

DATE: June 3, 2011

TO: Lee Robinson, Martin Booth, CERES Team

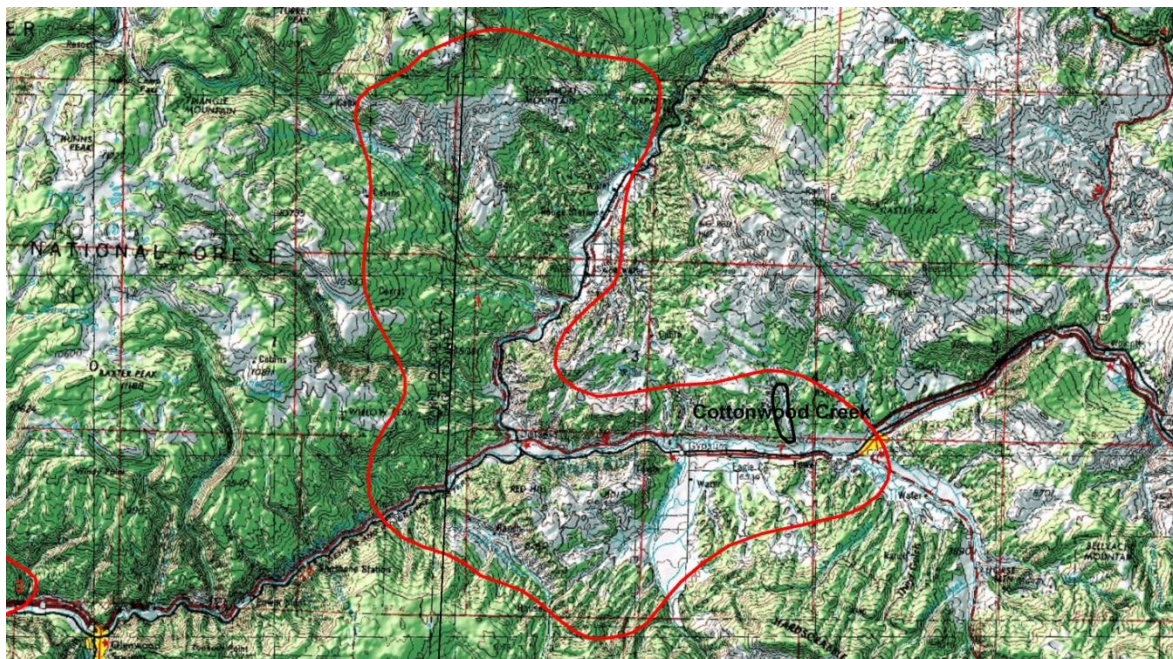
FROM: Rick Zehner

SUBJECT: Target selection from the 21 polygons

This memo is meant as an initial analysis of the geothermal potential of the 21 polygons identified by the CERES group using LANDSAT and ASTER remote thermal imaging. Using the thermal and alteration data they provided, plus additional GIS layers, I have come up with 30 targets for possible site visits.

The 30 targets were prioritized based on a qualitative ranking system that places highest values with direct physical evidence of an existing geothermal system that could be associated with and responsible for the thermal anomalies. This included (in rough descending order): 1) geothermal systems with 'good' geochemistry, 2) geothermal systems, 3) evidence from satellite or a USGS mines/prospect database (MRDS) of favorable mineralogy or alteration, association with known faults or photolinears, and 5) size, shape, and geographic location of the thermal anomalies themselves. These targets were then evaluated in terms of land ownership and proximity to transmission. Finally, taking these factors into account, they were ranked from 'low' to high'.

This first pass is meant to stimulate discussions for target selection only. I have included a zip file containing some of the shapefiles I constructed for this project, for the CERES team to evaluate.



Polygon 1: Eagle 1

Land Ownership: ~60% BLM land, 40% private ownership

Environmental: One small ACEC on west boundary.

Surface Thermal Manifestations:

Dotsero Warm Springs (32C; low geothermometer temperatures (~100C) from 6 samples)

Other springs wells are cold, have low geothermometer and F; a few (including Dotsero) have slightly elevated boron.

No temperature gradient data here.

Satellite Thermal Imagery: LANDSAT and ASTER anomalies don't match well. ASTER anomalies cover 17.4% of the polygon area, and are mostly associated with flat, south-facing slopes.

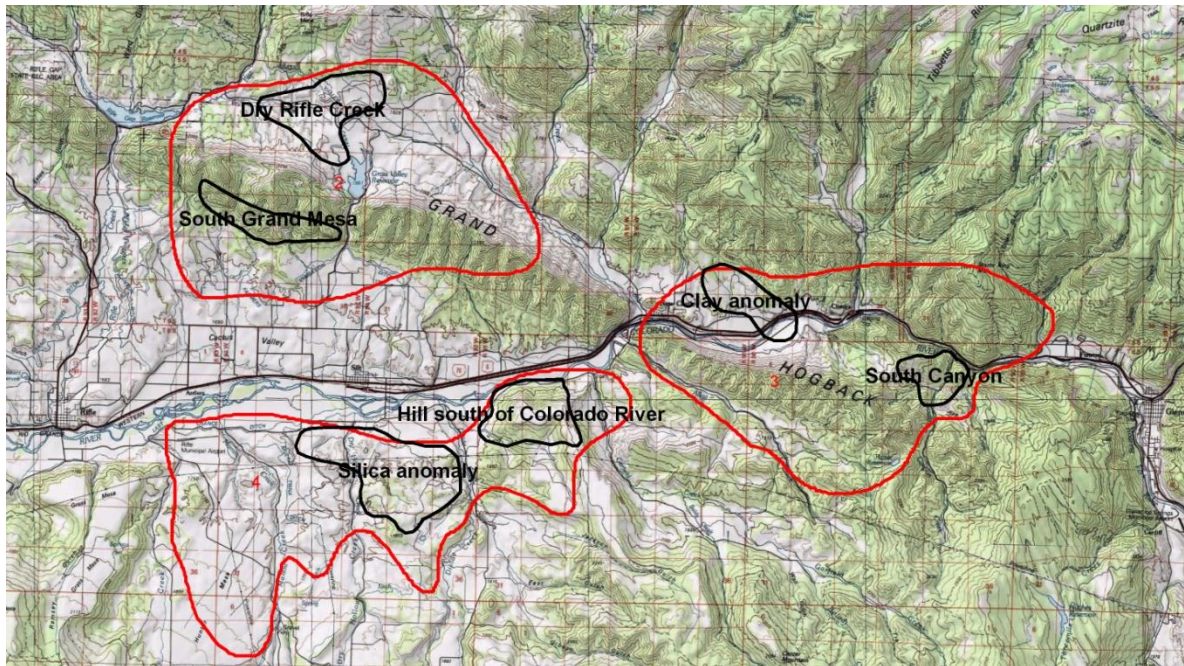
Alteration: Within the polygon the clay signature is most prominent, although it's not well spatially associated with the thermal anomalies. It seems associated with the 'Tbb' unit of the W. Colorado geologic map.

Mines and Prospects: The few mines and prospects are not spatially associated with either the thermal or alteration anomalies.

Wells: No oil or gas wells

Areas of Interest: Low priority from first pass. A couple accessible thermal anomalies with structures are in

- 1) Secs 26 and 35 of T4S R85W along Cottonwood Creek.
 - a) Ownership: BLM
 - b) Distance from transmission: 1 mile
- 2) Secs 22, 23, 27, and 34 of T3S R86W along west bank of Colorado River
 - a) Ownership: BLM
 - b) Distance to transmission: 12 miles



Polygon 2: Garfield 2

Comments: Satellite thermal anomalies comprise 20% of the area here but no surface thermal manifestations. In one area they correspond spatially to clay alteration. Dry Rifle Creek would be easy to sample with 2m equipment.

Land Ownership: ~50% BLM land, 50% private ownership

Environmental: No ACES, WSA's, or Wilderness

Surface Thermal Manifestations: None. No temperature gradient data here.

Satellite Thermal Imagery: LANDSAT and ASTER anomalies don't match well, but form 3 WNW-ESE bands parallel to the dominant fault (lineament) direction. The northern ASTER anomalies occupy the top and north sides of Grand Hogback, and one portion of which (Dry Rifle Creek) correlate spatially with silica anomalies (unit 'Km'). The central LANDSAT anomaly occurs on the south facing slope of Grand Hogback. The third ASTER anomalies are on top of flat ridges south of Grand Hogback

Alteration: Within the polygon the silica signature occurs, along Dry Rifle Creek. Not much else sticks out.

Mines and Prospects: None.

Wells: 18 wildcat oil and gas wells. No thermal data.

Areas of Interest: Two possible spots to do 2m sampling in an area without other thermal manifestations, but structural support:

- 1) ASTER anomaly on Dry Rifle Creek on the north side of Grand Mesa: Secs 1, 2, 3, 11, 12 of T5S, R92W. Moderate priority
 - a) Land Ownership: 75% private, 25% BLM
 - b) Distance to transmission: 3 miles
- 2) LANDSAT anomaly on south side of Grand Mesa in Secs 21, 22, 23, and 27 of T5S, R92W. Moderate priority
 - a) Land Ownership: 95% BLM
 - b) Distance to transmission: 3 miles

Polygon 3: Garfield 3

Land Ownership: ~40% BLM land, 60% private ownership

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: South Canyon Hot Springs (48C) occurs at a probable fault intersection about 1 mile south of the Colorado River. It has interesting Na-K-Ca (135C), moderate cation (117C), and low (65C) chalcedony geothermometer temperatures. No heat flow data from this polygon. A nearby cold well has a Na-K geothermometer temperature of 197C and elevated B, F, and TDS, suggesting a geothermal influence (though Na-K temperature is probably unreal).

No temperature gradient data here.

The polygon is just upriver from Glenwood Springs, which has ~149C Na-K, Na-K-Ca, and cation (but low silica) geothermometer temperatures.

Satellite Thermal Imagery: ASTER anomalies are concentrated in the NW, east, and SE parts of the polygon while LANDSAT anomalies are loosely spread throughout and don't match well with the ASTER. The NW ASTER anomalies occur at fault intersections on the north side of the Colorado River on flat to south facing slopes, close to a MRDS clay locality. This anomaly extends into flat lands right next to the Colorado River into T9S R9W S34 that looks easy to sample via 2m surveys. The eastern ASTER anomalies are also situated north of the river at fault intersections. The SE ASTER anomalies are close to the South Canyon Hot Springs and cold well with interesting geochemistry.

Alteration: Within this polygon the alteration signature is subdued and unassociated with either the surface or satellite thermal anomalies. There is a small satellite silica anomaly near the NW thermal anomaly, but situated on top of a building and associated yard. Clays seem to be associated with a fault zone along the southern border of the polygon.

Mines and Prospects: With the exception of the clay pit adjacent to the NW thermal anomaly, the few mines and prospects are not spatially associated with either the thermal or alteration anomalies.

Wells: 4 oil or gas wells

Areas of Interest:

- 1) 2m rods should be planted along South Canyon and ridges associated with the hot springs and associated thermal anomalies in Secs 2, 3, 10, and 11 of T6S R90W. This will probably require permission from operators at the nearby landfill. High priority.
 - a) Land Ownership: 80% Private, 20% BLM
 - b) Distance to transmission: 0 miles
- 2) Unsupported by surface thermal phenomena is the ASTER-clay anomaly in southern half of Secs 28, 29, northern half of Secs 32, and 33, and western ½ Sec 34 in T5S R90W. Low priority.
 - a) Land Ownership: 100% Private
 - b) Distance to transmission: 0-1 mile

Polygon 4: Garfield 4

Land Ownership: 90% Private, 10% BLM land

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None. Some cold spring/wells have slightly elevated boron contents (1-5 ppm), in 'Kmv' unit. No temperature gradient data here.

Satellite Thermal Imagery: Large ASTER anomalies on flat to gently north-facing slopes like Hunter's Mesa. Other (fewer) LANDSAT anomalies occur that don't match well spatially with the ASTER. An area around Weible Peak has both ASTER and clay anomalies (but not very coincident).

Alteration: Within the polygon the silica signature is most prominent, particularly around Mt. Weible ('Two' unit), lesser on parts of Hunter Mesa. Spotty FeOx.

Mines and Prospects: The few mines and prospects are not spatially associated with either the thermal or alteration anomalies.

Wells: No oil or gas wells

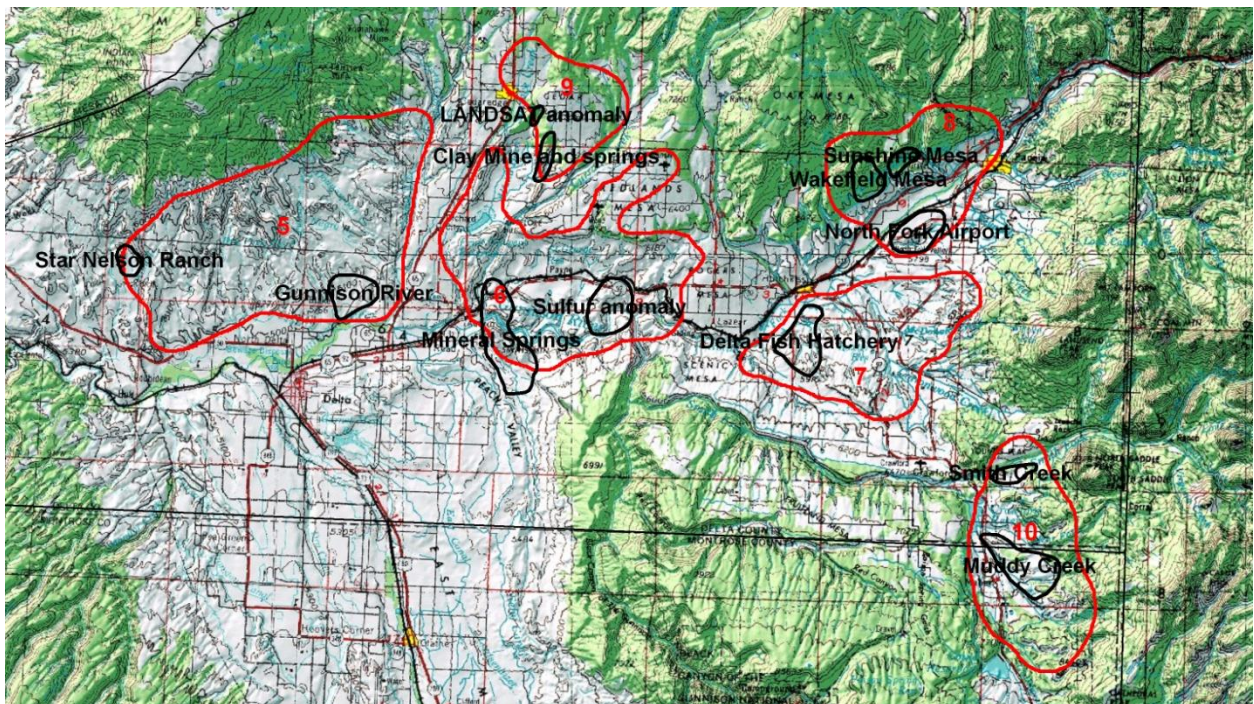
Areas of Interest: A few ASTER anomaly areas of size and shape to suggest outflow zones occur in areas that look mostly like flat surface solar effect, but no other supportive geology evidence other than photolinears to visit.

1) One hill in the NE portion of the polygon, just south of the Colorado River, has both ASTER and LANDSAT thermal anomalies on top and NW slopes that would be easy to sample by 2m survey (no other supporting evidence). This is in Secs 7, 8, and 18 of T6S R91W. Low-mod priority

- a) Land Ownership: 70% Private, 30% BLM
- b) Distance to transmission: 0 miles

2) Miscellaneous ASTER and silica anomalies, all in T6S R92W: a) WNW road going through SW1/4 Sec 14, b) all of Sec 15 and 16, c) eastern half Sec 22, d) all of Sec 23, e) NW1/4 Sec 24 and N1/2 of SW ¼ Sec 24. Low-moderate priority.

- a) Land Ownership: ~100% Private
- b) Distance to transmission: 0 miles



Polygon 5: Delta 5

Land Ownership: ~50% BLM land, 50% private ownership

Environmental: A large Wilderness Study Area takes up perhaps 25% of the center of the polygon. An ACEC occurs totally inside it.

Surface Thermal Manifestations: Lemon Hot Spring (33C, actually a 'warm' spring) has ~195C Na-K-Ca, ~154C cation, and 119C silica geothermometer temperatures, seriously hot, with

elevated TDS, F, and B. Several other springs and wells have high Na-K geothermometer values but this seems indigenous to the region and is discounted. These springs and wells might be very slightly elevated in B and F (<1 ppm). **NOTE: My hot springs book placed Lemon Hot Spring northwest of Telluride in San Miguel County. The NWIS data has occasional location problems. No hot springs occur on the topo map in this vicinity or wet spots on aerial photos. I think this is a spurious data point.**

No temperature gradient data in this polygon.

Satellite Thermal Imagery: ASTER anomalies cover a substantial portion of the eastern part of the polygon, mostly on flat to gently south-facing table lands of unit 'Km'. Small LANDSAT anomalies occur in the WSA and the SE edge of the polygon.

Small ASTER and LANDSAT anomalies also occur in the far western part of the polygon, near two hot/warm water surface anomalies. These anomalies are ½ mile apart in SE Sec 25, T14S, R97W and NW Sec 31, T14S, R96W, just north of the Star Nelson ranch and are surrounded by the anomalies.

Alteration: Minor small silica anomalies occur in the polygon, some of which are associated with the ASTER thermal anomalies on the east half of the polygon.

Mines and Prospects: One small uranium prospect occurs on an ASTER thermal anomaly, otherwise none.

Wells: The polygon is punctured by many oil or gas wells.

Areas of Interest:

- 1) Check out whether a Lemon Hot Springs actually occurs here and if so, follow it up in central Sec 7 of T14S R95W. High priority.
- 2) Possibly run a 2m survey around the thermal anomalies in SE Sec 25, T14S, R97W and NW Sec 31, T14S, R96W, just north of the Star Nelson ranch. Low priority.
 - a) Land Ownership: 60% BLM, 40% Private
 - b) Distance to transmission: 2 miles
- 3) Possibly test the LANDSAT and ASTER anomalies north of the Gunnison River by 2m survey along NE-trending road in NE Sec 5 of T15S R95W, and SE ¼ Sec 32 plus NW ¼ Sec 33 of T14S R95W. Low priority.
 - a) Land Ownership: 100% BLM
 - b) Distance to transmission: 8.5 miles

Polygon 6: Delta 6

Land Ownership: 80% private, 20% BLM

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: No hot springs/wells and no temperature gradient data occur within the polygon; however two cold springs about a kilometer apart on the western edge of the polygon have interesting geochemistry and geothermometry suggesting a geothermal system. Both have low silica, but high boron, fluoride, specific conductivity, and sulfate; one has high lithium (the other is not sampled for Li). Both have 150C Na-K-Ca geothermometers but too much Mg to make a high cation geothermometer temperature (this could be a surface phenomenon). **Note: one spring is called 'Mineral Spring' and is described as 12 miles east of Austin, while the spring itself is about 1 mile east of Austin (1.2 miles?) Location problem? I don't think so because there are two nearby occurrences with similar geochemistry.**

Satellite Thermal Imagery: In general, ASTER thermal anomalies cover a large portion (~30%) of this polygon and are almost certainly primarily solar driven. Within this broad anomaly could be a few geothermal-driven anomalies at Mineral Springs and the sulfur locality. LANDSAT anomalies are mostly associated with NE-striking ridge tops.

Alteration: Silica is associated with a NS fault on which the two geochemically-anomalous springs occur, and FeOx + silica are associated with this fault (and mines and prospects) south of the springs on Smith Mountain. A large silica anomaly occurs next to a hot/warm water surface anomaly on a northern spur of the polygon at Redlands Mesa. Smaller silica-FeOx anomalies are adjacent to the sulfur prospects (see below).

Mines and Prospects: Two sulfur and one clay prospects are located on BLM land in the southern part of the polygon at lineament intersections and within an ASTER thermal anomaly and splotchy silica-FeOx pixel signatures, indicating geothermal activity (past or present). No other mines or prospects within the polygon.

Wells: 13 oil and/or gas wells.

Areas of Interest:

- 1) Mineral Springs anomaly a) in T14S R94W: eastern half Sec 31; southern half Sec 32, b) in 15S R94W: western half Sec 5, eastern third of Sec 6, NW ¼ Sec 7, all of Sec 8, SW ¼ Sec 9, western half Sec 16, eastern half Sec 17. High priority. Not this area leaks out of the polygon by a half mile or so.
 - a) Land Ownership: 60% BLM, 40% private
 - b) Distance to transmission: 1-2 miles
- 2) The sulfur/clay/ASTER anomaly in eastern half of Sec 35 and all of Sec 36 of T14S R94 as well as the northern half of Secs 1 and 2 of T15S R94W should be sampled by 2m survey and nearby springs should be sampled for temperature and geochemistry. Areas around the anomalous geochemical springs should be sampled by 2m survey. High priority.
 - a) Land Ownership: 70% BLM, 30% private
 - b) Distance to transmission: 1 mile

Polygon 7: Delta 7

Land Ownership: 70% private, 30% BLM land

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None. No temperature gradient holes or water samples from the geochemical database.

Satellite Thermal Imagery: ASTER anomalies cover about 17% of surface area in the polygon, LANDSAT anomalies are almost zero. The ASTER anomalies are in two large zones in the NE and W parts of the polygon, broadly coincident with silica alteration. The western thermal anomaly seems to strike parallel to a set of NE lineaments.

Alteration: Geology is entirely 'Km' unit and alluvium. Two large silica anomalies are present, one in the NE portion of the polygon, the other in the western part of the polygon, both in Km unit (is KM something like sandstone?). Sparse Feox.

Mines and Prospects: One placer gold and 3 sand/gravel operations.

Wells: 3 oil/gas wells reported within the polygon.

Areas of Interest: Low priority, unless we want to test on the basis of large, unfocused ASTER thermal + silica anomalies (with some structure). A couple areas with roads to test this would be east of the Delta Fish Hatchery in a) western half of Secs 6 and 7 of T and Sec 1 of T15S R92W and eastern 1/4 of Sec 1 T15S R93W; NS boundary road between Secs 8 and 9 of T15S R92W. This area has 70% BLM 30% Private land ownership and a 2 mile distance to transmission.

Polygon 8: Delta 8

Land Ownership: 85% private, 15% BLM land

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: A 42C well occurs just north of the North Fork airport on private land. Water from the well has elevated boron and fluoride, and a 170C Na-K-Ca but only 60C cation geothermometer temperature (high Mg). Sample depth is 20m, flow rate 45 l/m. No other water samples/anomalies or temperature gradient holes.

Satellite Thermal Imagery: An ASTER thermal anomaly follows regional lineaments along Wakefield Mesa in the central part of the polygon. Another ASTER anomaly occurs on the mesa hosting North Fork airport immediately south of the hot well. Geologic unit at both anomalies is

'Km'. LANDSAT thermal anomalies are sparse in this polygon; one such small anomaly occurs in a drainage at Wakefield Mesa.

Alteration: A silica anomaly occurs on top of the Wakefield/Sunshine Mesa ASTER anomaly.

Mines and Prospects: None, except for sand and gravel.

Wells: None

Areas of Interest:

- 1) Visits to the hot well and ASTER anomaly on north side of North Fork airport. This is all of Sec 14 of T14S R92W as well as the SW ¼ Sec 15 and northern half of Sec 23. High priority.
 - a) Land Ownership: 100% private
 - b) Distance to transmission: 0 miles
- 2) Silica and ASTER/LANDSAT anomaly at Wakefield Mesa: a) ~NS jeep trail through central Sec 4, b) ~EW road through central Sec 9, (both in T14S R92W).
 - a) Land Ownership: 60% BLM, 40% private
 - b) Distance to transmission: 2.5 miles
- 3) Silica and ASTER/LANDSAT anomaly at Sunshine Mesa: road through southern ¼ Sec 34 of T13S R92W. Low priority.
 - c) Land Ownership: 60% BLM, 40% private
 - d) Distance to transmission: 2.5 miles

Polygon 9: Delta 9

Land Ownership: 100% private

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None.

Satellite Thermal Imagery: Rock type is either 'Km' or Qg. ASTER thermal anomalies occur almost entirely in the Qg unit. LANDSAT anomalies consist of 1 tiny area elongate along a lineament. There is one hot warm water surface anomaly distal to the other surface thermal anomaly (and up gradient from them) that appears to be a very shallow reservoir.

Alteration: Isolated small silica, FeOx, and clay pixels occur in the polygon, but are not associated with the thermal anomalies or in any pattern.

Mines and Prospects: One clay mine (rather extensive in aerial photo) occurs along a NE striking lineament with associated ASTER thermal anomaly. There are active springs above the pit.

Wells: No oil or gas wells

Areas of Interest:

- 1) The clay mine and spring area in SE ¼ Sec 33 of T13S R94W and eastern half Sec 4 of T14S R94E should be visited if permission to enter is granted, for 2m survey and water sampling of the springs. Moderate priority.
 - a) Land Ownership: 100% private
 - b) Distance to transmission: 7.5 miles
- 2) Similarly, a few rods could be planted along that LANDSAT fault anomaly in southern Sec 28 and northern Sec 33 of T13S R94W if I can get the truck in there – aerial photos show a small road leading up to it from the north. Low priority.
 - a) Land Ownership: 100% private
 - b) Distance to transmission: 9 miles

Polygon 10: Delta 10

Land Ownership: 90% private, 10% BLM

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None

Satellite Thermal Imagery: ASTER anomalies comprise ~27% of the area, LANDSAT anomalies <<1%. At 100,000 scale the ASTER anomalies seem to follow the lineament pattern (or resulting topography) well, particular the NW striking Muddy Creek in the center of the polygon (Qa). This could be flat-lying mesa tops cut by the drainages. Thermal anomalies do not mimic alteration well here except for one ridge north of Smith Fork in the northern part of the polygon.

Alteration: Several minor clay and silica anomalies, 3 of which appear to arranged along lineaments.

Mines and Prospects: None

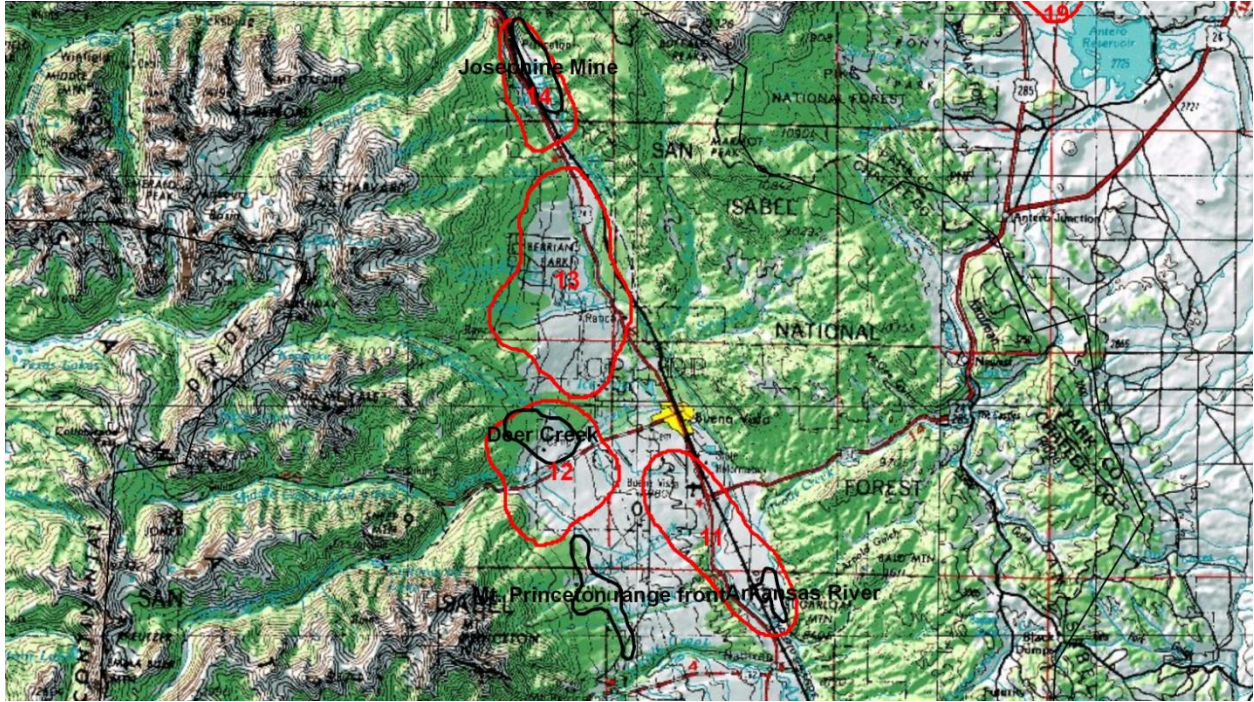
Wells: 3 oil or gas wells present in the polygon.

Areas of Interest: Both low priority.

- 1) An ASTER thermal anomaly occurs along a photolinear following Smith Creek together with a clay alteration anomaly in the SE ¼ Sec 32 and SW ¼ Sec 33 of T15S R91W. Low priority.
 - a) Land Ownership: 100% private
 - b) Distance to transmission: <1 mile
- 2) An ASTER thermal anomaly occurs in an area of crosscutting photolines in the Muddy Creek drainage together with patchy clay and silica alteration anomalies in the southern

part of Sec 19, western half Sec 28, all of Sec 29, eastern half of Sec 30, and northern half of Sec 32 in T15S R91W. Low priority.

- a) Land Ownership: 100% private
- b) Distance to transmission: 0 miles



Polygon 11: Chaffee 11

Land Ownership: 95% private, 2% BLM, 2% (USFS?)

Environmental: A WSA and associated ACEC occupy the range front just SE of the polygon, barely entering it.

Surface Thermal Manifestations: None; however, thermal outflow from the range front to the west seems to almost reach western edge of the polygon. I have to point out that LANDSAT thermal anomalies are associated with the western range front, which is between Mt. Princeton and Jump Steady hot springs and has elevated temperatures at depth and very high thermal gradients (misleadingly high).

Satellite Thermal Imagery: A hot/warm water thermal anomaly occurs on [what appears to be] a shallow dammed portion of Maxwell Creek. ASTER and LANDSAT ground anomalies are not widespread, but consist of two interesting NNW-oriented features in alluvium parallel to the regional structural grain of the valley (and lineaments), that are coincident with FeOx and clay anomalies. This suggests the anomalies are not solar derived.

Alteration: See above.

Mines and Prospects: None

Wells: None

Areas of Interest: Low-moderate priority.

- 1) Testing one of the two NNW striking ASTER-LANDSAT-carb-FeOx anomaly on private land would be a good way to test the efficacy of the approach in the absence of other indicators (except structural). The place to test this would be adjacent to the Arkansas River in Sec 2 and northern Sec 11 of T14S R78W.
 - a) Land Ownership: 100% private
 - b) Distance to transmission: 3 miles
- 2) I could make a case to extend the boundaries of this polygon west to also test LANDSAT anomalies along a possible range front structure between known the Mount Princeton and Cottonwood geothermal systems. This would include the eastern half of Secs 6 and 7 in T15S R78W, western half of Sec 36 in T14S R79W, and all of Sec 1 in T15S R79W.
 - a) Land Ownership: apparently 60% USFS land, 40% private
 - b) Distance to transmission: 1 mile

Once again, this target is outside any polygon, approx. 2 miles west of polygon 11 and immediately south of polygon 12.

Polygon 12: Chaffee 12

Note: This area includes the outflow zone from the 53C Rainbow (or Cottonwood) Springs geothermal system. Geothermometry from the springs indicates equilibration temperatures only slightly above that of the springs.

Land Ownership: 80% private, 20% USFS land.

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: Rainbow (or Cottonwood) Hot Springs is just west and up-gradient of the polygon, occurring at the structural intersection of the range front fault system and a NE linear that follows Cottonwood Creek. Geothermometry from the springs seems pretty dismal, with equilibration temperatures in the 60C – 80C range. Springs and wells within the polygon are cold with even lower geothermometer temperatures.

Satellite Thermal Imagery: According to the digital topo map, there are three Cottonwood Creeks right next to each other along this range front (that's pretty silly). But a prominent ASTER thermal anomaly occurs right along the junction of two photolines that follow Cottonwood Creek and, er, Cottonwood Creek perhaps 2 miles east and down gradient from Rainbow Springs. Also, LANDSAT thermal anomalies occur along the range front, one in a spot

drilled by AMAX Geothermal at Deer Creek and having a 65C/km temperature gradient. However, that high temperature gradient is misleading, coming from a shallow hole with a top temperature of 5C and a bottom hole temperature of 10C. The area now appears to be partly covered by a recent rural subdivision. Still, why was AMAX there?

Alteration: Very small, minor clay and FeOx anomalies occur in the polygon, not spatially associated with the hot springs or thermal anomalies.

Mines and Prospects: One clay prospect and two sand and gravel occurrences are in the polygon.

Wells: No oil or gas wells are reported in the polygon.

Areas of Interest: Low priority.

A quick 2m survey could test the uphill LANDSAT area at Deer Creek drilled by AMAX and a possible down gradient ASTER anomaly for temperature anomalies. The LANDSAT anomaly occurs in Sec 15 (75% USFS and 25% private) and the ASTER anomaly in Sec 14 (all private) in T14S R79W. and one of the LANDSAT thermal anomalies. A 115KV line is within a mile of this area.

Polygon 13: Chaffee 13

Land Ownership: 85% private, 10% USFS, 5% BLM

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None. Springs and wells are cold with uninteresting geochemistry. No temperature gradient wells.

Satellite Thermal Imagery: A large ovoid ASTER thermal anomaly comprises a large portion of the polygon, which is centered on the flat high mountain treeless valley. Several tiny LANDSAT anomalies occur distal to the ASTER anomaly and apparently unrelated.

Alteration: Several moderate-sized FeOx and clay anomalies occur in the center of the ASTER anomaly. One elongate clay anomaly occurs along a photolinear on the west side of the polygon.

Mines and Prospects: Only 1 sand and gravel occurrence on the polygon.

Wells: No oil or gas wells are reported in the polygon.

Areas of Interest: Not many. I'd guess the large ASTER thermal anomaly is not associated with a geothermal system.

Polygon 14: Chaffee 14

Land Ownership: 70% private, 15% USFS, 15% BLM

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None. Two water samples from cold wells have very uninteresting geochemistry.

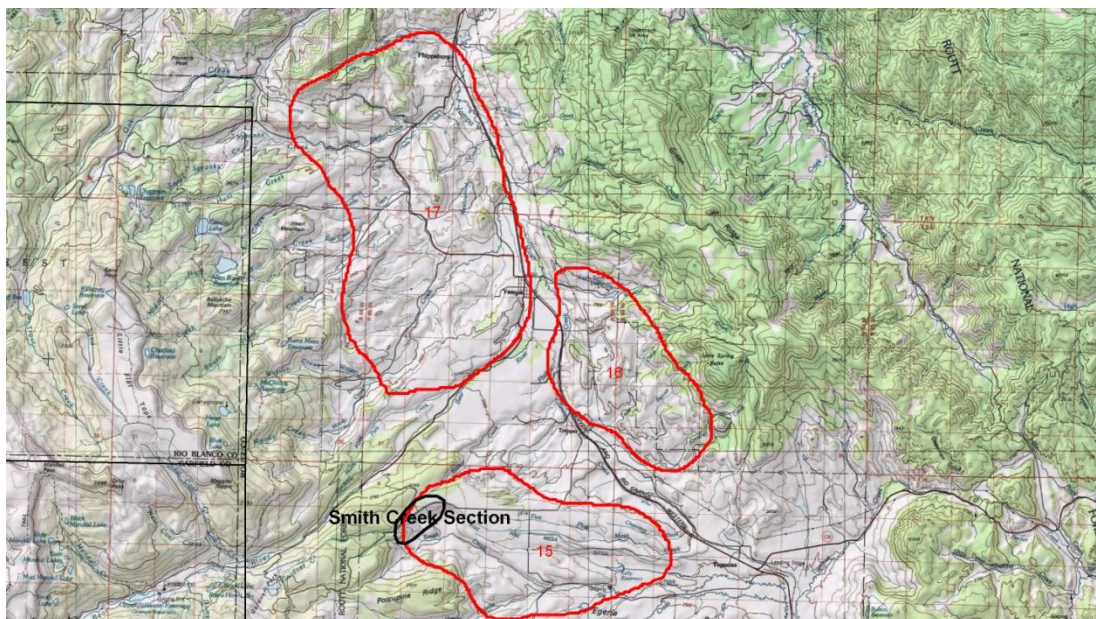
Satellite Thermal Imagery: ASTER thermal anomalies are located along NNW-striking lineaments and a NNE lineament that may represent normal boundary faults, as well as elsewhere. Small isolated LANDSAT anomalies also occur in the polygon unassociated with the ASTER anomalies.

Alteration: Little to no alteration anomalies are present in the polygon.

Mines and Prospects: There are four gold occurrences within the polygon. Three are placer and the fourth, the Josephine Mine, is granite hosted and on patented land within the NNW striking lineament zone on the east edge of the valley.

Wells: No oil or gas wells

Areas of Interest: The ASTER anomalies are associated with the range front fault lineaments. A moderate priority target is the NNW striking fault set on the east edge of the valley, in the Josephine Mine area. This area has >50% private ownership (in Secs 26, 27, 34, and 35 of T12S R79W), and is within a mile of transmission.



Polygon 15: Route 15

Land Ownership: 95% private, 5% USFS

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None

Satellite Thermal Imagery: Subtle, mostly elongate ASTER and LANDSAT anomalies are present within the polygon, some following linears, some ASTER anomalies occur on flat lying hilltops. One such anomaly, on a WNW striking spur of Five Pines Mesa, may be along a lineament and is adjacent to a hot/warm surface water anomaly (Kelly Reservoir).

Alteration: Consists mostly of clay anomalies, the biggest of which is atop Five Pines Mesa maybe 3 miles WNW of Kelly Reservoir.

Mines and Prospects: 1 gravel pit is within the polygon.

Wells: Three oil or gas wells are within the polygon.

Areas of Interest: A low priority target is the one section of private land along Smith Creek in this polygon through which a transmission line passes, Sec 8 of T10N R85W. There is a lineament with both ASTER and LANDSAT thermal anomalies, along with some clay signature, but no hard geothermal evidence of a system. I could simply plant a few test 2m rods in the morning and come back from this on my way home from visiting other Route targets.

Polygon 16: Route 16

Land Ownership: 90% private, 5% USFS, 5% BLM

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None

Satellite Thermal Imagery: Small thermally anomalous areas are present in both ASTER and LANDSAT data; very little intersection between the two. The anomalies form no distinguishable pattern (to me).

Alteration: A north striking clay anomaly occupies a flat ridge west of Todd Creek that is somewhat associated with small, 'pixilated' ASTER and LANDSAT thermal anomalies.

Mines and Prospects: None

Wells: No oil or gas wells

Areas of Interest: No targets selected in this polygon.

Polygon 17: Route 17

Land Ownership: 90% private, 5% USFS, 5% BLM

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: Two deep wells (670m and 760m) approximately a mile apart have ~39C temperatures and uninteresting geochemistry in the southern part of the polygon along Moody Creek at a lineament intersection – although hot, this corresponds to a moderate geothermal gradient of about 18C/km. All of the [cold] groundwater samples in and around this polygon other than these two wells have very high Na-K geothermometers. However, this seems to be typical for many springs and wells in Colorado and once the calcium correction is made, the geothermometer drops to very low values. No silica, boron, or fluoride to speak of.

Satellite Thermal Imagery: Thermal anomalies in this polygon are almost entirely ASTER; LANDSAT anomalies are of very small area. A couple of these anomalies follow ENE structural lineaments.

Alteration: Very little to speak of.

Mines and Prospects: None

Wells: 5 oil or gas wells occur in the polygon. One of them appears to be one of the deeper wells with the 39C water.

Areas of Interest: No targets selected in this polygon.

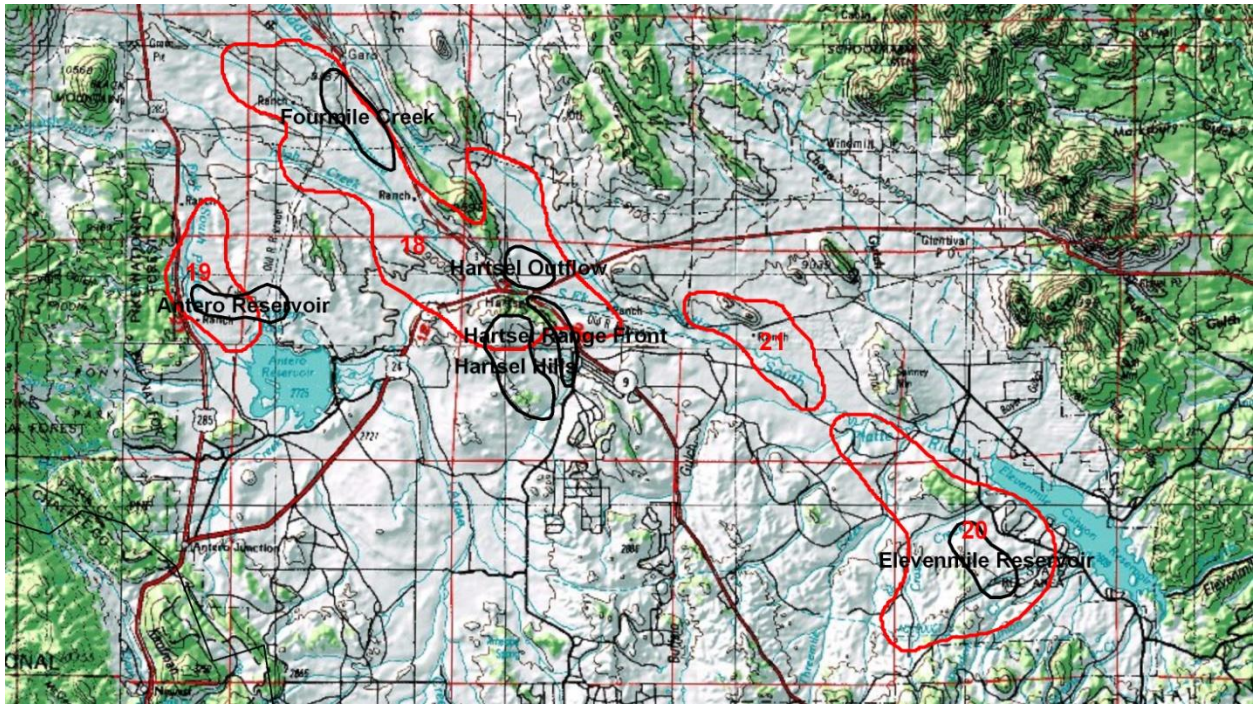
Polygon 18: Park 18

Land Ownership: 85% private, 10% BLM, 5% USFS(?)

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: Hartsel hot spring (53C) is located in the SE portion of the polygon, apparently along a NW-striking lineament. 2 wells in the hamlet of Hartsel (down gradient) have similar temperatures. The springs and wells have similar geochemistry with high Na-K and Na-K-Ca geothermometer temperatures but low silica and cation geothermometer temperatures (high Mg). Lithium is high, fluoride moderate, and boron contents are fairly low.

A cold chloride-sulfate spring 1 mile SE, along the same range front lineament, has high fluoride and a high Na-K-Ca geothermometer temperature.



Satellite Thermal Imagery: Both ASTER and LANDSAT anomalies occur in this polygon. One elongate NW-SE ASTER anomaly occurs just NE of Fourmile creek along the same NW structural trend as Hartsel hot springs. A smaller LANDSAT thermal anomaly occurs along the range front between Hartsel hot springs and the chloride-sulfate spring. The area NE and down gradient from Hartsel (both town and springs) has an ASTER thermal anomaly that looks suspiciously like an outflow zone. A small, shallow-looking pond behind a dammed portion of High Creek is a hot/warm water anomaly but is probably solar induced.

Alteration: FeOx anomalies are the principle alteration type in this polygon. Large anomalies in the hills west of both Garo (e.g. Fourmile Creek area) and Hartsel have FeOx anomalies that are visible in aerial photos and are associated with mines and prospects.

Mines and Prospects: Copper-uranium (roll front?) mineralization occurs in the altered areas associated with both the thermal anomalies and the hot springs. Gangue mineralization is limonite, clay, barite, and chalcedony, which could also be construed as geothermal.

Wells: 1 oil/gas well in the polygon.

Areas of Interest: I like this one. Time should be spent testing the thermal anomalies and altered areas NW and SE of Hartsel. There are several springs to sample, with the objective being to acquire geochemical information helpful in identifying the center of this system. Areas 2 and 3 below leak off Polygon 18 a bit.

- 1) Hartsel range front: SW ¼ Sec 9, all Sec 16, eastern half Sec 21 of T12S R75W. High priority.
 - a) Land Ownership: 100% private, according to the shapefile
 - b) Distance to transmission: 4 miles
- 2) Hartsel flats (looks like outflow zone to follow up directions): SW ¼ Sec 4, southern half Section 5, northern half Sec 8 in T12S R75W. High priority.
 - a) Land Ownership: 100% private, according to the shapefile
 - b) Distance to transmission: 2.5 miles
- 3) Hills behind (to west of) Hartsel: All Secs 18 and 20, west half of Sec 28 and NE half of Sec 29 in T12S R75W. High priority.
 - a) Land Ownership: 80% private, 20% BLM land
 - b) Distance to transmission: 5 miles
- 4) Fourmile Creek area: Southern half of Sec 9, western half of Sec 15, all of Sec 16 and 22 of T11S R76W. Moderate priority.
 - a) Land Ownership: 95% private, 5% USFS(?) land
 - b) Distance to transmission: 0 miles

Polygon 19: Park 19

Land Ownership: 50% private, 50% Pike National Forest

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None; however a spring just south of the polygon ('Salt Spring'), along the range front, has abnormally high TDS and a 133C Na-K-Ca geothermometer temperature (65C cation and chalcedony).

Satellite Thermal Imagery: Two large ASTER anomalies occur in the flats of the South Platte River NW of Antero Reservoir that could be an outflow zone coming from the hills to the east (hills next to Hartsel) or west, where LANDSAT anomalies occur along the range front.

Alteration: Subtle small silica and FeOx anomalies occur within the ASTER anomaly and in the hills east of it, which abuts the altered hills of Hartsel that's part of Polygon 19.

Mines and Prospects: None (except stone and gravel)

Wells: No oil or gas wells reported.

Areas of Interest: The adjacency to Hartsel, shape of the thermal anomalies, and Salt Spring are intriguing. Moderate priority. A possible geothermal outflow zone is apparent north of Antero Reservoir in southern half Sec 7 and northern half Sec 18 of T12S R76W and southern half Sec 12 and northern half Sec 13 of T12S R77W

- a) Land Ownership: 60% private, 40% USFS(?) land
- b) Distance to transmission: 5 miles

Polygon 20: Park 20

Land Ownership: 85% private, 10% BLM, 5% USFS(?), according to the land ownership GIS layers. However, the topo map says the NE part of the polygon is part of the Spinney Mountain State Park and State Wildlife Area.

Environmental: No ACES, WSA's, or Wilderness areas

Surface Thermal Manifestations: None

Satellite Thermal Imagery: ASTER anomalies cover a large portion of this polygon, essentially covering the NW-trending hills (many slopes and aspects) west of Elevenmile Reservoir. These hills. LANDSAT thermal anomalies are tiny but somewhat mimic the ASTER data. A small spring with pond ('8729') occurs in the eastern portion of the polygon.

Alteration: Small silica anomalies underlie some flat portions of the larger ASTER anomaly, while FeOx anomalies occur east of the ASTER anomalies in the low hills next to Elevenmile Reservoir. Thermal anomalies are not associated with the FeOx anomalies.

Mines and Prospects: A polymetallic vein occurs about 1 mile west of the polygon

Wells: None

Areas of Interest: I think the ASTER anomaly is much too big to be associated with a geothermal system and there is not much corroborative data to support. One could visit the silica anomalies in the center of the ASTER anomaly near Elevenmile Reservoir and perhaps plant a few 2m rods. The area is in all Sec 16, eastern half Sec 17, and northern half of Sec 21 in T13S R73W. Low priority.

- a) Land Ownership: 80% private, 20% USFS(?) land although the shapefile is calling land in Spinney Mountain State Park and Wildlife Area "private"
- b) Distance to transmission: 11 miles

Polygon 21:

Land Ownership: Spinney Mountain State Park and Wildlife Area

Environmental: State park and Wildlife area

Surface Thermal Manifestations: None

Satellite Thermal Imagery: Four small ASTER anomalies occur on flat topography in the polygon area. A curvilinear LANDSAT anomaly along the NW shore of Elevenmile Reservoir might be sun-heated moist ground with a high thermal inertia.

Alteration: Some very small silica and FeOx pixels, nothing much.

Mines and Prospects: None

Wells: Two just outside the polygon boundaries.

Areas of Interest: The thermal anomalies appear to occur in a wildlife area, and I think the difficulty to examine them far outweighs their ranking.