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STATE OF ALASKA

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February 1, 1979

Dr. Mort Smith
Los Alamos Scientific
Laboratory
P. O. Box 1665
Los Alamos, New Mexico 87545

Dear Mort:

I recently read that the Hot Dry Rocks Program is about to move into the demonstration phase. I am pleased to submit the new Alaska state capital at Willow, Alaska as a likely candidate for an exploration effort, and if the resource is found, a demonstration project.

I am enclosing materials for your review that will delineate the planning on the energy facilities. I am also enclosing background material on the site. If you will require more material, inform me and I will get it.

The present status of the Capital move is a bit unclear. The appropriations for the construction were turned down and the bondable costs will have to be approved by voters of the State according to the last statewide vote. The original move referendum, which was passed in 1974, stipulates that the Capital will be moved by 1981. These actions make it unclear as to when and how much of the State government will be moved. The enclosed material presents the planning to date.

I feel that the opportunity of tying in a Hot Dry Rocks Project with the construction of a new city is one that should not be missed.

Sincerely,

Donald R. Markle

Donald R. Markle
Research Associate
DRM/njk
Encl:

cc: Dr. Bob Browlee

08-H1 LH

CAPITAL SITE

In recent years, the citizens of the State of Alaska voted to move the state capital to a site near Willow from the present one at Juneau. Willow is located at Mile 70 along the Parks Highway, north of Anchorage (30 miles by air).

Numerous studies have been conducted by the State to determine the safest and cheapest energy source for possible development at the site. The studies conducted by the State indicated that three elements must be incorporated into the design of the new city to achieve the highest degree of energy efficiency:

1. A policy concommitant with energy conservation measures;
2. Sufficient control over development to require observance of energy conservation policy; and,
3. Inclusion of district heating and cogeneration elements in the community design.

The eventual design incorporated these concepts for a city of 30,000 people, based on "business as usual" in Southcentral Alaska. By 1994, the new capital will require 1.6 trillion Btu's per year for building space heat. The designed cogeneration plant would provide about 67½% of the annual energy requirements. The remaining increment falls into two categories.

First, heat produced by the cogeneration plant can only be economically delivered to areas of fairly dense development (about 8,000 sq. ft. of buildings per acre minimum). The low density residential development is exlcuded from using this energy source. This fraction amounts to about 25% of the total heat consumption.

Second, it is uneconomical to build the coal fired plant so large as to serve the peak thermal demands of the community. Cheaper, oil fired "district heating plants" are most effectively used for serving peak demand requirements. Thus, a fraction of peak heating energy equal to about 10% (7½% of the total annual community use) of the total served by this system will be generated by the district heating plants.

These designs have not considered geothermal energy. Since the present plan is based on energy economics, the Oregon Institute of Technology did a cost analysis of utilizing the local gradient heat source in the capital site to replace the space heating requirements of the cogeneration facilities.

The study was based on the logs of the Red Shirt #1 well drilled by Hill Productions. The bottom hole temperature of the well was 170 degrees F (76 degrees C), 2,050 feet from the surface. This is roughly three times the world normal gradient mean (115 degrees C/km).

The interpretation of the logs indicate the top of an igneous rock sequence is picked at 1,840 feet in hole depth. The lithology suggests that the rock is intrusive subject to a considerable period of weathering. Overlaying this igneous complex is a tertiary section contining some sandstones. A quaternary glacial crust rim complex of relative shallow depth lies across the tertiary sequence. This well is the only abnormally high heat flow well in the immediate area. Perhaps this is because it is the only well in the area north of the Castle Mountain fault and therefore the only well to encounter the crystalline intrusive previously mentioned.

The calculations were made using certain assumptions:

1. The geothermal system could compatibly fit into the existing heating system.
2. Wells drilled would produce 500 g/m.
3. The thermal gradient increases at a constant rate to depth.
4. Geothermal wells would be drilled at the Red Shirt #1 site which would need a 10-13 km pipeline. (It is possible that the wells could be drilled on the capital site, but this was not considered.)
5. A heat exchanger system would be utilized. (It is possible that the water could be pure enough to exclude this requirement.)

Five options were considered:

Option #1: Geothermal wells would be drilled to a depth of 2,750' which would produce geothermal fluids at 200 degrees F at a rate of 20,000 g/m to supply 500 x 10^6 Btu/m with heating district output water temperature at 140 degrees F.

Option #2: Geothermal wells would be drilled to 2,050' which would produce 170 degrees F water at a rate of 25,000 g/m. This water would be peaked with the fossil fuel plant to 200 degrees F producing 500 x 10^6 Btu/m. Output temperature would be 140 degrees F.

Option #3: Geothermal wells would be drilled to 2,750' producing 12,500 g/m at 200 degrees F. The heating system would be changed to maximize the Delta-T across the heat exchanger, lowering output water to 110 degrees F instead of 140 degrees F.

Option #4: Geothermal wells would be drilled to 2,050' producing 16,700 g/m at 170 degrees F. The district heating system would be modified to maximize the Delta-T across the heat exchanger lowering the output temperature to 110 degrees F instead of 140 degrees F.

Option #5: Geothermal wells would be drilled to 2,050' producing 9,300 g/m at 170 degrees F. The fluids would be peaked to 200 degrees F. The district heating system would be changed to maximize the Delta-T across the heat exchangers with a system heating output temperature of 110 degrees F.

Each of these options has a payback period of less than 7 tears. Option #3 and #5 seem most economical with about a 3 year payback in fuel savings along.

The scenario construction is based on a shortest time frame possible. This time frame is provided by the capital study. At this time, there is no guarantee that any of the exploration money will be approved to determine if the posulated flow and temperature values can be found. It is, however, speculated that the economics are sufficiently attractive to have officials want to explore the matter further.

The cogeneration plant is the single most environmentally hazardous element of the entire Capitol Site Committee's planned development. Serious environmental impacts will result from the mining, transporting and buring of the coal. Geothermal utilization becomes much more attractive when these environmental considerations are placed in the equation.

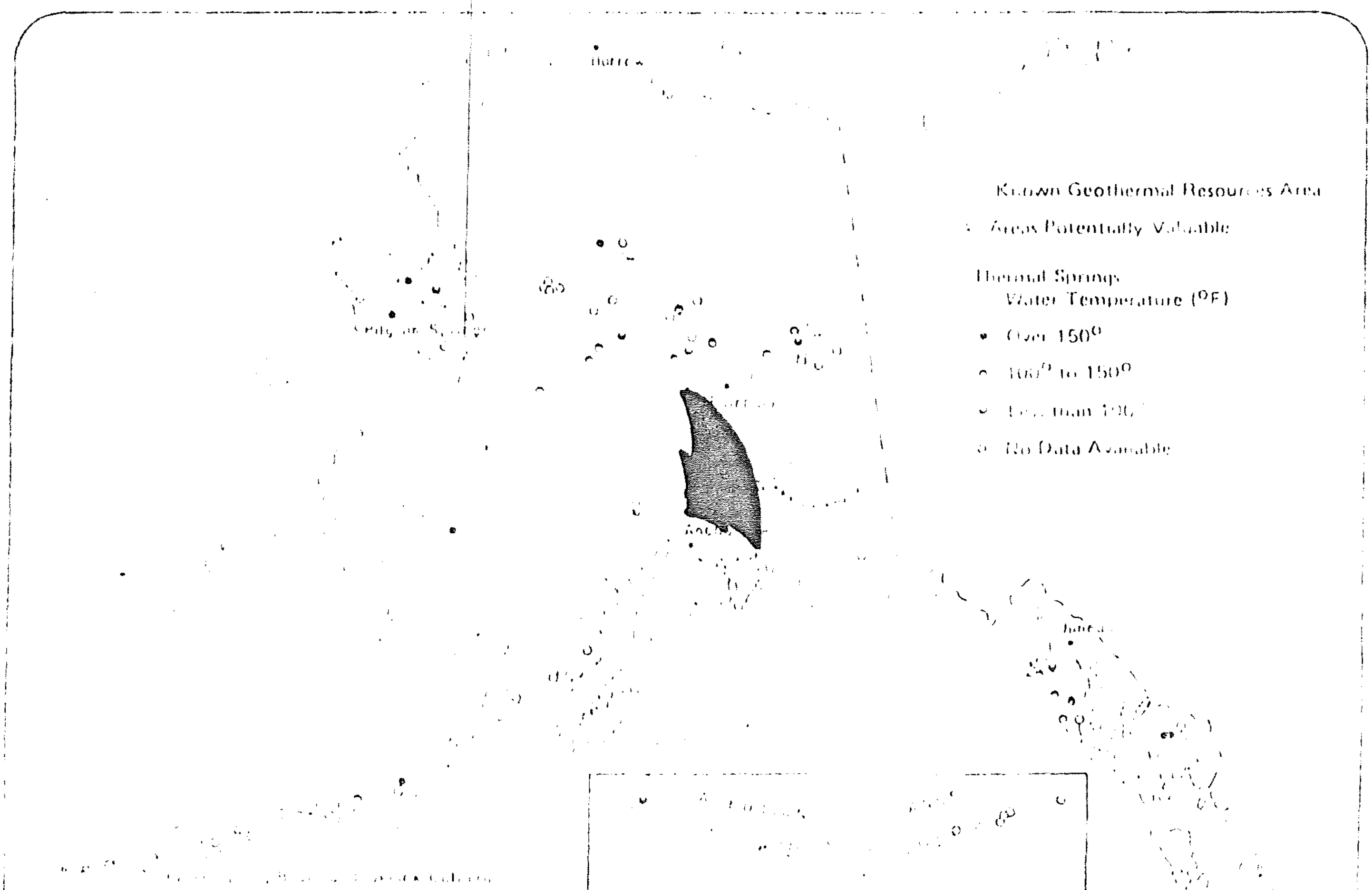
This cursory study indicates that elimination of the large cogeneration plant and one of the two district oil peaking plants would maximize the economics of geothermal direct heat applications at the capital site.

Ten percent of the peak heating load would be supplied by the remaining oil fired district peaking plant. This corresponds favorably with the models designed and implemented in Iceland.

If the granitic rocks do not provide the necessary flow rates, hot dry rocks technology should be utilized. Los Alamos officials indicate that demonstration projects are in the offing and this would fit nicely into the scenarios developed for this site.

SITE:

Thermal Springs and Areas of Geothermal Potential



Adapted from [illegible] 1971 [illegible] Engineer.

GEOTHERMAL ENERGY EVALUATION

NON-ELECTRIC GEOTHERMAL ENERGY APPLICATIONS

SITE: Capital Site

SITE DATA SUMMARY

SITE: Capital Site

••Physical Reservoir Data

••Temperature Bottom hole Temp Red Shirt #1, 170°F (77°C) at 2050' (625 m)
~~Surface~~ Subsurface:
••Total Dissolved Solids (PPM):
••Estimated Non-Electric Energy Potential (MBtuh* 30 years):
••Type of Overlaying Rock:
••Estimated Depth to Top of Reservoir (meters):

••Site Land Status

	FED.	STATE	PRIVATE	OTHER
Total Acres				
Total Acres Leased				

100 square miles of state lands surround the capital site. Numerous acres of borough and private lands surround the capital footprint to the west, south and north.

••Geothermal Development Status:

None

••Local and State Attitude Toward Geothermal Development:
Imperative to explore the potential

••Land Use and Population:
Present population apx. 400 - used for recreation and agriculture.

••Comments and Critical Issues:
~~Local gradient is such that there would not be considered a potential for geothermal energy from existing~~

Local gradient south of the Castle Mountain Fault is lower than the world norm.

SITE LOCATION AND PHYSICAL DESCRIPTION

SITE: Capital Site

••Latitude: 61° 42' N

••Longitude: 149° 45' N

••Rectilinear: ~~T18N 3W~~ T18N R3W SM Anchorage Quadrangle (wellsite)

••County: Mat-Su Borough

••Adjacent Counties:

••Topography

Located ~~In~~ in the Foothills of the Talkeetna Mountain Range at the Junction of the Susitna and Matanuska ~~Rivers~~ Valleys. The area has been glaciated and is gently rolling with dendritic drainage to the west away from the Talkeetna Mountains.

••Present Land Use:

- Agricultural and Recreational. Presently the town of Willow is located at mile 70 Parks Highway. The population of the town and the surrounding area is about 400 people.

••Future Land Use Plans:

The State Capital is mandated to move to a 100 square mile area here by the year 1981 under a referendum passed in 1974. The projections now being followed ~~is~~ are that a 30,000 + person city will be developed by 1991. (Background Reports Captiol Committee)

••Aesthetics:

Nancy Lake State Park is located to the west indicating the unique natural environment.

••Historical/Archaeological Significance:

The Willow Creek Mining District is located in Hatcher Pass within the Talkeetna Mountains. This was the site of the largest Alaskan hard rock mining operation south of the Alaska range. The Hatcher Pass and Willow areas were staked out in the late 40's and early 50's by homesteaders. Access at that time was by way of the Alaskan Railroad. Little Archaeological investigation has taken place.

GEOLOGICAL/GEOPHYSICAL DESCRIPTION

SITE: Capital Site

surface

··Geologic Description:

The ~~surficial~~ geology of the major portion of the Susitna Valley is Glacio/acustrine of ~~quaternamy~~ Quaternary time period.

Drilling indicates that the subsurface consists of a tertiary sedimentary sequence which has some coal ~~bearing~~ bearing strata. In Cook Inlet itself, this sequence produces both oil and gas. Underlying this is a Jurassic to Cretaceous meta-sediment sequence.

The Capital site is north of the Castle Mountain fault which is an east-west trending technologically important fault system. The south side of the fault has a deep sedimentary section while north of the fault has a relatively thin tertiary section overlaying granitic intrusives.

The Talkeetna Mountains to the east are ~~Jerossic~~ Jurassic to Tertiary igneous intrusives.

(Capitol Comittee Background Report)

··Geophysical Summary:

Exploration has been conducted by oil companies in the vicinity.

··Geologic Hazards:

Seismic activity and volcanic activities are high in the Cook Inlet Basin.

RESERVOIR CHARACTERISTICS

SITE: Capital Site

•• Reservoir Temperature

•• Surface: Bottom hole temperatures of the Red Shirt well 6 miles (9.6 Km) from the site indicated a BHT of 170°F (76°C) at 2050' (625 m) (Red Shirt Well Log)

•• Subsurface:

•• Geochemical

SiO_2:

None

Na-K-Ca:

•• Flow Rates:

•• pH:

•• Total Dissolved Solids: N/A

•• Fluid Chemistry:

•• Estimated Nonelectric Energy Potential (MBtuh 30 years):

1.44×10^{12} BTU/year

•• Subsurface Area of Reservoir:

LAND OWNERSHIP AND LEASING

SITE: Capital Site

TOTAL AREA (Acres)	FEDERAL (Acres)	STATE (Acres)	PRIVATE (Acres)	OTHER

The land in the capital site is owned by the State of Alaska private and Borough lands are found in the immediate vicinity.

Red ShirT #1 is located on State lands. Private lands lie between Red ShirT lands & Capitol site.

••Land Ownership

••Land Leased

••Highest Priced Leases
(Dollars/Acre)

$/Acre	Lessee

••Tentative Lease Sale Dates:

••Number of Sales Offered
But No Bids:

••Number of Bids Rejected
(Resulting in No Lease:

••Summary of Leasing Status and Needs:

GEOTHERMAL DEVELOPMENT STATUS

SITE: Capital Site

Present Development Status:

Initial environment data has now collected for the proposed capital site. Shallow water well drilling is proceeding through November and December of 1978. No geothermal exploration has been initiated.

Projected or Planned Development:

Central State employees are assumed to move to the new capital from 1982 through 1994. Federal and private sector basic employment should build slowly during the first years of the move. By 1994 the projected population would be over 30,000 people in the 100 square miles of land known as the Capital footprint. There are presently no facilities built or under construction that are associated with the new capital city design as provided by the new capital city planning process. The siting construction and occupancy of this city will truly be a monumental task to complete in 16 years.

The downtown heating district as outlined by the commission could be easily adapted to geothermal use. Exploration should begin immediately to determine if the potential exists for geothermal space heating, Over the next 2 years a well should be drilled to determine the extent of any resources. ~~If the resource exists.~~

INSTITUTIONAL CONSIDERATIONS

SITE:

EXTRACTED FROM CAPITOL COMMITTEE BACKGROUND REPORTS.

Institutional Requirements	Agency and Public Attitudes	Status of Requirements (i.e., EIA/EIS Requirements
This construction would be done on State lands. A ~~cadre~~ cadre of state permits and legislative approval would be necessary to develop geothermal resources. Drilling permits, right of way easements, capital site commission approval, Legislative approval State environmental Conservation and EPA approval would all be needed to develop. The State Division of Geology and Geophysical surveys would have to approve and oversee exploration activities as well as Dept of Natural Resources permitting for such activities. Borough regulations will have to be followed for construction and easements. All in all over 40 permits by some 20 agencies will be required to erect the capital. Voter approval required for bondable costs.	Presently the greatest environmental impact to the new capital site construction is considered to be the a proposed co-generation facilities ~~primarily~~ using coal as a fuel. The elimination of this pollutant would meet with enthusiastic support if economically sound. Recent studies have shown it would be, if a resource is available. ~~There for all it can be expected that~~ All concerned agencies would be supportive if a realistic chance of finding a resource is shown.	Initial environmental studies have been completed. Permitting schedules have been developed for all but the actual geothermal development. Upon funding, the necessary permitting would be a rather ~~a~~ minor portion of the scenario. All the environmental assessment should be completed by FY 1980 if funding ~~is~~ were made available.

ENVIRONMENTAL FACTORS

SITE: Capital Site

EXTRACTED FROM SOUTHCENTRAL REGIONAL PROFILE

••CLIMATE

••Prevailing Winds: low to moderate ~~[illegible]~~

••Precipitation (Annual): 24" (61cm)

••Days of Sunshine (Annual):

••Average Temperature Summer 40° - 70°F (4° to 21°C) Winter -10° to 30°F (-23° to -1°C)

Minimum: -56° F (-48°C)

Maximum: 90°F (32°C)

••Degree Days (Annual): 11,000

••Relative Humidity (Seasonal Peaks) Low

Summer:

Winter:

••AIR QUALITY:

There are no man made sources of ~~degration~~ degradation at this time.
Possible fule oil and coal plants will be major emmission sources.
~~(Report 11)~~ (CAPITOL SITE BACKGROUND REPORT 11)

••GEOLOGIC FACTORS:

CASTLE MOUNTAIN FAULT

••WATER QUALITY:

2 permanent streams in the area. Water quality is acceptable to state standards. Changes in water quality and flow will be major ~~impact upon~~ considerati during ~~completion of~~ construction. Testing subsurface water at this writing (Report 11)

••NOISE:

Construction operations and equipment will be a major source of noise during construction of the Capital. The airport and roads will be the chief pollutants after constuction. (Report 11)

ENVIRONMENTAL FACTORS
(continued)

SITE: Capital Site

BIOLOGICAL

Dominant Flora: Spruce, birch and willow dominate the hillsides. ~~[illegible]~~y bogs are found. (Capitol Committee Background Report 11)

Muskeg

Dominant Fauna: Moose, bear and some water fowl and fur bearing animals. Native and ~~anadrom~~es fish are found. (Report 11)

anadromous

Endangered Species

Flora:

Fauna:

TRANSPORTATION AND UTILITIES

SITE: Capital Site

Distance From the Site Access to Right-of-Way

••Utility or Energy Transmission Corridors and Facilities

An existing transmission line passes through the site. A major new easement has ~~been~~ been recently ~~appeared~~ granted to connect the capital site with existing electrical ~~cirds~~ grids near Wasilla. There will be further easements if the Susitna hydroelectric facility is built.

••Transportation Corridors or Facilities

The Parks Highway traverses the west boundary of the site. Hatcher Pass Road to the north side. No roads presently exist within the Capital foot print.

Numerous sub divisions and homestead roads border the site.

Other

The Alaska Rail Road parallels the Parks Highway to the west.

Nancy Lake State Park is found to the west as well.

POPULATION

SITE: Capital Site

••General Description of Population

The Matanuska Susitna Valley is undergoing rapid growth. This is due to its relationship to Anchorage as a bedroom and recreational community.

The impact of the capital move will accelerate the expansion into this area. The Mat-Su Valley is already one of the fastest growing areas in the country experiencing as much as 40% growth per year as in the case of Wasilla.

~~Population projection is as such that the present 20,000 aproximate people will expand to as much as 140,000 people by 1990. To date all population projection for this area have been low.~~

It is projected that the population of the Matanuska-Susitna Valley will increase from 20,000 to 140,000 people by 1990. To date all population projections for this area have been underestimated.

••Economics

••Present Land Use:

Presently the Valley is a bedroom and recreational community for Anchorage, receiving most of its tax dollars from Anchorage residents. Government is the largest employer. New service and construction industries are joining agriculture as secondary economic bases.

••Future Land Use:

The new capital will increase construction, and service segments of the economy. More than ever, however, the government will be the major employer. The cursory economic look completed by the Oregon Institute of Technology shows a very short pay back period for geothermal development.

~~The Capitol Site Development schedule using geothermal would be the same as projected that using oil heating districts plus construction of the co-generation plant, concept using the geothermal resource would replace the plant with a heat degree unit and production field.~~

The Capitol Site Development Schedule would not be significantly altered using geothermal energy.

R.KOEPPEN:db
6/13/78