G100954

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Dear Judy -

Enclosed are the CIPW norms for those Idaho analyses. I've marked a duplicate copy of the 1st one (#29) to indicate what is generated. With high alkalies and SiO_2 there are not many plots to discriminate or classify these rocks by chemistry.

If I had a better idea of what they were doing with these analyses I'd be in a better position to evaluate them, but that wasn't requested anyway.

As for "billing" I'm not sure how to proceed. How about a #20 donation to the Dept. of Geology?

Let me know if there's anything else I can do -

Best regards.

Don Fiesinger

Sample I.D

IDENTIFICATION READS...IDAHO 29 RED TOP VITRO

data entered with total Fe as FO

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	70.70	67.43	0.00	77.95	77.98	77.98
TIO2	0.53	0.38	0.00	0.44	0.44	0.44
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	13.00	14.61	0.00	8.45	8.45	8.45
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	3.82	3.05	0.00	3.52	3.52	3.52
MNO	0.08	0.06		0.07	0.07	0.07
NIO	0.00	0.00		0.00		
MGO	0.32	0.46	0.00	0.53	0.53	0.53
CAO	1.61	1.65	0.00	1.90	1.90	1.90
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.18	5.88	0.00	3.40	3.40	3.40
K2O	5.27	6.41	0.00	3.71	3.71	3.71
P2O5	0.08	0.07	0.00	0.04		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	98.59					
-O=F,CL	98.59					
-H2O	98.59					

CIPW NORM

MIN-ERAL	MOLE PCNT	WEIGHT PCNT	MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	24.67	25.86	OL	0.00	0.00
C	0.00	0.00	(FO)	0.00	0.00
I	0.00	0.00	(FA)	0.00	0.00
OR	32.06	31.14	CS	0.00	0.00
PL	35.21	32.54	MT	0.00	0.00
(AB)	29.41	26.91	CM	0.00	0.00
(AN)	5.80	5.63	IL	0.75	1.00
LC	0.00	0.00	HM	0.00	0.00
NE	0.00	0.00	TN	0.00	0.00
KP	0.00	0.00	PF	0.00	0.00
HL	0.00	0.00	RU	0.00	0.00
TH	0.00	0.00	AP	0.18	0.20
AC	0.00	0.00	FR	0.00	0.00
NS	0.00	0.00	PY	0.00	0.00
KS	0.00	0.00	CC	0.00	0.00
WO	0.00	0.00			
DI	1.49	1.58	SALIC	91.94	89.55
(WO)	0.74	0.75	FEMIC	8.06	9.04
(EN)	0.11	0.09			
(FS)	0.64	0.73	TOTAL	100.00	98.59
HY	5.64	6.27			
(EN)	0.81	0.71			
(FS)	4.83	5.56			

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	30.82	66.74
AB	32.07	15.91
OR	37.11	17.35
Q	61.54	80.03
NE	17.37	9.56
KP	21.09	10.42
AN	8.85	8.63
AB	42.25	43.71
OR	48.90	47.66
A	67.10	63.68
F	30.33	31.57
M	2.56	4.76

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	17.31	16.48	FA/OL	0.00	0.00	(NA+K)/AL	97.87	84.12	NA2O/(NA2O+K2O)	37.63	47.84
EN/HY	11.34	14.39	DIFNDX	83.91	86.14	(FE+MN)/(FE+MN+MG)	93.96	87.13	FEO/(FEO+FE2O3)	100.00	100.00

assorted ratios

IDENTIFICATION READS...IDAHO 29 RED TOP VITRO

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	70.70	67.43	0.00	77.95	77.98	77.98
TIO2	0.53	0.38	0.00	0.44	0.44	0.44
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	13.00	14.61	0.00	8.45	8.45	8.45
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	3.82	3.05	0.00	3.52	3.52	3.52
MNO	0.08	0.06		0.07	0.07	0.07
NIO	0.00	0.00		0.00		
MGO	0.32	0.46	0.00	0.53	0.53	0.53
CAO	1.61	1.65	0.00	1.90	1.90	1.90
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.18	5.88	0.00	3.40	3.40	3.40
K2O	5.27	6.41	0.00	3.71	3.71	3.71
P2O5	0.08	0.07	0.00	0.04		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	98.59					
-O=F,CL	98.59					
-H2O	98.59					

MINERAL	MOLE PCNT	WEIGHT PCNT	MINERAL	MOLE PCNT	WEIGHT PCNT
Q	24.67	25.86	OL	0.00	0.00
C	0.00	0.00	(FO)	0.00	0.00
Z	0.00	0.00	(FA)	0.00	0.00
OR	32.06	31.14	CS	0.00	0.00
PL	35.21	32.54	MT	0.00	0.00
(AB)	29.41	26.91	CM	0.00	0.00
(AN)	5.80	5.63	IL	0.75	1.00
LC	0.00	0.00	HM	0.00	0.00
NE	0.00	0.00	TN	0.00	0.00
KP	0.00	0.00	PF	0.00	0.00
HL	0.00	0.00	RU	0.00	0.00
TH	0.00	0.00	AP	0.18	0.20
AC	0.00	0.00	FR	0.00	0.00
NS	0.00	0.00	PY	0.00	0.00
KS	0.00	0.00	CC	0.00	0.00
WO	0.00	0.00			
DI	1.49	1.58	SALIC	91.94	89.55
(WO)	0.74	0.75	FEMIC	8.06	9.04
(EN)	0.11	0.09			
(FS)	0.64	0.73	TOTAL	100.00	98.59
HY	5.64	6.27			
(EN)	0.81	0.71			
(FS)	4.83	5.56			

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	30.82	66.74
AB	32.07	15.91
OR	37.11	17.35
Q	61.54	80.03
NE	17.37	9.56
KP	21.09	10.42
AN	8.85	8.63
AB	42.25	43.71
OR	48.90	47.66
A	67.10	63.68
F	30.33	31.57
M	2.56	4.76

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	17.31	16.48	FA/OL	0.00	0.00	(NA+K)/AL	97.87	84.12	NA2O/(NA2O+K2O)	37.63	47.84
EN/HY	11.34	14.39	DIFNDX	83.91	86.14	(FE+MN)/(FE+MN+MG)	93.96	87.13	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...IDAHO 30 R T BAKED ASH

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	66.80	66.09	0.00	76.11	76.13	76.13
TIO2	0.63	0.47	0.00	0.54	0.54	0.54
ZRO2	0.00	0.00	0.00	0.00		
AL203	14.87	17.34	0.00	9.98	9.99	9.99
CR203	0.00	0.00	0.00	0.00		
FE203	0.00	0.00	0.00	0.00	0.00	0.00
FEO	4.37	3.62	0.00	4.16	4.17	4.17
MNO	0.10	0.08		0.09	0.09	0.09
NIO	0.00	0.00		0.00		
MGO	0.97	1.43	0.00	1.65	1.65	1.65
CAO	1.87	1.98	0.00	2.28	2.28	2.28
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA20	2.11	4.05	0.00	2.33	2.33	2.33
K20	3.88	4.90	0.00	2.82	2.82	2.82
P205	0.06	0.05	0.00	0.03		
H20+	0.00			0.00		0.00
H20-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	95.66					
-O=F,CL	95.66					
-H20	95.66					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT	MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	30.80	31.13	OL	0.00	0.00
C	4.60	3.95	(FO)	0.00	0.00
Z	0.00	0.00	(FA)	0.00	0.00
OR	24.48	22.93	CS	0.00	0.00
PL	29.72	26.73	MT	0.00	0.00
(AB)	20.24	17.85	CM	0.00	0.00
(AN)	9.49	8.88	IL	0.94	1.20
LC	0.00	0.00	HM	0.00	0.00
NE	0.00	0.00	TN	0.00	0.00
KP	0.00	0.00	PF	0.00	0.00
HL	0.00	0.00	RU	0.00	0.00
TH	0.00	0.00	AP	0.14	0.14
AC	0.00	0.00	FR	0.00	0.00
NS	0.00	0.00	PY	0.00	0.00
KS	0.00	0.00	CC	0.00	0.00
WO	0.00	0.00			
DI	0.00	0.00	SALIC	89.61	84.74
(WO)	0.00	0.00	FEMIC	10.39	10.92
(EN)	0.00	0.00			
(FS)	0.00	0.00	TOTAL	100.00	95.66
HY	9.31	9.57			
(EN)	2.86	2.41			
(FS)	6.45	7.16			

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	43.29	77.50
AB	24.83	10.18
OR	31.88	12.32
Q	68.43	84.48
NE	13.45	7.02
KP	18.12	8.50
AN	17.88	17.50
AB	35.95	37.33
OR	46.17	45.17
A	52.87	46.99
F	38.57	37.99
M	8.55	15.02

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	33.21	31.91	FA/OL	0.00	0.00	(NA+K)/AL	60.82	51.58	NA20/(NA20+K20)	35.23	45.25
EN/HY	25.21	30.69	DIFNDX	71.92	75.53	(FE+MN)/(FE+MN+MG)	85.59	72.12	FEO/(FEO+FE203)	100.00	100.00

IDENTIFICATION READS...IDAHO 31 R T WELDED ASH

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	73.05	71.05	0.00	80.73	80.76	80.76
TIO2	0.49	0.36	0.00	0.41	0.41	0.41
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.24	14.03	0.00	7.97	7.97	7.97
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	3.56	2.90	0.00	3.29	3.29	3.29
MNO	0.07	0.06		0.06	0.06	0.06
NIO	0.00	0.00		0.00		
MGO	0.29	0.42	0.00	0.48	0.48	0.48
CAO	1.19	1.24	0.00	1.41	1.41	1.41
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.32	6.26	0.00	3.56	3.56	3.56
K2O	2.91	3.61	0.00	2.05	2.05	2.05
P2O5	0.08	0.07	0.00	0.04		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	97.20					
-O=F,CL	97.20					
-H2O	97.20					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	36.16	37.18
C	1.91	1.66
Z	0.00	0.00
OR	18.05	17.20
PL	36.94	33.45
(AB)	31.31	28.09
(AN)	5.63	5.36
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	6.04	6.59
(EN)	0.85	0.73
(FS)	5.19	5.86

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.72	0.93
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.18	0.20
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	93.06	89.49
FEMIC	6.94	7.71
TOTAL	100.00	97.20

TERNARY DIAGRAMS	WT PCT	MOLPCT
Q	45.08	78.56
AB	34.07	13.60
OR	20.85	7.84
Q	69.70	84.99
NE	18.45	9.52
KP	11.85	5.49
AN	10.59	10.24
AB	55.46	56.93
OR	33.95	32.83
A	61.79	59.78
F	35.31	35.07
M	2.91	5.14

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	16.03	15.25	FA/OL	0.00	0.00	(NA+K)/AL	75.31	70.35	NA2O/(NA2O+K2O)	53.29	63.42
EN/HY	11.08	14.07	DIFNDX	82.47	85.53	(FE+MN)/(FE+MN+MG)	94.10	87.42	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...IDAHO 32 M 2

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	68.80	67.15	0.00	77.35	77.39	77.39
TIO2	0.56	0.41	0.00	0.47	0.47	0.47
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.63	14.53	0.00	8.37	8.37	8.37
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	4.26	3.48	0.00	4.01	4.01	4.01
MNO	0.08	0.07		0.08	0.08	0.08
NIO	0.00	0.00		0.00		
MGO	0.39	0.56	0.00	0.65	0.65	0.65
CAO	1.87	1.96	0.00	2.25	2.25	2.25
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.96	5.60	0.00	3.23	3.23	3.23
K2O	4.95	6.16	0.00	3.55	3.55	3.55
P2O5	0.10	0.09	0.00	0.05		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	96.60					
-O=F,CL	96.60					
-H2O	96.60					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT	MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	24.96	25.57	OL	0.00	0.00
C	0.00	0.00	(FO)	0.00	0.00
Z	0.00	0.00	(FA)	0.00	0.00
OR	30.82	29.25	CS	0.00	0.00
PL	34.92	31.60	MT	0.00	0.00
(AB)	28.01	25.05	CM	0.00	0.00
(AN)	6.91	6.56	IL	0.81	1.05
LC	0.00	0.00	HM	0.00	0.00
NE	0.00	0.00	TN	0.00	0.00
KP	0.00	0.00	PF	0.00	0.00
HL	0.00	0.00	RU	0.00	0.00
TH	0.00	0.00	AP	0.23	0.25
AC	0.00	0.00	FR	0.00	0.00
NS	0.00	0.00	PY	0.00	0.00
KS	0.00	0.00	CC	0.00	0.00
WO	0.00	0.00			
DI	1.71	1.78	SALIC	90.70	86.43
(WO)	0.86	0.85	FEMIC	9.30	10.17
(EN)	0.13	0.11			
(FS)	0.73	0.82	TOTAL	100.00	96.60
HY	6.54	7.09			
(EN)	0.99	0.85			
(FS)	5.55	6.24			

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	32.02	67.97
AB	31.36	15.25
OR	36.62	16.78
Q	62.20	80.48
NE	16.99	9.30
KP	20.81	10.23
AN	10.78	10.51
AB	41.16	42.61
OR	48.07	46.88
A	63.00	59.29
F	33.93	35.05
M	3.07	5.66

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	20.75	19.79	FA/OL	0.00	0.00	(NA+K)/AL	94.32	80.97	NA2O/(NA2O+K2O)	37.42	47.61
EN/HY	11.99	15.18	DIFNDX	79.87	83.79	(FE+MN)/(FE+MN+MG)	93.55	86.32	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...IDAHO 34 ASH BETWEEN TRIPLE UNIT 2

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	72.30	71.44	0.00	81.08	81.09	81.09
TIO2	0.51	0.38	0.00	0.43	0.43	0.43
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	11.39	13.27	0.00	7.53	7.53	7.53
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	2.88	2.38	0.00	2.70	2.70	2.70
MNO	0.05	0.04		0.05	0.05	0.05
NIO	0.00	0.00		0.00		
MGO	0.42	0.62	0.00	0.70	0.70	0.70
CAO	1.28	1.36	0.00	1.54	1.54	1.54
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.33	4.46	0.00	2.53	2.53	2.53
K2O	4.79	6.04	0.00	3.43	3.43	3.43
P2O5	0.03	0.03	0.00	0.01		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		0.00	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	95.98					
-O=F,CL	95.98					
-H2O	95.98					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	34.65	35.06
C	0.14	0.12
Z	0.00	0.00
OR	30.19	28.31
PL	28.89	25.87
(AB)	22.32	19.72
(AN)	6.57	6.15
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	5.32	5.58
(EN)	1.23	1.04
(FS)	4.09	4.54

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.76	0.97
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.07	0.07
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	93.86	89.36
FEMIC	6.14	6.62
TOTAL	100.00	95.98

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	42.20	76.74
AB	23.73	9.89
OR	34.07	13.37
Q	67.79	84.13
NE	12.86	6.75
KP	19.36	9.13
AN	11.36	11.12
AB	36.39	37.78
OR	52.25	51.10
A	68.34	63.68
F	27.64	28.86
M	4.01	7.47

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	23.79	22.73	FA/OL	0.00	0.00	(NA+K)/AL	94.64	79.17	NA2O/(NA2O+K2O)	32.72	42.51
EN/HY	18.66	23.16	DIFNDX	83.08	87.16	(FE+MN)/(FE+MN+MG)	90.03	79.73	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...IDAHO 35 MIDDLE VITRO - TRIPLE UNIT

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	73.41	72.16	0.00	81.82	81.85	81.85
TIO2	0.47	0.34	0.00	0.39	0.39	0.39
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	11.71	13.57	0.00	7.69	7.69	7.69
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	2.89	2.38	0.00	2.69	2.69	2.69
MNO	0.05	0.04		0.05	0.05	0.05
NIO	0.00	0.00		0.00		
MGO	0.24	0.35	0.00	0.39	0.39	0.39
CAO	1.06	1.12	0.00	1.27	1.27	1.27
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.61	4.97	0.00	2.82	2.82	2.82
K2O	4.00	5.02	0.00	2.84	2.84	2.84
P2O5	0.06	0.05	0.00	0.03		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	96.50					
-O=F,CL	96.50					
-H2O	96.50					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT	MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	37.71	38.36	OL	0.00	0.00
C	1.52	1.31	(FO)	0.00	0.00
Z	0.00	0.00	(FA)	0.00	0.00
OR	25.08	23.64	CS	0.00	0.00
PL	30.02	26.93	MT	0.00	0.00
(AB)	24.87	22.08	CM	0.00	0.00
(AN)	5.15	4.85	IL	0.69	0.88
LC	0.00	0.00	HM	0.00	0.00
NE	0.00	0.00	TN	0.00	0.00
KP	0.00	0.00	PF	0.00	0.00
HL	0.00	0.00	RU	0.00	0.00
TH	0.00	0.00	AP	0.14	0.15
AC	0.00	0.00	FR	0.00	0.00
NS	0.00	0.00	PY	0.00	0.00
KS	0.00	0.00	CC	0.00	0.00
WO	0.00	0.00			
DI	0.00	0.00	SALIC	94.33	90.24
(WO)	0.00	0.00	FEMIC	5.67	6.26
(EN)	0.00	0.00			
(FS)	0.00	0.00	TOTAL	100.00	96.50
HY	4.84	5.23			
(EN)	0.69	0.59			
(FS)	4.15	4.64			

TERNARY DIAGRAMS	WT PCT	MOLPCT
Q	45.62	79.05
AB	26.27	10.43
OR	28.11	10.52
Q	69.80	85.24
NE	14.23	7.35
KP	15.98	7.41
AN	9.59	9.34
AB	43.67	45.14
OR	46.74	45.52
A	67.89	64.73
F	29.68	30.79
M	2.42	4.48

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	18.00	17.14	FA/OL	0.00	0.00	(NA+K)/AL	84.82	73.64	NA2O/(NA2O+K2O)	39.49	49.79
EN/HY	11.25	14.28	DIFNDX	84.08	87.66	(FE+MN)/(FE+MN+MG)	94.14	87.50	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...IDAHO 36 MEM #2

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	71.40	70.48	0.00	80.21	80.24	80.24
TIO2	0.47	0.35	0.00	0.40	0.40	0.40
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.20	14.19	0.00	8.08	8.08	8.08
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	3.63	3.00	0.00	3.41	3.41	3.41
MNO	0.07	0.06		0.07	0.07	0.07
NIO	0.00	0.00		0.00		
MGO	0.27	0.40	0.00	0.45	0.45	0.45
CAO	1.38	1.46	0.00	1.66	1.66	1.66
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.02	5.78	0.00	3.29	3.29	3.29
K2O	3.35	4.22	0.00	2.40	2.40	2.40
P2O5	0.08	0.07	0.00	0.04		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	95.87					
-O=F,CL	95.87					
-H2O	95.87					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	34.69	35.14
C	1.50	1.29
Z	0.00	0.00
OR	21.09	19.80
PL	35.63	31.87
(AB)	28.90	25.55
(AN)	6.73	6.32
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	6.21	6.69
(EN)	0.79	0.67
(FS)	5.41	6.02

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.70	0.89
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.18	0.19
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	92.91	88.10
FEMIC	7.09	7.78
TOTAL	100.00	95.87

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	43.66	77.62
AB	31.75	12.94
OR	24.60	9.44
Q	68.82	84.54
NE	17.20	8.94
KP	13.98	6.52
AN	12.23	11.87
AB	49.46	50.95
OR	38.31	37.18
A	62.03	59.56
F	35.35	35.70
M	2.63	4.73

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	19.82	18.90	FA/OL	0.00	0.00	(NA+K)/AL	77.77	70.44	NA2O/(NA2O+K2O)	47.41	57.81
EN/HY	10.05	12.80	DIFNDX	80.49	84.68	(FE+MN)/(FE+MN+MG)	94.64	88.49	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...IDAHO 27 TOP TRIPLE UNIT

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	65.87	65.73	0.00	75.02	75.06	75.06
TIO2	0.61	0.46	0.00	0.52	0.52	0.52
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	11.83	13.91	0.00	7.94	7.94	7.94
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	3.81	3.18	0.00	3.63	3.63	3.63
MNO	0.07	0.06		0.07	0.07	0.07
NIO	0.00	0.00		0.00		
MGO	0.50	0.74	0.00	0.84	0.84	0.84
CAO	4.74	5.07	0.00	5.78	5.79	5.79
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.86	5.53	0.00	3.16	3.16	3.16
K2O	4.10	5.22	0.00	2.98	2.98	2.98
P2O5	0.11	0.10	0.00	0.05		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.02	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	94.50					
-O=F,CL	94.50					
-H2O	94.50					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	23.46	23.51
C	0.00	0.00
Z	0.00	0.00
OR	26.10	24.23
PL	35.57	31.53
(AB)	27.67	24.20
(AN)	7.90	7.33
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	13.31	13.40
(WO)	6.65	6.45
(EN)	1.40	1.17
(FS)	5.26	5.78
HY	0.39	0.41
(EN)	0.08	0.07
(FS)	0.31	0.34

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.91	1.15
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.26	0.27
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	85.13	79.27
FEMIC	14.87	15.23
TOTAL	100.00	94.50

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	32.68	68.57
AB	33.64	16.17
OR	33.68	15.26
Q	62.64	80.70
NE	18.22	9.93
KP	19.14	9.37
AN	13.15	12.82
AB	43.40	44.87
OR	43.45	42.32
A	61.77	57.84
F	33.82	34.21
M	4.41	7.95

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	23.26	22.22	FA/OL	0.00	0.00	(NA+K)/AL	88.25	77.28	NA2O/(NA2O+K2O)	41.09	51.46
EN/HY	16.81	20.99	DIFNDX	71.94	77.23	(FE+MN)/(FE+MN+MG)	90.96	81.42	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS GUL3-1

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	73.70	71.47	0.00	82.01	82.04	82.04
TIO2	0.31	0.23	0.00	0.26	0.26	0.26
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	11.84	13.53	0.00	7.76	7.77	7.77
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	2.18	1.77	0.00	2.03	2.03	2.03
MNO	0.04	0.03		0.03	0.03	0.03
NIO	0.00	0.00		0.00		
MGO	0.13	0.19	0.00	0.22	0.22	0.22
CAO	0.59	0.61	0.00	0.70	0.70	0.70
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.72	5.11	0.00	2.93	2.94	2.94
K2O	5.66	7.00	0.00	4.02	4.02	4.02
P2O5	0.07	0.06	0.00	0.03		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	97.24					
-O=F,CL	97.24					
-H2O	97.24					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	32.33	33.33
C	0.38	0.33
Z	0.00	0.00
OR	35.01	33.45
PL	28.16	25.49
(AB)	25.57	23.02
(AN)	2.59	2.47
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	3.52	3.88
(EN)	0.38	0.32
(FS)	3.14	3.56

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.45	0.59
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.15	0.17
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	95.88	92.60
FEMIC	4.12	4.64
TOTAL	100.00	97.24

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	37.12	72.74
AB	25.63	11.51
OR	37.25	15.76
Q	64.95	82.36
NE	13.89	7.45
KP	21.17	10.20
AN	4.19	4.09
AB	39.05	40.48
OR	56.75	55.42
A	78.39	75.59
F	20.39	22.06
M	1.22	2.34

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	9.69	9.18	FA/OL	0.00	0.00	(NA+K)/AL	107.18	89.53	NA2O/(NA2O+K2O)	32.46	42.21
EN/HY	8.34	10.68	DIFNDX	89.79	92.91	(FE+MN)/(FE+MN+MG)	95.65	90.54	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS GS-ASH

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	68.51	70.66	0.00	80.87	80.90	80.90
TIO2	0.47	0.36	0.00	0.42	0.42	0.42
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.50	15.20	0.00	8.70	8.70	8.70
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	2.92	2.52	0.00	2.88	2.88	2.88
MNO	0.05	0.05		0.05	0.05	0.05
NIO	0.00	0.00		0.00		
MGO	0.17	0.26	0.00	0.30	0.30	0.30
CAO	0.81	0.90	0.00	1.02	1.02	1.02
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	1.56	3.12	0.00	1.79	1.79	1.79
K2O	5.22	6.87	0.00	3.93	3.93	3.93
P2O5	0.08	0.07	0.00	0.04		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	92.29					
-O=F,CL	92.29					
-H2O	92.29					

MINERAL	MOLE PCNT	WEIGHT PCNT
Q	36.68	35.56
C	3.65	3.00
Z	0.00	0.00
OR	34.34	30.85
PL	19.49	16.70
(AB)	15.60	13.20
(AN)	3.89	3.50
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	4.92	5.11
(EN)	0.52	0.42
(FS)	4.40	4.68

MINERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.73	0.89
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.19	0.19
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	94.16	86.10
FEMIC	5.84	6.19
TOTAL	100.00	92.29

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	44.67	78.60
AB	16.58	6.69
OR	38.75	14.72
Q	69.00	85.01
NE	8.98	4.68
KP	22.02	10.31
AN	7.35	7.23
AB	27.77	28.98
OR	64.88	63.79
A	68.69	64.24
F	29.59	32.40
M	1.72	3.36

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	20.94	19.97	FA/OL	0.00	0.00	(NA+K)/AL	82.99	65.73	NA2O/(NA2O+K2O)	23.01	31.23
EN/HY	8.29	10.62	DIFNDX	79.60	86.62	(FE+MN)/(FE+MN+MG)	95.75	90.75	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS CAN-2

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	74.72	70.75	0.00	81.32	81.34	81.34
TIO2	0.36	0.26	0.00	0.29	0.29	0.29
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.35	13.78	0.00	7.92	7.92	7.92
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	2.65	2.10	0.00	2.41	2.41	2.41
MNO	0.05	0.04		0.05	0.05	0.05
NIO	0.00	0.00		0.00		
MGO	0.17	0.24	0.00	0.28	0.28	0.28
CAO	0.61	0.62	0.00	0.71	0.71	0.71
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.39	6.22	0.00	3.58	3.58	3.58
K2O	4.92	5.94	0.00	3.42	3.42	3.42
P2O5	0.06	0.05	0.00	0.03		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	99.28					
-O=F,CL	99.28					
-H2O	99.28					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	31.05	32.79
C	0.54	0.48
Z	0.00	0.00
OR	29.71	29.07
PL	33.81	31.32
(AB)	31.12	28.69
(AN)	2.69	2.63
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	4.25	4.79
(EN)	0.48	0.42
(FS)	3.77	4.37

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.51	0.68
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.13	0.14
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	95.11	93.66
FEMIC	4.89	5.62
TOTAL	100.00	99.28

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	36.21	71.85
AB	31.68	14.40
OR	32.11	13.75
Q	64.59	81.99
NE	17.16	9.21
KP	18.25	8.80
AN	4.36	4.24
AB	47.50	48.99
OR	48.14	46.77
A	74.66	72.23
F	23.81	24.92
M	1.53	2.85

	WT PCT	MOLPCT
AN/PL	8.41	7.97
EN/HY	8.84	11.30

	WT PCT	MOLPCT
FA/OL	0.00	0.00
DIFNDX	90.55	91.88

	WT PCT	MOLPCT
(NA+K)/AL	100.96	88.27
(FE+MN)/(FE+MN+MG)	95.35	89.92

	WT PCT	MOLPCT
NA2O/(NA2O+K2O)	40.79	51.15
FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS TVB-2

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	71.47	69.80	0.00	79.97	80.02	80.02
TIO2	0.47	0.35	0.00	0.40	0.40	0.40
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.27	14.12	0.00	8.09	8.10	8.10
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	3.45	2.82	0.00	3.23	3.23	3.23
MNO	0.05	0.05		0.05	0.05	0.05
NIO	0.00	0.00		0.00		
MGO	0.25	0.36	0.00	0.42	0.42	0.42
CAO	1.14	1.19	0.00	1.37	1.37	1.37
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.59	4.90	0.00	2.81	2.81	2.81
K2O	5.06	6.30	0.00	3.61	3.61	3.61
P2O5	0.12	0.10	0.00	0.06		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.02	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	96.88					
-O=F,CL	96.88					
-H2O	96.88					

MINERAL	MOLE PCNT	WEIGHT PCNT	MINERAL	MOLE PCNT	WEIGHT PCNT
Q	31.24	31.98	OL	0.00	0.00
C	0.86	0.75	(FO)	0.00	0.00
Z	0.00	0.00	(FA)	0.00	0.00
OR	31.52	29.90	CS	0.00	0.00
PL	29.66	26.79	MT	0.00	0.00
(AB)	24.52	21.92	CM	0.00	0.00
(AN)	5.14	4.87	IL	0.89	0.89
LC	0.00	0.00	HM	0.00	0.00
NE	0.00	0.00	TN	0.00	0.00
KP	0.00	0.00	PF	0.00	0.00
HL	0.00	0.00	RU	0.00	0.00
TH	0.00	0.00	AP	0.26	0.28
AC	0.00	0.00	FR	0.00	0.00
NS	0.00	0.00	PY	0.00	0.00
KS	0.00	0.00	CC	0.00	0.00
WO	0.00	0.00			
DI	0.00	0.00	SALIC	93.28	89.42
(WO)	0.00	0.00	FEMIC	6.72	7.46
(EN)	0.00	0.00			
(FS)	0.00	0.00	TOTAL	100.00	96.88
HY	5.76	6.28			
(EN)	0.73	0.62			
(FS)	5.04	5.66			

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	38.16	73.59
AB	26.15	11.56
OR	35.68	14.85
Q	65.56	82.72
NE	14.17	7.56
KP	20.28	9.72
AN	8.59	8.40
AB	38.66	40.08
OR	52.75	51.52
A	67.40	63.79
F	30.40	32.07
M	2.20	4.14

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	18.19	17.32	FA/OL	0.00	0.00	(NA+K)/AL	94.27	79.36	NA2O/(NA2O+K2O)	33.86	43.76
EN/HY	9.91	12.63	DIFNDX	83.80	87.28	(FE+MN)/(FE+MN+MG)	94.76	88.72	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS HC-2

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	65.21	64.68	0.00	74.78	74.86	74.86
TIO2	0.77	0.57	0.00	0.66	0.66	0.66
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	13.04	15.25	0.00	8.81	8.82	8.82
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	4.80	3.98	0.00	4.60	4.61	4.61
MNO	0.08	0.06		0.07	0.07	0.07
NIO	0.00	0.00		0.00		
MGO	0.74	1.09	0.00	1.26	1.27	1.27
CAO	2.45	2.60	0.00	3.01	3.01	3.01
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.88	5.54	0.00	3.20	3.21	3.21
K2O	4.77	6.04	0.00	3.49	3.49	3.49
P2O5	0.22	0.18	0.00	0.11		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.03	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	94.95					
-O=F,CL	94.95					
-H2O	94.95					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	21.26	21.43
C	0.00	0.00
Z	0.00	0.00
OR	30.18	28.19
PL	36.87	32.94
(AB)	27.69	24.37
(AN)	9.18	8.57
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	1.84	1.86
(WO)	0.92	0.90
(EN)	0.22	0.19
(FS)	0.70	0.78
HY	8.21	8.56
(EN)	1.97	1.66
(FS)	6.24	6.91

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	1.15	1.46
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.49	0.52
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	88.31	82.56
FEMIC	11.69	12.41
TOTAL	100.00	94.96

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	28.97	64.75
AB	32.94	16.87
OR	38.10	18.38
Q	60.51	79.33
NE	17.84	9.89
KP	21.65	10.78
AN	14.02	13.69
AB	39.87	41.30
OR	46.11	45.01
A	58.00	53.28
F	36.39	36.65
M	5.61	10.07

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	26.01	24.89	FA/OL	0.00	0.00	(NA+K)/AL	88.33	75.92	NA2O/(NA2O+K2O)	37.65	47.85
EN/HY	19.35	23.97	DIFNDX	73.99	79.13	(FE+MN)/(FE+MN+MG)	89.46	78.71	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS TVM

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	71.62	70.15	0.00	80.43	80.47	80.47
TIO2	0.45	0.33	0.00	0.38	0.38	0.38
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.03	13.89	0.00	7.96	7.97	7.97
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	3.18	2.60	0.00	2.99	2.99	2.99
MNO	0.04	0.04		0.04	0.04	0.04
NIO	0.00	0.00		0.00		
MGO	0.19	0.28	0.00	0.32	0.32	0.32
CAO	0.99	1.04	0.00	1.19	1.19	1.19
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.80	5.32	0.00	3.05	3.05	3.05
K2O	5.02	6.27	0.00	3.60	3.60	3.60
P2O5	0.10	0.08	0.00	0.05		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	96.42					
-O=F,CL	96.42					
-H2O	96.42					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT	MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	30.99	31.64	OL	0.00	0.00
C	0.50	0.43	(FO)	0.00	0.00
I	0.00	0.00	(FA)	0.00	0.00
OR	31.36	29.66	CS	0.00	0.00
PL	31.09	27.95	NT	0.00	0.00
(AB)	26.59	23.69	CM	0.00	0.00
(AN)	4.50	4.26	IL	0.66	0.85
LC	0.00	0.00	HM	0.00	0.00
NE	0.00	0.00	TN	0.00	0.00
KP	0.00	0.00	PF	0.00	0.00
HL	0.00	0.00	RU	0.00	0.00
TH	0.00	0.00	AP	0.22	0.24
AC	0.00	0.00	FR	0.00	0.00
NS	0.00	0.00	PY	0.00	0.00
KS	0.00	0.00	CC	0.00	0.00
WO	0.00	0.00			
DI	0.00	0.00	SALIC	93.94	89.68
(WO)	0.00	0.00	FEMIC	6.06	6.74
(EN)	0.00	0.00			
(FS)	0.00	0.00	TOTAL	100.00	96.43
HY	5.17	5.65			
(EN)	0.55	0.47			
(FS)	4.62	5.18			

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	37.22	72.78
AB	27.88	12.49
OR	34.90	14.73
Q	65.07	82.38
NE	15.10	8.09
KP	19.83	9.54
AN	7.39	7.21
AB	41.12	42.57
OR	51.49	50.22
A	69.88	66.78
F	28.42	30.02
M	1.70	3.20

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	15.23	14.49	FA/OL	0.00	0.00	(NA+K)/AL	98.08	83.45	NA2O/(NA2O+K2O)	35.81	45.88
EN/HY	8.37	10.72	DIFNDX	84.99	88.94	(FE+MN)/(FE+MN+MG)	95.63	90.50	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS VD

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	71.93	70.36	0.00	80.62	80.65	80.65
TIO2	0.43	0.32	0.00	0.36	0.36	0.36
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.02	13.86	0.00	7.94	7.94	7.94
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	3.21	2.63	0.00	3.01	3.01	3.01
MNO	0.04	0.03		0.04	0.04	0.04
NIO	0.00	0.00		0.00		
MGO	0.20	0.29	0.00	0.33	0.33	0.33
CAO	0.87	0.91	0.00	1.04	1.05	1.05
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.44	4.63	0.00	2.65	2.65	2.65
K2O	5.54	6.91	0.00	3.96	3.96	3.96
P2O5	0.08	0.07	0.00	0.04		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	96.76					
-O=F,CL	96.76					
-H2O	96.76					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	31.50	32.20
C	0.71	0.62
Z	0.00	0.00
OR	34.56	32.74
PL	27.14	24.44
(AB)	23.14	20.65
(AN)	4.01	3.79
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	5.27	5.76
(EN)	0.58	0.50
(FS)	4.69	5.26

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.63	0.82
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.18	0.19
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	93.92	90.00
FEMIC	6.08	6.77
TOTAL	100.00	96.76

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	37.62	73.18
AB	24.12	10.75
OR	38.25	15.06
Q	65.19	82.55
NE	13.07	7.00
KP	21.74	10.46
AN	6.63	6.49
AB	36.11	37.50
OR	57.26	56.01
A	70.06	66.42
F	28.18	30.22
M	1.76	3.36

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	15.52	14.76	FA/OL	0.00	0.00	(NA+K)/AL	100.75	83.28	NA2O/(NA2O+K2O)	30.58	40.10
EN/HY	8.65	11.06	DIFNDX	85.58	89.20	(FE+MN)/(FE+MN+MG)	95.45	90.12	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS CH-VITRO-1

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	73.21	71.16	0.00	81.49	81.53	81.53
TIO2	0.49	0.36	0.00	0.41	0.41	0.41
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.21	13.99	0.00	8.01	8.01	8.01
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	2.64	2.15	0.00	2.46	2.46	2.46
MNO	0.03	0.02		0.03	0.03	0.03
NIO	0.00	0.00		0.00		
MGO	0.17	0.25	0.00	0.28	0.28	0.28
CAO	0.68	0.71	0.00	0.81	0.81	0.81
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	2.10	3.96	0.00	2.27	2.27	2.27
K2O	5.91	7.33	0.00	4.20	4.20	4.20
P2O5	0.10	0.08	0.00	0.05		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	97.54					
-O=F,CL	97.54					
-H2O	97.54					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	34.10	35.08
C	1.56	1.36
Z	0.00	0.00
OR	36.64	34.92
PL	22.64	20.49
(AB)	19.79	17.77
(AN)	2.86	2.72
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	4.12	4.52
(EN)	0.49	0.42
(FS)	3.62	4.09

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.72	0.93
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.22	0.24
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	94.95	91.86
FEMIC	5.05	5.68
TOTAL	100.00	97.54

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	39.97	75.13
AB	20.24	8.72
OR	39.79	16.15
Q	66.42	83.39
NE	10.97	5.82
KP	22.61	10.78
AN	4.91	4.82
AB	32.07	33.38
OR	63.02	61.80
A	74.03	70.23
F	24.40	26.71
M	1.57	3.07

	WT PCT	MOLPCT
AN/PL	13.28	12.61
EN/HY	9.38	11.97

	WT PCT	MOLPCT
FA/OL	0.00	0.00
DIFNDX	87.77	90.53

	WT PCT	MOLPCT
(NA+K)/AL	100.03	80.68
(FE+MN)/(FE+MN+MG)	95.29	89.81

	WT PCT	MOLPCT
NA2O/(NA2O+K2O)	26.22	35.07
FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS SF

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	71.54	66.35	0.00	76.73	76.80	76.80
TIO2	0.69	0.48	0.00	0.56	0.56	0.56
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	13.72	15.00	0.00	8.67	8.68	8.68
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	4.19	3.25	0.00	3.76	3.76	3.76
MNO	0.07	0.05		0.06	0.06	0.06
NIO	0.00	0.00		0.00		
MGO	0.72	1.00	0.00	1.15	1.15	1.15
CAO	1.82	1.81	0.00	2.09	2.09	2.09
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.53	6.35	0.00	3.67	3.67	3.67
K2O	4.71	5.57	0.00	3.22	3.23	3.23
P2O5	0.18	0.14	0.00	0.08		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.02	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	101.17					
-O=F,CL	101.17					
-H2O	101.17					

MINERAL	MOLE PCNT	WEIGHT PCNT
Q	23.66	25.51
C	0.00	0.00
Z	0.00	0.00
OR	27.86	27.83
PL	39.44	37.55
(AB)	31.74	29.87
(AN)	7.69	7.68
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.14	0.15
(WO)	0.07	0.07
(EN)	0.02	0.02
(FS)	0.05	0.06
HY	7.56	8.40
(EN)	1.97	1.78
(FS)	5.59	6.62

MINERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.96	1.31
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.38	0.43
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	90.96	90.89
FEMIC	9.04	10.28
TOTAL	100.00	101.17

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	30.65	66.50
AB	35.90	17.84
OR	33.45	15.66
Q	61.55	79.94
NE	19.45	10.68
KP	19.01	9.38
AN	11.75	11.43
AB	45.68	47.16
OR	42.57	41.40
A	62.66	58.40
F	31.86	31.84
M	5.48	9.75

	WT PCT	MOLPCT
AN/PL	20.46	19.51
EN/HY	21.17	26.08

	WT PCT	MOLPCT
FA/OL	0.00	0.00
DIFNDX	83.21	83.26

	WT PCT	MOLPCT
(NA+K)/AL	89.91	79.48
(FE+MN)/(FE+MN+MG)	88.40	76.84

	WT PCT	MOLPCT
NA2O/(NA2O+K2O)	42.84	53.25
FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS SF5

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	68.65	65.79	0.00	76.18	76.24	76.24
TIO2	0.69	0.50	0.00	0.58	0.58	0.58
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	13.48	15.23	0.00	8.82	8.82	8.82
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	4.22	3.38	0.00	3.92	3.92	3.92
MNO	0.07	0.06		0.07	0.07	0.07
NIO	0.00	0.00		0.00		
MGO	0.67	0.96	0.00	1.11	1.11	1.11
CAO	1.98	2.03	0.00	2.35	2.36	2.36
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.17	5.89	0.00	3.41	3.41	3.41
K2O	4.93	6.03	0.00	3.49	3.49	3.49
P2O5	0.16	0.13	0.00	0.08		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.02	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	98.02					
-O=F,CL	98.02					
-H2O	98.02					

MINERAL	MOLE PCNT	WEIGHT PCNT
Q	22.67	23.65
C	0.00	0.00
Z	0.00	0.00
OR	30.14	29.13
PL	37.73	34.82
(AB)	29.45	26.82
(AN)	8.27	7.99
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.65	0.68
(WO)	0.32	0.33
(EN)	0.08	0.07
(FS)	0.24	0.28
HY	7.48	8.06
(EN)	1.83	1.60
(FS)	5.64	6.46

MINERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.99	1.31
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.35	0.38
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	90.53	87.60
FEMIC	9.47	10.43
TOTAL	100.00	98.03

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	29.71	65.54
AB	33.70	17.03
OR	36.60	17.43
Q	60.95	79.60
NE	18.25	10.08
KP	20.80	10.32
AN	12.50	12.19
AB	41.94	43.40
OR	45.56	44.41
A	62.36	57.86
F	32.49	32.84
M	5.16	9.29

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	22.96	21.93	FA/OL	0.00	0.00	(NA+K)/AL	90.33	78.27	NA2O/(NA2O+K2O)	39.14	49.43
EN/HY	19.83	24.53	DIFNDX	79.60	82.26	(FE+MN)/(FE+MN+MG)	89.20	78.24	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS BQ3A

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	71.17	68.44	0.00	78.50	78.61	78.61
TIO2	0.65	0.47	0.00	0.54	0.54	0.54
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.64	14.33	0.00	8.22	8.23	8.23
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	.0.00	0.00	0.00	0.00
FEO	4.12	3.31	0.00	3.80	3.81	3.81
MNO	0.06	0.05		0.06	0.06	0.06
NIO	0.00	0.00		0.00		
MGO	0.38	0.54	0.00	0.62	0.63	0.63
CAO	1.50	1.55	0.00	1.77	1.78	1.78
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.10	5.78	0.00	3.31	3.32	3.32
K2O	4.32	5.30	0.00	3.04	3.04	3.04
P2O5	0.29	0.24	0.00	0.14		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.04	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	98.23					
-O=F,CL	98.23					
-H2O	98.23					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	29.46	30.63
C	0.94	0.83
Z	0.00	0.00
OR	26.50	25.53
PL	34.66	31.78
(AB)	28.90	26.23
(AN)	5.76	5.55
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	6.88	7.55
(EN)	1.09	0.95
(FS)	5.79	6.61

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.94	1.23
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.63	0.69
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	91.56	88.77
FEMIC	8.44	9.47
TOTAL	100.00	98.24

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	37.18	72.67
AB	31.84	14.26
OR	30.98	13.07
Q	65.15	82.33
NE	17.25	9.22
KP	17.61	8.45
AN	9.68	9.42
AB	45.77	47.26
OR	44.55	43.33
A	62.25	58.95
F	34.56	35.26
M	3.19	5.80

	WT PCT	MOLPCT
AN/PL	17.45	16.62
EN/HY	12.53	15.84

	WT PCT	MOLPCT
FA/OL	0.00	0.00
DIFNDX	82.39	84.85

	WT PCT	MOLPCT
(NA+K)/AL	87.98	77.34
(FE+MN)/(FE+MN+MG)	93.41	86.06

	WT PCT	MOLPCT
NA2O/(NA2O+K2O)	41.78	52.17
FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS BQ5

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	71.03	68.86	0.00	79.11	79.16	79.16
TIO2	0.61	0.44	0.00	0.51	0.51	0.51
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.53	14.32	0.00	8.23	8.23	8.23
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	3.95	3.20	0.00	3.68	3.68	3.68
MNO	0.04	0.03		0.04	0.04	0.04
NIO	0.00	0.00		0.00		
MGO	0.24	0.35	0.00	0.40	0.40	0.40
CAO	1.14	1.18	0.00	1.36	1.36	1.36
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.13	5.88	0.00	3.38	3.38	3.38
K2O	4.55	5.63	0.00	3.23	3.23	3.23
P2O5	0.13	0.11	0.00	0.06		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.02	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	97.35					
-O=F,CL	97.35					
-H2O	97.35					

MINERAL	MOLE PCNT	WEIGHT PCNT	MINERAL	MOLE PCNT	WEIGHT PCNT
Q	29.18	30.10	OL	0.00	0.00
C	0.79	0.70	(FO)	0.00	0.00
Z	0.00	0.00	(FA)	0.00	0.00
OR	28.13	26.89	CS	0.00	0.00
PL	34.45	31.29	MT	0.00	0.00
(AB)	29.42	26.49	CM	0.00	0.00
(AN)	5.03	4.81	IL	0.89	1.16
LC	0.00	0.00	HM	0.00	0.00
NE	0.00	0.00	TN	0.00	0.00
KP	0.00	0.00	PF	0.00	0.00
HL	0.00	0.00	RU	0.00	0.00
TH	0.00	0.00	AP	0.28	0.31
AC	0.00	0.00	FR	0.00	0.00
NS	0.00	0.00	PY	0.00	0.00
KS	0.00	0.00	CC	0.00	0.00
WO	0.00	0.00			
DI	0.00	0.00	SALIC	92.55	88.97
(WO)	0.00	0.00	FEMIC	7.45	8.38
(EN)	0.00	0.00			
(FS)	0.00	0.00	TOTAL	100.00	97.35
HY	6.27	6.92			
(EN)	0.69	0.60			
(FS)	5.58	6.32			

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	36.06	71.71
AB	31.73	14.46
OR	32.21	13.83
Q	64.51	81.93
NE	17.19	9.23
KP	18.31	8.83
AN	8.26	8.04
AB	45.52	47.00
OR	46.22	44.96
A	64.70	61.85
F	33.28	34.42
M	2.02	3.73

	WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	15.36	14.61	FA/OL	0.00	0.00
EN/HY	8.64	11.06	DIFNDX	83.47	86.73

	WT PCT	MOLPCT
(NA+K)/AL	91.97	80.40
(FE+MN)/(FE+MN+MG)	95.54	90.32

	WT PCT	MOLPCT
NA2O/(NA2O+K2O)	40.76	51.11
FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS BQ3-2

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	71.81	68.14	0.00	78.17	78.23	78.23
TIO2	0.64	0.46	0.00	0.52	0.52	0.52
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	12.71	14.22	0.00	8.15	8.16	8.16
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	4.10	3.25	0.00	3.73	3.74	3.74
MNO	0.07	0.06		0.07	0.07	0.07
NIO	0.00	0.00		0.00		
MGO	0.49	0.69	0.00	0.80	0.80	0.80
CAO	1.70	1.73	0.00	1.98	1.98	1.98
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.28	6.03	0.00	3.46	3.46	3.46
K2O	4.38	5.30	0.00	3.04	3.04	3.04
P2O5	0.15	0.12	0.00	0.07		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.02	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	99.33					
-O=F,CL	99.33					
-H2O	99.33					

MINERAL	MOLE PCNT	WEIGHT PCNT
Q	27.61	29.10
C	0.00	0.00
Z	0.00	0.00
OR	26.51	25.88
PL	37.37	34.78
(AB)	30.17	27.75
(AN)	7.20	7.02
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.35	0.37
(WO)	0.18	0.18
(EN)	0.03	0.03
(FS)	0.14	0.16
HY	6.92	7.63
(EN)	1.35	1.19
(FS)	5.57	6.44

MINERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.91	1.22
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.32	0.36
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	91.49	89.76
FEMIC	8.51	9.58
TOTAL	100.00	99.34

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	35.17	70.89
AB	33.55	15.49
OR	31.28	13.61
Q	64.05	81.60
NE	18.17	9.79
KP	17.78	8.60
AN	11.58	11.27
AB	45.75	47.23
OR	42.67	41.50
A	62.53	58.95
F	33.47	33.84
M	4.00	7.21

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	20.19	19.26	FA/OL	0.00	0.00	(NA+K)/AL	90.22	79.75	NA2O/(NA2O+K2O)	42.82	53.23
EN/HY	15.59	19.53	DIFNDX	82.74	84.30	(FE+MN)/(FE+MN+MG)	91.65	82.70	FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS GUL1

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	73.76	71.70	0.00	82.45	82.47	82.47
TIO2	0.28	0.20	0.00	0.24	0.24	0.24
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	11.90	13.63	0.00	7.84	7.84	7.84
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	2.01	1.63	0.00	1.88	1.88	1.88
MNO	0.02	0.01		0.02	0.02	0.02
NIO	0.00	0.00		0.00		
MGO	0.06	0.09	0.00	0.10	0.10	0.10
CAO	0.27	0.28	0.00	0.32	0.32	0.32
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.07	5.79	0.00	3.33	3.33	3.33
K2O	5.34	6.62	0.00	3.81	3.81	3.81
P2O5	0.05	0.04	0.00	0.02		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	96.76					
-O=F,CL	96.76					
-H2O	96.76					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	32.52	33.45
C	0.80	0.70
Z	0.00	0.00
OR	33.11	31.56
PL	29.99	26.99
(AB)	28.93	25.98
(AN)	1.06	1.01
LC	0.00	0.00
NE	0.00	0.00
KP	0.00	0.00
HL	0.00	0.00
TH	0.00	0.00
AC	0.00	0.00
NS	0.00	0.00
KS	0.00	0.00
WO	0.00	0.00
DI	0.00	0.00
(WO)	0.00	0.00
(EN)	0.00	0.00
(FS)	0.00	0.00
HY	3.06	3.41
(EN)	0.17	0.15
(FS)	2.89	3.26

MIN-ERAL	MOLE PCNT	WEIGHT PCNT
OL	0.00	0.00
(FO)	0.00	0.00
(FA)	0.00	0.00
CS	0.00	0.00
MT	0.00	0.00
CM	0.00	0.00
IL	0.41	0.53
HM	0.00	0.00
TN	0.00	0.00
PF	0.00	0.00
RU	0.00	0.00
AP	0.11	0.12
FR	0.00	0.00
PY	0.00	0.00
CC	0.00	0.00
SALIC	96.42	92.70
FEMIC	3.58	4.06
TOTAL	100.00	96.76

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	36.77	72.38
AB	28.55	12.88
OR	34.68	14.74
Q	64.82	82.21
NE	15.47	8.30
KP	19.71	9.49
AN	1.73	1.68
AB	44.37	45.85
OR	53.90	52.47
A	80.25	78.28
F	19.18	20.62
M	0.57	1.10

	WT PCT	MOLPCT
AN/PL	3.75	3.54
EN/HY	4.38	5.68

	WT PCT	MOLPCT
FA/OL	0.00	0.00
DIFNDX	90.98	94.56

	WT PCT	MOLPCT
(NA+K)/AL	106.55	91.01
(FE+MN)/(FE+MN+MG)	97.75	94.99

	WT PCT	MOLPCT
NA2O/(NA2O+K2O)	36.50	46.63
FEO/(FEO+FE2O3)	100.00	100.00

IDENTIFICATION READS...SOUTH HILLS GUL2-2

SPECIES	INPUT WT PCT	CATION PCNT	COMP ERROR	INPUT MOLPCT	DRY OX MOLPCT	WET OX MOLPCT
SIO2	74.62	71.69	0.00	82.27	82.30	82.30
TIO2	0.30	0.22	0.00	0.25	0.25	0.25
ZRO2	0.00	0.00	0.00	0.00		
AL2O3	11.64	13.18	0.00	7.56	7.57	7.57
CR2O3	0.00	0.00	0.00	0.00		
FE2O3	0.00	0.00	0.00	0.00	0.00	0.00
FEO	2.21	1.78	0.00	2.04	2.04	2.04
MNO	0.02	0.02		0.02	0.02	0.02
NIO	0.00	0.00		0.00		
MGO	0.07	0.10	0.00	0.12	0.12	0.12
CAO	0.46	0.47	0.00	0.54	0.54	0.54
SRO	0.00	0.00		0.00	0.00	0.00
BAO	0.00	0.00		0.00		
NA2O	3.23	6.02	0.00	3.45	3.45	3.45
K2O	5.28	6.47	0.00	3.71	3.71	3.71
P2O5	0.07	0.06	0.00	0.03		
H2O+	0.00			0.00		0.00
H2O-	0.00					
SO3	0.00	0.00	0.00	0.00		
S	0.00		0.00	0.00		
CL	0.00		0.00	0.00		
F	0.00		-0.01	0.00		
CO2	0.00	0.00	0.00	0.00		
TOTAL	97.90					
-O=F,CL	97.90					
-H2O	97.90					

MIN-ERAL	MOLE PCNT	WEIGHT PCNT	MIN-ERAL	MOLE PCNT	WEIGHT PCNT
Q	31.82	33.12	OL	0.00	0.00
C	0.00	0.00	(FO)	0.00	0.00
Z	0.00	0.00	(FA)	0.00	0.00
OR	32.36	31.20	CS	0.00	0.00
PL	31.82	29.00	MT	0.00	0.00
(AB)	30.09	27.33	CM	0.00	0.00
(AN)	1.73	1.67	IL	0.43	0.57
LC	0.00	0.00	HM	0.00	0.00
NE	0.00	0.00	TN	0.00	0.00
KP	0.00	0.00	PF	0.00	0.00
HL	0.00	0.00	RU	0.00	0.00
TH	0.00	0.00	AP	0.15	0.17
AC	0.00	0.00	FR	0.00	0.00
NS	0.00	0.00	PY	0.00	0.00
KS	0.00	0.00	CC	0.00	0.00
WO	0.00	0.00			
DI	0.13	0.14	SALIC	96.00	93.32
(WO)	0.06	0.06	FEMIC	4.00	4.57
(EN)	0.00	0.00			
(FS)	0.06	0.07	TOTAL	100.00	97.90
HY	3.29	3.70			
(EN)	0.20	0.17			
(FS)	3.09	3.53			

TERNARY DIAGRAMS

	WT PCT	MOLPCT
Q	36.14	71.82
AB	29.82	13.58
OR	34.04	14.60
Q	64.50	81.98
NE	16.15	8.68
KP	19.34	9.34
AN	2.77	2.70
AB	45.40	46.88
OR	51.83	50.42
A	78.87	76.90
F	20.48	21.87
M	0.65	1.23

	WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT		WT PCT	MOLPCT
AN/PL	5.76	5.44	FA/OL	0.00	0.00	(NA+K)/AL	110.04	94.74	NA2O/(NA2O+K2O)	37.96	48.18
EN/HY	4.62	5.98	DIFNDX	91.65	94.27	(FE+MN)/(FE+MN+MG)	97.62	94.70	FEO/(FEO+FE2O3)	100.00	100.00

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TELEPHONE 801-524-3422

M E M O R A N D U M

TO: Ben Lunis
Peggy Brookshier

FROM: Howard Ross

SUBJECT: Charles Waag Report on the Boise Geothermal System

DATE: September 4, 1987

I have reviewed the revised (second?) draft of the untitled report by Dr. Waag. My copy of this revision was limited to the SUMMARY, INTRODUCTION, and HYDROLOGIC SETTING AND DATA GATHERING sections, pg. 1-1 to 2-48.

These sections seem to read better than the earlier draft but still have some problems with typos, structure, and wording as noted by Leah Street and others. Figures 2-2 and 2-3 should be labeled thousands of gallons per minute (KGPM) rather than GPM. The presentation of more data as graphs which show the correlations between wells would have been useful throughout the report, as would a more rigid statistical correlation of production and drawdown.

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I can appreciate that some individuals will be deeply concerned about future drawdown and geothermal reservoir decline after reading the report. Nevertheless I think that Waag's general conclusions are correct, and should be stated. The final report should have an appropriate Disclaimer Statement to protect the DOE, however.

Please feel free to call me for further discussions of this report after I return from Ascension Island, about 21 September. I hope that these thoughts may be of some use to you in the interim.

Howard

Howard Ross
Project Manager

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October 14, 1987

Ms. Leah V. Street
Idaho-Department of Water Resources
2148 4th Avenue East
Twin Falls, ID 83301

Dear Leah:

Peggy Brookshier and Susan Prestwich have asked me to forward to you some additional comments on the Waag report, together with suggestions for changes in the text. I have compiled comments by Ben Lunis, DOE staff and others in addition to my own. Some of these may duplicate your own thoughts.

As you know we are concerned about the details of wording and conclusions because of the limited monitoring period and some limitations on the data base, because no quantitative or statistical study has been undertaken to support the interpretation, and because of an apparent conflict-of-interest on the part of Dr. Waag.

Please try to effect the changes which you think are appropriate as well as the others you have already pointed out. Please call me if you wish to discuss any of these comments in more detail. I hope that Dr. Waag is agreeable to these minor changes, and can complete the report very soon.

Best Regards,

Howard

Howard Ross
Project Manager

cc: P. A. M. Brookshier
S. M. Prestwich

enc.

HPR:kr

COMMENTS, DR. CHARLES WAAG REPORT 2nd DRAFT
2

1. Report needs a title and cover page

2. Report needs an acknowledgement of funding source: ID-DWR and DOE Grant

3. Report needs a List of Illustrations and Tables.

4. Report needs a Table of Contents

5. Include a DOE disclaimer statement (Strengthened, and in a prominent page position as suggested by Leah Street)

6. Pg. 1-2; para 3, l. 1 **delete** "and exploitation"

7. Pg. 1-2, para 3, l. 2 **delete** "an annual"

8. Pg. 1-3, para 2, l. 2 **delete** "Therefore, the most obvious explanation," **replace with** "One likely explanation"

9. Pg. 1-4, para 3, l. 1,2 **Suggest** "The aquifer seems to have been near or at equilibrium prior to the 1983-84 production by the ..."

10. p. 1-4, 1- 5 noteworthy, not "note worthy"

11. p. 1-5, para 2, **Suggest** "The increasing rates of decline in the recovery levels, evident since 1983, occurred without a significant corresponding increase in geothermal fluid production by the principal producers; it is cause for pause and concern."

12. p. 1-5, para 3, l. 3-9 **Suggest rewording of** "Serious consideration should be given to restricting further development and production from the system until we have a petter understanding of its recharge and thermal transfer characteristics, and its overall capacity for fluid production. Consideration should also be given to a requirement for reinjection of produced waters where feasible. Although the data base is insufficient to predict ... accurately ..."

13. p. 1-6, para 1, l. 2 "Suggests that an effective program of reinjection will significantly affect the economic productivity and extend the life of the resource."

14. p. 1-6, **Comment:** High recovery indicated by data taken since this spring by the City do not appear to be acknowledged.

15. p. 1-11, para 2, "Expansion of demand ...." This paragraph is a restatement of the previous page and should be deleted.

16. p. 1-12, duplicates p. 1-9 - **delete it**

17. p. 2-1, para 1, l. 8 "Figures 2-2 and 2-3 show drawdown ..." l. 10. "in thousands of gallons per minute (Kgpm) from ..."

18. p. 2-2, Figure 2-1, Map reproduction is of poor quality and difficult to read. Distance sale is lost in map detail. Label is difficult to read, needs capitalization of first words, etc.

19. p. 2-3, Figure 2-2, Vertical scale should be KGPM (I believe)

20. p. 2-4, Figure 2-3, (Same as above)

21. p. 2-7, para 1, l. 6 "... was well ahead of last year." **replace** last year with 1986-87 or 1984-85, whichever is intended - it's not clear from text or Figure 2-4.

22. p. 2-8, Fig. 2-4, Since water level is plotted in the inverse since, i.e., depth to water level, it would be useful to also plot an elevation sale with values on the left hand axis as for Fig. 2-2, 2-3.

23. p. 2-12, para 2, l. 3 **delete** "arbitrary" (not necessary and begs comment)

24. p. 2-19, para 1, l. 5 "These fluctuations are clearly ..." **replace** "with these fluctuations are interpreted as responses..." (no data are presented)

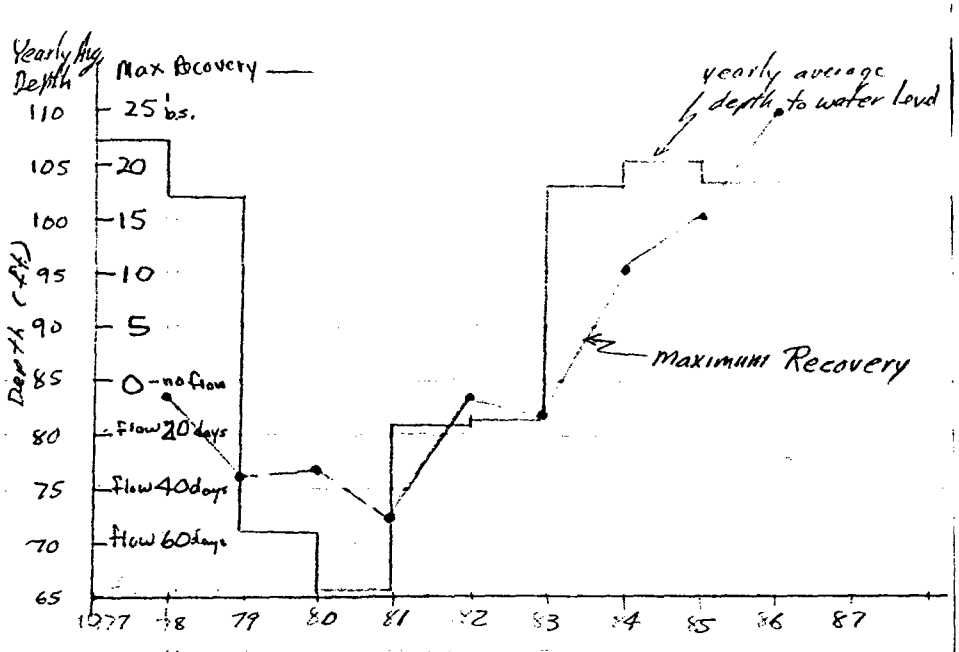
25. p. 2-20, para 1, l. 7 **delete** "clearly"

26. p. 2-27, l. 3 from bottom "annual head change" **not** "annual head charge"

27. p. 2-27, para 2, **Comment:** The analysis of a 100-110 feet cold water table fluctuation to induce the recorded potentiometric surface fluctuations must include other assumptions, i.e., (no) leakage from the cold water aquifer, rigidity, recharge variations etc. Are these sufficiently described on pg. 2-27, and 2-28?

28. p. 2-35 **Comment:** An attempt to graph the data of Table II and III(see attached graph) verifies that in general a good

correlation does exist; the correlation is substantially less than 100% (1:1) however, especially pre-1979. Thus some other factors are involved. This is adequately discussed on page 2-36.



Comparison of Tables II and III

Yearly Average Depth to Water Level
and
Maximum Recovery Level
(depth below surface)

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Howard

Howard Ross
Project Manager

@ESL 3 Dec. '85

PROGRESS REPORT ON BOISE GEOTHERMAL SYSTEM

The following is an initial summary of activity and data gathered under Geothermal Project Contract #DWR-03-42-102-61, Evaluation of Geothermal Resources in Idaho. Although the contract was not firm until mid-September, data collection under the agreement began in June 1985.

BOISE WARM SPRINGS WATER DISTRICT (BWSWD) WELLS NOs 1 and 2

Water levels within BWSWD wells 1 and 2, the pumping wells (Fig. 1), did not recover sufficiently to flow at the surface this year. The maximum recovery within those wells was to within 15 feet of the pumphouse floor and occurred during late August 1985. It is worthy of note that surface flow common to the system has not occurred since the summer of 1982. Figure 2 is a copy of a computer generated plot of the water levels in BWSWD Wells 1 and 2. Figure 2 also shows withdrawals from the geothermal system by Well #2 which is the principal pumping well in the Warm Springs District system.

BWSWD WELL NO. 3
(Observation)

Maximum recovery in BWSWD Well No. 3 (see data in Table 1) occurred on August 30, 1985, at 41.8 ft below the collar. In response to withdrawals by BWSWD Well No. 2, the water levels in Well No. 3 began to decline again by September 1, 1985.

KANTA WELL
(Observation)

The Kanta Well (fig. 1) is being monitored using a Stevens "F" type recorder. Until October 11, 1985, we were using an "A" recorder, however, it lacked the desired sensitivity so we have switched to an "F" type. Table II presents weekly readings from the records for this summary.

The water level in the Kanta Well reached its peak recovery on September 3, 1985, at a depth of 35.38 feet below the collar. This year's recovery was approximately 2 feet below last year's which peaked at 33.6 feet on September 20, 1984. Drawdown in the water level this fall within the Kanta Well is also more precipitous and has been declining somewhat more rapidly. On October 25, 1985 the water level was at a depth of 42.35 feet. On the same day in 1984, the water was at 38.7 feet, a difference of approximately 3.5 feet.

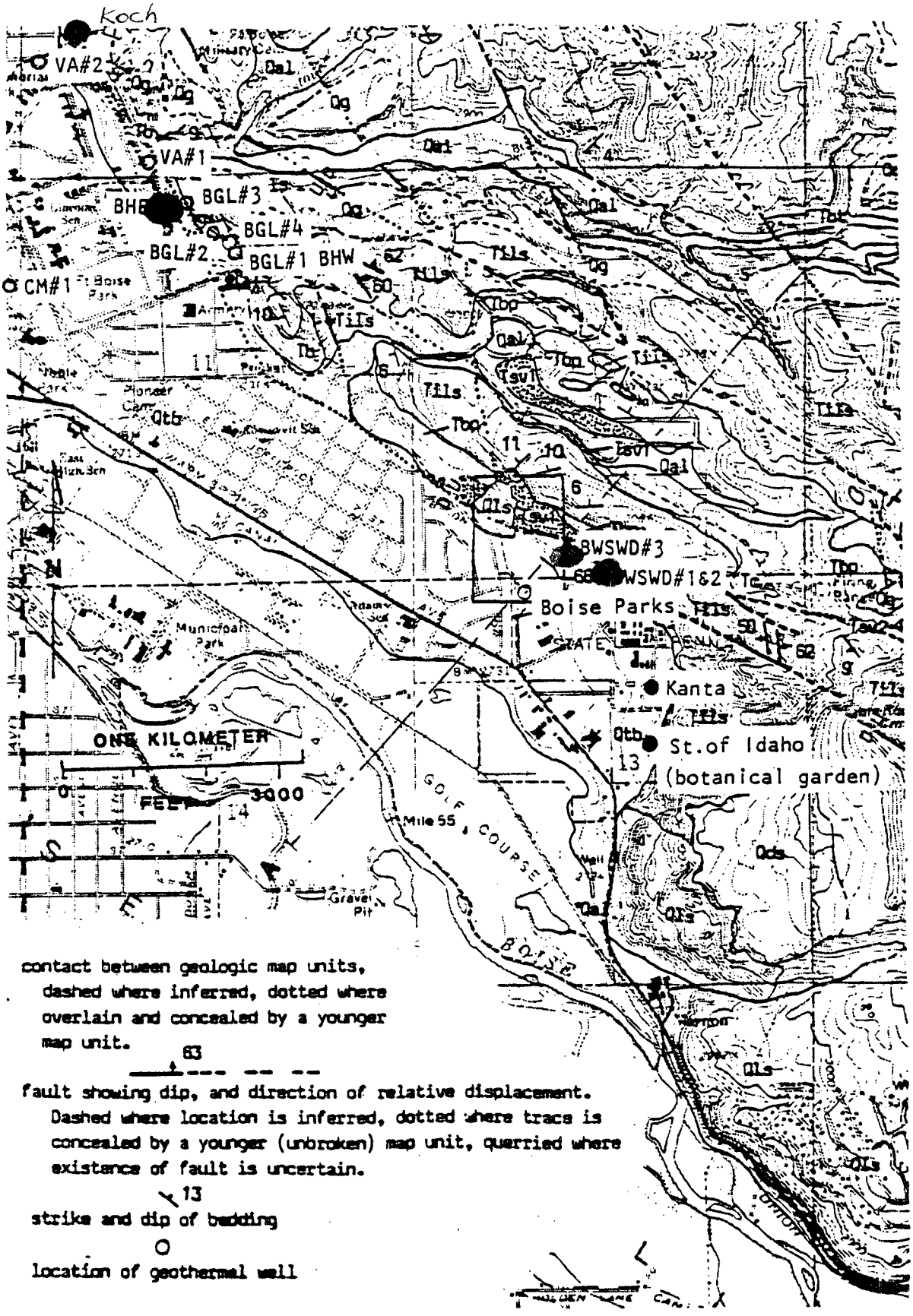
BLM (BEH) WELL
(Observation)

Owing to the delay in receiving the contract in final form, a continuous recording system has not yet been placed on the BLM Well (Fig. 1). We are, however, monitoring the well using a 30 psi pressure gauge in the lowest port on the casing. Measured pressures from the well are listed in Table III. All readings to date, show a positive pressure with maximum pressure recorded on September 4, 1985 at 4.9 psi (+10.4 ft.). Now that the contract has been approved, we have ordered a Druch pressure transducer and plan to install a data logger on the well as soon as the pressure transducer arrives.

Our intention was to have the Enviro-Lab recorders, that we have on loan from the Idaho Department of Water Resources, repaired; however, those instruments have a history of being fraught with problems. Currently we are planning to monitor with a data logger available in the Geology Department at BSU and the new Druch pressure transducer.

KOCH WELL
OBSERVATION

A Stevens "F" type recorder has been installed on the Koch Well, however, we have had difficulty obtaining good records. The observation well is approximately 8 feet from the pumping well. This close proximity causes the water level in the observation well to fluctuate 5-7 feet and to respond immediately to water level changes in the pumping well. These large drawdowns and recoverys, in addition to other water-level fluctuations in the well, require large counter weight movements. Unfortunately, the well bore is small, 3 inches in diameter, and cannot accommodate the counter weight. We are trying special riggings with pulleys for the counter weight and expect to have more complete data in the near future.



contact between geologic map units, dashed where inferred, dotted where overlain and concealed by a younger map unit.

63

fault showing dip, and direction of relative displacement. Dashed where location is inferred, dotted where trace is concealed by a younger (unbroken) map unit, querried where existance of fault is uncertain.

13

strike and dip of bedding

O

location of geothermal well

FIGURE 1.

TABLE I

WATER LEVELS (DEPTH BELOW COLLAR)

BWSWD WELL #3

DATE	FEET	DATE	FEET	DATE	FEET	DATE	FEET	DATE	FEET
6/3	80.9	7/1	57.6	8/1	45.9	9/1	42.7	10/4	76.6
6/4	79.1	7/13	49.8	8/2	46.6	9/2	46.1	10/7	78.6
6/5	70.7	7/14	49.3	8/3	46.2	9/3	48.5	10/8	79.8
6/6	76.7	7/15	48.8	8/4	45.8	9/4	48.7	10/9	81.7
6/11	70.7	7/17	48.2	8/5	45.6	9/9	50.0	10/12	85.3
6/12	70.9	7/18	47.9	8/6	45.3	9/10	54.5	10/13	86.4
6/13	70.3	7/19	47.5	8/7	44.8	9/11	55.6	10/14	87.4
6/18	67.1	7/21	42.2	8/9	45.7	9/12	57.6	10/15	88.5
6/19	65.8	7/22	46.3	8/10	45.2	9/16	60.0	10/16	89.1
6/20	64.7	7/24	46.3	8/11	46.0	9/18	63.0	10/17	89.9
6/21	64.4	7/25	46.5	8/13	45.8	9/22	66.9	10/18	90.3
6/22	63.6	7/26	46.5	8/20	43.9	9/23	67.5	10/25	91.75
6/23	62.3	7/29	46.2	8/21	44.0	9/26	66.9		
6/24	62.0	7/30	46.1	8/26	43.2	9/27	67.8		
6/25	61.2			8/30	41.8*	9/30	73.1		
6/26	61.1								
6/27	60.4								
6/28	59.2								
6/29	58.5								
6/30	57.8								

*Recovery Peak

TABLE II

WATER LEVEL (DEPTH BELOW COLLAR)

KANTA WELL

DATE	DEPTH TO WATER LEVEL	EL. OF WATER LEVEL (FEET)
6/1/85	45.7	
6/7	45.2	
6/14	44.1	
6/21	42.9	
6/28	41.8	
7/5	40.6	
7/12	39.9	
7/19	38.9	
7/26	38.2	
8/2	37.6	
8/9	37.1	
8/16	37.45	
8/23	36.2	
8/30	35.7	
9/3	35.38*	
9/7	36.4	
9/14	37.0	
9/21	37.5	
9/28	37.7	
10/5	38.9	
10/11	39.9	
10/13	40.2	
10/18	41.75	
10/25	42.35	

*Recovery Peak

TABLE III

PRESSURES AND EQUIVALENT WATER LEVELS

BEH (BLM) WELL

DATE	PSI	EQUIVALENT H20 LEVEL (FEET)
6/4/85	0.2	(+0.5)
6/26	2.0	(+4.6)
7/24	3.8	(+8.8)
7/31	4.0	(+9.24)
August	4.7	(+10.8)
9/4	4.9	(+11.3)
9/27	4.5	(+10.4)
10/11	3.4	(+7.8)
10/25	2.5	(+5.8)

TABLE IV

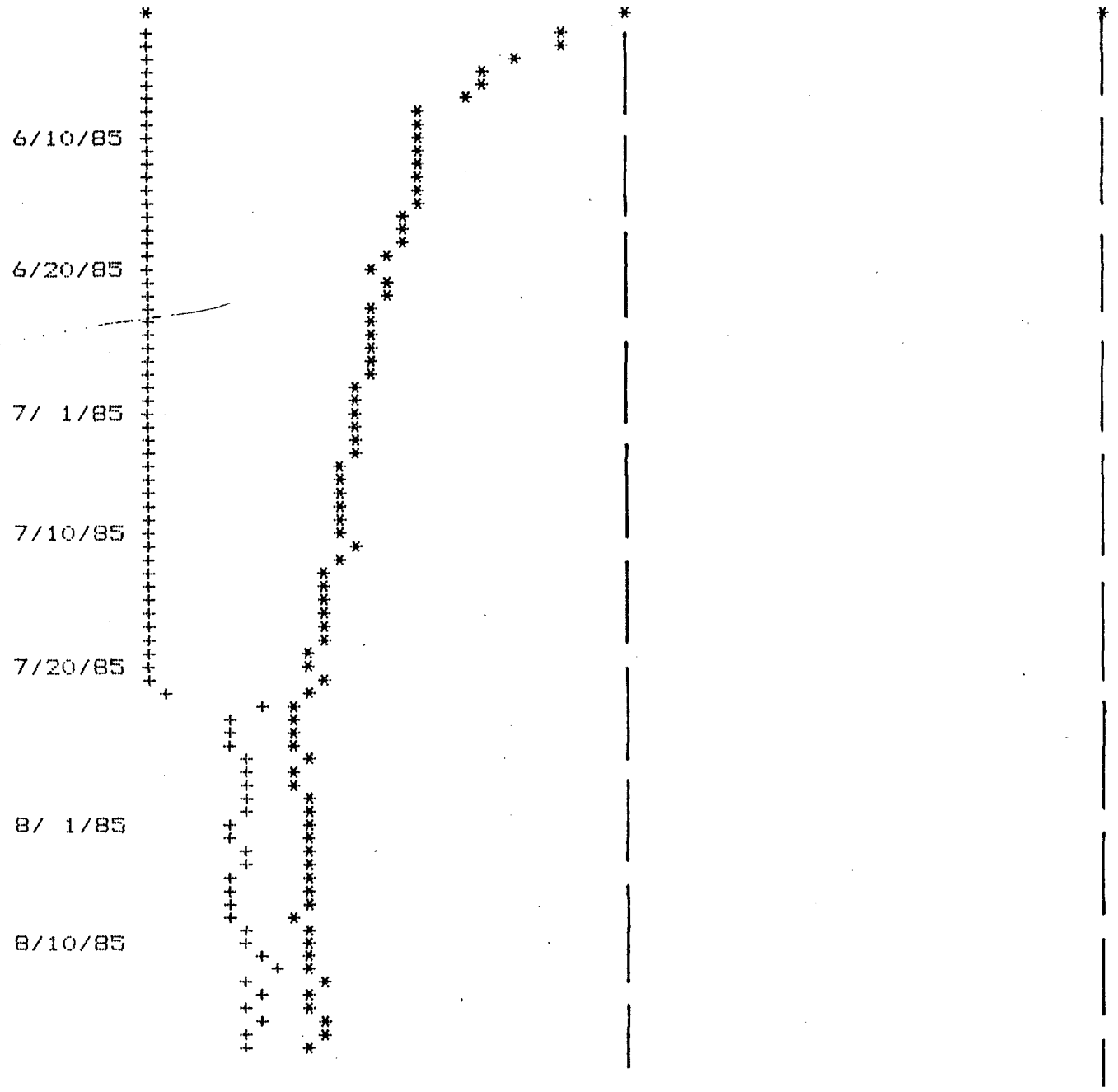
KOCH WELL
(Observation)

DATE	WATER LEVEL (Depth Below Surface)
6/4	-55.22
7/31	-59.72
7/31	-62.5
8/3	-60.0
8/7	-59.1
8/11	-59.8
8/15	-59.75
8/22	-59.6
8/26	-59.35
8/30	-59.2
9/3	-59.1
10/25	-61.5

BAUSWD WELL NO 1 (NONPU., N/A, FLOW RATE IS FROM WELL NO. 2.)

EAST WELL DRAWDOWN
THE CROSSES REPRESENT THE FLOW RATE AND THE ASTERISKS THE DRAW DOWN

THE FLOW RANGED FROM A MIN. OF 0.000 TO A MAX. OF 0.709 (1000 GAL/MIN.)
THE DRAW DOWN RANGED FROM A MIN. OF 21.50 TO A MAX. OF 78.00 (FEET)

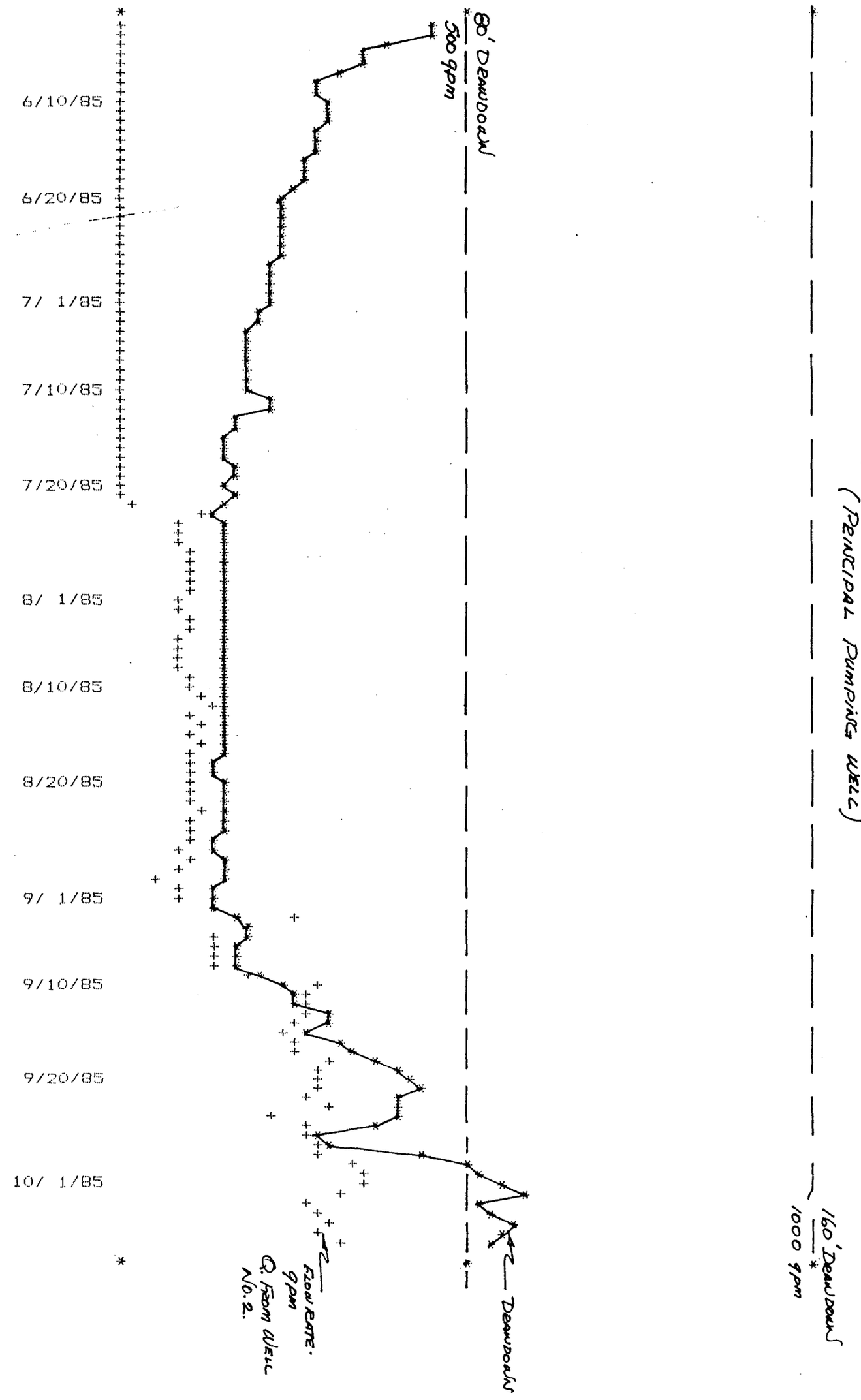


BAUSWD WELL NO. 2 (AUXILIARY PUMPING WELL)

BUSWD WELL NO. 2

THE CROSSES REPRESENT THE FLOW RATE AND THE ASTERISKS THE DRAW DOWN

THE FLOW RANGED FROM A MIN. OF 0.000 TO A MAX. OF 0.709 (1000 GAL/MIN.)
THE DRAW DOWN RANGED FROM A MIN. OF 20.00 TO A MAX. OF 92.50 (FEET)



SCP - IDWR subcontract w/ Boise State Univ. 3 Dec. '85 (e ESL)

for one of the parties to a contract the performance of an obligation under the contract. The term "delegate" includes, but is not limited to, a subcontractor.

2. DESIGNATION OF PROJECT COORDINATOR

A. The Department's Project Coordinator shall be Leah Street, who shall be the Department's representative for administration of this Contract.

B. The Contractor's Project Coordinator shall be Dr. Charles J. Waag. The Contractor's Project Coordinator shall be the Contractor's representative for administration of the Contract and shall have full authority to act on behalf of the Contractor.

C. All communications given to a party's project coordinator shall be as binding as if given to the party.

D. The Department's Director or anyone authorized to act on his behalf may change the Department's Project Coordinator at any time by written notice served on the Contractor. The Contractor may change its Project Coordinator at any time by written notice served on the Department.

3. STATEMENT OF PURPOSE

The purpose of this Contract is to gather data for a preliminary analysis of water-level and pressure fluctuations within the Boise geothermal system.

4. SCOPE OF WORK

A. Task 1. Establish Monitoring Network

The Contractor shall identify all geothermal wells in the Boise system. Potential observation wells that can be monitored will be selected, and, if necessary, permission obtained from well owners to install recording devices.

A minimum of six (6) wells will be selected for monitoring. The Contractor shall make every effort to include the following six wells in the monitoring network:

- Karta Well
- Boise Warm Springs Water District No. 1 Well
- Boise Warm Springs Water District No. 2 Well
- Boise Warm Springs Water District No. 3 Well
- BEH (BLM) Well
- Koch Observation Well

In the event that any of the above wells cannot be monitored, other available wells shall be selected and upon mutual agreement by both parties be made part of the monitoring network so that a total of six (6) wells are monitored.

B. Task 2. Installation of Equipment

The Contractor shall install the monitoring equipment in the selected wells. The Contractor shall be responsible for the purchase, care and maintenance of this equipment.

C. Task 3. Data Collection

The Contractor shall monitor water level fluctuations or pressure changes on all the six (6) wells selected for this

study as specified in Task I, Subdivision A of Section 4. Pumpage withdrawals will be recorded on all operating wells selected for this study. Monitoring data shall be made for nine (9) consecutive months within the duration of this contract.

In the event that any problem arises with the data collection and/or inability to complete monitoring for the six wells during the 9 months sampling period, the Department shall be notified immediately.

D. Task 4. Reporting Requirements

The Contractor shall submit a final technical report that will be a comprehensive report on the Boise geothermal system. This report will analyze all available data on seasonal water-level changes, drawdown effects of pumpage and aquifer characteristics and boundaries.

Available geologic and hydrologic data, including water chemistry, on all wells identified in Task 1, Subdivision A of Section 4, will also be summarized and analyzed.

The report will identify the scope and cost of additional studies needed to obtain a maximum understanding of the characteristics of the Boise geothermal system.

The Contractor shall also submit the following periodic progress reports to the Department:

i) Monthly Progress Summaries:

The Contractor shall submit monthly summaries within 15 days of the month's end which summarize the past month's

Susan
File

MPR

PUBLIC WORKS DEPARTMENT
CITY HALL - 4TH FLOOR
(208) 384-4292

CITY OF TREES

BOISE CITY, IDAHO

October 1, 1987

Peggy Brookshier
Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

RE: City of Boise Geothermal Project - Grant No. DE-FG07-87ID12663

Dear Peggy:

This is in response to your letter of September 16, 1987.

1) Updated priority list:

Confirming our phone discussion, please see the attached computer generated tabulation entitled "Tentative Priority Ranking of Primary Target Buildings" "(Priority List)".

This tabulation lists the buildings ranked in priority order and it combines the functions requested in the grant document, Statement of Work, page 2 of 6, Paragraph 4.0.

We have not separated this list into the two tabulations listed in the grant document, as it would not seem to satisfy any purpose. Please let us know if this is not satisfactory.

2) Revised projected cash flow:

You requested a revised projected cash flow ie: Table 34 of Boise's Phase 2 proposal. Table 34 was presented in our original document dated January 1986. I believe you mean Table 52, which was titled "Gross Revenues From Geothermal Heat Sales, Boise City Natural Gas Price Scenario" which shows revenues, both from the existing buildings and revenue from new buildings. Table 52 was published in the August 1986 proposal.

I have gone ahead and updated that table and have modified certain of the assumptions made in the August 1986 submittal.

For existing customers, we have utilized actual gas rate modifications to establish revenues for FY1987. There have been numerous gas rate changes from April 1, 1986 upon which the original Table 52 was based to the present. The 1987 numbers which are shown are an actual percentage adjustment based upon the various rate increases and decreases and are based upon rates which were in effect July 1, 1987.

Effective October 1, 1987 the general commercial customers will see a 2.94% rate increase and the large volume users will see a 4.63% increase. Those percentages were utilized for year 1988. Beginning in 1989, the revenues were escalated based on an annual 4% inflation rate.

3) Updated schedule:

BSU Easement Acquisition	10/87 - 11/87
BSU Pipeline Design	11/87 - 2/88
BSU Pipeline Construction	5/88 - 8/88
Boise River Crossing Design	Spring 1988
Boise River Crossing Construction	8,9/88

Customer Connections:

Art Gallery	10/87
Forest River VI	10/87
Statehouse Inn	Summer 1988

Other primary target buildings will not be contacted until such time as the revised contract with BGL is signed.

4) "The response of Boise City to media activities." Copies of past newspaper clippings were sent to your offices some time ago. There has been no further media coverage that we are aware of. We have not been asked to respond to any geothermal issues by the media. Our policy will be to respond to the media, upon request, and answer any questions that we can in a cooperative way.

5) The requested Technical Progress Report for the period from 5/1/87 through 9/30/87 is attached. In the future, this report will be submitted each calendar quarter.

In response to the last paragraph of your letter, our actions resulting from the two letters you mention will be as follows:

Warm Springs

We do not plan to proceed with the on-campus work of the BSU project until May 1988. We will proceed with the acquisition of easements for the pipeline alignment.

It appears however that Boise Warm Springs Water District is raising issues about supply of geothermal water. According to Boise's agreement with BGL the supply of geothermal water is the responsibility of BGL. In a letter dated September 15, 1987 from BGL's attorney concerns were expressed about Boise City meeting and corresponding with Boise Warm Springs Water District. We have, by letter of 9/30/87, informed Boise Warm Springs Water District that any challenges with respect to water rights are the responsibility of BGL. I am enclosing a copy of the 9/30/87 letter to Boise Warm Springs Water District.

We have met with Boise Warm Springs and have discussed an inter-connection between our piping system and theirs. Such an inter-connection should alleviate BWS's water shortage problems, and enable the City and BWS to jointly gain more revenues from at least one of their customers who is now on interruptable service. Further negotiations should be initiated by BGL.

Idaho Department of Water Resources is targeting a pump test of the geothermal aquifer in September 1988. This pump test may provide a better understanding of the hydraulics of the aquifer. Boise City is also initiating discussions with the State of Idaho regarding the usage of their wells for injection. If we are successful in these negotiations such an inter-connection between the City and State system could be accomplished in 3 or 4 months.

Department of Energy Grant

In your letter of 9/16/87 you reference a letter dated 8/28/87 and state "Do you plan to terminate the grant as recommended by the Commission?" (emphasis added).

The Commission did not recommend terminating the grant but only suspending further efforts to implement the grant until such time as we have a new contract with BGL. Additionally the Boise City Council has taken no action on the

Commission's recommendation. We do not expect to terminate the grant agreement because we fully expect to have a new agreement with BGL.

Please advise if we may furnish further information.

Sincerely yours,

Charles R. Mickelson / by SJ Jordan

Charles R. Mickelson, P.E.
Boise City Engineer

CRM:ab
1.46(093087)

Attachments:
Priority List
Projected Cash Flow
Technical Progress Report
9/30/87 Letter from Mayor to BWSWD

cc w/attachments:
Mike Wetherell, Boise City Councilman
Boise Geothermal Limited
Boise Geothermal Commission members
Steve Jordan, Geothermal Coordinator

SF
CF
WJA

TENTATIVE PRIORITY RANKING OF PRIMARY TARGET BUILDING ("Priority List")

Building	Pipeline Cost	All Other Costs	Building Owner's Cost	Grant Funds Needed	[3] Estimated Annual Revenue	[3] Ratio of Revenue/ Grant Funds
Art Gallery	$7,000	Unk.	Unk.	$7,000	$6,898	0.985
One Capitol Center		$125,000		$125,000	$22,419	0.179
Statehouse Inn	$45,000	$45,000	$45,000	$45,000	$7,824	0.174
Idaho First Plaza		$96,000		$96,000	$16,028	0.167
JB's Restaurant		$32,000		$32,000	$4,971	0.155
St. Luke's (new wing)	$76,000	$100,000	$100,000	$143,120	$20,989	0.147
BSU - Six Buildings [1]	$492,100	$573,000	$573,000	$492,100	$68,432	0.139
BSU - Science Ed. II [2]		$95,000		$95,000	$13,179	0.139
BSU - Science Ed. I [2]		$120,000		$120,000	$15,597	0.130
Forest River VI [4]	$4,070	Unk.	Unk.	$4,070	$500	0.123
Downtowner	$145,000	$120,000	$120,000	$155,000	$17,644	0.114
Idaho Linen	$20,000	$23,000		$43,000	$4,794	0.111
Imperial Plaza	$50,000	$108,000		$158,000	$16,876	0.107
Hoff Building (IB&T)		$21,000		$21,000	$2,205	0.105
Provident		$27,000		$27,000	$2,781	0.103
YMCA		$123,000		$123,000	$11,219	0.091
Family Fitness Center [5]		$126,000		$126,000	$10,260	0.081
TraveLodge	$10,000	$28,000		$38,000	$2,685	0.071

[1] Simplot-Micron, Business Building, Library Learning Center, Liberal Arts building, Physical Ed. Building, Pavillion.
[2] Additional BSU buildings beyond six-building package already agreed to by University.
[3] Based upon Geothermal water rates of 7/1/87, using % decrease of gas rates from last update.
[4] Waste water customer, new construction project has been bid. Construction cost shown.
[5] Waste water pipeline.
[6] St. Lukes is requesting a 3 year payback on hospital funds.

CRM (9/28/87)
LOTUS-1/GEOPRILST

TABLE 52. Gross Revenues from Geothermal 7/1/87 Gas Rates- Boise City Natural Gas Price Scenario

	1987(1)	1988(2)	1989	1990	1991	1992	1993	1994	1995	1996
Ada County Administration	4,484	4,618	4,803	4,995	5,195	5,403	5,619	5,844	6,077	6,320
Alaska Center	545	562	584	608	632	657	683	711	739	769
Armory		0	0	0	0	0	5,679	7,061	7,343	7,637
Boise City Hall	8,893	9,160	9,526	9,907	10,303	10,716	11,144	11,590	12,054	12,536
Boise High School	17,568	18,095	18,819	19,572	20,355	21,169	22,015	22,896	23,812	24,764
Boise Public Library	4,892	5,038	5,240	5,449	5,667	5,894	6,130	6,375	6,630	6,895
Boise Senior Center	324	334	347	361	375	390	406	422	439	456
Briggs and Associates	628	646	672	699	727	756	786	818	851	885
Bush Mansion	501	517	537	559	581	604	628	654	680	707
Carroll's	511	526	547	569	592	616	640	666	693	720
Central Station	682	702	731	760	790	822	855	889	924	961
Department of Employment	6,428	8,230	15,500	16,120	16,765	17,435	18,133	18,858	19,612	20,397
Eagles Center	754	776	807	840	873	908	944	982	1,022	1,062
Elk's Hospital	11,455	11,798	12,270	12,761	13,272	13,802	14,355	14,929	15,526	16,147
Fire Station No. 1	2,102	2,165	2,252	2,342	2,436	2,533	2,635	2,740	2,850	2,964
Fort Boise Community Center	3,146	3,241	3,370	3,505	3,645	3,791	3,943	4,101	4,265	4,435
Grand Oaks Healthcare	6,438	6,631	6,896	7,172	7,459	7,758	8,068	8,391	8,726	9,075
Idaho Clinic	478	492	512	532	553	575	599	622	647	673
Idaho Land & Appraisal	170	175	182	189	197	205	213	222	230	240
Idaho Veteran's Home	18,560	19,117	19,882	20,677	21,504	22,365	23,259	24,189	25,157	26,163
Jefferson Place Elks	3,155	3,250	3,380	3,515	3,655	3,802	3,954	4,112	4,276	4,447
Misc. Users	1,489	1,534	1,595	1,659	1,725	1,794	1,866	1,941	2,018	2,099
Old Telephone Building	1,262	1,300	1,352	1,406	1,462	1,520	1,581	1,645	1,710	1,779
Pat Lurg Building	439	453	471	490	509	529	551	573	596	619
Perrault-Fritchman	2,217	2,284	2,375	2,470	2,569	2,671	2,778	2,889	3,005	3,125
Steiner Laundry	11,589	11,937	12,415	12,911	13,428	13,965	14,523	15,104	15,708	16,337
REVENUE FROM EXISTING BUILDINGS	108,711	113,581	125,065	130,068	135,271	140,682	151,988	159,222	165,591	172,214
Boise Gallery of Art (2) (3)	0	4,000	7,389	7,685	7,992	8,312	8,644	8,990	9,349	9,723
Boise State University (6 Bldgs)(4)	0	0	103,907	108,063	112,386	116,881	121,557	126,419	131,476	136,735
BSU - Science Bd. II (4)	0	0	20,011	20,811	21,644	22,510	23,410	24,346	25,320	26,333
Idaho First Plaza	0	0	17,169	17,856	18,570	19,313	20,086	20,889	21,725	22,593
Idaho Linen	0	0	4,890	5,086	5,289	5,501	5,721	5,949	6,187	6,435
JB's Restaurant	0	0	5,325	5,538	5,759	5,990	6,229	6,479	6,738	7,007
One Capitol Center	0	0	24,015	24,976	25,975	27,014	28,094	29,218	30,387	31,602
St. Lukes Medical (new wing) (4)	0	0	88,103	91,627	95,292	99,104	103,068	107,191	111,478	115,938
REVENUE FROM NEW BUILDINGS	0	4,000	270,810	281,642	292,908	304,624	316,809	329,481	342,661	356,367

(1) Based on 7/1/87 gas rates.
(2) Revenues estimated based on rates in effect 10/1/87, i.e. 3% increase 7/1/87 to 10/1/87 for all GS1 customers.
(3) Boise Gallery of Art will be a customer only part of FY88. Revenues for FY89 6898 x 1.03 x 1.04 = 7,389
(4) BSU buildings & St. Lukes are served by LV.1 rates. Escalated from 7/1/87 estimate to 10/1/87 with a 4.6% rate increase then 4% each year thereafter beginning in 1989.

OSH FLOW 9/28/87
GROSSREV-LOTUS

TECHNICAL PROGRESS REPORT

BOISE CITY GEOTHERMAL PROJECT

5/1/87 Thru 9/30/87

INDEX

S.E. Jordan, P.E.
Geothermal Coordinator
Department of Public Works
Boise, City, Idaho

Item No.	Description
1.0	Geothermal Contracts
1.1	Statehouse Inn Contract Status: 8/19/87 Sent to owner for approval. The owner is now evaluating engineering & retrofit costs.
1.2	Forest River VI Contract Status: Customer has signed and returned agreement with an addendum which required study. The agreement has been revised to include the elements requested in the addendum and the customer approved the final draft on 9/24/87.

Item No.	Description

2.0 Prospective Customers

2.1 Fidelity Union Block NE Corner, 8th & Idaho, 48,000 square feet plus more storage space in basement.

Status: 9/2/87 CSQHA is now in last third of 90-day right-to-bid procedure. Also lining up potential tenants. Tentative schedule:

March '88 - Start remodel construction
May'88 - Geothermal hookup
Sept '88 - First geothermal usage

2.2 Simplot Building, SW corner of 8th & Idaho
Status: 9/2/87 owned by BRA. No developers have bid in response to recent advertising, but BRA is holding informal discussions with one developer.

2.3 Broadbent Building
Status: Discussed with customer on 9/16/87. They are waiting for the BRA to turn the bulding over to them. Excellent candidate for geothermal. Can connect into lines in basement of Alexander Bldg. and use a small pump if necessary. Connection cost will be very low.

2.4 Convention Center
Status: Architect is Joe LaMarche. Engineer is Don Wisdom. Discussed with Wisdom on 9/1/87. Customer is insisting on a full sized gas/hot water back-up system. We have asked Wisdom to let us review the report before it goes to the architect.

2.5 Oppenheimer Retail Space
Status: Heating decision not before late October. Developer will be tied up until then.

2.6 Egyptian Theater Block; Roper/Janns (Ropers Clothing)
Status: 9/18/87 BRA.anticipates retail construction to be complete in August, 1988. This is new construction & building will connect to the new main being constructed in Main St.

2.7 YWCA, 720 W. Washington Present heat is gas - hot water, old furnaces. Owner can get 3% interest loan for upgrading.

Location is unattractive, requires 2-1/2 blocks of new lines. Heating area 26,000 square ft. Could use geothermal for 18-20,000. Present 4 year plan calls for 9,000 square ft. addition.

Status: We are evaluating and looking or other potential customer in the area to justify lines.

2.8 Mode Building

Status: 9/18/87 - Owned by BRA. BRA has negotiated with present tenant for a long term lease, which will result in modernization of building including heating system (tenant will pay all utilities and maintenance costs). Good candidate for geothermal. Brian Smith, architect will handle.

Item
No. Description

3.0 Customer Systems Under Construction

3.1 Boise Art Gallery

Status: City design of supply and return lines has been completed. Cost estimates are over $5,000. Formal specs & request for bids are now being prepared.

3.2 Arid Club

Status: Service line connections were completed 8/27/87. We will read meter and start service on request.

3.3 Forest River VI

Status: Design of service lines done by City. Contractor has completed the work except for tapping into wastewater main, and surface restoration at that location.

3.4 Alexander Building

Status: Service lines are included in the contract to bring the main lines down Main Street. (See 5.6)

Item
No. Description

4.0 BSU Pipeline

4.1 River Crossing

Status: 9/2/87 - CH2M drawings prepared in 1983 for the bridge crossing have been reviewed by City. Further work is on hold until a new contract with CH2M is approved.

4.2 J-U-B Preliminary Report For Design of On-campus Pipeline System:

Status: We have reviewed the report and requested changes and additions. When corrections are made we will furnish a copy to D.O.E.

4.3 On Campus

Status: The major work by JUB is on hold pending resolution of items of conern expressed by BSU, which are basically:

a) No construction before classes are out (May '88) to preclude campus disruption.

b) JUB is exploring an option to use a steam-producing heat pump in lieu of retrofit of building.

c) Uncertainty of reliable geothermal source.

d) Cost of disruption and reconversion to conventional heating (if "C" happens) outweighs the energy savings to be realized between January and June '88 by going ahead now. JUB has been instructed to continue with easement aquisition.

Item No.	Description
5.0	City Extensions/Modifications
5.1	Crossover Valve Project Status: 9/23/87- Work 75% complete (parts late). Scheduled to complete 10/5/87.
5.2	Line Extension to Alexander Bulding: Main Street - Capitol to 9th Status: Contract awarded to T.C. Mac. Construction will start 10/21/87.
5.3	Intertie with State (Capital Mall) system. Status: 9/2/87 - The present plans are to investigate the use of one or both State wells for injection of both State and City (most of it) spent water. We will furnish hot water to the State. State to pay City for hot water based on terms to be negotiated. Estimates of piping tie-in costs are complete - about $60,000. Next step: Explore program with State authorities to determine their level of interest/cooperation.

Item
No. Description

6.0 Idaho Department of Water Resources

6.1 Data gathering of temperature, pressure, and flow for BGL wells.
Received 8/3/87 letter from L. Glenn Saxton requesting data gathering.

Status: Final meeting (until further notice) held on 8/8/87. The general decision arrived at by the task force deliberations are as follows:

1) A "pump test" of one of the BGL wells is desireable to determine effect on BWS wells.

2) Duration: 2-3 days may not be of any value. 30 days might be desireable but probably cost-prohibitive. 7 days is best compromise.

3) Best time is last week in August or first week in September.

4) There is/was not enough lead time remaining to conduct a pump test in 1987 so it will be postponed until 1988. IDWR will start now to plan, and to appoint people to be responsible for schedules and tests.

5) During the interim year, all "ordered" well operators/users have been asked to collect data on flows, temperatures, and water levels and report to IDWR. This order is presently on "hold" until IDWR gives further notice to proceed. They are studying instrumentation required and available funding to pay for data acquisition.

6.2 Potential Customers have inquired if funds from IDWR could be made more reasonable, (preseent loan program 6% interest - maximum 5 year term)i.e. 10 years @ 6%, or say 5 years at 4%.

Status: 9/2/87 - SEJ discussed with Joan Sipple. No chance of more favorable financing. Rules are made by IDWR. No one else has ever asked. Government customers can get 10 year loans.

ATTACHMENT NO. 4

OFFICE OF THE MAYOR

CITY OF TREES

BOISE CITY, IDAHO

DIRK A KEMPTHORNE
MAYOR

September 30, 1987

T. O'Rouark, Chairman
Boise Warm Springs Water District
2440 Old Penitentiary Road
Boise, Idaho 83712

Dear Mr. O'Rouark:

This letter is written in response to your letter of August 20, 1987. Please be advised that the City's water rights were assigned to Boise Geothermal Limited as part of the Geothermal Lease and Agreement entered into between the City of Boise and Boise Geothermal Limited. Consequently, it is the position of the City of Boise that it is the responsiblity of Boise Geothermal Limited to respond to any challenges regarding priority and impairment of water rights belonging to the Boise Warm Springs Water District.

For your information, however, I would like to advise you that Boise City will not be extending the pipeline to the Boise State University campus during the heating year of 1987-88. Since BSU will not be taking water during 1987-88 my staff advises me that the City will probably utilize about 130 million gallons, down from 170 million gallons as referenced in my August 7, 1987 letter.

Additionally, as my staff has pointed out to you, the City is installing temperature control valves at the ends of several of our dead-end pipelines where temperature degradation is a problem for our customers. The installation of these automatic valves should reduce the consumption of the water within the City system substantially.

Boise City is also pursuing the utilization of the State of Idaho Capital Mall geothermal wells for use as injection wells. A request has been forwarded to the Governor's office and we are awaiting a preliminary response in the near future. We intend to assist Boise Geothermal Limited in developing a formal proposal for an interconnecton which could allow the continuous supply of water to the Boise Warm Springs Water District in the event of a mechanical failure as well as uninterruptible supply to the Idaho State Health Lab. We are hopeful that Boise Geothermal Limited will be responding to this

matter in the very near future and we will be able to provide this formal proposal to your board. Please rest assured that the City is very anxious to resolve this geothermal supply issue which the Boise Warm Springs Board has raised.

Sincerely yours,

Dirk Kempthorne
MAYOR OF BOISE

DK:jr
4CM1/7

cc: William J. Ancell
Charles R. Mickelson
Steve Jordan
Jean R. Uranga
Boise Geothermal Limited
SF/CF

* Acquired [illegible] award
longer [illegible]

* Well written.

HPR
6/25/87

7/1/87
HPR.

INVESTIGATION OF THE BOISE, IDAHO GEOTHERMAL SYSTEM

by

R. Keith Higginson

and

Jack A. Barnett

Higginson-Barnett, Consultants

June 1, 1987

INVESTIGATION OF THE BOISE, IDAHO GEOTHERMAL SYSTEM

Introduction

Boise State University (BSU) entered into a contract in June 1986 to purchase geothermal water from the City of Boise to be provided by Boise Geothermal, Ltd. (BGL). The water is to be supplied from wells located in the Boise Military Reserve Park area along the Boise Front foothills near the northeast edge of the City. BSU's intended use is for space heating of campus buildings.

Several other organizations are either currently utilizing large quantities of geothermal water from the same or a similar source or plan to do so in the near future. These organizations include the Boise Warm Springs Water District (BWSWD), the State of Idaho Capitol Mall (CM), and the Veterans Administration (VA). Each of these entities have wells which have been constructed into the geothermal reservoir. The CM and VA systems include reinjection of the spent geothermal water while the BGL and BWSWD systems discharge to the Boise River or other surface disposal source. Figure 1 is a map of part of the Boise area showing the location of the various wells systems discussed in this report.

There are also a number of other wells which intercept thermal water in the Boise Area (12). These are principally used for heating of individual homes and businesses or for irrigation purposes and their total usage is unknown. Due to the lack of general information concerning these uses and the time constraints within which this study was to be accomplished, they have not been investigated. There are only a small number of such wells which withdraw water in close proximity to the Boise Front fault system so their effect on the wells investigated is not expected to be very great.

Concern has been expressed that the withdrawal and use of geothermal water from the Boise Front fault system by the various organizations over time may cause changes in the quantity of fluid which can be produced, or a lowering of water levels (pressure) and/or temperature of the water thus decreasing its value for space heating purposes. This could occur with regard to the small individual thermal wells as well as the larger systems studied in this investigation.

The purpose of this study is to review the existing information on the development and use of the Boise Front geothermal system and to make recommendations to the University regarding its proposed expenditures to retrofit the heating systems of existing campus buildings or incorporate geothermal heat into future structures. The authors acknowledge and express their thanks for the assistance of several organizations and

individuals who supplied information, reports and suggestions. These include Chet Shawver and Charles Waag of Boise State University, Norman Young and Paul Castelin of the Idaho Department of Water Resources, Charles Mickelsen and Jack Kelly, consultant, for the City of Boise, Terence O'Rouark and Robert Griffiths of the Boise Warm Springs Water District and William Young of the U. S. Geological Survey. In reaching our conclusions and recommendation we have also consulted with Gerald Niimi of ThermaSource, Santa Rosa, California. His written comments are contained in a letter included in this report. The numbers "(1)" which appear in this report refer to published reports and collections of data listed in the Bibliography which is attached.

While the Boise Warm Springs Water District and its predecessors have utilized geothermal water in the area for nearly a century, additional major uses have been commenced within the last 4 years which have altered the previously existing situation. The effects of these new uses may not be known nor detectible yet because of the lack of data. However, this report will examine the information currently available and will attempt to interpret any changes or trends which appear even though little data exists with respect to the recent changes in use.

System Description

The Boise Front geothermal system has been described (6, 13) as occurring in a series of deep seated southeast to northwest trending structural faults along the northern margin of the Snake River Plain at its boundary with the Idaho batholith. The general location of the faults is indicated on Figure 1. These faults have been mapped for distances of 20 km to the northwest and 65 km to the southeast of Boise (6). The fault blocks are downthrown to the southwest side of the fault under the Boise Valley and are overlain there with alluvium.

Water is believed to be heated by circulating deep within fractures in the batholith. This circulating water rises along the Boise Front fault system to the land surface or to buried basalt and rhyolite aquifers in the downthrown fault blocks through which it flows to the southwest away from the fault system and where it mixes with cool ground water. The highest ground water temperatures are measured along the Front fault in springs and wells at the northeast edge of Boise. As you move away from the fault the temperature of wells tends to become generally lower. This is presumed to be caused by mixing of the hot water from the fault system with the cooler ground water of the area.

Hot water from this system was first developed by drilling wells in the 1890's near the old Idaho State penitentiary. The water was used in the eastern part of the City for space heating

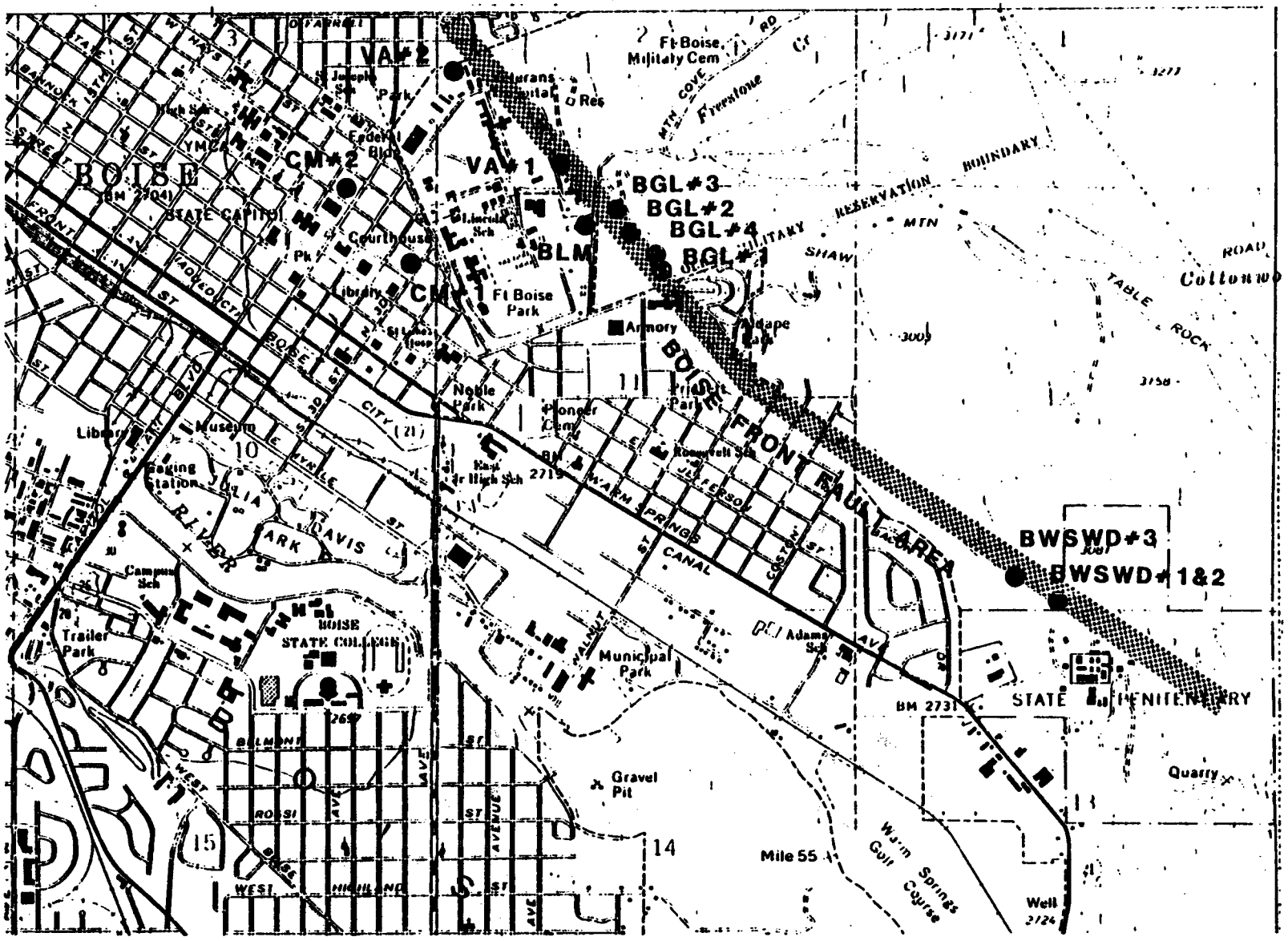


Figure 1. Boise Front Fault Area and Locations of Major Geothermal Wells.

and bathing purposes. The commercial hot water delivery system was very extensive in its earlier days and at one time including heating of a number of buildings in the central business district. The Boise Warm Springs Water District is the successor to this early development and presently operates a hot water supply system serving about 239 homes and businesses in the eastern part of the City of Boise.

In more recent years (beginning in 1981) other major geothermal water wells have been drilled into the Front fault or into the downthrown blocks southwest of the Front fault. The history of use and the data made available from the operation of all of these wells appears to have established the fact that the Front fault is the conduit which allows the geothermal water to rise from the depths where it has been heated. If the water is not intercepted by wells drilled into the fault zone it enters basalt and rhyolite aquifers at rather shallow depths and flows southwestward under the Boise valley. In these aquifers the water is cooled by mixing with cold ground water associated with the Boise River and its tributary streams.

Existing Developments

Boise Warm Springs Water District - The District owns three wells near the Old Penitentiary site which are described as follows:

BWSWD #1 - depth - 400 feet
casing - 12 inch to 160 feet

BWSWD #2 - depth - 400 feet
casing - 12 inch to 160 feet

BWSWD #3 - depth - 595 feet
casing 16 inch to 210 feet

Wells #1 and #2 were drilled in about 1891 and have supplied the District and its predecessor companies with hot water for almost 100 years. The quantity of water presently required varies with the seasonal temperature from a low of 125-150 gallons per minute (gpm) in the summer to as much as 850 gpm. Historically, it is estimated that the wells supplied about 1200 gpm at peak use (4). When not being pumped the water levels in the wells have recovered, at times in the past, sufficiently to cause the wells to flow at land surface. Until recently, the wells are reported to have flowed almost every summer season for from 4 to 6 weeks sufficient to supply the system's needs (R. Griffiths, personal communication). The District's records indicate that the wells flowed for one to two weeks during the months of July, August or September in each of the years 1980, 1981, 1982 and 1983. The wells have not flowed since 1983 and the water levels have not recovered during the summer low use

period since that year to closer than -25 feet below land surface.

BWSWD #1 and #2 each have pumps set in the casings at a depth of about 160 feet below land surface. This limits the depth of drawdown which can be tolerated at the present pump settings. If the water level is drawndown to greater depth the pumps break suction and can be damaged by continued operation. The District is considering lowering the pumps but it is noted that this will place the pumps in the uncased portions of the wells. The effects of this are unknown at this time.

BWSWD #3 was drilled in 1981 but was not successful and is used today only for observation of water levels in the fault system. Figure 2 is a record of water levels in this well since 1982. It shows a steady decline to the present of approximately 17 feet overall or about 4 feet per year. Unfortunately, there does not appear to be data on the water levels in the BWSWD wells for their first 90 years of use.

No Data? Can't be info.

The quantity of water produced by the BWSWD wells in recent years is approximately as listed in Table 1. The information is partially estimated due to the fact that the District's flow meter was not always operating during the reporting period. For such periods the monthly quantity pumped was estimated by comparison with usage during that particular month in other years and with usage for the months prior to and following the period of inoperability of the meter. The monthly quantity diverted varies with climatic conditions from a high of 46.8 million gallons in January 1982 to a low of 5.6 million gallons in August 1986. The District apparently has no long term records of the water temperature. The produced fluids are believed to be at about 172° F.

Table 1. Withdrawal of Geothermal Water by the Boise Warm Springs Water District Wells.

Year	Pumpage (million gallons)
1981	238.3
1982	266.2
1983	282.4
1984	292.5
1985	280.3
1986	245.7

All of the geothermal water produced by the District are lost to the system as there is no reinjection of the used fluid.

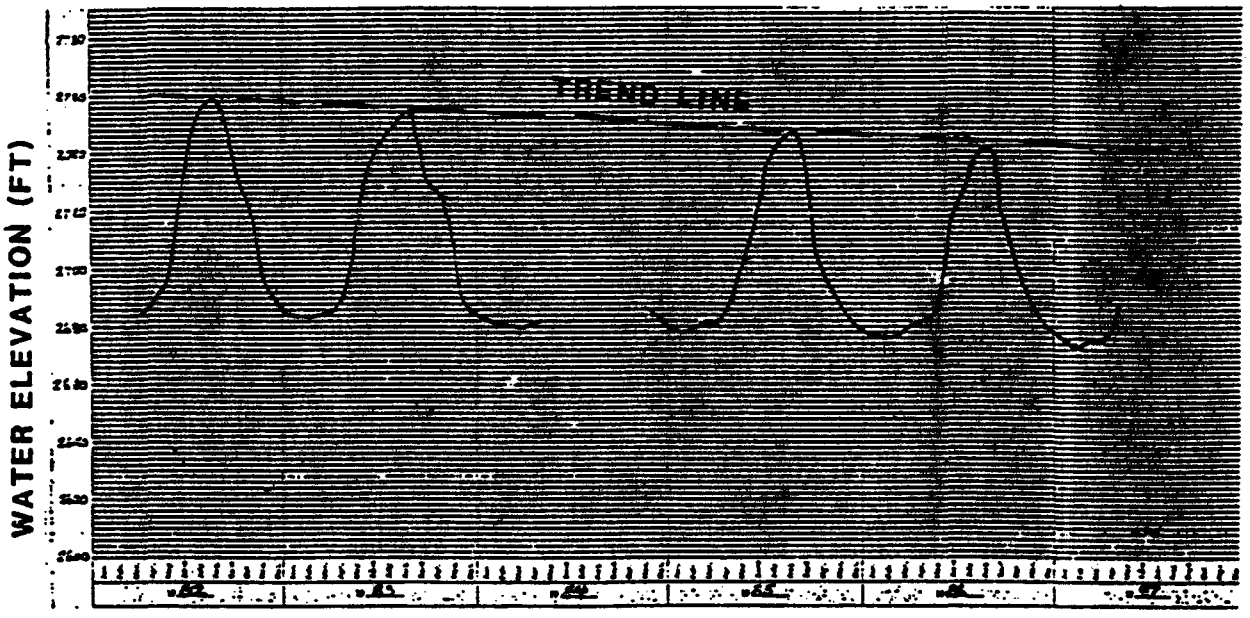


Figure 2. Plot of Water Levels in BWSWD Well #3

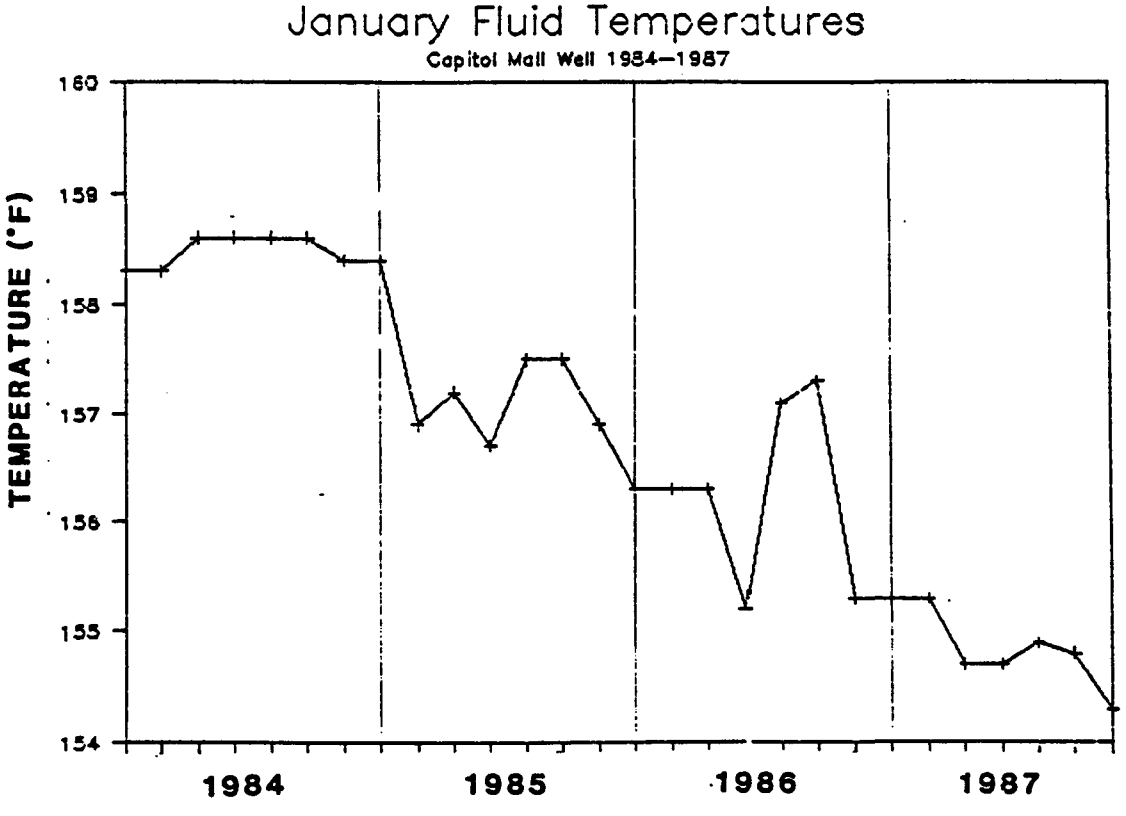


Figure 3. Plot of January Temperatures of CM #2 Well

State of Idaho Capitol Mall - The State drilled two wells in 1981 to obtain hot water for heating of the State Capitol and other buildings in the Capitol Mall area. These two wells are described as follows:

CM #1 - depth - 2150 feet
casing - 12 inch to 1750 feet, open hole to td.

CM #2 - depth - 3030 feet
casing - 12 inch to unperforated to 1258 feet, perforated to 2550 feet, open hole to td.

Well #2 is used for production and Well #1 for reinjection. All the geothermal water produced is reinjected. When first completed and placed in operation Well #2 produced fluid at about 159°F temperature. Records kept since the beginning of use in the 1982-1983 heating season indicate that the temperature of the hot water supply stream has declined slightly from about 159°F to 154°F through the 1986-1987 heating season. This decline has been at a rate of about 1°F per year. Figure 3 is a plot of temperatures of the supply stream taken on the 1st, 5th, 10th, 15th, 20th, 25th, and 30th of January in each of the years 1984 through 1987. January was chosen because pumping is at a maximum at that time of year.

The production of geothermal water from the CM #2 well has been as shown in Table 2. These records are compiled from information supplied by the State of Idaho.

Table 2. Withdrawal of Geothermal Water by the State of Idaho for the Capitol Mall.

Year	Pumpage (million gallons)
1983	79.0
1984	205.2
1985	196.4
1986	188.6

Use of the geothermal water for heating purposes in the CM system causes a temperature change of about -25°F. The water is produced at a present temperature of about 155°F and is reinjected into CM #1 at a temperature of about 130°F. Because of the well construction and perforation locations of CM #1 and CM #2 it is possible that the spent geothermal fluid being injected at CM #1 is mixing with the water being withdrawn from CM #2. The two wells may be partially recirculating the same water, thus explaining the cooling which appears to be taking place. It is also possible that withdrawal of geothermal water from the Front fault system by the pumping of the BGL and other

wells is intercepting part of the recharge to the CM production well thereby resulting in a cooling of the geothermal supply to the CM well because more cold water is now mixing in the fluids moving through the faults and aquifers tributary to the CM well.

Boise City (Boise Geothermal Ltd.) - Development of the BGL wells system began with the drilling of three slim holes and two exploratory test wells in 1976 (13). These were tested during 1976-1978. In 1981, four production wells were completed in the Boise Front fault system in Military Reserve Park (10). These wells are described as follows:

BGL #1 - depth - 2008 feet
casing - 12 inch to 857 feet, 8 inch perforated casing 857 to 1657 feet, open hole to td.

BGL #2 - depth - 880 feet
casing - 12 inch to 642 feet, open hold to td.

BGL #3 - depth - 1897 feet
casing - 12 inch to 680 feet, 8 inch perforated casing 680 to 1050 feet, open hole to td.

BGL #4 - depth - 1103 feet
casing - 12 inch to 687 feet, 8 inch perforated casing 687 to td.

BGL #2 and #4 were test pumped for varying period during 1982. The hot water delivery system was put into operation in October 1983. Table 3 lists the annual production of geothermal fluid from the BGL system through 1986.

Table 3. Withdrawal of Geothermal Fluid by the Boise Geothermal Ltd. System Wells.

Year	Pumpage (million gallons)
1983	53.8
1984	153.1
1985	129.1
1986	199.2

The water produced by the BGL wells has a temperature of about 172° F.

One of the exploratory test wells drilled for this project in 1976 is referred to as the BLM well. Records were kept of the water level in this well during the 1976-1978 period. A recorder was operated on the well in the 1981-1982 period. It was subsequently found that the new well drilled for the VA project (VA #1) had a similar water level so a recorder was placed on the VA well in 1983. It remained there until it was removed recently

because the VA system is being prepared for operation (J. Kelly, personal communication).

Records (13) collected from the combination BLM/VA observation wells show that at the time the exploratory program began in Military Reserve Park in 1976-1978 the geothermal aquifer was under sufficient artesian pressure that the shut-in well head pressure varied seasonally from 19 to 23 psia. This is equivalent to a water level of +43 to +53 feet above land surface.

Figure 4 is a plot furnished by Jack Kelly, consultant to BGL of records of water levels in the BLM/VA wells for the period 1981 to the present. These show that the water levels have decreased (presumedly due to pumping from the aquifer) to the point where during the current (1986-1987) heating season the level in the VA well started in September at -20 feet below land surface and drew down to -48 feet below land surface in February. There has been a net lowering of water level at the location of the BLM/VA wells of some 72 feet during the off-peak use period (September) and some 91 feet during the peak use period (January-February). The trend appears to be continuing with lowering at the rate of about 5 feet per year in the off-peak period and about 7 feet per year during the peak use period. We have not had the opportunity to examine any information on changes which may have taken place over time to the pumping levels of the BGL wells but it is expected that the drawdown in those wells for the same gallons per minute of production has substantially increased.

Records of pump testing (13) of the BGL and CM wells in 1981-1982 indicate that they mutually interfere with each other and that the effects of operation of either system can be measured at the BLM/VA wells.

The report (10) of test pumping of the BGL wells in 1982 indicates that BGL #2 and BGL #4 were operated at various pumping rates for the indicated periods of time.

BGL #2 - step test (400-1000 gpm) - April 7, 1982
BGL #2 - constant rate (900 gpm) - April 8 to April 15, 1982
BGL #4 - step test (35-180 gpm) - April 26, 1982
BGL #4 - 160 gpm - April 28 and 29, 1982

The test pump report indicates:

"No measurable effects from testing of BGL-2 and BGL-4 could be seen on the records of the ...BWSWD No. 3 wells. No estimate of aquifer characteristics at these wells can be made from the testing program data collection. BWSWD No. 3 may be in hydraulic connection with the other geothermal wells discussed above but this assertion is not supported by the test data."

Row long test?

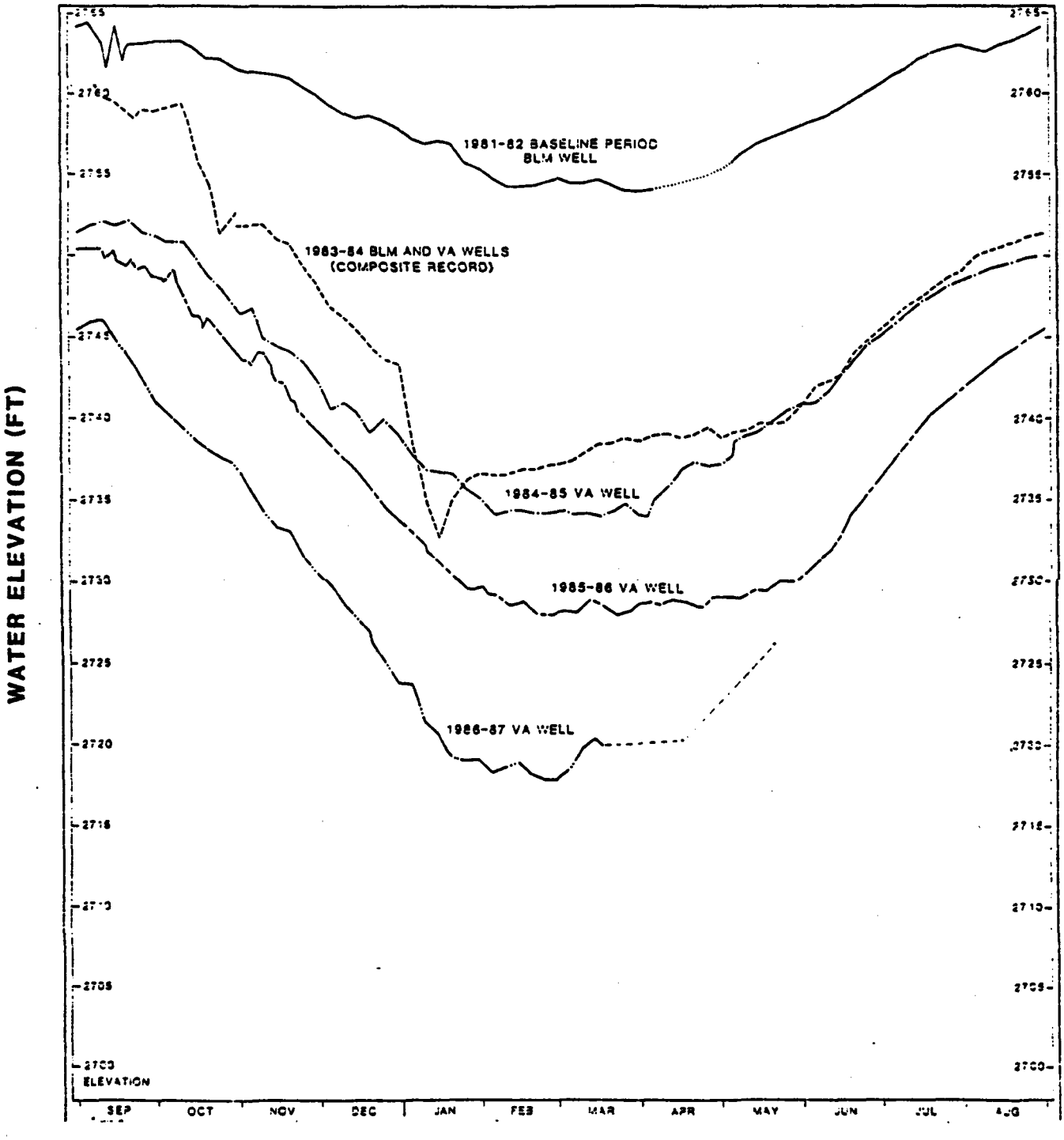


Figure 4. Plot of Water Levels in BLM and VA Wells

It is noted that the report does not conclude that there was no effect of the test pumping at the BWSWD wells, but instead that no effect could be measured. The BWSWD Well #3 is located approximately 6500 feet from the BGL wells. However, it is only about 600 feet from BWSWD Wells #1 and #2 and it would be expected that the water level in BWSWD #3 would be affected more quickly and to a larger degree by pumping rate variances in the producing BWSWD wells than by pumping wells much greater distance away.

The records of the BWSWD indicate that during the BGL testing period BWSWD wells #1 and #2 were also pumping. Unfortunately the Sparling meter which would have measured the pumping rate was not operating but the water level in those wells had been drawn down due to such pumping to levels between 50 and 158 feet below land surface. The date and the water level in each of these wells was as indicated below:

Date	BWSWD #1 Level (ft)	BWSWD #2 Level (ft)
4/7/82	-150	-125
4/8/82	-150	-155
4/9/82	no record	-140
4/10/82	no record	-145
4/11/82	-85	-110
4/12/82	-85	-120
4/13/82	-80	-110
4/14/82	-75	-105
4/15/82	-95	-140
4/16/82	-105	-155
4/17/82	-100	-145
4/18/82	-85	-125
4/19/82	-105	-155
4/20/82	-105	-158
4/21/82	-100	-155
4/22/82	-85	-120
4/23/82	-65	-80
4/24/82	-65	-80
4/25/82	-80	-90
4/26/82	-75	-90
4/27/82	-65	-85
4/28/82	-50	-65
4/29/82	-85	-120
4/30/82	-95	-110

Because of the obvious pumping operation of BWSWD wells #1 and #2 during the testing period of the BGL wells and the location of BWSWD Wells #1 and #2 within less than 600 feet of BWSWD Well #3 which was being used for observation of test results from testing of the BGL wells it is not surprising that the results were inconclusive. It is our belief that the pumping operation at the BWSWD wells masked any effects which otherwise

might have been measured at BWSWD #3 due to the pumping of the BGL wells.

All of the geothermal fluids produced by the BGL wells are lost to the system as there is no reinjection of the used fluid.

Veterans Administration - A production and an injection well were drilled for this project in August-September, 1983 but no information has been obtained concerning any testing which may have been conducted. The wells are described as follows:

VA #1 (Production) - depth - 1666 feet
casing - 16 inch to 140 feet, 12 inch to 802 feet, 8 inch perforated to 1500 feet, open hole to td.

VA #2 (Injection) - depth - 1840 feet
casing - 10 inch to 130 feet, 7 inch perforated to 1480 feet open hole to td.

The production well penetrated about 800 feet of rhyolite which appears to be the same aquifer as developed in the CM wells. The use of this well to monitor the effects of withdrawals from the BGL system is evidence that it is hydraulically connected also to the Front fault geothermal system. When the VA system is placed into operation it will increase the pumping load on the Boise Front fault and interconnected geothermal system. The extent of planned use by the Veterans Administration is unknown.

Analysis of Available Data and Anticipated Future Uses

From an analysis of the data assembled for this study several general findings are apparent.

1) The BWSWD wells have declined in production since the BGL and CM wells went into operation in 1983. The BWSWD wells have not recovered to a flowing condition following the heating season of heavy usage in the last three years. They reach their limit of drawdown (-155 to -160 feet due to pump setting) during the heating season for longer and longer periods of time than ever previously experienced by the system. This increased drawdown of the BWSWD wells does not appear to be caused by an increase in pumping and production from the BWSWD wells.

2) The water level in BWSWD Well #3 has declined steadily since the record was first started following drilling of the well in 1982. The high (August) level and the low (February) level have declined about 17 feet and about 12 feet respectively in the

four years for which records are available. This decline does not appear to be related to the operation of the BWSWD production wells but to a general decline in water levels or artesian pressures in the Boise Front fault aquifer system. Some other influence is causing the lowering of the water level in this observation well and in the BWSWD production wells. It cannot be a result of lack of natural recharge to the system since the years 1983, 1984 and 1986 were all above normal.

3) The CM and BGL wells have been determined by test pumping to mutually interfere with each other. As measured at the BLM/VA observation wells, the water level or artesian pressure in the geothermal aquifer system has declined significantly since the wells were first produced beginning in 1983. While it is recognized that production from a well causes a loss of pressure and a lowering of the water level in a well it is normally expected that water level recovery will take place during the low-flow or non-use period unless the amount of water being pumped is exceeding the natural recharge of the aquifer system. There has not been complete recovery in the system for any year of operation of the BGL and CM wells. The annual high water level appears to be falling progressively from year to year at a rate of about 5 feet per year. The low level is falling at the rate of about 7 feet per year.

4) The highest annual usage from the BGL wells system was in 1986 when 199.2 million gallons were pumped. The peak monthly usage was in January 1987 when the system pumped 34.2 million gallons. This required an average rate of diversion of 766 gpm. It is expected that the following BSU buildings will initially be served by the BGL system at the indicated peak geothermal water flow requirements:

Pavilion	180 gpm
Physical Education Building	110 gpm
Liberal Arts Building	50 gpm
Library/Learning Center	120 gpm
Business Building	60 gpm
Simplot-Micron Building	60 gpm
Total	580 gpm

The addition of the BSU service to the existing pumping load from the BGL well system would increase the potential withdrawal by about 75%.

5) Information furnished by Boise City (BGL) indicates that anticipated future "Normal Weather Year" usage including supply to BSU and other potential new customers will total about 273.4 million gallons. This would be an increase of pumpage of 73.8

million gallons or 37% higher than the usage from the aquifer system in 1986. The City also reports that of the 273.4 million gallons expected to be pumped in a "normal" year only 196.8 million gallons (72%) will be used and 76.6 million gallons (28%) will be "waste flows".

6) The temperature of the water obtained by the State of Idaho from CM #2 well has declined about 4° F since the well was first placed in operation in 1983. This decline has been continuous and consistent over the four years of records. It is our opinion that the temperature change has been caused by either or both of the following causes:

a. Reinjection of cooled spent geothermal water into CM Well #1 and recirculation of this water through the aquifer system to production well CM #2. Use within the Capitol Mall results in cooling of the water by about 25° F. Return of this cooled water to the aquifer system at a point where it cannot be reheated by deep circulation within the Boise Front fault system may be contributing to gradual and continuous cooling of the water available for withdrawal from CM Well #2.

b. Pumpage and consequent lowering of pressures in the Boise Front fault system by the BGL and BWSWD wells may be intercepting and thereby reducing the quantity of heated geothermal water which would otherwise rise along the fault and enter the aquifer from which the CM Wells produce. The interception of the recharge of the hotter fault system water may be lowering the overall temperature of the geothermal aquifer underlying the Capitol Mall area.

7) Water quality analyses (4) of thermal and shallow cold water in the Boise area indicate that the BWSWD, BGL and CM wells likely obtain thermal water from a common source. Records furnished by the City and information from BWSWD (R. Griffiths, personal communication) indicate that the BWSWD and BGL well water temperatures are each an almost constant 172° F. The CM water temperature is less, now 155° F, as would be expected away from the Front fault where the water likely mixes with cooler ground water.

8) A comparison of the water level elevations of the BWSWD #3 well and the BLM/VA well provides further corroboration of our conclusion that the geothermal resource developed by the BWSWD, CM, BGL and VA wells is interconnected.

The approximate high water (September) levels in these two observation wells during the recent years has been as follows:

Year	BWSWD #3 (ft)	BLM/VA (ft)
1982	2759	2764
1983	2755	2761
1984	-	2752
1985	2747	2750
1986	2742	2746

The relationship is too consistent to be coincidental. Both have declined 17-18 feet since 1982.

9) The report of the geothermal resource exploration which occurred in the 1976-1978 period (13), we believe, correctly concluded that "the area of the aquifer within the fault zone is believed to be relatively narrow. A narrow fault zone would result in a strongly elongated cone of depression, caused by pumping, with the long axis superimposed over the fault zone." If this is found to be true it can be expected that the effects of pumping from the fault zone will be transmitted primarily along the length of the fault zone. This will result in pressure reduction and water level declines at distances considerable greater along the fault than would be found at observation wells at right angles to the fault zone.

10) Test pumping information (10, 13) indicates that the Front fault aquifer penetrated by the wells in the Military Reserve Park area shows a high value for transmissivity (a measure of the ability of the aquifer to transmit water) during the early minutes of the tests. The value decreases in steps to very low values over time and the data indicate that the available aquifer system includes several physical boundaries. These boundaries may be the fault system or some other impediment to water movement to the pumping well. This information is indicative of a limited aquifer system which cannot be expected to yield large quantities of water over time without a lowering of the water table or artesian pressure until a new equilibrium is reached. The initial transmissivities calculated by the several investigations indicate hundreds of thousands of gallons per day per foot during the initial periods of operation of wells but only tens of thousands of gallons per day per foot during the later periods. We believe that the transmissivity which can be expected over the long period of aquifer is more correctly the smaller figures.

Water Right Considerations

The State of Idaho, Department of Water Resources regulates the use of hot water and geothermal energy resources. The 1987

Legislative Session passed amendments (SB 1133) to the ground water and geothermal laws which declared ground water with a temperature greater than 85°F and less than 212°F to be a "low temperature geothermal resource". Such resource is to be administered under the water laws of the state which follow the prior appropriation doctrine of "first in time is first in right". The bill provided that all geothermal rights to the use of a resource which would be classified as a low temperature geothermal resource pursuant to the bill and with priorities prior to July 1, 1987 were to remain valid.

It is uncertain how this bill may affect any entity which holds rights to develop geothermal resources and which does not also hold water rights to the fluid produced. Since all the water being produced by the various entities from the Front fault geothermal system fits in the temperature category of the new law and since all entities appear to have water rights covering their developments we assume that the water right laws will apply to this resource. This will mean that the first entity holding valid water rights to the resource will be protected in its continued usage as against all subsequent appropriators. Other provisions of the state ground water laws will also come into consideration such as the establishment of reasonable ground water pumping levels and the controlling of uses so as not to exceed the "reasonably anticipated average rate of future natural recharge".

The Idaho Department of Water Resources has provided a 17-page abstract of geothermal water rights covering wells used for heating in the Boise area. A copy is attached to this report. The abstract indicates that the Boise Warm Springs Water District claims rights to 12.80 cfs (5744 gpm) of water with a priority of 1894. Of the principal users whose systems have been examined in this study, Boise Geothermal Ltd. holds the next priority water permit for 12.00 cfs (5386 gpm), BWSWD next holds a permit for 4.00 cfs (1795 gpm) presumedly for the water it hoped to obtain from BWSWD Well #3, the State of Idaho holds the next permit for 5.57 cfs (2500 gpm) for the Capitol Mall, and then the Veterans Adminstration has a permit for 2.23 cfs (1000 gpm).

There are numerous other water rights on the state's abstract. It is possible that diversion and use of water under some of these may be affected by withdrawals from the Boise Front fault system. The total quantity of water under the claims and permits of the BWSWD, BGL, CM and VA systems is 36.60 cfs or 16,426 gpm. This should be compared against the present maximum monthly withdrawal of water from the presently-operating BWSWD, BGL and CM wells in January 1987 of 93.7 million gallons or an average rate of withdrawal of 2099 gpm. If each of these entities were to increase its use from the resource up to the quantity presently claimed or permitted the pumpage from the aquifer would expand nearly eightfold.

If it were to be determined that the present or planned future withdrawal of water from this resource is or will exceed the "natural recharge" or the safe sustained yield the Department could initiate any of a number of regulatory strategies.

The state could declare the area to be a "Critical Ground Water Area" (Sec 42-233a ICA). This would require a finding that the resource will not support the already developed or permitted withdrawals. With such designation it is expected that no new permits would be issued and use could even be curtailed under the existing permits and rights based on water right priorities. The Department could also designate the area a "Ground Water Management Area" (Sec 42-233b ICA). The users in the designated area would likely be required to report withdrawals of water and other information such as water levels, pressures, temperatures, etc.

The state may also consider requiring the various users who are not presently doing so to reinject the used geothermal water back into the ground. The injection well location, depth, design and costs associated with such action have not been examined but it will not be easy to accomplish.

It is also possible that a user may feel that its rights are being infringed by the use of another appropriator with a later priority and bring an action in the courts. This would likely result in litigation to determine the water rights of the parties and to determine the extent of any claimed interference. The result could be a restriction on the use of water from the resource by one or several of the present and proposed users.

Conclusions and Recommendations

It appears evident that recent developments in the use of the Boise Front fault geothermal system is resulting in changes in the pressures and temperatures of the aquifers. There is nothing currently available which would indicate that the aquifer has reached a new state of equillibrium and that conditions in the aquifers have stabilized. Present information indicates that it can be expected that water levels will continue to decline for some years to come. It is also likely that the temperature of the water supply for the Capitol Mall will continue to decrease as long as the State's reinjection well is used and/or the pumping continues from the Front fault aquifer.

The anticipated increased pumpage to provide the additional uses proposed by Boise Geothermal Ltd., including supply to Boise State University and the activation of the proposed heating system by the Veterans Adminsistration will place new loads on the system.

For the University, some risks are involved in its plans to retrofit existing campus buildings and to accept delivery of

thermal water from the BGL system. On the other hand, all risks may be entirely upon BGL since it has the responsibility under the contract with BSU of supplying hot water to the campus. But we believe the University must understand that there is a possibility that BGL cannot meet its obligations under the contract over the long term. Its inability to continue delivery could be caused by any or all of the following reasons:

1) If, as it appears, the Front fault aquifer is found to be limited in its ability to supply hot water the total quantity which can be withdrawn will have to be restricted with time to the "safe" or sustainable yield. This may be found to be less than enough to supply all the present uses and the additional proposed uses by Boise State University, the Veterans Administration and others.

2) The BGL system holds a secondary water right priority for the withdrawal of geothermal water to the Boise Warm Springs Water District. In the event future administrative or legal action is taken which results in a limitation on the quantity of geothermal water which may be withdrawn from the aquifer the BGL system could be shut down or restricted in use. It is evident that the Front fault system will not support all the development which has been claimed and permitted to date. It is also possible that, with time, the pumping of water from the geothermal system in the Front fault may affect other entities with rights for heating purposes which are included in the state's water right abstract.

3) Continued withdrawal and use of water from the Front fault system could result in a gradual cooling of the supply stream. As the pressure or water level in the geothermal aquifer is drawn down through use by the various entities it can be expected that there will be increased opportunities for thermal contamination of the aquifer from shallow cold water sources.

Given these possibilities, it is recommended that the University take all reasonable and legal steps possible to assure itself of continued future delivery of hot water in sufficient quantity and temperature to meet its needs before expending funds for conversion of the present heating systems. It may be that the present contract with BGL provides all the assurance needed. If, however, competent legal advice suggests that some contract amendments may be required to cover the eventualities listed above, then we recommend that contract amendment be pursued prior to commencing the modifications.

Consideration should also be given to the requirement for the posting of a bond or other security by BGL to protect the investment which BSU is preparing to make in conversion of its heating system and to cover costs of reconversion if there is ever a cut off of the hot water supply from BGL in the future.

The Boise Front fault geothermal system is an outstanding resource which has provided for space heating in the Boise area for about a century. Recent expansion of use of the system by BGL, CM, VA and others has given the promise of additional benefits to the community. However, the aguifer system is in a state of flux with changes taking place in temperature, pressure and quantity produced. Present uses may be exceeding the long-term sustainable yield of the system. However, today users are in the early stages of data collection and more information is needed before the developers and the regulating agency can determine if controls are needed on the allowable amount of use.

Bibliography

(1) Wood, Spencer H., Will Burnham and Dale Osterman, Field Trip Guide to the Boise Foothills, Idaho Association of Professional Geologists, May 1, 1982.

(2) Waag, C. J., and S. H. Wood, Base Line Data Analysis of a Developing Geothermal System, Boise, Idaho, Idaho Water Resources Research Institute, September, 1985.

(3) Wood, Spencer H., and Willis L. Burnham, Boise, Idaho Geothermal System, Geothermal Resources Council Transactions Vol. 7, October, 1983.

(4) Burnham, Will, and Spencer Wood, Field Trip Guidebook and Road Log, 12th Annual Rocky Mountain Groundwater Conference, 1983.

(5) Applegate, James K. and Paul R. Donaldson, Characteristics of Selected Geothermal Systems in Idaho, Geophysical Monograph 20, The American Geophysical Union, 1977.

(6) Mayo, Alan L., Anthony B. Muller, and John C. Mitchell, Geochemical and Isotopic Investigations of Thermal Water Occurrences of the Boise Front Area, Ada County, Idaho, Idaho Department of Water Resources Water Information Bulletin No. 30, Part 14, December 1984.

(7) Mitchell, John C., editor, Geological, Hydrological, Geochemical and Geophysical Investigations of the Nampa-Caldwell and Adjacent Areas, Southwestern Idaho, Idaho Department of Water Resources Water Information Bulletin No. 30, Part 11, December 1981.

(8) Young, H. W., Geochemistry and Hydrology of Thermal Springs in the Idaho Batholith and Adjacent Areas, Central Idaho, U. S. G. S., Water-Resources Investigations Report 85-4172, 1985.

(9) Preliminary Investigation of Potential Low Temperature Geothermal Water Application for Boise State University, CH2M Hill, April 1980.

(10) Flow Testing of Boise Geothermal Ltd. Wells Nos. 2 and 4, Anderson & Kelly, June 1982.

(11) Study of Energy Consumption on the Boise State University Campus, CH2M Hill, January 15, 1984.

(12) Well Testing and Annual Pumpage Information for Boise City Geothermal System, Boise City Public Works, September 15, 1986.

(13) Nelson, Lynn B., Warren L. Niemi, and Roger C. Stoker, Geothermal Resource Exploration in Boise, Idaho, EG&G Idaho, February 1980.

ThermaSource Inc.
725 Farmers Lane • P.O. Box 1236 • Santa Rosa, California 95402
(707) 523-2960

May 23, 1987

Mr. Keith Higginson
Higginson-Barnett, Consultants
106 West 500 South, Suite 101
Bountiful, Utah 84010

Dear Keith,

I have completed a review of the information that you sent me concerning the Boise, Idaho, geothermal system. The drawdown and production data indicate that the hot water system is large, but limited in extent. Although the system is capable of supporting additional hot water production, the data suggests a system that is nearing full development. Any significant new withdrawals would need to be approached cautiously.

Geologic studies have concluded that the two major hot water supply systems, BWSWD and BGL, draw their water from a common source. Yet the production data shows little if any direct interference between the two systems. Also the calculated values for transmissivity(very high) and compressibility(low) would lead to the expectation of interference between the systems. My examination indicates that the physical separation between the two systems both vertically and horizontally, precludes direct communication. Moreover the faults that created the conduits for the upwelling of geothermal fluids also provide barriers to pressure communication. There is little doubt that the two systems do interact somewhere, somehow. Attached is Figure 1 which is my conceptual idea of a simple fluid flow model to explain the observed data. A quantitative model would be more meaningful but would be difficult to obtain.

Water level data from BWSWD #3 shows a gradual lowering of the water levels at recovery and increased drawdowns to support stable water withdrawals. Such behavior was evident even before the BGL and Capitol Mall(CM) systems started. The data does not show that drawdowns were exacerbated by hot water production from the newer systems. In my opinion the BWSWD aquifer may be leaking into shallow ground water aquifers because the annual swings in water levels in BWSWD #3 (80-90 ft) are about four times greater than that observed in the BLM well (20 ft) for identical distances away from producers and only twice the withdrawals. My own calculations

of transmissivity(Kh) and storativity(ØCh) agree with published values. This reservoir system is characterized by high transmissivity (higher than BGL) and low storativity. Simple calculations would show that a reservoir with these properties would conduct pressure transients to the BGL system and vice-versa. The fact that no response between systems has been reported suggests the interference occurs at the reservoir boundaries. Doubling of withdrawals starting in 1983 did not create a sudden and marked response, which leads to the conclusion that the aquifer is extremely large. In reservoir terms, the boundaries are located miles away. My analysis indicates that the BWSWD system will continue to experience reduction in water levels and ever increasing drawdowns. Lowering of pump levels will be necessary, but direct interference from BGL wells will be minimal.

The BGL system behaves similarly. Water levels are dropping continuously despite relatively stable withdrawals. Analysis of the well tests on BGL #2 and #4 in April 1982 indicates very high transmissivity and low compressibility. The drawdown data shows a change in slope after about 3 1/2 days which could be interpreted as a fault. Interestingly, at the end of the one week test on BGL #2, the calculated radius of investigation was on the order of 1000 miles. This is a ridiculously high figure, but it indicates that the aquifer is extremely large. Reservoir parameters again would suggest interference with BWSWD wells but the existence of faults between the two areas may explain the lack of significant response.

Although there is no immediate threat of reservoir depletion, it is obvious that reservoir recharge is not keeping up withdrawals from the BGL wells. As a result, future users should take into account that water levels will accelerate their drop. To provide an insight into what might be expected, cumulative drawdowns observed in the BLM well were plotted against cumulative production from the BGL wells(See Figure 2). This empirical relationship shows that at current producing rates of 200 million gallons per year, water levels will drop 10 feet per year. A 50% increase would cause a levels to drop 15 feet per year. This behavior in an observation well 673 feet away would be magnified at the producing well. Whether this type of behavior can be tolerated in the system depends on the current drawdowns in the supply wells. This is by no means evidence that massive reservoir damage would occur. But it does point out the need to proceed with caution. One method to check the impact of additional withdrawals would be to produce at the higher rates during the winter when withdrawals are the greatest. A test in December would be much more meaningful than a test in April when the reservoir is not being stressed. One of the early signs of reservoir depletion would be temperature declines in the produced water. If the aquifer pressure is lowered to the point where cooler water starts to invade the

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geothermal aquifer, then problems could occur in maintaining deliveries.

Data from the Capitol Mall wells were interesting because of a gradual decline in water temperature of 0.5 degrees F per year. The likely cause of the cooling is injected water from CM #1 mixing with the produced water. The test data showed that both CM #1 and #2 responded to production from BGL #2. Thus CM #1 and #2 are in pressure communication. Again, whether this magnitude of temperature decline is tolerable or not depends on the design parameters of the heating system. Water levels are dropping, but less quickly than in the BGL wells. This could be due to reinjection of water and the lower withdrawal rates.

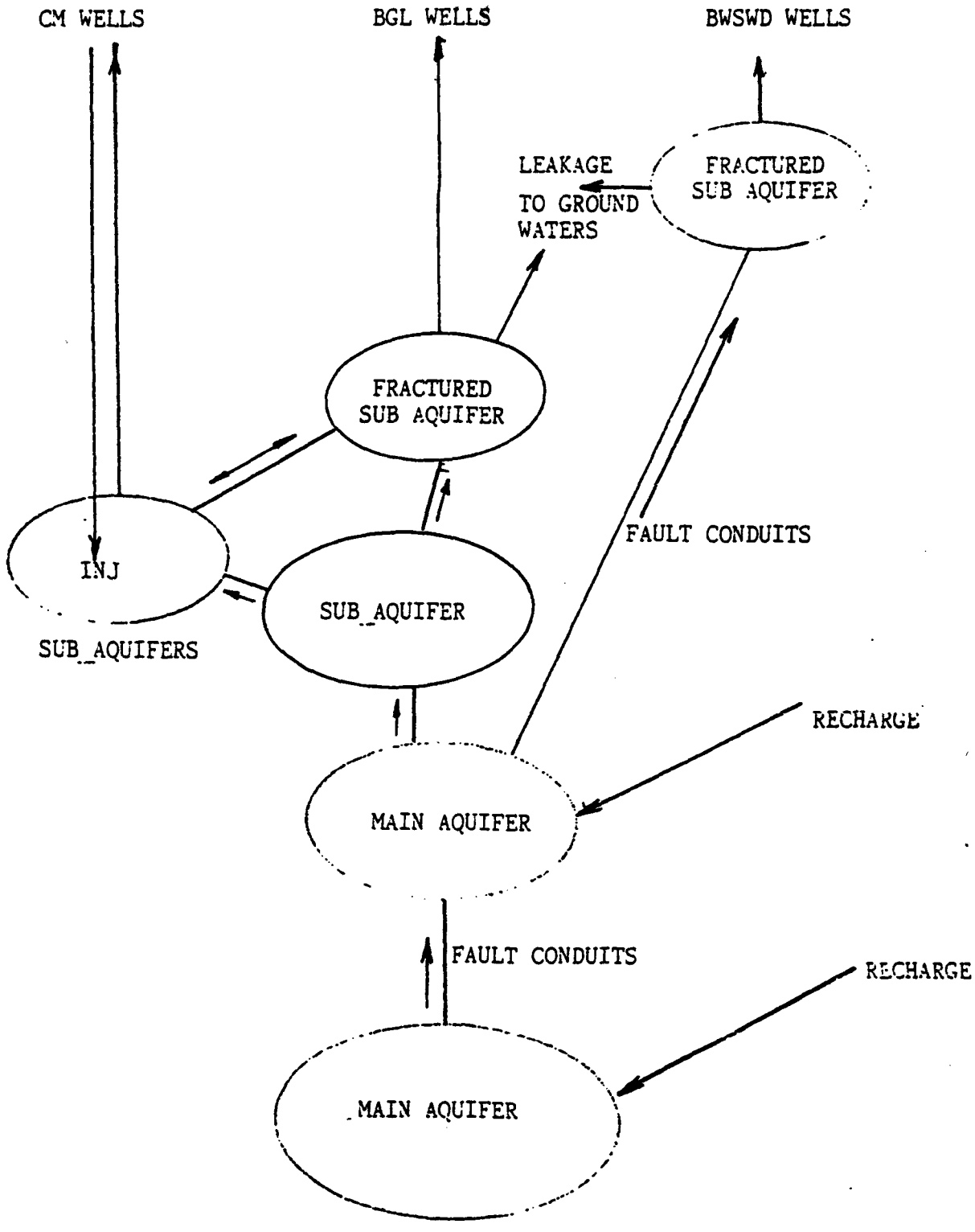
In conclusion, water levels are declining in the Boise hot water aquifer supplying the BWSWD, BGL and CM wells. The declines are due to the fact that recharge is occurring slower than than the withdrawal rate. The primary concern is whether the hot water wells can operate efficiently with moderate drops in water levels each year. It will cost more to pump from ever-increasing depths, and it will cost more to change pumping levels. I believe that the BWSWD and BGL areas may be connected to the same source but they do not behave as if in direct communication. In my opinion, it is essential that additonal data be gathered to understand the exact impact of additonal withdrawals from the BGL wells and whether such impact can be tolerated both from a resource standpoint and a cost standpoint.

If you have any questions concerning this appraisal, please call me.

Yours truly,

Gerald Nijmi

encl:



Main aquifers recharge sub-aquifers at a finite rate depending on permeability and pressure differential. The overall system behaves like a series of storage tanks that are connected by conduits.

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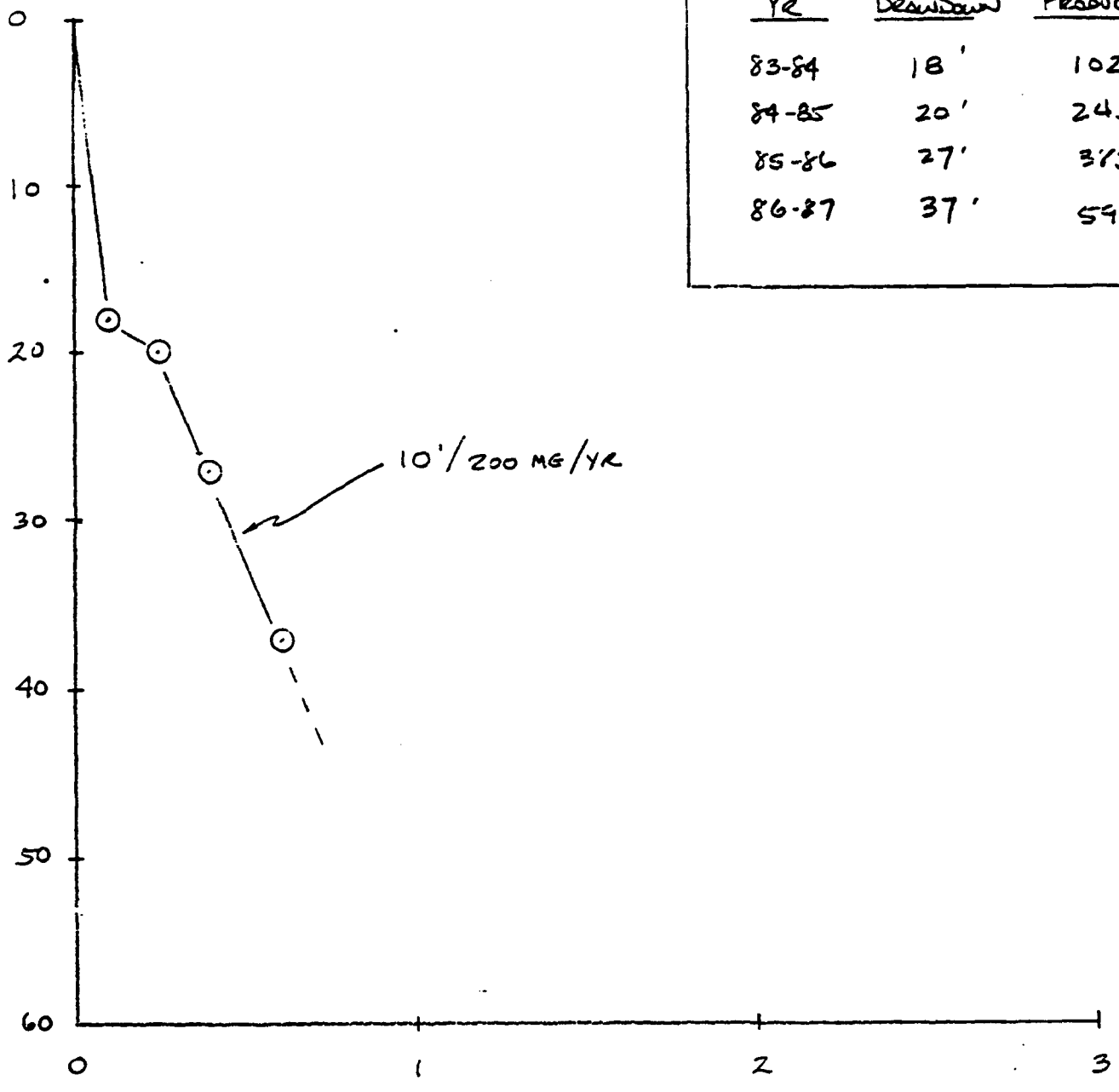
DRAWN	
FOR:	
BY:	
DATE:	
SCALE:	
DRAWING No.	

FIGURE 1
BOISE GEOTHERMAL CONCEPTUAL FLUID FLOW MODEL

BLM

TOTAL DRAWDOWN*

(FT)



YR	DRAWDOWN	PRODUCTION
83-84	18'	102
84-85	20'	243
85-86	27'	373
86-87	37'	597

CUMULATIVE WATER PRODUCED

BGL WELLS - MILLIONS GAL.

* BASE = 2764'

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DRAWN	
FOR:	
BY:	
DATE:	
SCALE:	
DRAWING No.	

FIGURE 2

EMPIRICAL RELATIONSHIP BETWEEN BLM DRAWDOWN & BGL PRODUCTION

State of Idaho
DEPARTMENT OF WATER RESOURCES
STATE OFFICE, 450 W. State Street, Boise, Idaho

CECIL D. ANDRUS
Governor

A. KENNETH DUNN
Director

Mailing address:
Statehouse
Boise, Idaho 83720
(208) 334-4440

May 28, 1987

Keith Higginson
106 W. 500 S.
Suite 101
Bountiful, UT 84010

RE: Boise Front Warm Water Area

Dear Keith:

You requested a listing of the water rights for diverting from the warm water aquifer in the Boise Front area. Attached is an abstract of the rights in our records which indicates "heating" as a beneficial use. Some of the rights listed probably do not divert from the warm aquifer, but I do not have a sure fire basis for sorting them out. The area covered by the water right search is shown on the attached map.

Other valid but unrecorded rights to use warm water may exist in the area.

If I can provide additional information, please give me a call.

Sincerely,

Norman C Young

NORMAN C. YOUNG
Administrator
Resource Administration Division

NCY:alw
Encl.

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
LISTING OF WATER RIGHTS

05/19/87

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION		STAGE
63-0012	MILSTEAD, O. L.	07-01-1921	IRRIGATION	-	-	.14	CFS	DECREE
			STOCKWATER	-	-		CFS	
			HEATING	-	-		CFS	
			DOMESTIC	-	-		CFS	
						.14	CFS TOTAL	
							AFA TOTAL	

SOURCE: GROUNDWATER TRIBUTARY:

REMARKS: TRANS. #268.
P/U DESC. BY METES & BOUNDS.

POINT OF DIVERSION:
T04N R02E S28 NWSW
S29 NESE

PLACE OF USE: IRRIGATION
T04N R02E S29 SENE NESE

PLACE OF USE: STOCKWATER SAME AS OTHER USE

PLACE OF USE: HEATING SAME AS OTHER USE

PLACE OF USE: DOMESTIC SAME AS OTHER USE

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION		STAGE
63-0013	MILSTEAD, O. L.	07-01-1922	IRRIGATION	-	-	.66	CFS	DECREE
			STOCKWATER	-	-		CFS	
			HEATING	-	-		CFS	
			DOMESTIC	-	-		CFS	
						.66	CFS TOTAL	
							AFA TOTAL	

SOURCE: GROUNDWATER TRIBUTARY:

REMARKS: TRANS. #268.
P/U DESCRIBED BY METES & BOUNDS.

POINT OF DIVERSION:
T04N R02E S28 NWSW
S29 NESE

PLACE OF USE: IRRIGATION
T04N R02E S29 SENE NESE

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
63-0013	PLACE OF USE: STOCKWATER	SAME AS OTHER USE					
	PLACE OF USE: HEATING	SAME AS OTHER USE					
	PLACE OF USE: DOMESTIC	SAME AS OTHER USE					
63-0014	EDWARDS, THOMAS F.	11-22-1926	IRRIGATION	-	-	.84 CFS	DECREE
			STOCKWATER	-	-	CFS	
			HEATING	-	-	CFS	
			DOMESTIC	-	-	CFS	
						.84 CFS TOTAL	
						AFA TOTAL	
	SOURCE: GROUNDWATER	TRIBUTARY:					
	REMARKS: .3 CFS FROM 10/1 TO 4/1. 4/1 TO 10/1 .4 CFS OR SO MUCH THEREOF THAT WILL NOT DEPLETE PLAINTIFFS WELL BELOW .8 CFS. AC. IRR.=25.58.						
	POINT OF DIVERSION: T04N R02E S29 NWNE SWNE						
	PLACE OF USE: IRRIGATION T04N R02E S29 NWNE SWNE						
	PLACE OF USE: STOCKWATER	SAME AS OTHER USE					
	PLACE OF USE: HEATING	SAME AS OTHER USE					
	PLACE OF USE: DOMESTIC	SAME AS OTHER USE					
63-0015	TIEGS, H. W.	03-23-1927	IRRIGATION	-	-	.80 CFS	DECREE
			STOCKWATER	-	-	CFS	
			HEATING	-	-	CFS	
			DOMESTIC	-	-	CFS	
						.80 CFS TOTAL	
						AFA TOTAL	
	SOURCE: GROUNDWATER	TRIBUTARY:					
	REMARKS: NO WATER TO BE ALLOWED TO FLOW OR BE USED FROM TIEGS WELL UNTIL FURTHER NOTICE BY COURT.						
	POINT OF DIVERSION: T04N R02E S28 NWSW						

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
63-0015	PLACE OF USE: IRRIGATION T04N R02E S28 NWSW						
	PLACE OF USE: STOCKWATER	SAME AS OTHER USE					
	PLACE OF USE: HEATING	SAME AS OTHER USE					
	PLACE OF USE: DOMESTIC	SAME AS OTHER USE					
63-0016	RYAN, J.	09-24-1927	IRRIGATION	-	-	.80 CFS	DECREE
			STOCKWATER	-	-	CFS	
			HEATING	-	-	CFS	
			DOMESTIC	-	-	CFS	
						.80 CFS TOTAL	
						AFA TOTAL	
	SOURCE: GROUNDWATER	TRIBUTARY:					
	REMARKS: NO WATER PERMITTED TO FLOW OR BE USED FROM RYAN WELL UNTIL FURTHER NOTICE BY COURTS.						
	POINT OF DIVERSION: T04N R02E S29 NENW						
	PLACE OF USE: IRRIGATION T04N R02E S29 NENW 20						
	20 ACRES TOTAL						
	PLACE OF USE: STOCKWATER	SAME AS OTHER USE					
	PLACE OF USE: HEATING	SAME AS OTHER USE					
	PLACE OF USE: DOMESTIC	SAME AS OTHER USE					
63-2402	EDWARDS, THOMAS F. BOISE, ID	11-22-1926	IRRIGATION	-	-	.84 CFS	LICENSE
			HEATING	-	-	CFS	
			DOMESTIC	-	-	CFS	
						.84 CFS TOTAL	
						AFA TOTAL	
	SOURCE: GROUNDWATER	TRIBUTARY:					
	POINT OF DIVERSION: T04N R02E S29 SWNE						

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
63-2402	PLACE OF USE: IRRIGATION T04N R02E S29 NANE 13 SWNE 13 26 ACRES TOTAL PLACE OF USE: HEATING SAME AS OTHER USE PLACE OF USE: DOMESTIC SAME AS OTHER USE						
63-2773	DUFRESNE, WALTER 1002 HARRISON BLVD. BOISE, ID 83702	07-14-1949	HEATING DOMESTIC	- -	- -	CFS .05 CFS .05 CFS TOTAL AFA TOTAL	LICENSE
	SOURCE: GROUNDWATER TRIBUTARY: OTHER USES: G/HEAT PUMP FOR 1 HOME. REMARKS: P/D LOTS 13, BLK. 8, LEMPS ADDN., BOISE CITY TOWNSITE. P/U LOTS 11 - 13, BLK. 8, LEMPS ADDN., BOISE CITY TOWNSITE. SEE FILE FOR P/D AND P/U. POINT OF DIVERSION: T03N R02E S03 SENW PLACE OF USE: DOMESTIC T03N R02E S03 SENW PLACE OF USE: HEATING SAME AS OTHER USE						
63-2847	NEITZEL, F. H. HOWELL, W. W. BOISE, ID	08-07-1954	HEATING DOMESTIC	- -	- -	CFS .04 CFS .04 CFS TOTAL AFA TOTAL	LICENSE
	SOURCE: GROUNDWATER TRIBUTARY: OTHER USES: G/HEATING PUMPS, D/2 HOMES. REMARKS: P/U S15, R2E, L 7 & 8 MESSA VISTA SUBD. POINT OF DIVERSION: T03N R02E S15 SENW						

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
63-2847	PLACE OF USE: DOMESTIC T03N R02E S15 SENW						
	PLACE OF USE: HEATING	SAME AS OTHER USE					
63-2861	MENDENHALL, J. R. BOISE, ID	05-21-1951	IRRIGATION HEATING	- -	- -	.09 CFS CFS .09 CFS TOTAL AFA TOTAL	LICENSE
	SOURCE: GROUNDWATER	TRIBUTARY:					
	POINT OF DIVERSION: T03N R02E S14 NENE						
	PLACE OF USE: IRRIGATION T03N R02E S14 NENE						
	PLACE OF USE: HEATING	SAME AS OTHER USE					
63-3153	STATE OF IDAHO DEPT. OF TRANS. DIV. OF HWYS. P.O. BOX 7129 BOISE, ID 83720	04-07-1959	IRRIGATION HEATING	- -	- -	3.40 CFS 3.40 CFS 3.40 CFS TOTAL AFA TOTAL	LICENSE
	SOURCE: GROUNDWATER	TRIBUTARY:					
	REMARKS: 2 P/D IN SWSW, S33, T4N, R2E.						
	POINT OF DIVERSION: T04N R02E S33 SWSW						
	PLACE OF USE: IRRIGATION T04N R02E S33 SWSW 6 6 ACRES TOTAL						
	PLACE OF USE: HEATING	SAME AS OTHER USE					
63-3430	STATE OF IDAHO DEPT. OF FISH & GAME P.O. BOX 25 BOISE, ID 83720	09-14-1964	IRRIGATION HEATING DOMESTIC	04-01 01-01 01-01	10-31 12-31 12-31	.04 CFS 9.00 AFA .34 CFS 85.00 AFA .04 CFS 2.00 AFA .38 CFS TOTAL 96.00 AFA TOTAL	LICENSE

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
63-3430	SOURCE: GROUNDWATER	TRIBUTARY:					
	OTHER USES: G/ HEATING & COOLING						
	REMARKS: 2 P/D IN NENW, SEC. 14, T03N, R02E.						
	POINT OF DIVERSION: T03N R02E S14 NENW						
	PLACE OF USE: IRRIGATION T03N R02E S14 NENW 2						
	2 ACRES TOTAL						
	PLACE OF USE: HEATING	SAME AS OTHER USE					
	PLACE OF USE: DOMESTIC	SAME AS OTHER USE					
63-5073	BOISE WARM SPRINGS WATER DIST. P.O. BOX 114 BOISE, ID 83701	11-05-1894	HEATING DOMESTIC	01-01 01-01	12-31 12-31	12.81 CFS 4.27 CFS 12.80 CFS TOTAL AFA TOTAL	STATRY CLAIM
	SOURCE: GROUNDWATER	TRIBUTARY:					
	OTHER USES: G/238 HOMES D/207 HOMES						
	REMARKS: P/U 680 AC.						
	POINT OF DIVERSION: T03N R02E S12 SESW						
	PLACE OF USE: HEATING T03N R02E S10 NENE SWNE SENE NESE S11 SWNW NESW NWSW SESW NESE NWSE SWSE SESE S12 SESW SWSE S13 NENW NWNW S14 NENE						
	PLACE OF USE: DOMESTIC	SAME AS OTHER USE					

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	TO	MAXIMUM DIVERSION	STAGE
63-5195	STIRALOW, RAYMOND F. STIRALOW, VERA K. 3911 WHITEBIRD BOISE, ID 83703	01-01-1900	IRRIGATION HEATING DOMESTIC	03-15 01-01 01-01	11-15 12-31 12-31	.06 CFS .74 CFS .10 CFS .90 CFS TOTAL AFA TOTAL	STATRY CLAIM
	SOURCE: GROUNDWATER	TRIBUTARY:					
	OTHER USES: D/6 HOMES						
	POINT OF DIVERSION: T04N R02E S29 SWNE						
	PLACE OF USE: IRRIGATION T04N R02E S29 SWNE 2						
	2 ACRES TOTAL						
	PLACE OF USE: HEATING	SAME AS OTHER USE					
	PLACE OF USE: DOMESTIC	SAME AS OTHER USE					
63-5291	BRIGGS, WELTHA W. BRIGGS, P.E., CARLYLE W. 619 GROVE ST. BOISE, ID 83702	01-01-1905	IRRIGATION HEATING COOLING DOMESTIC	03-15 01-01 01-01 01-01	10-31 12-31 12-31 12-31	.04 CFS .10 CFS .10 CFS .02 CFS .16 CFS TOTAL AFA TOTAL	STATRY CLAIM
	SOURCE: GROUNDWATER	TRIBUTARY:					
	POINT OF DIVERSION: T03N R02E S17 NWNW						
	PLACE OF USE: IRRIGATION T03N R02E S17 NWNW 2						
	2 ACRES TOTAL						
	PLACE OF USE: HEATING	SAME AS OTHER USE					
	PLACE OF USE: COOLING	SAME AS OTHER USE					
	PLACE OF USE: DOMESTIC	SAME AS OTHER USE					

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
63-8627	HARRIS, DALLAS H. H & H RANCHES 200 WISE WAY BOISE, ID 83706	03-21-1977	IRRIGATION HEATING	03-15 11-15 10-01 06-01	3.00 CFS 3.00 CFS 6.00 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER OTHER RIGHTS: BOISE RIVER. CONDITIONS OF APPROVAL: 01 03A	TRIBUTARY:				
	POINT OF DIVERSION: T03N R03E S20 NESW					
	PLACE OF USE: IRRIGATION T03N R03E S19 NESE 20 SESE 25 S20 NESW 10 NWSW 30 SWSW 35 SESW 35 SWSE 2 S29 NWNE 3 NENW 25 NWNW 10					
	195 ACRES TOTAL					
	PLACE OF USE: HEATING	SAME AS OTHER USE				
63-8681	BARNES, LILLIAN 7777 PIERCE PARK LN. RT. 1 BOISE, ID 83702	04-11-1977	HEATING DOMESTIC	09-01 05-31 01-01 12-31	.04 CFS .04 CFS .08 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER	TRIBUTARY:				
	POINT OF DIVERSION: T04N R02E S08 SWSE					
	PLACE OF USE: DOMESTIC T04N R02E S08 SWSE					
	PLACE OF USE: HEATING	SAME AS OTHER USE				
63-8861	ORE IDA FOODS INC. 220 W. PARKCENTER BLVD. BOISE, ID 83706	05-23-1977	IRRIGATION HEATING	04-01 10-31 01-01 12-31	.07 CFS 1.35 CFS 1.42 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER	TRIBUTARY:				
	OTHER USES: G/HEATING & COOLING.					
	REMARKS: AC. IRR.=3.3.					

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
63-8861	REMARKS: P/U LOT 6, BLK. 1, PARKCENTER BUSINESS PK.						
	POINT OF DIVERSION: T03N R02E S14 SENW						
	PLACE OF USE: IRRIGATION T03N R02E S14 SWNE 2 SENW 2						
	4 ACRES TOTAL						
	PLACE OF USE: HEATING T03N R02E S14 SENW						
63-8866	ALBERTSONS INC. 250 PARKCENTER BLVD. BOISE, ID 83706	05-23-1977	IRRIGATION HEATING	04-01 01-01	10-31 12-31	.30 CFS 6.18 CFS 6.48 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER TRIBUTARY:						
	OTHER USES: G/HEATING & COOLING.						
	REMARKS: AC. IRR.=15.1. P/U LOT 8, BLK. 1, PARKCENTER BUSINESS PK.						
	POINT OF DIVERSION: T03N R02E S14 SWNE						
	PLACE OF USE: IRRIGATION T03N R02E S14 SWNE 15						
	15 ACRES TOTAL						
	PLACE OF USE: HEATING SAME AS OTHER USE						
63-8867	ALBERTSONS INC. 250 PARKCENTER BLVD. BOISE, ID 83706	05-23-1977	IRRIGATION HEATING COOLING	04-01 01-01 01-01	10-31 12-31 12-31	.08 CFS 1.56 CFS 1.56 CFS 1.64 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER TRIBUTARY:						
	REMARKS: AC. IRR.=3.8. P/U LOT 9, BLK. 1, PARKCENTER BUSINESS PK.						

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
63-8867	POINT OF DIVERSION: T03N R02E S14 SWNE						
	PLACE OF USE: IRRIGATION T03N R02E S14 NWNE 2 SWNE 2						
	4 ACRES TOTAL						
	PLACE OF USE: HEATING	SAME AS OTHER USE					
	PLACE OF USE: COOLING	SAME AS OTHER USE					
63-8868	ALBERTSONS INC. P.O. BOX 20 BOISE, ID 83726	05-23-1977	IRRIGATION HEATING COOLING	04-01 01-01 01-01	10-31 12-31 12-31	.05 CFS 1.02 CFS 1.02 CFS 1.07 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER	TRIBUTARY:					
	OTHER USES: G/HEATING & COOLING.						
	REMARKS: AC. IRR.=2.5. P/U LOT 10, BLK. 1, PARKCENTER BUSINESS PK.						
	POINT OF DIVERSION: T03N R02E S14 SWNE						
	PLACE OF USE: IRRIGATION T03N R02E S14 SWNE 2						
	2 ACRES TOTAL						
	PLACE OF USE: HEATING	SAME AS OTHER USE					
	PLACE OF USE: COOLING	SAME AS OTHER USE					
63-8869	ALSCOTT INC. 500 E. BAYBROOK CT. BOISE, ID 83706	06-04-1977	IRRIGATION HEATING COOLING	04-01 01-01 01-01	10-31 12-31 12-31	.06 CFS 1.23 CFS 1.23 CFS 1.29 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER	TRIBUTARY:					
	OTHER USES: G/HEATING & COOLING.						

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
63-8869	REMARKS: P/U LOT 11, BLK. 1, PARKCENTER BUSINESS PK. REINSTATED 1/11/83.					
	POINT OF DIVERSION: T03N R02E S14 SENE					
	PLACE OF USE: IRRIGATION T03N R02E S14 SENE 3					
	3 ACRES TOTAL					
	PLACE OF USE: HEATING	SAME AS OTHER USE				
	PLACE OF USE: COOLING	SAME AS OTHER USE				
63-8870	J. A. ALBERTSON ENTERPRISES 380 E. PARKCENTER BLVD. BOISE, ID 83706	06-04-1977	IRRIGATION HEATING COOLING	04-01 10-31 01-01 12-31 01-01 12-31	.05 CFS .94 CFS .94 CFS .99 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER	TRIBUTARY:				
	OTHER USES: G/HEATING & COOLING.					
	REMARKS: AC. IRR.=2.03. REINSTATED 1-11-1983.					
	POINT OF DIVERSION: T03N R02E S14 SWNE					
	PLACE OF USE: IRRIGATION T03N R02E S14 SWNE 1 SENE 2					
	3 ACRES TOTAL					
	PLACE OF USE: HEATING T03N R02E S14 SENE					
	PLACE OF USE: COOLING	SAME AS OTHER USE				
63-8878	J. A. ALBERTSON ENTERPRISES 345 BOBWHITE CT. BOISE, ID 83706	06-04-1977	IRRIGATION HEATING COOLING	04-01 10-31 01-01 12-31 01-01 12-31	.04 CFS .82 CFS .82 CFS .84 CFS TOTAL AFA TOTAL	PERMIT

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
63-8878	SOURCE: GROUNDWATER TRIBUTARY:					
	OTHER USES: G/HEATING & COOLING OF BLDG.					
	REMARKS: P/U LOT 2, BLK. 3, PARKCENTER BUSINESS PK. REINSTATED 1-11-1983.					
	POINT OF DIVERSION: T03N R02E S14 SENW					
	PLACE OF USE: IRRIGATION T03N R02E S14 SENW 1 NESW 1					
	2 ACRES TOTAL					
	PLACE OF USE: HEATING SAME AS OTHER USE					
	PLACE OF USE: COOLING SAME AS OTHER USE					
63-8888	EMKAY DEVELOPMENT & REALTY CO. M-K PLAZA ONE BOISE, ID 83706	12-17-1977	IRRIGATION HEATING COOLING	04-01 10-31 01-01 12-31 01-01 12-31	.04 CFS .86 CFS .86 CFS .90 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER TRIBUTARY:					
	OTHER USES: G/HEATING & COOLING OF BLDGS.					
	REMARKS: AC. IRR.=2.1. REINSTATED 2-14-1983.					
	POINT OF DIVERSION: T03N R02E S14 NWSE					
	PLACE OF USE: IRRIGATION T03N R02E S14 NWSE 2					
	2 ACRES TOTAL					
	PLACE OF USE: HEATING SAME AS OTHER USE					
	PLACE OF USE: COOLING SAME AS OTHER USE					

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
63-8958	THUMMEL, GERALD F. 5211 HILL RD. BOISE, ID 83703	06-16-1977	IRRIGATION	04-15	10-15	.10 CFS	PERMIT
			HEATING	10-15	04-15	.10 CFS	
			DOMESTIC	01-01	12-31	.10 CFS	
						.10 CFS TOTAL	
						AFA TOTAL	

SOURCE: GROUNDWATER TRIBUTARY:
OTHER RIGHTS: BOISE VALLEY IRR. DIST.
CONDITIONS OF APPROVAL: 03A

POINT OF DIVERSION:
T04N R02E S19 NESE

PLACE OF USE: IRRIGATION
T04N R02E S19 NESE 5

5 ACRES TOTAL

PLACE OF USE: HEATING SAME AS OTHER USE

PLACE OF USE: DOMESTIC SAME AS OTHER USE

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
✓63-9138	CITY OF BOISE C/O LOUIS URANGA P.O. BOX 500 BOISE, ID 83701	04-17-1978	IRRIGATION	04-01	10-15	8.00 CFS	PERMIT
			COMMERCIAL	01-01	12-31	8.00 CFS	
			FISH PROPAGATION	01-01	12-31	8.00 CFS	
			HEATING	01-01	12-31	8.00 CFS	
			COOLING	01-01	12-31	8.00 CFS	
						8.00 CFS TOTAL	
						AFA TOTAL	

SOURCE: GROUNDWATER TRIBUTARY:

OTHER USES: C/VARIOUS G/SPACE HEATING & COOLING.
OTHER RIGHTS: 63-9139.
CONDITIONS OF APPROVAL: 01 04 09 16

REMARKS: P/U WITHIN CITY LIMITS OF BOISE.
NOT TO EXCEED 17.35 CFS.
3 P/D IN SWSE, S34, T4N, R2E.

POINT OF DIVERSION:
T04N R02E S34 SWSE

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	TO	MAXIMUM DIVERSION	STAGE
63-9139	BOISE GEOTHERMAL LTD. 331 W. IDAHO P.O. BOX 500 BOISE, ID 83701	04-17-1978	IRRIGATION HEATING COOLING MUNICIPAL	04-01 01-01 01-01 01-01	10-15 12-31 12-31 12-31	12.00 CFS 12.00 CFS 12.00 CFS 12.00 CFS 12.00 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER CONDITIONS OF APPROVAL: 01 04 09 16	TRIBUTARY:					
	REMARKS: P/U WITHIN CITY LIMITS OF BOISE. 2 P/D NENW, S2, T3N, R2E.4 2 P/D NENW, S11, T3N, R2E.						
	POINT OF DIVERSION: T03N R02E S02 SWSW SESW S11 NENW						
63-9160	BOISE WARM SPRINGS WATER DIST. 2440 OLD PENITENTIARY RD. BOISE, ID 83712	06-27-1978	HEATING DOMESTIC	01-01 01-01	12-31 12-31	4.00 CFS 4.00 CFS 4.00 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER CONDITIONS OF APPROVAL: 01C 04 10	TRIBUTARY:					
	REMARKS: P/U WITHIN BOISE WARM SPRINGS WATER DIST.						
	POINT OF DIVERSION: T03N R02E S12 SESW						
63-9215	STATE OF IDAHO DEPT. OF ADMINISTRATION RM. 125 LEN B. JORDAN BLDG. BOISE, ID 83720	03-02-1979	HEATING	01-01	12-31	9.00 CFS	PERMIT
	SOURCE: GROUNDWATER	TRIBUTARY:					
	OTHER USES: SPACE HEATING OF STATE BUILDINGS CONDITIONS OF APPROVAL: 01B 04 09						
	POINT OF DIVERSION: T03N R02E S13 SWNE						

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM TO	MAXIMUM DIVERSION	STAGE
63-9215	PLACE OF USE: HEATING T03N R02E S10 NENE NWNE SWSW SESW SWSE SESE S15 NENE NWNE NENW NWNW					
63-9341	STATE OF IDAHO DEPT. OF ADMINISTRATION LEN B. JORDAN BUILDING #100 BOISE, ID 83720	02-06-1980	HEATING	01-01 12-31	5.57 CFS	PERMIT
	SOURCE: GROUNDWATER TRIBUTARY:					
	OTHER USES: GEOTHERMALLY SPACE HEAT IDAHO STATE CAPITOL MALL CONDITIONS OF APPROVAL: 01C 09C 16					
	POINT OF DIVERSION: T03N R02E S10 NENE					
	PLACE OF USE: HEATING T03N R02E S10 NENE					
63-9343	HARRIS, DALLAS H. 3051 S. WISE WAY BOISE, ID 83702	02-12-1980	COMMERCIAL HEATING	01-01 12-31 01-01 12-31	6.00 CFS 6.00 CFS 6.00 CFS TOTAL AFA TOTAL	PERMIT
	SOURCE: GROUNDWATER TRIBUTARY:					
	OTHER USES: FISH PROP, GREENHOUSE, SWIMMING POOL, SPACE HEATING CONDITIONS OF APPROVAL: 26 16					
	REMARKS: THIS PERMIT IS SUBJECT TO THE AGREEMENT DATED 5/31/85 BETWEEN PERMIT HOLDER & PROTESTANT(S) TO THE EXTENT SUCH AGREEMENT COVERS MATTER WITHIN THE JURISDICTION OF THE IDWR. A FLOW MEASUREMENT PORT OR OTHER DEVICE AS SPECIFIED BY THE DEPT SHALL BE INSTALLED BY THE PERMIT HOLDER TO PROVIDE FOR THE INSTALLATION OF MEASURING EQUIP. & THE DETERMINATION OF THE RATE OF DIV. & PRESSURES BY THE DEPT. RETURN FLOW IF DISCHARGED TO A SUBSURFACE SYSTEM MUST BE AUTHORIZED BY A SEP. INJECTION WELL PERMIT & RETURN FLOW IF DISCHARGED TO A SURFACE WTR SYSTEM SHALL MEET IDAHO WATER QUALITY STANDARDS. IF DISCHARGED TO THE SURFACE, THE DISCHARGE SHALL BE PERMITTED OR APPROVED BY THE U.S. EPA. THE MAX. RATE OF DIV. OF WTR UNDER THIS PERMIT SHALL NOT EXCEED 6.0 CFS. PERMIT HOLDER SHALL SUBMIT FOR EACH WELL TO THE DEPT. A DRILLING PROSPECTUS WHICH INCLUDES PROPOSED CASING & GROUTING PROCEDURES FOR REVIEW & APPROVAL PRIOR TO DRILLING.					

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE

63-9343 REMARKS: THE DIRECTOR RETAINS JURISDICTION OF THIS PERMIT & MAY REQUIRE REINJECTION OF THE WATER IF DETERMINED TO BE NECESSARY FOR PROTECTION OF THE RESOURCE OR OTHER WATER RTS.

POINT OF DIVERSION:

T03N R03E S19		NESW
		NESE
		NWSE
		SESE
	S20	NENW
		SENW
		NESW
		NWSW
		SWSW
		SESW
		SWSE
		SESE
	S21	SWSW
	S28	NWNW
		SWNW
		NWSW
	S29	NENE
		NWNE

PLACE OF USE: COMMERCIAL

T02N R03E S04	NWNE	NENW	NWNW					
T03N R03E S19	NESW	NESE	NWSE	SWSE	SESE			
S20	NENE	NWNE	SWNE	SENE	NENW	NWNW	SWNW	
	SENW	NESW	NWSW	SWSW	SESW	NESE	NWSE	
	SWSE	SESE						
S21	SWSW							
S28	NWNW	SWNW	NWSW					
S29	NENE	NWNE	SWNE	SENE	NENW	NWNW	SWNW	
	SENW	NESW	NWSW	SWSW	SESW	NESE	NWSE	
	SWSE	SESE						
S30	NENE	SENE						
S32	NWNE	SWNE	NENW	SENW	NESE	NWSE	SESE	
S33	SWSW	SESW						

PLACE OF USE: HEATING SAME AS OTHER USE

63-9828	JOHNSON, WAYNE 2301 IRENE ST. BOISE, ID 83702	11-03-1981	HEATING DOMESTIC	01-01 01-01	12-31 12-31	.04 CFS .04 CFS .08 CFS TOTAL AFA TOTAL	PERMIT

RIGHT NUMBER	NAME AND ADDRESS	PRIORITY DATE	WATER USE	USE PERIOD FROM	USE PERIOD TO	MAXIMUM DIVERSION	STAGE
63-9828	SOURCE: GROUNDWATER	TRIBUTARY:					
	OTHER USES: G/HEATING OF DOMESTIC HOME CONDITIONS OF APPROVAL: 16						
	POINT OF DIVERSION: T04N R02E S33 SWSE						
	PLACE OF USE: HEATING T04N R02E S33 SWSE						
	PLACE OF USE: DOMESTIC	SAME AS OTHER USE					
63-9890	GOFF, JAMES A. VETERANS ADMN. MEDICAL CENTER 5TH AND FORT ST. BOISE, ID 83702	04-19-1982	HEATING	01-01	12-31	2.23 CFS	PERMIT
	SOURCE: GROUNDWATER CONDITIONS OF APPROVAL: 16	TRIBUTARY:					
	POINT OF DIVERSION: T03N R02E S02 NWSW SESW						
	PLACE OF USE: HEATING T03N R02E S02 NESW NWSW SWSW SESW						

State of Idaho
DEPARTMENT OF WATER RESOURCES
Southern Region, 2148 4th Ave. East, Twin Falls, Idaho 83301 (208) 734-3578

CECIL D. ANDRUS
Governor

R. KEITH HIGGINSON
Director

February 15, 1989

Ken Taylor
U.S. Department of Energy
785 DOE Place
Idaho Falls, Idaho 83402

Dear Ken:

I have spoken with the U.S. Geological Survey Boise office personnel regarding their deliquent report. I was told that it is still at the General Printing Office and should be out by the end of March. I am thereby requesting a no cost extension to Instrument # DE-FG07-84ID12549 until June 1, 1989. I'm hoping that we can wrap this up sooner than that.

Thank you for your patience and if you have any questions, please contact me at 734-3578.

Sincerely,

Leah V. Street
Hydrogeologist

CC: Howard Ross

DOE F 4600.1
(7-81)

U.S. DEPARTMENT OF ENERGY

NOTICE OF FINANCIAL ASSISTANCE AWARD

(See Instructions on Reverse)

Rec 11/24/86

Under the authority of Public Law 93-410 and subject to legislation, regulations and policies applicable to *(cite legislative program title)*:
Geothermal Research, Development and Demonstration Act of 1977

1. PROJECT TITLE
Geothermal Resource Evaluation in Idaho

2. INSTRUMENT TYPE
☒ GRANT ☐ COOPERATIVE AGREEMENT

3. RECIPIENT *(Name, address, zip code, area code and telephone no.)*
State of Idaho
Department of Water Resources, Statehouse
Boise, Idaho 83702

4. INSTRUMENT NO.
DE-FG07-84ID12549

5. AMENDMENT NO.
M005

6. BUDGET PERIOD
FROM: 6/1/86 THRU: 6/1/87

7. PROJECT PERIOD
FROM: 8/17/84 THRU: 6/1/87

8. RECIPIENT PROJECT DIRECTOR *(Name and telephone No.)*
Leah V. Street

10. TYPE OF AWARD
☐ NEW ☐ CONTINUATION ☐ RENEWAL
☒ REVISION ☐ SUPPLEMENT

9. REC
New Address 11/21/86
Sam
Leah V. Street
Idaho Dept. of Water Resources
Southern Division
2148 4th Ave. East
Twin Falls, ID 83301
(208) 734-3578

11. DO
Peg
U.S
785
No.)

12. ADMINISTERED FOR DOE BY *(Name, address, zip code, telephone No.)*
Ronald A. King (208) 526-0790
U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

13. RE
☐ GOV'T ☐ HOSPITAL ☐ FOR PROFIT ORGANIZATION ☐ INDIVIDUAL
IF TION ☐ OTHER NONPROFIT ORGANIZATION ☐ C ☐ P ☐ SP ☐ OTHER *(Specify)*

14. AC
a.
N/

15. EMPLOYER I.D. NUMBER/SSN

FT/AFP/OC | d. CFA Number

16. BU
a. (

b. CUMULATIVE DOE OBLIGATIONS

(1) DC	-0-	(1) This Budget Period [Total of lines a.(1) and a.(3)]	$ 138,724
(2) DOE Funds Authorized for Carry Over	$ -0-		
(3) DOE Funds Previously Obligated in this Budget Period	$ 138,724	(2) Prior Budget Periods	$ 19,855
(4) DOE Share of Total Approved Budget	$ 138,724		
(5) Recipient Share of Total Approved Budget	$ -0-	(3) Project Period to Date [Total of lines b. (1) and b. (2)]	$ 158,579
(6) Total Approved Budget	$ 138,724		

17. TOTAL ESTIMATED COST OF PROJECT $ _____

(This is the current estimated cost of the project. It is not a promise to award nor an authorization to expend funds in this amount.)

18. AWARD/AGREEMENT TERMS AND CONDITIONS

This award/agreement consists of this form plus the following:

a. Special terms and conditions (if grant) or schedule, general provisions, special provisions (if cooperative agreement)

b. Applicable program regulations *(specify)* _____ *(Date)* _____

c. DOE Assistance Regulations, 10 CFR Part 600, as amended, Subparts A and ☒ B (Grants) or ☐ C (Cooperative Agreements).

d. Application/proposal dated 9/30/86, ☐ as submitted ☒ with changes as negotiated

19. REMARKS
This document extends the budget period and project period with no increase in the approved budget or the DOE obligated funds.

20. EVIDENCE OF RECIPIENT ACCEPTANCE

_____
(Signature of Authorized Recipient Official) *(Date)*

_____
(Name)

_____
(Title)

21. AWARDED BY

William C. Drake 11/18/86
(Signature) *(Date)*

William C. Drake
(Name)

Contracting Officer
(Title)

DOE F 4600.1 (7-81)

U.S. DEPARTMENT OF ENERGY

NOTICE OF FINANCIAL ASSISTANCE AWARD

(See Instructions on Reverse)

JUN 08 1987

Under the authority of Public Law 93-410 and subject to legislation, regulations and policies applicable to *(cite legislative program title)*:

Geothermal Research, Development and Demonstration Act of 1977 Department of Water Resources

1. PROJECT TITLE
Geothermal Resource Evaluation in Idaho

2. INSTRUMENT TYPE
XX GRANT ☐ COOPERATIVE AGREEMENT

3. RECIPIENT *(Name, address, zip code, area code and telephone no.)*
State of Idaho
Department of Water Resources, Statehouse

4. INSTRUMENT NO.
DE-FG07-84ID12549 A

5. AMENDMENT NO.
A006

6. BUDGET PERIOD
FROM: 10/1/85 THRU: ~~2/28/87~~ 9/30/87

7. PROJECT PERIOD
FROM: 8/17/84 THRU: 9/30/87

8. RECIPIENT PROJECT DIRECTOR *(Name and telephone No.)*
Leah V. Street

9. RECIPIENT BUSINESS OFFICER *(Name and telephone No.)*
Same as Item #8.

10. TYPE OF AWARD
☐ NEW ☐ CONTINUATION ☐ RENEWAL
XX REVISION ☐ SUPPLEMENT

11. DOE PROJECT OFFICER *(Name, address, zip code, telephone No.)*
Peggy A. Brookshier (208) 526-1403
U.S. DOE, Idaho Operations Office
785 DOE Place, Idaho Falls, ID 83402

12. ADMINISTERED FOR DOE BY *(Name, address, zip code, telephone No.)*
R. Jeffrey Hoyles (208) 526-0790
U.S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

13. RECIPIENT TYPE
☒ STATE GOV'T ☐ INDIAN TRIBAL GOV'T ☐ HOSPITAL ☐ FOR PROFIT ORGANIZATION ☐ INDIVIDUAL
☐ LOCAL GOV'T ☐ INSTITUTION OF HIGHER EDUCATION ☐ OTHER NONPROFIT ORGANIZATION ☐ C ☐ P ☐ SP ☐ OTHER *(Specify)*

14. ACCOUNTING AND APPROPRIATIONS DATA

a. Appropriation Symbol	b. B & R Number	c. FT/AFP/OC	d. CFA Number
N/A			

15. EMPLOYER I.D. NUMBER/SSN

16. BUDGET AND FUNDING INFORMATION

a. CURRENT BUDGET PERIOD INFORMATION		b. CUMULATIVE DOE OBLIGATIONS	
(1) DOE Funds Obligated This Action	$ -0-	(1) This Budget Period [Total of lines a.(1) and a.(3)]	$ 138,724
(2) DOE Funds Authorized for Carry Over	$ -0-	(2) Prior Budget Periods	$ 19,855
(3) DOE Funds Previously Obligated in this Budget Period	$ 138,724		
(4) DOE Share of Total Approved Budget	$ 138,724	(3) Project Period to Date [Total of lines b. (1) and b. (2)]	$ 158,579
(5) Recipient Share of Total Approved Budget	$ -0-		
(6) Total Approved Budget	$ 138,724		

17. TOTAL ESTIMATED COST OF PROJECT $ _____

(This is the current estimated cost of the project. It is not a promise to award nor an authorization to expend funds in this amount.)

18. AWARD/AGREEMENT TERMS AND CONDITIONS

This award/agreement consists of this form plus the following:

a. Special terms and conditions (if grant) or schedule, general provisions, special provisions (if cooperative agreement)

b. Applicable program regulations *(specify)* _____ *(Date)* _____

c. DOE Assistance Regulations, 10 CFR Part 600, as amended, Subparts A and ☒ B (Grants) or ☐ C (Cooperative Agreements).

d. Application/proposal dated 3/17/86, ☐ as submitted XX with changes as negotiated

19. REMARKS

This document revises budget plans, within existing budget dollar ceilings, as attached, and provides a no-cost time extension to 9/30/87.

20. EVIDENCE OF RECIPIENT ACCEPTANCE

Wayne T. Haas 6/16/87
(Signature of Authorized Recipient Official) *(Date)*

Wayne T. Haas
(Name)

Administrator, Resource Analysis Division
(Title)

21. AWARDED BY

R. Jeffrey Hoyles 6/24/87
(Signature) *(Date)*

R. Jeffrey Hoyles
(Name)

Contracting Officer
(Title)

FEDERAL ASSISTANCE BUDGET INFORMATION FORM

FORM EIA-459C
(10/80)

FORM APPROVED
OMB No. 1900-0127

1. Program/Project Identification No.	2. Program/Project Title
DE-FG07-84ID12549	Geothermal Resource Evaluation in Idaho

3. Name and Address	4. Program/Project Start Date
State of Idaho Department of Water Resources Boise, ID 83702	8/17/84
	5. Completion Date 9/30/87

SECTION A - BUDGET SUMMARY

Grant Program, Function or Activity	Federal Catalog No.	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
BUDGET CATEGORY						
1. Other Direct		$	$	$ (3,000)	$	$ 3,175
2. Subcontracts (USGS)				+3,000		44,200
3.						
4.						
5. TOTALS		$	$	$	$	$

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	Grant Program, Function or Activity				Total (5)
	(1)	(2)	(3)	(4)	
a. Personnel	$ 40,936	$	$	$	$ 40,936
b. Fringe Benefits	9,415				9,415
c. Travel	3,800				3,800
d. Equipment	2,500				2,500
e. Supplies	828				828
f. Contractual	44,200				44,200
g. Construction	10,132				10,132
h. Other	3,175				3,175
i. Total Direct Charges	114,986				114,986
j. Indirect Charges	23,738				23,738
k. TOTALS	$ 138,724	$	$	$	$ 138,724
7. Program Income	$ -0-	$	$	$	$ -0-

DOE F 4600.1
(8-81)

U.S. DEPARTMENT OF ENERGY

NOTICE OF FINANCIAL ASSISTANCE AWARD

(See Instructions on Reverse)

6 Jan 86

Under the authority of Public Law 93-410 and subject to legislation, regulations and policies applicable to *(cite legislative program title)*:

Geothermal R&D Act of 1977

1. PROJECT TITLE
Geothermal Resource Analysis in Twin Falls, ID

2. INSTRUMENT TYPE
☒ GRANT ☐ COOPERATIVE AGREEMENT

4. INSTRUMENT NO.
DE-FG07-84ID12549

5. AMENDMENT NO.
A003

3. RECIPIENT *(Name, address, zip code, area code and telephone no.)*
Idaho Department of Water Resources
Southern Division
1041 Blue Lakes Blvd., Twin Falls, ID 83301

6. BUDGET PERIOD
FROM: 10/1/85 THRU: 2/28/87

7. PROJECT PERIOD
FROM: 8/17/84 THRU: 2/28/87

8. RECIPIENT PROJECT DIRECTOR *(Name and telephone No.)*
Leah Street (208) 734-3578

10. TYPE OF AWARD
☐ NEW ☐ CONTINUATION ☐ RENEWAL
☒ REVISION ☐ SUPPLEMENT

9. RECIPIENT BUSINESS OFFICER *(Name and telephone No.)*
Wayne Hass (208) 334-4440
450 W. State St., Boise, ID 83720

12. ADMINISTERED FOR DOE BY *(Name, address, zip code, telephone No.)*
Ronald A. King (208) 526-0790
United States Department of Energy
Idaho Operations Office
785 DOE Place, Idaho Falls, ID 83402

11. DOE PROJECT OFFICER *(Name, address, zip code, telephone No.)*
Peggy A. M. Brookshier, U.S. DOE
785 DOE Place
Idaho Falls, ID 83402 (208) 526-1403

13. RECIPIENT TYPE
☒ STATE GOV'T ☐ INDIAN TRIBAL GOV'T ☐ HOSPITAL ☐ FOR PROFIT ORGANIZATION ☐ INDIVIDUAL
☐ LOCAL GOV'T ☐ INSTITUTION OF HIGHER EDUCATION ☐ OTHER NONPROFIT ORGANIZATION ☐ C ☐ P ☐ SP ☐ OTHER *(Specify)*

14. ACCOUNTING AND APPROPRIATIONS DATA

a. Appropriation Symbol	b. B & R Number	c. FT/AFP/OC	d. CFA Number
89X0224.91	AM1510000	ID-54-91/410	

15. EMPLOYER I.D. NUMBER/SSN

16. BUDGET AND FUNDING INFORMATION

a. CURRENT BUDGET PERIOD INFORMATION

(1) DOE Funds Obligated This Action	$ 60,000 with
(2) DOE Funds Authorized for Carry Over	$ ~~79,994~~ 72
(3) DOE Funds Previously Obligated in this Budget Period	$ -0-
(4) DOE Share of Total Approved Budget	$ 138,724
(5) Recipient Share of Total Approved Budget	$ -0-
(6) Total Approved Budget	$ 138,724

b. CUMULATIVE DOE OBLIGATIONS

(1) This Budget Period *[Total of lines a.(1) and a.(3)]*	$ 60,000
(2) Prior Budget Periods	$ 98,579
(3) Project Period to Date *[Total of lines b. (1) and b. (2)]*	$ 158,579

17. TOTAL ESTIMATED COST OF PROJECT $ 158,579

(This is the current estimated cost of the project. It is not a promise to award nor an authorization to expend funds in this amount.)

18. AWARD/AGREEMENT TERMS AND CONDITIONS

This award/agreement consists of this form plus the following:

a. Special terms and conditions (if grant) or schedule, general provisions, special provisions (if cooperative agreement)

b. Applicable program regulations *(specify)* _____ *(Date)* _____

c. DOE Assistance Regulations, 10 CFR Part 600, as amended, Subparts A and ☒ B (Grants) or ☐ C (Cooperative Agreements).

d. Application/proposal dated 4/30/85. ☐ as submitted ☒ with changes as negotiated

19. REMARKS

This modification increases the scope by adding additional work as described in the Statement of Work (Part III.a) and increases the funding as provided in the revised Budget Plan (Part I).

20. EVIDENCE OF RECIPIENT ACCEPTANCE

Wayne T. Haas 12/12/85
(Signature of Authorized Recipient Official) *(Date)*

Wayne T. Haas
(Name)

Administrator, Resource Analysis Division
(Title)

21. AWARDED BY

William C. Drake 12/3/85
(Signature) *(Date)*

William C. Drake
(Name)

Contracting Officer
(Title)

INSTRUCTIONS

(This form shall be completed in accordance with the following instructions. For any clarification or additional information that might be needed, consult the appropriate section of the DOE Financial Assistance Procedures Manual (DOE-FAPM).

Insert in the space provided, in the line which begins, "Under the Authority of Public Law . . . ," the number and the name of the Public Law which authorizes this award. On the line below, enter the title of the pertinent program.

Block 1 - Enter the project title as it appears in the SF-424 or equivalent application/proposal face sheet.

Block 2 - Place a checkmark in the box beside the appropriate financial assistance instrument.

Block 3 - Enter the name, address and telephone number of the applicant/proposer as it appears in the SF-424 or equivalent application/proposal face sheet.

Block 4 - Enter the instrument number. (See DOE-FAPM.)

Block 5 - Enter the appropriate amendment number. (See DOE-FAPM for guidance.)

Block 6 - Enter the starting date and expiration date for the current budget period. If a budget period is being changed, enter the starting date and expiration date for the budget period, as changed.

Block 7 - Enter the starting date and anticipated completion date for the project. If a project period is being changed, enter the starting date and anticipated completion date for the project period, as changed.

Block 8 - Enter the name and telephone number of the individual designated by the applicant/proposer as the director of the project.

Block 9 - Enter the name and telephone number of the individual designated by the applicant/proposer as the contact for all business matters.

Block 10 - Place a checkmark in the box opposite the term which identifies the type of action being taken. (The terms are defined in the DOE-FAPM.)

Block 11 - Enter the name, address and telephone number of the individual designated by the DOE program office as the project officer.

Block 12 - Enter the name, address and telephone number of the individual/organization who will administer the agreement for DOE.

Block 13 - Place a checkmark in the box beside the applicable recipient type. If the recipient is a for-profit organization also check one of the lower boxes as follows: "C" for Corporation, "P" for Partnership and "SP" for Sole Proprietorship. If the recipient is of a type not indicated place a checkmark in the box beside "Other," and identify the recipient type in the space provided.

Block 14 - Enter where indicated, the appropriation symbol, B&R number, Fund Type (FT)/AFP Code (AFP)/Objective Class (OC) and CFA Number from the Procurement/Financial Assistance Request Authorization (DOE Form PR-799A). Completion of Block 14.d. is required only for awards made by Headquarters.

Block 15 - Enter the applicant's/proposer's Federal Employer Identification No. from the SF-424 or equivalent application/proposal face sheet, or if the applicant/proposer is an individual, enter his/her social security number.

Block 16 - Entries should be made as follows. (If no dollar entry is appropriate a zero should be entered to indicate there was no error of omission.)

Line a.(1) - Enter the amount of DOE funds obligated by this action.

Line a.(2) - Enter the amount of DOE funds not expended in prior budget period(s), if any, authorized by DOE for expenditure in the current budget period.

Line a.(3) - Enter the amount of DOE funds previously obligated in the current budget period.

Line a.(4) - Enter DOE's share of the total approved budget shown on Line a.(6).

Line a.(5) - Enter the recipient's share of the total approved budget shown on Line a.(6).

Line a.(6) - Enter the total approved budget for the current budget period. (Add the amounts in lines a.(4) and a.(5).)

Line b.(1) - Enter the amount of DOE funds obligated in the current budget period. (Add the amounts in lines a.(1) and a.(3).)

Line b.(2) - Enter the amount obligated by DOE in prior budget periods.

Line b.(3) - Enter the amount obligated by DOE in the project period to date. (Add the amounts in lines b.(1) and b.(2).)

Block 17 - Must be completed for cooperative agreements. Contracting Officers may exercise discretion as to whether to complete it for grants. Enter in the blank provided, the amount which represents the current estimate of total funds and dollar value of in-kind contributions (both DOE and recipient shares) needed to carry out the entire project. Include all funds and contributions previously provided, those being provided by this action, and all anticipated future obligations and contributions of both parties.

Block 18 - Complete as follows:

Item a. - No entry necessary.

Item b. - Enter the legal citation from the Code of Federal Regulations or Federal Register and the effective date for the program regulations applicable to the program under which the award is made.

Item c. - Mark the box beside B for grants or C for cooperative agreements.

Item d. - In the blank provided, enter the date of the application/proposal. (If SF-424 is used, see block 23c on page 1.) Place a checkmark in the appropriate box to indicate whether the application/proposal was accepted as submitted or with negotiated changes.

Block 19 - Enter any explanation or advisory comments which are required for, or applicable to, this action.

Block 20 - Will be completed by the recipient.

Block 21 - The Contracting Officer shall sign and date the top line. His/her name and title should be entered on the next two lines. This box must be signed prior to forwarding to recipient.

•U.S. GOVERNMENT PRINTING OFFICE: 1981—522-056/4703

GRANTEE - State of Idaho

BUDGET PLAN

		8/17/84 to 9/30/85[a]	10/1/85 to 2/28/87[b]
A.	Salaries	$11,546	$40,936
B.	Fringe Benefits (23% of A)	2,729	9,415[c]
C.	Travel	560	4,628
D.	Equipment		2,500
E.	Subcontracts:		
	1. USGS		$41,200
	2. State University		10,132
F.	Other Direct Cost	60	6,175
G.	Indirect	4,960	23,738[d]
H.	TOTAL	$19,855	$138,724

[a] Actual amount spent 8/17/84 to 9/30/85

[b] Total budget from 10/1/85 to 2/28/87 including estimated carry over.

[c] 23% of Item A

[d] 33.3% of Items A, B, C, E-2 and F

STATEMENT OF WORK

IDAHO DEPARTMENT OF WATER RESOURCES

In the Twin Falls - Banbury area (and, if time and funding permit, extending toward the Artesian City area), perform the following tasks:

Task 1. Continue ongoing monitoring program of temperature, pressure, and flow rate of selected wells. Identify additional wells to monitor. If possible, monitor the wells on a weekly basis.

Task 2. Continue collecting water samples from geothermal wells for chemical analysis. Evaluation of these results should include an analysis of possible mixing.

Task 3. Expand the area being geologically mapped under the present program to include the areas of additional wells being monitored and possible recharge zones, which are presumed to be south of the ground water management areas.

Task 4. Collect up to 10 rock samples for whole-rock geochemical analyses; coordinate these analyses with the Earth Science Lab/Univ. Utah Research Inst.

Task 5. If time and funding permit, obtain selected potassium-argon or fission track dates on rhyolites and/or Banbury basalts.

Task 6. Prepare a final report, which will include a geologic map of the study area, including geologic structures, age dates, and thermal wells. The report will also include results and interpretations of the monitoring and geochemical programs. A geologic model of the hydrothermal systems will be developed, and a suggested network for further well monitoring efforts will be identified.

Task 7. Provide overall project management and complete and report on tasks in a timely manner. Management reports shall be provided as defined by the attached DOE Form EIA 459A - Reporting Requirements Checklist. The original Final Report for this grant will still be due on the original due date. The required reports are also summarized as follows:

	REPORT	DUE
(1)	Form DOE 538 Notice of Energy RD&D	30 days after award of grant
(2)	Quarterly Management Summary Report	15 days after calendar quarter end
(3)	Project Status Report	15 days after calendar quarter end
(4)	Phase I Final Report (Draft)	Due 45 days prior to original completion date
(5)	Phase I Final Report	Due on original completion date
(6)	Final Report (Draft)	Due 45 days prior to updated completion date
(7)	Final Report	Due on updated completion date
(8)	Financial Status Report - Form 269	Due annually and upon OMB completion

The deliverables resulting from the tasks outlined above which will be delivered to DOE are summarized as follows:

1. The original Final Report (herein referred to as Phase I Final report) and the Final Report for this addition to the grant--one camera-ready copy plus sixteen additional copies will be distributed as specified in the attached DOE Form EIA 459A.

2. Reports previously described under Task 8 above will be prepared and issued in the amounts and at the frequency shown.

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE REPORTING CHECKLIST

FORM EIA-459A (10/80)

FORM APPROVED OMB NO. 1900-0127

1. Identification Number: DE-FG07-84ID12549	2. Program/Project Title: Geothermal Resource Assessment

3. Recipient: State of Idaho, Department of Water Resources

4. Reporting Requirements:	Frequency	No. of Copies	Addressees
PROGRAM/PROJECT MANAGEMENT REPORTING			
☐ Federal Assistance Milestone Plan			
☐ Federal Assistance Budget Information Form			
☒ Federal Assistance Management Summary Report	Q	1,1,1	A,B,C
☒ Federal Assistance Program/Project Status Report	Q	1,1,1	A,B,D
☒ Financial Status Report, OMB Form 269	Y,F	1	A
TECHNICAL INFORMATION REPORTING			
☒ Notice of Energy RD&D	Y	1,1,1	A,B.E
☐ Technical Progress Report			
☒ Topical Report	A*	1,1 **,1	A,B,D
☒ Final Technical Report	F*	1,1 **,1	A,B,D

FREQUENCY CODES AND DUE DATES:

A - As Necessary; within 5 calendar days after events.
F - Final; 90 calendar days after the performance of the effort ends.
Q - Quarterly; within 30 days after end of calendar quarter or portion thereof.
O - One time after project starts; within 30 days after award.
X - Required with proposals or with the application or with significant planning changes.
Y - Yearly; 30 days after the end of program year. (Financial Status Reports 90 days).
S - Semiannually; within 30 days after end of program fiscal half year.

5. Special Instructions:

*Draft Report due 45 days prior to completion date to allow for DOE review and comments and is within the Grant budget period.

**Camera ready copy must be included.

6. Prepared by: (Signature and Date)	7. Reviewed by: (Signature and Date) William C. Rork

REPORT DISTRIBUTION LIST

A. Ronald A. King
Contracts Management Division

U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

B. Peggy Brookshier
Advanced Technology Division
U. S. Department of Energy
785 DOE Place
Idaho Falls, ID 83401

C. Earl G. Jones
Financial Management Division

U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83402

D. Duncan Foley

University of Utah Research Institute
Earth Science Laboratory
391 Chipeta Way, Suite C
Salt Lake City, UT 84108

E. U. S. Department of Energy

Technical Information Center
P. O. Box 62
Oak Ridge, TN 37830

(7-81)

NOTICE OF FINANCIAL ASSISTANCE AWARD

(See Instructions on Reverse)

Under the authority of Public Law 93-410 and subject to legislation, regulations and policies applicable to *(cite legislative program title)*:
Geothermal Research, Development and Demonstration Act of 1977

1. PROJECT TITLE
Geothermal Resource Evaluation in Idaho

2. INSTRUMENT TYPE
☒ GRANT ☐ COOPERATIVE AGREEMENT

3. RECIPIENT *(Name, address, zip code, area code and telephone no.)*
State of Idaho
Department of Water Resources, Statehouse
Boise, ID 83702

4. INSTRUMENT NO.
DE-FG07-84ID12549

5. AMENDMENT NO.
M002

6. BUDGET PERIOD
FROM: 8/17/85 THRU: 8/31/86

7. PROJECT PERIOD
FROM: 8/17/85 THRU: 8/31/86

8. RECIPIENT PROJECT DIRECTOR *(Name and telephone No.)*
Leah V. Street

10. TYPE OF AWARD
☐ NEW ☐ CONTINUATION ☐ RENEWAL
☒ REVISION ☐ SUPPLEMENT

9. RECIPIENT BUSINESS OFFICER *(Name and telephone No.)*
Same as Item #8

12. ADMINISTERED FOR DOE BY *(Name, address, zip code, telephone No.)*
Ronald A. King (208)526-0790
U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, ID 83401

11. DOE PROJECT OFFICER *(Name, address, zip code, telephone No.)*
Peggy Brookshier (208)526-1403
U.S.DOE, Idaho Operations Office
785 DOE Place, Idaho Falls, ID 83401

13. RECIPIENT TYPE
☒ STATE GOV'T ☐ INDIAN TRIBAL GOV'T ☐ HOSPITAL ☐ FOR PROFIT ORGANIZATION ☐ INDIVIDUAL
☐ LOCAL GOV'T ☐ INSTITUTION OF HIGHER EDUCATION ☐ OTHER NONPROFIT ORGANIZATION ☐ C ☐ P ☐ SP ☐ OTHER *(Specify)*

14. ACCOUNTING AND APPROPRIATIONS DATA

a. Appropriation Symbol	b. B & R Number	c. FT/AFP/OC	d. CFA Number

15. EMPLOYER I.D. NUMBER/SSN

16. BUDGET AND FUNDING INFORMATION

a. CURRENT BUDGET PERIOD INFORMATION		b. CUMULATIVE DOE OBLIGATIONS	
(1) DOE Funds Obligated This Action	$ -0-	(1) This Budget Period [Total of lines a.(1) and a.(3)]	$ 98,579
(2) DOE Funds Authorized for Carry Over	$ -0-	(2) Prior Budget Periods	$ -0-
(3) DOE Funds Previously Obligated in this Budget Period	$ 98,579		
(4) DOE Share of Total Approved Budget	$ 98,579		
(5) Recipient Share of Total Approved Budget	$ -0-	(3) Project Period to Date [Total of lines b. (1) and b. (2)]	$ 98,579
(6) Total Approved Budget	$ 98,579		

17. TOTAL ESTIMATED COST OF PROJECT $ 98,579

(This is the current estimated cost of the project. It is not a promise to award nor an authorization to expend funds in this amount.)

18. AWARD/AGREEMENT TERMS AND CONDITIONS

This award/agreement consists of this form plus the following:

a. Special terms and conditions (if grant) or schedule, general provisions, special provisions (if cooperative agreement)

b. Applicable program regulations *(specify)* N/A *(Date)* _____

c. DOE Assistance Regulations, 10 CFR Part 600, as amended, Subparts A and ☒ B (Grants) or ☐ C (Cooperative Agreements).

d. Application/proposal dated 5/2/85, ☐ as submitted ☐ with changes as negotiated

19. REMARKS
This document revises budget plans, within existing budget dollar ceilings, as attached.

20. EVIDENCE OF RECIPIENT ACCEPTANCE

Wayne Haas 9/26/85
(Signature of Authorized Recipient Official) *(Date)*

Wayne Haas
(Name)

Resource Analysis Division Administrator
(Title)

21. AWARDED BY

William C. Drake 9/11/85
(Signature) *(Date)*

William C. Drake
(Name)

Contracting Officer
(Title)

CONTRACT MODIFICATIONS TO INSTRUMENT NO. DE-FG07-84ID12549

Salaries reduced by:	$2,000
Fringe reduced by:	460
State University Contract increased by:	2,000

This results in the following changes:

Salaries	$25,000
Fringe	5,570
State University	10,132

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

SOUTHERN REGION

John V. Evans
Governor

A. Kenneth Dunn
Director

1041 Blue Lakes Blvd. North
Twin Falls, Idaho 83301
(208) 734-3578

February 5, 1985

Duncan Foley
University of Utah Research Institute
Earth Science Laboratory
Research Park
391 Chipeta Way
Suite A
Salt Lake City, Utah 84108

Dear Duncan:

Enclosed is the draft proposal to D.O.E. for your review and comments. I feel that such a study would make a contribution in understanding Idaho's geothermal resources and would complement existing work.

If you have questions, please contact me at 208-734-3578.

Sincerely,

Leah V. Street
Geologist

State of Idaho
DEPARTMENT OF WATER RESOURCES
Southern Region, 2148 4th Ave. East, Twin Falls, Idaho 83301 (208) 734-3578

CECIL D. ANDRUS
Governor

R. KEITH HIGGINSON
Director

Rec 05/10/89

May 2, 1989

Howard Ross
University of Utah Research Institute
Earth Science Laboratory
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108-1295

Dear Howard:

Enclosed please find two copies of the report entitled "The Hydrothermal System in Central Twin Falls County, Idaho" by R.E. Lewis and H.W. Young. This report completes the final phase of the cooperative study funded by the DOE grant #DE-FG07-84ID12549. We will proceed with the closing of that grant.

Please let me know if you have any questions or comments.

Sincerely,

Leah

Leah V. Street
Hydrogeologist

May 18,1989

Kenneth J. Taylor
U. S. DOE, Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Dear Ken:

Enclosed please find one copy of the final Idaho-DWR report "Geothermal Resource Analysis in Twin Falls County, Idaho" by Leah Street and Robert DeTar.

My records indicate that a camera-ready copy of this report was sent to the Technical Information Center at Oak Ridge, TN on March 9, 1988 following receipt of patent approval.

Sincerely,

Howard P. Ross
Project Manager

encl.

State of Idaho
DEPARTMENT OF WATER RESOURCES
STATE OFFICE, 1301 North Orchard Street Boise, Idaho 83706-2237 • (208) 334-4440

CECIL D. ANDRUS
Governor

R. KEITH HIGGINSON
Director

Rec 1/11/88
KPE

January 6, 1988

Mr. Howard Ross
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, UT 84108

Dear Mr. Ross:

Enclosed please find seven (7) copies of the final report entitled "Geothermal Resource Analysis in Twin Falls County, Idaho" and one (1) copy of the Boise State University report entitled "Evaluation of the Boise Geothermal System". Both project reports were funded by the U.S. Department of Energy through Grant Number DE-FG07-84ID12549. Also enclosed is a copy of the report distribution list that has changed since the original contract was signed.

If you have any questions regarding this report, please contact Leah Street at (208) 734-3578.

Sincerely,

Wayne T. Haas
Administrator
Resource Analysis Division

WTH:LS:db
Enclosures

DISTRIBUTION LIST

Sent to:	No. of Copies IDWR Report[1]	No. of Copies BSU Report[2]
Elizabeth Hyster U.S. Department of Energy 785 DOE Place Idaho Falls, ID 83402	1	1
Susan Prestwich U.S. Department of Energy 785 DOE Place Idaho Falls, ID 83402	1	1
Marshall Reed U.S. Department of Energy Forrestal Building 1000 Independence Avenue, S.W. Washington, DC 20585	2	2
Howard Ross Earth Science Laboratory University of Utah Research Institute 391 Chipeta Way, Suite C Salt Lake City, UT 84108	5 bound 1 unbound 1 camera ready	1
Total	11	5

1. "Geothermal Resource Analysis in Twin Falls County, Idaho", Department of Water Resources, July, 1987
2. "Evaluation of the Boise Geothermal System", Department of Geology, Boise State University, December, 1987

State of Idaho
DEPARTMENT OF WATER RESOURCES
STATE OFFICE, 1301 North Orchard Street Boise, Idaho 83706-2237 • (208) 334-4440

CECIL D. ANDRUS
Governor

R. KEITH HIGGINSON
Director

December 21, 1987

Susan Prestwich
U.S. Department of Energy
785 DOE Place
Idaho Falls, Idaho 83402

Dear Sue:

Shortly, you will be receiving two of the three deliverables for contract number DE-FG07-84ID12549. The report that I have prepared and the report B.S.U. prepared will be in to you by December 31. Unfortunately, the U.S. Geological Survey has not submitted their final report because of computer problems and lack of staff in their reports section. I have discussed with Bob Lewis the importance of this report and he assured me that he is doing what he can to get the report out. Based upon this delay, I will need to ask for yet another no-cost extension to this grant until the end of February, 1988.

Thank you for your patience in the matter. Call me at 734-3578 if you have any questions.

Sincerely,

Leah V. Street
Geologist

CC: Howard Ross

State of Idaho
DEPARTMENT OF WATER RESOURCES
SOUTHERN REGION

rec 5/14/87

CECIL D. ANDRUS
Governor

A. KENNETH DUNN
Director

2148 4th Ave. E.
Twin Falls, Idaho 83301
(208) 734-3578

May 12, 1987

Howard Ross
Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, UT 84108

Dear Howard:

Enclosed are copies of my report entitled "Geothermal Resource Analysis in Twin Falls, Idaho" and "The Hydrothermal System in Central Twin Falls County, Idaho" by Lewis and Young. Both are in draft form and subject to revision. The Appendix, References, Table of Contents, etc. are not included in my report. If you want to see the drafts, I will be glad to send them.

I have also enclosed the list of tasks outlined in the DOE grants. Hopefully, everything is covered.

If you have any questions, please contact me.

Sincerely,

Leah V. Street
Geologist

LS:MB

Enclosures

STATEMENT OF WORK

IDAHO DEPARTMENT OF WATER RESOURCES

In the Twin Falls - Banbury area (and, if time and funding permit, extending toward the Artesian City area), perform the following tasks:

IDWR

Task 1. Continue ongoing monitoring program of temperature, pressure, and flow rate of selected wells. Identify additional wells to monitor. If possible, monitor the wells on a weekly basis.

USGS

Task 2. Continue collecting water samples from geothermal wells for chemical analysis. Evaluation of these results should include an analysis of possible mixing.

IDWR

Task 3. Expand the area being geologically mapped under the present program to include the areas of additional wells being monitored and possible recharge zones, which are presumed to be south of the ground water management areas.

IDWR

Task 4. Collect up to 10 rock samples for whole-rock geochemical analyses; coordinate these analyses with the Earth Science Lab/Univ. Utah Research Inst.

Task 5. If time and funding permit, obtain selected potassium-argon or fission track dates on rhyolites and/or Banbury basalts.

IDWR

Task 6. Prepare a final report, which will include a geologic map of the study area, including geologic structures, age dates, and thermal wells. The report will also include results and interpretations of the monitoring and geochemical programs. A geologic model of the hydrothermal systems will be developed, and a suggested network for further well monitoring efforts will be identified.

Task 7. Provide overall project management and complete and report on tasks in a timely manner. Management reports shall be provided as defined by the attached DOE Form EIA 459A - Reporting Requirements Checklist. The original Final Report for this grant will still be due on the original due date. The required reports are also summarized as follows:

STATEMENT OF WORK

Grantee: IDAHO DEPARTMENT OF WATER RESOURCES

The Grantee will accomplish the purpose of these Geothermal Energy Investigations by performing the following tasks:

USGS REPORT

Task 1. Sample, log, and perform chemical analyses for geothermal springs and approximately 25 wells which have been drilled in southern Idaho during the past two years. A report will be prepared which will contain a listing of the chemical analyses, estimates of reservoir temperatures, and where possible, temperature profiles.

USGS REPORT

Task 2. Characterize the geothermal reservoir in the Twin Falls area. Specific objectives will be to determine the volume, longevity, and effect of present development on the resource. A report will be prepared describing the findings of this study.

BSU REPORT

Task 3. Monitor and characterize the Boise geothermal resource. A monitoring system of pressure transducers would be installed on the non-producing wells, the data stored on tape, and interpreted using a computer. At the end of one year a report will be prepared detailing the results of this task.

Task 4. Provide the overall project management and complete and report on tasks in a timely manner. Management reports shall be provided as defined by the attached DOE Form EIA 459A, Reporting Requirements Checklist. The required reports are also summarized as follows:

1.	Form DOE 538 Notice of Energy R&D	Due 30 days after award of grant.
2.	Quarterly Management Summary Report	Due 15 days after calendar quarter end.
3.	Quarterly Project Status Report	Due 15 days after calendar quarter end.
4.	Three Topical Reports - One each for Tasks 1, 2, and 3	Due prior to or accompanying final report in both draft and in final form and including one camera-ready copy.
✓5.	Final Report (Draft)	Due 45 days prior to completion date.
6.	Final Report	Due on completion date.
7.	Financial Status Report, OMB Form 269	Due on completion date.

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

May 22, 1987

Ms. Leah V. Street
Idaho - Dept. of Water Resources
2148 4th Ave East
Twin Falls, ID 83301

Dear Leah:

Thank you for the opportunity to review the draft of your report "Geothermal Resource Analysis in Twin Falls County, Idaho and "The Hydrothermal System in Central Twin Falls County, Idaho" by Lewis and Young. I really enjoyed reading these reports and through them I have learned alot about the Snake River Plain geology and the hydrology of the study area. Taken together, the two reports seem to provide a good understanding of the geothermal resource.

I am enclosing review comments and markings on the text for your consideration. I hope that these may make the text even better reading for those not familiar with the area and the topic. I realize that neither report is in final form and that many minor changes would probably be made after another reading.

Please call me to discuss any comments that are unclear or inappropriate. Both reports are good studies that should play a major role in managing and protecting the geothermal resource. I look forward to seeing the final report.

Sincerely,

Howard

Howard Ross
Project Manager

encl
cc: P. Brookshier
HR

REVIEW COMMENTS

Geothermal Resource Analysis in Twin Falls County, Idaho

1. Needed for final report. Table of Contents; List of Illustrations and Tables; Acknowledgement of DOE Funding; DOE Disclaimer Statement; Abstract.

2. Introduction. The Introduction should be expanded to orient readers less familiar with the location of the project. Perhaps a page size index map showing the location of the project areas within the state, or a few sentences describing the location would suffice. Does this study provide background data to aid IDWR in establishing policy for water usage? If so this might be stated.

3. Writing Style. In some sections of the report, especially the introduction, the text seems quite terse and would be more clearly understood with a few more adjectives or explanatory phrases. See comments in the text. Chapter headings should be capitalized rather than underlined.

4. References. References are generally carefully noted, especially at the start of chapters. Some specific observations or conclusions are not referenced and do not appear to be results from the present study. Please reread the text with this comment in mind. Please be certain to cross check the Reference list, and year of reference, with the text.

5. The geologic/hydrologic discussions would benefit from more frequent reference to the appropriate figures. I was often uncertain as to which figure I should be looking. There are references to geographic features not included on the figures, i.e. Monument Hills, Clover, etc.

6. It is sometimes unclear if an observation or conclusion is due to the present authors or to other workers.

7. Hydrologic Studies. The results of the hydrologic studies (p.22, etc) are quite significant and the discussion should be expanded. What is the total decline in water level contours, and/or the decline in ft/yr? The water level contour map should be rotated (North up) and geographic features and scale added.

8. Temperature Variations. Monitoring of wells (p.23) included temperature measurements as well as shut-in pressures (Task 1). Temperatures (max or bht?) are listed for several wells in Table ( ). Were temperature variations observed during monitoring? How much? Does temperature correlate with pressure changes or is it seasonal? Any temperature variation could be quite meaningful, but it does not appear to be discussed.

9. Hydrograph Data. The hydrograph data are interesting. The basic instrumentation should be described in a few sentences for those less familiar with the technique. Were changes recorded with in-place pressure transducers and pressure readings converted to feet above/below land surface? The hydrographs would be more readable if vertical lines across the charts indicated the beginning of each new year. I am not familiar with the instrument details, but the truly flat areas on two hydrographs are certainly suggestive of instrument failure. Is this a possibility?

10. Summary and Recommendations. (p.30,31) These studies indicate (to me) the need for careful regulation of pumping rates, non-thermal (irrigation, well head power generation) usage, and drilling of new wells. Would DWR care to recommend production limitations or suggest regulatory actions based on these studies? What is a "safe " annual production level?

11. Task 5. This task called for K-Ar or fission track dates on rhyolites and/or Banbury basalt if time and funding permits. Time has been extended and a balance of funds remains. Were any new dates obtained? If not, why not?

12. Preliminary Model of the Thermal System. How deep do the ground waters have to circulate to achieve the observed temperatures? Do you agree with the Lewis and Young model?

REVIEW COMENTS

The Hydrothermal System in Central Twin Falls County, Idaho
by R. E. Lewis and H. W. Young

p.9,l.4; warm (not hot) water reservoir?

p.12,last line; refer to Figure 3

p.13,17; that the average

p.15, Acknowledgements- IDWR and DOE Funding, DOE Grant No.

p.25, last line; interbeds, as ..

p.30,l.13; declined ; l.14; refer to Figure 5.

p.31,l.12; The artesian..

p.34,l.12; cal/cm s C. By Substituting . .

p.35,l.3; a minimum depth .

p.36,l.1; waters; l.3; waters . . . exhibit . .

p.47,l.16; estimates for when. . .

p.54,12, isotope fraction . .

p.56,l.12; lines, are . . ; l.14,21,24; per_mil

p.59,l.5 from bottom; per_mil . .

p.63,l.2; to aid the . . to determine the . .

p.63,16; a point north of . .

p.64, l.8; Magnitudes (not intensities)

p.66,l.8,9; is faulting down to the south consistant with known geology?

p.67,l.4-8;contradiction(?); how can the middle unit near Hollister thicken southward and thin southward?

p.67,l.13,14; the profile ends at Sta.23-there is no data to indicate thickness south of Sta. 23.

p.68,l.2; to depth or thickness?; l.4; ..River Plain does not show an extension?

p.71,l.3 from bottom; South Hills not shown on Fig. 3 or 4.

p.74,l.1; the ~~system~~ Idavada volcanics . .

p.74,l.6; where much of the more soluble minerals . .

Note: I did not check references versus the text.

Subcontracts: Boise State $8,132.—
USGS-Ron ~38,200.—
USGS-WRD ~3,000.—

IDAHO $

Voucher	1 Amt.	2 $ Avail	3 $ left	4 $ billed	5 billed thru	6 comments	7	8	9	
1	5,000	98,579		5,000	4-17-85					
2	10,000			15,000						
3	10,000 25,000	98,579	73,579	25,000	11-17-85	advance, too				
4	~~20,000 45,000~~		~~53,579~~		~~11-7-84~~	in ID 9 Dec. '85 advance 11-18-85 to 2-28-86				Deleted Jan. 16 '86
4 5	10,000 35,000		63,579	35,000		in ID 11-18-85 to 1-31-86 ESL			1-22-86	
5 6	5,000 40,000		58,579	40,000		ESL 2-28-86				
6 7	10,000		48,579	50,000						
8		+60=158,579	108,579			incl. new $ of Mod 3				
7 9	5,000		103,579	55,000		thl 30 Apr 86				
8 10	5,000		98,579	60,000						
9 11	5,000		93,579	65,000		thru June 30				
10 12	5,000		88,579	70,000		" July 31				
HPR 11 13	5,000		83,579	75,000		" Aug 31	PMB → HPR say O.K.?	8/27 ✓		
HPR 12 14	5,000		78,579	80,000	10-31-86	" Sept 30	PMB → HPR	10/14	@ESL 10/17/86	
13 15	5,000		73,579	85,000	11-30-86	" Oct. 30	PMB → HPR	11/17/86	@ESL 11/20/86	
14 16	5,000		68,579	90,000	12-30-86	"	PMB → HPR ok	1/27/87	@ESL 1/30/87	
15 17	5,000		63,579	95,000		3/31/87	PMB → HPR ok	3/13/87	@ESL 3/16/87	
16 18	5,000		58,579	100,000		5/31/87	PMB → HPR by Phone	4/20/87	@ESL 4/23/87	
17 19	5,000		53,579	105,000		6/1-6/30/87	PMB-HPR by Phone	5/21/87	@ESL 5/26/87	
18 20	5,000		48,579	110,000		7/1-7/31/87	pmb-signed 6/18/87 →		@ESL 6/29/87	
19 21	5,000		43,579	115,000		8/1-9/30/87	pmb signed 8/3/89		@ESL 8/7/87	
20 22	5,000		38,579	120,000		9/1-9/30/87	pmb signed 9/15/87 KT 2/16/88		@ESL 9/25/87	
21 23	5,000		33,579	125,000						
22 24	33,579		0	158,579 ✓		Ad 1/88-6/30/89	OK + KT 5/23/89.		@ESL 5/23/87	ok 5/29
25										
26										
27										
28										
29										
30		Subcontracts:	USGS 41,200.—							
31			Boise St 8,132.—							
			Indir. 13,037.							
			$62,369							

EFFICIENCY LINE® 22-206 AMPAD

State of Idaho
DEPARTMENT OF WATER RESOURCES
STATE OFFICE, 450 W. State Street, Boise, Idaho

JOHN V. EVANS
Governor

A. KENNETH DUNN
Director

Mailing address:
Statehouse
Boise, Idaho 83720
(208) 334-4440

August 14, 1985

Peggy A. M. Brookshier
U. S. Department of Energy
Idaho Operations Office
550 Second Street
Idaho Falls, ID 83401

RE: Modification No. M001 to Grant No. DE-FG07-84ID12549

Dear Ms. Brookshier:

Enclosed please find the fully executed copy of the subject modification for your official file.

Sincerely,

Gerry D. Galinato
Supervisor
Resource Section

GDG:sb
encl

Duncan
For your files
Peggy

RECEIVED
AUG 15 1985
ADVANCED TECHNOLOGY
BRANCH

received 15 Aug. '85

State of Idaho
DEPARTMENT OF WATER RESOURCES
STATE OFFICE, 450 W. State Street, Boise, Idaho

JOHN V. EVANS
Governor

A. KENNETH DUNN
Director

Mailing address:
Statehouse
Boise, Idaho 83720
(208) 334-4440

August 8, 1985

Peggy A. M. Brookshier
U.S. Department of Energy
Idaho Operations Office
550 Second Street
Idaho Falls, ID 83401

RE: Grant No. DE-FG07-84ID12549

Dear Ms. Brookshier:

Enclosed please find the fully executed copy of the form "Assurances", which is required to complete the documents of the above grant.

I am also enclosing a copy of our Indirect Cost Negotiating Agreement (7/1/84-6/30/85). We are presently negotiating the new indirect cost agreement (7/1/85-6/30/86) and it might take three months to complete. We will send you the new agreement as soon as it is available.

If you have any questions, please call me at (208) 334-4461 or Leah Street at (208) 734-3578.

Sincerely,

Gerry D. Galinato
Supervisor
Resource Section

GDG:sb
encls
cc: Leah Street

ASSURANCES

The Applicant hereby assures that it will comply with the regulations, policies, guidelines and requirements, including the applicable OMB Circulars as they relate to the application, acceptance and use of Federal funds for this federally-assisted project. Also the Applicant assures and certfies that:

1. It possesses legal authority to apply for the grant; that a resolution, motion or similar action has been duly adopted or passed as an official act of the applicant's governing body, authorizing the filing of the application including all understandings and assurances contained therein, and directing and authorizing the person identified as the official representative of the applicant to act in connection with the application and to provide such additional information as may be required.

2. It will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352) and in accordance with Title VI of that Act, no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the applicant receives Federal financial assistance and will immediately take any measures necessary to effectuate this agreement.

3. It will comply with Title VI of the Civil Rights Act of 1964 (42 USC 2000d) prohibiting employment discrimination where (1) the primary purpose of a grant is to provide employment or (2) discriminatory employment practices will result in unequal treatment of persons who are or should be benefiting from the grant-aided activity.

4. It will comply with requirements of the provisions of the uniform Relocation Assistance and Real Property Acquisitions Act of 1970 (P.L. 91-646) which provides for fair and equitable treatment of persons displaced as a result of Federal and federally assisted programs.

5. It will comply with the provisions of the Hatch Act which limit the political activity of employees.

6. It will comply with the minimum wage and maximum hours provisions of the Federal Fair Labor Standards Act, as they apply to hospital and educational institution employees of State and local governings.

7. It will establish safeguards to prohibit emmployees from using their positions for a purpose that is or gives the appearance of being motivated by a desire for private gain for themselves or others, particularly those with whom they have family, business, or other ties.

8. It will give the sponsoring agency or the Comptroller General through any authorized representative the access to and the right to examine all records, books, papers, or documents related to the grant.

9. It will comply with all requirements imposed by the Federal sponsoring agency concerning special requirements of law, program requirements, and other administrative requirements.

10. It will insure that the facilities under its ownership, lease or supervision which shall be utilized in the accomplishment of the project are not listed on the Environmental Protection Agency's (EPA) list of Violating Facilities and that it will notify the Federal grantor agency of the receipt of any communication from the Director of the EPA Office of Federal Activities indicating that a facility to be used in the project is under consideration for listing by the EPA.

11. It will comply with the flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973, Public Law 93-234, 87 Stat. 975, approved December 31, 1976. Section 102(a) requires, on and after March 2, 1975, the purchase of flood insurance in communities where such insurance is available as a condition for the receipt of any Federal financial assistance for construction or acquisition purposes for use in any area that has been identified by the Secretary of the Department of Housing and Urban Development as an area having special flood hazards.

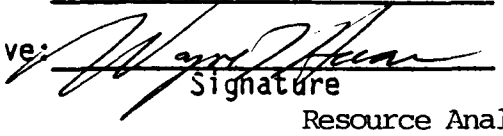
The phrase "Federal financial assistance" includes any form of loan, grant, guaranty, insurance payment, rebate, subsidy, disaster assistance loan or grant, or any other form of direct or indirect Federal assistance.

12. It will assist the Federal grantor agency in its compliance with Section 106 of the National Historic Preservation Act of 1966 as amended (16 U.S.C. 469a-1 et seq.) by (a) consulting with the State Historic Preservation Officer on the conduct of investigations, as necessary, to identify properties listed in or eligible for inclusion in the National Register of Historic Places that are subject to adverse effects (see 36 CFR Part 800.8) by the activity, and notifying the Federal grantor agency of the existence of any such properties, and by (b) complying with all requirements established by the Federal grantor agency to avoid or mitigate adverse effects upon such properties.

The Applicant certifies that it will comply with the above assurances if the assistance is approved.

Grant Applicant: Idaho Department of Water Resources

Project Title: Geothermal Resource Evaluations in Idaho

Certifying Representative: 
Signature

Wayne Haas, Resource Analysis Division Administrator
Name and Title

August 7, 1985
Date

H3c-3950H

STATE AND LOCAL DEPARTMENT/AGENCY
INDIRECT COST NEGOTIATION AGREEMENT

DATE: 1984

INSTITUTION: Idaho Department of Water Resources
Statehouse
Boise, Idaho 83720

FILING REF.: This replaces Negotiation Agreement dated October 27, 1983

The indirect cost rate(s) contained herein are for use on grants and contracts with the Federal Government to which Federal Management Circular 74-4 applies subject to the limitations contained in the Circular and in Section II A below. The rate(s) were negotiated by the Department of the Interior, Office of Inspector General, Western Region and the State of Idaho, Department of Water Resources in accordance with the authority contained in Attachment A, Section J.3. of the Circular.

SECTION I: Rates

Type	Effective Period From	To	Rate*	Locations	Applicable to
Final	7/1/82	6/30/83	30.6%	All	All
Fixed carry-forward	7/1/83	6/30/84	29.4%	All	All
Fixed carry-forward	7/1/84	6/30/85	33.3%	All	All

*Base: Total direct costs less pass-through funds, capital expenditures, and state dues paid to water commissions, councils, and conferences.

Treatment of fringe benefits: Fringe benefits applicable to direct salaries and wages are treated as direct costs.

A. LIMITATIONS: Use of the rate(s) contained in this agreement is subject to any applicable statutory limitations. Acceptance of the rate(s) agreed to herein is predicated upon the conditions: (1) that no costs other than those incurred by the grantee/contractor were included in its indirect cost rate proposal and that such costs are legal obligations of the grantee/contractor, (2) that the same cost that have been treated as indirect costs have not been claimed as direct costs, and (3) that similar types of costs have been accorded consistent treatment.

B. AUDIT: Adjustments to amounts resulting from audit of the cost allocation plan upon which the negotiation of this agreement was based will be compensated for in a subsequent negotiation.

C. CHANGES: If a fixed or predetermined rate(s) is contained in this agreement it is based on the organizational structure and the accounting system in effect at the time the proposal was submitted. Changes in the organizational structure or changes in the method of accounting for costs which affect the amount of reimbursement resultin from use of the rates in this agreement, require the prior approval of the authorized representative of the responsible negotiation agency. Failure to obtain such approval may result in subsequent audit disallowances.

D. THE FIXED RATE(S): Contained in this agreement is based on an estimate of the costs which will be incurred during the period for which the rate applies. When the actual costs for such period have been determined, an adjustment will be made in the negotiation following such determination to compensate for the difference between that cost used to establish the fixed rate and that which would have been used were the actual costs known at the time.

E. BILLING RATES: In accordance with the agreement allocating costs of central services provided by others, adjustments have been made to properly reflect costs of central services billed and also allocated to this department.

F. NOTIFICATION OF FEDERAL AGENCIES: Copies of this document may be provided to other Federal offices as a means of notifying them of the agreement contained herein.

G. SPECIAL REMARKS: None

ACCEPTANCE

By the State Department/Agency

/s/

A. Kenneth Dunn
Name

Director
Title

October 23, 1984
Date

By the Responsible Agency
For the Federal Government

/s/

Gerald W. Hicks
Name

Regional Audit Manager
Western Region
Title

U.S. Department of the Interior
Office of Inspector General
Agency

NOV 1984
Date

Negotiated by W. Michael Keefe

Telephone (916) 484-4768

(7-81)

NOTICE OF FINANCIAL ASSISTANCE AWARD

(See Instructions on Reverse)

Under the authority of Public Law 93-410 and subject to legislation, regulations and policies applicable to *(cite legislative program title)*:
Geothermal Research, Development, and Demonstration Act of 1977

1. PROJECT TITLE
Geothermal Resource Evaluations in Idaho

2. INSTRUMENT TYPE
☒ GRANT ☐ COOPERATIVE AGREEMENT

3. RECIPIENT *(Name, address, zip code, area code and telephone no.)*
State of Idaho
Department of Water Resources
Statehouse, Boise, Idaho 83720

4. INSTRUMENT NO.
DE-FG07-84ID12549

5. AMENDMENT NO.

6. BUDGET PERIOD
FROM: 8/17/84 THRU: 8/17/85

7. PROJECT PERIOD
FROM: 8/17/84 THRU: 8/17/85

8. RECIPIENT PROJECT DIRECTOR *(Name and telephone No.)*
Leah V. Street (208)334-3788

10. TYPE OF AWARD
☒ NEW ☐ CONTINUATION ☐ RENEWAL
☐ REVISION ☐ SUPPLEMENT

9. RECIPIENT BUSINESS OFFICER *(Name and telephone No.)*

12. ADMINISTERED FOR DOE BY *(Name, address, zip code, telephone No.)*
Elizabeth M. Hyster (208)526-1229
U. S. Department of Energy
Idaho Operations Office
550 Second Street
Idaho Falls, ID 83401

11. DOE PROJECT OFFICER *(Name, address, zip code, telephone No.)*
R. Eldon Bray (208)526-0086
U.S.DOE, Idaho Operations Office
550 Second Street, Idaho Falls, ID 83401

13. RECIPIENT TYPE
☒ STATE GOV'T ☐ INDIAN TRIBAL GOV'T ☐ HOSPITAL ☐ FOR PROFIT ORGANIZATION ☐ INDIVIDUAL
☐ LOCAL GOV'T ☐ INSTITUTION OF HIGHER EDUCATION ☐ OTHER NONPROFIT ORGANIZATION ☐ C ☐ P ☐ SP ☐ OTHER *(Specify)*

14. ACCOUNTING AND APPROPRIATIONS DATA

a. Appropriation Symbol	b. B & R Number	c. FT/AFP/OC	d. CFA Number
89X0224.91	AM1510000	ID-44-91/250	

15. EMPLOYER I.D. NUMBER/SSN

16. BUDGET AND FUNDING INFORMATION

a. CURRENT BUDGET PERIOD INFORMATION

(1) DOE Funds Obligated This Action	$ 98,579
(2) DOE Funds Authorized for Carry Over	$ -0-
(3) DOE Funds Previously Obligated in this Budget Period	$ -0-
(4) DOE Share of Total Approved Budget	$ 98,579
(5) Recipient Share of Total Approved Budget	$ -0-
(6) Total Approved Budget	$ 98,579

b. CUMULATIVE DOE OBLIGATIONS

(1) This Budget Period *[Total of lines a.(1) and a.(3)]*	$ 98,579
(2) Prior Budget Periods	$ -0-
(3) Project Period to Date *[Total of lines b. (1) and b. (2)]*	$ 98,579

17. TOTAL ESTIMATED COST OF PROJECT $ _____

(This is the current estimated cost of the project. It is not a promise to award nor an authorization to expend funds in this amount.)

18. AWARD/AGREEMENT TERMS AND CONDITIONS

This award/agreement consists of this form plus the following:

a. Special terms and conditions (if grant) or schedule, general provisions, special provisions (if cooperative agreement)

b. Applicable program regulations *(specify)* N/A *(Date)* _____

c. DOE Assistance Regulations, 10 CFR Part 600, as amended, Subparts A and ☒ B (Grants) or ☐ C (Cooperative Agreements).

d. Application/proposal dated 5/31/84, ☐ as submitted ☒ with changes as negotiated

19. REMARKS
This Grant consists of this NFAA, Part I-Budget Plan, Part II-Conditions, and Part III-Statemen of Work. The DOE Financial Assistance Rules (10CFR Part 600), OMB Circular A-102, OMB Circular A-87

20. EVIDENCE OF RECIPIENT ACCEPTANCE
Wayne Haas 8/24/84
(Signature of Authorized Recipient Official) *(Date)*
Wayne Haas
(Name)
Resource Analysis Division Administrator
(Title)

21. AWARDED BY
William C Drake 8/17/84
(Signature) *(Date)*
William C. Drake
(Name)
Contracting Officer
(Title)

Arr e BSL
29 June '84

TECHNICAL EVALUATION OF A GRANT PROPOSAL

TITLE: Geothermal Resource Evaluations in Idaho, 1984-1985.

SUBMITTED TO: Department of Energy, Idaho Operations Office.

SUBMITTED BY: State of Idaho
Department of Water Resources
Statehouse
Boise, ID 83720.

AMOUNT REQUESTED: $119,101.

PROPOSED DURATION: One year.

PROPOSAL DESCRIPTION: The proposer offers to perform four tasks which are:

(1) Sample, log, and perform chemical analyses for geothermal springs and approximately 25 wells which have been drilled in southern Idaho during the past two years.

(2) Characterize the geothermal reservoir in the Twin Falls area. Specific objectives will be to determine the volume, longevity, and effect of present development on the resource.

(3) Monitor and characterize the Boise geothermal resource.

(4) Provide a geothermal study fund at the three Idaho state universities.

The amount requested ($119,101) to perform these tasks is greater than the amount available ($90,000). The order of priority and the cost of each task is:

Task 2	$ 81,851
Task 3	12,250
Task 1	20,000
Task 4	5,000
	$119,101

Much of the work of Task 1 is necessary for the accomplishment of Task 2, so Task 1 cannot be eliminated. Task 4, however, can be eliminated without damaging the program.

GENERAL REMARKS:

1. Work Statement: The grantee's proposed work statement and schedule are compatible with DOE technical requirements with the exception of Task 4 which is of low priority and for which we lack sufficient funds.

2. Task Changes: The proposed activities of Tasks 2, 3, and 1 appear adequate to achieve the desired results. Task 4 should be eliminated or, if additional funding or cost reductions become apparent, it can be included as a low priority item.

3. Cost Information: Budget data, after telecon with the proposer, is adequate for evaluation of the proposal, and the amounts appear reasonable but there is a question of whether indirect costs should be charged for the $42,500 to be co-funded with the U. S. G. S.

SPECIFIC REMARKS:

1. Manhours: Salaries are expressed in dollars; telecons with the proposer indicate the manhours and costs are reasonable, but additional detail may be necessary.

2. Materials: Material costs are not listed separately, but are included in other categories such as laboratory and overhead.

3. Subcontracts: Subcontract activities, as indicated for Task 3, appear to be reasonable and appropriate.

4. Travel and Per Diem: Travel and per diem are combined in the cost figures; the figures appear reasonable and were explained via telecon with the proposer.

5. Other Direct Costs: Other direct costs include laboratory, geophysics, report publication, and equipment; they appear to be reasonable.

6. Proposers Capability to Meet the Objectives: The proposer has the education, experience, expertise, and support from others and is fully capable of meeting the key objectives of the proposal.

7. Key Personnel Qualifications: Leah V. Street, the Principal Investigator, has a Master of Science degree in Geology, has several years of experience in geothermal resources, and is fully qualified for this work. The qualifications of other individuals who will be working on the project will be reviewed by the P. I. and they will be directed by qualified personnel including the P. I.

8. Anticipated Objectives and Probability of Success: The anticipated objectives of all tasks funded should be met with a high probability of success. Tasks 2, 3, and 1 will contribute very significantly to the understanding of the Twin Falls and the Boise geothermal reservoirs.

June 26 1984
Date

R. Eldon Bray
General Engineer
Advanced Technology Division
U. S. Department of Energy
Idaho Operations Office

JUSTIFICATION FOR NON-COMPETITIVE AWARDS

I recommend that negotiations be conducted only with those organizations listed below for the services described herein in accordance with DOE-PR 9-3.805-501.

Organization

State of Washington, Department of Natural Resources
State of Washington, Energy Office
State of Oregon, Dept. of Geology & Mineral Industries
State of Oregon, Department of Energy
State of Alaska, Department of Commerce & Economic Development, Office of Energy
University of Alaska, Geophysical Institute
State of Alaska, Department of Natural Resources
New Mexico State University, Energy Institute
State of New Mexico Energy & Minerals Department
Idaho Department of Water Resources
State of Utah, Utah Geological & Mineral Survey
State of Utah, Division of Water Rights
State of Montana, Dept. of Natural Resources & Conservation
State of Montana, College of Mineral Science & Technology

1. Description of Supplies or Services to be Supported

A. The actions with the above named universities and state government agencies are for geothermal resource assessment and to promote geothermal technology transfer within the participating states. Emphasis will be placed on detailed studies within areas with high temperature resources and/or expansion of work previously conducted within the states.

B. The work to be provided by each university or state agency will be tailored to the needs within each state and DOE objectives for continued resource assessment and technology transfer.

2. History, Estimated Future Requirements, and Long-Range Objectives

A. The State Teams Programs were initiated approximately seven years ago. At the program peak DOE-ID was administering 39 geothermal contracts, cooperative agreements, or grants with universities and state agencies. Eight of the above mentioned organizations are at present in the final phases of their agreements with DOE; the remainder have completed the work, and their agreements were closed out.

B. This work is a continuation of the previous program in the sense that it is for geothermal resource assessment and technology transfer. However, the new emphasis will be in accordance with the generic guidelines set forth in C below and will investigate higher temperature systems.

C. All work will be within the generic guidelines of DOE which are to implement these activities within states which:

1. Have potential for high temperature geothermal resources
2. Whose resource assessment efforts will support R&D investigations required by magma and Cascades research programs
3. Have existing resource and energy groups actively supporting geothermal development
4. Are currently providing outstanding technology transfer and institutional problem mitigation activities

D. It is not anticipated that DOE will be able to develop competition for this work. The performing state agencies and universities were designated by the Governor's Office of each participating state. An attempt to stimulate competition would be contrary to DOE's policy of cooperation with state governments.

3. Estimated Cost

A. The program funding level of $1,925,000 was designated by the FY-84 Appropriations Bill and DOE-HQ. The funding levels for the individual states range from $ 90,000 to $145,000 and were established by ID and HQ based on the prior state teams annual funding levels, the amount and quality of work previously accomplished at these levels, and the amount of productive work remaining to be done.

B. The FY-84 funding level for the portion of the program to be administered at DOE-ID is $1,295,000 of the total program funding of $1,925,000. This level of funding is lower than any of the previous seven years; the amount to be funded in future years is uncertain.

C. It is the intent of this program to expand the knowledge of higher temperature resources within individual states. This work was performed in previous years by the organizations within each state which were designated by the respective Governor's Office. Any change in contractors at this time would increase costs and delay the program and could only be undertaken with the consent of the Governor's Office in each state.

4. Schedule Requirements

A. The basis for the rapid emplacement of the subject program is the imminent close-out of the agreements DOE now has with several of the organizations we wish to have perform under the FY-84 program. The agreements presently in place are scheduled for various completion dates ranging from almost immediately to September 1984.

B. It is important to get the work started as soon as possible because the existing expertise may be disbanded if the work presently contracted for is completed prior to the emplacement of this subject program. The existing expertise has been developed to a great extent under the previous DOE-ID contracts and a lapse in DOE funding could result in lack of financial support for the organizations. This cadre of experienced expertise is critical for high quality resource assessment and technology transfer, and it is doubtful that any other organizations can perform as well in the respective states as those which are listed above. Rapid emplacement of this program will help ensure the retention of the existing expertise.

C. It is doubtful that any savings can be realized or that competition can be increased by relaxing schedules.

5. Exclusive Capacity & Capability

It was determined at the beginning of the previous program to use universities and state agencies to perform the work because these organizations had already performed research in the particular areas, had basic staffs and departments capable of performing the research, and were designated by the state executives. The experience of these organizations has been further enhanced by the work they have conducted for DOE during the past seven years.

RECOMMENDED:

R E Wood

R. E. Wood, Director
Energy and Technology Division

CONCUR:

George C. Wingerson
Office of the Chief Counsel

J. F. Marmo 2/5/84

J. F. Marmo, Director
Contracts Management Division

APPROVED:

Troy E. Wade

2/7/84
Date

Troy E. Wade, Manager
Idaho Operations Office

STATEMENT OF WORK

IDAHO DEPARTMENT OF WATER RESOURCES

The purpose of these Geothermal Energy Investigations will be accomplished by performing the following tasks:

Task 1. Sample, log, and perform chemical analyses for geothermal springs and approximately 25 wells which have been drilled in southern Idaho during the past two years. A report will be prepared which will contain a listing of the chemical analyses, estimates of reservoir temperatures, and where possible, temperature profiles.

Task 2. Characterize the geothermal reservoir in the Twin Falls area. Specific objectives will be to determine the volume, longevity, and effect of present development on the resource. A report will be prepared describing the findings of this study.

Task 3. Monitor and characterize the Boise geothermal resource. A monitoring system of pressure transducers would be installed on the non-producing wells, the data stored on tape, and interpreted using a computer. At the end of one year a report will be prepared detailing the results of this task.

Task 4. Provide the overall project management and complete and report on tasks in a timely manner. Management reports shall be provided as defined by the attached DOE Form EIA 459A, Reporting Requirements Checklist. The required reports are also summarized as follows:

1.	Form DOE 538 Notice of Energy R&D	Due 30 days after award of grant.
2.	Quarterly Management Summary Report	Due 15 days after calendar quarter end.
3.	Quarterly Project Status Report	Due 15 days after calendar quarter end.
4.	Three Topical Reports - One each for Tasks 1, 2, and 3	Due prior to or accompanying final report in both draft and in final form and including one camera-ready copy.
5.	Final Report (Draft)	Due 45 days prior to completion date.
6.	Final Report	Due on completion date.
7.	Financial Status Report, OMB Form 269	Due on completion date.

The deliverables resulting from the tasks outlined above which will be delivered to DOE are summarized as follows:

1. One camera-ready plus 16 additional copies of the topical report for Task 1, above, to be distributed as specified in the attached DOE Form EIA 459A

2. One camera-ready plus 16 additional copies of the topical report for Task 2, above, to be distributed as specified in the attached DOE Form EIA 459A.

3. One camera-ready plus 16 additional copies of the topical report for Task 3, above, to be distributed as specified in the attached DOE Form EIA 459A.

4. One camera-ready plus 16 additional copies of the Final Report to be distributed as specified in the attached DOE Form EIA 459A.

5. Other reports previously described under Task 4, above, will also be prepared and issued in the amounts and at the frequency shown.

U.S DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE

REPORT DISTRIBUTION LIST

Addressees	Federal Assistance Reporting Form	Federal Assistance Budget Information Form	Federal Assistance Management Systems Summary Report	Federal Assistance Program Project Status Report	Federal Status Report	Notice of Energy RD&D Project Status Report, OMB Form 269	Technical Progress Report	Topical Report	Final Technical Report	Number of Report Copies
U. S. Department of Energy Idaho Operations Office 550 Second Street Idaho Falls, ID 83401										
Attn: R. Eldon Bray, Program Mgr. Energy & Technology Division						2	2		8	8
Attn: Elizabeth M. Hyster Contracts Management Div.						1	1	1	1	1
Attn: E. G. Jones, Director Financial Management Div.						1				
U. S. Department of Energy Forrestal Bldg., CE-324 1000 Independence Ave, S.W. Washington, DC 20585 Attn: Ron Toms						1	1		6	6
University of Utah Research Institute Earth Science Laboratory 391 Chipeta Way, Suite C Salt Lake City, UT 84108 Attn: Duncan Foley						1	1		1	1
U. S. Department of Energy Technical Information Center P. O. Box 62 Oak Ridge, TN 37830								1		

Special Instructions

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE REPORTING CHECKLIST

FORM EIA 459A
(10/80)

FORM APPROVED
OMB NO. 1900-0127

1. Identification Number: DE-FG07	2. Program/Project Title: Geothermal

3. Recipient:

4. Reporting Requirements:	Frequency	No. of Copies	Addressees
PROGRAM/PROJECT MANAGEMENT REPORTING			
☐ Federal Assistance Milestone Plan			
☐ Federal Assistance Budget Information Form			
☒ Federal Assistance Management Summary Report	Q		
☒ Federal Assistance Program/Project Status Report	Q		
☒ Financial Status Report, OMB Form 269	F		
TECHNICAL INFORMATION REPORTING			
☒ Notice of Energy RD&D	O		
☐ Technical Progress Report			
☒ Topical Report	A		
☒ Final Technical Report	F		

FREQUENCY CODES AND DUE DATES:

A - As Necessary; within 5 calendar days after events.
F - Final; Upon completion date
Q - Quarterly; within 15 days after end of calendar quarter or portion thereof.
O - One time after project starts; within 30 days after award.
X - Required with proposals or with the application or with significant planning changes.
Y - Yearly, 30 days after the end of program year. (Financial Status Reports 90 days)
S - Semiannually; within 30 days after end of program fiscal half year.

5. Special Instructions:

6. Prepared by: (Signature and Date)	7. Reviewed by: (Signature and Date)

U.S. DEPARTMENT OF ENERGY

DOE F 4220.2 (6-80) (Formerly PR-415)

SMALL BUSINESS/LABOR SURPLUS SET-ASIDE REVIEW

I.D. NO.

ITEM TITLE/DESCRIPTION
State of Idaho
Department of Water Resources
FY 84 Grant - Geothermal

SMALL BUSINESS SIZE STANDARD RECOMMENDED BY S.B. SPECIALIST
EMPLOYEES NUMBER _____
DOLLAR $ _____
SIC CODE: _____

PROGRAM OFFICE: Energy Tech + Conservation

PROCURING ACTIVITY: Contracts Mgmt Div.

SB/LS PARTICIPATION WAS CONSIDERED IN THE PREPARATION OF THIS PROCUREMENT ITEM AND FOLLOWING IS RECOMMENDED:

- ☐ Small Business Set-Aside _____ % $ _____
- ☐ Labor Surplus Set-Aside _____ % $ _____
- ☐ SBA Section 8(a) Procurement
- ☒ Set-Aside Action Not Recommended

NAME AND LOCATION OF PROPOSED SOURCE: (If Sole Source)

- ☐ Small Business ☐ Minority
- ☐ Labor Surplus Firm ☐ Other

SET-ASIDE NOT FEASIBLE BECAUSE:

- ☐ No Reasonable Expectation of Receiving Sufficient Offers from SB/LS Firms to Assure Award*
- ☐ Program Objectives Dictate Broadest Possible Solicitation to Obtain "Best Available" Expertise*
- ☐ Solicitation if for "Best Idea/Approach" R&D Effort
- ☐ Continuing and Directly Related R&D Effort. Competitive Procurement Not Feasible for Economic and/or Technical Reasons
- ☐ Procurement is for Completion or Within-Scope Expansion of Current Contract
- ☐ This is for Extension of Current Services to Allow Preparation/ Award of Competitive Follow on Procurement
- ☐ Sole Source as Determined Under Current DOE Policy Directives
- ☐ Funding of Unsolicited Proposal Under Current DOE Policy Directives
- ☒ Other*

*Explanation Required

EXPLANATION/ADDITIONAL COMMENT:
Supplementary Appropriation by Congress FY 84 for State Teams Geothermal activity in promoting technology utilization within participating states.

SMALL BUSINESS SPECIALIST CONSULTED (Check One) ☒ Yes ☐ No

583-0086
TELEPHONE

R Elton Bray
P.R. REQUESTOR

6-26-84
DATE

SMALL BUSINESS SPECIALIST'S ENDORSEMENT

- ☐ Accepts ☐ Requests Reevaluation
- ☐ Request Solicitation of SB/LS Sources Attached
- ☐ Request Special SB/LS/MB Incentive Provisions (Attached)
- ☐ Other Comments/Attached

_____ SMALL BUSINESS SPECIALIST

_____ DATE

REEVALUATION OF RECOMMENDATIONS/FINDINGS

- ☐ Reaffirmed
- ☐ Set-Aside Feasible

_____ AUTHORIZING PROGRAM OFFICIAL

_____ DATE

REVIEWED BY SBA

- ☐ Request Solicitation of SB Sources Attached
- SBA Form 70 Attached ☐ Yes ☐ No

_____ SBA REPRESENTATIVE

_____ DATE

PROCUREMENT OFFICER'S ACTION

- ☐ SB/LB Set-Aside ☐ Set-Aside Not Initiated
- ☐ Other Recommendations/Request Noted and Appropriate Action Taken

_____ PROCUREMENT OFFICER

_____ DATE

CONTRACT NO.(S) SB/MB/OTHER

ORIGINAL-CONTRACT FILE (FULLY EXECUTED)

DOE F 4200.33
(Rev. 11-82)

U.S. Department of Energy

Procurement Request-Authorization

Formerly PR-799A
(Previous editions are obsolete)

1. To Awarding Office: Contract Management Division

2. From Initiating Office: Energy Technology & Conservation Advanced Technology Division

3. PR Number —

4. Change/Correction to a PR in Process? ☐ Yes ☐ No

5. If Item 4 is yes, enter PR correction Letter

6. ☐ Procurement ☐ Assistance

7. Consistent with Principal Purpose of Program? ☐ Yes ☐ No

Action Description/Title (180 char. max.): Idaho Dept of Water Resources - FY 84 Grant for Geothermal Resource Chemistry Evaluations

If award is competitive, has list of sources been attached? ☐ Yes ☐ No

If Non-Competitive, Complete Items 9-11.

9. Name: State of Idaho

10. Division: Dept. of Water Resources

11. Address: Statehouse, Boise, Idaho 83720

12. For Procurement Actions Only: Product or Service Code

13. For Assistance Actions Only: CFDA Number

14. Cooperative Agreement ☐

15. Grant ☐

16. Controlled Deliverable For All Actions

17. Kind of Award Action (Recommended)

18. Master Bin

19. Desired Award Date: ASAP (Mo Day Year)

20. Unsolicited Proposal Number

21. Project Number

22. Government Property ____ F-Furnished, P-Purchased, N-Not involved

FINANCIAL DATA

23. Government Share: 90,000

24. Awardee Share

25. Total

FY FUNDS COMMITTED

26. Approp. Symbol	27. B&R Number	28. Dollar Amt.	29. Allotment	30. Object Class	31. AFP	32. CFA

33. From Continuation Sheet

34. Total Funds this PR

35. Project Period from ____ thru ____

36. Budget Period from ____ thru ____

PROJECT MANAGER/INITIATOR

37. Name	38. Signature	39 Date	40. Office Code / 41. FTS Telephone Number
R. Eldon Bray	R Eldon Bray	6-26-84	583-0086

PROGRAM REVIEWING OFFICIAL

42. Name	43. Signature	44. Date
Charles E. Gilmore		

PROGRAM OFFICE BUDGET OFFICIAL

45. Name	46. Signature
Dennis R. Bell	

CERTIFYING OFFICIAL. I hereby certify that the funds cited in item 34 are available

47. Name	48. Signature	49. Date
Frank S. Smith		

CONTRACTING OFFICE

18 June '84

Comments on ID proposal

- will student deliverables be able to be guaranteed on time
  (i.e. not Ralston type delays!)

Task 1 - add to inventory - springs not yet spld & inventoried, rephrase to: "extent poss. by funding"
  if noted somewhere | no set #, specific on analyses
  make phrase "thermal sites" data collected

Task 2 - More specifics on rept.
  why just AMT?
  no mention of cost share split, & qty to get DOE product, even if GS matching doesn't work

Task 3 - vy limited pressure study
  also need to relate to other well production characteristics
  if thesis, may take longer

Task 4 - timing on deliverable

SCP '84

More details on how will be managed, esp w/ coop agreement
who will USGS people be - to assure understanding of timly deliverably

much more detail on $ (how does this break out - is this revised?)

State of Idaho
DEPARTMENT OF WATER RESOURCES
STATE OFFICE, 450 W. State Street, Boise, Idaho

JOHN V. EVANS
Governor

A. KENNETH DUNN
Director

Mailing address:
Statehouse
Boise, Idaho 83720
(208) 334-4440

June 13, 1984

Duncan Foley
University of Utah
Research Institute
Research Park
391 Chipeta Way, Suite A
Salt Lake City, UT 84108

Dear Duncan:

Enclosed is a copy of the geothermal proposal to DOE. I have talked to Eldon and he knows that I am sending this copy directly to you.

If you have any questions, please contact me at (208) 334-3788.

Sincerely,

Leah V. Street
Geologist, Geothermal Program

LVS:dc

enclosure

INTRODUCTION

The state of Idaho along with other federal agencies has been involved in studying the thermal systems in Idaho for the past ten years. Currently the state is being funded by the Bonneville Power Administration to consolidate and evaluate currently available information in existing records and files into a common data base for the Pacific Northwest Region.

This program encompasses the following tasks:

1. Characterization of Geothermal Resource Sites Capable of Producing Electricity (>90°C)
2. Characterization of Direct Use Geothermal Resource Sites (<90°C)
3. Review of Federal, State, and Local Legal, Institutional and Environmental Requirements Which Impact Resource Developments
4. Site Ranking

Because this agreement is specified to use currently available data, no further geothermal resource data can be collected with these funds.

The present proposal is in direct response to a verbal request from DOE-Idaho to outline several tasks that will help to define and expand the geothermal resource data base.

EXECUTIVE SUMMARY

This proposal is being submitted by the Idaho Department of Water Resources. The tasks are designed to further characterize Idaho's geothermal resource data base. Identification of these tasks was a result of coordination among geothermal experts from the state, U.S. Geological Survey, Bureau of Land Management and private industry.

The proposal consists of an introduction, four task items, budgets, delivery mechanisms, histories, bibliographies and resumes. Some of the tasks are related to one another in that information acquired and developed in one task may be utilized by the others. However, each task is an independent work element with a specific deliverable.

Task 1 is a continuation of the sampling and logging of thermal wells in Idaho. It is estimated that 25 geothermal wells have been drilled in southern Idaho during the past two years. Deliverables will include a report listing the chemical analyses, estimates of reservoir temperatures and where possible, temperature profiles.

Task 2 will characterize the geothermal reservoir in the Twin Falls area. Specific objectives will be to determine the volume, longevity and effect of present development on the resource. Deliverables will include a report describing the findings of the study.

Task 3 will monitor and characterize the Boise geothermal resource. Several geothermal wells would be monitored and a

report will be delivered detailing the results.

Task 4 outlines a geothermal study fund to be utilized by senior or graduate students at the three state universities. Deliverables will include final reports of the research activities.

It is envisioned that all tasks would be completed in 12 months.

TASK #1 THERMAL WELL SAMPLING

Background: Most of the thermal springs and wells have been inventoried, sampled and in some cases these results have been interpreted and reported upon. The reports can be found in the bibliography of this proposal.

Problem: During the past two years approximately 25 thermal wells have been drilled. These wells need to be inventoried, sampled and where possible, temperatures logged.

Objective: This information would be used to update the existing data base.

Approach: The thermal wells will be located, inventoried, sampled, and the results analyzed. Using geothermometers, estimates of reservoir temperatures will be made.

TASK #2 TWIN FALLS THERMAL AQUIFER CHARACTERIZATION

Background: The Twin Falls area is one of the State's fastest growing areas for development of geothermal resources. Current development in this area is located between Salmon Falls Creek on the west, the city of Twin Falls on the east, and south to the Nevada border. The resource is being used for space heating of homes and greenhouses, and for some buildings on the campus of the College of Southern Idaho. Other uses include recreation and fish farming. In the last several years more than 40 wells have been drilled to provide hot water. The wells range in depth from several hundred feet to 2,200 feet. They produce water ranging in temperature from near 30° to 72°C. One well yields as much as 6,000 gallons per minute with a shut-in pressure of about 250 psi.

To date, the U.S. Geological Survey in cooperation with the U.S. Department of Energy (DOE IA No. DE-A107-80ID12173) has completed one study. Based on existing wells and springs, this study provided valuable hydrologic and chemical information descriptive of the geothermal resources as to: (1) the areal extent of the geothermal resource; (2) water temperatures and pressures at the land surface; (3) chemical and isotopic character of the thermal water; and (4) estimated reservoir temperatures at depth determined by use of geochemical thermometers. In addition, drilling has started on a 1,500 foot test hole in the area south of the town of Filer.

Problem: Although the above study has resulted in a better

understanding of the geothermal resources, definition of the areal extent of the resource is limited to areas of existing wells and springs. Consequently, little is known about the occurrance and extent of the resource in areas where there are no wells. Also, the effect of current development on the resource is virtually unknown.

Objective: Resource assessment should be completed in order to elucidate the complexities of this system. Specifically, the volume, longevity and effect of present development on the resource would be the main objectives of this proposed study.

Approach: The study approach would include the following: (1) inventory of any new hot water wells drilled in the area since the previous study and (2) collection of water samples from these new wells and selected cold springs to analyze for standard chemical constituents plus arsenic, boron, mercury, and lithium and the stable isotopes deuterium and oxygen-18. In addition, several AMT electrical profiles would be made. One well would be equipped with a continuous recorder to monitor head-pressure fluctuations. Periodically during the study, selected wells would be visited and water level or pressure measurements made. A report would be prepared for publication.

TASK #3 MONITORING OF GEOTHERMAL RESOURCE IN BOISE

Background: Currently the city of Boise ranks as the second largest geothermal space heating district in the world. Reykjavik, Iceland is number one. The increased use of this aquifer has caused serious concerns regarding the volume and future development of the system.

Problem: Although pump tests have been conducted on several of the wells, these tests have been over a short period of time and therefore are inadequate to predict the reservoir characteristics. Increased demands on this system could result in a water management problem.

Objective: In order to assist with responsible development of this resource, a study will be made that will determine the effects of present use.

Approach: The Water Resource Institute has funded Boise State University $3,500 in seed money to monitor the Boise system. This study is definitely a start, but a more comprehensive study is necessary to more fully understand the aquifer.

A pressure monitoring system would be installed on the non-producing wells. These wells would be equipped with pressure transducers. Output from the transducers would be stored on tape and interpreted using the Department's computer. At the end of one year, a document would be published outlining the results of the study. This task would be an excellent M.S. thesis project. A graduate student and a professional familiar with the Boise system would be able to produce a workable report for effective resource management.

TASK #4 GEOTHERMAL STUDY FUND

Background: The study of geothermal resources is multi-disciplinary and, in most cases, is not taught as a course. Researching site-specific resources is an opportunity for senior or graduate students to apply practical methods to a field problem.

Problem: Although most of Idaho's geothermal resources have been studied in some detail, sites should be targeted for more specific research.

Objective: These interpretative studies would add to the understanding of geothermal systems.

Approach: The geology departments at the three state universities would be contacted for participation in this program. Formal proposals would be accepted and monies awarded based on the following criteria: 1. geologic significance, 2. originality, and 3. research method. A final report would be turned in at the end of the nine month grant.

BUDGETS

TASK #1 and TASK #2

	IDWR	USGS	
Salaries	$27,000	$25,000	
Fringe	6,210	---	
Travel	3,000	2,250	
Equipment		2,000	
Vehicles		1,500	
Laboratory		2,500	
Geophysics		12,500	
Report Publication		1,000	
Overhead and Technical Support		38,250	
TOTAL	$36,210	$85,000	
	42,500		
	78,710	$42,500	IDWR
Indirect (.294)	23,141	$42,500	USGS
	$101,851		

Tasks #1 and #2 have been approved for co-funding by the U.S. Geological Survey. Therefore, monies allocated to IDWR by U.S.DOE for these two tasks will be equally matched by the USGS based on a cooperative agreement between the two agencies.

TASK #3 - Subcontracted to state university

Salaries	
Graduate Students	$ 6,000
Professional Hydrologic Advisor	2,000 - Reg Mink consulting?
Equipment (central receiver, probes, wiring, etc.)	2,500
Travel	750
Publication and misc.	1,000
	$12,500

Time: 1 year

TASK #4 - Grants to state universities

Grants $5,000

Contract management costs for Task #3 and #4 are included in the 1 FTE salary.

Is this Leah?

TOTAL BUDGETS

Task #1 and #2	$101,851
Task #3	12,500
Task #4	5,000
	$119,351

THE HISTORY OF THE
IDAHO STATE GEOTHERMAL PROGRAMS

Commercialization

One of the major highlights of the Idaho program was the realization of the Capitol Mall project. Staff members were involved in the early stages by providing the economics of the system to the governor. Geologists from the resource assessment team sited the successful wells. While the first well was being drilled, a staff geologist monitored the drilling and logged the cuttings. Both teams were instrumental in making this project a reality.

Another accomplishd task was the successful completion of 13 site specific studies. These studies examined in greater detail the factors which influence the prospects for geothermal development. Each site specific development plan defined the potential amount of usable geothermal energy available, and described actions neded to fulfill that potential.

Resource Assessment

The resource assessment team has mapped and sampled most of the thermal springs and wells in Idaho. Results of these studies have been published, and a state geothermal map has been compiled. Other than the involvement, as noted above, in the Capitol Mall project, the resource assessment group has done much to define Idaho's geothermal resources.

IDAHO GEOTHERMAL BIBLIOGRAPHY

Eastlake, W.B., 1979, Geothermal Alternatives for the Idaho Capitol Mall: GRC Transactions, Vol. 3, pp. 173-176.

Eastlake, W.B., 1980, A Primer on Economic Feasibility for Direct Users: GRC Transactions, Vol. 4, pp. 703-706.

Eastlake, W.B.; and McClain, D., 1980, Idaho Geothermal Commercialization Program Five Site Specific Development Plans: DOE/ID/12010-3, Idaho Office of Energy Pub.

Eastlake, W.B.; and Sifford, A., 1980, Big Creek Hot Springs - Site Specific Development Analysis: Idaho Office of Energy Pub.

Eastlake, W.B.; and Street-Martin, L., 1980, Challis, Idaho, Site Specific Development Analysis: Idaho Office of Energy Pub.

Eastlake, W.B.; and Street-Martin, L., 1980, Salmon, Idaho - Site Specific Development Analysis: Idaho Office of Energy Pub.

Eastlake, W.B.; and Street-Martin, L., 1980, Preston, Idaho - Site Specific Development Analysis: Idaho Office of Energy Pub.

Hammer, G.D.; and Esposito, L., 1979, Idaho Geothermal Handbook: Idaho Office of Energy Pub.

McClain, D.W., 1979, Geothermal Energy in Idaho: Site Data Base and Development Status: OIT Geo-Heat Utilization Center in cooperation with Idaho Energy Office.

McClain, D.W.; and Eastlake, W.B., 1980, Magic Hot Springs, Idaho - Site Specific Development Analysis: Idaho Office of Energy Pub.

McClain, D.W.; Eastlake, W.B.; and Sifford, A., 1980, Butte City, Idaho - Site Specific Development Analysis: Idaho Office of Energy Pub.

McClain, D.W.; and Eastlake, W.B., 1980, Grand View, Idaho - Site Specific Development Analysis: Idaho Office of Energy Pub.

McClain, D.W., 1980, A Review of Institutional Factors Affecting Geothermal Resource Development in Idaho: Idaho Office of Energy Pub.

McClain, D.W., 1979, Weiser Hot Springs, Idaho - Site Specific Development Analysis: Idaho Office of Energy Pub.

McClain, D.W.; Eastlake, W.B.; and Gross, M., 1979, Stanley, Idaho - Site Specific Development Analysis: Idaho Office of Energy Pub.

McClain, D.W.; and Eastlake, W.B., 1979, Hailey, Idaho - Site Specific Development Analysis: Idaho Office of Energy Pub.

Brott, C.A.; Blackwell, D.D.; and Mitchell, J.C., 1979, Geothermal Investigations in Idaho, Part 8, Heat Flow Studies of the Snake River Plain, Idaho: Idaho Department of Water Resources, Water Information Bulletin No. 30, 195 p.

Corbett, M.K.; Anderson, J.E.; and Mitchell, J.C., 1980, Geothermal Investigations in Idaho, Part 10, An Evaluation of Thermal Water Occurrences in the Tyhee Area, Bannock County, Idaho: Idaho Department of Water Resources, Water Information Bulletin No. 30, 67 p.

Mitchell, J.C., 1979, Geothermal Investigations in Idaho, Part 5, Geochemistry and Geologic Setting of the Thermal Waters in Northern Cache Valley Area, Franklin County, Idaho: Idaho Department of Water Resources, Water Information Bulletin No. 30, 47 p.

_____, 1976, Geothermal Investigations in Idaho, Part 6, Geochemistry and Geologic Setting of the Thermal and Mineral Waters of the Blackfoot Reservoir Area, Caribou County, Idaho: Idaho Department of Water Resources, Water Information Bulletin No. 30, 48 p.

_____, 1976, Geothermal Invesigations in Idaho, Part 7, Geochemistry and Geologic Setting of the Thermal Waters of the Camas Prairie Area, Blaine and Camas Counties, Idaho: Idaho Department of Water Resources, Water Information Bulletin No. 30, 44 p.

Mitchell, J.C.; Johnson, L.L.; and Anderson, J.E., 1980, Geothermal Investigations in Idaho, Part 9, Potential for Direct Heat Application of Geothermal Resources: Idaho Department of Water Resources, Water Information Bulletin No. 30, 396 p.

Mitchell, J.C., ed., 1981, Geothermal Investigations in Idaho, Part 11, Geological, Hydrological, Geochemical and Geophysical Investigations of the Nampa-Caldwell and Adjacent Areas, Southwestern Idaho: Idaho Department of Water Resources, Water Information Bulletin No. 30, 143 p.

Rightmire, C.T.; Young, H.W.; and Whitehead, R.L.; 1976, Geothermal Investigations in Idaho, Part 4, Isotopic and Geochemical Analyses of Water from the Bruneau-Grand View and Weiser Areas, Southwest Idaho: Idaho Department of Water Resources, Water Information Bulletin No. 30, 28 p.

Young, H.W., 1975 b, Geothermal Investigations in Idaho, Part 3, An Evaluation of Thermal Water in the Weiser Area, Idaho: Idaho Department of Water Resources, Water Information Bulletin No. 30, 35 p.

Young, H.W.; and Mitchell, J.C., 1973, Geothermal Investigations in Idaho, Part 1, Geochemistry and Geologic Setting of Selected Thermal Waters: Idaho Department of Water Resources, Water Information Bulletin No. 30, 43 p.

Young, H.W.; and Whitehead, R.L., 1975 a, Geothermal Investigations in Idaho, Part 2, An Evaluation of Thermal Water in the Bruneau-Grand View Area, Southwest Idaho: Idaho Department of Water Resources, Water Information Bulletin No. 30, 126 p.

Delivery Mechanisms

Monthly and quarterly reports will be supplied by the contractor to the U.S. DOE. These reports, along with the final, will be distributed as outlined in the attached Idaho Operations Office Report Distribution List.

U.S. DEPARTMENT OF ENERGY

FEDERAL ASSISTANCE REPORTING CHECKLIST

FORM EIA 459A
(10-80)

FORM APPROVED
OMB NO 1900-0127

1. Identification Number: DE-FG07	2. Program/Project Title: Geothermal
3. Recipient:	

4. Reporting Requirements:	Frequency	No. of Copies	Addressees
PROGRAM/PROJECT MANAGEMENT REPORTING			
☐ Federal Assistance Milestone Plan			
☐ Federal Assistance Budget Information Form			
☒ Federal Assistance Management Summary Report	Q		
☒ Federal Assistance Program/Project Status Report	Q		
☒ Financial Status Report, OMB Form 269	F		
TECHNICAL INFORMATION REPORTING			
☒ Notice of Energy RD&D	O		
☐ Technical Progress Report			
☒ Topical Report	A		
☒ Final Technical Report	F		

FREQUENCY CODES AND DUE DATES:

A - As Necessary; within 5 calendar days after events.
F - Final; 90 calendar days after the performance of the effort ends.
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O - One time after project starts; within 30 days after award.
X - Required with proposals or with the application or with significant planning changes.
Y - Yearly; 30 days after the end of program year. (Financial Status Reports 90 days).
S - Semiannually; within 30 days after end of program fiscal half year.

5. Special Instructions:

6. Prepared by: (Signature and Date)	7. Reviewed by: (Signature and Date)

U.S. DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE

REPORT DISTRIBUTION LIST

Addressees	Number of Report Copies																			
	Federal Assistance Awareness Fact	Federal Assistance Budget Information Form	Federal Assistance Management Summary Report	Financial Status Report (Project Status Report)	Notice of Energy RD&D Form 269	Technical Progress Report	Topical Report	Final Technical Report												
U. S. Department of Energy Idaho Operations Office 550 Second Street Idaho Falls, ID 83401																				
Attn: R. Eldon Bray, Program Mgr. Energy & Technology Division				2	2			8	8											
Attn: Elizabeth M. Hyster Contracts Management Div.				1	1	1	1	1	1											
Attn: E. G. Jones, Director Financial Management Div.				1																
U. S. Department of Energy Forrestal Bldg., CE-324 1000 Independence Ave, S.W. Washington, DC 20585 Attn: Ron Toms				1	1			6	6											
University of Utah Research Institute Earth Science Laboratory 391 Chipeta Way, Suite C Salt Lake City, UT 84108 Attn: Duncan Foley				1	1			1	1											
U. S. Department of Energy Technical Information Center P. O. Box 62 Oak Ridge, TN 37830						1														

Special Instructions

RESUME OF
KEY PERSONNEL

Leah V. Street
97 Rainier Lane
Boise, Idaho 83702
(208) 334-3788

EDUCATION

Academic:

B.Sc., Geology, Boise State University, 1975
M. Sc., Geology, Western Washington University, 1980
Specialized in the analytical and interpretive geochemistry of blueschist/greenschist, pelitic schist and iron. Thesis provided evidence for ophiolite affinity of formation.

Professional:

- State-Federal Geothermal Conference, Seattle, Washington, January, 1981. Sponsor - WSEO.
- Technical Training Course No. 7, Introduction to Geothermal Log Interpretation, Reno, Nevada, April, 1981. Sponsor - GRC.
- Short Course, Geothermal Potential of the Cascade Mountain Range, Portland, Oregon, May, 1981. Sponsor - GRC,WSEO,ODOE.
- Technical Assistance Training Session in Geothermal Direct-Use Applications, Klamath Falls, Oregon, June, 1981. Sponsor - OIT Geo-Heat Center.
- Current Geothermal Legislation, Seattle, Washington, August, 1981. Sponsor - WSEO,USDOE.
- Workshop on Siting, Planning, Drilling, and Completion of Low to Moderate Temperature Geothermal Production and Observation Wells, Reno, Nevada, February, 1983. Sponsor -GRC.

PROFESSIONAL ACTIVITIES

Member, Geothermal Resources Council
Chairperson, Exploration Subcommittee for 1983 Annual Meeting

Member, American Institute of Professional Geologists

Testimony before the Subcommittee on Public Lands and Reserved Water of the Energy and Natural Resources Committee, United States Senate on S. 1516 the "Geothermal Steam Act of 1981". December 12, 1981.

Served on regional geothermal task force that provided technical information to the Northwest Power Planning Council.

Guest Lecturer at Geothermal Resources Development Field Course, September, 1982. Sponsor - ODOE.

PROFESSIONAL EXPERIENCE

Geologist, Geothermal Program: Idaho Department of Water Resources, Bureau of Energy, Statehouse, Boise, Idaho 83720

Currently manage the Bureau's geothermal resource program which encompasses the geologic and regulatory aspects of geothermal resources. Collaborate with representatives of government, industry, and the general public regarding state and federal leasing and permitting regulations governing exploration and development. Advise resource owners and prospective resource owners concerning all aspects of geothermal development. Promote geothermal energy by making presentations to the news media, and civic and private organizations. Wrote Idaho's portion of regional BPA and DOE proposals. Monitored technical contract related to mineral resources.

(November 3, 1980 to Present)

Geologist: Bureau of Land Management, Route #3, Box 1, Burley, Idaho 83318

Had lead responsibility conducting a building stone inventory in the Burley BLM District which covers three counties in southern Idaho. Job required a working knowledge of state and federal mining laws, acquisition of mining properties under state and federal laws, research of mining claims at the county courthouses as well as BLM ownership records, including the new Automated Land and Mineral Record System, interviewing of quarriers and claim owners, estimating reserves of building stone, field investigation of the quarries as well as compiling this information into a written report and mining claim map. Advised claimants on environmental permits and the development of reclamation plans. Inspected gravel pits for compliance and wrote technical reports for Free-Use Permits and the land withdrawal review program.

(May 21, 1980 - August 15, 1980)

Biological Technician (Soils): A.R.S.U.S.D.A., 1175 Orchard, Suite 116, Patti Plaza, Boise, Idaho 83705

In charge of water quality lab and the field sampling for bacterial analyses. Used the standard method for coliform concentrations. Conducted field analyses for D.O. and pH, and determined suspended and bedload quantities in the lab. Helped to prepare reports and papers for publication. During the summer of 1976, supervised two field technicians as well as trained one of them to conduct the laboratory analyses.

(November 11, 1974 - August 12, 1976)

Teaching Assistant: Boise State University, Boise, Idaho 83725

Taught the lab portion of Physical Geology . Prepared lab lectures and tests and led the class on a field trip.

(Fall semester, 1975)

Research Assistant: Boise State University, Boise, Idaho 83725

Collected groundwater samples and analyzed them for coliform concentrations using standard methods. Drafted a map correlating septic tank failures to groundwater levels and wrote a report that discussed the results.

(May 1, 1974 - September 30, 1974)

PUBLICATIONS:

Babcock, R.S., J. Cruver, B. Christensen and L. Street, 1980, Geochemistry of Pre-Tertiary Mafic Volcanic Rocks in the Western Part of the North Cascades Range, paper presented by R.S. Babcock PNAGU Regional Meeting.

Eastlake, W.B. and L. Street-Martin, 1980, Challis, Idaho Site Specific Development Analysis: Idaho Office of Energy Publication.

Eastlake, W.B. and L. Street-Martin, 1980, Salmon, Idaho Site Specific Development Analysis: Idaho Office of Energy Publication.

Eastlake, W.B. and L. Street-Martin, 1980, Preston, Idaho Site Specific Development Analysis: Idaho Office of Energy Publication.

Stephenson, G.R. and L.V. Street, 1978, Bacterial Variations in Streams from a Southwest Idaho Rangeland Watershed, Jour. of Environ. Qual., vol. 7, no. 1, pp. 150-157.

Stephenson, G.R. and L.V. Street, 1978, Water Quality Inventory of Rangelan Watersheds in Southwest Idaho, A 3 - Year Summary Interim Report on Water Quality, A.R.S. - B.L.M. Cooperative Studies, A.R.S.U.S.D.A., Boise, Idaho.

Stephenson, G.R. and L.V. Street, 1976, Quality of runoff from nonpoint sources on a southwest Idaho rangeland watershed, Abstract, Pres. at the 43rd Annual Meeting of the Northwest Pollution Control Administration, Seattle, Washington, October.

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