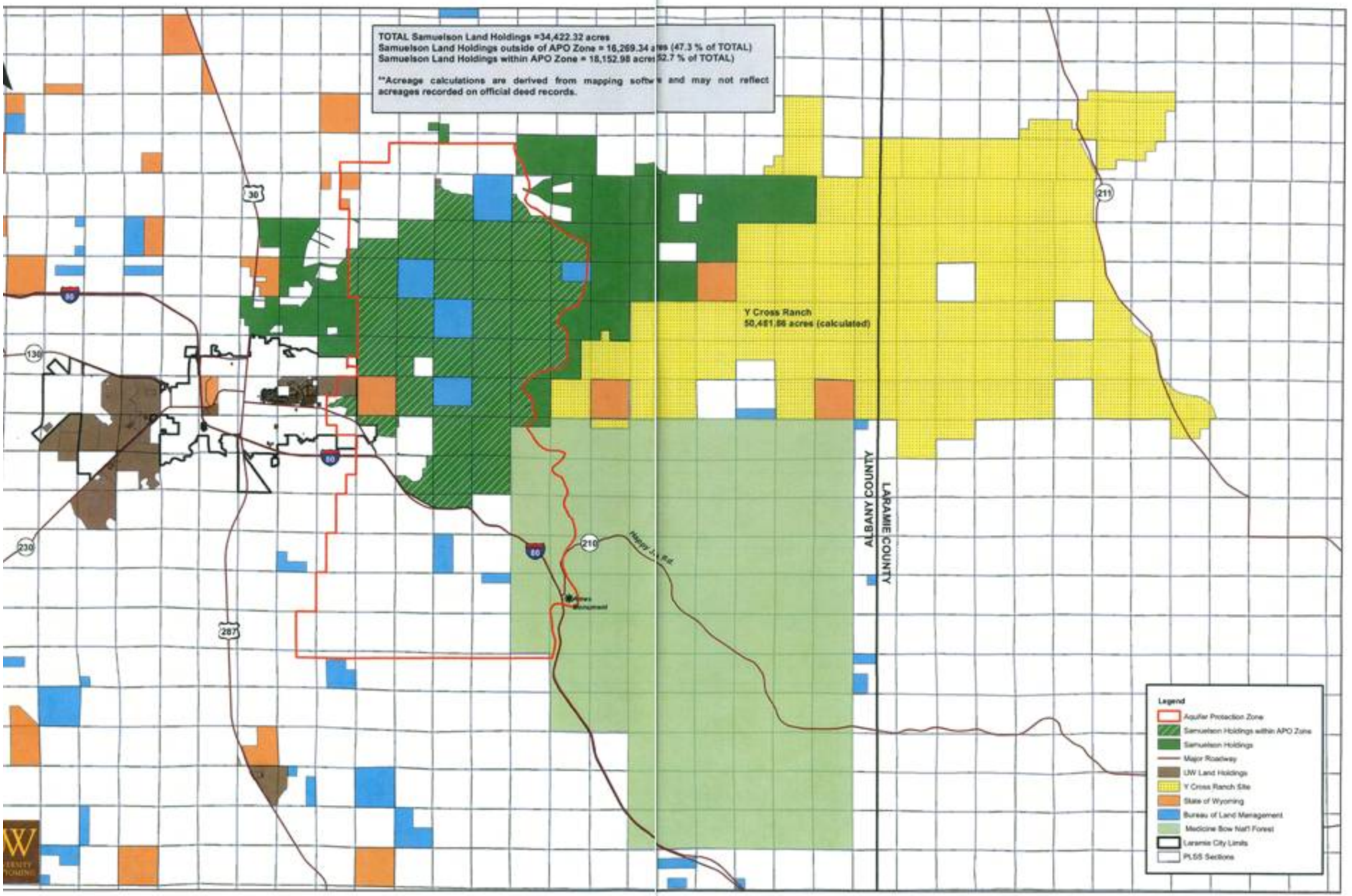

TOTAL Samuelson Land Holdings =34,422.32 acres
Samuelson Land Holdings outside of APO Zone = 16,269.34 acres (47.3 % of TOTAL)
Samuelson Land Holdings within APO Zone = 18,152.98 acres (52.7 % of TOTAL)
**Acreage calculations are derived from mapping software and may not reflect acreages recorded on official deed records.
Y Cross Ranch
50,481.86 acres (calculated)
ALBANY COUNTY
LARAMIE COUNTY
Legend
Aquifer Protection Zone
Samuelson Holdings within APO Zone
Samuelson Holdings
Major Roadway
UW Land Holdings
Y Cross Ranch Site
State of Wyoming
Bureau of Land Management
Medicine Bow Nat'l Forest
Laramie City Limits
PLSS Sections

Casper Aquifer Facts

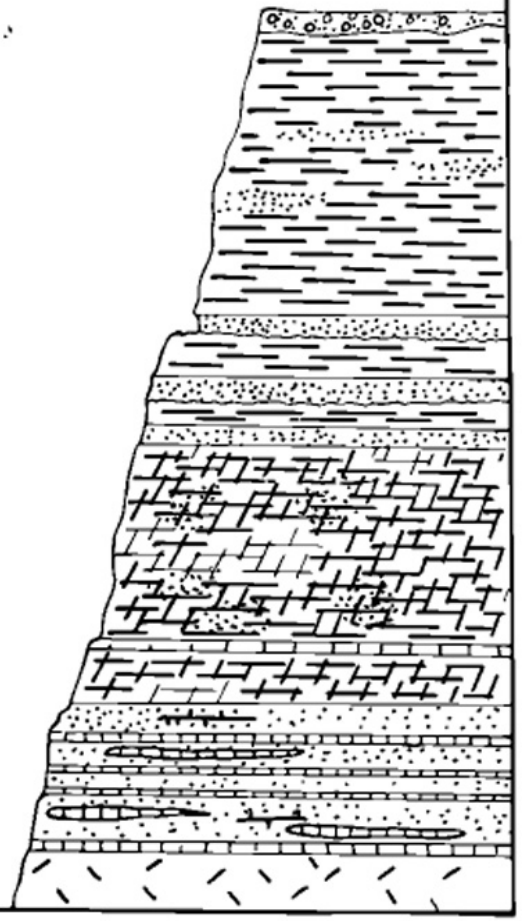
What is an aquifer?

- An *aquifer* is a *geologic formation* that can contain and *transmit* water (water can flow)
- The classic model is sand or porous rock (water flows very slowly) covered by a protective layer of soil
- Our local example has sparse protective soil and is characterized by open fracture systems (water flows very quickly)
- The Casper aquifer supplies 60% of Laramie's drinking water – 100% in a severe drought (2002)

Thickness and extent of the Casper formation

Age	Formation	Thickness (feet)	Water Supply
QUARTERNARY	ALLUVIUM	0-45	Contains small amounts of water
CRETACEOUS	UNDIVIDED	6500	Water yield depends on lithology. Majority of section is shale, and yields no water or small amounts of highly mineralized water. Some sandstones, notably in the Frontier formation and the Mesaverde Group, yield good water supplies to wells.
	CLOVERLY	115-236	Sands contain highly mineralized water.
JURASSIC	MORRISON	135-220	Highly mineralized but potable water.
	SUNDANCE	0-200	Contains water, but limited areal extent.
TRIASSIC	CHUGWATER	1100-1200	Sulfate-rich water. Used for irrigation water and for stock watering north and south of Laramie.
PERMIAN	FORELLE	9-25	Yields little or no water.
	SATANKA	230-300	Sulfate-rich water used for stock watering.
	CASPER	500-700	Most important aquifer in area Supplies water to wells and large springs on west flank of Laramie Rng.
PENNSYLVANIAN	FOUNTAIN	20-50	Included in "Casper Aquifer"
PRECAMBRIAN	UNDIVIDED		Yields small amounts of water.

Lithology



Sandstone – Siltstone

Shale

Limestone

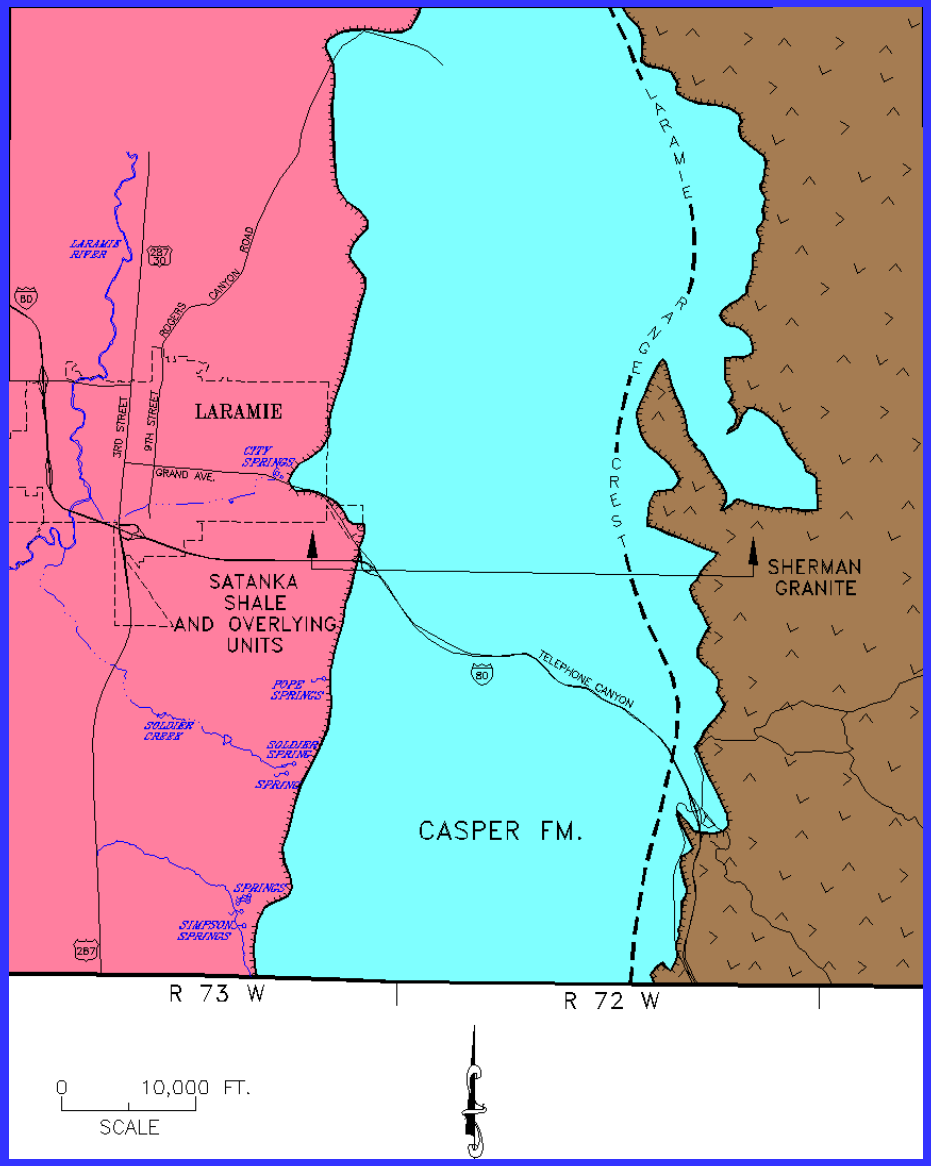
Dolomite

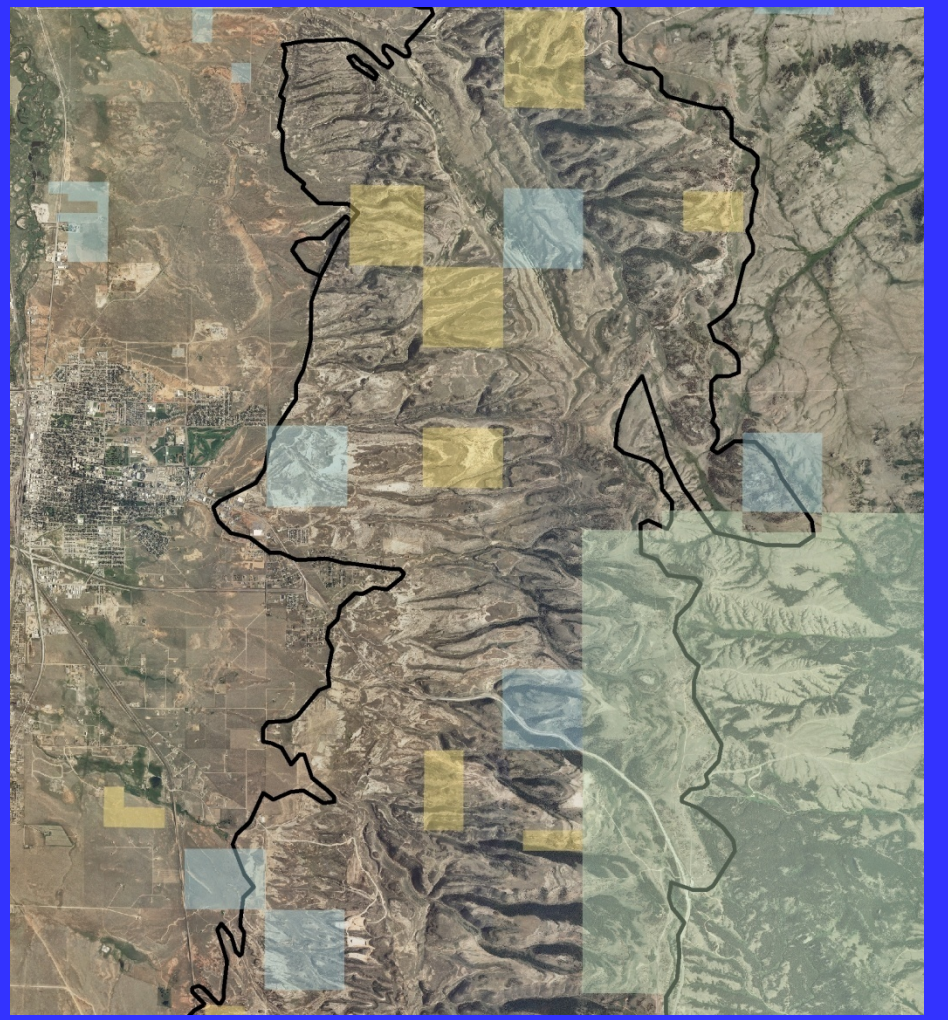
Gypsum

Igneous – Metamorphic

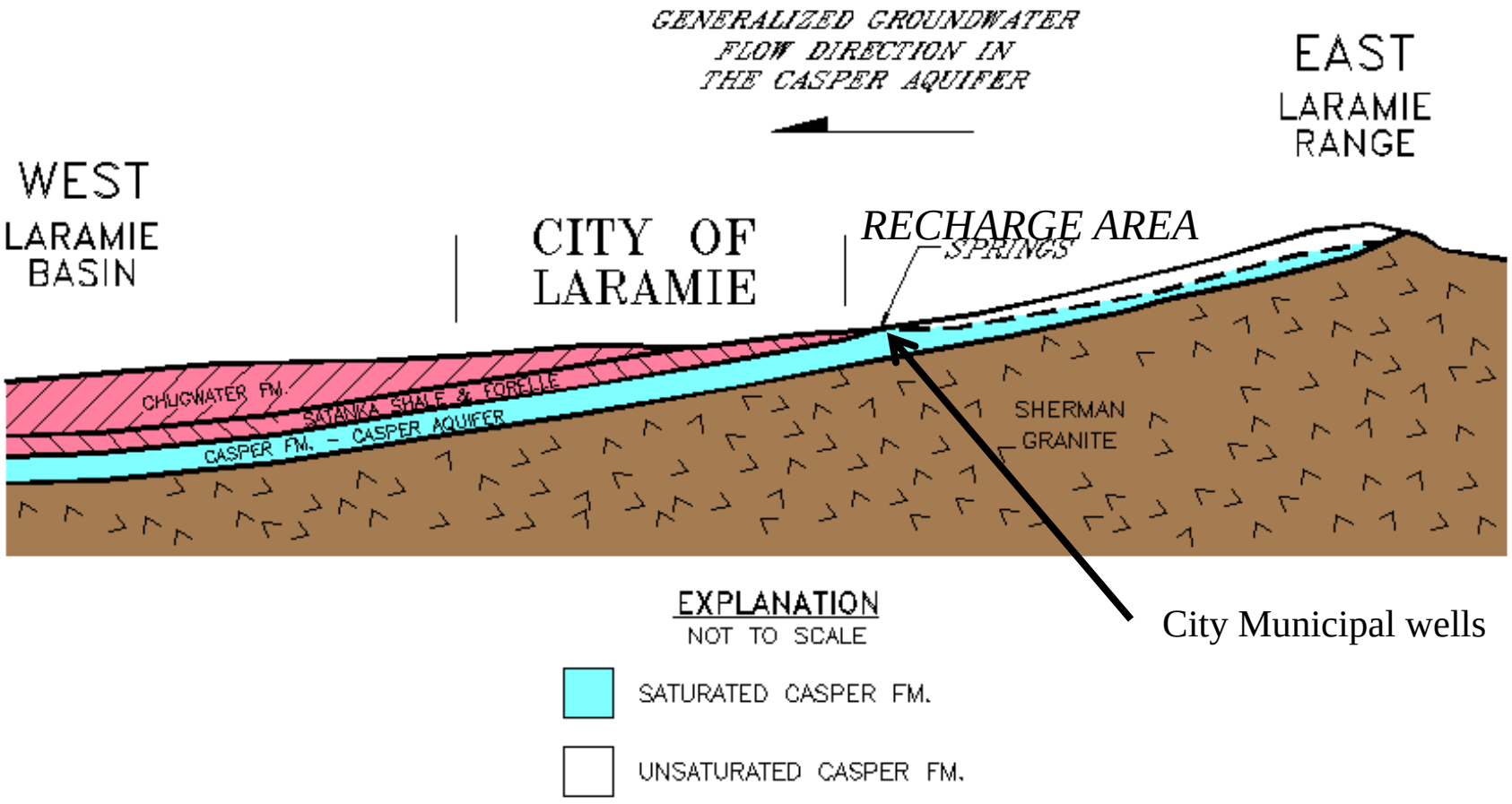
Gravel

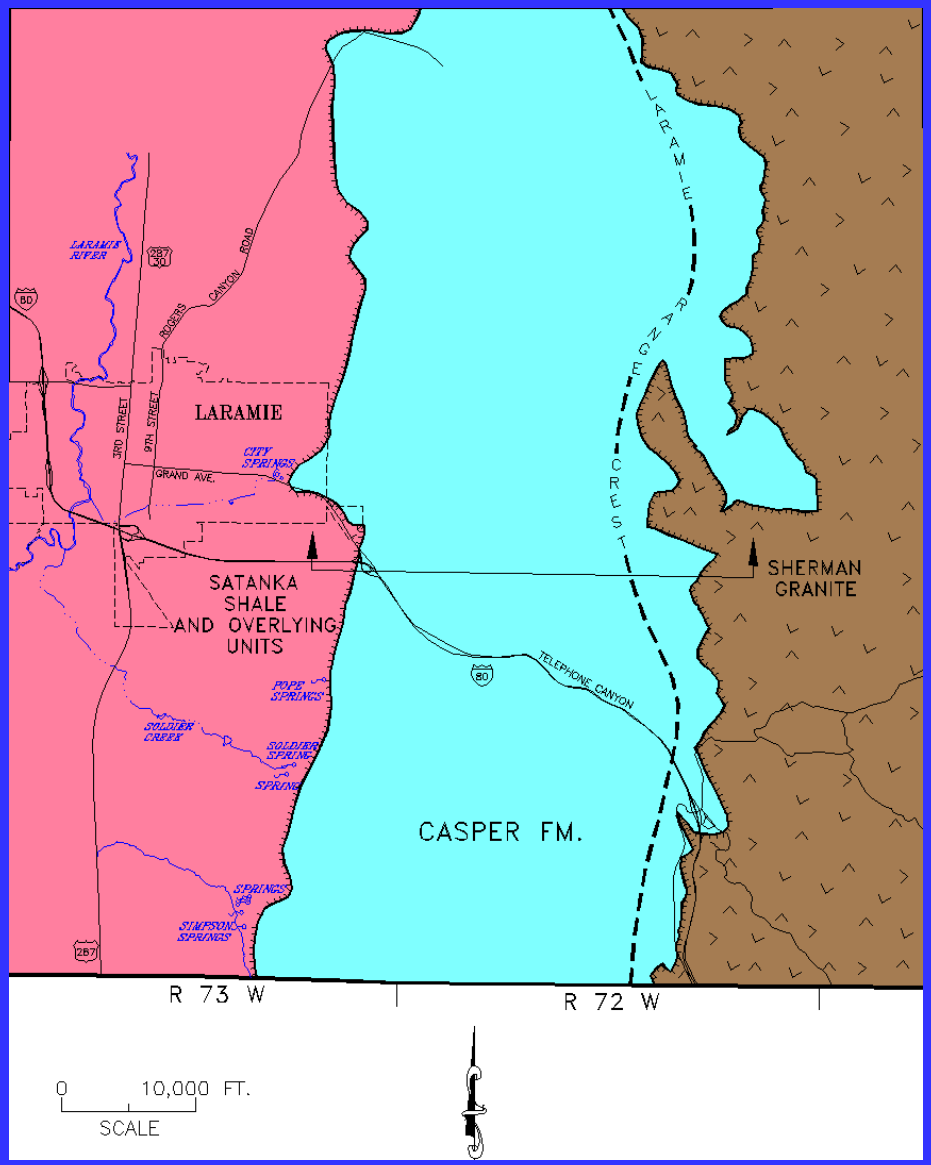
Aerial extent of the Casper formation

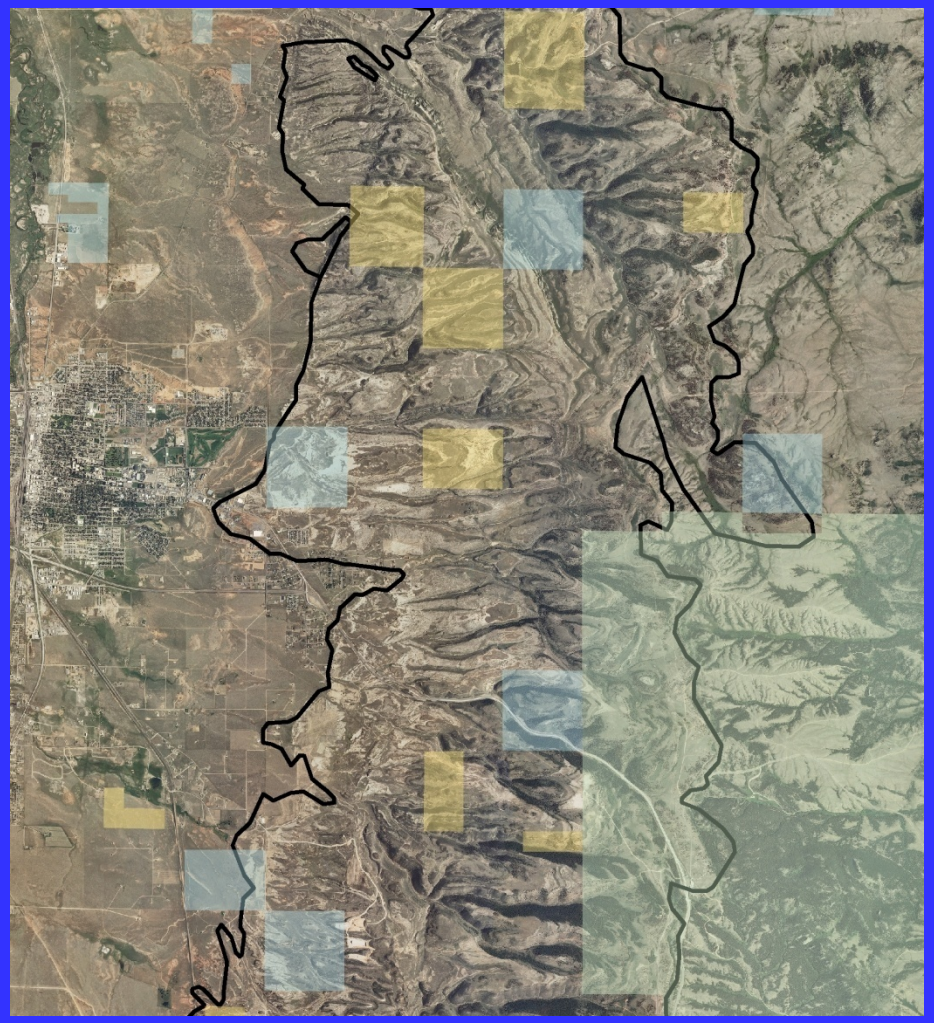




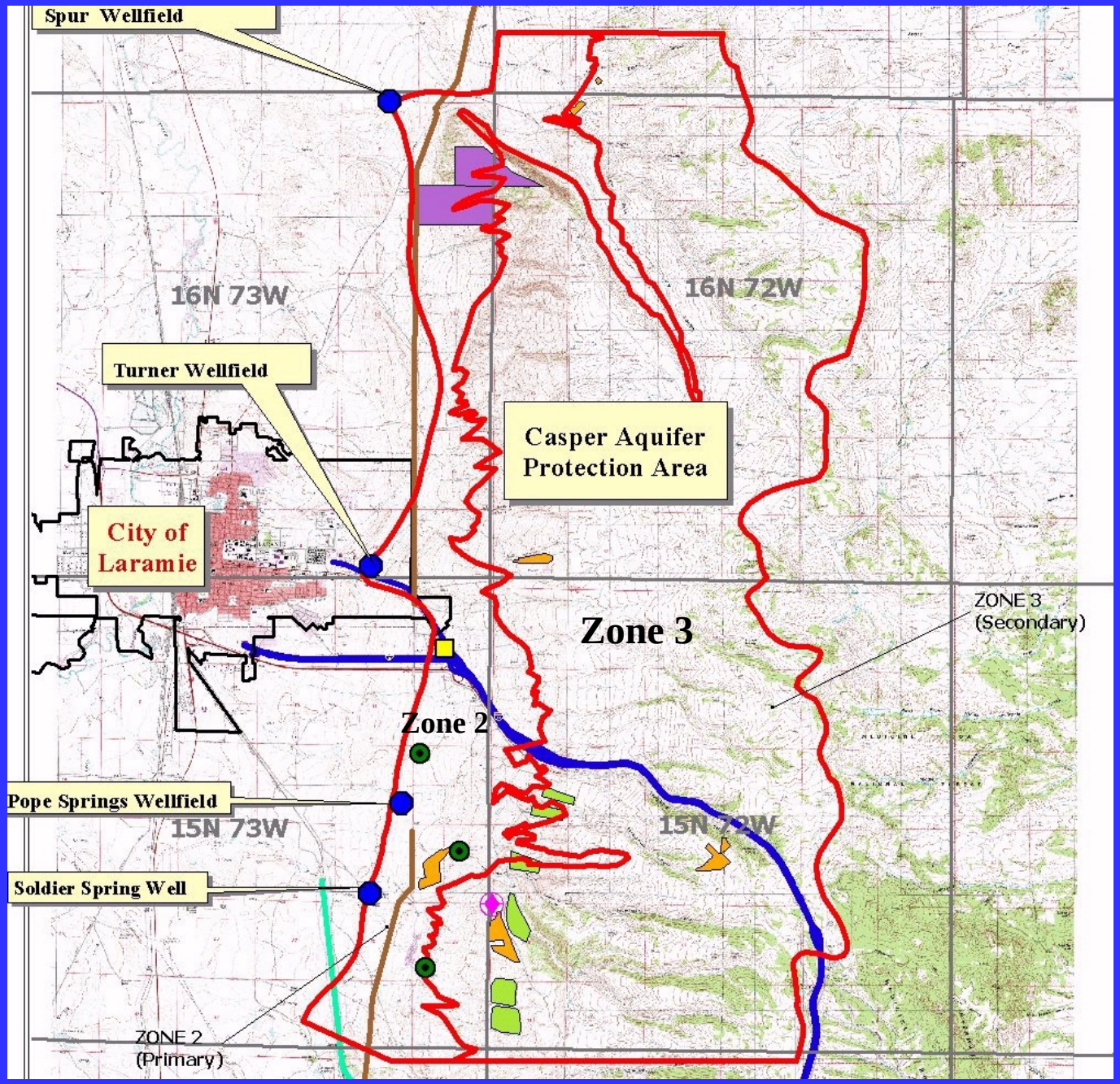
Cross section of Casper Formation/Aquifer







Blue area on map to left is the “recharge area”; it coincides with the bare bedrock seen on the right.



Casper Aquifer Protection Area

This area has been deemed by the City and the County to be highly sensitive with respect to development, due to vulnerability of the aquifer.

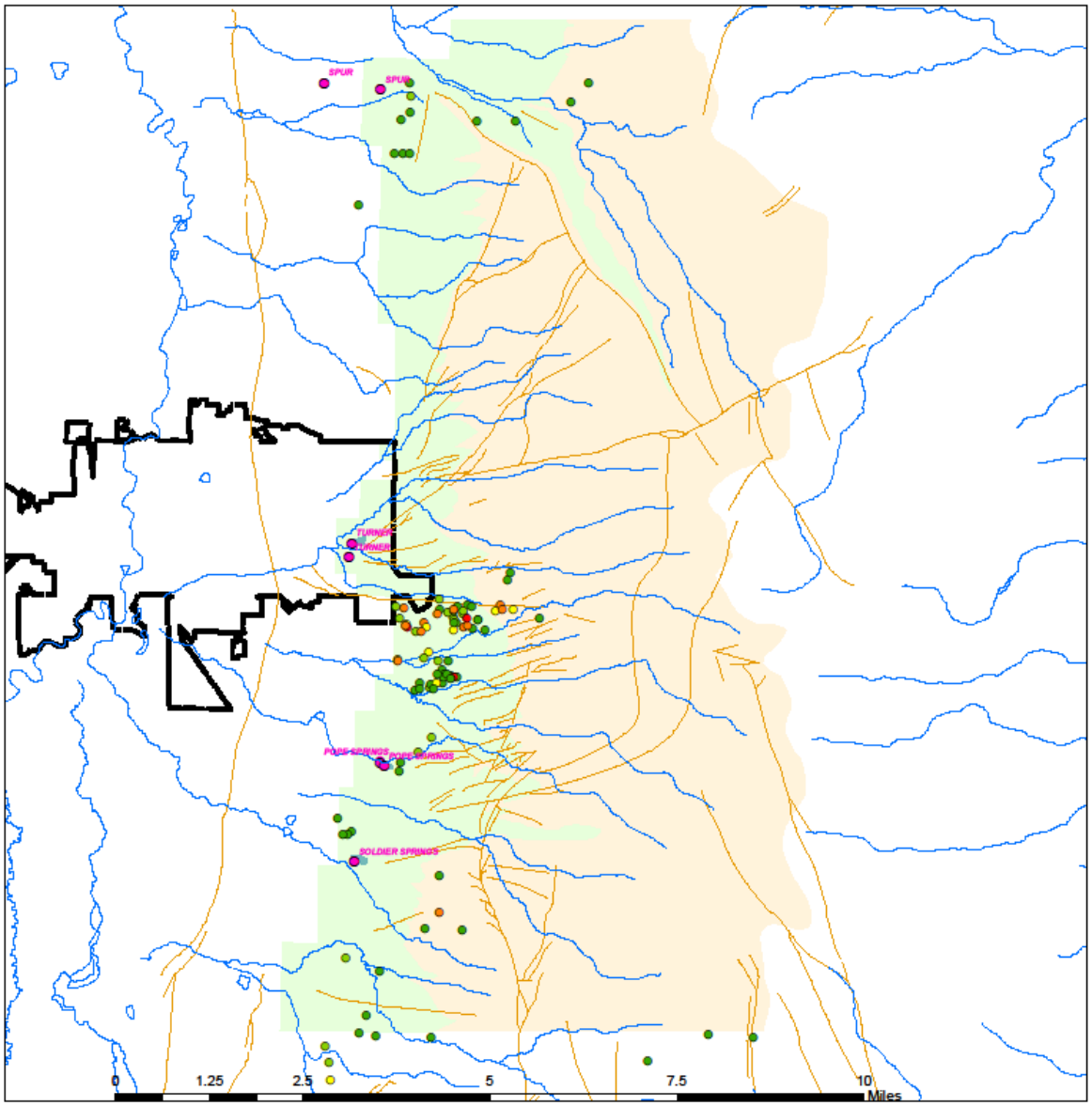
Recap – highly fractured, exposed bedrock/aquifer at surface

The Casper below the surface – also highly fractured

Highly permeable to water flow, susceptible to contamination

Photo showing fracture permeability in a city well

We already are seeing elevated nitrate in shallow Casper wells around development (background is <2 ppm)



2009 CAPA Nitrate-Nitrogen Monitoring Results

CAPA Wells Monitored 2009
NO3-N (ppm)
- 0-2
- 2-4
- 4-6
- 6-10
- 10-19
- Streams
- City Wellfields
- Faults
- City of Laramie Boundary 2009
- Zone 1 CAPA
- Zone 2 CAPA
- Zone 3 CAPA

LARAMIE

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Summary: why Laramie citizens are concerned about the recharge area east of town, based on geology and geography

Water is of very high quality and requires little treatment
(this is the kind of water companies bottle and sell)

Lack of soil cover makes it highly vulnerable to contamination

Fractured nature makes for highly productive wells, but also makes potential contaminants highly mobile (conduits impossible to “map “)

Proximity of town and development to the vulnerable recharge area

Questions?