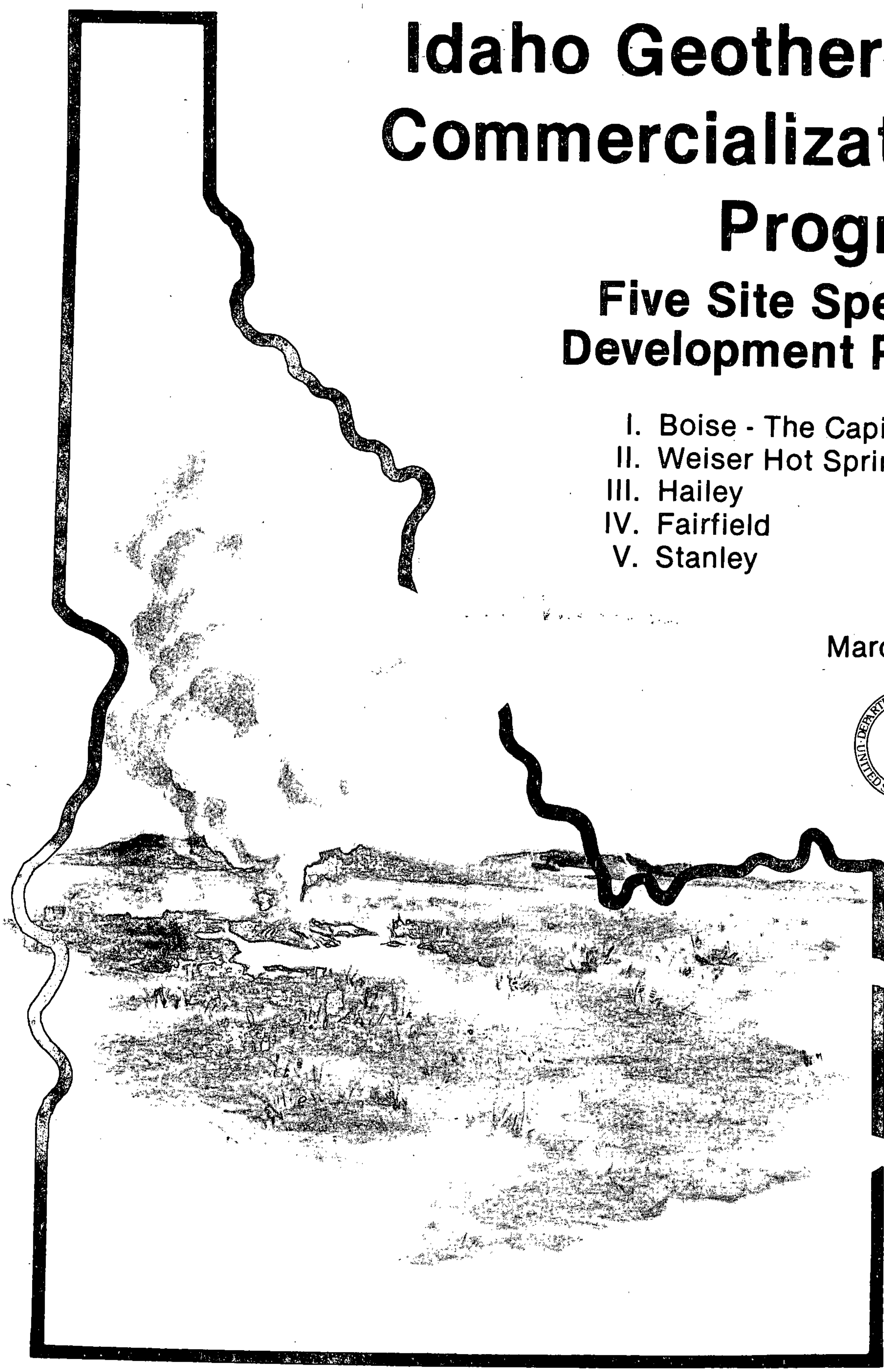
DOE/ID/12010-3

Idaho Geothermal Commercialization Program

Five Site Specific Development Plans

I. Boise - The Capital Mall
II. Weiser Hot Springs
III. Hailey
IV. Fairfield
V. Stanley

March 1980



NOTICE

DOE/ID/12010-3

IDAHO GEOTHERMAL COMMERCIALIZATION PROGRAM

FIVE SITE SPECIFIC DEVELOPMENT PLANS

I. BOISE - THE CAPITAL MALL
II. WEISER HOT SPRINGS
III. HAILEY
IV. FAIRFIELD
V. STANLEY

Prepared by:

Bill Eastlake
David McClain

Idaho Office of Energy
Statehouse
Boise, Idaho 83720

Published April 1980

Work performed under Contract No. DE-FC07-79ID12010
U.S. Department of Energy
Idaho Operations Office

TABLE OF CONTENTS

BOISE CITY GEOTHERMAL PROJECT
OPERATIONS RESEARCH REPORT

ABSTRACT

Although Boise has had some geothermal space heating since 1890, recent exploration and resource assessment by Boise City, the State of Idaho, and Warm Springs Water District have progressed to the point where geothermal space heat could be on line as early as September of 1980. The Idaho Office of Energy has prepared a preliminary analysis of the Boise Geothermal Project. This report consists of two major sections: Part I is an economic feasibility analysis of retrofitting and heating the seven state buildings in the Capital Mall. Part II is a time phase project plan which illustrates the historical and projected tasks which are necessary for the project to be completed by 1983. The two basic economic choices for the State are: (1) to buy geothermal water either from Boise City or from Warm Springs Water District, or (2) to construct its own geothermal system. The analysis indicates that each of the six possible alternatives is preferable to continued use of natural gas. If the project is to be completed on time, the State should begin its design and engineering process by Fall, 1979.

PART I
GEOTHERMAL ALTERNATIVES FOR THE IDAHO CAPITAL MALL

INTRODUCTION

Boise has had geothermal space heating for residences and a few commercial establishments since 1890 but it is only in the last five years that substantial interest has arisen in developing the resource for truly widespread use.

GEOTHERMAL ALTERNATIVES FOR THE IDAHO CAPITAL MALL

ABSTRACT

Although Boise has had some geothermal space heating since 1890, recent exploration and resource assessment by Boise City, the State of Idaho, and Warm Springs Water District have progressed to the point where geothermal space heat could be on line as early as September of 1980. Working as staff for the State Geothermal Task Force, the Idaho Office of Energy has prepared a preliminary analysis of the economic feasibility of retrofitting and heating seven state buildings in the Capital Mall. The two basic choices for the state are: (1) to buy geothermal water either from Boise City or from Warm Springs Water District, or (2) to construct its own geothermal system. The analysis that follows indicates that each of the six possible alternatives is preferable to continued use of natural gas and concludes that, on the basis of available data, the best of these alternatives is for the state to buy water at the proposed Boise geothermal public rate.

INTRODUCTION

Boise has had geothermal space heating for residences and a few commercial establishments since 1890 but it is only in the last five years that substantial interest has arisen in developing the resource for truly widespread use.

In late 1973, then-Governor Cecil Andrus sought the aid of the Energy Research and Development Administration (ERDA) in exploring the potential for development of Idaho's geothermal resources. This request resulted in the original Boise Geothermal proposal to the Atomic Energy Commission (AEC), in February of 1974, and a subsequent contract with the Idaho National Engineering Laboratory (INEL) for resource and engineering assessment of geothermal potential for the Boise Space Heating Project. Two exploratory wells were drilled along the Boise front fault, both indicating water in the 170^{o}F. range. The April, 1976, report on this project concluded that "no major resource or engineering difficulties exist that would prevent this project from being completed successfully".

Pursuing this project further, the state applied for a Pacific Northwest Regional Commission grant, awarded in May of 1976, to develop a geothermal demonstration project at the State Agricultural and Health Laboratory. In January of 1977, a contract was signed with Warm Springs Water District to supply geothermal water. After retrofit this 33,000 square foot building was placed on line in September of 1977. The Idaho Office of Energy continues to coordinate this demonstration project with CH2M HILL as the principal contractor. Several adjustments were made to the system and by the end of 1977 it was fully operational. Data on heating costs for the first four months of 1978 indicate substantial savings over the previous gas-fired system. The success of this pilot project has stimulated renewed interest in conversion of state buildings to geothermal energy, to the extent that in November of 1978 the Idaho Legislature appropriated $190,000 for retrofit of state buildings in the Capital Mall to geothermal heat.

Somewhat parallel with state efforts in the geothermal area, the City of Boise and Warm Springs Water District have fashioned a cooperative effort of their own to refurbish and expand the old Warm Springs system. This has been accomplished primarily through two ERDA grants, awarded in September of 1976 and 1977 to accomplish Phases I and II of the Boise Geothermal Energy Systems Plan. The city was awarded a Program Opportunity Notice grant in 1978 and the timetable therein calls for drilling of two production wells in the fall of 1979, with the Warm Springs well expected to be on line by September of 1980.

In February, 1979, Governor John Evans created a State Geothermal Task Force to analyze the future role of geothermal energy in the Capital Mall area and to advise as to appropriate actions to be taken. The Idaho Department of Water Resources will be concerned with regulations as they apply to geothermal leases and water rights. The State Department of Administration will deal with the procedures and actions called for by the Division of Public Works and the Bureau of Building Services in order to bring geothermal space heating into use. Finally, the Idaho Office of Energy will provide technical staff and act in an advisory capacity on the economic feasibility of using geothermal water in the Capital Mall area. The analysis carried out in this report represents the Idaho Office of Energy's contribution to the State Geothermal Task Force.

METHOD

Preliminary investigations of the geothermal potential of the downtown Boise area plus actual experience with the State Agricultural and Health Laboratory demonstration project indicate a viable geothermal resource which should be exploited as soon as possible.

Actual cost savings at the demonstration project corroborate the very quick payback period suggested by comparing retrofit costs to savings in natural gas costs, using figures from Table I.

In applying geothermal resources to space heating, two alternatives appear. Either the State of Idaho could buy water or it could establish its own system. Within each alternative several sub-alternatives appear. The state could buy water from Warm Springs Water District or from the City of Boise. In establishing its own system the state could drill and/or dispose of the spent water in several ways. The analysis that follows explores the costs associated with each sub-alternative and then compares each with the cost of the present natural gas heating system.

Table I details the characteristics of the Capital Mall area under consideration. It is comprised of seven buildings ranging from the old Capitol to the Twin Towers, still under construction. The basic data on heat rating and geothermal water requirements are based on minimum design temperature. Retrofit of these buildings has been studied extensively. The Capitol itself is already fitted with insulated pipe and ready for geothermal water when it becomes available. These Table I figures, which constitute the starting point for the analysis, are updated to reflect price change since the 1975 report in which they first appeared.

The geothermal water requirement in Table I is a peak requirement. Adjusted for the average number of degree days in Boise, the average water requirement is 346 GPM (.77 CFS).

TABLE I
Capitol Mall Area

Building	Estimated Conversion Cost	Heat Rating at Minimum Design Temperature (10^6BTU/hr)	Geothermal Water Required at Max. Heating Capacity (GPM)	Average Natural Gas Cost Per Season
1. Idaho State Capitol	$ 16,990	2.25	227	$ 18,285
2. State Veteran's Home	35,703	4.34	438	34,026
3. LBJ Office Bldg.	33,118	6.37	255	49,131
4. Idaho Supreme Court	28,563	3.72	149	29,097
5. Idaho State Library	19,329	5.10	170	39,750
6. "Hall of Mirrors" Office Bldg.	19,452	1.80	120	14,949
7. Twin Towers Office Bldg.	43,303	5.24	250	26,665
TOTALS	$196,458	28.82	1609	$211,900

Notes:

Data on buildings 1 through 6 from Table I, p. viii,"Feasibility/Conceptual Design Study for Boise Geothermal Space Heating Demonstration Project Building Modification", Donovan & Richardson, September, 1975.

Data on building 7 from State Department of Administration and Lombard, Conrad, Architects.

Conversion cost estimates have been expanded by the implicit price deflator to reflect 1979 price levels.

Fuel costs have been expanded to reflect 1979 commercial gas rates.

The average natural gas cost was estimated for each building based on average heat load factor and average number of degree days for Boise. The total natural gas cost for seven buildings at 1979 commercial gas rates was then projected over time at rates given in the Dames and Moore report. This projection, line A in Figures 1 and 2, is the benchmark against which geothermal savings are measured and rises at slightly over 8% yearly.

Analysis of Geothermal Water Purchase (see Figure 1):

The simplest alternative for geothermal use in the Capital Mall area is for the state to retrofit existing buildings and purchase geothermal water from another party, in this case either Boise City or Warm Springs Water District. Geothermal cost is made up of two parts: retrofit cost and cost of water purchased. The retrofit cost of $196,458 (see Table I) is amortized over 30 years at 10%, which gives a yearly amortization cost of $20,841. This is added to the cost of water purchase to give a total cost for each alternative.

Three possible rates were used for water purchase. The cheapest alternative would be for the state to purchase water at the rate obtaining in the contract with Warm Springs Water District for use in the Agricultural and Health Laboratory demonstration project. This contract specifies 45¢ per 100 ft.^{3} until 1980, 50¢ to 1984 and 55¢ starting in 1985. This same pattern of increase was extrapolated to 2000, giving line B^1 (Figure 1).

The Boise Geothermal Energy Systems Plan suggests rates needed to cover costs of their system based on its projected usage. One rate is suggested for a publicly-owned system, high enough to cover operating cost, depreciation, and debt service. The other rate is for a privately-owned system, which must also cover taxes and a profit (10% return on capital). The public rate starts at 87.8¢ per 100 ft.^{3}, rising to a peak of $1.23 in 1996, and falling after debt service is paid off to 93.2¢ in 2000. This water purchase alternative appears as line B^2 (Figure 1). The private rate starts at $2.40 per 100 ft.^{3} and ascends continuously to $3.63 in 2000. This private rate results in the cost shown as line B^3 (Figure 1).

From Figure 1, it is obvious that purchase at the Warm Springs rate is already competitive with use of natural gas. However, that rate was negotiated several years ago in a different economic climate and is probably unrealistically low. Point X_1 indicates the option of water purchase at Boise public rates will be competitive with gas as soon as that water is actually available for use. Point X_2 indicates that it will be a long while before purchase at Boise private rates will be competitive with present natural gas heating.

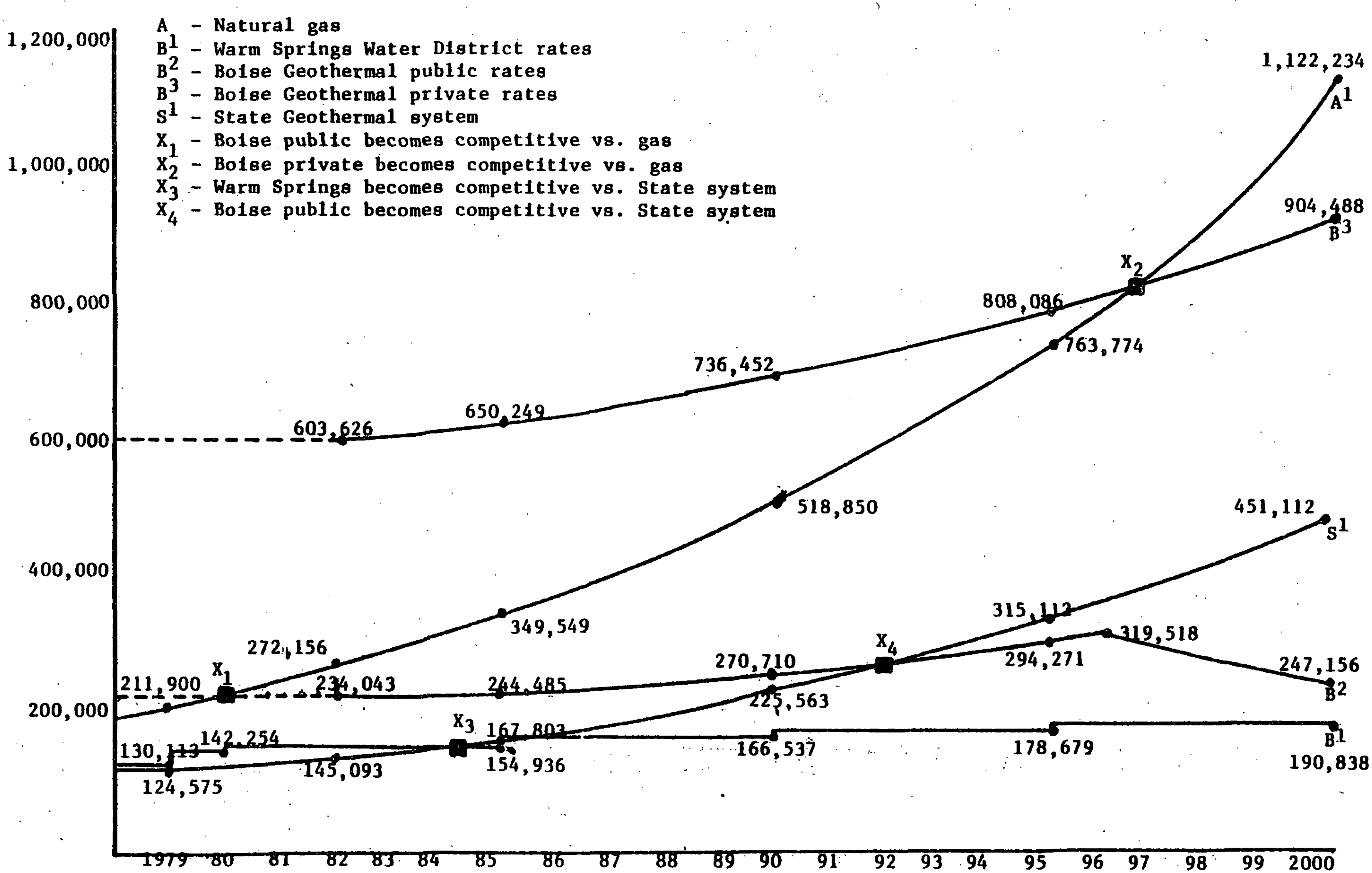
Analysis of State Geothermal System (see Figure 2):

If the State of Idaho cannot or does not wish to purchase geothermal water from other sources, the obvious alternative is to establish a state geothermal system. The cost of the system will be made up of individual cost components for drilling, pumping, and constructing a distribution system for production and in some cases for injection, plus the cost for retrofit of the seven Capital Mall buildings under consideration.

Three alternatives were considered. The differences between them were based on disposal of used water. The first two alternatives differ only in the distance from the production well at which injection is accomplished. The third alternative involves payment of a disposal fee.

FIGURE 1

Yearly Heating Cost
Natural Gas vs. Geothermal Water Purchase



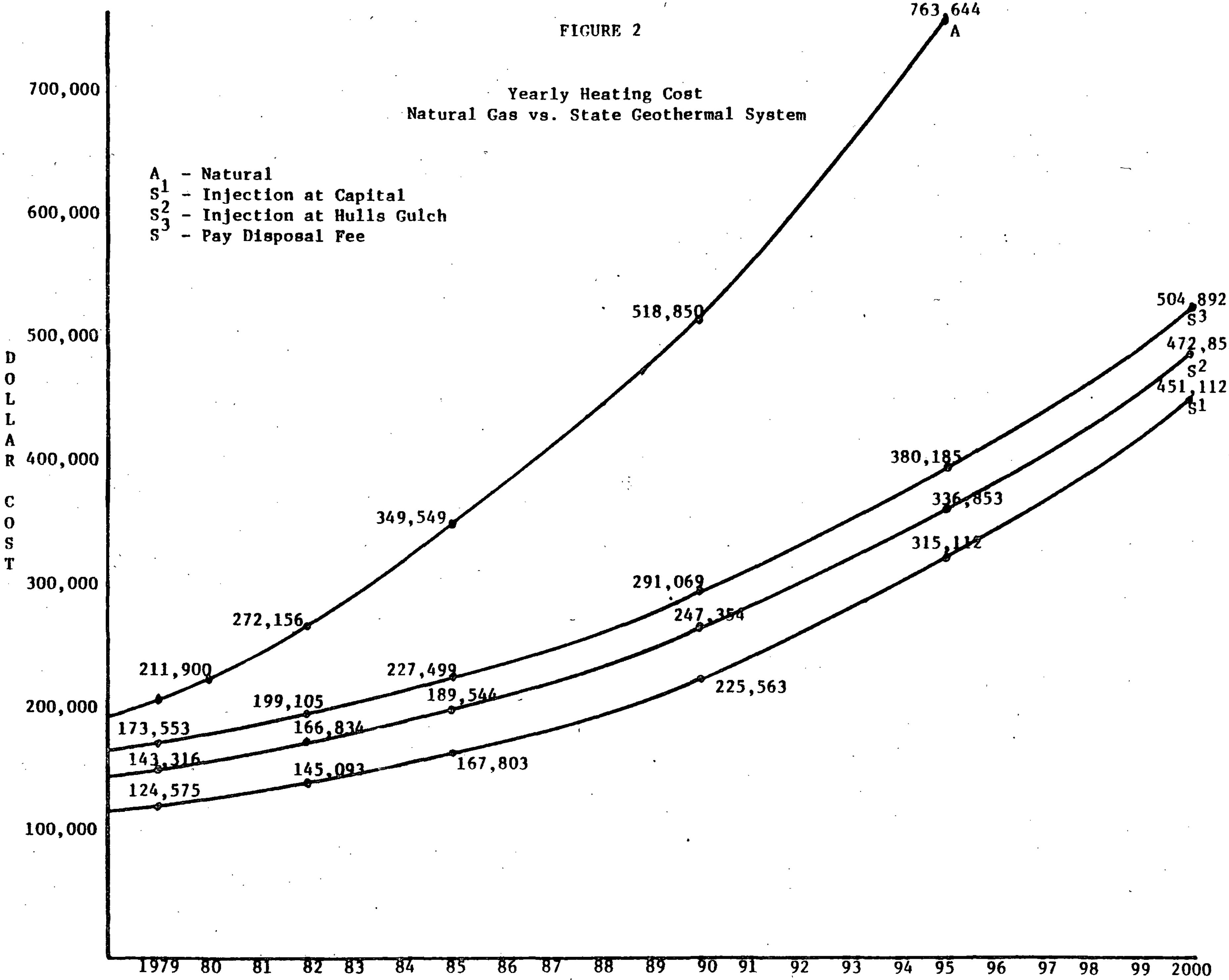


FIGURE 2
Yearly Heating Cost
Natural Gas vs. State Geothermal System
A - Natural
S1 - Injection at Capital
S2 - Injection at Hulls Gulch
S3 - Pay Disposal Fee
DOLLAR COST
700,000
600,000
500,000
400,000
300,000
200,000
100,000
1979
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
2000
763,644
A
518,850
349,549
272,156
211,900
504,892
S3
472,853
S2
451,112
S1
380,185
336,853
315,112
291,069
247,354
227,499
225,563
199,105
189,544
173,553
166,834
143,316
145,093
167,803
124,575

The production and distribution set-up is identical for all three alternatives. A 1500-foot production well, fully cased and tapering from 18" to 8", is to be drilled on state property near the Veterans Administration Hospital. The well will be equipped with a 275 hp. pump and hooked up to 3000 feet of 10" pipe which will carry geothermal water (about 170°F.) to the central heating plant in the Capital Mall. The total cost of these systems is $267,482. Table II presents a comprehensive summary of cost breakdown for all three alternatives.

The first alternative consists in drilling a shallow (600 ft.) injection well, either right next to the central heating plant or just across the street. This will require a minimal amount of pipe to get the spent fluids to the disposal well. Lacking more specific well test data it was assumed that injection would require the same pump and power as the production well. This alternative is S^1 in Figure 2.

The second alternative is to pipe the spent fluid to the Hull's Gulch area and drill a 1,000 foot injection well there. This will require 6,000 ft. of 10" pipe to carry spent water to Hull's Gulch. Again, pump and power costs are assumed to be the same as for the production well. This alternative is S^2 in Figure 2.

The last alternative is to have the State pay a disposal fee rather than constructing its own disposal system. Disposal of State water in the Boise City-Warm Springs Water District lines would be feasible since one of their disposal lines is planned to go right past the central heat plant but at this time we can hazard no guess on what sort of fee they might charge for disposal. As a high-side estimate of what a disposal fee might be we have used the minimum

TABLE II

Costs of State Geothermal System

		Capital Well Injection (S^1)		Hull's Gulch Injection (S^2)		Disposal Fee (S^1)
PRODUCTION:		$141,540		$141,540		$141,540
Drill and case well	$104,540					
Pump and fixtures	37,000					
DISTRIBUTION:		125,942		125,942		125,942
Pipe	90,000					
Power cost	35,942					
DISPOSAL:		106,950		313,470		92,395
Drill and case well	34,008		$ 60,528			
Pump and fixtures	37,000		37,000			
Power cost	35,942		35,942			
Return pipe	minimal		180,000			
Disposal fee					$ 92,395	
Total cost		$374,432		$580,952		$359,877
- Variable		-71,884		-71,884		-128,337
Capital cost		302,548		509,068		231,540
Amortized over 30 yrs. at 10%		31,850		53,591		24,375

Costs assembled from a variety of sources, including Boise Geothermal Energy Systems Plan, Geothermal Energy for Agri-Business, in consultation with CH2M Hill.

city sewer charge of 38¢ per 100 ft.^{3}, which gives a total cost of $92,395 for disposal of state geothermal water. This alternative is shown as S^3 in Figure 2.

Figure 2 shows yearly heating cost for the alternative state systems compared to natural gas. Natural gas cost is derived identically as in Figure 1. Various state geothermal system alternatives (S^1, S^2, S^3) are derived by adding pump power costs (escalating at rates given by Dames and Moore) to amortized capital costs for each system. The interpretation of Figure 2 is fairly simple. All three alternatives for a state geothermal system are, and will continue to be, competitive with use of natural gas for heating. The best alternative is disposal at the Capital Mall (S^1), then disposal at Hull's Gulch (S^2), finally payment of a disposal fee (S^3).

SUMMARY AND CONCLUSIONS

(See Figure I and Tables III, IV, V)

Data on all alternatives available to the State are cumulated and converted to dollars per therm in Table III. This table is based on the same data used for Figures 1 and 2, yet presented in a different form. In Table III all three alternatives for a state geothermal system are projected to be competitive (lower-priced) with natural gas beginning as soon as wells can be drilled and the new system put on line. As for water purchase, the Warm Springs rate seems unbelievably low. The Boise private rate results in higher prices per therm than natural gas until sometime in the late 1990s. Water purchase at the Boise public rate results in lower heating cost than natural gas by 1982.

Tables IV and V present figures used to make a choice between the two best alternatives, a state geothermal system with injection near the Capitol (S^1) and purchase of geothermal water at the Boise public rate (B^2). Alternative S^2 was excluded from this final choice because its savings were identical to S^1 while its initial capital investment was much higher due to injection at considerable distance from the Capitol.

Let it be noted that the choice between alternatives S^1 and B^2 is made on the basis of <u>projected</u> values for both projects. <u>If</u> Boise Geothermal can supply hot water at the projected price of 87.8¢ per 100 ft^2 and <u>if</u> the state can secure legal rights to actually drill its own well, then the state should buy water at the above noted price.

Each of these two alternatives is based on a possible view of the future. Because it is in the future, the actual costs for each will change. Detailed analysis of the two alternatives indicates

TABLE III

COMPARISON OF FUEL ALTERNATIVES
FOR CAPITAL MALL, in $/therm

Reference to Figs. 1 and 2	1979	1982	1985	1990	1995	2000	
A - Gas	$.274	$.352	$.452	$.671	$.988	$1.451	
B[1] - WSWD	.172	.188	.204	.220	.236	.252	
B[2] - B. Pub.	.309	.309	.323	.357	.409	.326	
B[3] - B. Pvt.	.797	.797	.858	.972	1.067	1.194	
S[1] - Dispose Capital	.164	.192	.221	.298	.416	.596	
S[2] - Dispose Hull's Gulch	.193	.220	.250	.327	.445	.624	
S[3] - Pay Fee	.227	.244	.259	.298	.358	.449	Disposal fee fixed
	Hypothetical prices since systems are not on line	.263	.300	.384	.502	.666	Disposal fee rises 5%

A - 1979 commercial gas rate increased by Dames and Moore projections
(8.7% - 1986)
(8.1% 1987-1992)
(8.0% 1993-2000)

B's - Dollars for geothermal water purchased plus amortized conversion cost divided by 757,621 therms (24,282,720 ft.^{3}) average usage for system

S's - Electric power purchased plus amortized capital cost of system (pump, distribution and injection) divided by average usage

TABLE IV

Projected Yearly Savings for Capital Mall

	Gas Costs (1)	(B^2) Water Purchase Boise Public (2)	Yearly Savings (1)-(2)	Present Value at 20% (3)	(S^1) State System Power Costs (4)	Yearly Savings (1)-(4)	Present Value at 20% (5)
1979	$211,900	-	-	-	$ 71,884	$140,016	$116,680
1980	230,335	-	-	-	78,569	151,766	105,393
1981	250,473	-	-	-	85,826	164,498	95,196
1982	272,156	$213,202	$ 58,954	$ 49,128	92,402	179,754	86,687
1983	295,834	216,359	79,475	55,191	99,425	196,409	78,932
1984	321,572	220,001	101,571	58,780	106,981	214,591	71,866
1985	349,549	223,644	125,905	60,718	115,112	234,437	65,427
1986	379,960	228,257	151,703	60,966	123,860	256,100	59,561
1987	410,737	231,171	179,566	60,136	134,636	276,101	53,510
1988	440,007	238,213	205,794	57,433	146,349	297,658	48,073
1989	479,972	243,798	236,174	54,927	159,082	310,890	41,842
1990	518,850	249,869	268,981	52,130	172,922	345,928	38,798
1991	560,877	256,425	304,452	49,171	187,966	372,911	34,854
1992	606,308	263,710	342,598	46,110	204,319	401,989	31,309
1993	654,813	271,481	383,332	42,993	222,095	432,718	28,086
1994	707,198	279,737	427,461	39,952	241,417	465,781	25,193
1995	763,774	288,964	474,910	36,989	262,421	501,353	22,598
1996	824,876	298,677	526,199	34,153	285,251	539,625	20,269
1997	890,866	186,491	704,375	38,098	310,067	580,799	18,180
1998	962,135	198,147	763,988	34,435	337,043	625,092	16,304
1999	1,039,106	210,531	820,575	31,122	366,366	672,740	14,623
2000	1,122,234	226,315	895,919	28,043	398,421	723,813	13,111
				$890,475 Net Present Value			$1,086,492 Net Present Value

TABLE V

	Water Purchase at Boise public rate (B^2)	State Geothermal System Capital Injection (S^1)
Net present value of yearly savings discounted at 20%	$890,475	$1,086,492
Capital investment:		
Retrofit cost	$196,458	$196,458
Well system		302,548
	$196,458	$499,006
Present value payback period	3.55 years	5.22 years
Internal rate of return	52.88%	36.53%
Internal rate of return with gas cost cut 10% and geothermal cost raised 10%	35.94%	30.65%

two very basic differences. First, Boise Geothermal's total yearly cost is made up of only 20% operating cost (of which only 9.6% is pumping cost), with the rest going for debt service and depreciation. For the projected state system however, operating cost (which is entirely pumping cost) makes up 58% of total cost, the remainder being amortized capital and retrofit costs. This means that the S^1 curve must necessarily rise much faster than the B^2 curve.

Second, the state system power costs are based on a single pump big enough to handle peak flow requirements but often running at considerably below that rate. This means pumping costs are considerably above the minimum which could be achieved with a more ideal system. The Boise figures for pumping costs are considerably lower since their system, with an array of pumps, allows more efficient pumping through fitting the number and sizes of pumps to be used to the water demand at a given time.

Table IV calculates savings from the two final alternatives and discounts those annual savings at a 20% rate to generate the present value of those savings flows. In each case, yearly savings represent the difference between yearly operating costs for the present gas system and yearly operating costs for the geothermal alternative. In the case of alternative B^2, the operating cost is the cost of water purchased at Boise public rates. In the case of alternative S^1, operating cost is the cost of electric power required for pumps to lift and later inject the geothermal water from state wells.

Maintenance costs have been omitted from specific inclusion since we feel there will be little marginal change in the expense of maintaining a geothermal system as opposed to the existing state gas-fired system.

Table V is the result of calculations based on Table IVs yearly savings and present value figures. Yearly present values were combined to give a net present value figure. While the net present value of the savings stream from alternative B^2 is less than that for alternative S^1, when we take into account the total capital investment required, we find that savings streams from B^2 will pay back the original investment in only 3.55 years versus 5.22 years for alternative S^1.

Finally, we calculated an internal rate of return which is a rate of interest which would make the value of the discounted yearly savings just equal to the original capital investment. Higher internal rates of return indicate higher yield investment opportunities. This internal rate of return was considerably higher for B^2 than for S^1. To explore quickly the sensitivity of our analysis to higher or lower savings than projected, we cut the projected gas costs by 10% while raising the cost of the two geothermal alternatives by 10%. This considerably worsens the yearly savings from each alternative, yet it leaves them both with internal rates of return over 30%.

Table V summarizes neatly the reasons for our choice of water purchase at Boise public rates, alternative B^2, as the best alternative for utilizing geothermal heat in the Capital Mall. This water purchase option generates a significant amount of yearly cash savings from a rather small initial investment in retrofit of seven state buildings. The payback period, even in terms of present value savings flows, is short and the internal rate of return is very high.

The State of Idaho would use its funds wisely in pursuing the transition to geothermal heat in the Capital Mall by purchasing water.

DISCUSSION OF ECONOMIC ANALYSIS

The previous analysis concluded that the best of the six geothermal alternatives available to the State of Idaho was to buy geothermal water at the Boise Geothermal public price of 87.8¢ per 100 ft.^{3}. In other words, over the years until 2000 paying that much for geothermal water was the cheapest way to heat the seven Capital Mall buildings under consideration.

However, the 87.8¢ per 100 ft.^{3} is merely an average price needed to enable the proposed Boise public system to cover all its costs for operations and debt service and depreciation. The Boise Geothermal Energy Systems Plan does not have a specific rate structure proposed. It has stopped short, leaving only that average cost figure of 87.8¢ per 100 ft.^{3} and making some general points about things to consider in setting up specific rates for specific customers.

What this means is that there is much room for negotiation about specific rates which might be paid by the State of Idaho for use in the Capital Mall. Boise Geothermal knows in a general sort of way what it must get for each 100 ft.^{3} of water to cover its costs. The State of Idaho knows that the average cost figure presented, 87.8¢, is an economically attractive price as it stands.

What the state needs to know is whether that 87.8¢ is the best possible price that Boise Geothermal would be willing to offer.

The Boise Geothermal report indicates that about $1.40 per 100 ft.^{3}, a rate which would equate the price per therm for geothermal water and natural gas, is probably the most they could sell geothermal water for. They also indicate that the 87.8¢ already referred to is the minimum price they need to cover costs.

The State of Idaho's position, based on the analysis in this report, is that about 99¢ per 100 ft.^{3} is the most it could pay for geothermal water and still pay less than for heating with natural gas. While there is no minimum amount the state should pay, one might easily suggest the 55¢ per 100 ft.^{3} rate now in the state contract with Warm Springs Water District as a practical minimum. Figures from the best state system, alternative S^1 in the report, indicate the State could provide water at about 60¢ per 100 ft.^{3} initially.

We believe that the State should push for the lower range of its bargaining position (60¢ → 99¢) for two reasons. First the state represents a potential first and biggest customer to any proposed system. The state already has retrofit money approved by the legislature and should be ready to purchase water immediately as it becomes available. The demonstration effect of successful heating of state buildings should provide examples of the technical practicality and financial savings of conversion to geothermal energy. All this should combine to create additional customer demand for the Boise Geothermal System.

Second, we believe that Boise Geothermal might be able to offer the State a lower rate since the subsidy issue is not relevant. Much discussion in the Boise Geothermal report centered on the need to cover all costs to make sure that no group of taxpayers was subsidizing another group through rates which failed to cover all costs of the system. Savings achieved by the State through conversion to geothermal represent a subsidy, lower costs of State government, which is to the benefit of all taxpayers.

Another way to approach the Boise Geothermal price is to examine their analysis in greater detail, specifically to decide whether their cost projections are supportable. Possible changes in their costs will show up in the possibility of lower prices.

One specific suggestion is to extend the debt service cost from 15 years to 30 years to allocate that cost more realistically over the life of the project. Such a change, which might cause cash flow problems in the first few years, would reduce debt service from $682,000 per year to about $530,000, resulting in a decline in average cost per 100 ft.^{3} from 87.8¢ to 76.5¢, a 13 percent decline.

Boise Geothermal included retrofit costs, for 4 state buildings and 6 private buildings, in the overall project cost. While it is possible to include retrofits and charge for them in the water rates, since we have used retrofit costs in our analysis of a state system we might delete them from Boise Geothermal's costs. Taking out all retrofit costs reduces the amount to be financed by $794,000 and cuts yearly debt service to $580,000, resulting in a decline in costs from 87.8¢ to 84.7¢ per 100 ft.^{3}.

Another possibility for reducing cost would be to cut out depreciation, $256,000 per year. This would result in a decline in cost from 87.8¢ to 68.8¢ per 100 ft.^{3}. However, in later years it would leave the burden of replacement of the system entirely on users at that time.

A closer look at pumping costs, still to be undertaken, offers little hope for significant savings since energy cost represents only 9.7% of yearly costs for Boise Geothermal.

Changing the debt service to 30 years, excluding retrofit costs and cutting out depreciation, if all pursued together, have the potential of reducing the Boise Geothermal public cost from 87.8¢ to the vicinity of 50¢ per 100 ft.^{3}. These major changes all need to be examined more closely as to their actual feasibility. (Even a cut in cost from the 87.8¢ to 75¢ would result in roughly a 50 percent increase in savings for the State.)

What is needed at this juncture is detailed negotiations between the State of Idaho and representatives of Boise Geothermal to determine which of these changes are feasible as ways of reducing the cost to the State of purchasing water from Boise Geothermal.

There is a wide range of possible rates below 87.8¢. It is in the State's interest to reduce that rate as far as possible. However, further discussion and careful analysis is required before specifying a price which is right for both parties. Also, it is in the interest of both parties to keep the cost for buying geothermal water to its minimum level.

TIME PHASE PROJECT PLAN

INTRODUCTION

The function of the time phase project plan is twofold. 1) The plan shows the complexity of historical actions which have brought the Boise Geothermal Project to its present state. 2) The plan also shows what tasks must be completed and the projected timetable for the tasks necessary for the Boise Geothermal Project to come on line by the 1983 completion date.

HISTORICAL TASK TRACKING

The development of geothermal resources in the Boise area occurred as early as 1890. The Warm Springs Water District geothermal heating system has been continuously providing geothermal heat to as many as 400 customers since the turn of the century. The historical chronology presented in this report does not attempt to show all the history of geothermal development in Boise. The tasks that are discussed are the principal management tasks that have occurred since 1973. In 1973, a resurgence of interest in geothermal development occurred with the advent of rising energy prices.

The historical chronology begins with then-Governor Andrus requesting aid from the Energy Research and Development Administration to determine the feasibility of supplying the State Capital Mall with geothermal fluids for space heating. The Idaho National Engineering Laboratory completed a design and cost analysis study on retrofitting the Capital Mall and conducted exploration drilling in the Military Reserve Park area. The resulting report to the Governor concluded that no major resource or engineering difficulties exist that would prevent the project from being completed. The report did recommend further research through a demonstration project.

Governor Andrus then obtained funds from the Pacific Northwest Regional Commission for a demonstration project. The PNRC project has resulted in two major state office buildings, the Idaho Agriculture Health Laboratory and the Department of Agriculture Building, being successfully heated with geothermal heat. A third building, the Labor and Industrial Services Building, is currently being studied for retrofit to geothermal heat under the PNRC sponsored program.

The original INEL study also stimulated involvement of the City of Boise which conducted two years of development study and planning under grants from the Energy Research and Development Administration. These studies resulted in a joint application by the Warm Springs Water District and the City of Boise for a grant from the Federal Department of Energy to cost share an extensive expansion of the geothermal district heating system. The new Boise geothermal project would heat the Capital Mall, the Central Business District and expand the residential system. Appendix A lists the historical and projected tasks that are necessary for a successful completion of this project. Figure 3 displays these tasks as a function of time and shows the interconnections between the various tasks.

PROJECTED TASK TRACKING

A number of institutional and logistical tasks will be necessary over the next three years in order to complete the geothermal project by the projected 1983 date. Three major development activities must

FIGURE 3

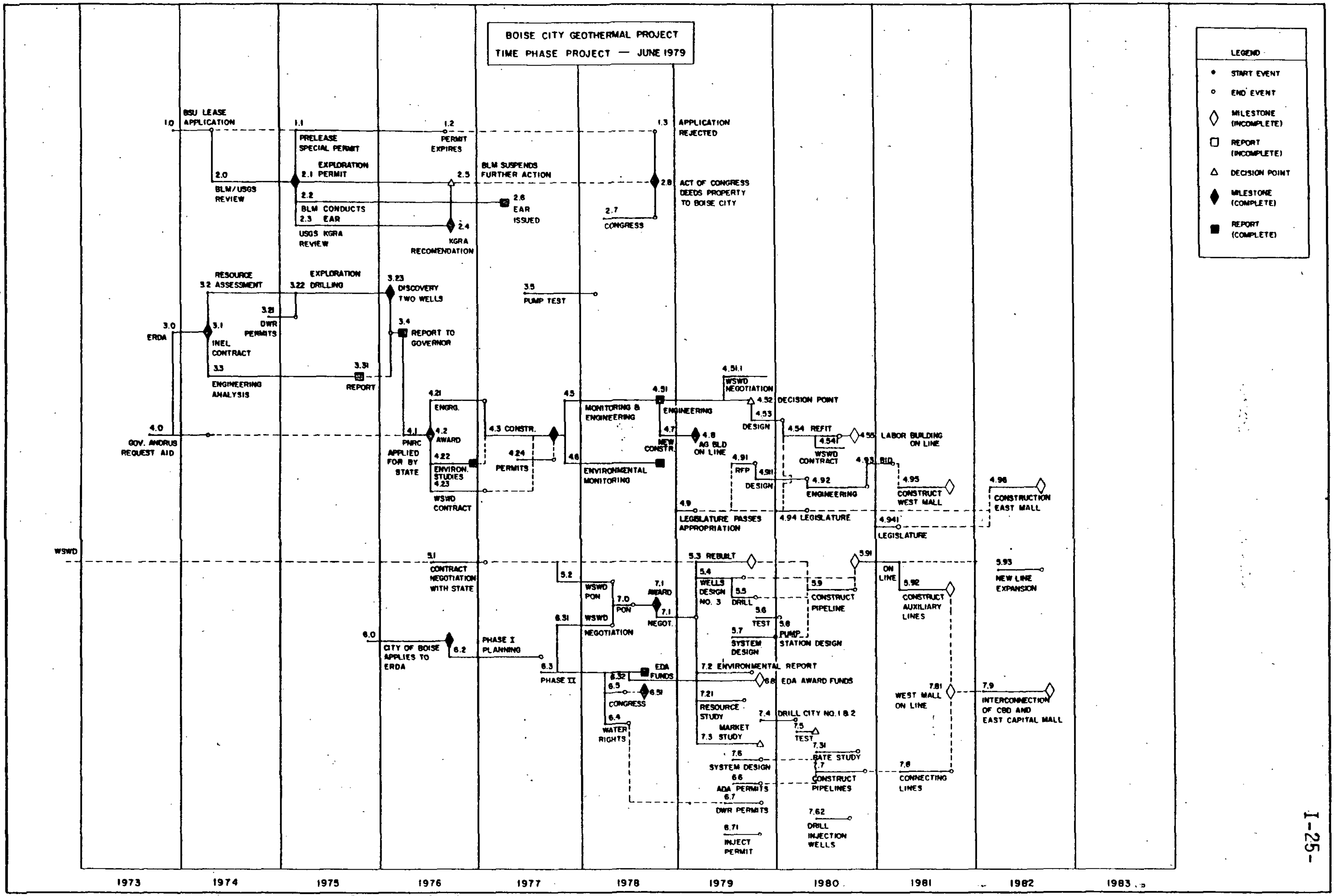


FIGURE 3

occur in a parallel sequence between now and 1983: 1) The retrofit of the Capital Mall, 2) The rebuilding of the Warm Springs Water District System, and 3) The construction of the Boise City geothermal system.

Capital Mall Retrofit:

The State of Idaho first initiated a program to assess the geothermal heating potential in 1973. The initial studies resulted in two exploration wells, a retrofit engineering study and a pilot demonstration. The completion of the Capital Mall geothermal project depends upon the timeliness of the construction process over the next three years.

In February, 1979, the Idaho Legislature appropriated $190,000 to retrofit the Capital Mall to geothermal heat. In order for the retrofit to begin by 1981, the State must start its administrative procedures by October, 1979. The first major action by the State would be a request for proposals to complete the necessary systems engineering. This will require the approval of the Permanent Building Fund. This action could take up to four months to complete. The actual engineering and systems design could be completed within eight months of the contract date. A major result of this study will be a more exacting cost estimate.

With a more definitive cost estimate, the Department of Administration, Division of Public Works, could, if necessary, request additional funds from the Permanent Building Fund for the Capital Mall Retrofit. This action would require legislative approval. The engineering and cost estimate study must be completed by October, 1980, in order for additional funding requests to be included in the 1981 budget appropriation.

The actual retrofit construction must occur during the warmer spring and summer months. The construction period should occur sometime between April and November, 1981. Because of the size of the project and the design of the present heating system, it is realistic that only half of the Capital Mall would be retrofitted during the 1981 construction season. The remaining buildings would be retrofitted during the 1982 construction season. This would bring the entire Capital Mall "on-line" during the 1982-83 heating season.

The projected cost of heating the Capital Mall with natural gas for 1982 is $272,156. The estimated operation cost for the geothermal heating system for the same period at $.878/100 cf. of water is $213,202. When the amortized retrofit cost of $20,841 is included, the yearly cost savings to the State is estimated at $38,113.

By retrofitting to geothermal heat, approximately 774,036,000 cubic feet of natural gas per year will be conserved. This is equal to 13,362 barrels of oil per year or the water and space heating needs of approximately 500 homes in Idaho. By the year 2001, natural gas savings will have totaled 14.7 billion cubic feet of gas which is equal to 253.4 million barrels of oil.

Warm Springs Water District Rehabilitation:

The Warm Springs Water District owns its facilities. These include the two existing geothermal wells, pumps, associated controls, geothermal pipeline, valves and distribution piping. Major portions of this system are over forty years old. The entire system will be rehabilitated over the next three year period. The rehabilitation program will include refurbishing the existing wells and pumps and replacing the present main transmission line.

The rehabilitation of the Warm Springs Water District will begin with the rebuilding of the current production wells and the drilling of a third production well. Refurbishing and expanding the Warm Springs Water District wells is projected to occur in the summer months of 1979. The new wells should be on line by October, 1979, in time for the heating season. Construction of the new pipeline will begin the following spring in April of 1980. This activity must be completed by October, 1980, in time for the heating season. Rehabilitation of auxiliary lines and construction of new expansion is expected to occur during the summer months of 1981 and 1982.

Boise City Geothermal System:

The unified development of the Boise geothermal resources will include the development of a new well field and distribution system by the City of Boise. Development of this system should occur in parallel with the retrofit of the Capital Mall and the rehabilitation of the Warm Springs Water District. It is the city geothermal system which is projected to deliver thermal water to the Capital Mall. The timeliness of the Capital Mall retrofit is based on the projected construction schedule of the Boise City Geothermal System.

The construction of the Boise City geothermal system will begin in the fall of 1979 with the drilling of two production wells. The production drilling is projected to occur between November, 1979 and March, 1980. This drilling activity should begin as soon as the Warm Springs Water District drilling is completed in October, 1979.

This will allow for continued operation of the drilling rig without interruption which will keep mobilization cost to a minimum. The drilling of injection wells for a disposal system is projected to begin in April, 1980, as soon as the drilling equipment is available from the production drilling phase. The disposal wells will serve both the Warm Springs Water District and Boise City geothermal systems.

Pipeline construction is projected to occur in two phases. The first phase will involve the construction of the pump station and main service line to the Capital Mall and the Central Business District. This phase is expected to begin by June 1980 and continue through November 1980 when winter weather could slow construction. The second phase of construction is projected for the spring of 1981. Construction should begin by March 1981 and be completed by October 1981. Phase II construction will include connecting buildings to the system and interconnecting the Boise mainlines and disposal lines with the Warm Springs Water District lines. The combined mainlines would serve the Central Business District. Waste water pipelines from both systems are interconnected to common disposal wells.

Critical Parallel Task:

A timely unified development of a Boise geothermal district heating system depends upon parallel completion of several critical tasks by the State of Idaho, the City of Boise and the Warm Springs Water District. Critical to the timetable for retrofit of the Capital Mall is the expected delivery date of the Boise City geothermal system. The state could begin the engineering and construction process as early as October, 1979. The incentive for an aggressive retrofit program by the State is an early target date for delivery of geothermal water. Based on a projected delivery date of summer 1981, the State must begin bid request for engineering by October, 1979, in order for retrofit construction to be completed by the delivery date.

Critical to the timely completion of both the Warm Springs Water District and Boise City geothermal projects is the coordinated planning of drilling activities. Drilling activities should be scheduled such that when drilling has been completed at one site, the rig can be immediately moved to the next location.

The Warm Springs Water District wells are projected to be refurbished first. Drilling activity at the District's well field must occur during the summer months to minimize the inconvenience to present customers of the District. A third production well will be drilled after the old production wells are refurbished. Drilling by Warm Springs Water District should be completed by November, 1979.

Upon completion of drilling at the District's well field, the drill rig could then be moved to the site of the Boise City well field. Drilling at this site could continue through the winter. Successful completion of the Boise City wells should occur by March or April, 1980. The drilling would then be moved to the site of the injection wells. Completion of at least one injection well must occur by September, 1980, in order to inject fluids from the refurbished Warm Springs Water District system.

The projected drilling program calls for drilling three new production wells, the refurbishing of two current wells, and drilling two injection wells at three well field locations over an 18 month period. Well depths of approximately 1,500 feet are anticipated for production wells and 1,000 feet for injection wells. Planned coordination of the drilling program will reduce cost due to delays and reduce the mobilization and demobilization cost of drilling.

REFERENCES

Agribusiness Geothermal Energy Utilization Potential of Klamath and Western Snake River Basins, Oregon.

"Drilling for Geothermal Resources. Rules & Regs.". Idaho Dept. of Water Resources, June, 1978.

"Feasibility/Conceptual Design Study for Boise Geothermal Space Heating Demonstration Project Building Modifications." L.E. Donovan & A.S. Richardson,Aerojet Nuclear, September, 1975.

"Feasibility Review for Geothermal Conversion of Existing H & V Systems on the Boise Geothermal Space Heating Project." L.D. Torgerson, A.S. Richardson, Aerojet Nuclear Co., September, 1975.

Geothermal Energy.
H. Christopher, H. Armstead,
E. & F.N. Spon Ltd., London, 1978.

"Geothermal Energy Systems Plan for Boise City". Energy Office, Boise City, January, 1979.

"Geothermal Space Heating Project Involving Idaho State Owned Buildings in Boise, Idaho." Aerojet Nuclear Co., March 10, 1975.

"Natural Gas Supply Requirements for the State of Idaho". Dames & Moore, San Francisco, November, 1977.

"Preliminary Plan for Boise Geothermal Energy System". City of Boise Energy Task Force, April, 1977.

"Report to the Idaho Governor - Project Summary for the Boise Space Heating Project". R.C. Schmitt, L.E. Donovan, S.G. Spencer, J.G. Kelly, R.C. Stoker, April, 1976.

"Well Construction Standards Rules & Regs., Idaho Dept. of Water Resources", June, 1978.

PERSONAL COMMUNICATIONS

Stephen Allred, Director, Idaho Department of Water Resources, March, 1979.

John Austin, Principal Engineer, Boise Geothermal Project, CH2M-HILL Engineering, March, 1979.

Robert Griffiths, Consulting Engineer, Warm Springs Water District, March, 1979.

Ken Hall, Administrator, Division of Public Works, State of Idaho, April, 1979.

Phil Hanson, Director, Boise Geothermal Project, April, 1979.

Nathan Little, Engineer, Boise Geothermal Project, CH2M-HILL, April, 1979.

Mike Merz, Consultant Economist, Boise Geothermal Project, Boise State University, May, 1979.

Dorothy Mott, Secretary, Warm Springs Water District, April, 1979.

Lee Post, Boise City Energy Office, April, 1979.

Rich Trembley, Research Analysis, Department of Administration, State of Idaho, June, 1979.

APPENDIX A

BOISE TIME PHASE PROJECT PLAN

GEOTHERMAL PROJECT TRACKING
CHRONOLOGY

Boise State Lease Application Activities

1.0 Boise State University prepares lease application for Military Reserve Park 12/73; application filed 3/29/74.

1.1 BLM issues BSU a special land use permit for exploration drilling 3/75.

1.2 BSU Special Land Use Permit expires 8/76.

1.3 Act of Congress deeds property to City of Boise. All further lease application action terminated 10/78.

BLM Activities

2.0 BLM receives Boise State University Geothermal Lease Application for Boise Barrack Property 3/29/74. Begins lease review process with U.S.G.S.

2.1 BLM issues Special Land Use Permit to BSU for exploration drilling 3/75.

2.2 BLM begins environmental review of lease area 3/75.

2.3 USGS begins KGRA review 3/75.

2.4 USGS recommends Fort Boise Barracks as a KGRA 10/76.

2.5 BLM suspends consideration of BSU lease application until ERDA/BSU drilling and reservoir testing program is completed 10/76.

2.6 BLM issues EAR for BSU lease application 3/77.

2.7 Senator Church, at Boise City's request, introduces legislation to transfer ownership of Ft. Boise geothermal rights to the City. 4/78

2.8 Congress deeds mineral and geothermal rights to Military Reserve Park and Boise Barracks to City of Boise, terminating any further Dept. of Interior action 10/78.

ERDA/DOE Activities

3.0 ERDA receives request from Governor Cecil Andrus for assistance in assessing the potential for geothermal resource development in Boise to heat the Capitol Mall and Boise State University 11/73.

3.1 ERDA awards INEL contract to provide resource exploration and engineering studies 3/74 cooperative with BSU.

3.2 Resource Assessment begins, geophysical surveys 3/74.

3.21 Drilling Permits applied for 11/74.

3.21.1 Drilling and special use permits acquired 3/75.

3.22 Exploration drilling begins 3/75.

3.23 Exploration drilling ends, permits expire, two wells successfully completed, 350 meter 170^{o}F. 3/76.

3.3 Engineering Assessment by INEL of Capitol Mall and BSU begins 3/74.

3.31 INEL issues engineering feasibility report on geothermal heating the Capitol Mall and Boise State University 10/75.

3.4 Final report to Governor Cecil Andrus, recommends further study through demonstrated use. 4/76.

3.5 Pump test by INEL of Beard and BLM wells 3/78.

State of Idaho Activities

4.0 Governor Cecil Andrus creates the Idaho Office of Energy and requests aid of ERDA in assessing the geothermal potential of Boise for spaceheating the Capitol Mall and Boise State University 11/73.

4.1 Governor Andrus/Idaho Office of Energy apply to PNRC for funds to convert the State of Idaho Agriculture and Health Laboratory to geothermal heat using existing Warm Springs Water District geothermal heat 4/76.

4.2 PNRC awards Idaho Office of Energy a $300,000 grant to retrofit the Ag-Health Lab and continue engineering and environmental studies 6/76.

4.21 Idaho Office of Energy awards CH2M-HILL contract for engineering design and studies 6/76.

4.22 Idaho Department of Water Resources and CH2M-Hill begin an environmental review of water disposal problems report issued 12/76.

4.23 Negotiate Water Contract with Warm Springs Water District for 400 gpm maximum interceptable flow at $.45/100 cf., for first two years. Price can then rise to $.50/100 cf. until 1980 and rise to $.55/100 cf. after 1985. 7/76 thru 2/77.

4.24 Disposal permits obtained from Idaho Department of Health and Welfare, Division of Environment, and U.S. Army Corps of Engineers for surface disposal in the Boise River. Action begins 4/77, end 12/77

4.3 Construction of Heating System begins 2/77.

4.4 Ag-Health Lab put on geothermal system 9/77.

4.5 Continued Engineering Design for new Department of Agriculture Office Building next to the Ag-Health Lab. System design for geothermal heating by CH2M-HILL.

The new office building will use the same heat exchanger as Ag-Health Lab. Also monitoring of system and instrumentation design by University of Idaho Chemical Engineering Department 9/77.

State of Idaho Activities (Continued)

4.51 Report on first year's monitoring and engineering design completed on new Department of Agriculture Office Building 10/78.

4.51.1 Continued Engineering Studies and systems design and monitoring. Retrofit studies of Labor and Industrial Services Building 10/78 thru 10/79.

4.51.2 Negotiation with Warm Springs Water District for a firm 50 gpm to heat Health Lab and Department of Agriculture Office Building.

4.52 Report on 78-79 year and recommendations regarding geothermal retrofit of Labor and Industrial Services Building. Report issued 10/79.

4.53 Engineering design of geothermal conversion of the Labor and Industrial Services Building. 10/79 thru 1/80.

4.54 Installation of geothermal heating system at the Labor and Industrial Services Building 2/80 thru 7/80.

4.54.1 Contract negotiations with WSWD for additional firm supply for the Labor and Industrial Services Building.

4.55 Labor and Industrial Services Building is connected to the new Warm Springs Water District mainline. Building goes on geothermal heat 10/80.

4.6 Environmental Monitoring program to analyze discharge of thermal water is established by Idaho Office of Energy and Boise State University 9/77.

4.61 Report Issued 10/78 (No environmental problem indicated).

4.7 Construction of new Department of Agriculture Office Building begins 10/78.

4.8 Idaho Department of Agriculture Office Building goes on geothermal heat 4/79.

4.9 Idaho State Legislature passes $190,000 appropriation to retrofit State buildings to geothermal heat 2/79.

State of Idaho Activities (Continued)

4.91 Engineering Design and cost estimate for geothermal heating system at the Capitol Mall. RFP for Systems Engineering. Building Fund Committee approval 10/79.

4.92 Engineering of heating system begins 2/80 ends 10/80.

4.93 Construction bids are requested and evaluated 11/80 thru 1/81.

4.94 The Department of Administration, Division of Public Works, request additional funds from the Permanent Building Fund for the Capitol Mall retrofit (if necessary) 1/81 thru 3/81. Legislative approval necessary.

4.95 Retrofit Construction on West half of the Capitol Mall begins 4/81 and ends by 11/81.

4.96 Retrofit construction of east half of the Capitol Mall begins 4/82 and ends by 11/82.

Warm Springs Water District Activities

5.0 Creation of WSWD from Old Boise Water Corporation 1970 System currently serves 170 customers.

5.1 Warm Springs Water District negotiates a contract with the State of Idaho for 400 gpm at $.45/100 cf. of water for the first two years $.50/100 cf. for the next 1980-1984. $55/100 cf. thereafter 84. Contract negotiated 6/76 thru 1/77.

5.2 Warm Springs Water District negotiates a joint powers agreement with the City of Boise for the purpose of jointly applying for funds from the DOE/PON program 9/77 thru 5/78.

5.3 Rebuild Warm Springs Water District Wells #1 and #2 4/79 thru 9/79.

5.4 Design WSWD #3 well, 4/79 thru 8/79.

5.5 Drill WSWD #3 well, 9/79 thru 10/79.

5.6 Pump test well #3 well, 10/79 thru 12/79.

5.7 Design Pipeline for new WSWD mainline 9/79 thru 11/79.

5.8 Design of pump station for new wells and pipeline size begins 1/80 and ends 4/80.

5.9 Construction of pump station and new main pipeline for Warm Springs Water District begins 4/80 and ends by 10/80.

5.91 New WSWD Mainline is on line and Labor and Industrial Services Building is hooked up to this line 10/80.

5.92 Auxiliary lines for WSWD system are rebuilt 4/81.

5.93 New pipeline expansion to accommodate subdivisions 4/82 thru 10/82.

Boise City Activities

6.0 Boise City applies for ERDA funding for City geothermal planning 11/75.

6.1 ERDA awards $71,502 to Boise City for Phase I planning of geothermal project 10/76.

6.2 Phase I planning begins 10/76. Phase I is a study of the legal and institutional ramifications of geothermal development within the city limits. Phase I end in 11/77.

6.3 ERDA awards $141,848 to Boise City for Phase II planning beginning 9/77. Phase II planning includes a continuation of Phase I institutional studies and an environmental and resource assessment. Phase II ends 10/78.

6.31 City of Boise negotiates a joint powers agreement with Warm Springs Water District for the purpose of jointly applying for funds from the DOE/PON program 10/77 thru 6/78.

6.32 EDA funds applied for by the City of Boise 8/78.

6.4 City of Boise applies for water rights 4/78. Two applications for a total of eight well sites in Military Reserve Park and Camelsback Park. Application was for 12 cfs. from five wells in Military Reserve Park and 8 cfs. from three wells in Camelsback Park.

6.5 Boise City Council asks Sen. Frank Church to introduce legislation to Congress to transfer the geothermal rights of Military Reserve Park to the City of Boise 3/78.

6.6 City of Boise request right-of-ways for pipelines from Ada County Highway District 8/79 thru 11/79.

6.7 City of Boise applies for production drilling permits from Idaho Department of Water Resources 7/79 thru 10/79.

6.71 City of Boise applies for injection well permit from Idaho Departments of Water Resources and Health and Welfare 7/79 thru 10/79.

6.8 EDA funds Boise City $500,000 for geothermal development.

PON/Boise Geothermal Activities

7.0 PON Proposal written by City of Boise under a joint powers authority with Warm Springs Water District. PON submitted by Boise Geothermal on 7/78.

7.01 DOE notifies City of Boise of PON award on 10/78.

7.1 DOE and Boise Geothermal conduct contract negotiations from 10/78 thru 3/79.

7.2 Environmental and Resource Assessment on Boise City geothermal well fields conducted 3/79 thru 7/79.

7.3 Market Study of proposed Boise geothermal expansion 3/79 thru 10/79.

7.31 Rate study of proposed systems begin 4/80 thru 9/80.

7.4 Exploration drilling of Boise City production wells #1 and #2 begins in 11/79 thru 3/80.

7.5 Pump testing of Boise City production wells begins 3/80 thru 5/80.

7.6 Total system design occurs from 8/80 thru 10/80.

7.61 Engineering design of pumps and pipelines for Boise City System begins 5/80 thru 11/80.

7.62 Drilling of injection wells begins no sooner than 3/80 and ends by 8/80.

7.7 Letting of bids, selection of contractor and pipeline construction for Boise City System begins 6/80 and construction continues thru 11/80.

7.8 Pipeline construction finishes and interconnections to buildings and feeder lines and collection lines 3/81 thru 9/81.

7.81 Boise City System begins service to East Capitol Mall and interconnects with Warm Springs Water District System 10/81.

7.9 Pipelines are extended into the new CBD Shopping Mall with construction beginning 2/82 and completed by 8/82.

RECOMMENDATIONS

1) It is recommended that:

The Department of Administration renegotiate an uninterruptible contract for the Agriculture Health Lab with Warm Springs Water District. The present contract allows for an allocation up to 400 gpm on an interruptible basis. The State should secure an uninterruptible flow of 50 gpm minimum for the Agriculture Health Laboratory and Agriculture Office Building geothermal system. The current system has a natural gas boiler for backup. The capacity of this boiler will be exceeded by the demands of these buildings if an interruption of geothermal flow were to occur during a peak heating need. These negotiations should occur prior to the 1979-1980 heating season.

2) Preliminary design and economic analysis of a geothermal retrofit of the State Industrial Administration Building indicates a retrofit is warranted. Estimated retrofit cost is $88,600. Assuming a cash payment for the retrofit and using current Warm Springs Water District rates of 55¢/100 $ft.^3$, a payback of 9 years can be expected. Using the Boise City rate of 87.8¢/100 $ft.^3$ a payback period of 13 years can be expected. It is recommended that a tentative time schedule and a detailed cost analysis be developed for geothermal retrofit. In order for retrofit of the Industrial Administration to be completed by the 1980-81 heating system a more exacting design and cost estimate process should begin by October, 1979.

3) It is recommended that:

The Department of Administration, Division of Public Works, should prepare a legislative budget appropriation request for the permanent building fund for retrofit of the Industrial Administration Building, to be considered by the 1980 Legislature.

4) It is recommended that:

The Department of Administration should seek to negotiate a contract with Warm Springs Water District for future delivery of geothermal fluids to the Industrial Administration Building. The rehabilitation of the Warm Springs Water District wells and pipelines should be completed by October, 1980. A timely retrofit of the Industrial Administration Building would allow it to be one of the new hook-ups to the Warm Springs Water District system. The expansion of the District's system will be limited to available flows. Early negotiations could result in a firm uninterruptible contract while allocations are still available. Approximately 160 gpm is the estimated flow rate needed for the Industrial Administration Building.

5) A key element to a successful retrofit of the Industrial Administration Building is the disposal of the spent thermal fluids. The most

attractive disposal method is to discharge the spent geothermal water directly into the Boise City Canal, which runs behind the building. It is recommended that the Department of Administration should hold formal discussions with the Boise City Canal Board of Directors to arrange an agreement for this type of discharge. Further contact at the appropriate time would be made by contacting:

Boise City Canal Company Board of Directors
C/o L.D. Holsinger
4747 Glenwood; Suite 203
Boise, Idaho 83704

6) In order for a timely completion of the Capital Mall retrofit to coincide with the projected completion of the Boise City Geothermal System, it is recommended that the Department of Administration, Division of Public Works, should issue a RFP for design and engineering of the retrofit by August or September of 1979. The results of this design analysis should exact the cost estimate for the retrofit. Engineering design should be completed by October, 1980. Retrofit construction could be completed on at least the west half of the Capital Mall by the October, 1981 delivery date of the Boise City geothermal pipeline. By beginning the engineering design process by late 1979 an exact cost estimate will be available by late 1980. If additional funds are necessary, then the Department of Administration could seek further appropriation from the 1981 legislature.

7) It recommended that:

The Department of Administration should immediately enter into informal discussions with the Boise Geothermal Group. These informal discussions will aid in coordination of time tables between the State and the City. If negotiations for delivery of geothermal fluids result from the informal discussions it is the recommendation of this report that negotiations must include detailed consideration of the propriety of Boise Geothermal's projected cost structure, with emphasis on ways in which the cost can be reduced from the quoted price of 87.8¢/100 $ft.^3$. A price in the range of .75¢ would result in a 50% increase in savings for the State over the suggested 87.8¢ price.

WEISER HOT SPRINGS, IDAHO

SITE SPECIFIC DEVELOPMENT ANALYSIS

JULY 1979

By

David W. McClain

and

William B. Eastlake

IDAHO OFFICE OF ENERGY

OFFICE OF THE GOVERNOR

Prepared for the United States Department of Energy,
Division of Geothermal Energy, Idaho Falls Operations Office
DOE/ID/12010-5

CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

WEISER HOT SPRINGS, IDAHO

SITE SPECIFIC DEVELOPMENT ANALYSIS

PREFACE

Weiser Hot Springs has been identified by the Idaho Department of Water Resources as a potential geothermal resource site with a potential resource temperature between 90° C (194° F). The Idaho Office of Energy has identified this site as a high potential location for developing geothermal resources for industrial applications at a new industrial park. This site has significant potential for locating a geothermal-ethanol hybrid plant and other agricultural processing facilities.

The Weiser Hot Springs site was selected for site specific development analysis because the site has a number of geographical aspects which are critical locational criteria for industrial development. The geothermal prospect is located close to the state's major east-west railroad, a natural gas pipeline, major power transmission lines and the interstate freeway. These support facilities are necessary for industrial development and with the unique combination of a nearby geothermal energy source, the Weiser site is logical location for a new geothermal-industrial park.

1.0 INTRODUCTION

A site specific development plan is a qualitative and quantitative analysis of technical, economic, environmental and institutional factors which influence the scale and timing of geothermal development. The plan is based on current information available in the literature and reflects the intent of private development interest in the Weiser area. Resource data for the Weiser site was provided by the Idaho Department of Water Resources and the U. S. Geological Survey. A review of all current available socio-economic data and technical papers on geothermal industrial utilization was conducted to determine the types of industrial process which could be supported from local raw products. State policies and local planning reports were reviewed to determine the institutional factors effecting development.

The Weiser Site Specific Development Plan describes the institutional, logistical and economic parameters which will effect the development of a new industrial park based on geothermal energy. The development concept involves locating one or more industrial facilities at the railroad located 4,877 meters (16,000 feet) south of the proposed well field.

The resource temperatures are expected to range from a minimum of 90° C (194° F) to a maximum of 140° C (284° F) based on the geochemistry of the water. The types of processes considered for the industrial park were based on local and regional raw products. The types of processing envisioned are: potato starch, ethanol distillation, corn canning and processing, and onion dehydration.

2.0 SITE DESCRIPTION

2.1 Location:

Weiser Hot Springs is located approximately 10.5 km (6.5 miles) west of the town of Weiser, Idaho, in Washington County. Washington County is located in the southwestern part of the State of Idaho. The Snake River flows along its western border and separates the county from the neighboring State of Oregon. Neighboring counties are Adams County to the north, Gem County to the east and Payette County to the south. (see Figure 2.1)

The Weiser Hot Springs geothermal site is located along the northern margin of a prime agricultural area known as the West Weiser Flat. The site is located two miles north of the Union Pacific Railroad mainline between Portland and Salt Lake City. The principal highway through Weiser is U. S. 95, the major north-south traffic carrier in Idaho connecting Lewiston with Boise. U. S. 30N connects Weiser with I 80N which is located 24 km (15 miles) west of the community. Figure 2.2 is a site map of the Weiser Hot Springs geothermal prospect and the potential industrial park.

FIGURE 2.1

Site Location Weiser Hot Springs

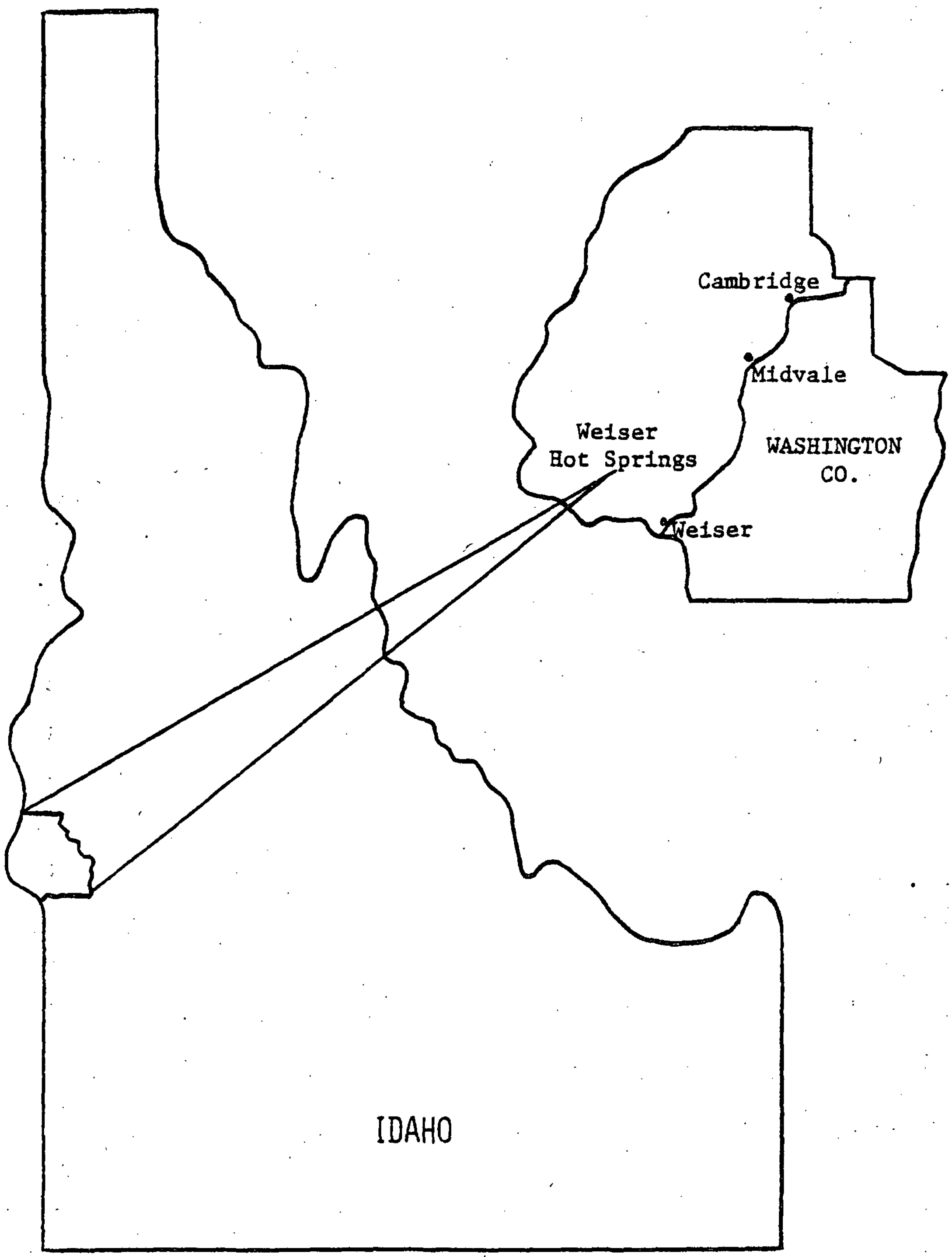
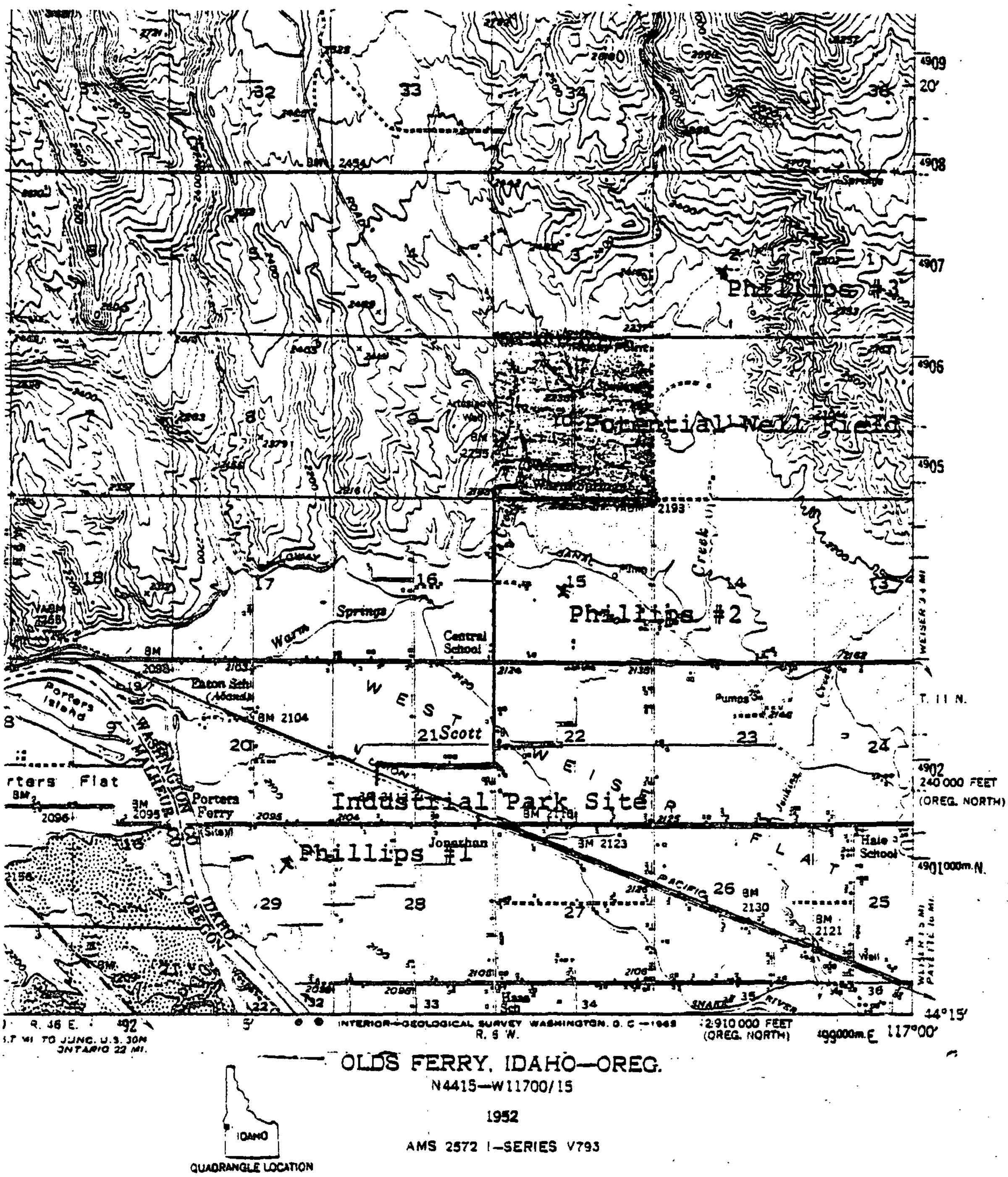


Figure 2.2 **Weiser Hot Springs Site Map**



2.2 Demographics:

The estimates of the future population of the county and its population centers are made on the basis of past trends. Many changes in circumstances, especially in economic conditions, can change these trends. The local city and county population changes can vary from the experience of a larger area, such as the state. However, the usual situation is for the smaller area to follow a pattern set by the larger region. The estimates for Washington County are related to the state estimates and assumptions for these are discussed below.

Three estimates, high, medium and low, were made for the population of Idaho until 1990. All of these are based on published estimates made by the Census Bureau.

The projected estimates for Washington County are based upon the medium series of estimates of the state population. Growth in the county is predicted to concentrate in and around Weiser. Since small towns, which function largely as supply centers for agriculture, tend to decline as agriculture becomes more mechanized, Midvale and Cambridge will show modest trends. Growth in these small towns depends on factors other than demographic situation. It must be understood that a new industry or a better highway system connecting to an area provides a new life for such places.

The population projections (Table 2.3) are projections of a range of population at ten and twenty-year intervals, 1980 - 1990, using the 1970 Census as the population base.

In summary, Washington County represents a rural county which will continue to grow, and in this growth will become more urban. The preference for a rural residence will allow for some growth in small towns and country-sides by persons whose incomes are urban-based. The town of Weiser has the greatest potential for industrial development. Table 2.4 lists the population of the Labor-Drawing area of Weiser, Idaho. Table 2.5 lists the current statistics concerning labor force within the proposed market area of the Weiser industrial site.

2.3 Economy of Site Area:

Washington County economic activities were analyzed to provide a working knowledge of the present and past economic base, as well as to estimate the type of future activities which could occur. Washington County has had an increasing economy in terms of total number of persons employed and the percentage of total personal income generated. The Weiser area's economy depends primarily on farm products of various kinds. Principal crops grown include alfalfa, corn, grain, sugar beets, onions, and forage, but livestock production, including range and feed lot operations are the largest income producers.

TABLE 2.3

POPULATION TRENDS AND PROJECTIONS

WASHINGTON COUNTY

Community	Actual Population 1950	1960	1970	May 1976	Projections (1970 Base) 1980	1990
Cambridge	354	473	383	451	402	421
Midvale	231	211	176	185	185	194
Weiser	3,961	4,208	4,108	4,607	4,313	4,518
Washington County	8,576	8,378	7,633	8,485	8,337	9,907
*Washington County	8,576	8,378	7,633		7,050	6,700

Source: Idaho Department of Water Resources - Population and Employment Forecast, State of Idaho, Series 2 Projections 1975-2000

*Bonneville Power Administration Projection

TABLE 2.4

1970 POPULATION OF THE PRIMARY
LABOR-DRAWING AREA OF WEISER, IDAHO

	Distance	Population	Projected Population - 1990
IDAHO			
Adams County		2,877	4,660
Council	112 km (70 mi.)	899	
Canyon County		61,288	109,900
Caldwell		14,219	
Greenleaf		323	
Melba		197	
Middleton		739	
Nampa		20,768	
Notus		304	
Parma		1,817	
Wilder		748	
Gem County		9,387	16,850
Emmett		3,945	
Payette County		14,390	18,760
Fruitland	25.7 km (16 mi.)	2,063	
New Plymouth		968	
Payette	25 km (13 mi.)	4,521	
Washington County		7,633	13,660
Cambridge		383	
Midvale	45 km (28 mi.)	211	
Weiser		4,108	
OREGON			
Malheur County		23,169	28,200
Ontario	30.5 km (19 mi.)	6,523	
Nyssa		2,620	
Vale		1,448	
Baker County		14,919	17,500
Huntington	33.7 km (21 mi.)	580	

2.4 Elements of the Area Economy:

Percent of average monthly unemployment - 1976

Jan.	13.9%	Feb.	12.8%	Mar.	12.5%	Apr.	9.7%	May	7.6%	Jun.	6.1%
Jul.	8.7%	Aug.	6.8%	Sep.	5.4%	Oct.	4.8%	Nov.	6.8%	Dec.	9.4%

Percent of labor force unemployed: 1970: 5.7% 1972: 7.1%
1975: 10.5% 1976: 8.6%

Month and percentage of highest unemployment: 1975: Jan. 19.1% 1976: Jan. 13.9%

Month and percentage of lowest unemployment: 1975: Oct. 5.5% 1976: Oct. 4.8%

Percent of females (16+) in labor force: 1960 (14+): 33.8% 1970: 34.1%

Employment (B.E.A. data)	1967	1970	1974	1975
Total employment	2,703	2,828	3,244	
Farm proprietors	654	631	604	598
Non-farm Proprietors	384	420	454	455
Wage and salary employment:				
Federal civilian	68	49	53	50
Military	4	4	3	3
State & local	373	444	466	501
Manufacturing	71	(D)	395	382
Mining	(D)	(D)	(D)	(D)
Construction	97	56	110	95
Trans., Comm. & Pub. Util.	118	60	60	66
Trade	388	398	573	574
Finance, Insurance & Real Estate	49	51	51	72
Services	202	222	187	190
Other	(D)	(D)	(D)	(D)
Farm	247	244	244	339

(D) Not shown to avoid disclosure of confidential information.

Average Idaho tax return (county) - 1976: $276

Average Idaho tax return (State) - 1976: $396

Total assessed valuation: 1975*: $26,474,276 1976: $26,614,058
*1974 subsequent rolls, 1975 real and personal rolls, and 1975 utilities.

Average levy county-wide paid per $100 assessed valuation:
1975: $6.81 1974: $7.25 1975: $7.38 1976: $8.51

Sales tax: 1974*: $358,496 1975*: $400,456 1977*: $465,574 *Fiscal year

Property tax as percent of full value: County - 1976: 1.61% State - 1976: 1.55%

Per capita income:	1970:	$2,944	1974:	$4,104	1975:	$4,573
% of national average:	1970:	74.2%	1974:	75.3%	1975:	77.5%
% of state average:	1970:	89.5%	1974:	83.4%	1975:	88.3%

Median family income - 1969: $6,409   Median family income - 1976: $10,250
*HUD estimate

Transfer payments (thousands of dollars - county):
1970: $3,180   1974: $5,627   1975: $6,779

Number of business establishments - 1974: 172

2.5 Previous Industrial Development:

Two major types of industry are currently located in the Weiser area—mobile home and component manufacture, and onion packaging. Three mobile home assembly plants are located at the Weiser Industrial Park producing single and double-wide mobile homes, and solar furnaces for mobile homes. Four onion packaging plants operate seasonally out of the Weiser area but are not located at the industrial park. A small insulation manufacturing plant was built in 1977 at the industrial site and is the most recent expansion of the industrial park.

The Weiser Industrial Park is located 2.4 km (1½ miles) south of Weiser and is owned by the Weiser Industrial Corporation. The site is located along the Union Pacific Railroad and U.S. Highway 95. Power and natural gas are available at the Weiser Industrial Park as well as unlimited amounts of high quality water. The site is zoned industrial, has fire rating #3, and tax rate 8.0164/$100 of assessed valuation. The Weiser Industrial Park is the established center for industrial development for the City of Weiser. There appears to be no local government opposition to establishing additional industrial sites provided such developments are located along the railroad and do not endanger prime agricultural lands.

3.0 Resources Evaluations:

The Weiser Hot Springs site has been utilized for space heating, greenhouses, swimming and balneological bathing for over two decades. Five shallow, small diameter wells yield enough water at the site of a former hot springs to carry on the above operation.

The U.S. Geological Survey estimates of the Weiser Hot Springs reservoir volume and thermal energies are listed in Table 3.0 Gravity surveys indicate a low amplitude gravity high in the Weiser Hot Springs area. A ground temperature survey made by Idaho Department of Water Resources apparently outlines an area of high heat flow centered at or near the Weiser Hot Springs, and it also correlates very well with high boron concentrations measured in water samples collected in the same survey area. Idaho Department of Water Resources has estimated, by geothermical analysis, that aquifer temperatures range from 141° C (285° F) to 157° C (314° F). Surface water temperature at the Weiser Hot Springs is 77° C (170° F).

TABLE 2.5

PROPOSED MARKET AREA
WEISER HOT SPRINGS INDUSTRIAL SITE
LABOR FORCE - JULY 1976

IDAHO COUNTIES AND CITIES	Labor Force	Unemployed	Rate	Employed
Adams County	1,764	146	8.3	1,618
Council				
New Meadows				
Canyon County	36,440	2,680	7.4	33,760
Caldwell				
Greenleaf				
Melba				
Middleton				
Nampa				
Notus				
Parma				
Wilder				
Gem County	4,581	456	10.0	4,125
Emmett				
Payette County	6,714	443	6.6	6,271
Fruitland				
New Plymouth				
Payette				
Valley County	2,395	171	7.1	2,224
McCall				
Donnelly				
Cascade				
Washington County	3,456	277	8.0	3,179
Cambridge				
Midvale				
Weiser				
OREGON COUNTIES AND CITIES				
Malheur County	11,785	760	6.9	11,025
Ontario				
Nyssa				
Vale				
Adrian				

TABLE 3.0

U.S.G.S. RESERVOIR VOLUMES AND THERMAL ENERGIES ESTIMATE
WEISER HOT SPRINGS

Mean Reservoir Temperature:	$130 \pm 14^{o}C$
Mean Reservoir Volume:	$4.4 \pm 1.7\ km^3$
Mean Reservoir Thermal Energy:	$1.38 \pm 0.55 \times 10^{18}$ J
Estimated Well Head Thermal Energy:	0.34×10^{18} J
Estimated Beneficial Heat:	0.083×10^{18} J

Source: U.S. Geological Survey Circular 790, (1978).

3.1 Exploration Activities

GeoSolar Growers, Inc.

Weiser Hot Springs, Sec. 10, T. 11 N., R. 6 W., Boise Meridian. An exploration plan has been developed and the principal owners of Weiser Hot Springs, GeoSolar Growers, Inc., are expected to begin drilling program in 1980.

Phillips Petroleum Company

Phillips has drilled four exploration holes in the Weiser area since 1975.

Weiser Stratographic Well #1, 12/9/75
Sec. 32, T. 11 N., R. 3 W., Boise Meridian

Weiser Stratographic Well #2, 1/21/76
Sec. 15, T. 11 N., R. 6 W., Boise Meridian

Weiser Stratographic Well #3, 7/28/76
Sec. 2, T. 11 N., R. 6 W., Boise Meridian

Christensen Well #1, 9/23/77
Sec. 29, T. 11 N., R. 3 W., Boise Meridian

4.0 Specific Potential Applications:

The following is a brief outline of the industrial commercialization possibilities for the conceptualized Weiser Hot Springs Industrial Park. A well program was developed for three possible depths to obtain a realistic range of drilling cost. Three possible distribution systems to deliver the resource to the point of use and the pump and power requirements necessary to deliver the resource were also developed to obtain an estimated deliverable energy cost.

Preliminary calculations were made on the quantity of heat available from the available resources for several process applications. A deliverable resource temperature of 140^{o} C (284^{o} F) was assumed and potential for use of this resource for corn processing, onion processing, potato starch and ethanol production was investigated.

The results are indicative of potential for application of geothermal energy to agricultural processing. Subsequent to the uses mentioned herein, there is still the potential for a variety of cascade uses, like spaceheating or greenhouses. The exact choice of process or mix of uses requires more specific information, both about the exact nature of the resource and the specific choice of production technology.

4.1 Costs of Development and Delivery of Geothermal Water

A. Well Program

Three alternative depths. All wells drilled 25 cm (10 in.) to 48.7 m (160 Ft.), set 20 cm (8 in.) casing, then 20 cm (8 in.) hole with 15 cm (6 in.) casing to depth. Drilling costs $3.22/cm/meter ($2.50/in/ft.), increasing $1 for every 152 m (500 ft.) of depth.

Casing costs $1/in/ft.

Well depth:	304.8 m (1,000 ft.)	609.8 m (2,000 ft.)	914.4 m (3,000 ft.)
	32,080 Drill & Case	78,280	140,280
	+ 30% Contingency	+ 30%	+30%
Total Cost:	$41,704 or $138/m ($42/ft.)	$101,764 or $167/m ($51/ft.)	$182,364 or $200/m ($61/ft.)

B. Transmission Lines

A/C pipe, 25 cm (10 in.) diameter, insulated with urethane at $98/m ($30/ft.).

Carries 1,000 GPM to point of utilization from two production wells of 500 GPM each.

1. Industrial Park at rail site

4876 m (16,000 ft.) X $98.43/m ($30/ft.) = $480,000.

2. Straight line to Weiser

8851 m (29,040 ft.) X \$98.43/m (\$30/ft.) = \$871,200

3. Weiser via established right-of-way

10836 m (35,640 ft.) X \$98.43/m (\$30/ft.) + \$1,069,200

C. Pump size and power requirements

Two wells, each producing 1892 l/m (500 GPM). Water pumped from 63 m (200 ft.) in wells. (Friction loss of 2.4 ft./100 ft. in 10" pipe.)

1. Pump size HP = $\frac{\text{500 GPM X Head}}{\text{3960 X .7}}$

a. Industrial park $\frac{500 \times 584}{2772}$ = 105 HP

b. Straight to Weiser $\frac{500 \times 896}{2772}$ = 162 HP

c. Right-of-Way to Weiser $\frac{500 \times 1054}{2772}$ = 190 HP

2. Power requirements KWH = .746 X 8760 X HP (yearly maximum use) Price of KWH = \$.02

a. Industrial park

.746 X 8760 X 105 = 686,170 KWH X \$.02 = \$13,723 per pump

b. Straight to Weiser

.746 X 8760 X 162 = 1,058,663 KWH X \$.02 = \$21,173 per pump

c. Right-of-Way to Weiser

.746 X 8760 X 190 = 1,241,642 KWH X \$.02 = \$24,833 per pump

D. Quantity of heat available for use

Calculations assume a 140° C (284° F) resource at two flow levels, the expected 3785 l/m (1,000 GPM) and a conservative flow of just 2839 l/m (750 GPM).

	3785 l/m (1,000 GPM)	2839 l/m (750 GPM)
$\Delta t = 37.8\,^{\circ}C\ (100^{\circ}\ F.)$	4.7×10^{7} BTU/hr.	3.6×10^{7} BTU/hr.
$\Delta = 22.2^{\circ}\ C\ (72^{\circ}\ F.)$	3.4×10^{7} BTU/hr.	2.6×10^{7} BTU/hr.
$\Delta = 10\,^{\circ}C\ (50^{\circ}\ F.)$	2.4×10^{7} BTU/hr.	1.8×10^{7} BTU/hr.

4.2 Potential uses of 140°C (284° F) resource.

A. Range of possibilities

Temperature	Process
140° C (284° F)	Potato starch
130° C (266° F)	Ethanol (Distillation)
120° C (248° F)	Corn canning and processing
110° C (230° F)	Onion dehydration
100° C (212° F)	
90° C (194° F)	Ethanol (fermentation)
80° C (176° F)	
70° C (158° F)	

B. Below is a list of potential uses of the 140° C (284° F) water from the Weiser area. For each potential use we have investigated the: (a) operation period and product demand, (b) temperature requirements, (c) present energy demands, and (d) possible savings from conversion to the geothermal resource.

1. Corn (or other vegetable) Processing Canning (See Rocket Research)

a. Plants typically operate 60 days a year, 24 hours a day. Plant requires 100 tons an hour of corn in the husk. Peak demand would use 144,000 tons per season.

Washington County and Payette County produced 17,000 tons of sweet corn in 1974. Would need additional sources of supply.

b. Corn is blanched, then husked, cut and canned in a vacuum. Cans are then cooked in a retort for 20 minutes at about 121° C (250° F.) to sterilize the product. A 100° C (212° F) to 121° C (250° F.) resource could supply 100 % of the energy requirements currently supplied by natural gas.

c. A large plant requiring 100 tons per hour (Green Giant) utilizes 24.9 x 10^9 BTU/yr. of electricity and 57.8 x 10^9 BTUs/yr. of natural gas. A smaller plant producing beans and corn uses 3.4 x 10^9 BTUs/yr. of natural gas.

d. Water temperature of the Weiser resources should be easily sufficient to provide 100 % of present gas energy requirements, 57.8 X 10^9 BTU in the larger plant or 37.8 X 10^9 BTU in the smaller plant.

Since we are talking about constructing a brand-new plant rather than retrofitting an old one, we make the assumption that costs are identical for a new plant, whether it uses geothermal or natural gas. This means the projected savings from a geothermal plant would be equal to the natural gas costs not incurred. Future gas costs are inflated at the rate of increase suggested in Dames and Moore's study for the Idaho Public Utility Commission (slightly over 8%). This future stream of savings from not using gas is then discounted at 10% to find its present value. Table 4.2 lists gas savings and their present values over a 20-year period for corn processing.

Note: Under provisions of the Energy Tax Act of 1978, Sections 401-404, developers of geothermal properties may deduct intangible drilling and development costs and geothermal deposits qualify for percentage depletion, at the rate of 22% of gross income through 1980 and decreasing 2% a year thereafter. Any reductions in taxable income generated through these provisions would reduce tax liability and represent an additional element of saving to be added to the reduction in natural gas bills.

2. Onion Dehydration (See Oregon Agribusiness)

a. Plants typically operate 150 days a year, 24 hours per day. Requiring 10,000 lbs./hr of raw product (Creole or Southport Globe Onions) this makes an annual requirement of 36 X 10^7 lbs. of raw onions. Based on average Idaho yield of 475 cwt./acre, annual input requirements need about 775 acres of onions in the vicinity. 1979 estimates of onion acreage in Washington and Payette County total about 2400 acres. There is plenty of product available.

TABLE 4.2

Corn Processing Plant

5.78×10^5 therms/yr. x $.28375/therm = $164,007

Gas Savings		Present Value (Discounted 10%)
1979 -	164,007	
1980	178,272	162,065
1981	193,786	160,154
1982	210,645	158,261
1983	228,969	156,389
1984	248,887	154,539
1985	270,544	152,715
1986	294,080	150,909
1987	319,669	149,128
1988	345,563	146,552
1989	373,550	144,020
1990	403,808	141,532
1991	436,517	139,088
1992	471,873	136,685
1993	510,097	134,324
1994	551,418	132,005
1995	596,091	129,727
1996	641,354	127,482
1997	696,548	125,280
1998	752,961	123,115
1999	813,939	120,987
	TOTAL	$2,844,957

b. Onions unloaded at the plant are cured in large bins using 37° C (100° F.) air for 48 to 72 hours before processing. After washing and slicing the onions are transferred to a dryer conveyor where onions are reduced from 83% to 25% moisture by 104° C (220° F.) air (could be as low as 83° C (180° F.). Onions pass through three more stages of drying to reduce the moisture content to about 4%.

A resource of 43° C (110° F.) could satisfy 96% of the energy requirement currently supplied by natural gas. Only the last stage, a Bryair dessicator which required 194° C (300° F.) air, is beyond the bounds of the resource temperature. Geothermal would be used for preheat at this stage.

c. A plant using 10,000 lbs./hr. of raw product to produce 1500-1800 lbs. of dry product has a total energy requirement of 22 to 26 x 10^6 BTU/hr., depending on ambient air temperature. With ambient air at 4° C (40° F.), this works up to 5.28 X 10^8 BTU/day or 9.5 X 10^{10} BTU per 180-day season.

d. The final stage dessicator, using 149° C (300° F.) air, is not able to be converted to geothermal, so its .4320 X 10^{10} BTU would still be supplied by natural gas. The remaining 9.07 X 10^{10} BTU per season could be supplied by geothermal water. Table 4.3 lists gas savings and their present value for onion dehydration.

3. Potato Starch (See Oregon Agribusiness)

a. Plants typically operate September to May on an eight hour a day basis, about 1400 hours per season. Such a plant requires 14 tons per hour of potatoes, mostly low grade and culls, for starch extraction. Based on the average Idaho yield of 245 cwt, the seasonal input requirement of 3.92 X 10^7 lbs. of potatoes could be met by the produce of about 1600 acres. Washington and Payette counties combined grow about 400 acres, not enough, but nearby Malheur County of Oregon produces something around 8500 acres. Ample potato acreage seems to be present.

b. Potatoes are watered and hammered to allow separation of starch from skin and fiber. Centrifugal sieves allow separation of starch milk from the pulp, which is used for cattle feed. After the purified starch is formed into cubes, it is flash dried from 45 to 18% moisture content. A resource of 138° C (280° F.) could supply the 121° C (250° F.) air needed for the five stage blower drying process.

TABLE 4.3

Onion Dehydration Plant
9.07×10^5 therms/yr. x $.28375/therm = $257,361

Gas Savings		Present Value (Discounted 10%)
1979 -	257,361	
1980	279,746	259,315
1981	304,051	251,282
1982	330,547	248,345
1983	359,299	245,406
1984	390,554	242,503
1985	424,539	239,641
1986	461,473	236,809
1987	501,625	234,012
1988	543,075	230,317
1989	586,176	225,996
1990	633,657	222,093
1991	684,985	218,257
1992	740,466	214,187
1993	800,446	210,782
1994	865,287	207,143
1995	935,389	203,568
1996	1,011,124	200,045
1997	1,093,026	196,590
1998	1,181,549	193,193
1999	1,277,237	189,853
	TOTAL	$4,464,637

Reject water at 82 C (180° F.) could also be put through a heat exchanger to supply all space heating for the plant. The expected resource temperature of 140° C (284° F.) should be sufficient to meet all energy requirements of the plant.

c. Space heat load of 1.0×10^6 BTU/hr. and 3.53×10^6 BTU/hr. for the drying process totals 4.53×10^6 BTU/hr. or 6.34×10^9 BTU/season. This is well within the capacity of the two wells with 3785 l/m (1,000 GPM) flow that we have projected.

d. All energy requirements presently served by natural gas could be replaced with geothermal water at 140° C (284° F.). The seasonal energy requirement of 6.34×10^9 BTU/season amounts to 6.34×10^9 therms. At an average price of $.28375/therm, the GS-2 schedule, this works out to a yearly cost of $17,990 for natural gas. This, and all future gas, would be replaced by geothermal and thus represent gross savings from use of geothermal. Table 4.4 lists gas savings and their present value for potato starch production.

4. Ethanol Production

a. The projected plant will operate year-round, 350 days and 24 hrs. per day. Based on the conversion coefficients in 4.5, production of 1 million gallons of ethanol (our choice of a target size plant) would require 384,615 bushels of corn, wheat, barley, or mixed grains, 769,231 cwt. of potatoes or 45,454 tons of beet sugar. The Weiser area already has sufficient quantities of these products available to generate 1 million gallons of ethanol.

b. The temperature requirements for fermentation and distillation range up to 100° C which is easily within the capabilities of the expected resource.

c. Energy requirements for 1 million gallons of ethanol are based on an assumed heat requirement of 25,000 BTUs per gallon, a total of 2.5×10^{10} BTUs per year. The most modest estimates of the heat content of the projected water flow from two production wells are considerably greater than the heat required for a ethanol plant of this size.

TABLE 4.4

POTATO STARCH PLANT

6.34×10^4 therms/yr. X $.28375/therm = $17,990

Gas Savings	Present Value (Discounted 10%)
1979 - 17,990	
1989 - 19,554	17,776
1981 - 21,256	17,567
1982 - 23,105	17,359
1983 - 25,115	17,154
1984 - 27,300	16,951
1985 - 29,676	16,751
1986 - 32,257	16,553
1987 - 35,064	16,358
1988 - 37,904	16,075
1989 - 40,974	15,797
1990 - 44,293	15,524
1991 - 47,881	15,256
1992 - 51,759	14,993
1993 - 55,952	14,734
1994 - 60,484	14,479
1995 - 65,384	14,229
1996 - 70,678	13,983
1997 - 76,403	13,742
1998 - 82,591	13,504
1999 - 89,280	13,271
TOTAL	$312,056

TABLE 4.5

ETHANOL POTENTIAL OF WEISER AREA

	Conversion Coefficients	Acres	Production	Ethanol Production Potential
Corn	2.6 gal./bu	9,000	157,600 bu.	409,760 gal.
Wheat	"	23,000	813,600 bu.	2,115,360 gal.
Barley	"	12,200	650,600 bu.	1,691,560 gal.
Mixed Grains	"	1,365	73,743 bu.	191,732 gal.
Potatoes	1.3 gals./cwt.	8,783	3,069,237 cwt.	3,990,008 gal.

Sources: Acreage and production from 1978 Idaho Agricultural Statistics for Payette and Washington counties. Conversion coefficients from University of Idaho, Agricultural Engineering Department.

d. The heat requirements could easily be 100% satisfied by 140° C (284° F) geothermal water, completely erasing the cost of natural gas. Table 4.6 has gas savings and present value calculations over the next 20 years.

TABLE 4.6

ETHANOL PLANT

250,000 therms X $.28375/therm =

Gas Savings		Present Value (Discounted 10 %)
1979 - $ 70,937		
1980 - 77,108		70,098
1981 - 83,818		69,271
1982 - 91,110		68,452
1983 - 99,035		67,642
1984 - 107,650		66,842
1985 - 117,018		66,054
1986 - 127,198		65,273
1987 - 138,265		64,502
1988 - 149,465		63,388
1989 - 161,570		62,292
1990 - 174,658		61,217
1991 - 188,805		60,159
1992 - 204,098		59,120
1993 - 220,630		58,099
1994 - 238,503		57,096
1995 - 257,825		56,110
1996 - 278,700		55,139
1997 - 301,275		54,187
1998 - 325,675		53,250
1999 - 352,050		52,330
	TOTAL	$1,230,521

5.0 DEVELOPMENT PROCESS

5.1 Financial Factors:

GeoSolar Growers, Inc. of Weiser, Idaho, are the principal private investors in the Weiser Project. No federal funding, other than outreach assistance, has been involved with this project. The major goal of GeoSolar Growers is the establishment of an industrial park. This group currently is operating a small natatorium and aquaculture project at the site. Interest in developing an industrial park is currently focused on establishing a geothermal-ethanol plant in the area.

GeoSolar Growers did apply for a PRDA grant in 1979 but the application was rejected. The group has had its principal management contractor, Integrated Energy Systems, Inc. of Boise, Idaho, consult with DOE on other possible funding mechanism such as the Loan Guarantee Program.

5.2 LAND LEASING:

GeoSolar Growers, Inc. owns the land area surrounding Weiser Hot Springs. There are no federal or state lands involved in this development.

5.3 PERMITTING REQUIREMENTS FOR GEOTHERMAL DEVELOPMENT:

1. An approved permit from the Department of Water Resources is generally required before work can begin on geothermal wells. The permit forms required under the Geothermal Resource Act are:

    a) Form 4003-1, Application for Permit to Drill for Geothermal Resources;

    b) Form 4003-2, Application for Permit to Alter a Geothermal Well;

    c) Form 4003-3, Application for Permit to Convert a Well to a Geothermal Injection Well;

    d) Form 4005, Geothermal Resource Surety Bond;

    e) Form 4007, Notice of Intent to Abandon a Well;

    f) Form 4009, Report of Abandonment of a Well

2. Permit applications must be accompanied by a filing fee of:

    a) One hundred dollars ($100) for any production or exploratory well;

    b) Fifty dollars ($50) for an injection well;

    c) Fifty dollars ($50) for an amendment to a permit;

    d) No filing fee shall be charged for filing a Notice of Intent to construct a hole for gathering geotechnical data.

3. Bonds are required as a condition of every permit. A bond of not less than ten thousand dollars ($10,000) is required for each well.

4. The two exemptions to the Geothermal Resource Permit requirements relate to exploration wells and to low temperature geothermal wells.

   a) If an exploration well is less than 15 cm (6 in.) in diameter and less than 304 m (1,000 ft.) deep and is used only for collecting geotechnical data, the owner must simply file a Notice of Intent to drill with the Department of Water Resources.

   b) As explained in Section 42-0003(e), Idaho Code, wells from which low temperature water is used for such purposes as space heating or fish propagation need only obtain an approved water right.

5. Although a water right is not required under the geothermal permit, it is highly recommended that water rights be applied for in order to obtain assurances against subsequent developers.

5.4 LOCAL GOVERNMENT PERMITS: (Washington County)

County Planning & Zoning Permits: Change of zoning needed. County Highway Department: Right-of-way permits required. Weiser City Zoning Permit: Change of zoning needed.

5.5 TIME FACTORS FOR PERMITS:

Idaho Department of Water Resource permits can be issued in less than four weeks but can take up to six months. Contested water right permits can take six months to one year to resolve. Planning and zoning permits take from one week to two months for issuance.

5.6 BARRIERS TO DEVELOPMENT:

Construction and operation of an ethanol distillation plant requires a license from the Regional Regulatory Administration, Bureau of Alcohol, Tobacco, and Firearms. Under the current laws there is no difference getween making alcohol for gasahol and making alcohol for liquor, therefore the permit requirements are quite detailed.

Disposal of the geothermal fluids after processing may pose environmental problems. Three types of disposal are being considered: biomass enrichment, surface disposal in irrigation canals and injection. GeoSolar Growers are currently investigating the feasibility of using the waste fluids as a growth medium for biomass product to be used in the ethanol plant. This process is expected by the developers to consume the majority of the waste fluids from the ethanol plant. High concentrations of boron are found in the Weiser Hot Springs water and injection may be the final disposal of these solutions.

Because of the fact that about 70% of the production cost of ethanol depends on the price of farm crops, gasahol plants could be victims of the variations in the farm markets. Venture capital investors and bankers will recognize this fact, and will probably judge gasahol as a higher risk than investments in oil, gas and other risk ventures. The investment capital and debt financing may be difficult to obtain without some sort of guarantee. GeoSolar Growers hopes to alleviate the supply problems by developing biomass in the waste fluid medium and using a mix of raw products from local agriculture to supplement their own product supply.

Currently the production of ethanol and gasahol is not profitable. A considerable rise in the price of gasoline is necessary to make ethanol profitable. New techniques would alter this problem very little, but by-product sales of protein and CO_2 may help the economics. How much of a price rise is needed for gasoline and when it is likely to occur are pieces of information which are basic to determining when and if gasahol will be economically feasible.

There are fifty established water rights within ten miles of the Weiser Hot Springs site. The deepest well is 350 feet and is used for irrigation. The majority of these wells are domestic use wells. These shallow aquifer water rights must be respected and any deterioration of water quality or availability could hinder development. Figure 5.6 is a conceptual timeline for project development.

6.0 SUMMARY AND RECOMMENDATIONS:

The Weiser site has considerable potential for developing a geothermal industrial park. The Weiser Hot Springs geothermal area has excellent location with respect to transportation and utility corridors. The area has abundant agricultural production and could supply the raw product needs of the types of processes outlined in this report. Development interests who are working without Federal assistance are currently studying the feasibility of a geothermal-ethanol plant at this location.

Better funding mechanisms are needed for direct application projects to obtain risk capital for exploration. Also, a loan guarantee program is needed for construction of a hybrid geothermal-ethanol plant. A prototype plant is needed to demonstrate the feasibility of geothermal ethanol production.

Figure 5.6 Conceptual Timeline for Projec ~evelopment Weiser Hot Sr~

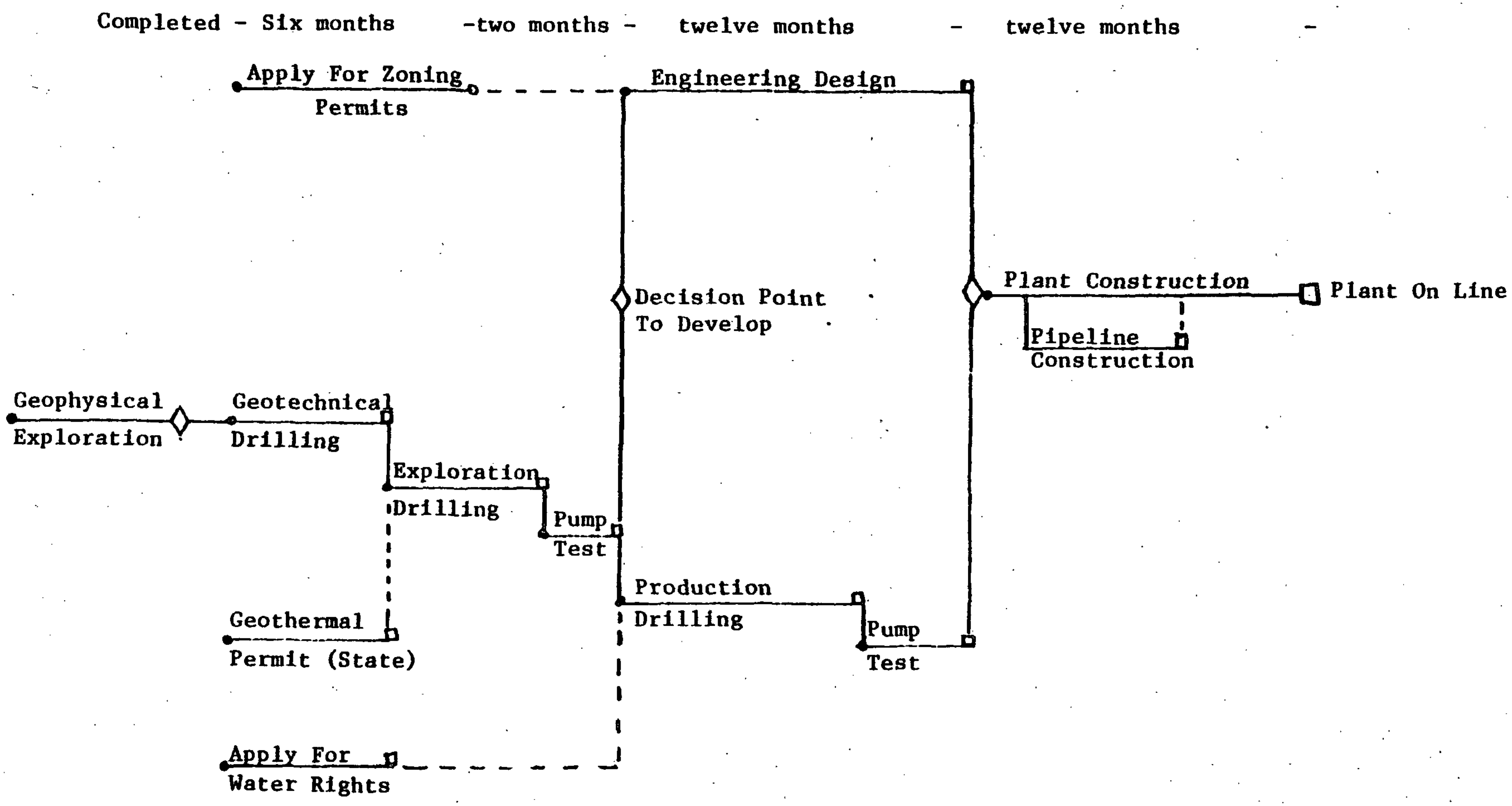


Figure 5.6 Conceptual Timeline for Project Development, Weiser Hot Springs

BIBLIOGRAPHY

Boise City Energy Office, Geothermal Energy Systems Plan for Boise City, City of Boise, 1979.

Drysdale, F.R. and C.E. Calef, The Energetics of the United States of America: An Atlas, Brookhaven National Laboratory, 1977.

Gerich, J.A., Industrial Utilization of Geothermal Energy, Masters Thesis, University of Idaho, 1976.

Hornburg, C.D. and B. Lindal, Preliminary Research on Geothermal Energy Industrial Complexes, U.S. Department of Energy, IDO-1627-4, 1978.

Howard, S.M., Direct Utilization of Geothermal Energy in Western South Dakota Agribusiness, U.S. Department of Energy, ET-78-F-07-1729, Second Quarterly Report, Dec. 1978.

Idaho Department of Agriculture, 1978 Idaho Agriculture Statistics, Idaho Crop and Livestock Reporting Service, 1978.

Idaho Department of Water Resources, Population and Employment Forecast, State of Idaho, 1978.

Idaho Division of Budget, Policy Planning and Coordination, County Profiles of Idaho, State of Idaho, 1978

Lienau, P.J., Agribusiness Geothermal Energy Utilization Potential of Klamath and Western Snake River Basins, Oregon. Geo-Heat Utilization Center, Oregon Institute of Technoligy, 1978.

Mitchell, J.C., L.L. Johnson, and J.E. Anderson, Potential for Direct Heat Applications of Geothermal Resources, Water Information Bull. 30, Part 9, Geothermal Investigations in Idaho, Idaho Department of Water Resources, 1979.

Muffler, L.P., Edt., Assessment of Geothermal Resources of the United States - 1978, U.S. Geological Survey Circular 790, 1979.

Reistad, G.D., W.E. Schmisseur, J.R. Shay, J.B. Fitch, An Evaluation of Uses for Low to Intermediate Temperature Geothermal Fluids in Klamath Basin, Oregon, Oregon State University, 1978.

Rightmire, C.T., H.W. Young, and R.L. Whitehead, Isotopic and Geochemical Analysis of Water from the Bruneau-Grandview and Weiser Areas, Southwest Idaho, Water Information Bull. 30, Part 4, Geothermal Investigations in Idaho, Idaho Department of Water Resources, 1976.

Rocket Research Company, Industrial Waste Heat for Adjacent Communities and Industrial Applications, Task II Report, Idaho Data Base, Pacific Northwest Regional Commission, 1978.

Sherwood, P.B. and K.L. Newman, Engineering and Economic Feasibility of Utilizing Geothermal Heat from Heber Reservoir for Industrial Processing Purposes, U.S. Department of Energy SAN-1323-3, 1977.

State of California, Economic Study of Low Temperature Geothermal Energy in Lassen and Modoc Counties, California, Division of Oil and Gas, 1977.

University of Idaho, Manufacturing Directory of Idaho, Center for Business Development and Research, 1979.

Washington County, A Comprehensive Plan for Washington County, Washington County Joint Planning Council, 1973.

Washington County, Subdivision Regulations, Washington County Joint Planning Council, 1974.

Weiser Chamber of Commerce, Weiser, Idaho Industrial Brochure, 1978.

Young, H.W., W.A. Horenberg, and H.R. Seitz, Water Resources of the Weiser River Basin, West-Central Idaho, Water Information Bulletin 44, Idaho Department of Water Resources, 1977.

Young, H.W. and Whitehead, R.L., An Evaluation of Thermal Water in the Weiser Area, Idaho, Water Information Bulletin 30, Part 3, Geothermal Investigations in Idaho, 1975.

HAILEY, IDAHO

SITE SPECIFIC DEVELOPMENT ANALYSIS

August 1979

By

David W. McClain

and

William B. Eastlake

IDAHO OFFICE OF ENERGY

OFFICE OF THE GOVERNOR

Prepared for the United States Department of Energy,
Division of Geothermal Energy, Idaho Falls Operating Office
DOE/ID/12010-6

TABLE OF CONTENTS

LIST OF FIGURES

TABLE OF TABLES

HAILEY, IDAHO

SITE SPECIFIC GEOTHERMAL DEVELOPMENT ANALYSIS

Preface:

Hailey Hot Springs has been identified by the Idaho Department of Water Resources and the U.S. Geological Survey as a potential geothermal resource site with a known surface temperature of 59C° (138°F) and a potential subsurface resource temperature between 80C° (176°F) and 135C° (275°F). The Idaho Office of Energy has identified the Hailey Hot Springs site as a high potential location for developing geothermal resources for space heating the City of Hailey, Idaho.

The Hailey site was selected for site specific development analysis because there has been a historical use of the thermal water for spaceheating the Hiawatha Hotel in Hailey for over forty years. The following feasibility analysis will evaluate major factors having a direct bearing on the potential for expanding the use of geothermal space heating in the City of Hailey.

1.0 Introduction

A site specific development plan is a qualitative and quantitative analysis of technical, economic, environmental and institutional factors which influence the scale and timing of geothermal development. The plan is based on current information available from local sources, field examination, and literature research. The resource data for the Hailey Hot Springs site was provided by the Idaho Department of Water Resources and the U.S. Geological Survey. A review of currently available socio-economic data and technical papers on district heating was conducted to determine the scale and feasibility of a district heating system for the City of Hailey. State policies and local planning reports were reviewed to determine the institutional factors affecting development.

The City of Hailey is located 3.2 km East of Hailey Hot Springs. The economy of the area is dependent primarily on tourism and recreation. The residential population of Hailey is generally employed in service-oriented industries such as merchandising, lumbering, mining, construction and agriculture.

Natural gas, electricity, and heating oil are the principle energy forms which are currently used for residential and commercial spaceheating in Hailey. The cost of heating with natural gas in Hailey is currently $4.77/MBtu. The cost of heating with electricity is currently $7.31/MBtu.

This study will compare the cost of deliverable geothermal water for space heating from a district heating system, with the current conventional energy forms available in Hailey, Idaho.

2.0 Site Description

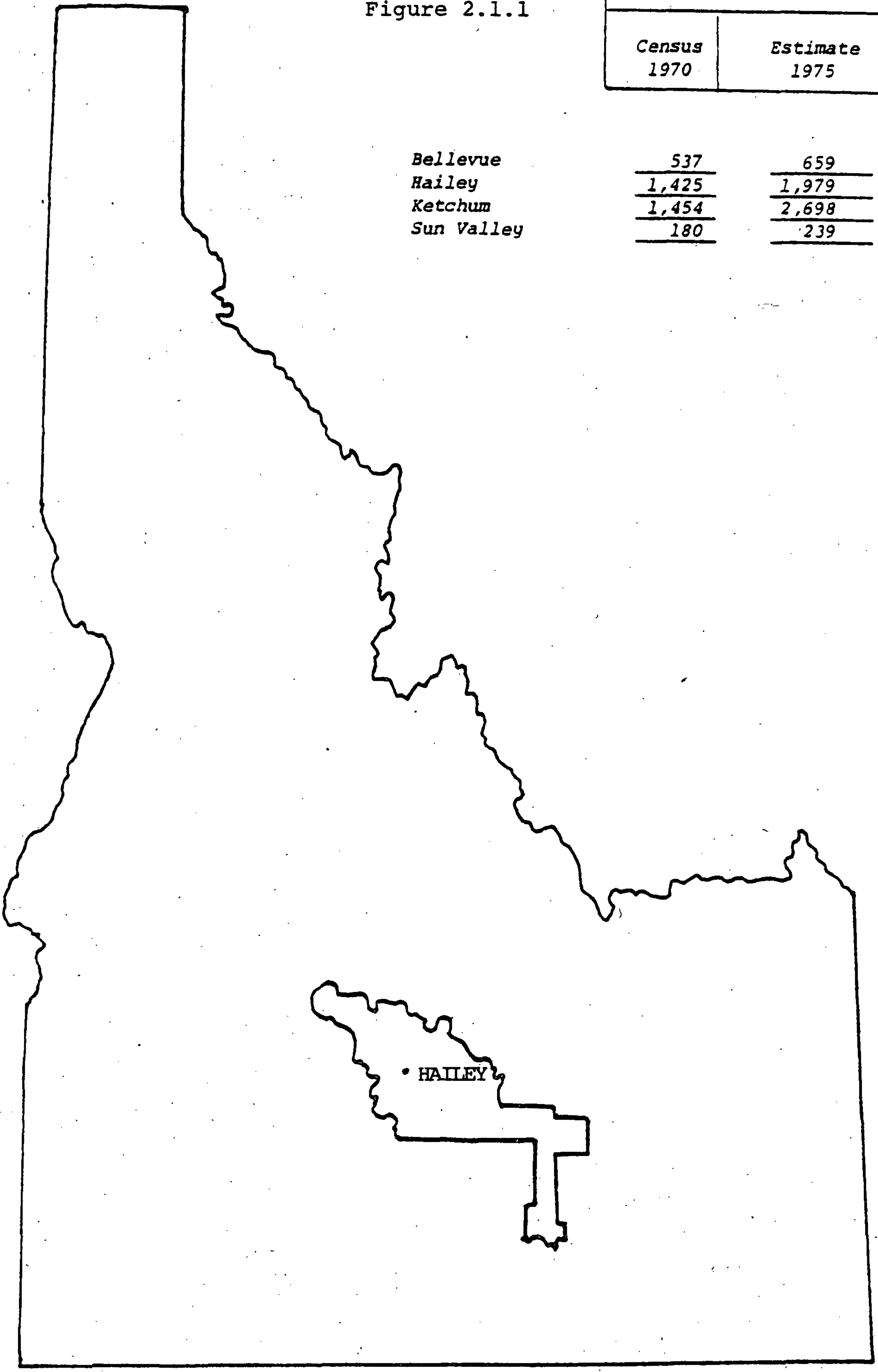
2.1 Location

Hailey Hot Springs is located 3.2 kilometers West of the City of Hailey, in Blaine County, Idaho. The City of Hailey is located 127 kilometers north of the City of Twin Falls, Idaho and 20 kilometers south of Sun Valley, Idaho. Hailey is located along U.S. Highway 93 and is serviced by a spur of the Union Pacific Railroad. Neighboring counties are Bingham, Butte, Camas, Cassia, Custer, Gooding, Lincoln, Minidoka, and Power.

The Hailey Hot Springs geothermal site is located in Democrat Gulch which is a north branch of Croy Creek Canyon. Croy Creek follows a major north-northeast trending valley which is probably fault-controlled. The hot springs are located at the intersection of Democrat Gulch and Croy Creek Canyon. An

Figure 2.1.1

City Population			
	Census 1970	Estimate 1975	Percent Change
Bellevue	537	659	22.7
Hailey	1,425	1,979	38.9
Ketchum	1,454	2,698	85.6
Sun Valley	180	239	32.8



unimproved dirt road provides access to the hot springs site, located .5 kilometers from a heavy duty gravel road which leads to the City of Hailey. Figure 2.1.2 is a site map of the Hailey Hot Springs geothermal prospect.

2.2 Demographics

The estimates of the future population of Blaine County and its population centers are made on the basis of past trends. Many changes in circumstances, especially in economic conditions, can change these trends. The local city and county population changes can very from the experience of a larger area, such as the state. However, the usual situation is for the smaller areas to follow a pattern set by the larger region. The estimates for Blaine County are related to the state estimates and assumptions for these are discussed below.

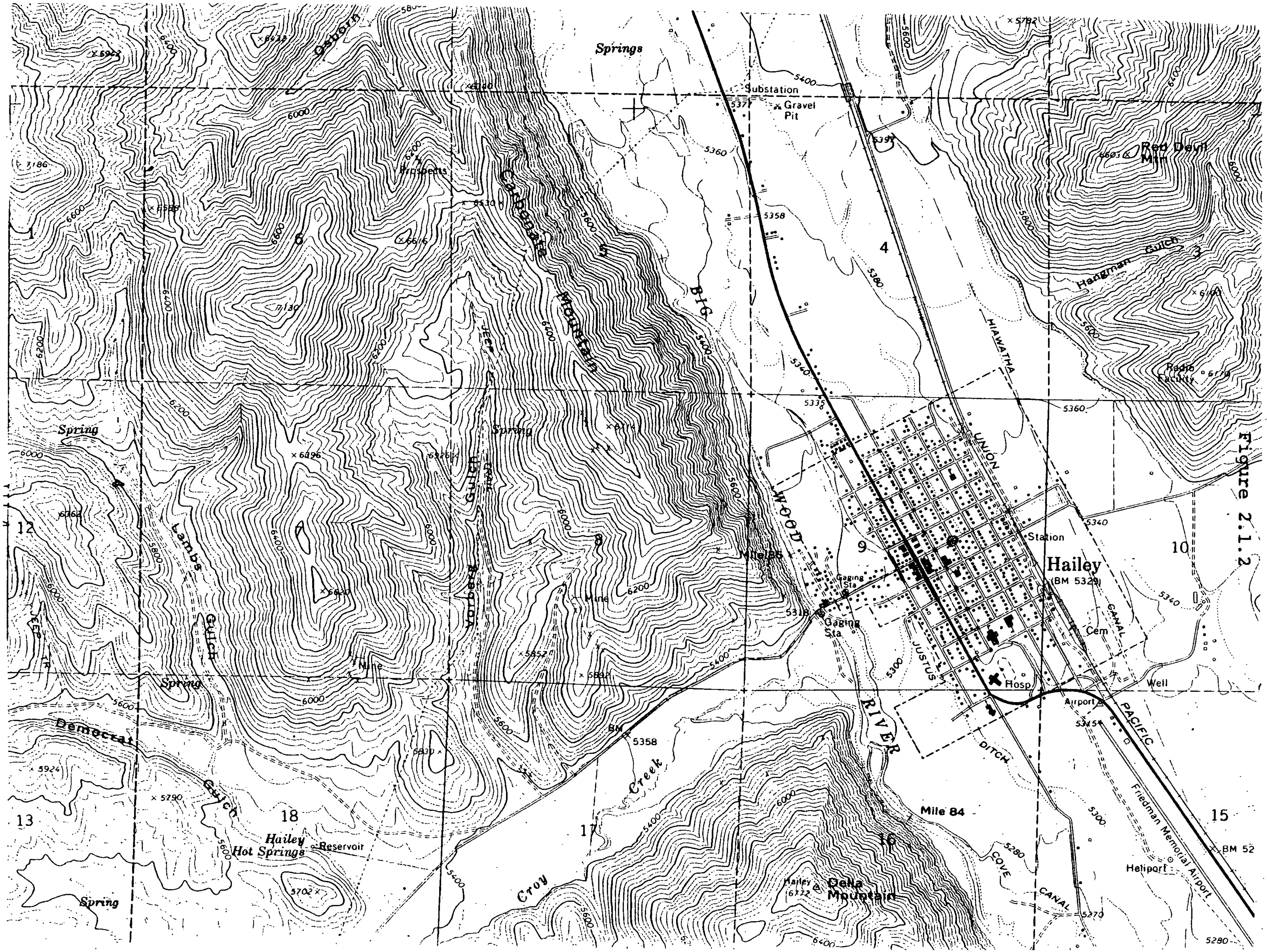
Three estimates, high, medium and low, were made for the population of Idaho until 1990. All of these are based on published estimates made by the Census Bureau.

The projected estimates for Blaine County are based upon the medium series of estimates of the state population. Growth in the county is predicted to concentrate along the Wood River between Hailey and Sun Valley.

Hailey with a 1979 estimated population of 2050, is the county seat of Blaine County. The majority of this population resides within the one square mile area of the Hailey City limits. Hailey Hot Springs is located in an agricultural area. There is one residence (a mobile home) located near the hot springs. There are no major structures between the hot springs and the City of Hailey.

The populations of the major communities in the Hailey area are listed in Table 2.2.1. Population projections for Blaine County are listed in Table 2.2.2. Blaine County is a rural county which will continue to grow and that growth will be urban and concentrated in the Upper Wood River Basin. The City of Hailey has only moderate potential for growth.

Growth in the Hailey area will depend upon continued growth in the tourist industry and the location of a year round industry in the area.



Springs
Substation
Gravel Pit
Prospects
Carbonate Mountain
Red Devil Mine
Hangman Gulch
Radio Facility
Osborn
BIG WOOD RIVER
HIAWATHA
UNION
PACIFIC
Spring
Lambs Gulch
Jeep
Yorberg Gulch
Mine
Mile 85
Gaging Sta
Station
Hailey
(BM 5329)
CANAL
Cem
JUSTUS
DITCH
Hosp
Well
Airport
Democrat Gulch
Hailey Hot Springs
Reservoir
Croy Creek
Mile 84
Della Mountain
COVE CANAL
Friedman Memorial Airport
Heliport
BM 52

Figure 2.1.2

TABLE 2.2.1

POPULATIONS OF MAJOR CITIES IN THE WOOD RIVER AREA

	1970 Census	1975 Estimate	Percent Change
Blaine County			
Bellevue	537	659	+ 22.7
Hailey	1,425	1,979	+ 38.9
Ketchum	1,454	2,698	+ 85.6
Sun Valley	180	239	+ 32.8
Camas County			
Fairfield	336	400	+ 19.0
Gooding County			
Bliss	114	138	+ 21.1
Gooding	2,599	2,835	+ 9.1
Wendell	1,122	1,492	+ 33.0
Twin Falls County			
Twin Falls	21,914	23,709	+ 8.2

TABLE 2.2.2

POPULATION AND EMPLOYMENT FORECAST

BLAINE COUNTY - 1978

EMPLOYMENT SUMMARY

	1972	1975	1980	1985	1990	1995	2000
Agriculture	392	403	362	322	285	259	235
Mining	4	6	6	6	6	6	6
Construction	344	246	393	484	585	725	896
Food and Kindred	20	27	32	36	41	48	55
Wood Products	6	16	18	20	23	26	28
Other Manufacturing	98	268	398	481	569	690	838
Trans. Comm. & Utils	74	106	136	157	181	211	247
Whsle and Retail Trade	782	1043	1471	1738	2052	2432	2889
Finance, Ins. Real Est.	121	232	328	393	469	562	674
Services and Misc.	1043	1347	1854	2202	2615	3109	3699
State and Local Govt.	494	627	830	974	1140	1339	1677
Federal Government	74	98	98	99	100	100	101
Total	3452	4419	5932	6918	8072	9512	11251

FORECAST SUMMARY

	1970	1975	1980	1985	1990	1995	2000
Total Population	5740	7750	10390	12100	14090	16500	19370
Total Employment	3450	4410	5930	6910	8070	9510	11250
Labor Force	3530	4720	6350	7400	8630	10170	12020

Source: Idaho Department of Water Resources and Center for Research, Grants and Contracts, Boise State University

2.3 Economy of the Site Area

Blaine County economic activities were analyzed to provide a working knowledge of the present and past economic base, as well as to estimate the type of future activities which could occur. Blaine County has had a growing economy in terms of total number of persons employed and personal income. Employment is seasonal and dependent upon the winter ski season. The economy of the Hailey area depends primarily on tourism. The community is service-oriented with no major industries other than agriculture and tourism.

The City of Hailey has shown a steady increase in housing starts over the last ten years. Since 1970 approximately 300 new homes have been constructed in Hailey. The unincorporated areas surrounding Hailey and Ketchum have also shown a steady increase in new housing units over the last ten years. This growth is in part due to an increasing number of vacation homes being constructed in the upper Wood River Basin. Residential growth in the Hailey area has been concentrated north and east of the city while areas west of Hailey are agricultural in character.

2.4 Elements of Blaine County's Economy

Jan. 11.2% Feb. 11.1% Mar. 11.7% Apr. 21.7% May 22.0% Jun. 14.5%

Jul. 10.9% Aug. 11.0% Sep. 10.6% Oct. 15.1% Nov. 18.9% Dec. 16.5%

Percent of labor force unemployed: 1970: 9.5% 1972: 11.7% 1975: 15.0% 1976: 14.4%

Month and percentage of highest unemployment: 1975: May 23.1% 1976: May 22.0%

Month and percentage of lowest unemployment: 1975: Aug. 9.8% 1976 Sep. 10.6%

Percent of females (16+) in labor force: 1960 (14+): 39.5% 1970: 50.7%

Employment (B.E.A. data)	1967	1970	1974	1975
Total employment	2,484	3,159	4,650	4,784
Farm proprietors	256	259	247	244
Non-farm proprietors	354	468	504	505
Wage and Salary employment:				
Federal civilian	88	73	101	98
Military	—	—	—	—
State & Local	225	396	542	627
Manufacturing	30	59	223	280
Mining	(D)	(D)	(D)	6
Construction	73	194	354	244
Trans., Comm. & Pub. Util.	43	57	109	95
Trade	368	490	927	908
Finance, Ins. & Real Estate	40	53	173	233
Services	(D)	931	1,311	1,312
Other	—	(D)	(D)	43
Farm	162	136	136	189

(D) Not shown to avoid disclosure of confidential information.

Average Idaho tax return (county) - 1976: $ 379

Average Idaho tax return (State) - 1976 $ 396

Total assessed valuation: 1975*: $41,395,708 1976: $43,158,000

*1974 subsequent rolls, 1975 real and personal rolls, and 1975 utilities.

Average levy county-wide paid per $100 assessed valuation:

1973: $8.57 1974: $8.57 1975: $8.53 1976: $9.08

Sales tax: 1974*: $1,030,358 1975*: $1,219,403 1977*: $1,292,307 *Fiscal Year

Property tax as percent of full value: County - 1976: 1.62% State - 1976: 1.55%

Per capita income: 1970 $3,764 1974 $5,333 1975 $5,602

% of national average: 1970 94.9% 1974 97.9% 1975 94.9%

% of state average: 1970 114.4% 1974 108.4% 1975 108.2%

Median family income - 1969: $8,580 Median family income* - 1976: $11,375
* HUD estimate

Transfer payments (thousands of dollars - county):
1970 $2,021 1974 $3,819 1975 $4,971

Number of business establishments - 1974: 286

2.5 Public Issue Considerations

2.5.1 Previously Established Development Patterns

Current zoning will limit commercial and light industrial development to the Hailey City limits and along the railroad right-of-way. Residential growth has been largely confined to the Hailey City limits and north of the city. A major residential and commercial development has been proposed for the Quigley Gulch area east of the City of Hailey. This development would lie between the eastern city limits and the eastern slopes of the Big Wood River Valley.

2.5.2 Major Water Sources and Applications

The major water sources for irrigation and domestic uses in the Hailey area are the Big Wood River, Croy Creek and groundwater. The predominant irrigation source is surface water. Surface diversions of the Big Wood River are used to irrigate

25,369 acres. The entire flow of the Big Wood River has been allocated for down stream uses. Groundwater is used for irrigation in the Big Wood River valley below Hailey. In the Hailey area and north of Hailey groundwater is obtained from localized fluvioglacial deposits. In the upper portions of the valley and in the Croy Creek Canyon area wells are typically less than 100 feet deep and the aquifer is confined.

Relatively little land with potential for irrigation remains to be developed in Blaine County. A reconnaissance land classification by the Bureau of Reclamation in 1967 identified about 65,000 acres of potentially irrigable land. Only half of this land is considered to be feasible for development. The sources of water for irrigation of this land will be groundwater. The federal government owns and manages most of the lands that appear to be suitable for irrigation and federal policy will dictate whether any significant additional water and irrigation development will occur in Blaine County.

Shallow aquifers appear to be the major future source of domestic water supply for the Upper Wood River valley above Hailey. Continued growth in this area could be limited by the availability of groundwater for domestic use.

2.5.3 Water Rights Hailey Hot Springs Area

Table 2.5.2. list all uses of water appearing on valid licenses and applications for permit on file with the Idaho Department of Water Resources, as of July, 1979, for the Croy Creek and Democrat Gulch areas. Both surface and groundwater sources are tabulated.

The water rights at the Hailey Hot Springs site were originally established in 1909 by court degree. In S.C. Frost vs. Alturas Water Company, the decision established that all surface waters in the Democrat Gulch area were "pertinent to the land with a priority water right of June 1, 1880." The water from the hot springs has been used for the past 60 years to heat the Hiawatha Hotel in downtown Hailey. The Hotel was destroyed by fire in January 1979. The hot water used to heat the hotel was obtained under a lease arrangement. The current status of ownership of the water is unclear. The Frost decree indicates that the diversion point land owner is the holder of the water rights of all surface waters in the Democrat Gulch area. The beneficial use for which this water is diverted is irrigation. The flow of Hailey Hot Springs is presumed by this author to be included in the surface water allocations incorporated in the Frost Decree of 1909. Subsequent separations of estates and liens on this property can only be determined by a title search of the Hailey Hot Springs property. Hailey Hot Springs is not specifically mentioned in any recorded water declarations.

Table 2.5.2
Existing Water Rights, Hailey Hot Springs Geothermal Prospect

Decreed Water Rights:

Decree Number	Ownership	Amount	Date	Comments
37-0549	J.J. Plummer	4 cfs	6-30-1882	Diversion was for the suface flow of Croy Creek, no points of diversion or application to benificial use are specified.

Licenced Water Rights:

Licence Number	Ownership	Amount	Date	Comments
37-2142	J.J. Plummer	1.5 cfs	6-24-1909	Point of diversion: Lot 4, Sec. 18, T. 2 N., R. 18 E. Points of application to benificial use are specified and diversion is for irrigation, 75 acres total. Diversion is noted as a branch of Croy Creek.
37-2313	S.J. Bension	1.1 cfs	6-21-1915	Diversion is for surface water of Croy Creek. Point of diversion is NE, NE, Sec. 17, T. 2 N., R. 18 E. Points of application are specified and divsersion is for irrigation of 55 acres total.

Domestic Water Wells (undeclared)

Well Number	Ownership	Elevation (ft)	Year Drilled	Depth (ft)	Casing (ft)	Well Log	Comments
2N-18E- 9ba	Sahaka	5340	-	30	30	NO	No known flow rates.
2N-18E-19bb	Rotarum	5400	1968	198	33	YES	184 foot drawdown after 24 hour pump test.
2N-18E-18db	Hill	5400	1969	80	80	YES	No known flow rates.

No ground water licenses have been issued for this site on any other locations in the general vicinity of Croy Creek and Democrat Gulch. Although the question of water right ownership of surface flows is currently unclear, the groundwater allocations are currently unincumbered. Presumably, the Hailey Hot Springs location could develop groundwater resources if development did not subtract from the surface flows which have been diverted for irrigation.

2.5.4 Local Land Use Zoning

Blaine County has established land use planning and zoning districts. These designations have been made to realize the general purposes stated in the Blaine County Comprehensive Plan. The Democrat Gulch area where Hailey Hot Springs is located is zoned R-5. The specific purpose of this zoning district is to limit the area to Residential/Agricultural developments of one unit per five acres. A primary objective of the Blaine County Comprehensive Plan is to allow planned development projects on unproductive agricultural lands and limit development on productive agricultural lands.

2.6 Climate

The climate of Blaine County varies with elevation. The lower Big Wood River Valley and the Snake River Plain areas have a semi-arid climate with warm summers and moderate winters. The mountainous areas are cool in summer and cold in winter, with heavy snowfalls.

The average frost free period for the major agricultural areas is 80 to 110 days. Due to the short growing seasons, crops that are frost tolerant and mature quickly are the most successful. These include grains, hay, pasture and seed potatoes.

Table 2.6 summarizes data from Hailey and Sun Valley. Data from Richfield, in Lincoln County, was added to more accurately reflect the climate of the county occurring on the Snake Plain.

2.7 Soils

The mountainous areas of Blaine County are comprised of a variety of rock types and the soils developed from these rock types reflect this variation. For the most part, the soils at higher elevations are darker in color and higher in organic matter than those of the Snake Plain. Soil depths and textures vary with steepness of terrain and exposure.

Soils of the Croy Creek valley have formed in mixed alluvial fill. Many of the soils are quite gravelly and most are underlain by gravels and cobbles at moderately shallow depths. For the most part, these alluvial soils are well drained and salts are not a problem. Textures are mostly medium and well suited for most crops.

TABLE 2.6

CLIMATOLOGICAL DATA FOR BLAINE COUNTY

Station	Hailey	Sun Valley	Richfield**
Elevation	5,328'	5,812'	4,306'
Years of Record	59	29	44
Average Daily Temperature (°F)			
January Minimum	6.7	1.9	11.1
January Maximum	30.6	30.8	29.9
July Minimum	49.5	36.9	50.7
July Maximum	86.5	82.1	87.4
Lowest Temperature of Record	-36	-46	-40
Highest Temperature of Record	109	96	105
Average Annual Days			
Maximum of 90° or more	19	6	19
Minimum of 32° or less	191	285	188
Growing Season*	94	95	105
Average Precipitation (inches)			
Annual Precipitation	14.53	17.01	9.64
Annual Snow Fall	88.5	118.9	35.4
January Precipitation	2.11	2.22	1.41
July Precipitation	.41	.71	.26
Average Annual Number of Days with Precipitation			
.10 inches or more	40	49	39
.50 inches or more	8	13	6
Degree Days	8070	9986	7306

** Richfield was added from Lincoln County

* The average number of days between mean last 32° temperature in spring and mean first 32° in fall, that is the average freeze free period.

Source: Idaho Climatological Summary Data by Counties. National Weather Service Climatology in Cooperation with the Idaho Department of Commerce and Development, Boise, Idaho. October 1971.

3.0 Resource Evaluation

3.1 Description of Springs

Hailey Hot Springs has been utilized for spaceheating the 6,000 square foot Hiawatha Hotel for over 40 years. This structure was recently destroyed by fire and the water system is currently not in service. The spring has a discharge of 4.42 liter per second and a surface temperature of 59C^{o} (138^{o}F). There are several thermal seeps in the vicinity of the major spring which is partially diverted into a small diameter pipeline which is connected to the former Hiawatha Hotel site, 3.2 kilometers to the east of Hailey Hot Springs.

3.2 General Physiography and Geology

Mountains of both the Sawtooth and Pioneer Range are prominent in the Upper Wood River Basin. Several peaks are over 3048 Meters in height. Carboniferous sedimentary rocks and challis volcanics are the dominant rocks present in the mountains with minor inclusions of granitics and other rocks.

The Carbonate Mountains dominate the topography in the Hailey Hot Springs area. Elevations range from 1645.9 meters at the Croy Creek Springs to 2046.4 meters at the summit of Della Mountain near Hailey. Hailey Hot Springs has an elevation of 1662.6 meters. The City of Hailey is 47.2 meters lower than the hot springs with an elevation of 1615.4 meters. There are no major topographic barriers between the hot springs and the City of Hailey.

The geological framework of the Hailey area consists of undifferentiated paleozoic and mesozoic marine sedimentary rocks (Mitchell, Johnson and Anderson, Idaho Department of Water Resource Water Info. Bull. 30, Part 9, 1979). The hot springs are located in Democrat Gulch which is a north trending tributary of Croy Creek which is in turn a southwest trending tributary of the Big Wood River. The structural setting of the hot springs infers that the thermal waters are fault controlled. Croy Creek appears to be a fault-controlled drainage. The exact nature of the Democrat Gulch structure has not been determined but is probably fault-controlled. Hailey Hot Springs is located near the intersection of Croy Creek and Democrat Gulch structures.

It is not known which structure controls the occurence of thermal waters at Hailey Hot Springs. Hailey Hot Springs does lie along a north trending curvilinear (Mitchell, Part 9, 1979) which connects several hot springs in the area. This curvilinear trend is in echelon with the structures which control the Big Wood River valley.

In general the geological structure in the area is poorly known, but is believed to be very complex. Extensive folding, thrusting and faulting in the area makes interpretation difficult. Knowledge of the structural geology should be developed in order to better understand the occurence of thermal water and the depth of the alluvial fill in the valley floors. Detailed surface mapping is needed.

The depth of the alluvial fill is unknown. Except for wells near the edge of the Big Wood Valley and along the margins of the tributary valleys, most wells in the area do not encounter bedrock. This is especially true of wells near Hailey.

3.3 Exploration

Mitchell and Anderson (1979) reporting on the occurence of thermal water in Blaine County stated, "It is not known which structure or structures control the occurence of thermal water at Hailey Hot Springs (Big Wood structure, Croy-Quigley Creek structure or Democrat Gulch structure). In order to confirm the size and exact location of the geothermal reservoir for spaceheating the town's buildings and residences, it will be advisable to evaluate, in some detail, reservoir characteristics to determine the amount and characteristics of geothermal water which could be withdrawn for use. This could be done by drilling observation wells and running well tests, and perhaps drilling exploration holes to see if existing water flows could be augmented, or a new source found closer to Hailey."

Mitchell's (1979) geochemical analysis on Hailey Hot Springs indicates a temperature of 78C^{o} (172^{o}F) might be encountered by deeper drilling. It is not known at what depth this temperature might be encountered but it may be as deep as 1,000 Meters.

3.4 Geochemical and Geophysical Description

The U.S. Geological Survey estimates of the Hailey Hot Springs reservoir volume and thermal energies are listed in Table 3.4.1. Gravity surveys indicate a strong regional gradient controlled by the transition from Snake River Plain gravity high to the gravity low over the Idaho Batholith (Applegate and Donaldson, 1979). Any detailed interpretation from gravity will necessitate increasing the amount of local data. A small amplitude, low frequency magnetic high identified by Applegate and Donaldson (1979) is centered over the Bald Mountain area north of Hailey Hot Springs. An associated low to the north may indicate buried igneous rocks.

The geochemistry of Hailey Hot Springs (Mitchell, 1979) is listed in Table 3.4.2. Geochemical thermometry indicates that the maximum subsurface temperature expected at Hailey Hot Springs should range between 78C^{o} (189^{o}F) and 97^{o}C (206^{o}F). Table 3.4.3 list the geochemical temperature estimates for hot springs located near Hailey, Idaho.

TABLE 3.4.1

U.S.G.S. RESERVOIR VOLUMES AND

THERMAL ENERGIES ESTIMATE HAILEY HOT SPRINGS

Location T. 2N. R. 18 E. Sec. 18, Boise Meridian	
Reservoir Temperature	80C° (176°F) to 130°C (266°F)
Reservoir Volume	1.0 ± .5 km^3
Reservoir Thermal Energy	.17 x 10^{18} J
Best Estimate - Beneficial Heat	.67 x 10^{18} J
Depth to Reservoir	1,500 meters to 3,000 meters

Source: U.S. Geological Survey Circulary 790 (1978).

TABLE 3.4.2

CHEMICAL ANALYSIS OF HAILEY HOT SPRINGS
(Chemical Constituents in milligrams per liter)

Sample Collection Data	Discharge (GPM)	Temperature (OC)	Silica (Si)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Phosphate (P)	Chloride (CI)	Fluoride (F)	Nitrate (NO_3)	TDS	pH
7-11-72	70	59	85	2	0	68	1.5	88	0	51	.02	10	12	.07	273	8.7

TABLE 3.4.3
Geothermometer Temperatures

Springs or Well Identification	Discharge l/m	Known Temp. °C	Aquifer Temperature Predicted by Geochemical Thermometry °C * T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Guyer Hot Springs 4N 17 E 15 aac	1,000	71	128	125	9	101	88	88	64	88
Clarenden H. S. 3N 17 E 27 deb	100	47	125	122	6	97	87	45	53	87
Hailey Hot Springs 2N 18 E 18 dbb	70	59								
Magic Hot Springs Landing 1 S 17 E 23 aab	10	72	139	135	19	113	174	172	148	99

*

T_1 = Silica Temperature assuming quartz equilibrium and Conductive cooling (no steam loss)

T_2 = Silica temperature assuming quartz equilibrium and adiabatic expansion at constant enthelpy (maximum steam loss)

T_3 = Silica temperature assuming equilibrium with amorphous silica

T_4 = Silica temperature assuming equilibrium with chalcedony and conductive cooling (no steam loss)

T_5 = Na-K-Ca temperature

T_6 = Na-K-Ca temperature corrected for PCO_2

T_7 = Na-K-Ca temperature corrected for Mg

T_8 = Ha-K temperature

Source: Idaho Department of Water Resources
Bull 30, Part 9, 1979

3.5 Potential Applications of Resource

The potential resource temperature range of Hailey Hot Springs is from 60C° (140°F) to 80C° (176°F). Resources in this temperature range are generally used for space heating. Several possible space heating applications are possible. Three scenarios are realistic: 1) Spaceheating of greenhouses at the hot springs location; 2) Spaceheating a new subdivision development somewhere between the hot springs and the City of Hailey; 3) Spaceheating residential and commercial buildings in Hailey.

The development of a greenhouse complex at Hailey Hot Springs would be compatible with the zoning regulations of the area. The major factor limiting this type of development is limited market potential for produce in the area.

The development of a new subdivision at Hailey Hot Springs or at a location west of Hailey is not considered realistic. Current planning and zoning discourages growth west of Hailey.

Space heating residential and commercial buildings in Hailey is considered the most probable development scenario. Hailey represents an available and reliable market. Historical use of the hot springs to heat the Hiawatha Hotel has created a climate of awareness and demonstrated the reliability of the resource. The potential for development of Hailey Hot Springs for spaceheating the City of Hailey is analyzed in the following section.

4.0 Site Specific Application

The development of Hailey Hot Springs for a district heating system capable of heating the residential and commercial building in Hailey is estimated to cost $2.16 million. This cost estimate includes capital investment required for production, transmission and injection systems. The following economic analysis represents a preliminary examination of the economic viability of geothermal space heating at Hailey, Idaho. Table 4.0 details the estimated capital investment required to develop the Hailey geothermal spaceheating system.

TABLE 4.0

Capital Cost Breakdown

I.	Transmission System:		$ 1,039,000
	Main to City	$ 388,000	
	Perimeter	354,000	
	Connectors	297,000	
II.	Supply System:		309,400
	A. Supply Wells @ 1500 ft.	253,400	
	B. Supply Pumps 4 @ 52 HP	56,000	
III.	Disposal System:		808,300
	A. Injection Well 2 @ 1000 ft.	81,300	
	B. Injection Pumps 2 @ 52 HP	28,000	
	C. Disposal Line	699,000	
	Total Capital Investment		$ 2,156,700

Amortized Over 30 years
at 10% = $228,781 per year

4.1 Consideration for a Heating System

The real issues here are: What is the demand for heat in Hailey and how much heat would be available from the proposed geothermal wells?

An unofficial population figure supplied by the City of Hailey indicates 2400 citizens, a figure which is consistent with past estimates and future projections by the Idaho Division of Budget, Policy Planning, and Coordination. Dividing that figure by 3.5, the average number of persons per household gives an estimate of 686 residential customers for a heating system. A very tentative estimate of the number of commercial buildings in Hailey is 50. Adding that to residential customers gives an estimate of 736 heat customers.

Hailey has 8070 heating degree days and an average January minimum temperature of -14°C (6.7°F). Using a design temperature difference of 21°C (70°F), 18.3°C (65°F) to -15°C (-5°F), for an 1800 square foot house of average energy efficiency, one gets an annual heat load of 1.55×10^8 BTUs (8070 X 19,200 BTUs). This individual demand for heat multiplied by 736 customers gives an annual heat load of 1.14×10^{11} BTUs per year for Hailey heat customers.

Design heat load per house is 5.6×10^4 BTU per hour (21°C (70°F) X 800 BTUs per hour). This means a total demand for all Hailey customers of 4.12×10^7 BTUs per hour.

Water flow requirements to meet this peak heat load are found by dividing the design heat load by 500 times the temperature drop, which is expected to be 2.7°C (37°F) for water of 80°C (176°F). To meet the design heat load, therefore, about 2200 gallons per minute will be required. This flow would provide 4.07×10^7 BTUs per hour of peak heat flow, enough to meet total demand.

Over the year 2200 gallons per minute would provide 3.57×10^{11} BTU, which is considerably higher than the annual heat load of 1.14×10^{11} BTUs. This would seem to indicate considerable potential for cascade uses in non-peak periods.

4.2 Proposed Facilities

4.2.1 Transmission System

Water would be pumped in a straight line to the nearest county road, then along the road to the first cross street in Hailey. From that point a smaller diameter pipe would carry water along the perimeter of the city in a rectangular system. Final delivery to customers would be accomplished with twelve parallel connectors across the system. (See Figure 4.2.1).

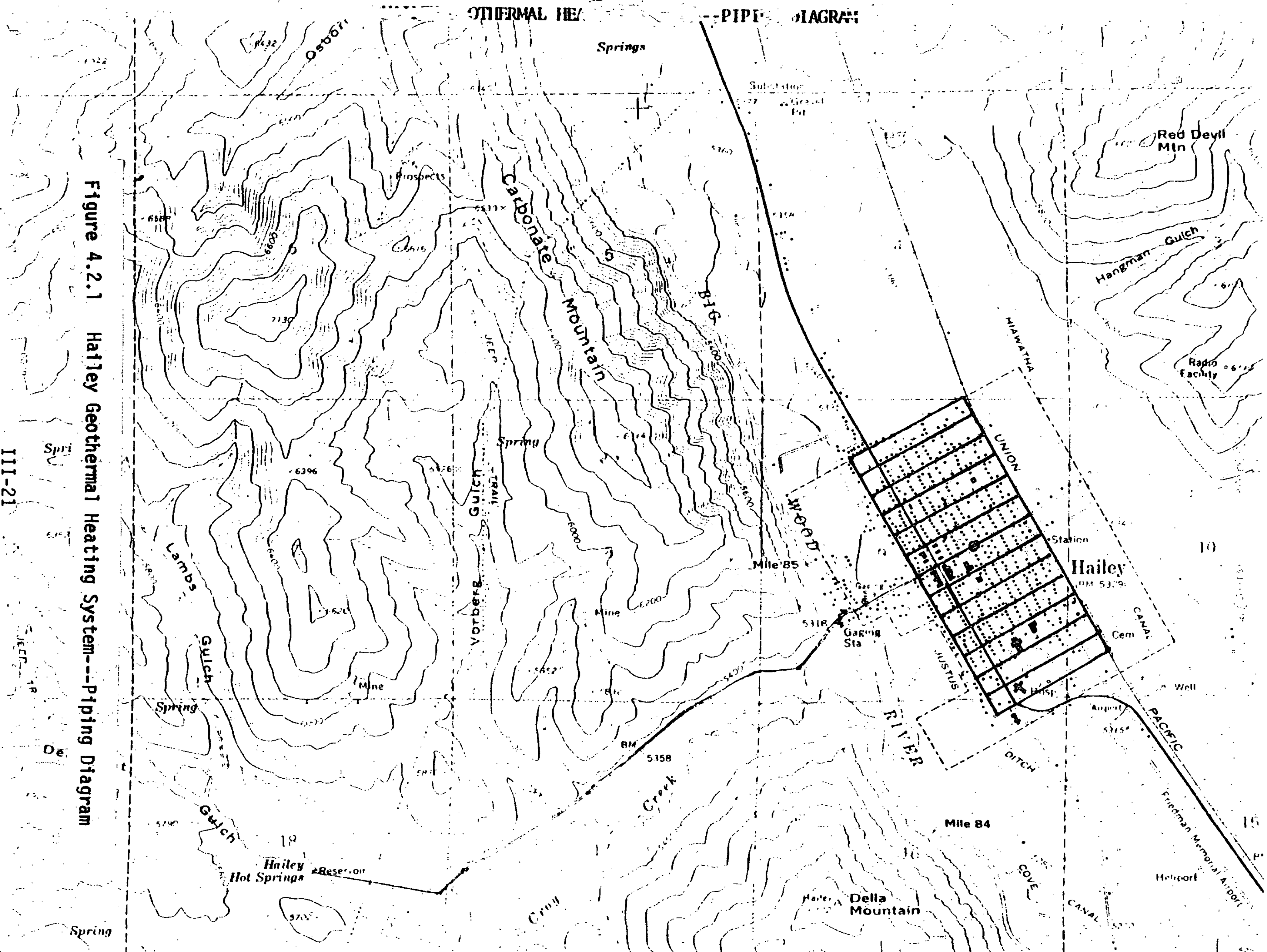


Figure 4.2.1 Hailey Geothermal Heating System--Piping Diagram

A 10" pipe would extend 12,125 feet from the wellhead to the edge of town. The perimeter piping would require 14,750 feet of 8" pipe and the twelve connectors will require 27,500 feet of 3" pipe. All pipe would be asbestos cement, insulated and buried to a depth of 3 feet. Pipe costs are estimated as $32 per foot for 10", $24 per foot for 8", and $11 per foot for 3".

4.2.2 Supply System

A. Supply Wells

Four 550 GPM wells would have to be drilled near the present site of Hailey Hot Springs to provide a total supply flow near 2200 GPM. The well program chosen was worked up for a 1500 foot depth. A 10" hole would be drilled to 160 feet and an 8" casing set. The hole would then be drilled 8" to depth and 6" casing would be set over the total depth.

Drilling costs were estimated at $1 per inch of diameter for 160 feet, $2.50 per inch of diameter to 500 feet, with an additional $1 per inch of diameter for every additional 500 feet. Casing costs were $1 per inch of diameter per foot. A generous allowance of 25% of drilling and casing cost was added to cover overhead items plus unspecified drilling problems.

B. Supply Pumps

Vertical turbine downhole pumps set for a 150 foot lift would pump the geothermal fluid from the well to the city. Four pumps of 52 HP each could accomplish this task. These pumps would require a maximum of $6796 per year in electric power, based on a pumping rate of 2¢ per KWH. Total cost for each pump, including installation and contractors fees and the main valves, would be approximately $14,000.

4.2.3 Disposal System

A. Injection Well

Spent geothermal fluid could be disposed of by injection at a site near the Hailey Airport, about 1500 feet southeast of the perimeter piping. The injection well would be 1,000 feet deep drilled 12" to 160 feet with 10" casing, then a 10" hole to depth with 8" casing the entire 1,000 feet to the surface. Drilling cost estimates are the same as for the supply well. A 25% allowance for contingencies is also included in the final well cost.

B. Injection Pump

This pump was sized the same as supply pumps, and the estimate is also the same.

C. Disposal Lines

Disposal lines cover the same distances as the perimeter and connector distances listed under the transmission system. In addition, 1500 feet of 10" pipe is necessary to take the spent water from the perimeter piping to the disposal site near the airport. Though the return pipe would be uninsulated, it would also be asbestos cement. Due to the small relative cost of insulation and the uncertainty associated with pipe cost estimates, the same dollar figures were used for both transmission and disposal systems.

4.3 Cost Analysis

A 20-year cost comparison of gas with geothermal heat is shown in Table 4.3.1. The cost of natural gas is derived by assuming average heat load of 56,000 BTU/hour and a heat load factor of .32, then multiplying by 736 customers, to get total heating demand for the city. Converting this to therms and multiplying by present gas rates gives present year costs if all homes were gas heated. This cost was then projected to increase at rates given in the Dames and Moore study, footnoted in Table 4.4. Electricity cost represents the maximum requirement for all six pumps (4 production and 2 injection). Operations and maintenance are estimated as 1/2% of cost for piping and 3% of cost for pumps, escalating at 7% per year. Taxes and insurance are estimated at 2% of capital cost, rising at 2% per year. Annual savings represent what would have been spent for gas minus actual operating expense with geothermal. The annual savings streams were discounted at 10% and 20% to convert them to present worth. The higher discount factor reduces the present value of 20-years' savings and increases the payback period from 8.1 to 15.3 years. The payback period and savings stream from this investment are attractive economically only at the lower of the two discount rates, 10%.

Table 4.3.2 presents price projections for conventional fuel sources, in billing terms and converted to millions of BTUs for easier comparison. These prices have been adjusted for conversion efficiency so that final prices are for millions of usable BTUs. (Electricity is assumed to be 100% efficient, gas 80% and oil 70%). All prices in Table 4.3.2, plus all other energy prices in the overall analysis, have been escalated at rates given in the Dames and Moore study prepared for the Idaho Public Utilities Commission. These projections were prepared in late 1977 and today there is considerable doubt as to their accuracy. Particularly for gas prices, the Dames and Moore rates are low. Since no more comprehensive set of projections has appeared, we will continue to use Dames and Moore.

TABLE 4.3.1
20-YEAR COST COMPARISON OF GAS WITH GEOTHERMAL HEAT

	(1) Cost of Natural Gas	(2) GEO Electricity	(3) GEO Operations & Maintenance	(4) GEO Taxes & Insurance	Annual Saving 1-(2+3+4)	Present Worth (10%)	Present Worth (20%)
1979	412,235	40,776	11,210	43,134	317,115	288,286	264,263
1980	441,504	44,487	11,995	43,997	341,025	281,839	236,823
1981	472,850	48,535	12,834	44,877	366,604	275,435	212,155
1982	506,423	52,952	13,733	45,774	393,964	269,083	189,990
1983	545,417	57,029	14,694	46,690	427,004	265,136	171,603
1984	587,415	61,420	15,723	47,623	462,649	261,153	154,940
1985	632,645	66,150	16,823	48,576	501,096	257,141	139,847
1986	681,359	71,248	18,001	49,547	542,388	253,028	126,142
1987	733,824	76,729	19,261	50,538	587,296	249,071	113,822
1988	790,328	83,404	20,609	51,549	634,766	244,730	102,518
1989	851,184	90,660	22,052	52,580	685,892	240,401	92,313
1990	916,725	98,548	23,595	53,632	740,950	236,090	83,102
1991	987,312	107,121	25,247	54,704	800,240	231,801	74,794
1992	1,063,335	116,441	27,014	55,798	864,082	227,540	67,300
1993	1,145,212	126,571	28,905	56,914	932,822	223,310	60,545
1994	1,233,394	137,583	30,929	58,053	1,006,829	219,115	54,457
1995	1,328,365	149,553	33,094	59,214	1,086,504	214,959	48,972
1996	1,430,649	162,564	35,410	60,398	1,172,277	210,844	44,032
1997	1,540,809	176,707	37,889	61,606	1,264,607	206,773	39,583
1998	1,659,451	192,080	40,541	62,838	1,363,992	202,749	35,578
						4,858,484	2,361,751
						Capital Payback 8.1 years	Capital Payback 15.3 years

Table 4.3.2
FUEL PRICES - PROJECTED 20 YEARS

	Electricity		Gas		#2 Fuel Oil		Electricity with Planning Bill	
	\$/Kwh	\$/10^6 BTU	\$/Therm	\$/10^6 BTU	\$/Gal.	\$/10^6 BTU	\$/Kwh	\$/10^6 BTU
1979	.02497	7.316	.382	4.776	.739	7.610	.02497	7.316
1980	.02724	7.982	.409	5.115	.789	8.127	.02487	7.287
1981	.02972	8.708	.438	5.478	.843	8.680	.02477	7.258
1982	.03243	9.501	.469	5.867	.900	9.270	.02824	8.274
1983	.03492	10.101	.506	6.284	.961	9.901	.03219	9.432
1984	.03761	10.879	.544	6.730	1.027	10.574	.03670	10.753
1985	.04051	11.716	.586	7.208	1.097	11.293	.04184	12.259
1986	.04363	12.618	.632	7.720	1.171	12.061	.04769	13.973
1987	.04699	13.716	.680	8.268	1.251	12.881	.05437	15.930
1988	.05060	14.909	.733	8.855	1.338	13.783	.06198	18.160
1989	.05450	16.207	.789	9.483	1.432	14.748	.07066	20.703
1990	.05870	17.617	.850	10.157	1.532	15.780	.08055	23.601
1991	.06322	19.149	.915	10.878	1.640	16.885	.09183	26.906
1992	.06808	20.815	.986	11.650	1.754	18.066	.10468	30.671
1993	.07333	22.626	1.061	12.477	1.877	19.331	.11934	34.967
1994	.07897	24.594	1.143	13.363	2.009	20.684	.13605	39.863
1995	.08505	26.734	1.231	14.312	2.149	22.132	.15509	45.441
1996	.09160	29.060	1.326	15.328	2.300	23.681	.17681	51.80
1997	.09866	31.588	1.428	16.416	2.461	25.339	.20156	59.057
1998	.10625	34.336	1.538	17.582	2.633	27.113	.22978	67.326

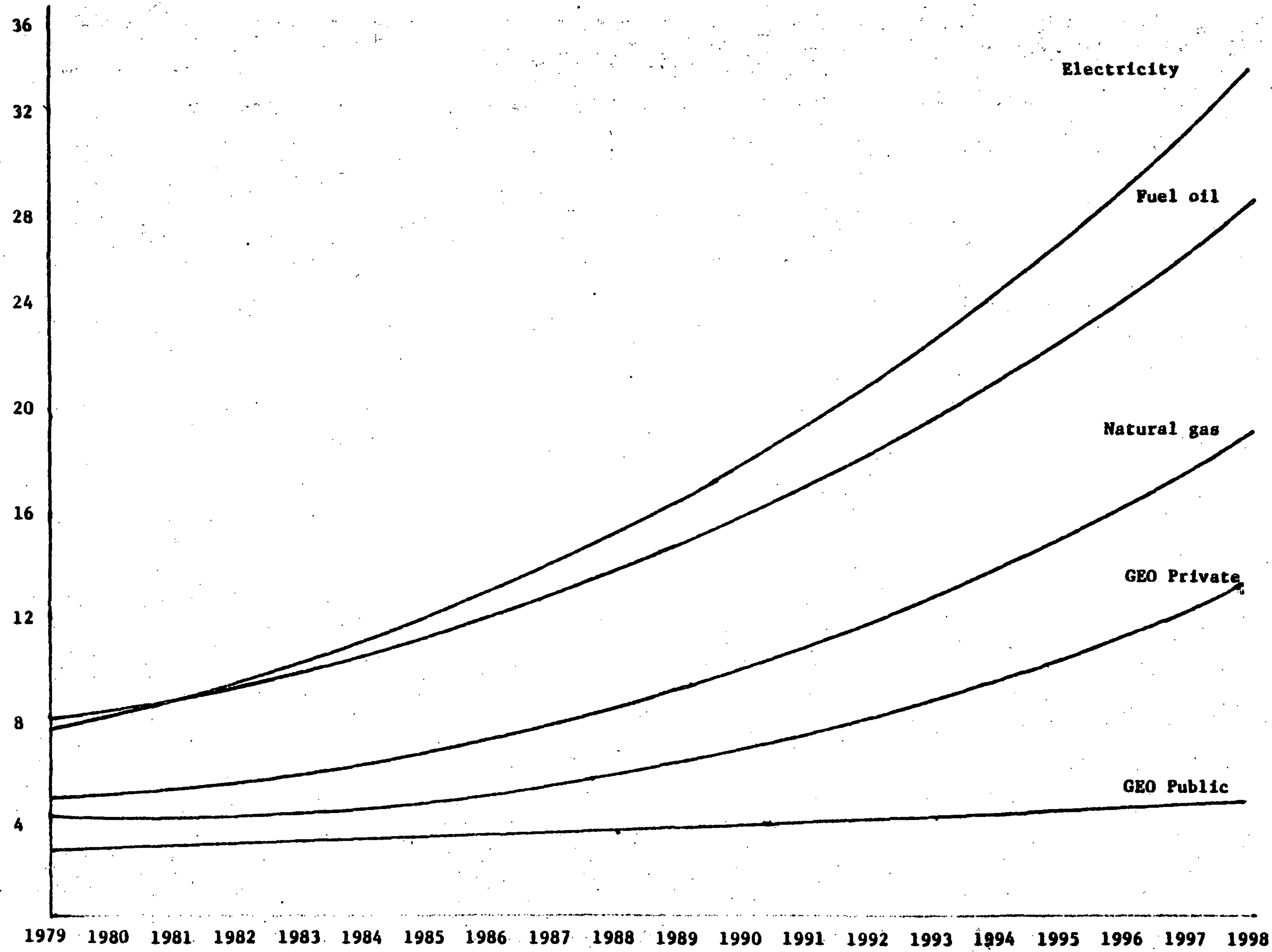


Figure 4.3.3 20-Year Projection of Energy Prices

Keep in mind that if a case for geothermal heat can be made, with these rates of increase for conventional fuel alternatives, which we know are conservative, actual increases beyond these conservative projections only serve to enhance the competitiveness of geothermal heat.

The final column in Table 4.3.2 represents an unofficial estimate by IPUC staff of the impact of the proposed NW Energy Policy Planning Act on Electricity prices. Basically, it projects that the Energy Northwest Bill will put off price increases for about 3 years, at which time electricity rates will start to rise at a rate of 13% per year. (Table 4.3.2 carries the 13% rate all the way to 1998).

Estimates of future fuel prices from Table 4.3.2 along with estimates of geothermal prices for both public and private facilities from Tables 4.4 and 4.5 are found in graphical form in Figure 4.3.3.

4.4 Private and Public Geothermal Systems

Tables 4.4 and 4.5 present estimates of the costs of providing geothermal heat to the City of Hailey with a private or public system. Footnotes to each table give all necessary information on how estimates for cost categories were derived and how they are expected to change over time.

The important differences between the two ownership forms for a geothermal heating system show up in the last (cost) columns in each table (or see Table 4.6). Maintenance and power costs are identical for both. The public system, with a billing system already intact in connection with other city business, is estimated to need only $25,000 for management versus $75,000 for a private firm starting anew. The only other cost for the public firm is amortization. Although the system could be revenue bonded and financed through taxes, it has been treated for purposes of cost analysis as if the city had borrowed the capital cost and had to make yearly payments over the life of the mortgage.

For the private system, depreciation, taxes and a 10% return on total investment have been included as costs. These are items the private firm will want to, or must, cover if it is to remain economically viable.

Total heat available with a 2.77°C (37°F) temperature drop and a flow of 2200 GPM was divided by the available cubic feet of water at that flow to establish heat content of the water. This heat content figure was multiplied by the available water and Hailey's heat load factor to establish the number of therms of heat available.

TABLE 4.4
GEO PUBLIC

	(1) Electric Power	(2) Maintenance	(3) Management	(4) Amortization	(5) Total Cost	(6) Cost/100 ft^3	(7) Cost/Therm	(8) Cost/10^6 BTU
1979	40,776	11,210	25,000	228,781	305,767	$ .621	$.267	$2.67
1980	44,487	11,995	26,750		312,013	.634	.273	2.73
1981	48,535	12,834	28,623	"	318,773	.648	.279	2.79
1982	52,952	13,733	30,626		326,092	.663	.285	2.85
1983	57,029	14,694	32,770	"	333,274	.677	.292	2.92
1984	61,420	15,723	35,064		340,988	.693	.298	2.98
1985	66,150	16,823	37,518	"	349,272	.710	.305	3.05
1986	71,243	18,001	40,145		358,170	.728	.313	3.13
1987	76,729	19,261	42,955	"	367,726	.747	.322	3.22
1988	83,404	20,609	45,961		378,755	.770	.331	3.31
1989	90,660	22,052	49,178	"	390,671	.794	.342	3.42
1990	98,548	23,595	52,621		403,545	.820	.353	3.53
1991	107,121	25,247	56,305	"	417,454	.848	.365	3.65
1992	116,441	27,014	60,246		432,482	.879	.378	3.78
1993	126,571	28,905	64,463	"	448,720	.912	.392	3.92
1994	137,583	30,929	68,976		466,269	.948	.408	4.08
1995	149,553	33,094	73,804	"	485,232	.986	.424	4.24
1996	162,564	35,410	78,970		505,725	1.028	.442	4.42
1997	176,707	37,889	84,498	"	527,875	1.073	.462	4.62
1998	192,080	40,541	90,413	"	551,815	1.122	.483	4.83

(1) Power for six pumps projected to increase at Dames & Moore rates, 9.1% thru 1982, 7.7% thru 1987, 8.7% thereafter
(2) Projected to increase 7% per year
(3) Projected to increase 7% per year
(4) Capital cost of $2,156,700 amortized over 30 years at 10%
(5) Total of (1) + (2) + (3) + (4)
(6) Total cost per year divided by yearly water use of 49.28 X 10^6 ft.^{3}.
(7) Total cost per year divided by yearly therms available from water, 1,143,296 therms.
(8) Column (7) multiplied by 10 to convert to millions of BTUs.

TABLE 4.5

GEO PRIVATE

	(1) Electric Power	(2) Main-tenance	(3) Manage-ment	(4) Depreci-ation	(5) Taxes	(6) Return on Investment	(7) Total	(8) Cost/ 100 ft.^{3}	(9) Cost/ Therm	(10) Cost 10^6 BTU
1979	40,776	11,210	75,000	71,890	43,134	215,670	457,680	$ .929	$ .400	$ 4.00
1980	44,487	11,995	80,250	"	43,997	230,767	483,386	.981	.423	4.23
1981	48,535	12,834	85,868	"	44,877	246,921	510,925	1.037	.447	4.47
1982	52,952	13,733	91,878	"	45,774	264,205	540,432	1.097	.472	4.72
1983	57,029	14,694	98,310	"	46,690	282,699	571,312	1.159	.499	4.99
1984	61,420	15,723	105,191	"	47,623	302,488	604,335	1.226	.528	5.28
1985	66,150	16,823	112,595	"	48,576	323,663	639,697	1.298	.559	5.59
1986	71,243	18,001	120,434	"	49,547	346,319	677,434	1.375	.592	5.92
1987	76,729	19,261	128,864	"	50,538	370,561	717,843	1.457	.628	6.28
1988	83,404	20,609	137,884	"	51,549	396,500	761,836	1.546	.666	6.66
1989	90,660	22,052	147,536	"	52,580	424,256	808,974	1.642	.707	7.07
1990	98,548	23,595	157,864	"	53,632	453,953	859,482	1.744	.751	7.51
1991	107,121	25,247	168,914	"	54,704	485,730	913,606	1.854	.799	7.99
1992	116,441	27,014	180,738	"	55,798	519,731	971,611	1.972	.849	8.49
1993	126,571	28,905	193,390	"	56,914	556,112	1,033,782	2.098	.904	9.04
1994	137,583	30,929	206,927	"	58,053	595,040	1,100,422	2.233	.962	9.62
1995	149,553	33,094	221,412	"	59,214	636,693	1,171,856	2.378	1.024	10.24
1996	162,564	35,410	236,911	"	60,398	681,262	1,248,432	2.533	1.091	10.91
1997	176,707	37,889	253,495	"	61,606	728,950	1,330,537	2.700	1.163	11.63
1998	192,080	40,541	271,240	"	62,838	779,976	1,418,565	2.879	1.240	12.40

(1) Power for six pumps projected to increase at Dames & Moore rates
(2) & (3) Projected to increase 7% per year
(4) Straight-line, 30 yr. life, on investment of $2,156,700
(5) Estimated at 2% of investment, rising 2% per year
(6) Estimated at 10% of investment, rising 7% per year
(7) Total of all previous items
(8) Column (7) divided by geothermal water flow of 49.28 X 10^6 ft.^{3}
(9) Column (7) divided by heat available from water, 1,143,296 therms
(10) Column (9) X 10

TABLE 4.6

GEO PUBLIC AND GEO PRIVATE RATES OF RETURN

	(1) COST OF NATURAL GAS	(2) GEO PRIVATE COST	(3)=(1)-(2) SAVINGS	(4) GEO PUBLIC COST	(5)=(1)-(4) SAVINGS
1979	412,235	457,680	45,445	305,767	106,468
1980	441,504	483,386	41,882	312,013	129,491
1981	472,850	510,925	38,075	318,773	154,077
1982	506,423	540,432	34,009	326,092	180,331
1983	545,417	571,312	25,895	333,274	212,143
1984	587,415	604,335	16,920	340,988	246,427
1985	632,645	639,697	7,052	349,272	283,373
1986	681,359	677,434	3,925	358,170	323,189
1987	733,824	717,843	15,981	367,726	366,098
1988	790,328	761,836	28,492	378,755	411,573
1989	851,184	808,974	42,210	390,671	460,423
1990	916,725	859,482	57,243	403,545	513,180
1991	987,312	913,606	73,706	417,454	569,858
1992	1,063,335	971,611	91,724	432,482	630,853
1993	1,145,212	1,033,782	111,430	448,720	696,492
1994	1,233,394	1,100,422	132,972	466,269	767,125
1995	1,328,365	1,171,856	156,509	485,232	843,133
1996	1,430,649	1,248,432	182,217	505,725	924,924
1997	1,540,809	1,330,537	210,272	527,875	1,012,934
1998	1,659,451	1,418,565	240,886	551,815	1,107,636
			Internal Rate of Return = -3.36%		Internal Rate of Return = 13.33%

Cost figures from both private and public systems were divided by these figures, cubic feet of water and therms, to arrive at costs per 100 cubic feet of geothermal water and costs per 10^6 BTUs. Figures were then ready for comparison with each other and with costs of conventional fuel sources. A graph of this comparison is found in Figure 4.3.3.

4.5 Economic Conclusions

Annual savings in operating costs for geothermal heating versus natural gas heating amount of $317,115 in the first year and rise over time with natural gas prices. Table 4.3.1 carries out this comparison over 20 years.

The internal rate of return, which equates a 20 year stream of savings to capital costs for a geothermal system, is a favorable 13.33% for a public system, versus a low -3.36% for a private system (see Table 4.6).

The economic analysis is summed up in the graphical relationships shown in Figure 4.3.3. Both public and private geothermal systems have costs per therm lower than all conventional fuel alternatives over the 20 year term of the comparison. However, the private system is attractive only in the sense that its projected cost per therm is below that of alternative fuels -- to an investor such a system would not return enough funds to make investment worthwhile.

The costs enumerated in both private and public systems are susceptible to some re-estimation which would create the sense of a range of possible costs rather than the single cost figures given in Figures 4.4 and 4.5. Adding a depreciation figure, $71,890 with straight-line depreciation over 30 years, would help provide funds for eventual replacement of the system and would raise the first year cost in the public system from $2.67 per 10^6 BTUs to $3.30, still leaving the public system with a well-defined cost advantage over all alternatives. The private system is probably on the low side of a possible range of costs. Raising management costs by $50,000, for instance, would raise the first year cost estimate from $4.00 per 10^6 BTU to $4.44. That increase would still leave a private system cost-competitive with conventional energy forms, but would not be enough added revenue to make such an investment profitable.

Overall, the preferable alternative is to heat Hailey through use of a public geothermal system. This alternative has a clear cost advantage and one substantial enough to allow for a fair level of confidence in prediction.

5.0 Development Process

5.1 Private Funding Potential

To obtain private funding for geothermal development, the owner/developer can approach private investors, investment companies and lending institutions. The key to private funding is sufficient collateral to offset the bank risk. In Idaho, lending institutions lack experience in the economics of alternative energy development. A developer must be prepared to prove that the investment is sound. Although there has been interest from private investors in developing Hailey Hot Springs, the critical issue of water rights and resource ownership has deterred any action.

5.2 Public Funding Potential

There are a number of public funding mechanisms available to develop Hailey Hot Springs. The City of Hailey can revenue bond a geothermal district heating system under current Idaho Code regarding public water systems. The City of Hailey does not have a Standard and Poor's bond rating. The Hailey School District does have an "A" Moody's Investor Service bond rating.

The Economic Development Administration has technical assistance and public works grants for public services and/or facilities. The application for these funds can be made by a public or private non-profit organization such as a water district. These funds are generally cost share projects.

The Federal Department of Energy has two funding programs which could be used by the City of Hailey for funding a district heating system. The Program Opportunity Notice program is a competitive grant program which emphasizes a cost share. The Geothermal Loan Guaranty Program provides loan guarantees for up to 75% of project cost with the Federal government guaranteeing up to 100% of the amount borrowed and the applicant contributing 25% equity.

5.3 Resource Ownership

Hailey Hot Springs is privately owned property. The property is currently owned by Devere Barker, a seasonal resident of Ketchum, Idaho, whose permanent residence is Sparks, Nevada. The ownership of the geothermal resource is probably tied to the ownership of the subsurface water rights. Under the current ownership matrix, the development of the Hailey Hot Springs geothermal prospect is dependent upon obtaining access rights and water rights from the current owners. There are no federal or state lands associated with the resource site.

5.4 Permitting Requirements for Geothermal Development:

5.4.1 State Permits

An approved permit from the Department of Water Resources is generally required before work can begin on geothermal wells. The permit forms required required under the Geothermal Resource Act are:

a) Form 4003-1, Application for Permit to Drill for Geothermal Resources;

b) Form 4003-2, Application for Permit to Alter a Geothermal Well;

c) Form 4003-3, Application for Permit to Convert a Well to a Geothermal Injection Well;

d) Form 4005, Geothermal Resources Surety Bond;

e) Form 4007, Notice of Intent to Abandon a Well;

f) Form 4009, Report of Abandonment of a Well

Permit applications must be accompanied by a filing fee of:

a) One hundred dollars ($100) for any production or exploratory well;

b) Fifty dollars ($50) for an injection well;

c) Fifty dollars ($50) for an amendment to a permit;

d) No filing fee shall be charged for filing a Notice of Intent to construct a hole for gathering geotechnical data.

Bonds are required as a condition of every permit. A bond of not less than ten thousand dollars ($10,000) is required for each well.

The two exemptions to the Geothermal Resource Permit requirements relate to exploration wells and to low temperature geothermal wells.

a) If an exploration well is less than six inches in diameter and less than 1,000 feet deep and is used only for collecting geotechnical data, the owner must simply file a Notice of Intent to drill with the Department of Water Resources.

b) As explained in Section 42-0003(e), Idaho Code, wells from which low temperature water is used for such purposes as space heating or fish propagation need only obtain an approved water right.

Although a water right is not required under the geothermal permit, it is highly recommended that water rights be applied for in order to obtain assurances against subsequent developers.

5.4.2 Local Government Permits (Blaine County)

Blaine County Planning and Zoning Permit:	Special use permit required.
County Highway Department:	Right-of-way permits required.
Hailey City Zoning Permit:	Special use permit
Building Permit Required:	City and County

5.5 Time Factors for Permits:

Idaho Department of Water Resource permits can be issued in less than four weeks but can take up to six months. Contested water right permits can take six months to one year to resolve. Planning and zoning permits take from one week to two months for issuance.

5.6 Barriers to Development

5.6.1 Institutional

The ownership of water rights at Hailey Hot Springs is a complex issue which must be resolved before any development can be initiated. It is very possible that litigation will be necessary to determine the water rights issue.

The lack of availability of financial assistance for public development is considered by local government interest to be the major institutional barrier to geothermal development at Hailey. Federal programs are currently designed around a competitive grant program and there are no state programs available to assist local communities in developing geothermal resources.

5.6.2 Environmental

The disposal of thermal fluids by injection will require approval by both the Idaho Department of Water Resources and the Department of Health and Welfare.

Injection near the City of Hailey will require the injection to occur in the alluvium which fills the Wood River Basin. This same alluvium is the source for irrigation down stream from Hailey. The environmental impact of disposal will have to be carefully examined before permits for development can be obtained.

5.6.3 Financial

The tax base of Hailey has steadily increased since 1970 but this funding base is no longer available to local governments. In 1979 the Idaho Legislature passed a 1% limitation for property tax assessed valuation. This has severly limited local governments ability to fund local public works projects. The City of Hailey does not have a Standard and Poor's municipal bond rating. The City would need to acquire a rating in order to sell revenue bonds for a public works project.

6.0 Conceptual Timeline for Development

Figure 6.0 illustrates a conceptual time line for developing Hailey Hot Springs production wells, constructing transmission lines and developing injection wells. The entire construction process should require approximately 12 to 18 months. Considering the severe winter conditions which can exist, construction periods were confined to spring, summer and fall.

Because there are no immediate plans from either the public or private sectors to develop the aforementioned geothermal district heating system, projection of an initial construction date cannot be made. It is estimated that construction of the district heating system could begin as early as 1982. If current fuel prices continue to increase at present rates geothermal development will be economically viable and competitive against all currently available fuel forms by the year 1981.

7.0 Summary and Recommendations

Capital investment required for production, transmission and injection systems amounts to $2,156,700 (detailed in Table 4.0).

Annual savings in operating cost for geothermal heating versus gas heating amount to $317,115 in the first year and rise over time with natural gas prices. Table 4.3.1 carries out this comparison over 20 years.

In terms of dollar cost per 10^6 BTU, geothermal heating supplied by a public system is projected to be cheaper than all alternative fuels, both now and over the next 20 years. Geothermal heating supplied by a private firm is competitive with electricity and fuel oil now, and becomes even more competitive over time. Table 4.3.2 contains price projections for alternative fuel sources. Geothermal heat from a private firm never becomes cost competitive with natural gas since the private system fails to turn a profit.

The internal rate of returning which equates a 20 year stream of savings to capital cost for a geothermal system, is a favorable 13.33% for a public system, versus a low -3.36% for a private system. (See table 4.6).

The major constraints to developing a Hailey district heating system which utilizes Hailey Hot Springs are the questions of water rights and resource ownership at the Hot Springs. It is apparent from the available public information that there are no major constraints to groundwater development in Democrat Gulch. The question of current water claims, implied or recorded, is confined to diversion of surface waters for irrigation. To what extent the surface diversion of Hailey Hot Springs will restrict the development of ground water resources is unknown. This is because the question of surface water rights to Hailey Hot Springs is unclear.

It is apparent from this analysis, that the city owned district heating system has the highest potential for successful economic development.

The City of Hailey should investigate the possibilities of developing this resource site. Several funding mechanisms appear to be available for the City. Revenue bonding, grants from EDA and DOE and loan guarantees are available funding mechanisms. The City of Hailey needs to establish a bond rating.

A title search should be conducted to determine what covenances are on the land title and to determine what severances have occurred regarding water rights.

Further resource assessment is needed to understand the hydrology of the hot springs.

The development of a geothermal district heating system for Hailey, Idaho could save approximately 1.14×10^{11} BTU/year of current energy loads which are largely natural gas.

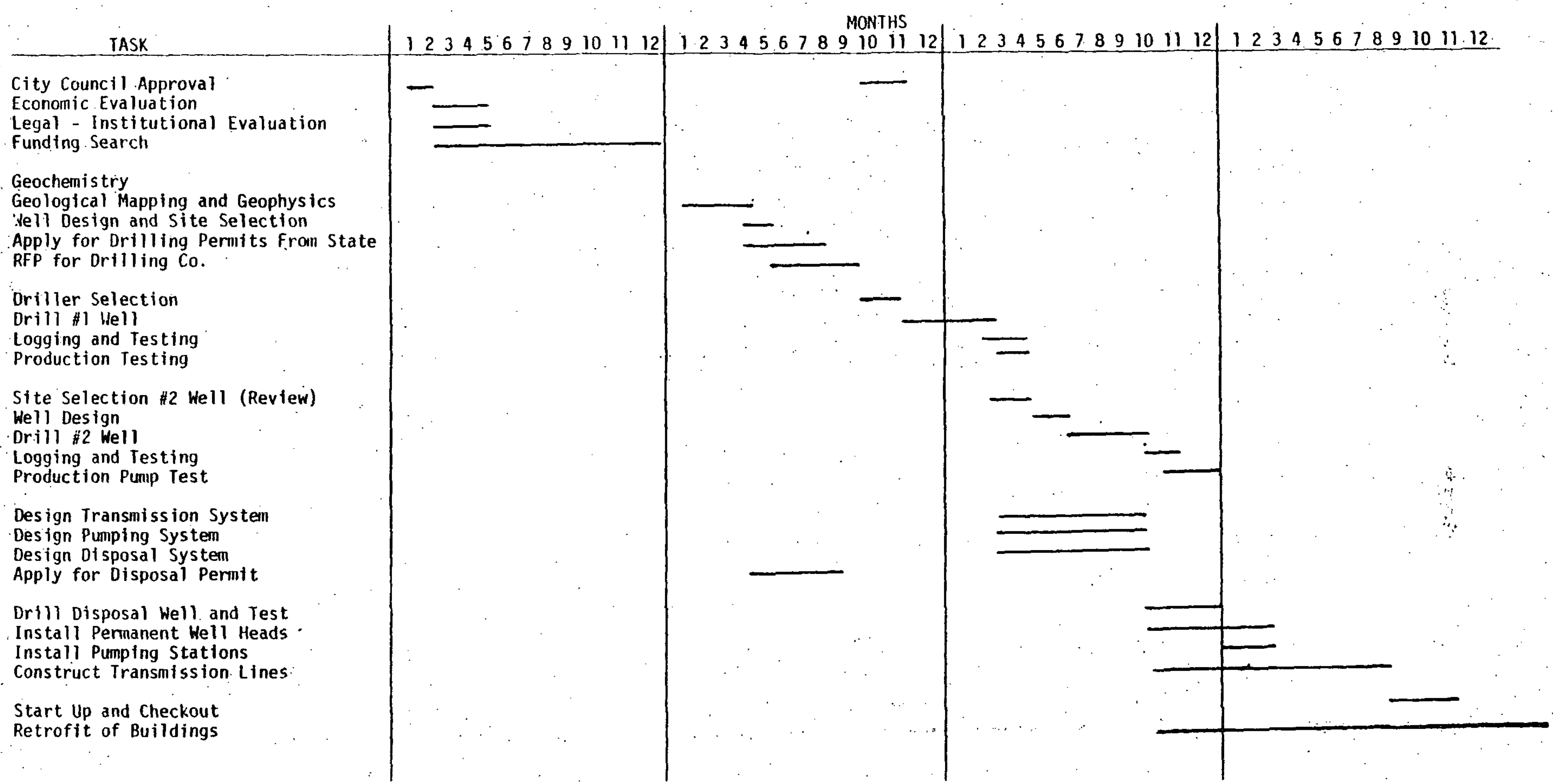


Figure 6.0 Conceptual Development Timeline, Hailey Hot Springs, Idaho

REFERENCES

Blaine County, 1977, "Blaine County Comprehensive Plan", Blaine County Planning and Zoning Commission

Castelin, P.M. and J. E. Winner, 1975, "Effects of Urbanization on the Water Resources of the Sun Valley-Ketchum Area, Blaine County, Idaho", Water Info. Bull. 40, Idaho Dept. of Water Resources.

City of Boise, 1979, "Geothermal Energy Systems Plan for Boise City", Boise City Energy Office.

Dames and Moore Co., 1977, "Natural Gas Supply Requirements for the State of Idaho", Idaho Public Utilities Commission.

E.G. & G. Idaho, Inc., 1977, "Geothermal Space Heating", D.O.E./ Idaho Falls Operations Office.

Geo-Heat Utilization Center, 1979, "Geothermal Home Heating Facilities, Green Valley Estates, Fernley, Nevada, Oregon Institute of Technology.

Hawkins, D. 1973, "Impact Study on the McClullech Addition of the City of Hailey, Blaine County, Idaho", Trico Development Corporation.

Leroy, D. H. 1979, Attorney General Opinion No. 79-11, (Geothermal), State of Idaho, Office of the Attorney General.

Little, N. H. 1979, CH 2 M -Hill Engineering, consulting and personal communication.

Lineau, P. J., 1978, Agribusiness Geothermal Energy Utilization Potential of Klamath and Western Snake River Basins, Oregon", Oregon Institute of Technology, Geo-Heat Utilization Center.

Meale, R. and J. Weeks, 1978, "Population and Employment Forecast - State of Idaho", Department of Water Resources and Boise State University.

Mitchell, J. C. 1976, "Geochemistry and Geological Setting of the Thermal Waters of the Camas Prairie Area, Blaine and Camas County", Geothermal Investigations in Idaho, Idaho Water Information Bulletin 30, Part 9, Idaho Department of Water Resources.

Mitchell, J. C., L. L. Johnson and J. E. Anderson, 1979, Potential for Direct Heat Applications of Geothermal Resources", Geothermal Investigations in Idaho, Water Information Bull. 30, Part 9, Idaho Department of Water Resources.

Nelson, Roma, 1979, Wood River Resource Area Resource Conservation and Development Council, personal communications.

N.O.A.A., 1971, "Idaho Climatological Summary By Counties", National Weather Service Climatology in cooperation with the Idaho Department of Commerce and Development.

State of Idaho, 1975, "Blaine County, Idaho, Water Related Land Use", Idaho Department of Water Resources.

State of Idaho, 1978, "County Profiles of Idaho", Idaho Division of Budget, Policy Planning and Coordination.

State of Idaho, 1978, "Drilling for Geothermal Resources Rules and Regulations and Minimum Well Construction Standards", Department of Water Resources.

Young, H. W. and J. C. Mitchell, 1973, "Geochemistry and Geological Setting of Selected Thermal Waters", Geothermal Investigations in Idaho, Water Information Bull. 30, Part 1, Idaho Department of Water Resources.

FAIRFIELD, IDAHO

SITE SPECIFIC DEVELOPMENT ANALYSIS

November 1979

By

David W. McClain

and

William B. Eastlake

with a section on
Resource Evaluation
by

Roger C. Stoker
Energy Serivces Inc.

IDAHO OFFICE OF ENERGY

OFFICE OF THE GOVERNOR

Prepared for the United States Department of Energy
Division of Geothermal Energy, Idaho Falls Operations Office
DOE/ID/12010-7

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FAIRFIELD, IDAHO

SITE SPECIFIC DEVELOPMENT ANALYSIS

Preface:

Fairfield, Idaho is a small agricultural community located on the Camas Prairie in central Idaho. The community is located at an elevation of 1543.8 meters (5,065 ft.) and has 8,575 heating degree days. The Camas Prairie area has been classified by the Idaho Department of Water Resources as a Geothermal Resource Area. All wells drilled deeper than 914.4 meters (3,000 ft.) in the Camas Prairie must have a geothermal resource permit from the State. Hot springs located in the area vary in temperature from 32.2 °C to 71° C (90° F to160° F). The community of fairfield and the Camas County are interested in developing these local resources for possible industrial application and spaceheating of public buildings.

The Fairfield area was selected for a site development analysis because: the State Water Resources Department has classified the area as a Geothermal Resource Area, the City has requested assistance from the Idaho Office of Energy regarding potential for spaceheating public buildings; and Camas County, through the Wood River Resource Council, requested assistance from the Office of Energy regarding an evaluation of potential resource locations for industrial applications.

The Office of Energy contractedEnergy Services, Inc. of Idaho Falls, Idaho to make a brief and limited evaluation of the geothermal resource potential of the Fairfield, Idaho area.

1.0 Introduction

A site development analysis is a preliminary qualitative and quantitative analysis of technical, economic, environmental, and institutional factors which influence the scale and timing of geothermal development. The analysis is based on current information available in the literature and reflects the intent of public and private development interest in the Fairfield area. Resource data for the Fairfield area was evaluated for the Office of Energy by Energy Service Inc. of Idaho Falls, Idaho and that evaluation was based on published information provided by the Idaho Department of Water Resources and the U.S. Geological Survey.

A review of current available socio-economic data and technical papers on industrial and spaceheating applications of geothermal energy was conducted to determine the scale and estimated cost of resource development. Federal, state, and local planning and regulatory documents were reviewed to determine the institutional factors affecting development.

The Fairfield Site Development Analysis describes the institutional, logistical, and cost parameters which will affect the exploration for geothermal resources in the Fairfield area. Two development concepts are considered: 1) providing hot water to the City of Fairfield for spaceheating, and 2) developing geothermal resources with the intent of locating industrial applications at the wellhead.

2.0 Site Description

2.1 Location

Fairfield, Idaho, the county seat, is located in the center of Camas County and on the northern edge of the Camas Prairie Area of southcentral Idaho. Fairfield is situated approximately 75.6 km (47 mi.) northeast of Mountain Home and 43.5 km (27 mi.) southwest of Hailey (See Figure 2.1).

Fairfield has an elevation of 1,543.8 meters (5,065 ft.) and is located in an east-west trending intermountain basin which is surrounded by mountains of the Idaho batholith and Bennett Ranges. The area is a transition zone between the granitic rocks of the batholith and the volcanic rocks of the Snake River Plain.

2.2 Demographics

The city of Fairfield has an estimated, 1979, population of 450 persons. The community has experienced a steady increase in population since 1970. If the current immigration continues, the population of Fairfield will reach 500 by 1985. Camas County is rural agriculture country with a 1977 population of 900. Table 2.2 lists the State of Idaho population and employment forecast of Camas County and Fairfield. These forecasts are based on historical trends and do not consider the prospect of new employment.

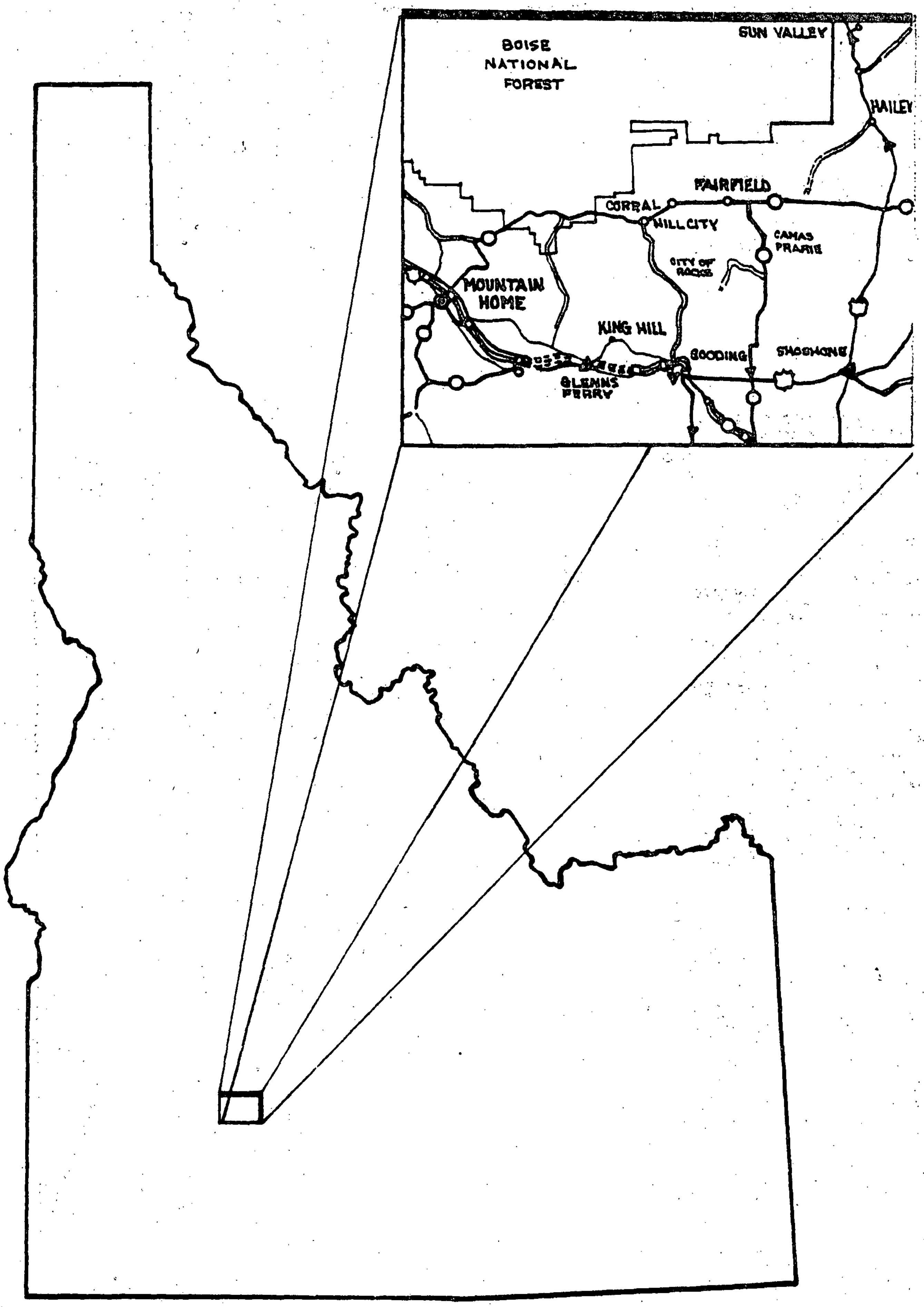


Figure 2.1 Location of Fairfield, Idaho

TABLE 2.2

POPULATION AND EMPLOYMENT FORECAST - July 1978
Camas County

EMPLOYMENT SUMMARY

	1972	1975	1989	1985	1990	1995	2000
AGRICULTURE	175	164	152	139	128	119	111
CONSTRUCTION	17	3	3	3	4	4	4
WOOD PRODUCTS	25	33	36	39	43	46	50
TRANS. COMM. AND UTILS	11	10	11	11	12	13	14
WHSLE AND RETAIL TRADE	56	68	68	68	69	69	70
SERVICES AND MISC.	6	81	85	87	90	94	97
STATE AND LOCAL GOVT.	65	81	81	82	84	85	86
FEDERAL GOVERNMENT	17	22	22	22	22	22	22
TOTAL	372	462	461	456	454	455	458

FORECAST SUMMARY

	1970	1975	1980	1985	1990	1995	2000
TOTAL POPULATION	720	860	940	940	840	770	750
TOTAL EMPLOYMENT*	370	460	460	450	450	450	450
LABOR FORCE **	400	460	460	450	440	450	460
TOTAL SCHOOL ENROLLMENT	230	250	230	190	180	180	170
NURSERY	0	0	0	0	0	0	0
KINDERGARTEN	0	10	10	10	10	10	0
ELEMENTARY	160	140	120	120	120	110	100
HIGH SCHOOL	60	100	90	50	40	40	60
COLLEGE	0	0	0	0	0	0	0
HOUSEHOLD HEADS	210	230	260	270	250	230	220

* Employment Base Year = 1972
** Labor Force Base Year = 1970
** Labor Force is Dependent Upon Unemployment Rate and the Average Number of Jobs Held by Each Worker

SOURCE: Idaho Department of Water Resources and Center for Research, Grants and Contracts, Boise State University

Population and Employment Forecast - July 1978

2.3 Economy of Site Area

Camas County's economic activities were analyzed to provide a working knowledge of the present and past economic base as well as insight into what type of future activities might be possible. Camas County has had a stable but stagnant economy in terms of total employment and per capita income for the past ten years. The county has not experienced any significant growth since 1970. Table 2.3 lists the major elements of Camas County's economy.

Camas County's economy depends primarily on agriculture. Unemployment has increased steadily since 1970 and is acute during the winter months when unemployment is often over twenty percent.

2.4 Land Use Considerations

The major land uses in Camas County are rangeland, agricultural land, and forest land. These land uses are, to a large extent, predetermined by the ownership. The Federal Government owns over 65% of the land in Camas County. These lands are primarily forest and rangelands. The State owns owns approximately 3% of the land in the county, and these lands are leased for grazing. Private ownership accounts for 31% of the land in Camas County, and this land is primarily used for agricultural purposes. See Table 2.4.

2.5 Climate

Camas County has a very cool climate. Located in a high intermountain valley the area has cool summer evenings and cold winters with long periods of deep snow coverage. Table 2.5 summarizes the climatic data for Camas County

3.0 Resource Evaluation

This section of this study was conducted by Energy Services, Inc. of Idaho Falls, Idaho under a contract with the Idaho Office of Energy to provide technical assistance regarding the evaluation of geothermal resource potential within the State of Idaho.

Energy Services, Inc. was directed by the Office of Energy to make a brief and limited evaluation of the geothermal resource and potential of the Fairfield, Idaho Area. Available geological data concerning the area was reviewed and a temperature versus depth well study was conducted. The most helpful and reliable report for reference purposes was "Geothermal Investigations In Idaho, Part 7," by John C. Mitchell of the Idaho Department of Water Resources. Most of the geological evaluation section is drawn from that report. This section, more specifically, presents interpretation of the pertinent data, reconnaissance findings, and recommendations concerning the geothermal potential of the area.

TABLE 2.3

ELEMENTS OF CAMAS COUNTY ECONOMY

Percent of average monthly unemployment - 1976

Jan. 20.7%   Feb. 16.6%   Mar. 20.0%   Apr. 12.5%   May 11.0%   Jun. 5.1%

Jul. 3.8%   Aug. 2.0%   Sep. 3.8%   Oct. 6.6%   Nov. 8.2%   Dec. 13.7%

Percent of labor force unemployed: 1970 4.8%   1972 8.7%   1975 12.2%   1976 10.5%

Month and percentage of highest unemployment: 1975: Feb. - 22.2%   1976: Jan. - 20.7%

Month and percentage of lowest unemployment: 1975: Aug. - 3.7%   1976: Aug. - 2.0%

Percent of females (16+) in labor force: 1960 (14+): 29.1%   1970: 25.6%

Employment (B.E.A. data)	1967	1970	1974	1975
Total employment	386	383	411	435
Farm proprietors	120	120	115	114
Non-farm proprietors	25	42	45	45
Wage and salary employment:				
Federal civilian	15	15	26	22
Military	—	—	—	—
State & local	54	62	74	81
Manufacturing	D	D	D	D
Mining	—	D	—	—
Construction	D	—	D	D
Trans., Comm. & Pub. Util.	10	10	17	D
Trade	19	20	26	24
Finance, Insurance & Real Estate	D	—	—	—
Services	18	5	12	26
Other	D	—	—	—
Farm	67	57	56	78

D Not shown to avoid disclosure of confidential information

Average Idaho tax return (county) - 1976: $ 373

Average Idaho tax return (State) - 1976: $ 396

Total assessed valuation: 1975*: $4,241,656   1976: $4,304,154
*1974 subsequent rolls, 1975 real and personal rolls, and 1975 utilities.

Average levy county-wide paid per $100 assessed valuation:
1973: $6.19   1974: $6.21   1975: $5.79   1976: $6.35

Sales tax: 1974*: $ 24,124   1975*: $ 28,351   1977*: $ 30,408   *Fiscal Year
Property tax as percent of full value: County - 1976: 1.19%   State - 1976 1.55%
Per capita income: 1970 $ 4,509   1974 $6,861   1975 $3,652
% of national average: 1970 113.7%   1974 125.9%   1975 61.9%
% of state average: 1970 137.1%   1974 139.5%   1975 70.5%
Median family income - 1969: $10,095   Median family income* - 1976: $14,000
Transfer payments (thousands of dollars - county) 1970 $292   1974 $466   1975 $547
Number of business establishments - 1974: 19
Percent of families below poverty level - 1969: 2.7%

TABLE 2.4

LAND USE AND OWNERSHIP

Land ownership - 1977	Hectares	Acres	% Total
Federal land	178,377	(440,763)	65.3
BLM	48,168	(118,992)	27.0
National Forests	130,163	(321,628)	73.0
Other	51	(143)	—
State land	8,118	(20,059)	3.0
Endowment land	8,101	(20,018)	99.8
Fish and Game	16	(41)	.2
County land	939	(2,320)	.3
Municipal land	—	—	—
Private land	85,638	(211,610)	31.4
Total land ownership acres	273,072	(674,752)	100.0

Land use* - 1976			
Urban or built-up land	243	(600)	1
Agricultural land	49,454	(122,200)	18.0
Rangeland	162,406	(401,300)	59.2
Forest land	60,462	(149,400)	22.0
Water	850	(2,100)	.3
Barren land	1,113	(2,800)	.4
Total land use acres	274,548	(678,400)	100.0

*U.S.G.S. land use/cover classification system. The water category and the rounding and estimating of satellite based data results in slightly higher totals for land use.

TABLE 2.5

CLIMATOLOGICAL DATA FOR FAIRFIELD, IDAHO

Elevation: 1,543.8 meters (5,065 ft)

Years of Record: 20

Mean Daily Temperature

January Minimum:	- 16° C	(3.2° F)
January Maximum	- 2.4° C	(27.6° F)
July Minimum:	7.8° C	(46.0° F)
July Maximum	29.3° C	(84.8° F)

Lowest Temperature of Record: -38.8° C (-38° F)

Highest Temperature of Record: 37.8° C (100° F)

Average Annual Days

Maximum of 32° C (90°): 13 days
Minimum of 0° C (32° F) or less: 211 days

Growing Season (Average Freeze Free Period): 68 days

Average Precipitation

Annual Precipitation: 39.7 cm (15.64 in.)
Annual Snow Fall: 211.3 cm (83.2 in.)

January Precipitation: 7.26 cm (2.86 in.)
July Precipitation: .63 cm (.25 in.)

Average Annual Number of Days with Precipitation

.25 cm (.10 in.) or more: 44
1.27 cm (.50 in.) or more: 10

Heating Degree Days: 8,575

Source: Idaho Climatological Summary Data by Counties National Weather Service Climatology in Cooperation with the Idaho Department of Commerce and Development Boise, Idaho - October 1977.

3.1 Topography and Geology

Fairfield, Idaho is located on a broad structural valley known as the Camas Prairie. This valley is approximately 64 km (40 mi) long (E-W) and 16 Km (7 to 10 mi) wide (N-S). The prairie is completely enclosed by hills and mountains of the Idaho Batholith to the north and volcanic rocks associated with the Snake River Plain to the south. It is a relatively flat plain that slopes (.1%) from west to east with an elevation difference of only 79 meters (260 ft.) over the entire length of 64 km (40 mi).

Camas Prairie consists of poorly sorted sediments of Pliocene to Holocene Age derived from the mountains to the north and ranging in size from clay to boulders. A bedrock of Cretaceous granite exists at a depth of 152 meters to 167 meters (500 to 550 ft) near the center of the prairie. Soldier Mountains to the north and part of Mount Bennett Hills to the southwest are made up of Cretaceous granitic rocks from the Idaho Batholith whose main body lies further to the north. Part of the Soldier Mountains consist of Challis volcanic rocks which crop out along the northcentral part of the basin. These volcanic flows and lower Pliocene volcanic rocks are also found along southern portions of Camas Prairie. Other basalt flows are found along the southeastern and western edges.

The structural control of the Camas Prairie Basin is to a large extent unknown. Two conflicting ideas exist: one describes the prairie merely as a shallow depression in the granitic surface that has been partially filled with sediment from the marginal highlands. Evidence to support this theory is the occurrence of Cretaceous granitic rock on the northern and southern boundaries as well as at a relatively shallow depth of 152 meters (500 ft) near the center of the valley. There are no visible structural trends that would strongly indicate any other geological setting, although that conclusion may be attributed to the lack of geologic work being done in the area. On the other hand the Camas Prairie has been described as a graben and some evidence was found for fault control of the valley in a study of the Mount Bennett Hills. This east-west trending range is a complexly faulted, southerly and easterly tilted upthrown fault block.

Camas Pairie is separated from the Snake River Plain by the low-lying, flat-topped Mount Bennett Hills. A low divide separates the Prairie from the South Fork Boise River drainage basin to the west. To the north, Soldier Mountains rise abruptly to a height of 3077 meters (10,095 ft) at Smokey Dome. To the east, a low divide (Clay Bank Hills) separates Camas Prairie from the plain of the upper Big Wood River drainage basin.

3.2 Hydrology

Camas Creek constitutes the surface drainage originating on the Western divide near Packer Butte and draining into Magic Reservoir on the eastern edge of the prairie. The majority of tributary streams originate in the Soldier Mountains to the north. Little additional flow is contributed by the few intermittent streams originating in the Mount Bennett Hills to the south.

3.2 Hydrology - Continued

The movement of groundwater in the Camas Prairie generally parallels Camas Creek and its tributaries. The major source of ground water is the Soldier Mountains to the north with minimal input from the Mount Bennett Hills to the south. Two major acquifers composed of fine grained sands and gravels of low permeability exist in the valley fill at approximately 61 to 121 meters (200 to 400 ft).

3.3 Hot Springs

There are several hot springs in and around the Camas Prairie that may be used as indications of the geothermal system that exists in the area. Surface discharge temperatures and predicted reservoir temperatures for these springs are tabulated in Table 3.3. This data should be reviewed with caution and only used as indicators of possible geothermal reservoirs in the area of interest.

Barron's Hot Springs, the strongest evidence of a geothermal resource of the prairie, is located approximately 12 kilometers (7 mi) southwest of Fairfield. A surface temperature has been recorded of 72° C (163° F) with a predicted reservoir temperature of 125° C (257° F). The springs issue from the valley fill material.

Two other hot springs in the area show strong evidence of a moderate temperature geothermal resource existing below the valley fill. Hot Springs Ranch (Wardrup Hot Springs) and Elk Creek Hot Springs both have discharge temperatures above 54° C (130° F).

3.4 Existing Water Wells

Most of the irrigation wells in the area have higher than normal water temperatures. Unusually high temperatures indicate that a geothermal resource is present in the area and has mixed with cold ground water at depth.

Water well temperatures have been plotted at the 91.4 meter (300 ft) depth in Figure 3.4 and contours were constructed that connect the points of equal temperature. Two areas stand out as geothermal anomalies in Figure 3.4. One in the area southwest of Fairfield, just north of Barron's Hot Springs. Wells with temperatures near 21.1° C (70° F) are common in this area and Barron's Hot Spring is an extremely high point at 71.1° C (160+° F). The second anomalous area is centered approximately 3.2 km (2 mi) south of Fairfield. Temperatures(91.4 meters (300 ft) below ground level) above 21.1° C (70° F), occur in an area 9.6 km (6 mi) long (E-W) and 1.6 km (1 mi) wide (N-S).

In Figure 3.4 the contours have been drawn to predict ground water temperatures at 91.4 meters (300 ft) using known well water temperatures at depth and calculated temperature gradients. Gradients were used in order to extend the known well temperatures below their drilled depth to 91.4 meters (300 ft). The general trend suggests that hotter water exists at shallow depths to the south of Fairfield. Due to the lack of data, it is difficult to determine the trend further to the south near Twin Lakes Reservoir and to the north more than 1 km (.6 mi) past Fairfield.

TABLE 3.3

CAMAS PRAIRIE
WARM SPRINGS AND WELLS

	Distance From Fairfield	Surface Temp.		Predicted Reservoir Temperature Silica**		Na/K/Ca**	
		°C	(°F)	°C	(°F)	°C	(°F)
Hot Springs Ranch (Wardrup H.S.)							
IN-13E-32abc 1S		60	(140)	125	(257)	33.9	(93)
IN-13E-32abc 2S	11.6 km (7.2 mi)	66.7	(152)	125	(257)	135	(275)
IN-13E-32abc 3S		63.9	(147)	125	(257)	85	(185)
Elk Creek Hot Springs							
IN-15-E-14ada 1S		55	(131	125	(257)	95	(203)
IN-15-E-14ada 2S	15.8 km (9.8 mi)	55	(131	125	(257)	85	(185)
IN-15-E-14ada 3S		45	(113)	125	(257)	85	(185)
IS-12E-16cba 1S	20.1 km (12.5 mi)	45	(113)	115	(239)	55	(131)
1S-12E-16cab 1S	20.1 km (12.5 mi)	48.9	(120)	115	(239)	55	(93)
1S-13E-22ccc 1	9.5 km (5.9 mi)	26.1	(79)	125	(257)	90	(194)
1S-13E-27ccb 1	10.3 km (6.4 mi)	35	(95)	125	(257)	63.9	(147)
1S-13E-27ccb 2	10.3 km (6.4 mi)	45	(113)	115	(239)	95	(203)
Barron's Hot Springs							
1S-13E-34bcc 1	10.8 km (6.7 mi)	48.9	(120)	125	(257)	95	(203)
1S-13E-34bcb 1S		72.8	(163)	125	(257)	125	(257)
Magic Hot Springs Well	32.5 km (20.2 mi)						
1S-17E-23aab 1		72.2	(162)	140	(284)	175	(347)

* Table compiled from Idaho Department of Water Resources Bulletin No. 30, Part 7.

** Silica and Na-K-Ca geothermometer indicated temperatures are less reliable at the lower temperatures. None of the predicted temperatures were made using the enthalpy/chemical dilution correction model, which would give higher results than shown here.

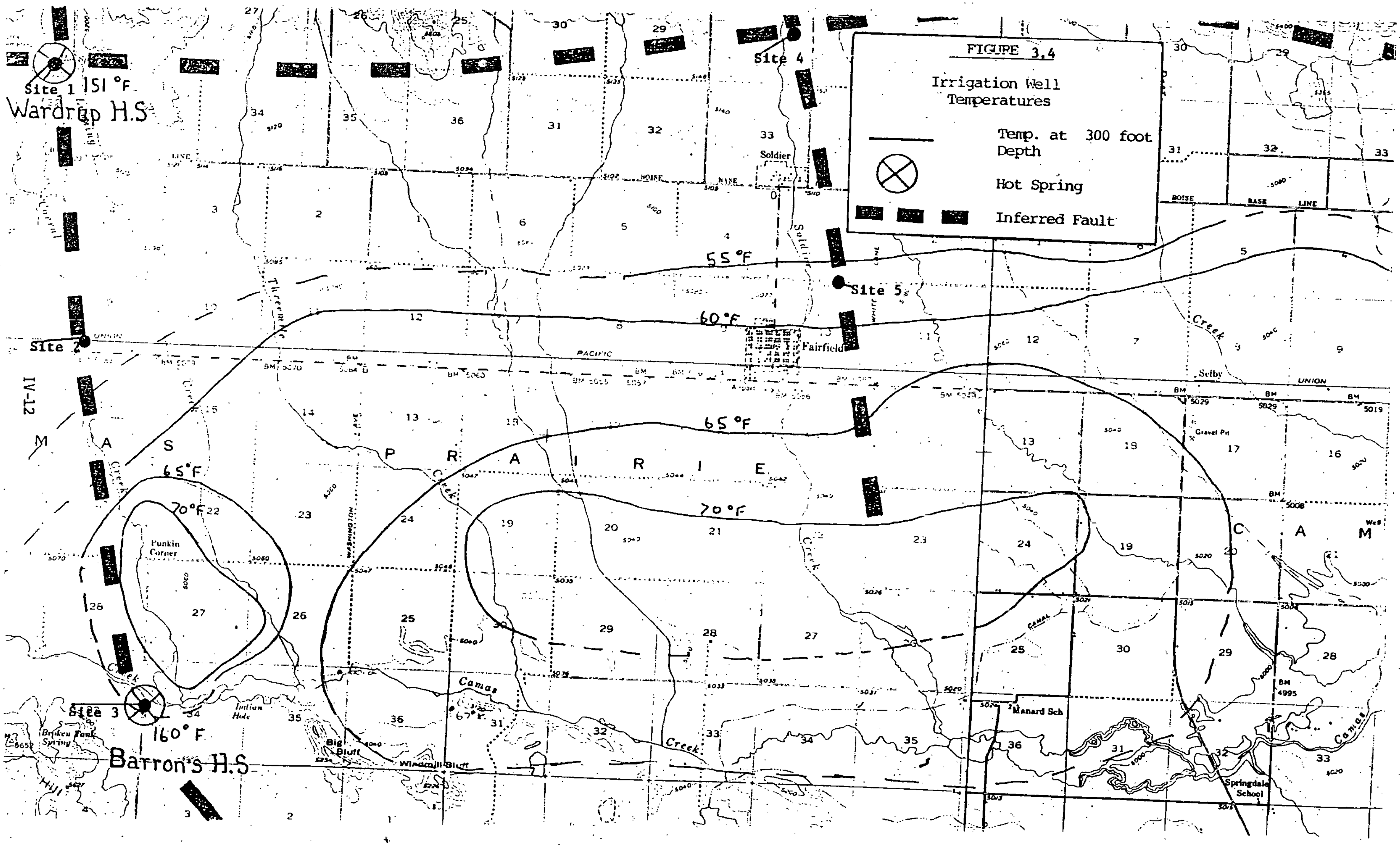


FIGURE 3.4
Irrigation Well Temperatures
Temp. at 300 foot Depth
Hot Spring
Inferred Fault
Site 1 151 °F
Wardrup H.S
Site 2
Site 3
160° F
Barron's H.S
Site 4
Site 5
55 °F
60 °F
65 °F
65 °F
70 °F
70 °F
67 °F
CAMAS PRAIRIE
Soldier
Fairfield
Selby
Punkin Corner
Indian Hole
Big Bluff
Windmill Bluff
Manard Sch
Springdale School
Camas Creek
BOISE BASE LINE
UNION PACIFIC
Gravel Pit

3.5 Temperature Gradients

Temperature gradients (rate of temperature increase with depth) in the area depict, roughly, the same information as Figure 3.4. A temperature gradient of 146° C/km (8° F/100 ft) has been calculated in the area to the southwest of Fairfield around Barron's Hot Springs. However, a temperature gradient of less than 36° C/km (2° F/100 ft) (still above normal) was calculated for the area to the southeast of Fairfield although well water temperatures are near 21.1° C (70° F). The two areas have the same near-surface temperatures, but the area around Barron's Hot Springs has a known hotter resource (hot spring source) at depth whereas the other area has unknown temperatures at depth.

3.6 Geothermal Development

Geothermal potential of Fairfield and Camas Prairie Area can be developed economically if the specific resource site can be located reasonably close 3.2 km (2 - 3 mi) to a large user facility. A comparison of the geothermal system (well, distribution and retrofit) costs and facility benefit savings can be accomplished for several different potential users.

Camas Prairie appears to be a shallow depression in granitic bedrock that is influenced by visible faulting in the hills to the south and mountains to the north. Some of these southern faults (Bennett Hills) are shown on the 1978 State Geological Map and in the report by Mitchell (1974). The State Geological Map shows an inferred fault crossing the western part of the prairie from the hills on the south into the mountains to the north. These faults do not appear to structurally control the valley, but apparently have a relationship to the geothermal water encountered in the area.

Figure 3.4 shows three inferred faults that are based on this study. One runs roughly east-west on the north side of the prairie and marks the break between the mountains and prairie. A second fault runs out of the canyon north of Fairfield and is thought to extend into the valley. The third fault connects Barron's Hot Spring with the Hot Spring's Ranch (Wardup Hot Spring) geothermal occurrence. This fault trace represents a slight modification of the trace shown on the State Geological Map. The fault traces shown in Figure 3.4 are based on an area reconnaissance only. There has been almost no published geological work done in the area, especially in the mountains to the north. More detailed work would help determine the true origin of Camas Prairie.

Maximum temperature and production of geothermal resources occur whenever the permeability of the rock is sufficient enough to allow the geothermal fluids to move freely. The most successful areas of exploratory drilling are around fault zones that extend down to great depths. Generally, wide and long fault zones have better probability of successful geothermal wells. Camas Prairie appears to be a shallow depression, but the shallow geothermal fluids appear to be dependent upon faults for their upward migration. There is undoubtedly some lateral movement of the geothermal water whenever permeable beds are encountered by the fault zones. However, for maximum production and temperature, the area fault zones should be explored by drilling.

3.7 Potential Geothermal Exploration

There are three possible sources for the area's geothermal resource. The first is from the mountains to the north, the second is from the hills to the south, and the third is a combination of the first two. The authors believe that the major source of geothermal water is from the north. The water migrates to depth where it is heated and then moves upward in a southern direction along zones of permeability (faults).

There are three areas around Fairfield that appear to offer excellent to good chances for geothermal exploration. The area around Barron's Hot Springs, on the downdip (east) side of the fault, appears an excellent area for both shallow and deep exploration. This includes the area between Barron's Hot Springs and Hot Springs Ranch (Wardrup Hot Springs). A second area, also rated excellent for shallow exploration is located south of Fairfield and enclosed by the 21.1° C (70° F) contour shown on Figure 3.4. The third area is rated as a very good area for deep exploration and is located along the downdip (east) side of the N-S trending inferred fault passing just to the east of Fairfield.

There is little direct evidence resulting from the well study on which to evaluate the third area immediately around Fairfield. However, this is due to a lack of data from wells deeper than 45 meters (150 ft) and is not indicative of negative data. The presence of numerous reported warm springs in the mountains to the north and the strong evidence of a major fault trending onto the Prairie from the canyon north of Fairfield, combine to make this area a very good exploration site. Geothermal wells must be drilled into fault zones in order to encounter permeable zones that will result in maximum production and temperature.

3.8 Recommendations for Exploration

A. Conduct geophysical (electromagnetic VLF radio and earth magnetic) surveys to pinpoint the existence and attitude of faults in the valley that extend down into the granitic basement.

B. Select one of the three areas identified (or modified by geophysical data) and drill to a 243 meter to 609 meter (800 to 2,000 ft) deep geothermal exploratory well with 20 cm (8 in) casing installed in the top 60 meters to 152 meters (200 to 500 ft) of the well.

3.9 Potential Applications

Camas County is interested in developing the area's geothermal resources for spaceheating public buildings and for locating a new industrial park. Other potential applications include controlled breeding conditions for livestock and green house. The following section describes the estimated cost of exploration at several potential sites in Camas County.

4.0 Site Specific Applications

Based on the resource analysis outlined in Section 3.0, five sites on the Camas Prairie, near Fairfield, were selected by the Idaho Office of Energy for the purpose of estimating cost of geothermal development. Sites were selected based on the following criteria:

a) Site must be located on a known or inferred fault and/or area of high geothermal gradient.

b) Site must be located near a transportation corridor.

Figure 3.4 locates each potential development site on a map of the Fairfield area. Each site is identified by a number which corresponds with a potential development scenario outlined in Table 4.0. Table 4.0 lists the estimated drilling depth and potential direct heat application for each site. It is recommended that detailed geophysical surveys be conducted prior to any exploration drilling.

TABLE 4.0

POTENTIAL DEVELOPMENT SITES

Site Number	Description	Depth	Potential Appl.
Site #1	Wardrup Hot Springs 1N-13E-32	244 meters (800 ft)	Industrial Park
Site #2	Intersection of North Trending Fault w/Railroad 1S-13E-9	610 meters (2,000 ft)	Industrial Park
Site #3	Barron Hot Springs 1S-13E-34	244 meters (800 ft.)	Industrial Park
Site #4	Intersection of Two Inferred Faults 1N-14E-28	610 meters (2,000 ft.)	Industrial Park
Site #5	NE of Fairfield 1S-14E-3	610 meters (2,000 ft.)	Spaceheating for Fairfield

4.1 Considerations for Direct Applications of Geothermal Energy

The most important question to ask is whether the geothermal water will generate enough heat to meet potential demand. For Sites 1 through 4 no specific projection of potential demand will be made. The intention for these sites is only to indicate that a certain quantity of heat may be available at a location near transportation facilities for possible industrial use. For Site #5, with a potential for spaceheating the town of Fairfield, an estimate of demand was made. Based on a city population estimate of 450 by the Idaho State Division of Budget, Policy, Planning, and Coordination and an average family size of just over three persons, the projected number of households in Fairfield is 150. Assuming an average home uses about $.2 \times 10^9$ BTU's per year, total heating demand for Fairfield is about 3×10^{10} BTU's per year. Since Fairfield has 8575 heating degree days, the annual heat load translates into a design heat load of 1.17×10^7 BTU's per hour, the peak heat load any heating system must satisfy.

With an expected water temperature of 100° C (212° F), the temperature drop to be expected is 14° C (57° F). With that temperature drop and the expected flow of 500 gallons per minute, the heat delivered by the water is 1.43×10^7 BTU's per hour or 1.25×10^{11} BTU's per year. Thus, available heat from the geothermal water is expected to be sufficient to meet the Fairfield spaceheating demand.

4.2 Proposed Facilities

4.2.1 Transmission System

Four of the sites considered will be industrial parks located close enough to the geothermal water source to keep piping costs negligible. The fifth site, for spaceheating of the City of Fairfield, will require a transmission system detailed on Figure 4.2.1.

The Fairfield transmission system would pipe fluids 1768 meters (5,800 ft) along road right of way in 20 cm (8 in) pipe to the city limits, thence in 15 cm (6 in) pipe 3,292 meters (10,800 ft) about the perimeter of the city, and finally 3,962 meters (13,000 ft) on five connectors of 8 cm (3 in) across the perimeter. All pipe would be asbestos cement, buried and insulated with polyurethane foam. Costs are projected at $24 per foot for 20 cm (8 in), $16 for 15 cm (6 in.), and $11 for 8 cm (3 in) pipe.

4.2.2 Supply System - Wells

A. Sites 1 and 3 will have 244 meter (800 ft) wells. These wells will be drilled 25 cm (10 in) to a depth of 61 meters (200 ft) and 20 cm (8 in) casing will be set. Then drilling will proceed another 183 meters (600 ft) at a diameter of 20 cm (8 in) with 15 cm (6 in) casing set. Sites 2, 4, and 5 will extend 549 meters (1800 ft) below the initial casing.

Drilling costs are estimated at $1 per inch of diameter foot up to 600 feet; $2.50 per inch of diameter per foot from 600 to 1,000 feet; $3.50

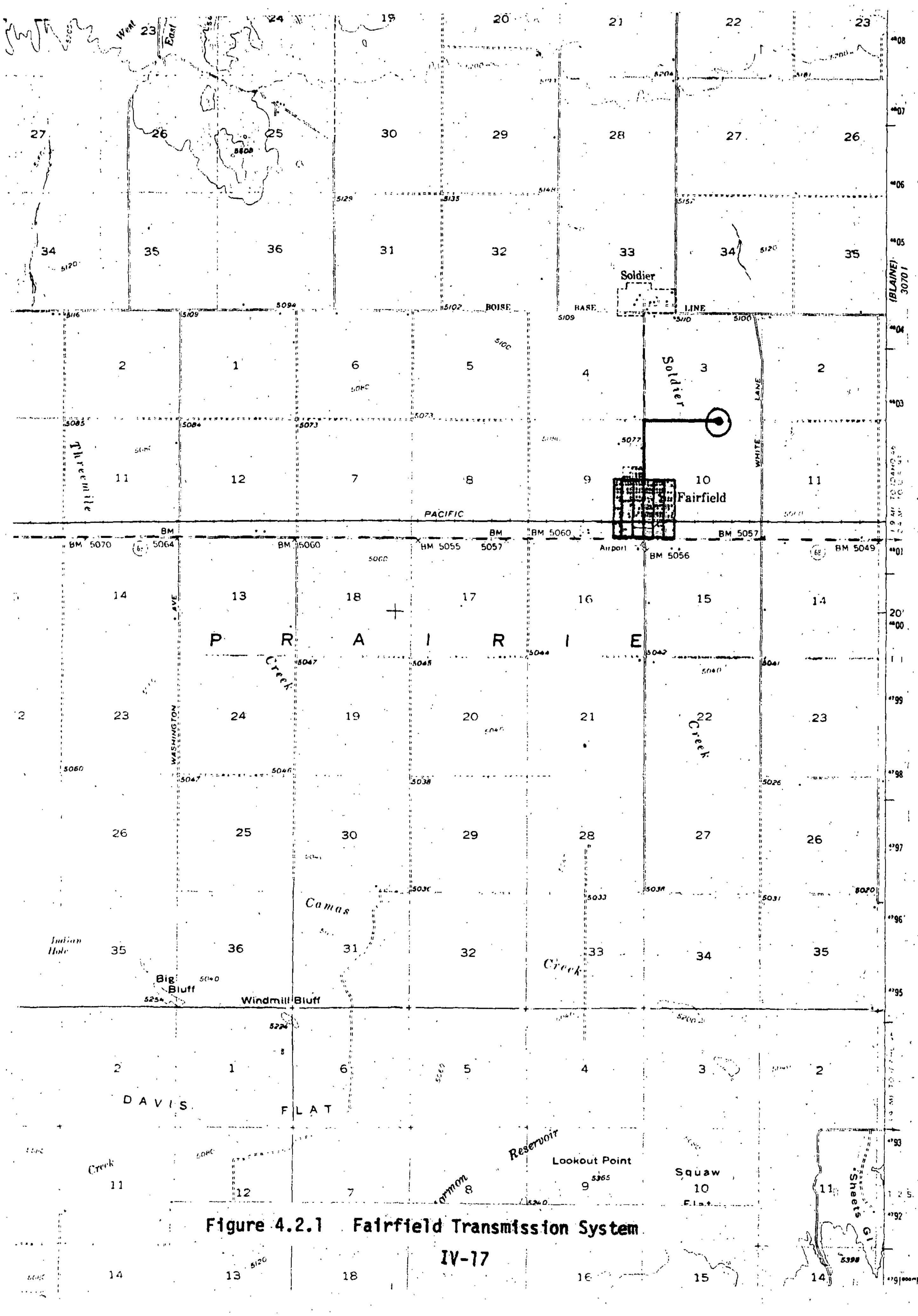


Figure 4.2.1 Fairfield Transmission System

A. Wells

per inch of diameter per foot for the next 500 feet; and $4.5 per inch of diameter per foot from 1,500 to 2,000 feet. This means a cost, including a 30% contingency figure of $18,720 for 244 meters (800 ft) of well and a cost of $74,880 for 610.6m (2,000 ft) of well.

B. Pumps

A two-stage, vertical turbine downhole pump of 25 HP would be used to pump 500 GPM. The pump would be set for 15 meters (50 ft), and using electricity at 2¢ per kwh, would require a maximum of $3,267 in power cost. Total cost for the pump, motor, main valves, and installation would be about $12,000.

4.2.3 Disposal System

For this preliminary analysis due to the uncertainty as to the possible uses of geothermal fluids in the Fairfield area, plant construction costs and disposal costs have been omitted. The purpose of the analysis has been limited to projecting the cost of BTU's deliverable at the wellhead for possible further use. Further specification of actual usage of geothermal fluids is necessary before a projection of disposal costs can be made. In general, injection wells are similar in cost to production wells though they usually require less pumping power.

4.3 Cost Analysis

Table 4.3.1 details the capital and operating costs of providing 500 GPM of 100° C (212° F) at the wellhead for the four potential commercial sites and the City of Fairfield for space heating purposes. The only operating cost of providing the water for the commercial-industrial sites would be the power cost for pumping, $3,267 per year. Maintenance would be minimal with no pipeline yet under consideration. Since the space heating project for the City of Fairfield has a substantial pipeline, a maintenance expense equal to ½ % of the cost of piping plus 3% of the cost of pumps, in addition to the $3,267 power costs, was included.

Total heat available with a 14° C (57° F) temperature drop and a flow of 500 GPM was divided by the available cubic feet of water at

TABLE 4.3.1

CAPITAL AND OPERATING COSTS FOR POTENTIAL SITES

Site	(1) Well Cost	(2) Pump Cost	(3) Trans-mission Cost	(4) Capital Cost	(5) Maint-enance Cost	(6) Power Cost	(7) Operating Cost	(8) Amortized Capital Cost
1	18,720	$12,000	------	30,720	------	3,267	3,267	3,608
2	74,880	12,000	----	86,880	-----	3,267	3,267	10,205
3	18,720	12,000	----	30,720	-----	3,267	3,267	3,608
4	74,880	12,000	----	86,880	----	3,267	3,267	10,205
5	74,880	12,000	455,176	542,056	2,635	3,267	5,902	63,670

(4) Capital Cost = (1) + (2) + (3)
(7) Operating Cost = (5) + (6)
(8) Amortized Capital Cost = (4) amortized over 20 years at 10%

that flow to establish heat content of the water. This heat content figure was multiplied by the available water and Fairfield's heat load factor (.294) to establish the number of therms of heat available. Given the figures above, Fairfield has 1.029×10^7 ft.^{3} of geothermal water available with a total heat content of 36,750 therms or 3.675×10^{10} BTU's during a normal year. These figures are used for Site #5 (space heating Fairfield) to derive the costs listed in Table 4.3.2.

For a space heating system water and heat availability must be tempered with the local heat load factor to reflect the fact that they are not in use all year at peak levels. For commercial or industrial (nonspace heating) uses, the variation in load characteristic of heating does not apply. Therefore, for Sites #1 through #4, we have used the total BTU's per year and total volume of water per year, undiminished by this fractional heat load factor. The 500 GPM well operating at a constant rate year-round would produce 3.5×10^7 ft.^{3} of geothermal water. With the assumed temperature drop of 14° C (57° F), this volume of water would contain 1.25×10^{11} BTU's. These yearly figures are used to derive costs for Sites #1 through #4.

Table 4.3.2 derives cost figures per 10^6 BTUs for all five potential sites. The figures allow comparison with the conventional fuels listed in Table 4.3.3.

Table 4.3.3 presents price projections for conventional fuel sources, in billing terms and converted to millions of BTU's for easier comparison. These prices have been adjusted for conversion efficiency so that final prices are for millions of usable BTU's. (Electricity is assumed to be 100% efficient, gas 80%, and oil 70%). All prices in Table 4.3.3, plus all other energy prices in the overall analysis, have been escalated at rates given in the Dames and Moore study prepared for the Idaho Public Utilities Commission. These projections were prepared in late 1977 and today there is considerable doubt as to their accuracy. Particularly for gas prices, the Dames and Moore rates are low. Since no more comprehensive set of projections has appeared, we will continue to use Dames and Moore.

Keep in mind that if a case for geothermal heat can be made, with these rates of increase for conventional fuel alternatives, which we know are conservative, actual increases beyond these conservative projections only serve to enhance the competitiveness of geothermal heat.

The final colum in Table 4.3.3 represents an unofficial estimate by IPUC staff of the impact of the proposed NW Energy Policy Planning Act on Electricity prices. Basically, it projects that the Northwest Energy Bill will put off price increases for about three years, at which time electricity rates will start to rise at a rate of 13% per year. (Table 4.3.3 carries the 13% rate all the way to 1988. Figure 4.3.4 presents a graphical picture of these same projections.)

TABLE 4.3.2

GEOTHERMAL COSTS PER 10^6 BTU FOR POTENTIAL SITES

Site	(A) Capital Cost Per 10^6 BTU	(B) Annual Cost Per 10^6 BTU
1	$ .246	$ .055
2	.695	.108
3	.246	.055
4	.695	.108
5	14.70	$1.89

A Capital cost from Table 4.3.1 divided by $1.25 X 10^{11}$ BTU's for sites 1 through 4; by $3.675 X 10^{10}$ BTU's for site 5

B Annual cost is the sum of maintenance cost plus power cost plus amortized capital cost from Table 4.3.1 divided by $1.25 X 10^{11}$ BTU's for sites 1 through 4; by $3.675 X 10^{10}$ BTU's for site 5

Table 4.3.3
FUEL PRICES - PROJECTED 20 YEARS

	Electricity		Gas		#2 Fuel Oil		Electricity with Planning Bill	
	$/Kwh	$/10^6 BTU	$/Therm	$/10^6 BTU	$/Gal.	$/10^6 BTU	$/Kwh	$/10^6 BTU
1979	.02497	7.316	.382	4.776	.739	7.610	.02497	7.316
1980	.02724	7.982	.409	5.115	.789	8.127	.02487	7.287
1981	.02972	8.708	.438	5.478	.843	8.680	.02477	7.258
1982	.03243	9.501	.469	5.867	.900	9.270	.02824	8.274
1983	.03492	10.101	.506	6.284	.961	9.901	.03219	9.432
1984	.03761	10.879	.544	6.730	1.027	10.574	.03670	10.753
1985	.04051	11.716	.586	7.208	1.097	11.293	.04184	12.259
1986	.04363	12.618	.632	7.720	1.171	12.061	.04769	13.973
1987	.04699	13.716	.680	8.268	1.251	12.881	.05437	15.930
1988	.05060	14.909	.733	8.855	1.338	13.783	.06198	18.160
1989	.05450	16.207	.789	9.483	1.432	14.748	.07066	20.703
1990	.05870	17.617	.850	10.157	1.532	15.780	.08055	23.601
1991	.06322	19.149	.915	10.878	1.640	16.885	.09183	26.906
1992	.06808	20.815	.986	11.650	1.754	18.066	.10468	30.671
1993	.07333	22.626	1.061	12.477	1.877	19.831	.11934	34.967
1994	.07897	24.594	1.143	13.363	2.009	20.684	.13605	39.863
1995	.08505	26.734	1.231	14.312	2.149	22.132	.15509	45.441
1996	.09160	29.060	1.326	15.328	2.300	23.681	.17681	51.80
1997	.09866	31.588	1.428	16.416	2.461	25.339	.20156	59.057
1998	.10625	34.336	1.538	17.582	2.633	27.113	.22978	67.326

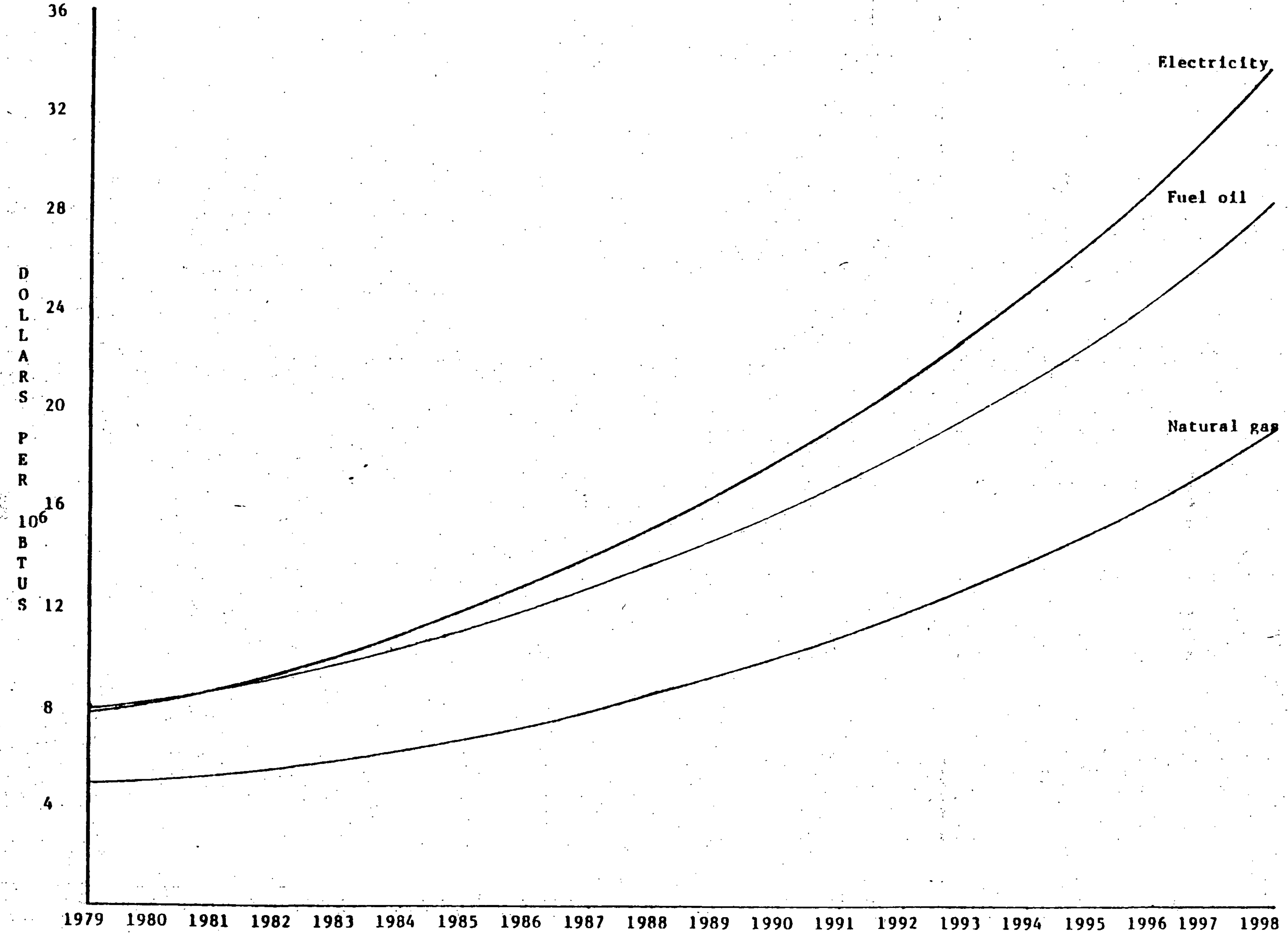


Figure 4.3.4 20-Year Projection of Energy Prices

TABLE 4.4

20-YEAR COST COMPARISON OF PROPANE WITH GEOTHERMAL HEAT

YEAR	(1) PROPANE COST	(2) GEOTHERMAL COST	(3) SAVINGS	(4) PRESENT WORTH (10%)
1979	$ 18984	$ 5902	$ 13982	$ 11893
1980	20256	6383	13873	11465
1981	21613	6906	14707	11050
1982	23061	7471	15590	10648
1983	24399	8023	16376	10168
1984	25814	8617	17197	9707
1985	27311	9255	18056	9266
1986	28895	9939	18956	8039
1987	30571	10676	19895	7670
1988	32252	11527	20725	7264
1989	34026	12448	21578	6875
1990	35898	13443	22453	6504
1991	37872	14518	23354	6150
1992	39955	15679	24276	5811
1993	42153	16936	25217	5488
1994	44471	18294	26177	5179
1995	46917	19761	27156	4884
1996	49497	21348	28149	4603
1997	52220	23065	29155	4334
1998	55092	24919	30173	4077
			TOTAL	$151,075

(1) Annual heat load of 3×10^{10} BTU's per year for 150 homes in Fairfield divided by 91,500 BTU's per gallon to convert to gallons, then multiplied by 57.9¢ per gallon of propane to convert to annual cost of heating. This cost was then projected over 20 years at rates presented in the Dames & moore report to the Idaho Public Utilities Commission (6.7% through 1982, 5.8% through 1987, 5.5% thereafter)

(2) Geothermal operating cost = Power cost plus maintenance.

(3) Savings = Propane Cost minus Geothermal Cost.

(4) Savings stream converted to present worth at 10% discount rate.

4.4 Economic Conclusions

The costs at the wellhead for Sites #1 through #4 are all very low compared to alternative fuel costs. Even though these costs do not include a disposal system, they are so low as to suggest that any commercial or industrial establishment able to locate at the heat source would derive huge benefits in terms of fuel savings from use of geothermal fluids. For Site #5, space heating of Fairfield, it also appears that even with the possible inclusion of additional costs for possible disposal or management fees geothermal space heating would be a tremendously attractive proposition. Table 4.4 indicates operating cost savings from use of geothermal for space heating in Fairfield.

5.0 Development Process

5.1 Private Funding Potential

To obtain private funding for geothermal development, the owner/developer can approach private investors, investment companies and lending institutions. The key to private funding is sufficient collateral to offset the bank risk. In Idaho, lending institutions lack experience in the economics of alternative energy development. A developer must be prepared to prove that the investment is sound. Although there has been interest from private investors in developing geothermal resources in Camas County, the high cost of drilling has deterred any action by local landowners.

5.2 Public Funding Potential

There are a number of public funding mechanisms available. Fairfield can revenue bond a geothermal district heating system under current Idaho Code regarding public water systems.

The Economic Development Administration has technical assistance and public works grants for public services and/or facilities. The application for these funds can be made by a public or private nonprofit organization such as a water district. These funds are generally cost-share projects.

The Federal Department of Energy has two funding programs which could be used for funding a district heating system. The Program Opportunity Notice program is a competitive grant program which emphasizes a cost-share. The Geothermal Loan Guaranty Program provides loan guarantees for up to 75% of project cost with the Federal government guaranteeing up to 100% of the amount borrowed and the applicant contributing 25% equity.

5.3 Resource Ownership

There are no Federal lands leased for geothermal resources in the Fairfield area. All available State lands in Camas County have been leased to Simasko Production Company for geothermal resources. Several large land owners in Camas County have joined together to form the Camas Geothermal Resource Association. Several private landowners have leased their lands to Gulf Oil Corporation for geothermal exploration.

5.4 Permitting Requirements for Geothermal Development

5.4.1 State Permits

Idaho Department of Water Resources Regulations through authority granted by Section 42-4003 (f), Idaho Code, states the Director shall have the authority to and may designate any area of the state a geothermal resource area where the director finds or has reason to believe that such designation is necessary to protect the geothermal resource from waste and to protect other resources of the state from contamination or waste.

Information pertaining to the classification of lands as G.R.A (Geothermal Resource Areas) in the State of Idaho fall into four categories:

a) Geology, including geochemical and geophysical data;

b) Competitive interests;

c) Nearby discoveries to already classified areas;

d) Other; any pertinent geological, engineering and/or economic data may be considered along with other available data in determining G.R.A's. New methods of evaluation may be incorporated from time to time as they become available and various new theories may be applied to determining G.R.A's as they are proposed.

The Director of the Idaho Department of Water Resources has designated the Camas Prairie of Camas County, Idaho a Geothermal Resource Area. Under the authority of this designation (Idaho Code 42-4003 (g)(h)) the following special conditions apply to all exploration drilling in the Camas Prairie:

a) No person shall drill a well for any purpose to a depth of three thousand (3,000) feet or more below land surface in a designated geothermal resource area without first obtaining a permit under the provisions of this section. Such permits shall be in addition to any permit required by other provisions of law.

b) The owner of any well constructed or being constructed pursuant to Section 42-320, Idaho Code, which encounters a geothermal resource, and who intends or desires to utilize such resource, shall make application for a geothermal permit as required under this section, provided however, that no additional filing fee shall be required.

An approved permit from the Department of Water Resources is generally required before work can begin on geothermal wells. The permit forms required under the Geothermal Resource Act are:

5.4.1 State Requirements - Continued

a) Form 4003-1, Application for Permit to drill for Geothermal Resources;

b) Form 4003 - 2, Application for Permit to Alter a Geothermal Well;

c) Form 4003-3, Application for Permit to Convert a Well to a Geothermal Injection Well;

d) Form 4005, Geothermal Resources Surety Bond;

e) Form 4007, Notice of Intent to Abandon a Well;

f) Form 4009, Report of Abandonment of a Well

Permit applications must be accompanied by a filing fee of:

a) One hundred dollars (100) for any production or exploratory well;

b) Fifty dollars ($50) for an injection well;

c) Fifty dollars ($50) for an amendment to a permit

d) No filing fee shall be charged for filing a Notice of Intent to construct a hole for gathering geotechnical data.

Bonds are required as a condition of every permit. A bond of not less than ten thousand dollars ($10,000) is required for each well.

The two exemptions to the Geothermal Resource Permit requirements relate to exploration wells and to low temperature geothermal wells.

a) If an exploration well is less than six inches in diameter and less than 1,000 feet deep and is used only for collecting geotechnical data, the owner must simply file a Notice of intent to drill with the Department of Water Resources

b) As explained in Section 42-003(e), Idaho Code, wells from which low temperature water is used for such purposes as space heating or fish propagation need only obtain an approved water right.

Although a water right is not required under the geothermal permit, it is highly recommended that water rights be applied for in order to obtain assurances against subsequent developers.

5.4.2 Local Government Permits

Camas County Planning and Zoning: Special Use Permit required.

5.5 Time Factors for Permits:

Idaho Department of Water Resource permits can be issued in less than four weeks but can take up to six months. Contested water right permits can take six months to one year to resolve. Planning and zoning permits take from one week to two months for issuance.

5.6 Barriers to Development

5.6.1 Institutional

The lack of availability of financial assistance for public development is considered by local government interest to be the major institutional barrier to geothermal development. Federal programs are currently designed around a competitive grant program and there are no state programs available to assist local communities in developing geothermal resources.

5.6.2 Environmental

The disposal of thermal fluids by injection will require approval by both the Idaho Department of Water Resources and the Department of Health and Welfare.

Injection near the City of Fairfield will require the inection to occur in the alluvium which fills the Camas Prairie. This alluvium is the source for irrigation water and domestic water. The environmental impact of disposal will have to be carefully examined before permits for development can be obtained.

5.6.3 Financial

The tax base of Camas County has steadily increased since 1970 but this funding base is no longer available to local governments. In 1979 the Idaho Legislature passed a 1% limitation for property tax assessed valuation. This has severely limited local governments ability to fund local public works projects.

6.0 Conceptual Timeline for Development

Figure 6.0 illustrates a conceptual timeline for developing exploration wells. The entire process should require approximately 12 to 24 months. Considering the severe winter conditions which can exist, periods were confined to spring, summer, and fall.

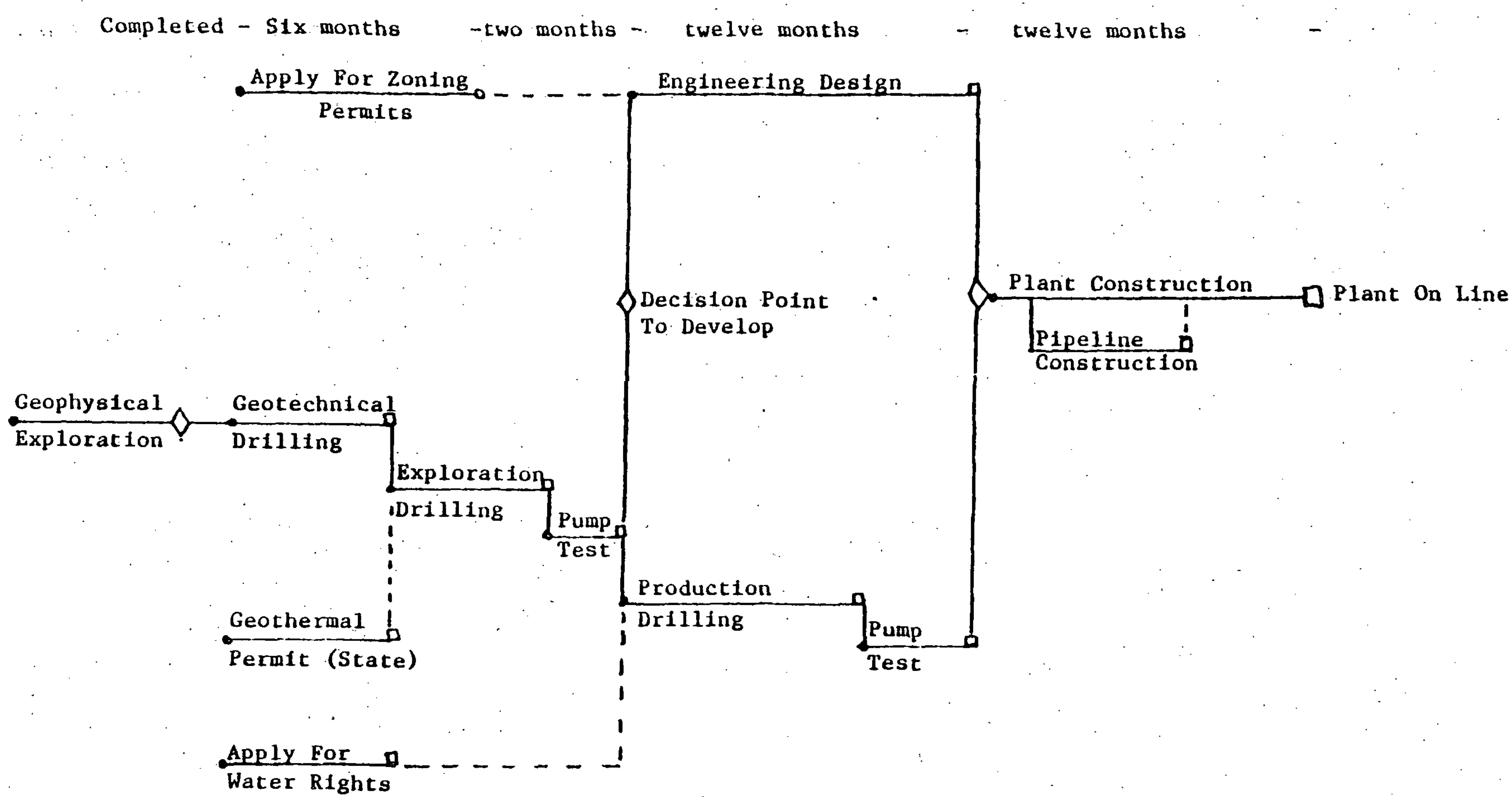


Figure 6.0 Conceptual Timeline for Project Development, Fairfield

R E F E R E N C E S

Boise City Energy Office, Geothermal Energy Systems Plan for Boise City, City of Boise, 1979.

Dames & Moore Co., Natural Gas Supply Requirements for the State of Idaho, Report to the Idaho Public Utilities Commission, 1977.

Dewey, J.W., W.L. Dillinger, J. Taggart, and S.W. Algermissen, A Technique For Seismic Zoning: Analysis of Earthquake Locations and Mechanisms in Northern Utah, Wyoming, Idaho, and Montana, Proc. Intern. and Microzonation, 2nd, Seattle WA, 1972.

Drysdale, F.R. and C.E. Calef, The Energetics of the United States of America: An Atlas, Brookhaven National Laboratory, 1977.

EG & G Idaho, Inc., Rules of Thumb for Geothermal Direct Applications, September, 1978.

Idaho Department of Water Resources, Population and Employment Forecast, State of Idaho, 1978.

Idaho Division of Budget, Policy Planning and Coordination, County Profiles of Idaho, State of Idaho, 1978.

Lienau, P.J., Agribusiness Geothermal Energy Utilization Potential of Klamath and Western Snake River Basins, Oregon. Geo-Heat Utilization Center, Oregon Institute of Technology, 1978.

Makey, D.R. and C.M. Tschanz, Aeromagnetic Survey Map of Idaho, U.S. Geological Survey, 1978.

Mitchell, J.C., Geochemistry and Geological Setting of Thermal Waters of the Camas Prairie Area, Blaine and Camas Counties, Idaho, Water Information Bull. 30, Part 7, Geothermal Investigations in Idaho, Idaho Department of Water Resources, 1976.

Mitchell, J.C., L.L. Johnson, and J.E. Anderson, Potential for Direct Heat Applications of Geothermal Resources, Water Information Bull. 30, Part 9, Geothermal Investigations in Idaho, Idaho Department of Water Resources, 1979.

Muffler, L.P., Edt., Assessment of Geothermal Resources of the United States - 1978, U.S. Geological Survey Circular 790, 1979.

National Weather Service, Idaho Climatological Summary Data by Counties, N.O.A.A. in Cooperation with Idaho Department of Commerce and Development, October 1971.

Pennington, W.D., R.B. Smith and A.B. Trinkle, A Microearthquake Survey of Parts of the Snake River Plain and Central Idaho, Bull. of the Seismological Society of America, Vol. 64, No. 2 pp. 307-312, April 1974.

Rember, W.C., and E.H. Bennett, Geological Map of Hailey Quadrangle Idaho, Idaho Bureau of Mines, Moscow, Idaho, 1979.

Rember, W.C., and E.H. Bennett, Geologic Map of the Challis Quadrangle, Idaho, Idaho Bureau of Mines, Moscow, Idaho, 1979.

Ross, Sylvia, Geothermal Potential of Idaho, Idaho Bureau of Mines and Geology, Pamphlet 150, Moscow, Idaho, Nov. 1971.

Sisco, H.G., Ground Water Levels and Descriptions of Observation Wells in Idaho, 1975, Idaho Department of Water Resources Bulletin 43, Boise, Idaho, Dec. 1976.

Smith, R.B. and M. Sbar, Intraplate Tectonics and Seismicity of the Western United States, cited in Pennington, et al, Bull. of the Seismological Society of America, Vol. 64, No. 2, April 1974.

State of California, Economic Study of Low Temperature Geothermal Energy in Lassen and Modoc Counties, California, Division of Oil and Gas, 1977.

Stocker, R.C., Geothermal Evaluation of the Fairfield, Idaho Area, Energy Services, Inc., Idaho Falls, Idaho, for Idaho Office of Energy, 1979.

University of Idaho, Manufacturing Directory of Idaho, Center for Business Development and Research, 1979.

Vincent, K.R. and J.K. Applegate, A Preliminary Evaluation of the Seismicity of Southwestern Idaho and Eastern Oregon: Implications for Geological Engineering Studies, Department of Geology and Geophysics, Boise State University, Boise, Idaho, 1978.

Young, H.W. and J.C. Mitchell, Geochemistry and Geological Setting of Selected Thermal Waters, Geothermal Investigations in Idaho, Water Info. Bull. 30, Part I, Idaho Department of Water Resources, 1973.

STANLEY, IDAHO

SITE SPECIFIC DEVELOPMENT ANALYSIS

December 1979

By

David W. McClain

William B. Eastlake

and

Mark Gross

IDAHO OFFICE OF ENERGY

OFFICE OF THE GOVERNOR

Prepared for the United States Department of Energy,
Division of Geothermal Energy, Idaho Falls Operations Office
DOE/ID/12010-8

CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

STANLEY, IDAHO

SITE SPECIFIC DEVELOPMENT ANALYSIS

Preface:

Stanley is an isolated mountain community in interior regions of Idaho's Sawtooth Mountains. The community is located at an elevation of 1,903 meters (6,260 ft.) and has 10,739 heating degree days. A significant hot springs with a surface temperature of 41° C (105° F) is located within one kilometer (.6 mi.) of the community. The community of Stanley is interested in developing this geothermal prospect for space heating.

The Stanley Hot Springs geothermal prospect was selected for site specific development analysis because: the site has high heating degree days; the city has requested assistance from the Idaho Office of Energy, and the site can be considered a "type example" of the geothermal development potential which is typical of Idaho's intermountain communities.

1.0 Introduction

A site specific development analysis is a qualitative and quantitative analysis of technical, economic, environmental, and institutional factors which influence the scale and timing of geothermal development. The analysis is based on current information available in the literature and reflects the intent of public and private development interest in the Stanley area. Resource data for the Stanley Basin was provided by the Idaho Department of Water Resources, the U.S. Geological Survey, the University of Utah Research Institute, and Boise State University.

A review of current available socio-economic data and technical papers on geothermal space heating was conducted to determine the scale and cost of a district heating system. Federal, State, and local planning reports were reviewed to determine the institutional factors affecting development.

The Stanley Site Specific Development Analysis describes the institutional, logistical, and economic parameters which will affect the development of a geothermal district heating system which could service the community of Stanley. The development concept involves locating a production well at Stanley Hot Springs and distributing hot water for space heating to all major buildings in the community of Stanley.

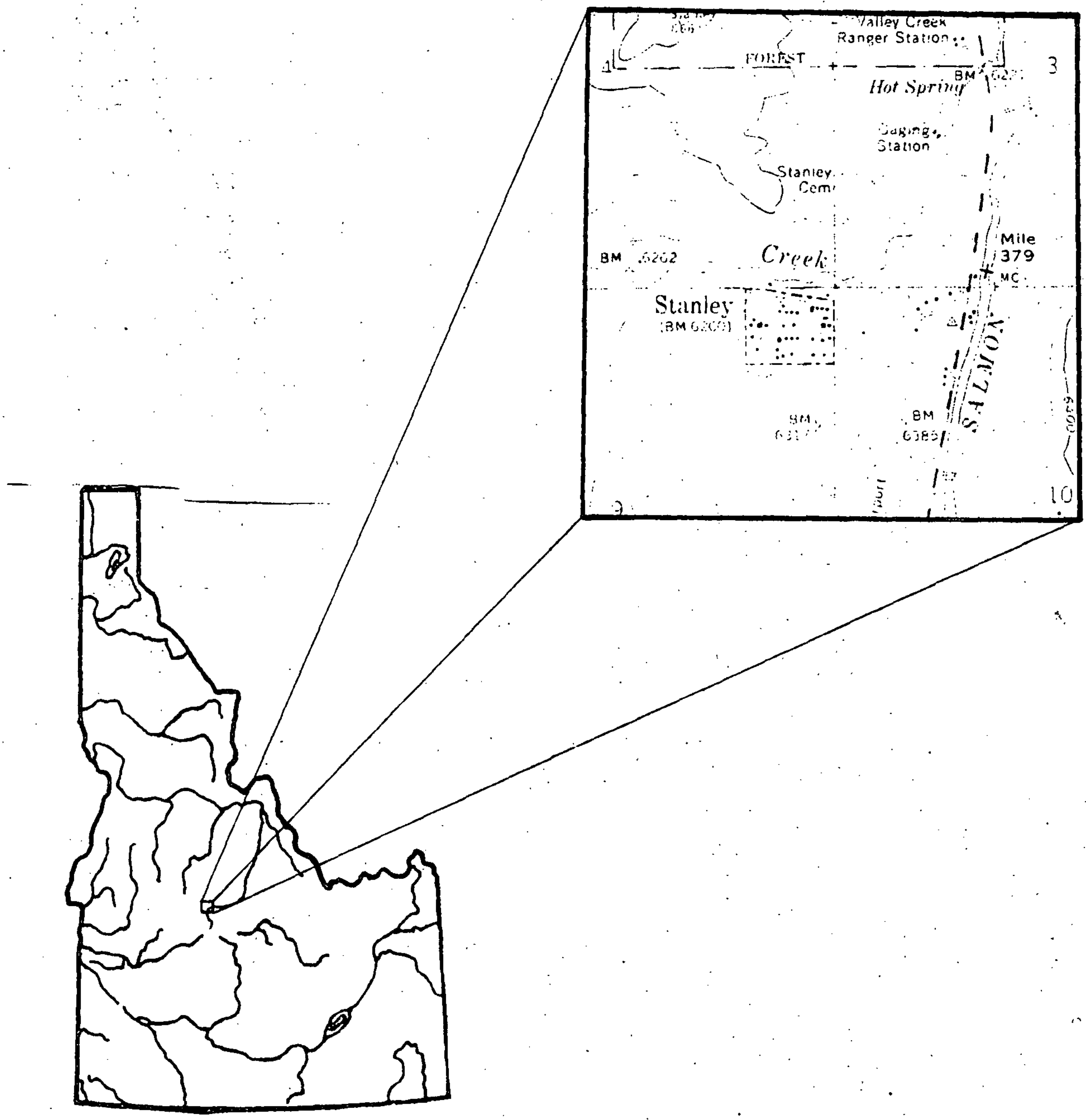
The resource temperatures are expected to range from a minimum to 41° C (105° F) to a maximum of 75° C (167° F). The higher temperature is based on geochemical thermometry. A realistic temperature of 60° C (140° F) could be expected from a 100 to 200 m (328 - 656 ft.) deep well.

Stanley is a small community with a population of approximately 70 year-round residents. The community is the only incorporated town in the Sawtooth National Recreation Area (see Figure 1.0). This small community is service area for the recreation area. The community consists of several service oriented small businesses such as: service stations, cafes, hotels and motels, a grocery store, and post office.

The principal energy supplies for Stanley are electricity, number two fuel oil, propane, and firewood. Monthly heating bills for commercial buildings in Stanley can be as high as $1,000 per month in the winter.

Figure 1.0

Location of Stanley, Idaho



2.0 Site Description

2.1 Location

Stanley, Idaho is located within the boundaries of the Sawtooth National Recreation Area in Custer County at the junction of U.S. Highway 93 and State Highway 21. The community has an elevation of 1,908 meters (6,260 ft.) and is located in an intermountain basin which is surrounded by mountains of the Sawtooth and White Clouds ranges.

Stanley Basin is a large fault controlled basin which is filled to an undetermined depth with alluvium. The basin is a major water shed of the Salmon River.

Stanley Hot Springs is located along the Salmon River, one kilometer (.6 mi.) north of Stanley at the confluence of Valley Creek and the Salmon River. Figure 1.0 shows the location of Stanley Hot Springs and the City of Stanley. The topography of the hot springs and community is relatively level. The City of Stanley is 12 meters (40 ft.) higher than the hot springs. Stanley Hot Springs is located in Section 3, T. 10 N. R. 13 E., Boise Meridian.

2.2 Demographics

The City of Stanley has an estimated, 1979, population of 70 persons. The community has experienced a steady increase in population since 1970. If the current immigration continues the population of Stanley will reach 100 by 1985. Table 2.2 lists the state population and employment forecast of Custer County and its communities. These forecasts are based on historical trends and do not consider the prospects of new employment trends.

Renewed interest in mining activity north of Stanley may cause a substantial immigration into the Stanley Basin. A Los Angeles based firm, Cyprus Mines Corporation, is considering establishing an openpit molybdenum mine and mill complex in Custer County on Thompson Creek, approximately 40 kilometers (25 mi.) northeast of Stanley. A decision to develop the mine will be made in 1980 and depends on approval of a number of operation permits. If all permits are approved in a timely manner, production could commence by 1983.

Anticipated total project employment will be nearly 550 people. Secondary impact could mean an increase of over 2,000 people in the region. Operational plans currently call for the majority of these people to live in the community of Challis which is located 60 kilometers (37 mi.) northeast of the mine site. Some population overflow is expected to impact Stanley.

TABLE 2.2

DEMOGRAPHICS AND EMPLOYMENT

CUSTER COUNTY

County's population as percentage of the State total - 1976: 0.39%

	1950	1960	1970	1976
Population	3,318	2,996	2,967	3,300
Percent of population change			12.4%	12.4%
Percent change (Idaho)			16.5%	16.5%
Population per square mile	0.7	0.6	0.6	0.7

Percent of 1970 population:	Rural farm	22.5%
	Rural non-farm	77.5%
	Urban	0

CITY POPULATION

	Census 1970	Estimate 1975	Percent Change
Challis (County Seat)	784	953	2.16
Clayton	36	35	-2.8
Lost River	40	41	2.5
Mackay	539	615	14.1
Stanley	47	67	42.6

TABLE 2.2 - Continued

Employment Summary

	1972	1975	1980	1985	1990	1995	2000
Agriculture	405	402	384	366	348	334	321
Mining	42	98	110	124	135	144	150
Construction	2	2	2	2	3	3	3
Wood Products	8	6	6	7	8	9	10
Other Manufacturing	10	4	4	5	6	7	7
Trans. Comm. and Utils	55	44	51	56	62	68	75
Whsle and Retail Trade	244	237	259	271	285	299	315
Finance, Ins. Real Est	42	46	48	50	52	54	56
Services and Misc.	188	154	208	248	294	348	412
State and Local Govt.	226	249	282	308	338	369	404
Federal Government	110	144	151	163	175	184	195
Total	1332	1386	1511	1606	1710	1823	1953

Forecast Summary

	1970	1975	1980	1985	1990	1995	2000
Total Population	2960	3240	3740	4020	4290	4410	4580
Total Employment*	1330	1380	1510	1600	1710	1820	1950
Labor Force	1320	1400	1530	1630	1730	1840	1970

*Source: Idaho Dept. of Water Resources, Population and Employment Forecast - State of Idaho, 1978.

2.3 Economy of Site Area

Custer County's economic activities were analyzed to provide a working knowledge of the present and past economic base as well as to provide insight as to the type of future activities which could occur. Custer County has had a stable but stagnant economy in terms of total employment and per capita income for the past five years. The county has not experienced any significant growth since 1970. Table 2.3 lists the major elements of Custer County's economy.

The Stanley area's economy depends primarily on tourism. Unemployment is high during the winter months when tourism is restricted to winter sports. In the recent past, the major contributors to the City of Stanley's economic base were livestock, timber, and mining activities. These activities are currently restricted and will be maintained at a low level on Federal lands because of the National Recreation Area designation.

Opportunities for economic growth in Custer County are currently tied to opportunities of new mining activities and increased tourism. New mining operations are expected to center their base of operations in the Challis area which is the main service center in Custer County. At full operation, in 1983, the Cyprus Mining Company expects to have a local payroll of approximately eight million dollars. The opening of this new mine will bring a growth boom to Custer County which could darw approximately 2,000 new residents into the county.

2.4 Land Use Considerations

The City of Stanley consists of approximately 124.8 hectares (308.5 acres). Approximately 78.9 hectares (195) acres of 63% of the land within the city limits are currently vacant land. An additional 25% of the total land area, 27.1 hectares (67 acres) is used for municipal and civic purposes such as the school, clinic, airport, and sewer lagoons. Current residential land use accounts for only 8% of the total land use. This residential land use is concentrated in 1.0 hectares (2.5 acres) area. Commercial land use, 6.8% of the total land area, is concentrated along the main streets and intersections and accounts for less than 8.5 hectares (21 acres).

Year-round residential occupancy in Stanley is low. Most residential use occurs during the summer and is related to the increase in tourism. Summer population of Stanley can exceed 250 residents. Some commercial businesses are also seasonal and close during the winter months. Present commercial activities are merchandizing, hotels, motels, restaurants, and service stations. These commercial activities are located along the highway areas and in the center of the residential area.

Stanley's major land use concern is the allocation of land uses in such a way as to provide for private and public needs while still maintaining the community's historic setting.

Stanley is in an unusual land use planning position. It is unique by being surrounded by federally controlled lands and by being affected by Federal legislation (P.L. 92-400) concerning land use on private land within the Sawtooth National Recreation Area.

TABLE 2.3

Economy:

Percent of average monthly unemployment - 1976:

Jan. 11.0% Feb. 13.6% Mar. 11.6% Apr. 8.9% May 4.3% Jun. 3.8%
Jul. 3.8% Aug. 3.7% Sep. 4.7% Oct. 4.8% Nov. 8.0% Dec. 9.7%

Percent of labor force unemployed: 1970: 5.0% 1972: 8.7% 1975: 7.6% 1976: 7.0%

Month and percentage of highest unemployment: 1975: Feb.-15.3%
1976: Feb.-13.6%

Month and percentage of lowest unemployment: 1975: Sep.- 3.1%
1976: Aug.- 3.7%

Percent of females (16+) in labor force: 1960 (14+): 30.6% 1970: 37.3%

Employment (B.E.A. data)	1967	1970	1974	1975
Total employment	1,210	1,248	1,377	1,393
Farm proprietors	278	247	237	235
Non-Farm proprietors	194	227	247	247
Wage and salary employment:				
Federal civilian	122	107	153	144
Military	--	--	--	--
State & local	164	207	234	249
Manufacturing	24	(D)	17	10
Mining	64	84	71	99
Construction	23	(D)	5	(D)
Trans., Comm. & Pub. Util.	41	37	45	43
Trade	91	106	110	103
Finance, Insurance & Real Estate	16	19	19	18
Services	74	95	32	95
Other	--	--	--	(D)
Farm	119	108	107	149

(D) Not shown to avoid disclosure of confidential information.

Average Idaho tax return (county) - 1976: $232

Average Idaho tax return (State) - 1976: $396

Total assessed valuation: 1975*: $7,290,547 1976: $7,676,434
*1974 subsequent rolls, 1975 real and personal rolls, and 1975 utilities

Average levy county-wide paid per $100 assessed valuation:
1973: $8.21 1974: $7.25 1975: $7.14 1976: $7.43

Sales tax: 1974*: $159,886 1975*: $168,543 1977*: $171,818
*Fiscal Year

Property tax as percent of full value: County-1976: 1.01%
State -1976: 1.55%

Per capita income:	1970 $2,500	1974 $3,551	1975 $3,435
% of national average:	1970 63.0%	1974 65.2%	1975 58.2%
% of state average:	1970 76.0%	1974 72.2%	1975 66.4%

Median family income - 1969: $7,063

Median family income* - 1976: $8,625
*HUD estimate

Transfer payments (thousands of dollars - county):
1970 $960 1974 $1,785 1975 $2,185

Number of business establishments - 1974: 68

All housing units 1,320

Number of vacant - seasonal and migratory units 163

Number of mobile homes or trailers 111

Population per occupied unit 3.0

2.4 Land Use Consideration - Continued

Section 4 of P.L. 92-400 states:

> "The Secretary shall make and publish regulations setting standards for the use, subdivision, and development of privately owned property within the boundaries of the recreation area. Such regulations shall be generally in furtherance of the purposes of this Act and shall have the object of assuring that the highest and best private use, subdivision, and development of such privately owned property is consistent with the purposes of the Act and with overall general plan of the recreation area..."

All Development in Stanley, including building design, must comply with the regulations set forth in the Sawtooth National Recreation Area Act.

Figure 2.4 shows the major surface landowners in the Stanley area. The Stanley town site is the area with the highest density of commercial and residential structures. In recent years, commercial development has grown along the highway rights. New subdivisions have been partially developed, but very few residential structures have actually been built. New residential growth is expected to concentrate north of Valley Creek and within the old Stanley town site.

2.5 Climate

The Stanley Basin has an extremely cool climate. Located in a high intermountain valley the area has cool summer evenings and cold winters with heavy snowfalls. The average frost free period for the area is 15 days. Table 2.5 summarizes the climatic data for the Stanley Basin.

3.0 Resource Evaluation

3.1 Description of Springs

Stanley Hot Springs is located in Section 3, T. 10 N., R. 13 E., Boise Meridian, in Custer County, Idaho. The spring discharges from quartenary alluvium near Cretaceous granitic rocks. The discharge area is a gravel bar which separates the mouth of Valley Creek from the Salmon River. Several thermal seeps and springs discharge into both the Salmon River and Valley Creek from both sides of the gravel bar along a 400 meter (1,312 ft.) long area.

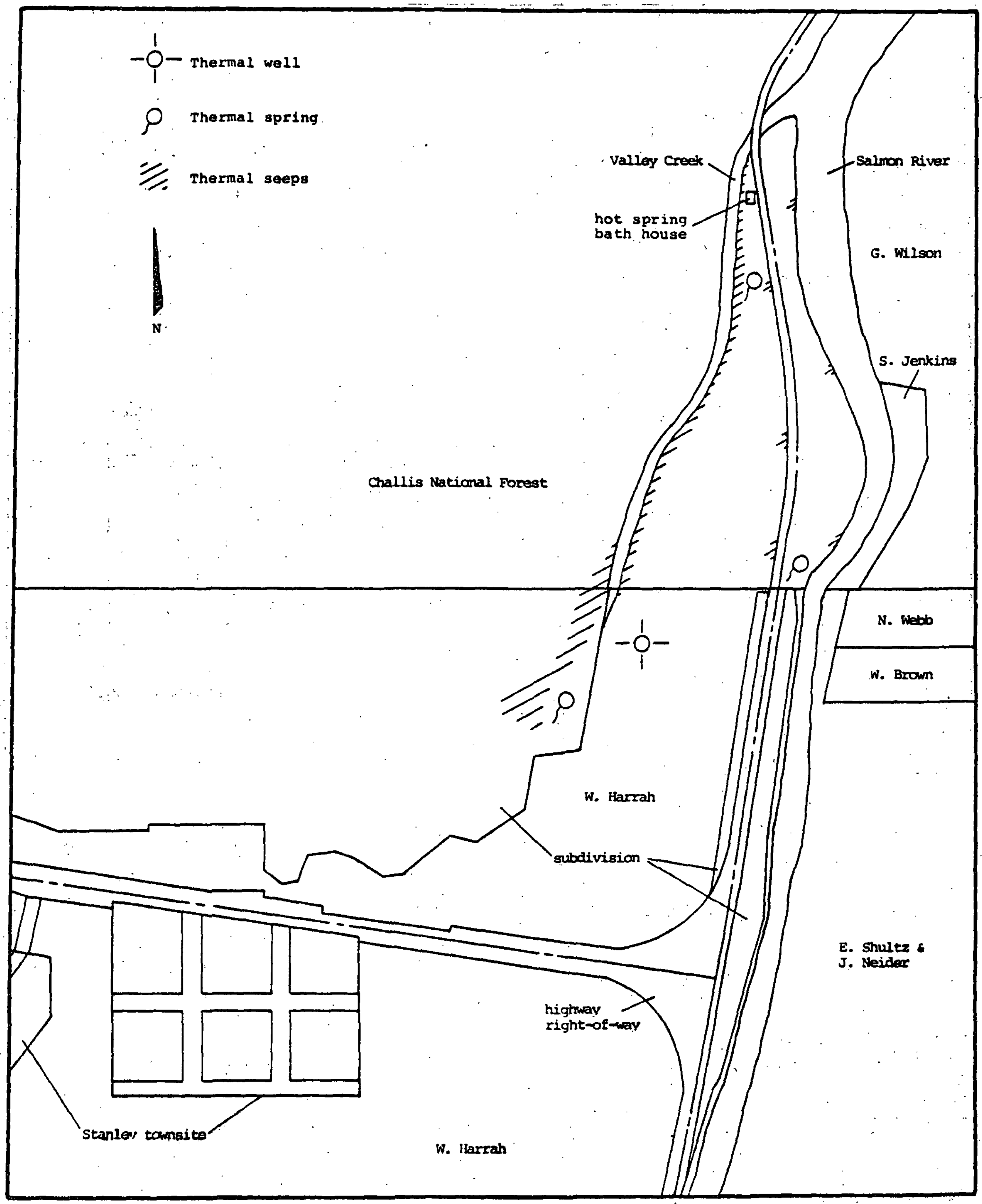


Figure 2.4 Surface Ownership

TABLE 2.5

CLIMATOLOGICAL DATA FOR STANLEY, IDAHO

Elevation: 1,926 meters (6,230 ft.)

Years of Record: 19

Mean Daily Temperature

January Minimum: -18°C (-.7°F)
January Maximum: -3.2°C (26.2°F)

July Minimum: 1.05°C (33.9°F)
July Maximum: 25.6°C (78.1°F)

Lowest Temperature of Record: -45.5°C (-50°F)

Highest Temperature of Record: 35.5°C (96°F)

Average Annual Days

Maximum of 32°C (90°F): 3 days
Minimum of 0°C (32°F) or less: 310 days

Growing Season (Average Freeze Free Period): 15 days

Average Precipitation

Annual Precipitation: 41.2 cm (16.23 in.)
Annual Snow Fall: 238.5 cm (93.9 in.)

January Precipitation: 4.52 cm (1.78 in.)
July Precipitation: 1.50 cm (.61 in.)

Average Annual Number of Days with Precipitation

.25 cm (.10 in.) or more: 53
1.27 cm (.50 in.) or more: 7

Heating Degree Days: 10,739

Source: Idaho Climatological Summary Data by Counties. National Weather Service Climatology in Cooperation with the Idaho Department of Commerce and Development, Boise, Idaho. October 1971.

3.1 Description of Springs - Continued

The discharge of the spring area is estimated to be between (400 and 600 l/min. (150 and 160 GPM). The surface discharge temperature of the thermal water ranges from 31° C to 41° C (88° F to 106°F). Reliable geochemical thermometers indicate subsurface temperatures of 90° C (194° F) to 110° C (230° F). The springs are located 400 meters (1,312 ft.) north and 12 meters (40 ft.) lower in elevation than the city of Stanley.

3.2 General Physiography and Geology

The Stanley Basin is the upper water shed of the Salmon River. The Salmon River flows out of the southeastern side of the basin into the narrow canyon of the Salmon River near Stanley. Valley Creek, which drains the northwest half of the basin, is the major tributary of the Salmon River. The confluence of Valley Creek and the Salmon River occurs at the City of Stanley. Stanley Hot Springs is located at this confluence which is the lowest point in the Stanley Basin.

The mountains of the Sawtooth Range and the White Clouds Range are the prominent features in the landscape of the Stanley Basin. Elevations range from 1,896 meters (8,120 Ft.) at Stanley Hot Springs to over 3,000 meters (9,840 ft.) in the Sawtooth Mountains. The Stanley Basin is a broad structurally controlled intermountain valley. The strong northwest trend of this valley parallels the northern front of the Sawtooth Range.

There is very little detailed knowledge available about the structural geology of the Stanley Basin. Remker and Bennett (1979) have mapped a major inferred fault along the base of the Sawtooth Mountains which forms the western margin of the Stanley Basin. Aerial photo data shows a strong structural linear trending northwest from the Snake River Plain near Hailey, Idaho. This large structural trend is topographically expressed in the Wood River Valley and the Sawtooth Valley. Stanley Basin is located in the center of what is known as the Sawtooth Valley.

The Sawtooth Valley, in the vicinity of the Stanley Basin, separates two distinct lithologies. Cretaceous granite of the Idaho Batholith outcrops along the eastern margin of the valley. Late Eocene pink granites of the Sawtooth Batholith outcrop along the western margin of the valley. The structural control of this valley is probably related to the contact between these two batholiths.

The Sawtooth Valley is filled to an undetermined depth with glacial alluvium. Quarternery glacial till forms the foothills along the Sawtooth Mountain front. Quarternary terrace gravels and alluvium fill the broad flat basin around the City of Stanley and Stanley Hot Springs.

An east trending fault has been mapped by Remker and Bennett (1979) at the location of Stanley Hot Springs. This fault controls the course of the Salmon River Canyon to the east of the Stanley Basin. Several hot springs are located in the Salmon River Canyon along this east trending fault. This series of thermal springs is known as the Sunbeam Hot Springs District. Tscharz, Killsgaard and Seeland (1974) named this sheer zone the Mormon Bend Fault.

3.2 General Physiography and Geology - Continued

Stanley Hot Springs is located along the trace of this east trending fault where the fault intersects the northern margin of the Stanley Basin. The thermal waters of Stanley Hot Springs are discharging from a lobe of quarternary terrace gravels which separate the confluence of Valley Creek from the Salmon River. Cretaceous granite outcrops near these terrace gravels.

3.3 Well Data

A limited number of shallow water wells have been drilled near Stanley Hot Springs. Water wells drilled within 200 meters (656 ft.) of the hot spring normally encounter bedrock within 50 meters (164 ft.) of the surface. A well drilled into the terrace gravel deposit, from which the hot springs are discharging, encountered thermal mud at a depth of 30 meters (98 ft.). A shallow water well drilled 100 meters (328 ft.) north of the hot springs and along the margin of the basin, encountered less than 10 meters (33 ft.) of terrace gravels and was abandoned at a depth of 30 meters (98 ft.) in weathered and altered granite. Wells drilled south of the hot springs in the City of Stanley are less than 50 meters (164 ft.) deep and do not encounter bedrock.

3.4 Seismic Data

Relatively little is known about the seismicity of southwest Idaho. Previous knowledge has been limited to felt reports, temporary microseismic networks and seismic monitoring by instruments relatively distant from the area.

An earthquake swarm occurred near Stanley in 1963 (Dewey, et. al., 1972). Over 50 events were reported in one month by the U.S. Coast and Geodetic Survey. Several events were of magnitude 4 and larger. In 1964, reconnaissance microearthquake investigations (Westphal and Lange, 1966) located several events roughly 25 kilometers (15.5 mi.) east of Stanley. Focal depths of the seismic events were determined to range from 14.5 kilometers (9 mi.) to 29.1 kilometers (18 mi.). In 1972, 40 microearthquakes were recorded in eight days by Pennington (1974). Pennington's report states:

> " All of the events in the Stanley area occurred in the uppermost part of the crust, with focal depths of less than 6 kilometers. A single focal mechanism cannot be determined by a composite plot of first motions. The events cluster in space and time, suggesting earthquake swarm developments perhaps associated with the geothermal activity of the Sunbeam Hot Springs District."

Eighteen of these events were located. Five events occurred in a 24-hour period within 3 milometers (1.8 mi.) of Stanley. All five events exhibited first motions which were consistently compressional for rays leaving upward and to the east. Seven additional events occurred in another 24-hour period. Located very near Stanley, the first motions of these events were inconsistent. All the events near Stanley were shallow (Pennington, et. al., 1974).

3.4 Seismic Data - Continued

Focal mechanism studies of the largest earthquakes in the 1963 swarm show normal faulting on a fairly steep dipping east, trending fault plane (Smith and Sbar, 1974). Pennington (1974) points out that microearthquake data indicates a more northerly striking fault plane. The discrepancy may be due to the epicenter of the 1963 event being 25 kilometers (15.5 mi.) east of the 1972 activity which suggests that several active seismic systems are evident in the Stanley area.

During 1976 and 1977, Boise State University's Department of Geology and Geophysics operated a network of three radiotelemetry seismographs in the Boise area. Over 800 seismic events were recorded. Although epicenters locate throughout central Idaho, the seismic events most frequently occur near Stanley and west of Challis in Custer County. Vincent and Applegate (1978) report nineteen seismic events located near Stanley appear to be associated with the eastern boundry of the Sawtooth Mountains. Six additional events align with the western boundary of the Sawtooth Mountains. The magnitude of the Stanley seismic cluster range from 1.3 to 4.0 and were most frequently between 1.9 to 3.0. The majority of these events were located within a 15 mile radius of the Stanley basin.

Earthquake swarms like the 1963 Stanley Swarm are often indicative of hydrothermal, volcanic or magmatic activity (Sykes, 1970). Shallow swarms have been observed in geothermal areas associated with fissure systems (Ward and Bjornsson, 1971). The seismic activity in the Stanley-Sunbeam area may be related to geothermal or perhaps magmatic activity (Pennington, et. al., 1974).

3.5 Aeromagnetic Data

The aeromagnetic map of Idaho (See Figure 3.5 USGS, 1978) shows the Stanley Basin (See Figure 3.5) to be a magnetic low anomaly of 880 to 900 gammas contrasted to highs in the neighboring Sawtooth and White Cloud Ranges of 1,040 to 1,220 gammas. The basin is controlled by north trending faults against the Sawtooth Batholith on the west and the Idaho Batholith on the east. The high magnetic gradient between the valley and ranges to the east and west is indicative of fault control. The lowest magnetic values are in the south and central portions of the basin, indicating that the sedimentary fill is deepest south of Stanley.

3.6 Geochemical Analysis

The geochemistry of Stanley Hot Springs (Mitchell and Anderson, 1979) is listed in Table 3.6.1. This spring has the low total dissolved solids and is relatively "clean" water. The hot spring does have high fluoride content (14 mg/l) which may pose disposal problems. Safe drinking water standards for fluoride are 2 mg/l. Stanley Hot Springs have an anomalously low potassium (.5 mg/l) compared to other hot springs in the area. The low potassium levels have a significant affect on the geochemical thermometry used to predict aquifer temperatures. Stanley Hot Springs has a potassium count which is 80% lower than the other hot springs in the area.

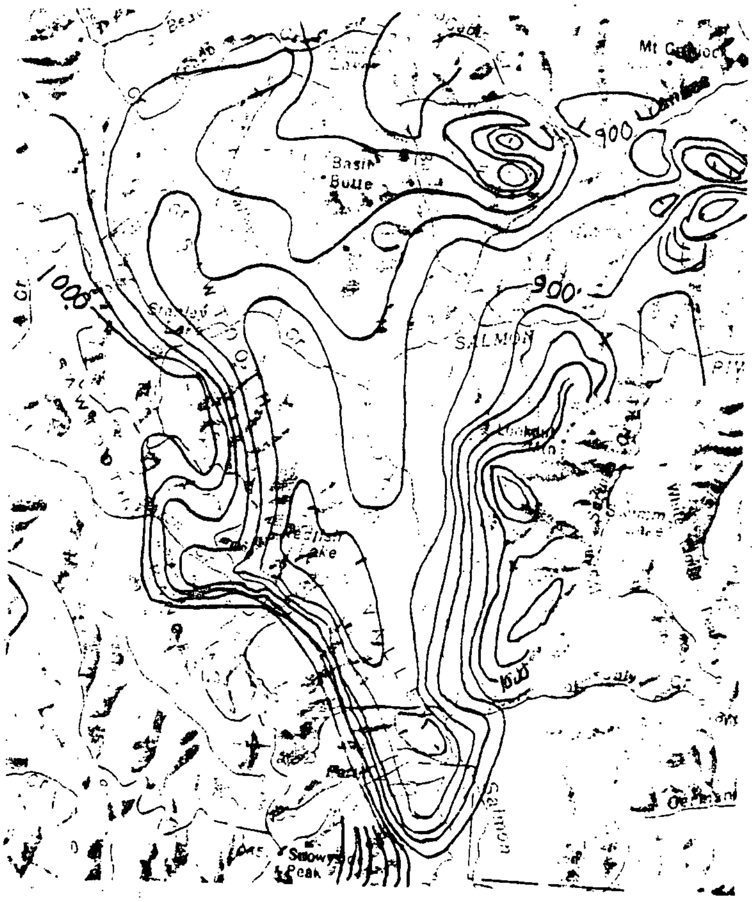


Figure 3.5 Aeromagnetic Map

TABLE 3.6.1

CHEMICAL ANALYSIS OF STANLEY HOT SPRINGS
(Chemical Constituents in milligrams per liter)

Sample Collection Data	Discharge (GPM)	Temperature (OC)	Silica (Si)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Phosphate (P)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	TDS	pH
7-12-72	110	41	55	2.2	0.10	60	0.50	30	28	31	0.01	5.0	14	.05	71	8.8

Source: Idaho Department of Water Resources
Bull. 30, Part 9, 1979.

TABLE 3.6.2

Geothermometer Temperatures

Springs or Well Identification	Discharge l/m	Known Temp. °C	Aquifer Temperature Predicted by Geochemical Thermometry °C* T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Stanley Hot Springs 10 n, 13 E, 3 caa	110	41	106	106	-10	75	47	47	6	47
Elkhorn H. S. 11 N 13 E, 36 baa	13	57	121	119	- 3	93	137	37	83	137
Basin Creek H.S. 11 N 14 E, 21 aab	7	60	131	127	11	104	144	44	102	144
Sunbeam H. S. 11 N 15 E, 19 cba	444	78	131	128	12	104	129	129	72	129
Robinson Bar H.S. 11 N 15 E, 26 ddc	40	49	125	122	6	97	148	148	109	148

T_1 = Silica temperature assuming quartz equilibrium and conductive cooling (no steam loss)
T_2 = Silica temperature assuming quartz equilibrium and adiabatic expansion at constant enthelpy (Maximum steam loss)
T_3 = Silica temperature assuming equilibrium with amorphous silica
T_4 = Silica temperature assuming equilibrium with chalcedony and conductive cooling (no steam loss)
T_5 = Na-K-Ca temperature
T_6 = Na-K-Ca temperature corrected for PCO_2
T_7 = Na-K-Ca temperature corrected for Mg
T_8 = Na-K temperature

Source: Idaho Department of Water Resources Bull. 30, Part 9, 1979.

3.6 Geochemical Analysis - Continued

Aquifer temperatures predicted by geochemical thermometry are listed in Table 3.6.2 for several hot springs located near Stanley in the Sunbeam Hot Springs belt. The lower potassium count is reflected in the lower Na-K-Ca temperature thermometers for the spring.

In this case the most reliable geochemical thermometer is probably the Silica temperature assuming equilibrium with chalcedony. This geochemical thermometer predicts an aquifer temperature of 75° C (167° F). Exploration wells drilled in other locations throughout Idaho have not encountered temperatures which exceed the Silica with chalcedony equilibrium geochemical thermometers. This geochemical thermometer is considered to be a reliable measure of upper temperature limits which can be expected for low temperature resources.

3.7 Reservoir Potential

The reservoir area has significant potential for production of large amounts of thermal water. The U.S. Geological Survey (Tschanz, Killsgaard and Seeland, 1974) estimated the reservoir size by using magnetic surveys, structural interpretation and surface area influenced by past and present discharge. The USGS reports that Stanley Hot Springs District with an estimated reservoir size of 15.2 hectares (38 acres), with significant permeability and fluid content.

3.8 Potential Applications of the Resource

Commercial interests have considered developing a spa - bathhouse complex on private land adjacent to the hot springs. Such a complex would take advantage of large volume of tourist traffic which passes through the Sawtooth National Recreation Area during summer and fall months. Two attempts at this endeavor have failed in recent years due to a lack of investment capital. The concept of a spa is currently being considered by the Stan Harrah Company which is the largest landowner in Stanley. Stan Harrah Company operates a large motel and several large major commercial buildings in Stanley. A spa complex could attract winter tourism and increase the visitor rate during the winter months.

Both the City of Stanley and Stan Harrah Company are interested in developing the thermal water for space heating. Currently, the community depends upon electricity, propane, and wood for space heating. The community has over 300 days per year when the temperature falls below 0° C (32° F). Because Stanley has a high space heating demand and is co-located with the hot springs, space heating of commercial and residential buildings in Stanley appears to be the most realistic development scenario. Rising energy cost has created a growing awareness in Stanley of the need for alternative energy forms and the potential for geothermal space heating. The potential for development of Stanley Hot Springs for space heating the City of Stanley is analyzed in the following section.

4.0 Site Specific Application

The development of Stanley Hot Springs for a district heating system capable of heating the residential and commercial buildings in the City of Stanley is estimated to cost $111,164. This cost estimate includes capital investment required for production and transmission systems. The following economic analysis represents a preliminary examination of the economic viability of geothermal space heating at Stanley, Idaho. Table 4.0 details the estimated capital investment required to develop such a system.

TABLE 4.0

Capital Cost Breakdown

I. Transmission Systems:		$90,674
Main to City	$75,004	
Connectors	15,760	
II. Supply System:		
A. Supply Well 1 well @ 152 m (500 ft.)		7,400
B. Supply Pump 1 @ 30 HP		13,000
III. Disposal System		
No extra facilities needed	-----	
Total Capital Investment		$111,164

4.1 Considerations for a Heating System

Before potential cost savings from a geothermal space heating system can be considered in detail, it is necessary to examine both demand and supply for space heat in Stanley to determine whether a proposed well of a given temperature is capable of supplying the heat demand both in peak periods and on an annual basis. This analysis contains some projections of heating demand, but it is based on actual fuel bills wherever it was possible to obtain such information.

4.2 Heat Demand

Stanley has approximately 10,000 heating degree days and minimum temperatures often reach -34° C (-30° F), which generates a design temperature difference of 35° C (95° F), 18° C (65°F) to -34° C (-30° F).

4.2 Heat Demand - Continued

Stanley has a large commercial complex (consisting of gas stations, restaurant, bar, supermarket, and lodge) belonging to the Harrah estate; an elementary school, a hotel, two stores, two bars, a post office, a laundromat, and approximately 36 residences.

Actual power bills for 1978 - 1979 were received from the Harrah complex, the hotel, and the laundromat, probably the three biggest heat consumers in Stanley. These bills were converted to units of fuel purchased and thence to BTUs. Thus it was possible to get a good picture of total yearly demand as well as monthly peak demand.

For other heat customers average energy usage was assumed based on EG & G's Rules of Thumb publication and EG & G's cost simulation model for space heating installations. Total yearly demand and peak demand estimates are detailed in Table 4.2.1. Both yearly and hourly peak heat requirements are well within the amounts of heat available from the projected 1894 liter/min. (500 GPM) well.

4.3 Heat Available

Economical temperature drop across a heat exchanger is given by the equation:

$$t = (.6 \times \text{temperature}) - 70 \text{ F}$$

With 75° C (167° F) water this gives a temperature drop (Δ t) of 30° F. The quantity of heat available from a single 500 GPM well is given by the equation:

$$Q = 500\ (\Delta t)\ w, \quad Q = \text{quantity of heat in BTU/hr.}$$
$$t = \text{temperature drop}$$
$$w = \text{flow in gallons per minute}$$

$$Q = 500\ (30\ )\ (500 \text{ GPM})$$
$$7.5 \times 10^{6} \text{ BTU/hr.}$$

This represents the peak heat available in a given hour from the projected well.

Multiplying this figure by 8,760 (the number of hours in a year) gives a figure of 6.57×10^{10} BTUs, the total heat available over a whole year. Assuming a household uses $.2 \times 10^{9}$ BTU per year, the projected well could serve 328 residential customers.

Comparison of the heat demand figures in Table 4.2.1 with the heat available indicates that 4.75×10^{10} BTUs per year or 2.65×10^{6} BTU/hr. are surplus heat capacity available for possible use beyond present needs. This excess capacity could be used for additional space heating in Stanley , or a pipeline could be run to Lower Stanley which would service customers there but probably at a prohibitive cost due to the length of pipe required.

TABLE 4.2.1

Stanley Heat Demand

	Yearly Demand (BTUs)	Peak Demand (BTU/hr.)
Harrah Complex:		
Gas	3.08×10^9	3.94×10^5
Electric	4.45×10^9	5.67×10^5
Hotel		
Gas	5.12×10^8	9.80×10^4
Electric	2.97×10^8	3.90×10^4
Laundromat		
Gas	5.31×10^8	2.85×10^4
Residences	7.20×10^9	2.85×10^6
School	1.20×10^9	4.75×10^5
Other Commercial Establishments	1.00×10^9	3.95×10^5
Totals	1.817×10^{10}	4.85×10^6

Notes:

For Harrah Complex, hotel, laundromat, derivation of figures is as follows:

Yearly demand derived by dividing electric bills by 1.7¢ Kwh and multiplying by 3,413 BTU/Kwh, dividing gas (propane) bills by 57.9¢/gal. and multiplying by 91,500 BTU/Gal. Peak demand derived by applying same procedure outlined above to peak monthly bills (January - February), then dividing by 720 to reduce the monthly figure to BTUs per hour. Laundromat peak demandis in August, so the January figure was used. For other users, the following assumptions were made:

Each of 36 residences assumed to use $.2 \times 10^9$ BTU per year. Dividing annual heat load by 2.52×10^3 (the product of 8,760 hours and an annual utilization factor of .28839) gives a design heat load or peak demand figure of 7.92×10^4 BTU/hr. per house. The school is assumed to be 5,000 $ft.^2$ with a design temperature difference of 95° F (65° F - (-30° F)) and a heat load of 1 BTU/hr./ft. per F. This gives a design heat load of 4.75×10^5 BTU/hr. which is projected to yearly heat load using the above annual utilization factor. Four other commercial establishments are assumed to have annual heat load of $.25 \times 10^9$ BTU each which is divided as for residences to give a design heat load.

4.3 Heat Available - Continued

Another use of hot water from the projected well would be a public spa or hot springs pool. Interest in such a facility has been expressed by several parties over the past few years and the Forest Service is said to be receptive to construction of such a facility in the Sawtooth National Recreation Area (SNRA). Heavy use of the area in summer by tourists also allows the possibility of a hot shower facility for campers, either separate or in combination with a spa. Conversion of the surplus BTUs listed above into flow rates indicates that about 662 liter/min (175 GPM) may be available for uses other than meeting present demand.

4.4.0 Proposed Facilities

4.4.1 Transmission System

Water would be pumped straight east to the Highway (U.S. 75), south along the highway approximately 400 meters (a quarter mile) and thence west on Idaho 21 for approximately 800 meters (half a mile). Two lateral lines would extend south into the heart of town. (See Figure 4.4.1).

A 15 cm (6 in.) pipe would extend a total of 1346 meters (4,412 ft.) from the wellhead to the western boundary of the pipeline, at a cost of $5.18/meter ($17 per foot). The two lateral connecting lines would be 5 cm (2 in.) pipe, costing $3.05/meter ($10 per foot) and extending 480 meters (1,576 ft).

All pipe would be Bonstrand 1600 series RTRP pipe in a PVC jacket with polyurethane foam insulation supplied by Rovanco Company. The pipe would be buried to a depth of one meter (3 ft.) and located on the edge of the roads to minimize surface restoration cost.

4.4.2 Supply System

A. Supply well

A single 1,894 liter/min (500 GPM) well would be drilled between Valley Creek and Highway 95 (see Figure 4.4.1) to a depth of 152 meters (500 ft.). A 25 cm (10 in.) hole would be drilled to 12 meters (40 ft.) and a 20 cm (8 in.) casing set. Then drilling would proceed 140 meters (460 ft.) with a 20 cm (8 in.) hole. The entire 152 meters (500 ft.) would be cased to the surface with 15 cm (6 in.) casing. Cost figures of $0.39 per cm ($1 per ft.) of diameter per .304 meters (one ft.) of depth were used for both drilling and casing, for an overall well cost of about $49 per meter ($15 per ft.).

B. Supply pump

A vertical turbine downhole pump set for 152 meters (500 ft.) lift would pump the geothermal fluid from the well into Stanley. A three stage 30 HP pump, using a maximum of $3,920 per year in electric power at a rate of 2¢ per Kwh would cost about $13,000 including main valves and installation costs.

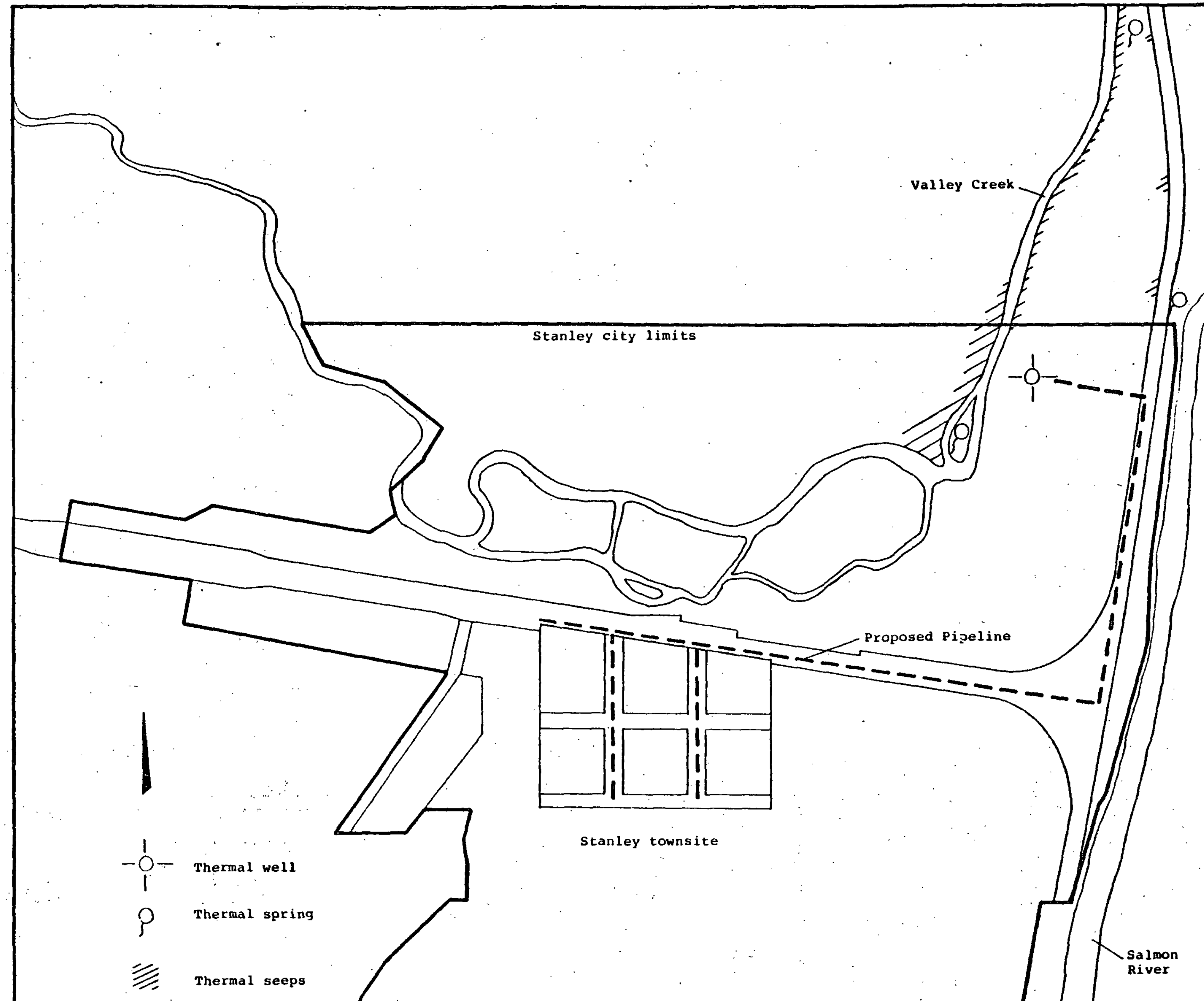


Figure 4.4.1 Stanley Geothermal Transmission System

4.4.3 Disposal System

Spent geothermal fluids would be voided directly into the city sewer system rather than injected. It is felt at this time that the comparatively small amount of water involved would be handled by the newly-installed sewer lagoon system and might have the added benefit of promoting evaporation and chemical changes in the sewage lagoon. At the present the lagoon is frozen over for extended periods. Addition of hot water may enhance the performance of this sewage treatment system. An engineering analysis is needed to accurately assess the capacity for geothermal fluid disposal into the sewer system.

4.5 Cost Analysis

A 20-year cost comparison of propane with geothermal heat is shown in Table 4.5.1. The cost of propane is derived by taking an annual heat load of 1.342 X 10^{10} BTU (total demand of 1.817 X 10^9 BTUs from Table 4.2.1 minus electricity usage of .475 X 10^9 BTU), dividing by 91,500 BTUs per gallon to convert to gallons of propane then multiplying by the price of propane. This cost rises over time as propane prices rise at the rates projected by Dames and Moore. Electricity cost represents maximum yearly usage for the pump required to produce the geothermal water. Maintenance costs are estimated at 2% of capital cost. Annual savings represent what would have been spent for propane minus actual operating expenses with geothermal. The annual savings streams were then discounted at 10% and 20% to convert these future amounts to their present worth. In both cases the savings streams and payback periods are substantial with respect to the projected investment.

Table 4.5.2 presents price projections for conventional fuel sources, in billing terms and converted to millions of BTUs for easier comparison. These prices have been adjusted for conversion efficiency so that final prices are for millions of usable BTUs. (Electricity is assumed to be 100% efficient, gas and propane 80% efficient, and oil 70%). All prices in Table 4.5.2, plus all other energy prices in the overall analysis, have been escalated at rates given in the Dames and Moore study prepared in late 1977 for the Idaho Public Utilities Commission. There is considerable reason now to believe that these projections are too low but in the absence of a more comprehensive set of projections we will continue to use them.

Keep in mind that is a case for geothermal heat can be made with these rates of increase for conventional fuel alternatives, which we know are conservative, actual increases beyond these conservative projections only serve to enhance the competitiveness of geothermal heat.

Estimates of future fuel prices from Table 4.5.2 along with estimates of geothermal prices from Table 4.5.3 are found in graphical form in Figure 4.5.4.

TABLE 4.5.1
20-YEAR OPERATING COST SAVING FROM GEOTHERMAL HEAT

(1) PROPANE Cost	(2) GEO ELECTRICITY Cost	(3) GEO MAINTENANCE Cost	(4) ANNUAL SAVING	(5) PRESENT WORTH (10%)	(6) PRESENT WORT (20%)
84,939	3,920	2,223	78,796	71,633	65,163
90,630	4,277	2,378	83,974	69,400	58,315
96,702	4,666	2,545	89,491	67,236	52,049
103,181	5,025	2,723	95,433	65,182	46,023
109,166	5,412	2,914	100,740	62,552	40,485
115,497	5,829	3,118	106,550	60,145	35,683
122,196	6,278	3,336	112,582	57,772	31,420
129,283	6,761	3,570	118,952	55,492	27,664
136,782	7,349	3,820	125,613	53,272	24,345
144,305	7,989	4,087	132,229	50,979	21,355
152,242	8,684	4,373	139,188	48,785	18,733
160,615	9,439	4,679	146,497	46,678	16,431
169,449	10,260	5,007	154,182	44,661	14,410
178,769	11,153	5,357	162,259	42,728	12,638
188,601	12,123	5,732	170,746	40,875	11,082
198,974	13,178	6,133	179,663	39,100	9,718
209,917	14,324	6,563	189,030	37,399	8,520
221,463	15,571	7,022	198,870	35,764	7,470
233,643	16,925	7,514	209,204	34,207	6,548
246,494	18,398	8,040	220,056	32,710	5,740
			TOTAL	1,016,561	TOTAL 514,262
				Payback Period 1.6 Years	Payback Period 2.0 Years

(1) Yearly heat demand of 1.342 X 10^{10} BTU converted to propane cost at 57.9¢ per gal. and 91,500 BTUs per gal.
(2) Projected to increase at Dames & Moore rates.
(3) Estimated at 2% of capital cost, increasing 7% per year.
(4) Annual cost of propane (1) - operating cost of geothermal (2) & (3).
(5) & (6) Years savings converted to present value.

TABLE 4.5.2
FUEL PRICES - PROJECTED 20 YEARS

	1 Electricity		2 Gas		3 #2 Fuel Oil		4 Propane		5 Geothermal
	$/Kwh	$/$10^6$ BTU	$/Therm	$/$10^6$ BTU	$/Gal.	$/$10^6$ BTU	$/Gal.	$/$10^6$ BTU	$/$10^6$ BTU
1979	.0293	8.585	.382	4.776	.739	7.610	.579	7.961	1.002
1980	.0319	9.347	.409	5.115	.789	8.127	.618	8.498	1.029
1981	.0349	10.226	.438	5.478	.843	8.680	.659	9.061	1.058
1982	.0380	11.134	.469	5.867	.900	9.270	.703	9.666	1.087
1983	.0410	12.013	.506	6.284	.961	9.901	.744	10.230	1.117
1984	.0441	12.921	.544	6.730	1.027	10.574	.787	10.821	1.150
1985	.0475	13.918	.586	7.208	1.097	11.293	.833	11.454	1.185
1986	.0512	15.001	.632	7.720	1.171	12.061	.881	12.114	1.223
1987	.0551	16.144	.680	8.268	1.251	12.881	.932	12.815	1.267
1988	.0599	17.551	.733	8.855	1.338	13.783	.984	13.530	1.315
1989	.0651	19.074	.789	9.483	1.432	14.748	1.038	14.272	1.366
1990	.0708	20.744	.850	10.157	1.532	15.780	1.095	15.056	1.422
1991	.0770	22.561	.915	10.878	1.640	16.885	1.155	15.881	1.483
1992	.0837	24.524	.986	11.650	1.754	18.066	1.219	16.761	1.548
1993	.0909	26.634	1.061	12.477	1.877	19.331	1.286	17.683	1.619
1994	.0989	28.978	1.143	13.363	2.009	20.684	1.356	18.645	1.696
1995	.1075	31.498	1.231	14.312	2.149	22.132	1.431	19.676	1.779
1996	.1168	34.222	1.326	15.328	2.300	23.681	1.510	20.763	1.869
1997	.1270	37.211	1.428	16.416	2.461	25.339	1.593	21.904	1.966
1998	.1380	40.434	1.538	17.582	2.633	27.113	1.680	23.100	2.071

1 Electric power projected to increase at Dames & Moore rates, 9.1% through 1982, 7.7% through 1987, 8.7% thereafter
2 Gas price " " " " " " " " " " " " " " 7.1% 7.7% 7.1%
3 Oil price " " " " " " " " " " " " " " 6.8% 7.5% 7.0
4 Propane (LPG) " " " " " " " " " " " " 6.7% 5.8% 5.5%
5 Derived from Table 4.3.4

20 YEAR PROJECTION OF GEOTHERMAL COSTS

TABLE 4.5.3

	(1) Amortization	(2) Maintenance	(3) Electric Power	(4) Total Geothermal Cost	(5) Cost/100 ft.^{3}	(6) Cost/10^6 BTU
1979	12,870	2,223	3,920	19,013	.188	1.002
1980	12,870	2,379	4,277	19,526	.193	1.029
1981	12,870	2,545	4,666	20,081	.199	1.058
1982	12,870	2,723	5,025	20,618	.204	1.087
1983	12,870	2,914	5,412	21,196	.210	1.117
1984	12,870	3,118	5,829	21,817	.216	1.150
1985	12,870	3,336	6,278	22,484	.223	1.185
1986	12,870	3,570	6,761	23,201	.230	1.223
1987	12,870	3,820	7,349	24,039	.24	1.267
1988	12,870	4,087	7,989	24,946	.247	1.315
1989	12,870	4,373	8,684	25,927	.257	1.366
1990	12,870	4,679	9,439	26,988	.267	1.422
1991	12,870	5,007	10,260	28,137	.289	1.483
1992	12,870	5,357	11,153	29,380	.291	1.548
1993	12,870	5,732	12,123	30,725	.304	1.619
1994	12,870	6,133	13,178	32,181	.319	1.696
1995	12,870	6,563	14,325	33,758	.334	1.779
1996	12,870	7,022	15,571	35,463	.351	1.869
1997	12,870	7,514	16,925	37,309	.370	1.966
1998	12,870	8,040	18,398	39,308	.389	2.071

(1) Capital cost of $111,164 amortized at 10% for 20 years
(2) Estimated at 2% of capital cost, rising 7% per year
(3) Projected to rise at Dames & Moore rates, 9.1% until 1982, 7.7% through 1987, 8.7% thereafter
(4) Total of (1) & (2) & (3)
(5) Total cost from column (4) divided by yearly water use of 10,093,650 ft.^{3}
(6) Total cost from column (4) divided by yearly therms available, 187,762, multiplied by 10 to convert to millions of BTUs.

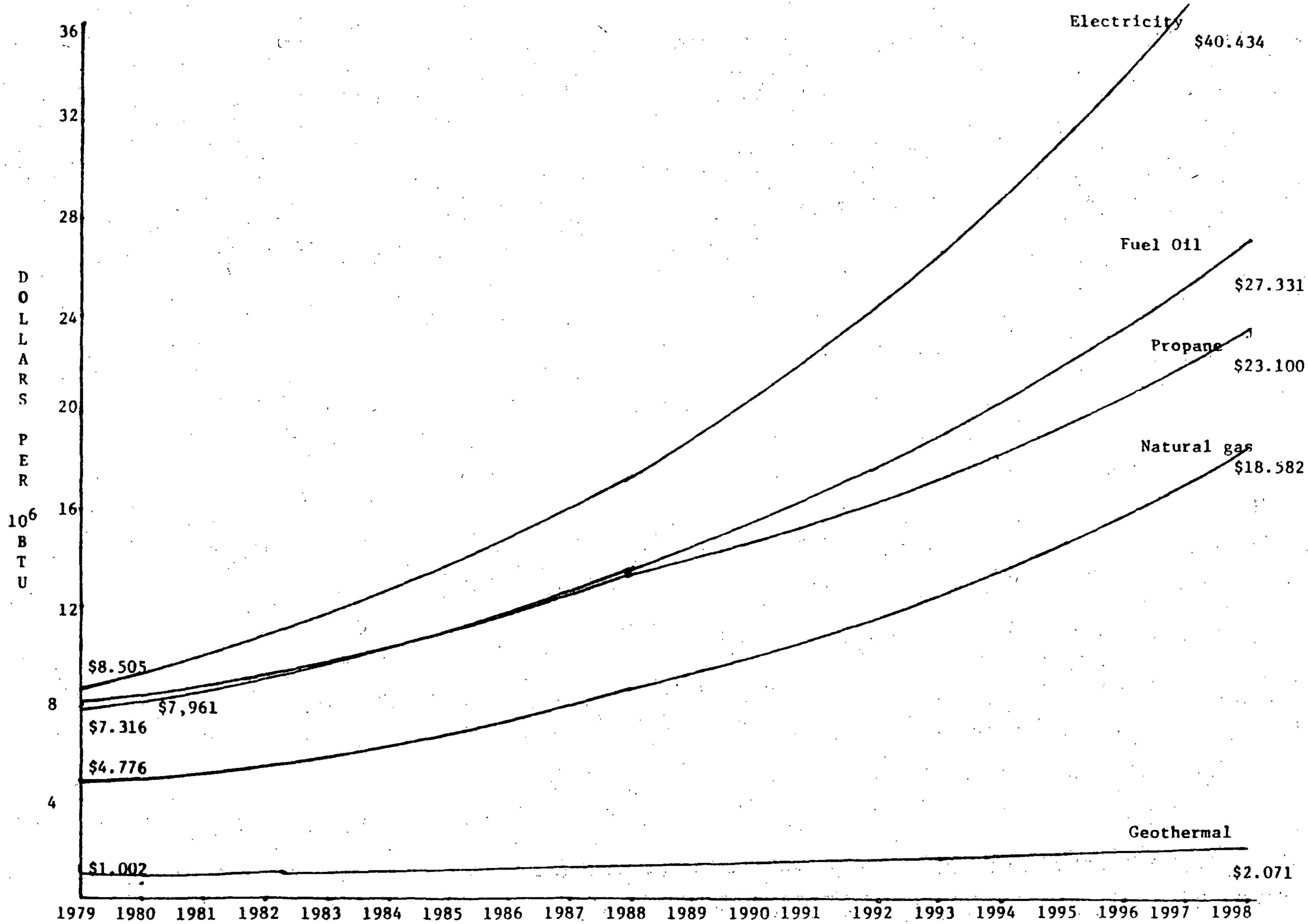


Figure 4.5.4 20-Year Projection of Energy Prices

4.5 Cost Analysis - Continued

Table 4.5.3 presents estimates of the costs of providing geothermal heat to the City of Stanley. Footnotes to Table 4.5.3 give all necessary information on how estimates for cost categories were derived and how they are expected to change over time. The total cost of geothermal is made up of allowances for amortizing the capital cost plus operating costs (maintenance and electric power).

Total heat available with a -1.1° C (30° F) temerature drop and a flow of 500 GPM was divided by the available cubic feet of water at that flow to establish heat content of the water. This heat content figure was multiplied by the available water and Stanley's heat load factor to establish both the number of cubic feet and the number of available BTUs. The total geothermal costs (column (4) of Table 4.5.3) were then divided by these numbers to establish cost per 100 $ft.^3$ and cost per 10^6 BTUs. The cost per 10^6 BTUs is then readily comparable to costs for traditional fuel sources, as seen in Figure 4.3.3.

4.6 Economic Conclusions

Annual savings in operating costs for geothermal heating versus propane gas heating amounts to $78,796 in the first year and rise over time with propane prices. Table 4.5.1 carries out this comparison over 20 years.

The internal rate of return, which equates a 20-year stream of savings to capital costs for a geothermal system, is an extraordinarily favorable 67% (see Table 4.6.1).

The economic analysis is summed up in the graphical relationships shown in Figure 4.5.4. The prospective geothermal system has a cost per million BTUs much lower than the cost of any alternative fuel source over the entire 20-year period.

Since the projected system was a "bare bones" system with no injection, it came as little surprise that the cost per 10^6 BTU was so favorable. A second system, with disposal pipe and a 1,000 ft. injection well was costed for comparison. This more expensive system had a capital cost of $229,938. The yearly amortization amount was $26,618. The larger amortization, coupled with constant maintenance cost and doubled power cost, give yearly costs ranging from $36,681 to $71,454. This obviously reduces the annual savings but the internal rate of return remains a substantial 28.7% despite a doubling of capital costs. Yearly costs per 10^6 BTUs range from $1.95 in 1979 to $3.80 in 1998.

Whether the system is a "bare bones" one or a more expensive one with injection pumping, all evidence indicates use of geothermal fluid for space heating the City of Stanley is a sound economic proposition.

TABLE 4.6.1

Rate of Return on Geothermal Space Heating

	(1) Cost of Propane	(2) Cost of Geothermal	(3) = (1)-(2) Savings
1979	84,939	19,013	65,926
1980	90,630	19,526	71,104
1981	96,702	20,081	76,621
1982	103,181	20,618	82,563
1983	109,166	21,196	87,970
1984	115,497	21,817	93,680
1985	122,196	22,484	99,712
1986	129,283	23,201	106,082
1987	136,782	24,039	112,748
1988	144,305	24,946	119,359
1989	152,242	25,927	126,315
1990	160,615	26,988	133,627
1991	169,449	28,137	141,312
1992	178,769	29,380	149,389
1993	188,601	30,725	157,876
1994	198,974	32,181	166,793
1995	209,917	33,758	176,159
1996	221,463	35,463	186,000
1997	233,643	37,309	196,334
1998	246,494	39,308	207,186

Internal Rate
of Return = 66.7%

5.0 Development Process

The development of Stanley Hot Springs will require close cooperation between the City of Stanley, Stan Harrah Corporation, and the Administration of the Sawtooth National Recreation Area. The City of Stanley controls the right-of-ways for pipelines. Stan Harrah Corporation is the largest commercial customer in Stanley and the owner of the primary exploration area. Stanley, located within the Sawtooth National Recreation Area, is governed by Federal regulations regarding land use and mineral development.

5.1 Private Funding Factors

The Stan Harrah Corporation is the largest single commercial business in Stanley. Stan Harrah Corporation owns five major commercial buildings and represents the largest potential customer for a geothermal heating system. The Harrah Corporation also owns a major portion of the thermal discharge area of Stanley Hot Springs. This area could be developed to heat Harrah's building by the Stan Harrah Corporation.

5.2 Public Funding Factors

The City of Stanley has very limited potential for funding a geothermal district heating system. With a city budget of approximately $20,000 per year and a population of less than 70 persons, Stanley cannot generate the revenue necessary to construct a geothermal district heating system.

There are several public funding mechanisms available to the City of Stanley. Under Idaho Code 50-323, the City of Stanley can seek to fund all or part of a district heating system with a revenue bond. Such a bond would require a two-thirds majority approval by the voters and the selling of the bond on the bond market. The bond would be repaid by revenues generated from user fees or from tax money. Property tax limitations limit the property tax revenue capabilities of the city.

The Economic Development Administration has public works grants and loans for which the City of Stanley could apply. These grants or loans require approval and support of the city as well as the regional economic development agency. The extent of funds available is generally sixty percent (60%) of the total project cost.

The U.S. Department of Housing and Urban Development offers a grant program in which Stanley may qualify for funds. The Urban Development Action Grant program is a highly flexible economic development tool which seeks to create partnerships among government, the community and private industry to overcome problems of development.

Action Grants are designed to assist severely distressed cities in revitalizing their stagnating economies and reclaiming deteriorated neighborhoods. The program seeks unique opportunities where qualifying communities can use Federal funds to stimulate new, or increased private investment.

Eligible cities have been identified on the basis of any three of the following five criteria:

1. Age of housing - 33.7% constructed prior to 1940.

2. Per capita income - net increase between 1969 and 1975 of $1,762 or less.

3. Poverty - 11.07% or more below poverty level based on 1970 data.

4. Population decline - population growth rate during 1970-1976 of 0.032% or less.

5. Job lag - a rate of growth in retail and manufacturing employment of 7.08% or less.

Interested eligible cities must first submit a Form 424 to establish final eligibility. By regulation, the form should be filed 60 days in advance of the grant application, but a shorter period is sometimes allowed. Region X has a special UDAG staff in Portland, Oregon.

Urban Development Action Grants are authorized by Section 110 of Title I of the Housing and Community Development Act of 1977. Rules and regulations governing the program can be found in 24 Code of Federal Regulations (CFR) Part 570, Subpart G.

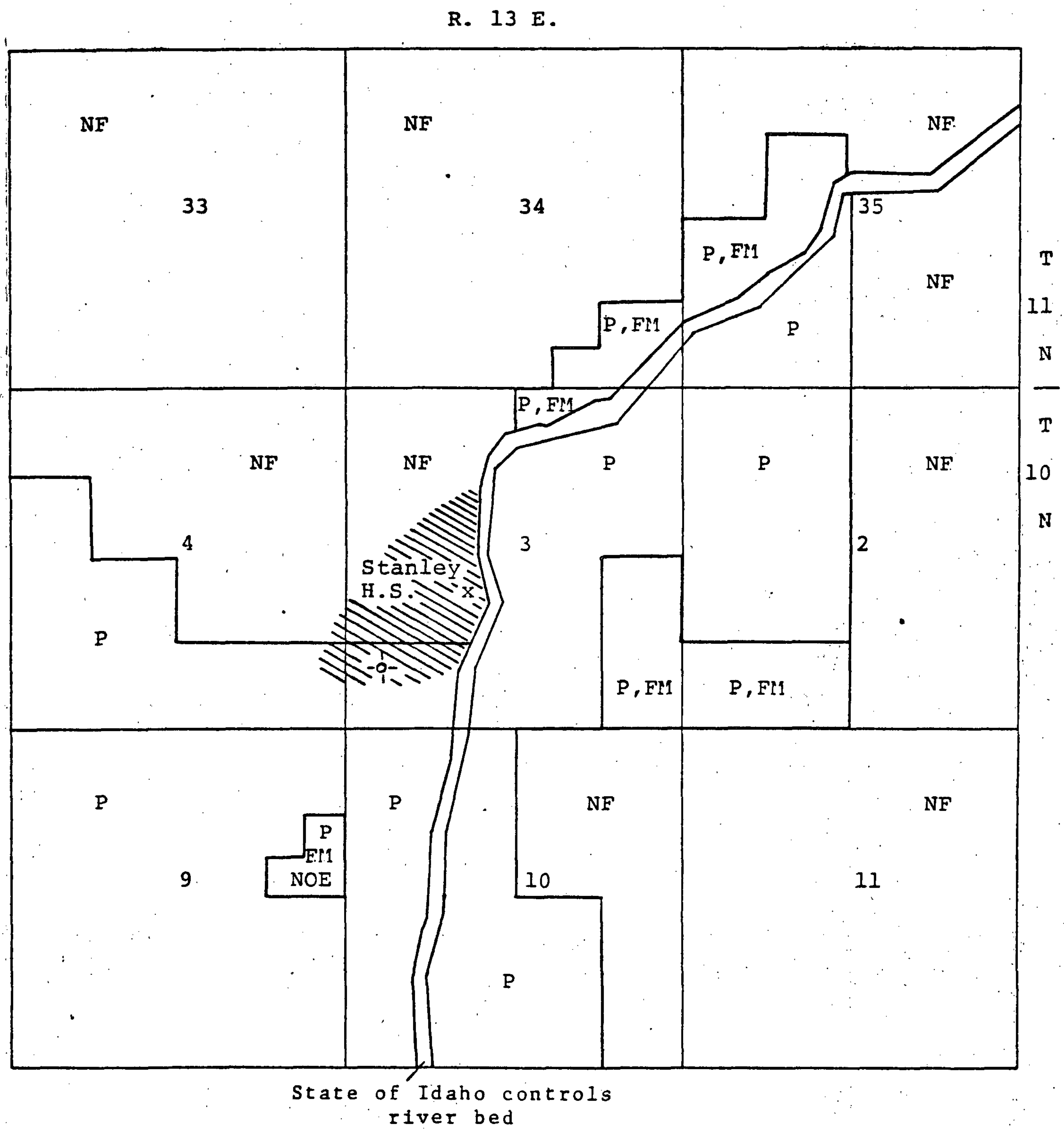
5.3 Resource Ownership

The thermal discharge area of Stanley Hot Springs is located in an area of mixed federal and private mineral ownership. A broad area of thermal seeps and springs occurs from an elongated terrace deposit which separates the steam channel of Valley Creek from the riverbed of the Salmon River. This area is split in half by Federal and private ownership.

The historical Stanley Hot Springs pool site is located on National forest lands. A large area of thermal seeps and a capped thermal well of unknown production capacity is located on private lands. The mineral estate of the stream beds of Valley Creek and the Salmon River are controlled by the State of Idaho.

Figure 5.3 is a master title plat for the area near Stanley Hot Springs which shows areas of federal and private ownership. Several areas have private surface ownership and federal mineral ownership. All federal lands in the National Recreation Area have been withdrawn from mineral entry as of May 8, 1973.

Figure 5.3 Surface and Mineral Estate Ownership Status



Source: Master title plat, Records Division, US BLM, Boise.

NF - National Forest
P - Private
FM - Federal ownership of mineral estate
NOE - Not available for entry
-ϕ- - Thermal well
≈ - Thermal discharge area

Public Law 92-400 established the Sawtooth National Recreation Area. Mining and mineral leasing activities are restricted within the National Recreation Area (NRA) to established claims which do not conflict with the purposes for which the NRA was established. All mineral development (including geothermal) must comply with the adopted regulations pursuant to Section 11, P.L. 92-400. These regulations preclude any new mineral entries in the NRA and will restrict development of geothermal resources from Federal lands pursuant to the Geothermal Steam Act of 1970.

The Stan Harrah Corporation is the major private land owner with significant resource potential. The Harrah property borders the National Forest boundary which separates the Stanley Hot Springs discharge area into two land parcels.

5.4 Permitting Requirements for Geothermal Resources

5.4.1 State Permits

The groundwaters of the State of Idaho are a public resource. The Department of Water Resources has responsibility for administration of the use of these groundwater resources, and to conserve and protect them against waste and contamination.

Section 42-237a and Sections 42-1601 through 42-1605, Idaho Code, require all flowing wells to be capped or equipped in a manner that will allow the flow of water to be completely stopped when not in use. Flowing and nonflowing wells are to be constructed in a manner as to prevent waste and contamination through leaky well casings, pipe fittings, valves or pumps, either above or below the land surface or through improper or inadequate sealing.

Section 42-238, Idaho Code, gives the Department of Water Resources authority to establish and require compliance with minimum water well construction standards. Every water well constructed in Idaho must be in compliance.

Title 42, Chapter 39, Idaho Code, gives the Department authority to establish and require compliance with standards for construction and abandonment of waste disposal and injection wells.

Pursuant to the provisions of Section 42-238. Idaho Code, Title 42, Chapter 39, Idaho Code, and the provisions of Title 67, Chapter 52, Idaho Code, the Idaho Water Resource Board has established minimum standards for construction of water wells, and minimum standards for construction or abandonment of waste disposal and injection wells.

All wells deeper than 18 feet must be drilled by a well driller licensed to operate in Idaho. Well drillers must conform to the rules and regulations of the Idaho Department of Water Resources when constructing water wells and waste disposal and injection wells.

All water wells shall be constructed in a manner that will guard against waste and contamination of the groundwater resources of the State of Idaho.

All wells constructed for public supply of domestic water must meet all of the requirements set forth by the Idaho Department of Health and Welfare. The well driller and the property owner are charged with the responsibility of taking whatever steps might be necessary in any unique situation to guard against waste and contamination of the groundwater resources. It will be necessary in some cases to construct wells with significant additional controls beyond the minimum standards to accomplish these goals. Casing shall be installed in every well, and for water wells shall extend at least 12 inches above the land surface surrounding the water well, and to a minimum of 18 feet below land surface.

An approved permit from the Department of Water Resources is generally required before work can begin on geothermal wells. The two exemptions to this requirement relate to exploratory wells and to low temperature geothermal wells. If an exploratory well is less than six inches in diameter and less than 1,000 feet deep and is to be used only for collecting geotechnical data, the owner must simply file a notice of intent to drill with the director of the department. Also, as explained in Section 42-0003(e), Idaho Code, wells from which low temperature water is used for such purposes as space heating or fish propagation are exempt from the permit requirement if the owner has obtained an approved water right.

The following bonds and permits are required under the geothermal resources act:

a) Form 4003-1, Application for Permit to Drill for Geothermal Resources;

b) Form 4003-2, Application for Permit to Alter a Geothermal Well;

c) Form 4003-3, Application for Permit to Convert a Well to a Geothermal Injection Well;

d) Form 4005, Geothermal Resources Surety Bond;

e) Form 4007, Notice of Intent to Abandon a Well;

f) Form 4009, Report of Abandonment of a Well

5.4 Permitting Requirements for Geothermal Resources - Continued

a) One hundred dollars (100) for any production or exploratory well;

b) Fifty dollars ($50) for an injection well;

c) Fifty dollars ($50) for an amendment to a permit;
d) No filing fee shall be charged for filing a Notice of Intent to construct a hole for gathering geotechnical data.

Bonds are required as a condition of every permit. A bond of not less than ten thousand dollars ($10,000) is required for each well.

Although a water right is not required under the geothermal permit, it is highly recommended that water rights be applied for in order to obtain assurances against subsequent developers.

An approved permit is required from the Idaho Department of Health and Welfare before construction can begin to alter or extend the Stanley sewage disposal system.

5.4.2 Federal permits

The development of a geothermal district heating system for the City of Stanley will require review and comment on proposed project by the Administrator of the Sawtooth National Recreation Area. A detailed plan of operation must be approved by the Area Ranger prior to any construction activities.

5.4.3 Local Government Permits

Custer County: Comprehensive Plan is in the development stages. There are no countywide ordinances regarding construction and development.

City of Stanley: Comprehensive Plan
Zoning Ordinance
Subdivision Ordinance
Building Code

5.5 Time Factors for Permits

Idaho Department of Water Resources permits can be issued in less than four weeks but can take up to six months. Contested water right permits can take six months to one year to resolve. Planning and Zoning permits take from one week to two months. Approval of construction by the Administrator of the Sawtooth National Recreation Area can take from one month to six months.

5.6 Barriers to Development

5.6.1 Institutional

The mineral entry withdrawal of all Federal lands within the Sawtooth National Recreation Area will restrict exploration to private lands. The Geothermal Steam Act of 1970 (CFR 43-3201.1-6) specifically forbids the development of geothermal resources on federal lands within National Parks, National Recreation Areas and National Wildlife Refuges.

The lack of availability of financial assistance for public development is considered by local government interest to be the major institutional barrier to geothermal development at Stanley. Federal programs are currently designed around a competitive grant program and there are no state programs available to assist local communities in developing geothermal resources.

5.6.2 Environmental

The disposal of thermal fluids from a district heating system into the Stanley Sewer system will require an engineering analysis. The capacity of the sewage lagoons is limited and an evaluation is needed to determine if the current system can process the additional load.

Disposal of thermal fluids by injection will require approval by both the Idaho Department of Water Resources and the Department of Health and Welfare. If injection is the only acceptable method of disposal, then additional wells and disposal pipelines will be needed.

5.6.3 Financial

In 1979 the Idaho Legislature passed a 1% limitation for property tax assessed valuation. This severely limits the city government's ability to fund any public works projects. The City of Stanley is currently not eligible for HUD, Urban Development Action Grants because HUD does not have statistical data on the community.

6.0 Conceptual Timeline for Development

Figure 6.0 illustrates a conceptual timeline for developing a Stanley Hot Springs production well and constructing a transmission line. The entire construction process should require approximately 6 to 12 months. Considering the severe winter conditions which can exist, construction periods were confined to spring, summer, and fall.

Because there are no immediate plans from either the public or private sectors to develop the aforementioned geothermal district heating system, projection of an initial construction date cannot be made. It is estimated that construction of the district heating system could begin as early as 1982.

The geothermal district heating system described in this report is economically viable and competitive against all currently available fuel forms in 1979.

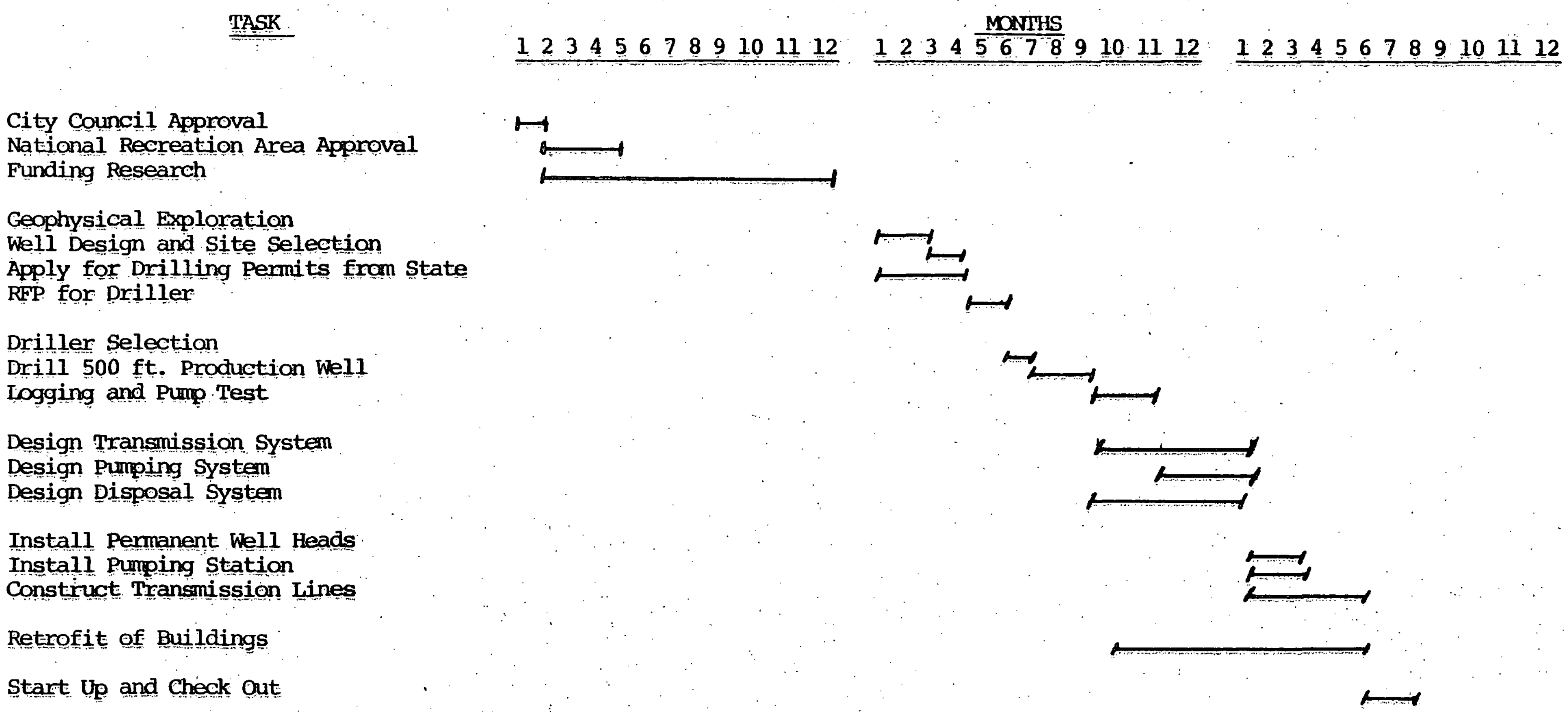


Figure 6.0 Conceptual Development Timeline, Stanley, Idaho

REFERENCES

Boise City Energy Office, Geothermal Energy Systems Plan for Boise City, City of Boise, 1979

Bureau of Land Management, Master Title Plot, T. 10 N., R. 13 E., U.S. Department of Interior, Idaho State BLM Mineral Records Office, Boise, Idaho, Nov. 1979.

Code of Federal Regulations:
36 CFR 292 (c), Private Land Acquisition and Standards for Use of Private Lands, 1972 (86 Stat. 613).

43 CFR 3201.1-6, Geothermal Steam Act, 1970

City of Stanley, Comprehensive Plan, Stanley Planning and Zoning Committee 1976

Custer County, Master Title Plat, T. 10 N., R. 13 E., Custer County Surveyors Office, Nov. 1979.

Custer County, Overall Economic Development Plan, Custer County Board of Commissioners, 1975.

Dames & Moore Co., Natural Gas Supply Requirements for the State of Idaho, Report to the Idaho Public Utilities Commission, 1977.

Dewey, J. W., W. L. Dillinger, J. Taggart, and S. W. Algermissen, A Technique For Seismic Zoning: Analysis of Earthquake Locations and Mechanisms in Northern Utah, Wyoming, Idaho, and Montana, Proc. Intern. and Microzonation, 2nd, Seattle WA, 1972.

Drysdale, F. R. and C.E. Calef, The Energetics of the United States of America: An Atlas, Brookhaven National Laboratory, 1977.

EG & G Idaho, Inc., Rules of Thumb for Geothermal Direct Applications, September, 1978.

Idaho Department of Water Resources, Population and Employment Forecast, State of Idaho, 1978.

Idaho Division of Budget, Policy Planning and Coordination, County Profiles of Idaho, State of Idaho, 1978.

Lienau, P.J., Agribusiness Geothermal Energy Utilization Potential of Klamath and Western Snake River Basins, Oregon. Geo-Heat Utilization Center, Oregon Institute of Technology, 1978.

Makey, D. R. and C. M. Tschanz, Aeromagnetic Survey Map of Idaho, U.S. Geological Survey, 1978.

Mitchell, J.C. , L.L. Johnson, and J.E. Anderson, Potential for Direct Heat Applications of Geothermal Resources, Water Information Bull. 30, Part 9, Geothermal Investigations in Idaho, Idaho Department of Water Resources, 1979.

Muffler, L.P., Edt., Assessment of Geothermal Resources of the United States - 1978, U.S. Geological Survey Circular 790, 1979.

Noames, E.R. and H.D. Hofterson, Preliminary Report on Water Quality For the Sawtooth National Recreation Area, U.S. Forest Service, Division of Recreation and Lands, Sawtooth National Forest, 1972.

National Weather Service, Idaho Climatological Summary Data by Counties, N.O.A.A. in Cooperation with Idaho Department of Commerce and Development, October 1971.

Pennington, W.D., R.B. Smith and A.B. Trinkle, A Microearthquake Survey of Parts of the Snake River Plain and Central Idaho, Bull. of the Seismological Society of America, Vol. 64, No. 2 pp. 307-312, April, 1974.

Personal Communications:

Gerald Nicholson	Mayor, Stanley, Idaho
Steve Colen	Owner, Sawtooth Mountain Hotel
John Burger	Manager, Stan Harrah Corporation
Charlie Brunk	Custer County Surveyor

Public Laws of the United States:
P.L. 92-400, Sawtooth National Recreation Act, (1972).
P.L. 59-209, Antiquities Act, (1906).

Rember, W.C., and Bennett, E.H., Geologic Map of the Challis Quadrangle, Idaho, Idaho Bureau of Mines, Moscow, Idaho, 1979.

Ross, Sylvia Geothermal Potential of Idaho Idaho Bureau of Mines and Geology, Pamphlet 150, Moscow, Idaho, Nov. 1971.

Sisco, H.G. Ground Water Levels and Descriptions of Observation Wells in Idaho, 1975, Idaho Department of Water Resources Bulletin 43, Boise, Idaho, Dec. 1976.

Smith, R.B. and M. Sbar, Intraplate Tectonics and Seismicity of the Western United States, cited in Pennington, et al, Bull. of the Seismological Society of America, Vol. 64, No. 2, April, 1974.

State of California, Economic Study of Low Temperature Geothermal Energy in Lassen and Modoc Counties, California, Division of Oil and Gas, 1977.

State of Idaho, Community Resource Bulletin, Bureau of Economic Resources and Community Affairs, Division of Budget Policy Planning and Coordination, Oct. 1979.

Tschanz, C.M., T.H. Killsgaard, and D.A. Seeland, Mineral Resources of the Eastern Part of the Sawtooth National Recreation Area, Custer and Blaine Counties, Idaho, U.S. Geological Survey Open File Report, 1974.

University of Idaho, Manufacturing Directory of Idaho, Center for Business Development and Research, 1979.

U.S. Department of Agriculture, Regulations Covering Land Acquisition, and Standards for Use Subdivision, and Development of Private Lands Within the Sawtooth National Recreation Area, Sawtooth National Forest, Idaho, 1974.

Vincent, K.R. and J.K. Applegate, A Preliminary Evaluation of the Seismicity of Southwestern Idaho and Eastern Oregon: Implications for Geological Engineering Studies, Department of Geology and Geophysics, Boise State University, Boise, Idaho, 1978.

Williams, P.L., Glacial Geology of Stanley Basin, Idaho Bureau of Mines and Geology, Moscow, Idaho, 1961.

Young, H.W. and J.C. Mitchell, Geochemistry and Geological Setting of Selected Thermal Waters, Geothermal Investigations in Idaho, Water Info. Bull. 30, Part I, Idaho Department of Water Resources, 1973.