

Infrastructure Development For A Geothermal Field At Mount Spurr, Alaska

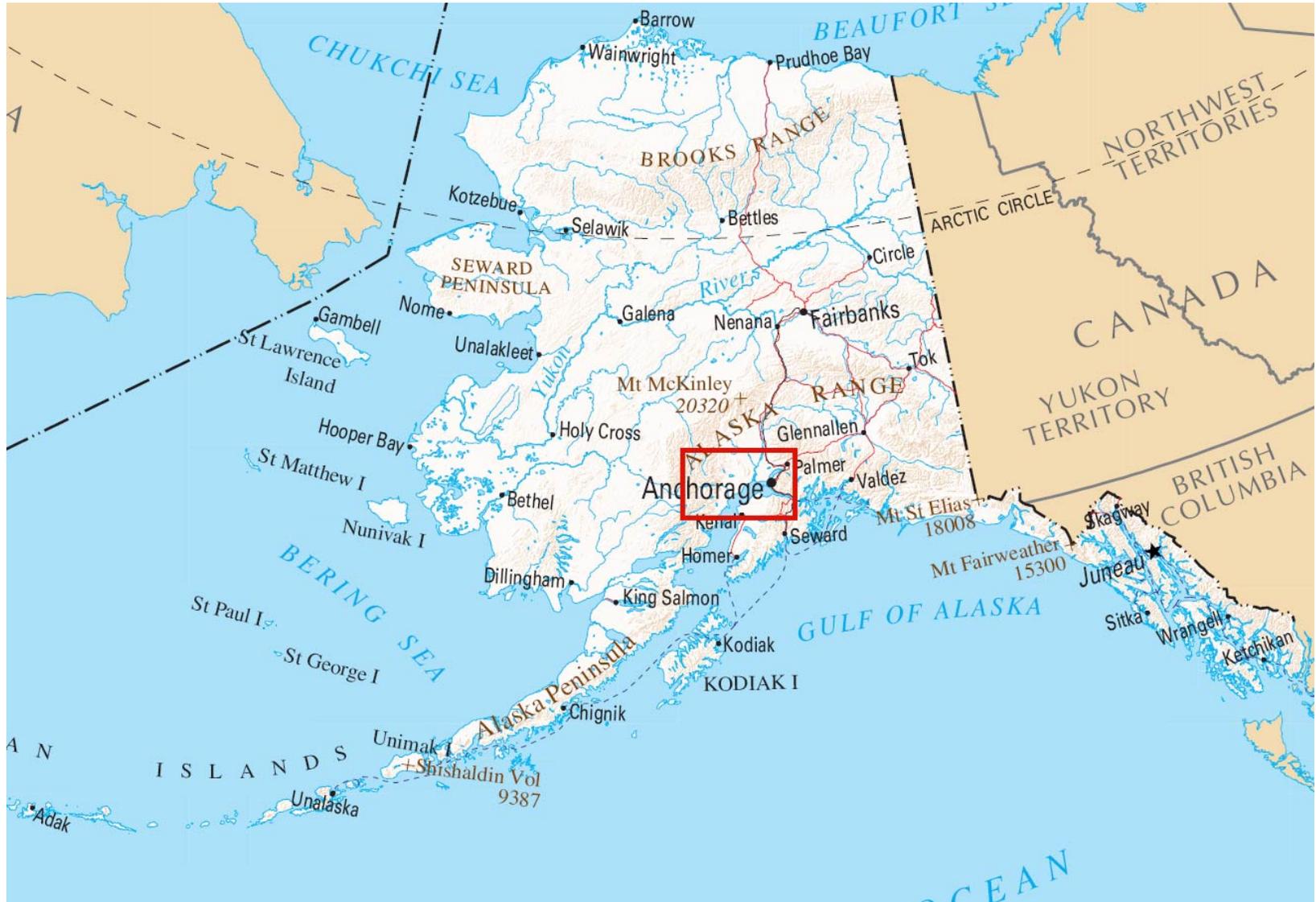


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Purpose:

- Present a broad first look at needed infrastructure for a geothermal field and power plant at Mount Spurr
- Provide order of magnitude costs – costs were estimated from bid sheets, experience in region, and gravel costs

Location

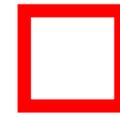




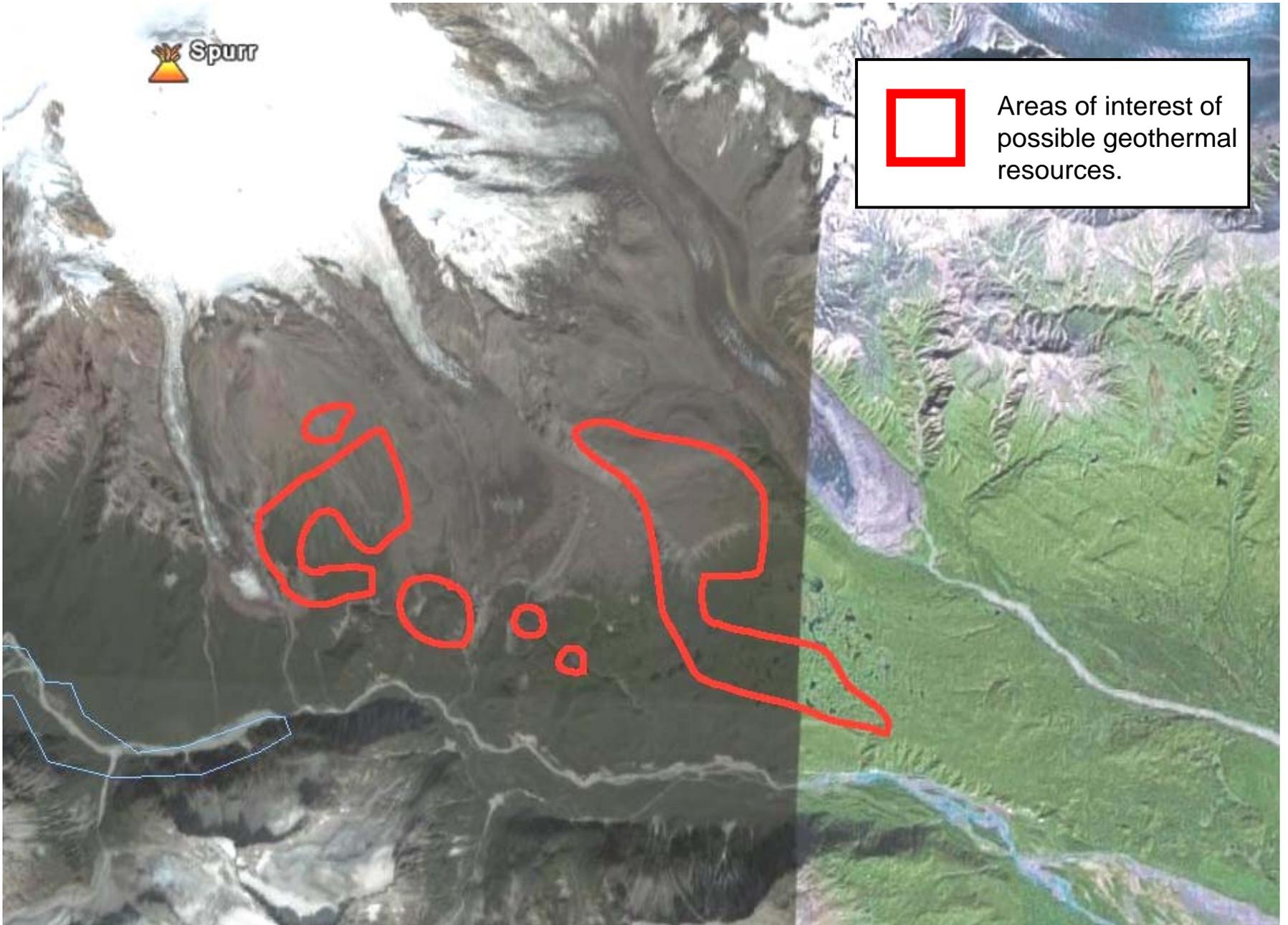
Located 70 airmiles from Anchorage
Tyonek about 33 miles from Mount Spurr
Shirleyville, Beluga

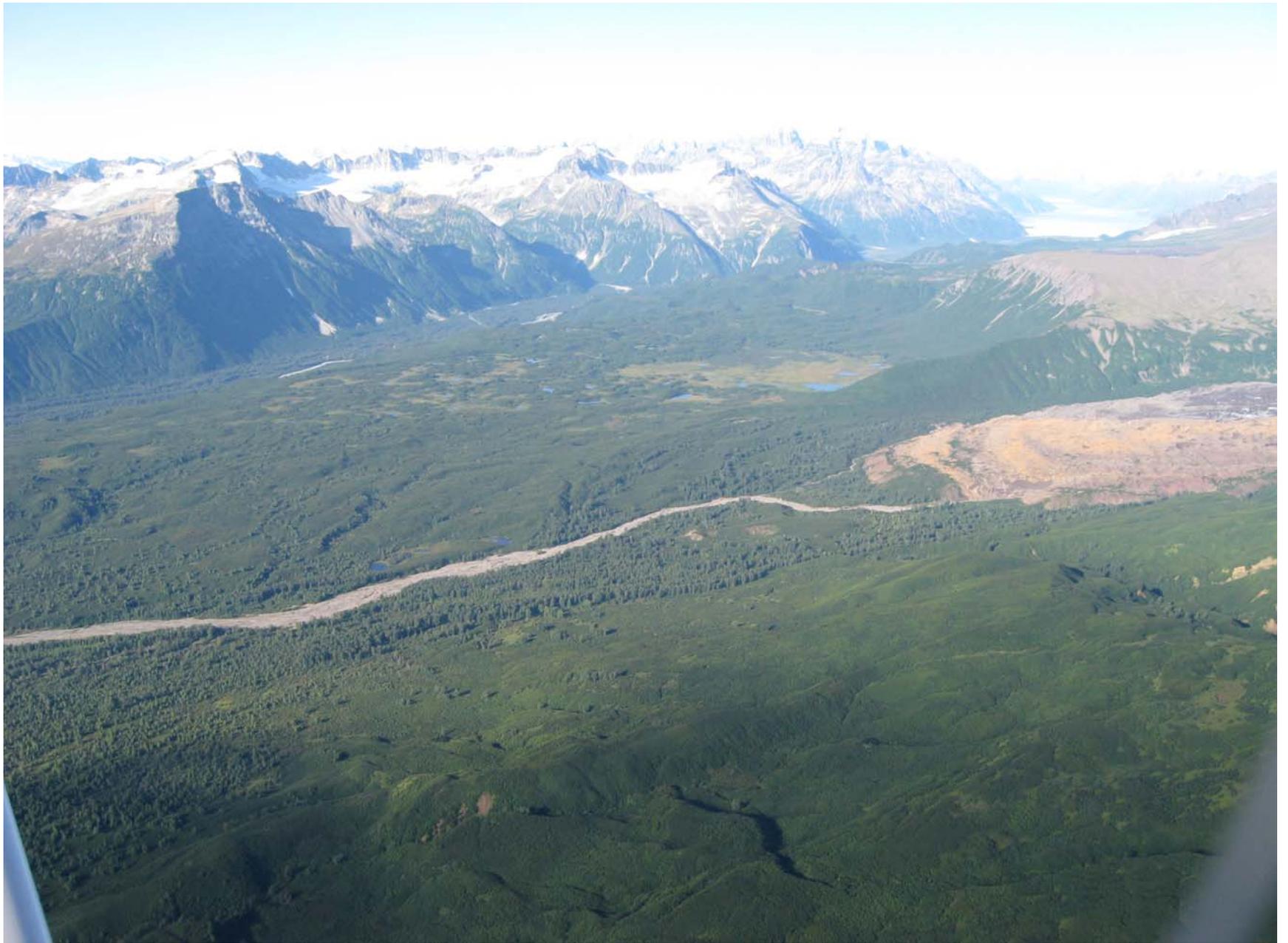
Existing Infrastructure





Areas of interest of possible geothermal resources.





Geothermal Power Plant



Nesjavellir, Iceland Power Plant

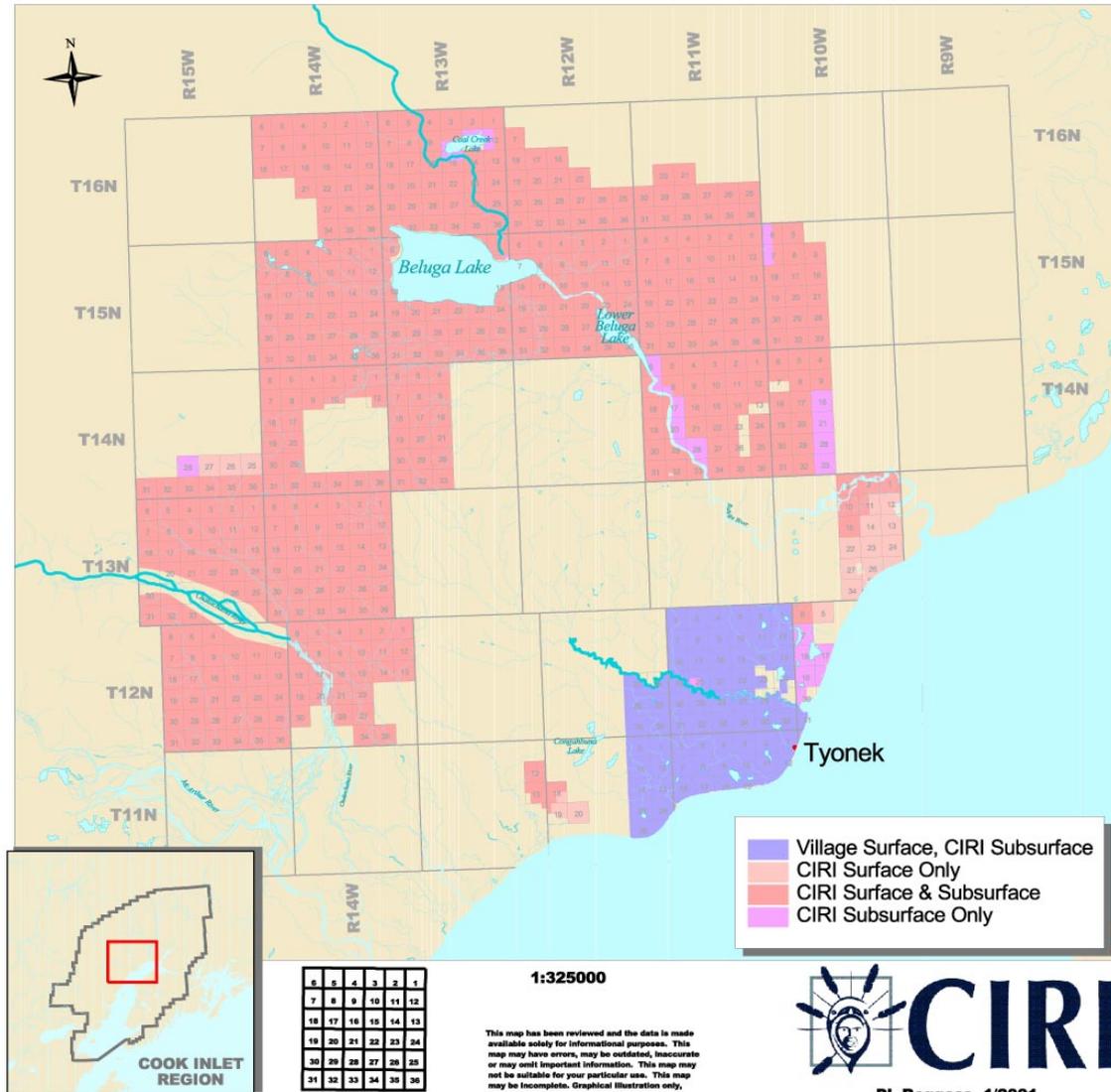
Infrastructure Needs

- Short Term Construction
 - Access – docks, roads, airports
 - Material sources
 - Temporary Power
 - Camp – 50 to 100 men
 - Water/Wastewater facilities
 - Maintenance shop
 - Staging areas

Long Term Infrastructure

- Plant – power generation, piping, geothermal wells, waste fluid disposal
- Support Facilities – transmission line, road, airport, living quarters, water supply & storage, wastewater treatment, maintenance shop, drilling equipment/core shop, emergency shelters

Land Rights



Accessibility

- Barge/dock Facilities
- Roads
- Airports





Barge/Dock Facilities

- North Foreland Port Facility (Tyonek)
 - Preferred site for export of Beluga Coal



- Capacity – 700' of berthing space, 26' deep, 70 acre storage area
- Challenges – 30 foot tides, strong (10 knot) currents, ice flows

Roads



Proposed Road





Proposed Road

- Approximately 13 Miles of new roadway
 - 24 feet wide
 - 5 foot section
 - 1 major river crossing (2 million)
- Material Needed: 300,000 to 1 million cubic yards of gravel depending upon soils
- Using local gravel sources estimated cost is \$25 to \$100 per cubic yard depending upon material source location and quality
- Route selection is critical – minimize costs
- Total cost for road construction:
\$8 to \$100 million

Airports

- Existing Area Airports – All Private,
 - Tyonek (village): 3,350' Runway
 - Beluga (Chugach Electric): 5,000' Runway
 - Nikolai Creek/Shirleyville (Aurora): 4,100' Runway
 - All Gravel
 - Beluga only one lighted
 - No instrument approaches
- All at least 30 miles away from plant site

Onsite Airfield

- For emergency/safety use/personnel
- Designed to accommodate small single aircraft - \$15 million
- Designed for larger freight planes - \$30 to \$40 million
- Challenges – high gusty winds, IFR weather conditions, volcanic ash
- Needs – clear approaches, aligned with prevailing wind, sufficient length

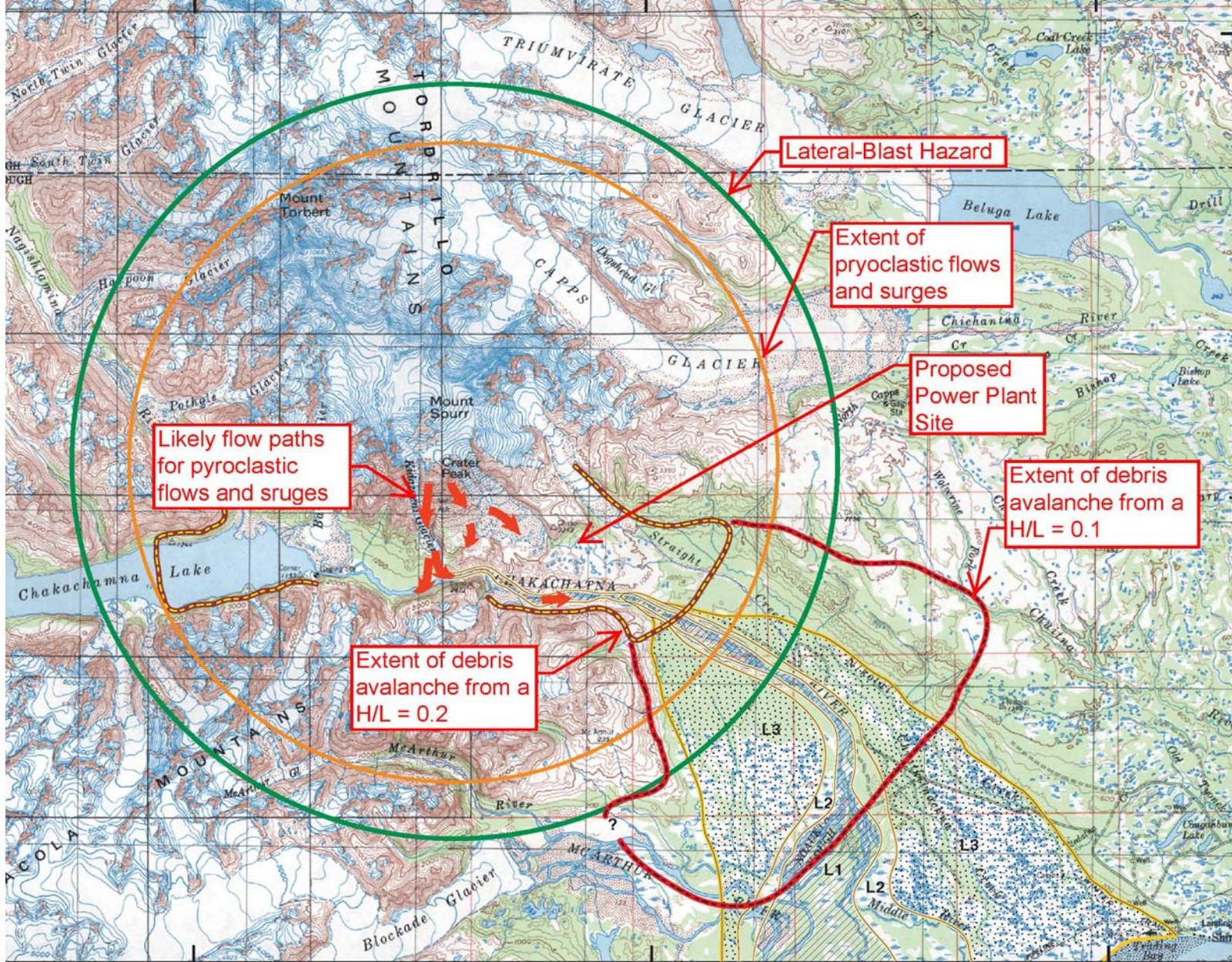
Site Challenges



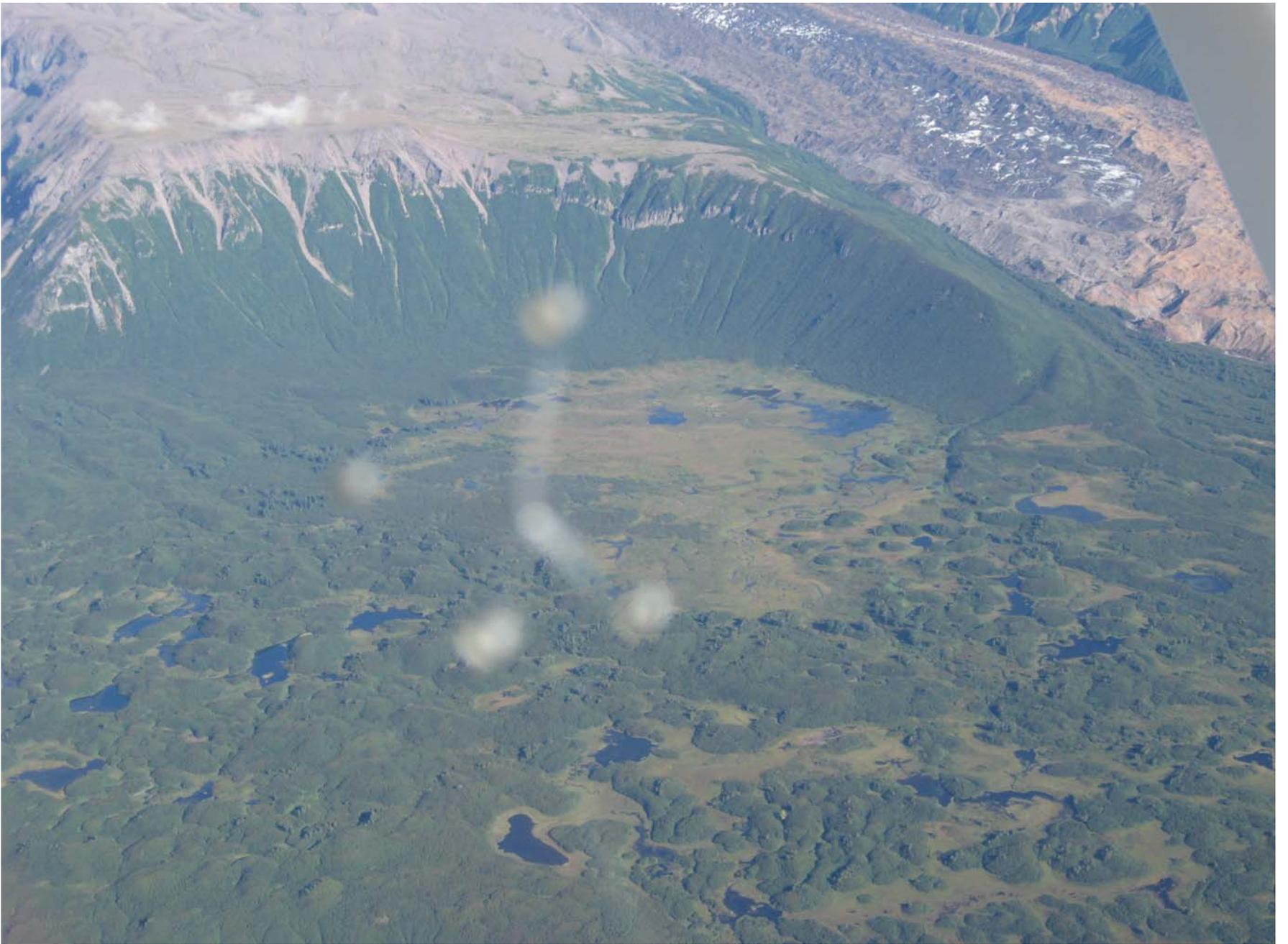
Site Challenges

- Mount Spurr (active)
 - Lava Flows
 - Volcanic Ash
 - Mud Flows
 - Earthquakes
- Glaciers
- Avalanches
- Permafrost
- Flooding





USGS Volcano-Hazard Assessment Waythomas and Nye, 2002



Site Development

- Plant & Support Facilities
- Estimated area of 200,000 to 300,000 square foot for plant, shops, living quarters, utility systems
- Gravel – assume 5 foot section – 40,000 to 60,000 cubic yards
- \$1 to \$6 million

Geothermal Power Plant

- Estimated construction costs for a flash power plant: ~\$1,500 per kW
- Due to economy of scale (100 MW), proposed power plant construction costs could be between \$100 and \$150 million.

Steam Gathering System

- Cost factors
 - Site topography
 - Well productivity
 - Brine status



- Estimated costs \$250/kW to \$400/kW
\$25 to \$40 million

Support Facilities

- Living quarters, shops, shelters - \$1 to \$2 million for all structures
- Utilities – water supply & storage and wastewater treatment - \$300,000 to \$2.5 million



Transmission Line

- Connection to Beluga
 - Existing transmission lines from Beluga to Anchorage
 - 35 miles of new transmission line needed straight
 - 45 miles if following road
 - Cost of transmission line ranges from \$300,000 to \$600,000 per mile.
 - Total cost: \$10 to \$27 million



Transmission Line



Costs

- Road Construction: \$8 to 100 million
- Airstrip Construction: \$15 to \$40 million
- Site Development: \$137 to \$201 million
- Transmission Line: \$10 to \$27 million

TOTALS: \$170 to \$368 million

