depth of close to 7,000 feet. Dip projections and extrapolations from the single existing outcrop of Nugget in the general area indicate that the top of the Nugget Formation to be approximately 6,440 feet below ground level. No evidence whatsoever exists which may even indicate that the Nugget Formation may be closer to the surface than previous investigations and reports have stated.

b) The quality of subsurface water in the Nugget is unknown in the Oakley area. However, since surface recharge areas for the formation are virtually nonexistent in the vicinity of the Oakley area, any water in the Nugget has had a long residence time and is in a relatively passive state. This residence time and lack of fresh water recharge would indicate that the quality at such
considerable depth may possibly not meet the specifications for domestic potability. It is recognized that the Nugget consists principally of aeolian quartz sand and quartzite which are relatively inert and it may be that good water does exist in the Nugget at depth.

c) The available volumes of water in the Nugget would be subject to porosities and permeabilities of the formation with depth. Scattered oil field drill stem tests indicate good porosity and permeability in the Nugget so that volume may not be a negative criteria. However, artesian pressures and specific hydrostatic data are unknown and water from the formation may have to be pumped a considerable vertical distance from the aquifer's artesian level to the surface.

d) The expense of drilling even a slim 6,500 foot test well in the Oakley Subdivision would be a costly undertaking. The estimated cost of a test well would be in excess of $200,000.00 with no guarantee of success. If a sufficient supply were to be found, the cost for completing the test hole as a production well would be an additional 80 to 100 thousand dollars. Additional costs would be a pump, electrical power, and plumbing at about $20,000.00.

e) Even if the quality of water in the Nugget proved to be adequate for domestic use and
the quantity of water was adequate for pumping all the water that could be used, the cost of drilling a pilot hole and completing it as a production well would be prohibitive on a cost per residence basis for the Oakley Subdivision as compared to the cost of a Frontier Sandstone test well. If the same Nugget well were to be drilled and successfully completed for a municipality, the costs could be spread over a much higher residence number and reduce the unit cost.

Conversely, if either the quality or quantity of water were inadequate to meet minimum requirements for Oakley, then the effort to develop that groundwater source would be called a failure and the residents and the State would have thrown those funds away. In addition, since inadequate data is available to support the location of a 6,500 foot water well in Oakley, the Consultant would be remiss in his responsibilities to the contract to recommend a drilling location or to encourage expenditure of drilling funds without some certainty of success.

Thus a recommendation to drill a Nugget well on a potential chance for success cannot be made in good conscience. In order to recommend a Nugget Formation test well, the Consultant would have to have substantiated evidence indicating that the well would have a high percent chance of success. At present, the evidence does not exist so the chance of success is not high.
Although a possibility that the Nugget Formation may produce the required domestic volumes and qualities of water, it is recommended that the proposal to drill a test water well into the Nugget Formation in the Oakley Subdivision should be eliminated from further consideration for this project because the cost of approximately $10,000 per residence for just a test well and an additional $6,000 cost for a completed well (not including the storage or distribution system) would be too great an expense compared to a test well of the Frontier Sandstone.

**Frontier Sandstone:**

The search for a subsurface source of potable water in quantities large enough to serve the Oakley Subdivision led to the consideration of the Frontier Formation. The outcrop of the Oyster Ridge Sandstone Member, herein called the Frontier Sandstone, is found just west of Oakley and from this investigation, may be a source to satisfy the requirements of the subdivision.

Two geological investigation trips were made to study the outcrops and subsurface potential within short distances of Oakley as a part of the study effort. Other target aquifers in the immediate area were considered for ground water potential for test/production well development since the Nugget Formation has been rejected by this report as a viable target. The Frontier Sandstone was the next most attractive aquifer for investigation. Other potential water-producing strata were also considered.
Between the Cretaceous Frontier Formation and the Nugget Formation and in descending order, the stratigraphy includes the Aspen Shale, Bear River Formation, Gannet Group, Stump and Preuss Sandstones and the Twin Creek Limestone. Records from the Wyoming State Engineer's Office indicate one well completed in the Aspen Shale for 15 gpm and one well completed in the Bear River Formation. No wells have been reported to have been completed in any of the other strata listed above.

The Twin Creek Limestone supplies water to springs existing north of the general Kemmerer area. An oil and gas test well about 16-17 miles north of Kemmerer encountered flows of 100 gpm from the Twin Creek Limestone.

The five stratigraphic zones could be logged and tested during the drilling of a deep Nugget test well, but at this time are not considered prime targets for subsurface water development due to lack of data specific to the Oakley Subdivision area. In other areas of the Overthrust Belt, the Bear River Formation and Gannett Group contain low yields of up to 15 gpm for minor aquifers and 75 gpm for the Lakota and Belcher members of the Gannet Group (Ahern, 1).

Well development for Oakley is restricted to short distances from the subdivision because of economic and financial restrictions. Costs for water well drilling and a pipeline from the well to a storage tank would have to be less than or equal to the cost of a pipeline from Kemmerer to the storage tank.
The initial trip to Kemmerer was for geological reconnaissance and developing limits within which further studies should be conducted. The second trip involved detailed geologic investigation which determined the specific potential for drilling a test/production well into the Frontier Sandstone at a point west of the outcrop, yet within economical distances of the water storage tank necessary for Oakley.

Figure 1 is a map of the area just west of Oakley and within the limits where a test well should be placed. It shows the 2 lines of cross-section in Figures 2 and 3 and the location of a Frontier Sandstone test well.

Figure 2 is the A-A' cross-section north of the cross-section in Figure 3. It identifies the area of the Frontier Sandstone where it has been incised by erosion of the Ham's Fork. The incised area would drain any directly updip water contained in the sandstone and would preclude any hydrostatic recharge available from updip drainage.

The Frontier Sandstone subcrops under the valley floor and recharge would occur only by the Hams Fork over a distance of less than 1/4 mile. In the situation of the second cross-section (Figure 3), recharge occurs, (1) by rain and snow occurs on the outcrop where the Frontier Sandstone is exposed; (2) by the Hams Fork north of the cross-section (see Figure 2); and (3) by the Ham's Fork where the stream crosses the outcrop southwest of US Highway 30 at the southwest corner of the Oakley Subdivision.

Figure 3 is a cross-section showing the geologic structure and stratigraphy of the area from a point on
AREA OF INCISED FRONTIER SANDSTONE

PROPOSED TEST WATER WELL

PROPOSED STORAGE TANK LOCATION

APPROXIMATE STRIKE LINE, TOP OF FRONTIER SANDSTONE

FIGURE 1

1/4 MILE
1.320 FEET SCALE
CROSS-SECTION A-A' SHOWING INCISED FRONTIER SANDSTONE NORTHWEST OF OAKLEY

FIGURE 2
CROSS-SECTION B-B' SHOWING
TEST WELL LOCATION AND DEPTH
TO TOP AND BOTTOM - FRONTIER SANDSTONE

FIGURE 3
the Frontier Sandstone outcrop west of Oakley to where a test well of the Frontier Sandstone Member could be drilled.

The Frontier Formation of Cretaceous age consists of sandstone, shale, siltstone and coal. It is divided into the upper, middle and lower units. The upper unit contains tan sandstone, lignitic shale and the Kemmerer No. 1 Coal Bed. The Middle Member is composed of white to tan sandstone, dark shale and the Willow Creek No. 5 Coal Bed near its base. The most prominent strata in this member is a 40 to 60 foot continuous sandstone zone known as the Oyster Ridge Sandstone Member (called the Frontier Sandstone). The lower unit is made up of thin brown and white sandstone beds, tan siltstone and dark grey shale.

Microscopic examination of samples from the outcrop of the Frontier Sandstone on the ridge directly above Oakley show that the section consists of the following:

Sample 1 - From top 2 feet of outcrop at the crest of the power line road, where the beds are fractured. Sandstone, white to tan, rare medium brown, fine grained, streaks and zones contain black grains of carbonaceous material, quartz grains, subangular to subrounded, medium to well sorted, non-calcareous, silty cement, medium to well cemented, fair to good porosity, trace iron stain.

Sample 2 - From a point 5 feet above base of massive cross-bedded sandstone located on the ridge directly above Oakley. Sandstone, white to
tan, very fine to fine grained, subrounded, well sorted, matrix has blebs and bars of calite, fractures contain crystalline calcite, calcareous and silty cement, medium to well cemented, fair to good porosity, trace iron stain.

The Frontier Sandstone outcrops along the western side of the Oakley Subdivision where the dip is measured to be 21° to the west and the strike to be N 2° E. North along the crest of the Oyster Ridge the dip is 18° to the west northwest and the strike is N 10° E.

The upper portion of the Frontier Sandstone is fractured at the surface with 2 major and 1 minor set of fracture traces. This same pattern is probably tectonically derived and is expected to continue into the subsurface to a limited extent but at least to the extent of the depth of the test well. These fractures increase the potential for groundwater storage and transmissibility. The lower portion of the Frontier Sandstone is more massive in nature but still has potential for fracturing but to a lesser degree than in the upper portion.

Hydrogeology

No wells have been completed in the Frontier Sandstone in the specific area under investigation, and no Frontier water wells exist in the perimeter area of less than 2 miles from Oakley. Three ground water reports of the general area (1, 2 & 3) indicate that Frontier wells produce water in the Cumberland area south of Oakley. Such wells have been reported to produce from 5 to 100 gpm but averaging 30 to 50 gpm.
Production rates in the Oakley area will depend on subsurface fracture frequency, porosity, and permeability. The reported values for the parameters range from 8 to 25 porosity and transmissivities from 10-30 gpd/ft.

Data on Frontier Sandstone water quality is scarce since no wells are available for sampling but information reports the quantity to be potable to marginally potable where tested.

North of Kemmerer, Frontier Formation water quality is reported ranging from 366-503 Mg/L TDS. In the subsurface of the Laeart syncline, the water is sodium bicarbonate type and ranges from 750-1500 Mg/L TDS. However fresh water influx from outcrops and streams would provide better quality in near surface aquifers. The shallow depth of the test well and the 2-fold recharge potential indicate that the water should be better at the near surface depths than at greater depths within the aquifer at the test well location.

**Location** - The proposed well should be located just north of Highway 30 and just west of the Hams Fork at the base of the highway bank. This location will take advantage of potential stream recharge both north and south of the location. It should also receive recharge from outcrops of the Frontier Sandstone south of the incised area shown in Figure 1.

**Design** - A test well to the Frontier Sandstone must exclude the subsurface water in the alluvial deposits in the Hams Fork drainage and the water contained in the Kemmerer No. 1 Coal Bed and the remainder of the unit of the Upper Frontier Formation. A well design is
proposed in Figure 4. The intermediate casing should be set several feet into the Frontier Sandstone to assure that only the Frontier Sandstone is tested. The 4 inch casing should be sealed with either cement or volclay to prevent contamination from other water sources.

Overlying shales and coal could be expected to contribute water of lesser quality to the total water column if the hole were allowed to be completed as open hole throughout or at least below the influence of the alluvial or vadose water zone. Surface casing set in bedrock will eliminate such water from the water column. An artesian water level in the well can be expected because of the comparatively steep dip of the Frontier Sandstone but the water level will be determined only by testing.

General depth of the well is projected from the outcrop to subsurface using 21° as dip and elevation from topographic map control. The hole should penetrate the entire thickness of the Frontier Sandstone to expose the maximum thickness of the potential water-bearing zone in the well. Open hole below the casing should be sufficient for testing. Depths to the top of the Frontier Sandstone are projected to be between 270 and 300 feet and the thickness to be drilled should be 50' - 55' to penetrate true thickness of 45 feet.

Test drilling should be conducted with a rotary rig using air or air/foam to make detection of aquifer or water bearing/producing zones readily apparent. However, if too much water is encountered in uphole strata, a water or water/mud system may be reverted to
FRONTIER FORMATION TEST WELL IN
THE FRONTIER SANDSTONE
WELL DESIGN

0-
8"-9" SURFACE HOLE
7" SURFACE CASING

100-
6" HOLE

200-
4" CASING

250-
	SUBMERSIBLE PUMP

210-

320-
3 5/8" HOLE

FIGURE 4
for attaining desired depth. Testing should be accomplished with a pump adequate for producing 30-50 gpm from depths of 270-300 feet. The testing procedure will consist of a step test with 3 or 4 steps, then a constant rate test of a minimum of 48 hours, followed by a 98% recovery test.

Two samples will be taken for quality analysis; the first at the midway point and the second at the end of the constant rate test. The samples will be sent to a qualified laboratory for a complete analysis according to EPA primary and secondary standards, including radionuclides.

Assuming a successful test, the hole should be reamed, proper casing set and cemented from bottom to top, and a pump set to produce the required volume of water.

A pipeline and pump from the well to a storage tank placed on the ridge west of Oakley would provide a dependable supply of water for the present homes and also for limited expansion of the Oakley area. A level area in a cul-de-sac in the Frontier Sandstone on Oyster Ridge is present at the southern end of the ridge at about the 7000 foot elevation level. A pump would be necessary to lift the well water about 150-170 feet from the wellhead to the storage tank. The tank could be situated at a lower level on the ridge if necessary, but a suitable area must be found or constructed.

Preliminary projected drilling costs for the test hole are less than $20,000 and management and on-site geology costs would be added. The straight line distance from the well to the storage area on Oyster Ridge is about 1800 feet.
A distribution system to all homes should be designed and costed as part of the systems planning.

The Frontier Sandstone has a fair to good potential for producing quantities of water from a well drilled and completed in the full section of continuous sandstone in the Frontier Sandstone which outcrops just west of Oakley.

From this and other studies, the Frontier Sandstone could be expected to produce 30-50 gpm continuously. However, after the storage tank is initially filled, the well need not be pumped continually on a 24-hour-per-day-basis. The storage tank will provide water for both domestic use and for fire control. A well drilled and completed in the Frontier Sandstone will not satisfy requirements for a large municipality but would provide adequate water (with storage tank) for the Oakley Subdivision residents at present and for expansion of the subdivision within limits.

The quality of water from the Frontier Sandstone at depths of 250-300 feet is unknown at present; however, the chances for its potability are good because of its proximity to the surface and to its 2 sources of recharge. Waters within the Frontier Sandstone are most likely in an active rather than passive state.

Drilling and testing a small (6" diameter) water test hole of about 325 feet in depth in the Frontier Sandstone is recommended, at a location less than 0.5 mile west of Oakley and on the west side of Ham's Fork. If successful, this water source would be more cost effective on a per residence basis than a pipeline built from the Kemmerer area to Oakley.
References:


The following cost components were estimated for Alternate "B" - detailed information is contained in the Appendix:

5. Meter Reading and Billing.

1. **Capital Costs for Well and Transmission Line**

These costs include: well, pump and pump house; six inch diameter transmission pipeline from well to storage tank; 50,000 gallon storage tank; appurtenances and related items of work. Total Capital Costs are estimated at $230,522.00, of which 33% is assumed to be in the form of a loan amortized over 30 years at a 4% interest rate.

This calculates to a monthly rate of $18.35 per residence.

2. **Capital Costs for Distribution System**

These costs are the same as those for Alternate "A" - Options 1 and 2, which are $6.30 per month per lot.

3. **Power Costs for Pump**

Power costs are based on Utah Power and Light Company's Electric Service Schedule No. 6 - General Service Single Meter. Demands were calculated assuming a total pumping
head of 300 feet (actual pumping head cannot be determined until a test well is drilled). A flow rate of 70 gallons per minute driven by a 7.5 H.P. motor with an overall pump/motor efficiency of 75% (wire to water) was assumed to deliver 630,000 gallons per month to the storage tank to supply 300 gallons per capita per day to the service area.

Total monthly power costs were thus calculated at $5.36 per residence.

4. System Maintenance and Operation

These costs were determined assuming a part time maintenance person 10 hours per month at $15.00 per hour; vehicle at 10 hours per month at $10.00 per hour; and supplies expensed at $25.00 per month. Total monthly operation and maintenance costs would be $275.00 or $13.75 per residence per month.

5. Meter Reading and Billing

These costs would be the same as those for Alternate "A" - Option 2 or $13.50 per month per lot.
Total costs for Alternate "B" - Development of Groundwater are summarized as follows:

**CAPITAL COSTS**

- Well and Transmission Line $19.10
- Distribution System $13.40

**POWER COSTS**

$5.36

**SYSTEM MAINTENANCE**

$13.75

**METER READING AND BILLING**

$13.50

**TOTAL COSTS PER MONTH - ALTERNATE "B" FRONTIER FORMATION WELL**

300 G/C/D $65.11
V ALTERNATE "C" - REVERSE OSMOSIS AND SOFTENING UNITS
FOR EXISTING WELL WATER

Well samples were taken from 13 of the existing wells and analyzed for chemical constituents. A tabulation of these analyses is included in the Appendix to the Report.

The tabulation was given to two businesses in Rock Springs who sell reverse osmosis and water softening equipment who were asked to provide an estimate of the type and cost of equipment to treat the well water being considered. One business did not respond. The other provided information and costs for Culligan Aqua Sensor water conditioning units and reverse osmosis drinking water systems, pre-filtering units, and maintenance/servicing costs. These costs are summarized as follows:

1. Mark 812 Aqua Sensor Water Softening Units $1,475.00 each
2. Reverse Osmosis Drinking Water Systems $975.00 each
3. Pre-filtering Units $109.07 each

Total Cost per Residence $2,559.00

Assuming a life of 15 years for each of these units, and amortizing the capital cost at 10% per year, yields an equivalent annual cost of $337.00 per year, or $28.00 per month.

Servicing and maintenance costs are estimated at $21.00 per month and the cost for electricity is set at about $9.00 per month. This results in a total estimated monthly cost of $58.00.
The daily capacity of these units is not stated; brochures and information describing them are included in the Appendix. Furthermore, no fire protection is afforded under Alternate "C".

The above costs are for units to treat the water having median quality as presented in the tabulation in the Appendix. Some residences may require less treatment while one residence may require two softeners and a larger R.O. unit than quoted. Each one will be sized according to the quality of the particular well water to be conditioned and treated.

Costs for this Alternate are summarized below:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Capital Cost for</td>
<td></td>
</tr>
<tr>
<td>Units at 10% for 15 years</td>
<td>$ 28.00</td>
</tr>
<tr>
<td>Monthly Servicing and Maintenance Cost</td>
<td>$ 21.00</td>
</tr>
<tr>
<td>Monthly Power Cost</td>
<td>$ 9.00</td>
</tr>
<tr>
<td><strong>Total Monthly Cost</strong></td>
<td><strong>$ 58.00</strong></td>
</tr>
</tbody>
</table>

The installation of individually owned and operated water softening equipment will, however, create a complication relative to forming any kind of a water district. EPA regulations prohibit their use in conjunction with consideration of developing a district public water supply.

Thirteen private, domestic water wells were sampled for water quality analysis. All are considered unsuitable for human consumption according to EPA Standards. Wyoming Department of Agriculture Standards indicate that eight wells are unsuitable for livestock use, and all but one are unfit for lawn and garden irrigating.
An appraisal of each individual well is not presented herein; however, work is continuing on an assessment of each private well in regard to:

1. Geology/Stratigraphy
2. Construction
4. Quality Considering Wyoming Department of Agriculture Standards for:
   a. Human Consumption
   b. Livestock Use
   c. Irrigation of Lawns and Gardens
5. Maps and Permits

The results of this work will be presented in a "Supplement" to this Report at a date in the near future.

VI SUMMARY OF MONTHLY COSTS

The Alternates considered are as follows:

ALTERNATE "A" - OPTION 1

This option considers construction of an 8 inch diameter transmission pipeline from the Kemmerer distribution system to Oakley within the U.S. Highway 30 right-of-way. The transmission pipeline would connect into the Kemmerer system at the northeast corner of the intersection of U. S. Highways 30 and 189.

A distribution system would be constructed to deliver water within Oakley.
Maintenance of facilities would be contracted out as necessary, however, meter reading and billing services would be provided by the City of Kemmerer.

Each property owner in Oakley would have to bear the cost of his own service line and water meter. These costs are not reflected in the cost figures presented in this Report, nor has a connection fee been considered.

**ALTERNATE "A" - OPTION 2**

All facilities considered in Option 1 would also be constructed under this Option. The only difference is that Oakley would provide meter reading and billing services rather than Kemmerer.

**ALTERNATE "B"**

This Alternate involves drilling and developing a production well in the Frontier Formation as shown on the Drawings.

A test well would have to be drilled into the Frontier before drilling and completing a production well. The cost of the test well is estimated at $18,266.00. A breakdown of this cost is presented in the Appendix to this Report. The monthly cost figures presented herein do not include any repayment of the costs for the test well because it is assumed that the test well would be funded under a Wyoming Water Development Commission grant.
**ALTERNATE "C"**

This plan involves the treatment and conditioning of water from each of the existing individual domestic wells to improve water quality. This would be done by installing water conditioning and reverse osmosis water treatment equipment. Such a program would provide no fire protection to the community. The cost of purchasing, maintaining and servicing the equipment would be borne entirely by the homeowners involved.

**COMPARATIVE COSTS**

The comparative costs for Alternates "A", "B" and "C" are summarized below.

<table>
<thead>
<tr>
<th>ALTERNATE</th>
<th>ESTIMATED MONTHLY WATER COST PER RESIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 G/C/D</td>
</tr>
<tr>
<td>A. Connect to Kemmerer System - Option 1 Kemmerer Provides All Services</td>
<td>$ 71.89</td>
</tr>
<tr>
<td></td>
<td>Option 2 - Oakley Reads Meters and Bills Users</td>
</tr>
<tr>
<td>B. Develop Water Well</td>
<td></td>
</tr>
<tr>
<td>C. Individual In-House Water Treatment Units</td>
<td>$ 58.00*</td>
</tr>
</tbody>
</table>

* Provides no Fire Protection and quantity per capita per day is not given.
VII CONCLUSIONS AND RECOMMENDATIONS

Alternate "C" - Reverse Osmosis and Softening Units for Existing Well Water offers the least expensive course of action for the members of the Oakley Water Users Association; however, this Alternate falls short in the area of fire protection and may not satisfy the needs of the homeowners.

As stated earlier, a "Supplement" to this Report will be submitted assessing each private well in regard to:

1. Geology/Stratigraphy
2. Construction
4. Quality Considering Wyoming Department of Agriculture Standards for:
   a. Human Consumption
   b. Livestock Use
   c. Irrigation of Lawns and Gardens
5. Maps and Permits

It is recommended that Alternate "B" - Development of Groundwater, be pursued further if the residents of Oakley reject Alternate "C".

Alternate "B" would require drilling a test well before proceeding further. The cost of the test well is estimated at $18,266.00.
Revised August 22, 1989

COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "A" - CAPITAL COSTS

Connection to Kemmerer System

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>UNIT PRICE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 8&quot; Dia. Pipeline</td>
<td>15,060 L.F.</td>
<td>$12.00</td>
<td>$180,720.00</td>
</tr>
<tr>
<td>2. Valves</td>
<td>10 Each</td>
<td>$1000.00</td>
<td>10,000.00</td>
</tr>
<tr>
<td>3. Air Relief Valves</td>
<td>6 Each</td>
<td>$300.00</td>
<td>1,800.00</td>
</tr>
<tr>
<td>4. Boring</td>
<td>200 L.F.</td>
<td>$150.00</td>
<td>30,000.00</td>
</tr>
<tr>
<td>5. Trenching in Rock</td>
<td>1,100 L.F.</td>
<td>$25.00</td>
<td>27,500.00</td>
</tr>
<tr>
<td>9. Connection to City of Kemmerer</td>
<td>Lump Sum</td>
<td></td>
<td>25,000.00</td>
</tr>
<tr>
<td>10. Meter</td>
<td>Lump Sum</td>
<td></td>
<td>7,500.00</td>
</tr>
<tr>
<td>11. River Crossing</td>
<td>250 L.F.</td>
<td>$60.00</td>
<td>15,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TOTAL $297,520.00</td>
</tr>
</tbody>
</table>

Plus 10% Engineering $29,752.00

Plus 15% Contingency $44,628.00

TOTAL PROJECT COST $371,900.00

33% Loan $122,727.00

Annual Cost @ 4% Interest for 30 Years $7,097.00

Cost Per Lot Per Month $29.60
COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "A" AND "B" CAPITAL COSTS
DISTRIBUTION SYSTEM

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>UNIT PRICE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 6&quot; Dia. Pipeline</td>
<td>1,800 L.F.</td>
<td>$10.50</td>
<td>$18,900.00</td>
</tr>
<tr>
<td>2. Boring</td>
<td>100 L.F.</td>
<td>$150.00</td>
<td>15,000.00</td>
</tr>
<tr>
<td>3. Fire Hydrants</td>
<td>10 Each</td>
<td>$1,500.00</td>
<td>15,000.00</td>
</tr>
<tr>
<td>4. Valves</td>
<td>8 Each</td>
<td>$800.00</td>
<td>6,400.00</td>
</tr>
<tr>
<td>Plus 10% Engineering</td>
<td></td>
<td></td>
<td>$5,530.00</td>
</tr>
<tr>
<td>Plus 15% Contingency</td>
<td></td>
<td></td>
<td>8,295.00</td>
</tr>
<tr>
<td>TOTAL PROJECT COST</td>
<td></td>
<td></td>
<td>$69,125.00</td>
</tr>
</tbody>
</table>

50% Loan                  $34,563.00
Annual Cost @ 8.5% Interest for 30 Years $3,216.00
Cost Per Lot Per Month    $13.40
Revised August 22, 1989

COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "A" VARIABLE COSTS PAYABLE TO KEMMERER

Option 1 (Sheet 1)

METER CHARGE

Cost Per Lot/Month = $5.26

INCREASED COST

Total Yearly Use - Oakley
@ 300 G/C/D = 7,665,000 gal.

Total Yearly Average - Kemmerer
= 220,000,000 gal.

\[
\frac{7,665}{220,000} = 0.035 \text{ or } 3.5\%
\]

Costs Allocated to Increased Demands
(per Kent Smith Report) (Annual Cost)

<table>
<thead>
<tr>
<th>Cost</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Plant Operation and Maintenance</td>
<td>$106,049.00</td>
</tr>
<tr>
<td>Meter Maintenance</td>
<td>$8,130.00</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$114,179.00</strong></td>
</tr>
</tbody>
</table>

\[
(0.035) \times ($114,179.00) = $3,996.00/Year
\]

\[
\frac{3996.00}{7665} = 0.50/1000 \text{ gal.} = $0.50
\]

**TOTAL COST PER 1000 GALLONS** = $1.75 + $0.50 = $2.25
COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "A" VARIABLE COSTS PAYABLE TO KEMMERER

Kemmerer Reads Meters and Bills

Option 1 - Sheet 2

WATER COSTS

Cost per Family per Month
(Payable to Kemmerer)

100 G/C/D $ 28.89

300 G/C/D $ 76.14
COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "A" TOTAL MONTHLY COSTS (Option 1)
Kemmerer Provides Meter and Billing Service

CAPITAL COSTS
Transmission Line $ 29.60
Distribution System $ 13.40

VARIABLE COSTS TO KEMMERER/MONTH
100 G/C/D $ 28.89
300 G/C/D $ 76.14

TOTAL COSTS PER MONTH - ALTERNATE "A" - OPTION 1
100 G/C/D $ 71.89
300 G/C/D $ 119.14
COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "A" METER READING AND BILLING BY OAKLEY

(Option 2)

METER READING

4 hrs/month @ $15.00 = $ 60.00

BILLING

8 hrs/month @ $15.00 = $ 120.00

VEHICLE

8 hrs/month @ $10.00 = $ 80.00

SUPPLIES

= $ 10.00

TOTAL MONTHLY COST

= $ 270.00

COST PER LOT PER MONTH

= $ 13.50
Revised August 22, 1989

COST ESTIMATE:  OAKLEY WATER PROJECT

ALTERNATE:  "A" TOTAL MONTHLY COSTS  (Option 2)

Oakley Provides Meter and Billing Service

<table>
<thead>
<tr>
<th>CAPITAL COSTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Line</td>
<td>$ 29.60</td>
</tr>
<tr>
<td>Distribution System</td>
<td>$ 13.40</td>
</tr>
</tbody>
</table>

| METER READING AND BILLING  | $ 13.50|

| Sub Total                  | $ 56.50|

<table>
<thead>
<tr>
<th>VARIABLE COSTS PAYABLE TO KEMMERER/MONTH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100 G/C/D @ $1.75/1000 gal</td>
<td>$ 18.38</td>
</tr>
<tr>
<td>300 G/C/D @ $1.75/1000 gal</td>
<td>$ 55.13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOTAL COSTS PER MONTH - ALTERNATE &quot;A&quot; - OPTION 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100 G/C/D</td>
<td>$ 74.88</td>
</tr>
<tr>
<td>300 G/C/D</td>
<td>$ 111.63</td>
</tr>
</tbody>
</table>
COST ESTIMATE:  OAKLEY WATER PROJECT

ALTERNATE:  "B" - PRODUCTION WELL

FRONTIER FORMATION

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>UNIT PRICE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reaming</td>
<td>270 L.F.</td>
<td>$12.00</td>
<td>$3,240.00</td>
</tr>
<tr>
<td>2. Casing</td>
<td>270 L.F.</td>
<td>$14.00</td>
<td>3,780.00</td>
</tr>
<tr>
<td>3. Drill through Cement Plug</td>
<td>50 L.F.</td>
<td>$12.00</td>
<td>600.00</td>
</tr>
<tr>
<td>4. Submersible Pump</td>
<td>1 Each</td>
<td>Lump Sum</td>
<td>7,000.00</td>
</tr>
<tr>
<td>5. Well Head</td>
<td>1 Each</td>
<td>Lump Sum</td>
<td>2,000.00</td>
</tr>
<tr>
<td>6. Well House and Power</td>
<td>1 Each</td>
<td>Lump Sum</td>
<td>10,000.00</td>
</tr>
</tbody>
</table>

**TOTAL PROJECT COST**  $26,620.00
Revised August 22, 1989

COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "B" - CAPITAL COSTS

FRONTIER FORMATION WELL

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>UNIT PRICE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Well, Pump and Pump House</td>
<td></td>
<td>Lump Sum</td>
<td>$ 26,620.00</td>
</tr>
<tr>
<td>2. 6&quot; Dia. Pipeline</td>
<td>2,055 L.F.</td>
<td>$ 10.50</td>
<td>21,577.00</td>
</tr>
<tr>
<td>3. Storage Tank 50,000 gal</td>
<td>1 Each</td>
<td>Lump Sum</td>
<td>30,000.00</td>
</tr>
<tr>
<td>4. Boring under Railroad</td>
<td>100 L.F.</td>
<td>$ 150.00</td>
<td>15,000.00</td>
</tr>
<tr>
<td>5. River Crossing</td>
<td>250 L.F.</td>
<td>$ 60.00</td>
<td>15,000.00</td>
</tr>
<tr>
<td>6. 6&quot; Valves</td>
<td>3 Each</td>
<td>$ 800.00</td>
<td>2,400.00</td>
</tr>
<tr>
<td>7. Air Relief Valves</td>
<td>4 Each</td>
<td>$ 300.00</td>
<td>1,200.00</td>
</tr>
<tr>
<td>8. 8&quot; Dia. Pipeline</td>
<td>3,010 L.F.</td>
<td>$ 12.00</td>
<td>36,120.00</td>
</tr>
<tr>
<td>9. Trenching in Rock</td>
<td>1,600 L.F.</td>
<td>$ 25.00</td>
<td>40,000.00</td>
</tr>
<tr>
<td>10. 8&quot; Valves</td>
<td>4 Each</td>
<td>$1000.00</td>
<td>4,000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td>$191,917.00</td>
</tr>
<tr>
<td>Plus 10% Engineering</td>
<td></td>
<td></td>
<td>19,192.00</td>
</tr>
<tr>
<td>Plus 15% Contingency</td>
<td></td>
<td></td>
<td>28,788.00</td>
</tr>
<tr>
<td>TOTAL PROJECT COST</td>
<td></td>
<td></td>
<td>$239,897.00</td>
</tr>
</tbody>
</table>

33% Loan $ 79,166.00
Annual Cost @ 4% Interest for 30 Years $ 4,578.00
Cost Per Lot Per Month $ 19.10
ASSUME PUMPING

Hd = 300 ft.

Q = 70 gpm = 0.16 cfs

\[
HP = \frac{(0.16)(62.4)(300)}{550 \times 0.75} = 7.26
\]

Say 7.5 HP

Total Pumpage/month =

\[
(20)(300)(3.5)(30) = 630,000 \text{ gal.}
\]

Pump Hours = \[
\frac{630,000}{(70)(60)} = 150 \text{ hours}
\]

7.5 H.P = 5.60 KW

KW Hours = 839.25 KW

\[
\begin{align*}
\text{Service Charge} &= \quad $18.20 \\
\text{Power @ 0.105302 x 839.25} &= \quad $88.96 \\
\text{TOTAL} &= \quad $107.16
\end{align*}
\]

COST PER LOT PER MONTH = $5.36
COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "B" - MAINTENANCE, METER READING AND BILLING
FRONTIER FORMATION WELL

MAINTENANCE
10 hrs/month @ $15.00 = $150.00

VEHICLE
10 hrs/month @ $10.00 = $100.00

SUPPLIES = $25.00

TOTAL MONTHLY COST = $275.00

COST PER LOT PER MONTH = $13.75

METER READING AND BILLING

COST PER LOT PER MONTH = $13.50
(See Sheet 6)
COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "B" - TOTAL MONTHLY COSTS
FRONTIER FORMATION WELL

COST PER LOT PER MONTH

CAPITAL COSTS

Well and Transmission Line $19.10
Distribution System (See Sheet 2) $13.40

POWER COSTS

$5.36

SYSTEM MAINTENANCE

$13.75

METER READING AND BILLING

$13.50

TOTAL COSTS PER LOT PER MONTH -
ALTERNATE "B" - FRONTIER FORMATION WELL

300 G/C/D $65.11
## COST ESTIMATE: OAKLEY WATER PROJECT

### ALTERNATE: "B" - TEST WELL

#### FRONTIER FORMATION

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>UNIT PRICE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mobilization/ Demobilization</td>
<td></td>
<td>Lump Sum</td>
<td>$ 5,000.00</td>
</tr>
<tr>
<td>2. Surface Hole</td>
<td>28 L.F.</td>
<td>$ 12.00</td>
<td>336.00</td>
</tr>
<tr>
<td>3. Surface Casing Cemented in Place</td>
<td>30 L.F.</td>
<td>$ 10.00</td>
<td>300.00</td>
</tr>
<tr>
<td>4. Rotary Drilling 6&quot; dia.</td>
<td>242 L.F.</td>
<td>$ 10.00</td>
<td>2,420.00</td>
</tr>
<tr>
<td>5. Casing</td>
<td>270 L.F.</td>
<td>$ 8.00</td>
<td>2,160.00</td>
</tr>
<tr>
<td>6. Rotary Drilling 3-5/8&quot; dia.</td>
<td>50 L.F.</td>
<td>$ 8.00</td>
<td>400.00</td>
</tr>
<tr>
<td>7. Pump and Pump Test</td>
<td>1 Each</td>
<td>Lump Sum</td>
<td>2,200.00</td>
</tr>
<tr>
<td>8. Sampling</td>
<td>6 Each</td>
<td>$ 25.00</td>
<td>150.00</td>
</tr>
<tr>
<td>9. Electric Log</td>
<td>1 Each</td>
<td>Lump Sum</td>
<td>1,000.00</td>
</tr>
<tr>
<td>10. Abandonment (if required)</td>
<td>1 Each</td>
<td>Lump Sum</td>
<td>300.00</td>
</tr>
<tr>
<td>11. Right to Access</td>
<td></td>
<td>Lump Sum</td>
<td>1,000.00</td>
</tr>
</tbody>
</table>

Sub Total Well Costs $15,266.00

Professional and Technical Services $3,000.00

TOTAL PROJECT COST $18,266.00
COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "B" - COST TO DRILL 6" HOLE INTO NUGGET FORMATION

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>UNIT PRICE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mobilization/ Demobilization</td>
<td></td>
<td>Lump Sum</td>
<td>$ 15,000.00</td>
</tr>
<tr>
<td>2. 14&quot; dia. Surface Hole</td>
<td>60 L.F.</td>
<td>$ 14.00</td>
<td>840.00</td>
</tr>
<tr>
<td>3. Surface Casing</td>
<td>60 L.F.</td>
<td>$ 14.00</td>
<td>840.00</td>
</tr>
<tr>
<td>4. Drilling</td>
<td>6,340 L.F.</td>
<td>$ 12.00</td>
<td>76,080.00</td>
</tr>
<tr>
<td>5. Casing</td>
<td>6,400 L.F.</td>
<td>$ 12.00</td>
<td>76,800.00</td>
</tr>
<tr>
<td>6. Drill Cement Shoe</td>
<td>200 L.F.</td>
<td>$ 10.00</td>
<td>2,000.00</td>
</tr>
<tr>
<td>7. Submersible Pump</td>
<td>1 Each</td>
<td>$4000.00</td>
<td>4,000.00</td>
</tr>
<tr>
<td>8. Step Tests/ Recovery Tests</td>
<td></td>
<td>Lump Sum</td>
<td>6,000.00</td>
</tr>
<tr>
<td>9. Water Sampling</td>
<td>2 Each</td>
<td>$100.00</td>
<td>200.00</td>
</tr>
<tr>
<td>10. Contingency- Power, Testing, Professional Services</td>
<td></td>
<td>Lump Sum</td>
<td>18,000.00</td>
</tr>
</tbody>
</table>

TOTAL PROJECT COST $199,760.00
COST ESTIMATE: OAKLEY WATER PROJECT

ALTERNATE: "C" - INDIVIDUAL REVERSE OSMOSIS AND WATER SOFTENING UNITS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>UNIT PRICE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mark 812 Aqua Sensor - Water Softener</td>
<td>Each</td>
<td>$1,475.00</td>
<td>$1,475.00</td>
</tr>
<tr>
<td>2. Reverse Osmosis Drinking Water System</td>
<td>Each</td>
<td>$975.00</td>
<td>975.00</td>
</tr>
<tr>
<td>3. Pre Filter Unit</td>
<td>Each</td>
<td>$109.95</td>
<td>109.95</td>
</tr>
</tbody>
</table>

TOTAL COST $2,559.95

Annual Cost @ 10% for 15 Years = $337.00

Monthly Cost $28.00

Monthly Cost - Servicing and Maintenance $21.00

Monthly Cost - Power $9.00

TOTAL COST PER LOT PER MONTH $58.00
Revised August 22, 1989

COST ESTIMATES: OAKLEY WATER PROJECT

COMPARATIVE COSTS - ALTERNATES "A", "B", AND "C"

<table>
<thead>
<tr>
<th>ALTERNATE</th>
<th>ESTIMATED MONTHLY WATER COST PER RESIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 G/C/D</td>
</tr>
<tr>
<td>A. Connect to Kemmerer System - Option 1</td>
<td></td>
</tr>
<tr>
<td>Kemmerer Provides All Services</td>
<td>$ 71.89</td>
</tr>
<tr>
<td>Option 2 - Oakley Reads Meters and Bills Users</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$ 74.88</td>
</tr>
<tr>
<td>B. Develop Water Well</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$ 65.11</td>
</tr>
<tr>
<td>C. Individual In-House Water Treatment Units *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$ 58.00*</td>
</tr>
</tbody>
</table>

* Provides no Fire Protection and quantity per capita per day is not given.
RESULTS OF THE WATER WELLS SAMPLED IN THE OAKLEY SUBDIVISION

<table>
<thead>
<tr>
<th>WELL OWNERS</th>
<th>SPECIFIC CONDUCTANCE (MICRO MHO/CM)</th>
<th>NITRATES (ppm)</th>
<th>TOTAL DISSOLVED SOLIDS (ppm (CaCO₃))</th>
<th>HARDNESS TOTAL ALUMINUM</th>
<th>COLIFORM TOTAL 100 ml MF</th>
<th>ALPHA GROSS</th>
<th>BETA GROSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOZIER UP #1</td>
<td>1230 &lt;0.2</td>
<td>833</td>
<td>260</td>
<td>210</td>
<td>180</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>MILLER #2</td>
<td>3940 &lt;0.2</td>
<td>2670</td>
<td>100</td>
<td>930</td>
<td>1400</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>DONNAFIELD #7</td>
<td>2340 &lt;0.2</td>
<td>1580</td>
<td>900</td>
<td>230</td>
<td>720</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>JETKOSKI #8</td>
<td>3030 &lt;0.2</td>
<td>2050</td>
<td>650</td>
<td>550</td>
<td>1100</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>VERNAL LONG #9</td>
<td>1350 &lt;0.2</td>
<td>914</td>
<td>110</td>
<td>280</td>
<td>280</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>GOLAB #10</td>
<td>4300 &lt;0.2</td>
<td>2910</td>
<td>780</td>
<td>820</td>
<td>1700</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>M. LONG #11</td>
<td>1550 1.7</td>
<td>1050</td>
<td>640</td>
<td>120</td>
<td>380</td>
<td>0</td>
<td>5.67</td>
</tr>
<tr>
<td>R ROBERTS #12</td>
<td>6980 2.2</td>
<td>5930</td>
<td>2400</td>
<td>1000</td>
<td>3000</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>C ANNALA #15</td>
<td>2150 2.1</td>
<td>1460</td>
<td>510</td>
<td>270</td>
<td>130</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>W WILSON #16</td>
<td>3080 &lt;0.2</td>
<td>2080</td>
<td>1200</td>
<td>300</td>
<td>800</td>
<td>0</td>
<td>5.40</td>
</tr>
<tr>
<td>FITZPATRICK #17</td>
<td>1680 &lt;0.2</td>
<td>1140</td>
<td>110</td>
<td>360</td>
<td>410</td>
<td>0</td>
<td>&lt;4.29</td>
</tr>
<tr>
<td>PARK #18</td>
<td>1600 2.2</td>
<td>1080</td>
<td>670</td>
<td>130</td>
<td>390</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>BAGGETT #19</td>
<td>2120 &lt;0.2</td>
<td>1430</td>
<td>640</td>
<td>260</td>
<td>570</td>
<td>1</td>
<td>NS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INORGANICS</th>
<th>EPA STANDARD</th>
<th>LONG #11</th>
<th>W WILSON #16</th>
<th>FITZPATRICK #17</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARSENIC</td>
<td>0.050</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>BARIUM</td>
<td>1.000</td>
<td>&lt;0.100</td>
<td>&lt;0.100</td>
<td>&lt;0.100</td>
</tr>
<tr>
<td>CADMIUM</td>
<td>0.010</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>CHROMIUM</td>
<td>0.050</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>LEAD</td>
<td>0.050</td>
<td>&lt;0.002</td>
<td>&lt;0.002</td>
<td>&lt;0.002</td>
</tr>
<tr>
<td>MERCURY</td>
<td>0.002</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SELENIUM</td>
<td>0.010</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>SILVER</td>
<td>0.050</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
<td>&lt;0.005</td>
</tr>
<tr>
<td>SODIUM</td>
<td>120.000</td>
<td>300.000</td>
<td>350.000</td>
<td></td>
</tr>
<tr>
<td>NITRATES *</td>
<td>10 ppm</td>
<td>1.600</td>
<td>&lt;0.200</td>
<td>&lt;0.200</td>
</tr>
<tr>
<td>FLUORIDE</td>
<td>0.300</td>
<td>0.300</td>
<td>0.400</td>
<td></td>
</tr>
</tbody>
</table>

FOOT NOTES

ppm = parts per million
* NITRATES - NO₃ + NO₂ AS N
HYDRAULIC GRADIENTS

ALTERNATE "A"

Hydraulic Gradient - Transmission Line

\[ Q = 500 \text{ gpm} \]

\[ S = \left( \frac{1.12 \times 0.011}{0.00614 \times 256} \right)^2 \]

\[ S = \left( \frac{0.01232}{0.1572} \right)^2 \]

\[ S = 0.006 \]

\[ \Delta \text{El} = 0.006(15,000) = 92.2 \text{ ft.} \]

\[ Q = 70 \text{ gpm} \]

\[ S = 0.000125 \]

\[ \Delta \text{El} = 0.000125(15,000) \]

\[ = 1.87 \text{ ft.} \]
HYDRAULIC GRADIENTS

ALTERNATE "B"

Hydraulic Gradient - Well to Storage Tank

\[ Q = 70 \text{ gpm (est)} \]
\[ = 0.16 \text{ cfs} \]
\[ n = 0.011 \]
\[ d = 6'' \]
\[ S = \text{Slope Hydraulic Gradient} \]

\[ Q = \frac{0.000614}{n} d^{8/3} S^{1/2} \]

\[ S = \left( \frac{Qn}{0.000614 d^{8/3}} \right)^2 \]
\[ S = \left( \frac{0.16 \times 0.011}{0.000614 \times 119} \right)^2 \]
\[ = \left( \frac{0.00176}{0.07307} \right)^2 \]
\[ S = 0.00058 \]

\[ \Delta E_1 = 0.00154 \times (2405) \]
\[ = 1.4 \text{ ft.} \]
HYDRAULIC GRADIENTS

ALTERNATE "B"

Hydraulic Gradient - Storage Tank to End of Transmission Line

\[ Q = 70 \text{ gpm} \]

\[(1.00 \text{ gpm/C} \times 3.5 = 3.5 \text{ gpm/residence } 3.5 \times 20 = 70 \text{ gpm})\]

\[ \frac{n}{d} = 0.011 \]

\[ n = 0.011 \]

\[ d = 8" \]

\[ S = \text{Slope Hydraulic Gradient} \]

\[ S = \left( \frac{0.16 \times 0.011}{0.000614 \times 256} \right)^2 \]

\[ S = \left( \frac{0.00176}{0.1572} \right)^2 \]

\[ S = 0.000125 \]

\[ \Delta E1 = 0.000125 \times 2300 = 0.00289 \]

\[ \Delta E1 = 0.3 \text{ ft.} \]

\[ Q = 500 \text{ gpm} = 1.12 \text{ cfs} \]

\[ S = \left( \frac{1.12 \times 0.011}{0.1572} \right)^2 \]

\[ S = 0.006 \]

\[ \Delta E1 = 0.006 \times 2300 = 14.2 \text{ ft.} \]
THE CULLIGAN AQUA-SENSOR®
For state-of-the-art water conditioning.

Patented Versatile Timer—automatically regulates all cycles of operation including backwash, brine rinse and refill.

Aqua-Sensor® Controller—monitors electronic signals from hardness sensor in softening resin bed. When need for a recharge is detected, signal is stored and recharging occurs at a convenient time.

These two-tank conditioners can be conveniently installed in the basement, utility room, garage or other locations.

Pictured here: the Mark 89 Aqua-Sensor® unit, for households with demanding water conditioning requirements.
THE CULLIGAN DRINKING WATER SYSTEM.

Makes water the healthiest drink in the house.
A Culligan Aqua-Clear® System uses existing cold water lines, and fits easily under your sink, or in a utility closet or other concealed location. Pre-mounted cabinet model (shown here) also available.
INSTRUCTIONS FOR INSTALLATION OF THE R.O. Booster Kit TO THE H-8 SYSTEM

*************************************************************

STEP 1.) The mounting board is premarked for the prefilter, postfilter and module housing. Mount the prefilter to the board, install and connect tubing to outlet of prefilter.

STEP 2.) Mount module housing to board. Inlet on module housing at bottom should be removed and teflon tape used to prevent leaks. DO NOT over tighten when re-installing fitting.

STEP 3.) Install tubing from discharge of pump to inlet of module. Remove capillary tube from top of module housing. With virgin razor blade, cut capillary tube at an angle leaving 3/4" of capillary tube. (NOTE: To remove capillary tube assembly see exploded view on page 2 of Drinking Water Systems Parts List-Culligan Manual. Loosen 2 screws at top of module housing and turn 1/8 turn to pull assembly out of housing. After removing, separate assembly for trimming.)

STEP 4.) Install Tee in Reservoir Tank, using teflon tape. Install reservoir cap and angel valve on 3/4 Tee using teflon tape, and set precharge and reservoir at 7 lbs. (NOTE: refer to page 11 for necessary connections to water supply and drain.) Hook together electrical connections from pump to pressure switch.

STEP 5.) Install & mount postfilter below pump on mounting board. Extra tubing along with fittings is furnished in KIT for carbon postfilter.

STEP 6.) Silicone glue rubber sponges at bottom of housing for vibration dampner.

STEP 7.) Refer to page 12 of Culligan Installation Instruction Manual on how to turn water supply to system. A 30/50 pressure switch is used (already assembled). Set pressure relief valve at 53 lbs. (Refer to Culligan Installation Instruction Manual page 12 on how to set pressure relief valve.) Turn on pump and adjust pressure relief valve. Remember water must be flowing in system before turning on pump.

This completes the necessary steps for the SUPER H-8 SYSTEM.

********** QUESTIONS, ANSWERS & TIPS **********

Question: How high T.D.S. will this R.O. system take care of?
Answer: We have a system out on a T.D.S. of 7,470 (sulphates 3500 mpl and sodium 2800 mpl). We have experienced high quality product water and no problems.

Question: Can you use a different pressure switch?
Answer: On high T.D.S. we use either a 30/50 or 40/60 pressure switch. This way the pump runs longer.

Question: Does water still go through the pump and membrane when the pump is not running?
Answer: Yes, this keeps the membrane flushed and will extend its life.

Question: How much water does this unit make?
Answer: On a unit we have on city water with a T.D.S. of 250 it will make 32 gallons per day. On another unit we have on T.D.S. of 1500 it produces 20 gallons per day.

Question: Will this pump system handle two modules?
Answer: YES