GL04229

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Feb. 26, 1980
DATE

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TO	ORG./LOCATION	TELEPHONE NUMBER

Debbie Struhsacker	ESL/UURI	801-581-5283
FROM	ORG./LOCATION	TELEPHONE NUMBER

THIS TRANSMITTAL CONSISTS OF 6 PAGES.
(excluding cover sheet)

VERIFICATION TELEPHONE NO. 801-581-5283

February 27, 1980

TO: JACK SALISBURY

FROM: MIKE WRIGHT, DEBBIE STRUHSACKER

RE: ENERGY ESTIMATES FOR SELECTED GEOTHERMAL SYSTEMS.

Tables 1 and 2 summarize the mean reservoir thermal energy content for geothermal systems $>150^{o}C$ and $150\text{-}90^{o}C$ respectively. The systems listed were chosen on the basis of resource quality and proximity to a probable nearby user. All data is from USGS Circular 790.

TABLE I.

GEOTHERMAL AREAS >150°C WITH PROBABLE USERS

STATE	790 NAME & NUMBER	LOCATION / USER	MEAN RESERVOIR TEMPERATURE (°C)	MEAN RESERVOIR THERMAL ENERGY (10^{18} J ≈ 1 QUAD)
ARIZONA	#29 POWER RANCHES, INC.	SE of PHOENIX	165 ± 6	1.12 ± 0.36
CALIFORNIA	#35 SURPRISE VALLEY AREA	NE CALIF. - NEAR ALTURAS	152 ± 12	.79 ± 32
	#57 COSO AREA	CHINA LAKE AREA	220 ± 11	25 ± 7
	#58 RANDSBURG AREA	CHINA LAKE AREA	172 ± 29	4.0 ± 1.2
	IMPERIAL VALLEY AREA:	SE CALIFORNIA		
	#64 SALTON SEA		323 ± 8	97 ± 28
	#64A WESTMORLAND		217 ± 7	67 ± 19
	#65 BRAWLEY		253 ± 10	22 ± 5
	#68 EAST MESA		182 ± 7	16.3 ± 3
	#70 BORDER		160 ± 4	1.57 ± .25
	#71 HEBER		175 ± 5	31 ± 6
	THE GEYSERS AREA:	NORTH OF SAN FRANCISCO		
	#48 THE GEYSERS		237 ± 8	100 ± 24
	#46 SULPHUR BANK		194 ± 6	3.2 ± 0.9
	#47 CLEAR LAKE AREA		190 ± 9	39 ± 17
COLORADO	#78 PARADISE H.S.	NW of DURANGO	154 ± 9	1.25 ± .36
IDAHO	#93 CRANE CREEK - COVE CREEK	Western Idaho, NE of WEISER, Id.	171 ± 10	16.4 ± 7.6

TABLE I.
GEOTHERMAL AREAS >150°C (CONT)

STATE	790 NAME + NUMBER	LOCATION/USER	MEAN RESERVOIR TEMPERATURE (°C)	MEAN RESERVOIR THERMAL ENERGY (10^{18} J ≈ 1 QUAD
NEVADA	#141 STEAMBOAT SPRINGS	RENO AREA	200 ± 5	14.4 ± 5.9
	LOVELOCK - RENO DISTRICT:	WEST-CENTRAL NV.		
	#144 SODA LAKE		157 ± 5	7.5 ± 4.3
	#145 STILLWATER AREA		159 ± 8	23 ± 9
	#146 FERNLEY AREA		182 ± 13	1.51 ± .44
	#147 BRADY H.S.		155 ± 6	8.2 ± 4.2
	#148 DESERT PEAK		221 ± 5	29 ± 10
NEW MEXICO	#171 VALLES CALDERA	WEST OF LOS ALAMOS	273 ± 8	87 ± 39
OREGON	LAKEVIEW DISTRICT	SOUTH-CENTRAL OR.		
	#190 CRUMP'S H.S.		167 ± 9	3.0 ± 1.2
	VALE DISTRICT	EAST-CENTRAL OR.		
	#203 NEAL H.S.		188 ± 8	1.56 ± .44
	#204 VALE H.S.		157 ± 2	45 ± 21
UTAH	MINERAL MTNS. DISTRICT	SW UTAH		
	#208 CONE FORT-SULPHURDALE		167 ± 6	16.0 ± 4.1
	#209 ROOSEVELT		265 ± 8	32 ± 13
				TOTAL = 772.01 ± 264.25

TABLE 2.

GEOTHERMAL RESOURCE AREAS 150-90°C WITH PROBABLE USERS

STATE	790 NAME + NUMBER	LOCATION / USER	MEAN RESERVOIR TEMPERATURE (°C)	MEAN RESERVOIR THERMAL ENERGY (10^{18} J ≈ 1 QUAD)
ARIZONA	#32 GILLARD H.S.	CLIFTON-MORENCI AREA	126 ± 12	1.00 ± .30
	#33 SAN SIMON WELL	SOUTH OF CLIFTON-MORENCI	135 ± 4	.75 ± .17
CALIFORNIA	ALTURAS DISTRICT	NE CALIFORNIA		
	#34 FORT BIDWELL		135 ± 17	1.08 ± .34
	#36 W. VALLEY RESERVOIR H.S.		143 ± 3	1.15 ± .32
	#37 BASSETT H.S.		98 ± 7	.74 ± .22
	#38 KELLY H.S.		118 ± 10	.93 ± .27
	#42 WENDELL-AMADEE AREA	SUSANVILLE KGRA	126 ± 7	3.2 ± 0.9
	#50 CALISTOGA H.S.	SOUTH OF THE GEYSERS	144 ± 3	2.4 ± 0.7
	#60 SCOVERN H.S.	NE OF BAKERSFIELD	106 ± 7	.82 ± 0.24
	#62 ARROWHEAD H.S.	E OF LOS ANGELES	132 ± 8	1.06 ± 0.31
	IMPERIAL VALLEY AREA:	SE CALIFORNIA		
	#63 PILGER ESTATES H.S.		105 ± 7	.81 ± 0.24
	#66 GLAMIS (E. BRAWLEY)		132 ± 14	1.05 ± 0.32
	#67 GLAMIS EAST		132 ± 14	1.57 ± 0.56
	#69 DUNES		132 ± 14	2.8 ± 0.8
COLORADO	#72 ROUTT H.S.	STEAMBOAT-CRAIG AREA	130 ± 11	1.04 ± 0.31
	GUNNISON-SALIDA DISTRICT	CENTRAL COLORADO		
	#74 MT. PRINCETON H.S.		112 ± 10	1.68 ± 0.48
	#75 PONCHA H.S.		109 ± 7	0.84 ± 0.24
	#76 WAUNITA H.S.		141 ± 10	1.14 ± 0.33

TABLE 2.
GEOTHERMAL RESOURCE AREAS 150-90°C (CONT)

STATE	790 NAME + NUMBER	LOCATION / USER	MEAN RESERVOIR TEMPERATURE (°C)	MEAN RESERVOIR THERMAL ENERGY (10^{18} J ≈ 1 QUAD)
COLORADO (CONT)	# 82 SPLASHLAND WELL	ALAMOSA AREA	141 ± 10	1.14 ± 0.33
IDAHO	# 94 WEISER AREA	WESTERN IDAHO BORDER	130 ± 14	1.38 ± 0.55
	# 95 ROYSTONE H.S.	NORTH OF EMMETT	135 ± 5	1.08 ± 0.21
	# 102 BRUNEAU-GRANDVIEW	SW IDAHO	107 ± 6	450 ± 110
	CAMAS DISTRICT	SOUTH-CENTRAL IDAHO		
	# 109 MAGIC RESERVOIR		149 ± 6	1.20 ± 0.37
	# 110 WORSWICK H.S.		94 ± 5	0.71 ± 0.20
	# 111 WARDROP H.S.		97 ± 14	0.74 ± 0.25
	# 112 BARRONS H.S.		103 ± 7	0.79 ± 0.23
	PRESTON DISTRICT	SE IDAHO		
	# 118 MAPLE GROVE H.S.		93 ± 6	.70 ± .20
	# 119 RIVERDALE AREA		99 ± 10	.76 ± .23
	# 120 WAYLAND		113 ± 12	.88 ± .27
	# 121 SQUAW		119 ± 14	.94 ± .29
MONTANA	# 123 BROADWATER	HELENA AREA	118 ± 8	.92 ± .27
	# 126 FAIRMONT H.S.	WEST OF BUTTE	118 ± 6	.92 ± .26
	# 129 ENNIS	SW MONTANA	129 ± 8	1.03 ± .30
NEVADA	# 140 MOANA AREA	RENO AREA	116 ± 14	2.4 ± .6
	# 150 COCAOO	LOVELOCK AREA	97 ± 14	.73 ± .24
	# 155 GOLCONDA	EAST of WINNEMUCCA	96 ± 7	.73 ± .21

TABLE 2.

. GEOTHERMAL RESOURCE AREAS 90-150°C (CONT)

STATE	790 NAME + NUMBER	LOCATION/USER	MEAN RESERVOIR TEMPERATURE (°C)	MEAN RESERVOIR THERMAL ENERGY (10^{18} J ± 1 QUAD)
NEVADA (cont)	#165 CARLIN AREA	ELKO-CARLIN AREA	96 ± 8	.73 ± 0.22
	#166 HOT HOLE (ELKO H.S.)	ELKO AREA	93 ± 7	.70 ± 0.21
NEW MEXICO	VALLES DISTRICT	W OF LOS ALAMOS		
	#172 JEMEZ SPRING		105 ± 7	.81 ± .24
	#173 SPENCE SPRING		103 ± 15	.79 ± .26
	#176 LIGHTENING DOCK	LORDSBURG AREA	144 ± 13	1.16 ± .35
OREGON	#177 MT. HOOD	E OF PORTLAND	122 ± 12	.96 ± .29
	#186 KLAMATH HILLS AREA	SOUTH-central OR.	124 ± 7	3.1 ± 1.1
	#187 KLAMATH FALLS AREA	SOUTH-Central OR.	111 ± 7	30 ± 15
	#189 LAKEVIEW AREA	South-Central OR	150 ± 3	5.6 ± 2.0
	#191 FISHER HOT SPRING	South-central OR.	114 ± 7	.89 ± .26
	#202 LITTLE VALLEY AREA	VALE, OR area	127 ± 6	1.01 ± 0.29
UTAH	#206 MONROE-RED HILL	SW UTAH	101 ± 8	1.09 ± 0.38
	#211 NEWCASTLE	CEDAR CITY AREA	130 ± 11	1.90 ± .91
WYOMING	#218 AUBURN H.S.	IDAHO-Wyo. Border	90 ± 6	.67 ± .20
				TOTAL 540.5 ± 143.87

(note contribution of BRUNEAU-GRANDVIEW)

Electric

#1 - generic models

magmatic

magmatic ??

non-magmatic / high heat flow

deep circulation

#2 Future Discoveries

increase knowledge + expansion of known districts

discovery of new districts

electric sites → invest heat too

Exploration Targets (150°-90°C)

State	790 Name and Number	Total
Arizona	#32 Gillard Hot Springs #33 San Simon Well	2
California	#34 Fort Bidwell Area, #37 Bassett H.S., #38 Kelly H.S., #39 Big Bend H.S., #42 Wendel-Amadee, #43 Sierra Valley #50 Calistoga H.S., #52 Fales H.S., #60 Scovern H.S. #62 Arrowhead H.S., #63 Pilger Estates, #66 Glamis (East Brawley), #67 Glamis East, #69 Dunes	14
Colorado	#72 Routt H.S., #74 Mt. Princeton H.S., #75 Poncha H.S., #76 Waunita H.S., #82 Splashland Well	5
Idaho	#87 Riggins H.S., #90 Vulcan H.S., #92 Boiling Spgs #94 Weiser Area, #96 Bonneville H.S.(?), #98 Neinmeyer H.S.(?) #102 Bruneau-Grandview, #107 Sunbeam H.S., #108 Slate Creek H.S., #113 White Arrow Rock Spgs, #118 Maple Grove H.S. #120 Wayland (Battle Ck.) #121 Squaw H.S.	13 + 2
Montana	#122 Marysville Test Well, #123 Broadwater H.S., #126 Gregson (Fairmont) H.S., #129 Ennis	4
Nevada	#140 Monna Area, #142 Wabuska H.S., #152 Columbo(?) Area #155(?) Golconda H.S., #165 Carlin Area, #166 Hot Hole (Elko H.S.), #167 Santa Jacinto H.S.	7 + 2
New Mexico	#172 Jemez Spgs., #173 Spence Springs, #176 Lightening Dock	3

State	790 Name and Number	Total
Oregon	#177 Mt. Hood Area, #178 Carey (?) (Austin) H.S. #179 Breitenbush H.S. (?), #181 Belknap H.S. #186 Klamath Hills Area, #187 Klamath Falls Area, #189 Lakeview Area, #193 Harney Lake #202 Little Valley Area	9 ± 3
Utah	#206 Monroe Red Hill, #207 Joseph H.S., #210 Thekmo H.S., #211 Newcastle	4
Washington		0
Wyoming	#217 Granite H.S., #218 Auburn H.S.	2
	Total	63 ± 5

Criteria

1) Large Flow and/or High Temp.
2) Near User
3) Elephant Country (District Concept)

} Random Combo of these considerations

Exploration Targets (">" 150°C)

State	790 Name + Number	Total
Arizona	#29 Power Ranches, Inc.	1
California	#35 Surprise Valley (District), #57 Coso (?), #58 Randsburg Area (China Lake) + Geysers + Imperial Valley	~~3~~ 5
Colorado	#78 Paradise H.S. (District)	1
Idaho	#93 Crane Creek - Cove Creek (District (?)), #105 Big Creek H.S.	2
Nevada	#141 Steamboat Spgs. (District), #145 Stillwater, #146 Fernley, #147 Brady, #148 Desert Peak)	5
New Mexico	#171 - Valles Caldera (fringes of)	1
Oregon	#184 Newberry Caldera, #190 Crump H.S. (District), #203 Neal H.S. (District), #204 Vale	4
Utah	#208 Cove-Fort-Sulphurdale (District), #209 Roosevelt	2
		~~19~~ 21

Criteria:

- Most of these won't have electric potential → but may need further exploration for direct use
- Co-ordination of user for direct applications

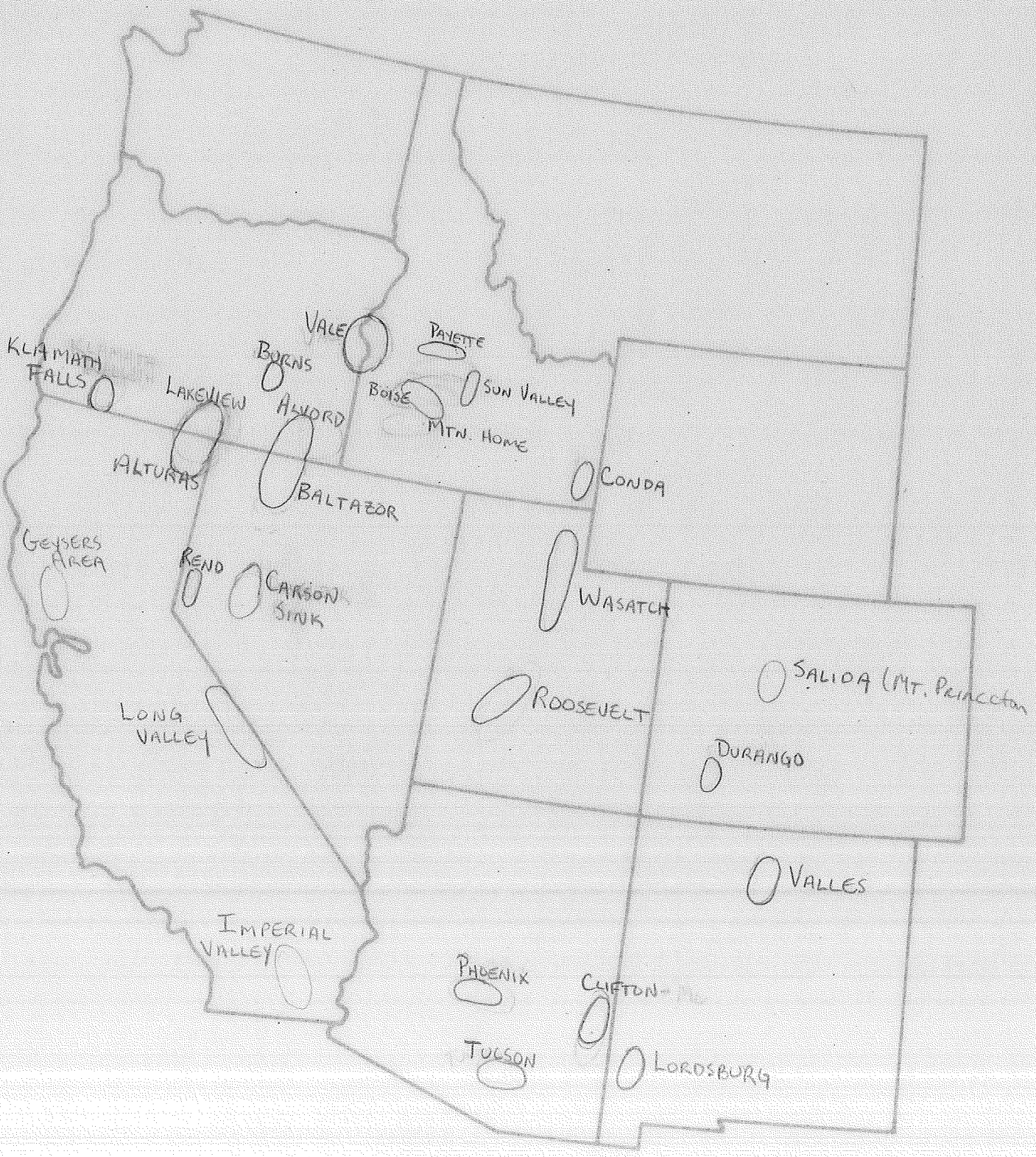
  Can probably be a little more remote than lower temp. direct-use resources, since offer more energy + will attract industrial users
- Elephant Country - District Consent

EXPLORATION TARGETS <90°C

STATE	790 NAME & NUMBER	TOTAL
ARIZONA	#6 HARQUALA-TONOPAH, #7 HYDER, #8 PHOENIX CHANDLER #9 COTTON CENTER, #10 GILA BEND, #11 MARICOPA / #12 COOLIDGE-CASA-GRANDE "PHOENIX DISTRICT" "TUCSON DISTRICT" #13 AVRA VALLEY, #16 TUSCON / #17 CLIFTON, #18 SAFFORD-BOWIE	11
CALIFORNIA	#1 SURPRISE VALLEY, #2 KELLY H.S. / #3 SUSANVILLE, #5 LOVELADY-WILBUR H.S., #6 THE GEYSERS / #7 BRIDGEPORT #8 MONO LAKE, #9 LONG VALLEY / #13 IMPERIAL VALLEY ALTURAS DISTRICT GEYSERS DISTRICT LONGVALLEY DISTRICT	9
COLORADO	#1 STEAMBOAT-ROUTT, #2 GLENWOOD CANYON #3 CEMENT CK-RANGER SPRINGS, #5 PINKERTON-TRIPP H.S. #6 PAGOSA SPRGS #7 RIO GRANDE RIFT AREA, #8 CANYON CITY	17
IDAHO	#3 STANLEY-CHALLIS, #8 KETCHOM #9 SW IDAHO: 9-1 (COUNCIL CAMB-RIDGE), 9-2 (BOISE FRONT) 9-3 (NAMPA-CALDWELL), #10 CAMAS PRAIRIE, #13 POCATELLO	7
MONTANA	#4 WARM SPRINGS, #7 BOZEMAN, #10 ENNIS H.S.	3
NEVADA	#6 WINNEMUCCA-GOLCONDA, #7 WELLS, #8 ELKO-CARLIN #10 CARSON DESERT-BLADY'S-HAZEN, #12 CRESCENT VALLEY-BEOWAWE #14 STEPTOE VALLEY, #15 SIERRAN FRONT, #16 YERRINGTON #17 HAWTHORNE, #18 LAS VEGAS-VALLEY	10
NEW MEXICO	#4 VALLES CALDERA, #5 CROWN POINT-WHITE MESA, #7 SOCORRO #10 RIO GRANDE RIFT, #11 NORTH ANIMAS VALLEY	5

State	790 Name & Number	Total
Oregon	#1 Belknap-Foley, #2 Willamette Pass, #3 Craig Mtn. #5 N. Harney Basin, #6 S. Harney Basin, #8 Lakeview #9 Klamath Falls	7
Utah	#1 Cache Valley, #2 Wasatch Front, #3 Tooele-Skull Valleys #6 Central Sevier River-San Pete Valleys, #~~7~~ Abraham H.S.-Newcastle,	- 5
Washington	#2 Yakima,	1
Wyoming	#1 Thermopolis, #2 Gas Hills, # Douglas	3
		68

DIRECT HEAT GEOTHERMAL EXPLORATION DISTRICTS (7/79)



Drilling Proposal Footage Requirements

(Assume 500 Exploration Sites) - half simple / half complex

Thermal Gradient

Simple: 1500' / site @ $20 / FT ⇒ 375,000' = $7,500,000

Complex: 4000' / site @ $25 / FT ⇒ 1,000,000' = 25,000,000

1,375,000' = $32,500,000

Production Wells

Simple: 1500' / site @ $60 / FT ⇒ 375,000' = 22,500,000

Complex 2000' / site @ $60 / FT ⇒ 500,000' = 30,000,000

875,000' = 52,500,000

1st year 99 sites:

Thermal Gradient

Simple: 1500' / site x 50 sites = 75,000'

Complex: 4000' / site x 50 sites 200,000'

275,000

drill x 100,000 '/ yr. maximum

50,000 yr ballpark

200 ft / day

200 working day year

Exploration Targets (150°-90°C)

State	790 Area Numbers	Total
Arizona	#32, #33	2
California	#34, #37, #38, #39, #42, #43, #50, #52 #60, #62, #63, #66, #67, #69	14
Colorado	#72, #74, #75, #76, #82	5
Idaho	#87, #90, #92, #94, #96, #98, #102 #107, #108, #113, #118, #120, #121	13
Montana	#122, #123, #126, #129	4
Nevada	#140, #142, #150(?), #155(?) #160, #166, #167	7 ± 2
New Mexico	#172, #173, #176	3
Oregon	#177, #178(?) (user?), #179(?), #181(?) (user?), #186, #187 #189, #193, #202	9 ± 3
Utah	#206, #207, #210, #211	4
Washington		0
Wyoming	#217(?), #218	2
		63 ± 5

Criteria

Large Flow and/or High Temp.
Near User and/or Prime Electricity Country

6/8/79

TO: MIKE
FROM: DEBBIE
RE: AVAILABILITY OF ROTARY DRILLING EQUIPMENT

ACCORDING TO MY FATHER, RIG AVAILABILITY SHOULDN'T BE A PROBLEM ASSUMING THE FOLLOWING:

AVERAGE FOOTAGE/DAY/RIG ≈ 300'

AVERAGE WORKING YEAR ≈ 200 days/year

AVERAGE FOOTAGE/YEAR/RIG ≈ 60,000'/yr

(A REALLY AGRESSIVE DRILLER W/ GOOD EQUIPMENT CAN MAKE AS MUCH AS 100,000'/yr/RIG)

1st YEAR'S FOOTAGE REQUIREMENTS ASSUMING 100 PROJECTS:

TEMP. GRADIENT HOLES = 275,000'

PRODUCTION HOLES = 175,000'
450,000

Areas with Direct Heat Potential

based on Circ. 790

T > 150°C

All sites in Circ. 790 that are listed as >150°C, and which are not actively persued by industry by (?) FY 83 (?) should be picked up as direct heat sites. Although remote in many cases, the resource quality might be good enough to attract a user. Table 5 (p 46-57) lists 52 such areas (not including Yellowstone)

T - 90°-150°C

note Balcones Fault Zone might have such temps in Texas (?)