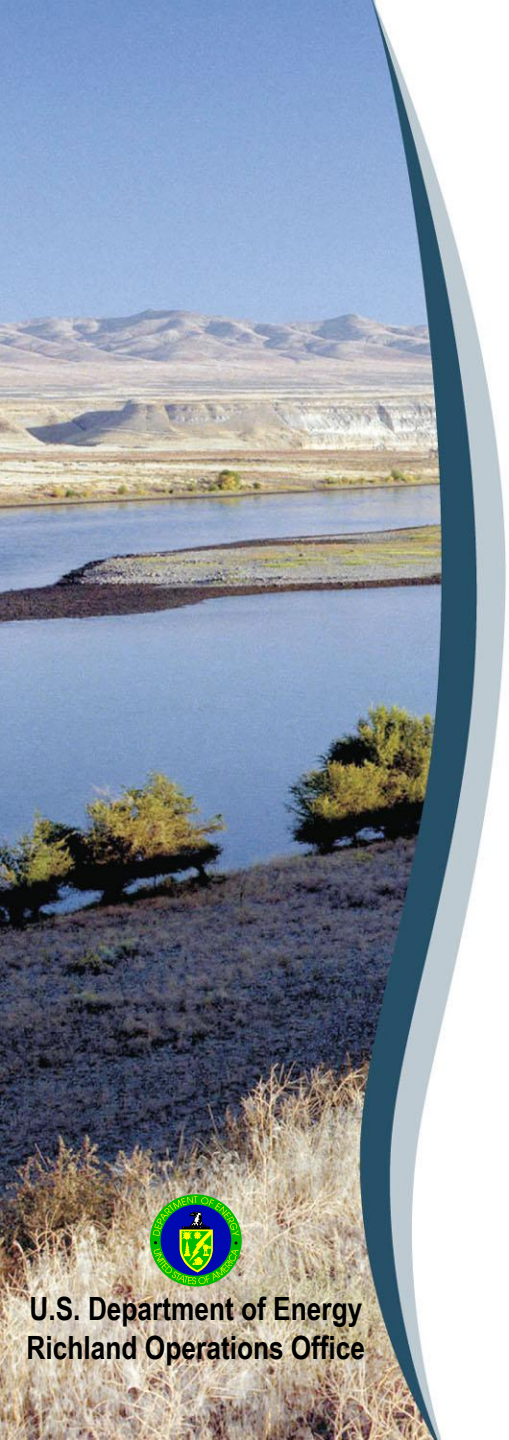


Remedial Investigation of Hanford Site Releases to the Columbia River – Overview

River and Plateau Comittee

John Sands
DOE/RL Project Manager

August, 2011

U.S. Department of Energy
Richland Operations Office

Key Documents

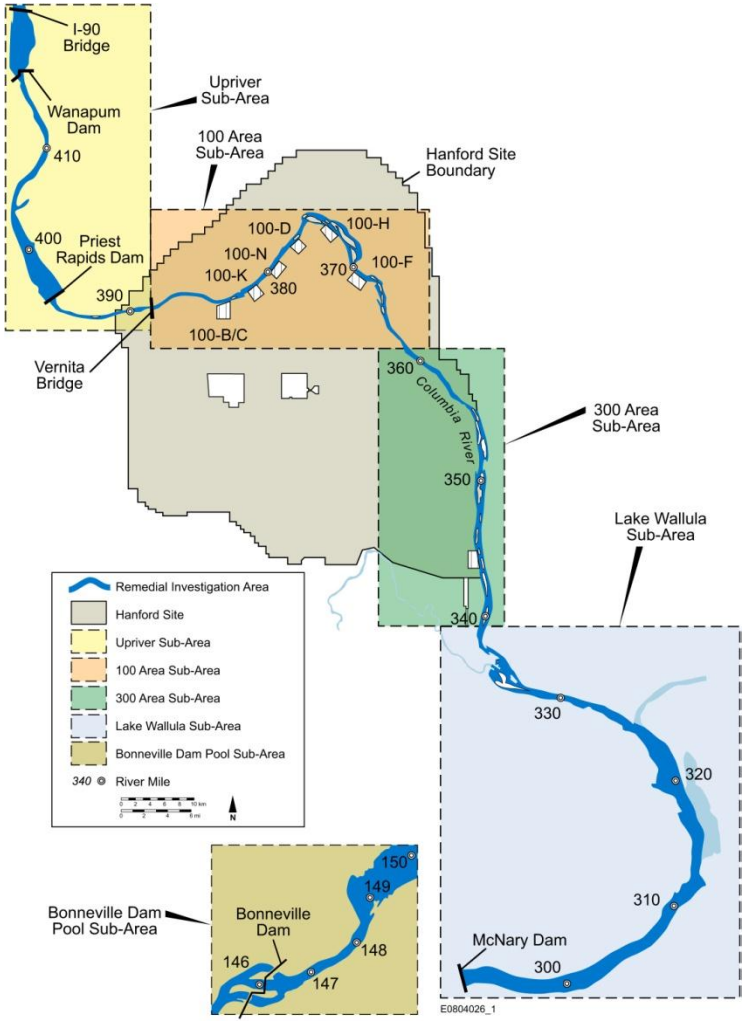
- Columbia River Component Data Evaluation Summary Report, July 2006
  - Compiled existing data from the Pacific Ocean to Grand Coulee Dam
- Columbia River Component Data Gap Analysis, October, 2007
- DQO Summary Report for the Remedial Investigation of Hanford Site Releases to the Columbia River, June, 2008
- Remedial Investigation Work Plan for Hanford Releases to the Columbia River, October 2008 (DOE/RL-2008-11)
- Draft Ecological and Human Health Risk Assessments due out for regulatory review in coming months

Data Gaps Filled through Sampling

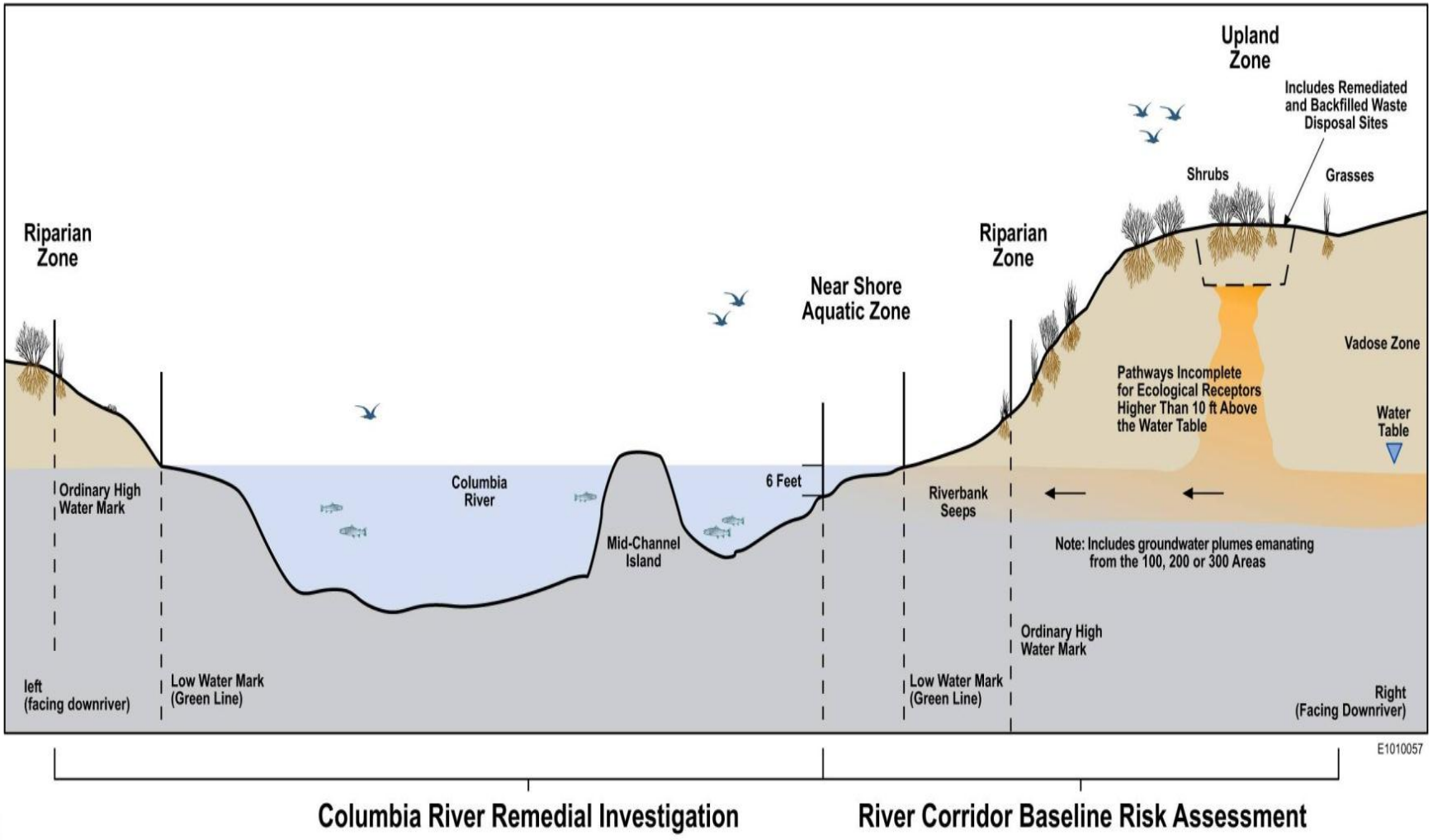
- Shoreline across the river from Hanford operations
- Island soils
- Sediment deposition areas
  - Determine potential loading from direct discharges
  - Determine potential loading from upwelling groundwater
- Media sampled
  - River water, pore water, sediment, island soil, fish
    - Pore water is the groundwater before it mixes with the river water

Remedial Investigation of Hanford Site Releases to the Columbia River

- Investigation Area
  - 120-mile stretch of Columbia River
  - Includes portions of Snake, Yakima and Walla Walla Rivers



River Corridor Risk Assessments



Sources of Contamination in Columbia River

- Primary Hanford sources in decreasing order of overall contribution
  - Reactor cooling water direct discharge (primarily radionuclides)
    - No longer active
  - Groundwater plumes migrating toward the river and discharging to river in seeps and upwelling
    - Key contaminants include Cr+6, Sr-90, Tritium, Uranium
  - Stacks and overland flow
    - No longer active

Non-Hanford Upstream Sources

- Mining (metals)
- Municipalities (PAHs, metals, TPHs, VOC, pesticides, PCBs, Nitrates)
- Farming (pesticides, fertilizers)
- Coal fire plants (Hg)
- Pulp and paper mills, transformer spills (PCBs)
- Salmon (PCBs and pesticides)
  - PCBs and pesticides are bioaccumulators
- Fallout from Nuclear Weapons (radionuclides)

Data Collected to Supplement Existing Data

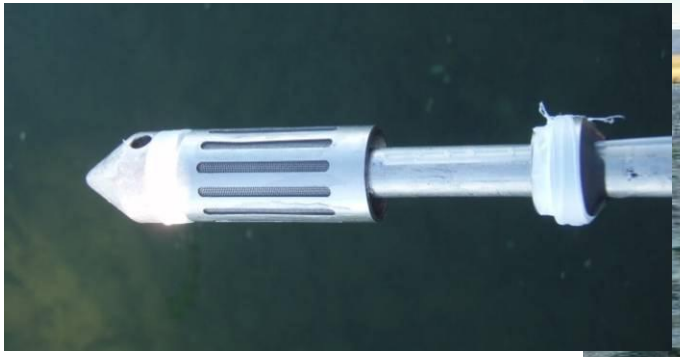
- 530 fish
  - Sturgeon, whitefish, bass, carp, sucker, walleye
- 74 sediment locations
- 21 core locations
- 8 Island soil locations
- 35 surface water locations (2/3 depth)
- Phased pore water and sediment sampling
  - Identify areas of upwelling (685 locations sampled)
  - Identify areas of indicator contaminants (233 stations)
  - Co-located pore water, sediment, surface water (foot above bottom) for suite of contaminants (47 stations)
- ~ 244,000 sample data results.

Investigation Tools

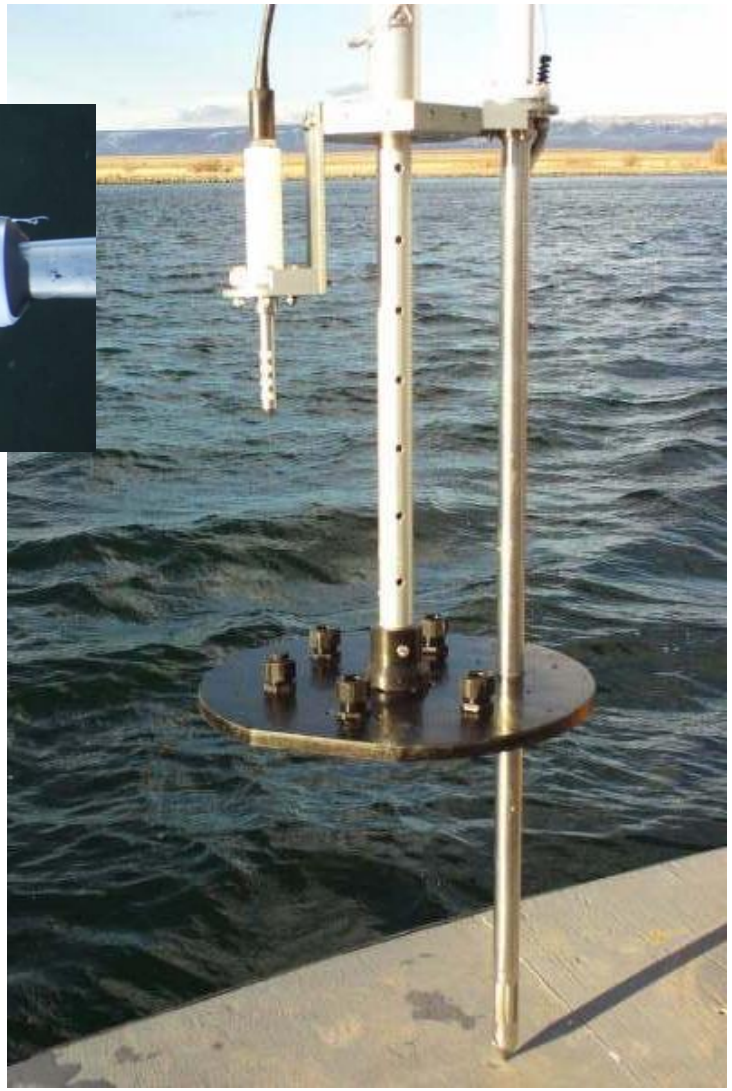
- Trident Probe – pore water, sediment, surface water
- Power Grab – sediment
- Trowel – island soil
- Split spoon core barrel
- Vibratory – sediment cores

Trident Probe Frame

Liquid-Phase Trident Probe[1]



Pore-Water (PW) Probe
- Measures pore-water specific conductivity and temperature
- Obtain samples of pore-water



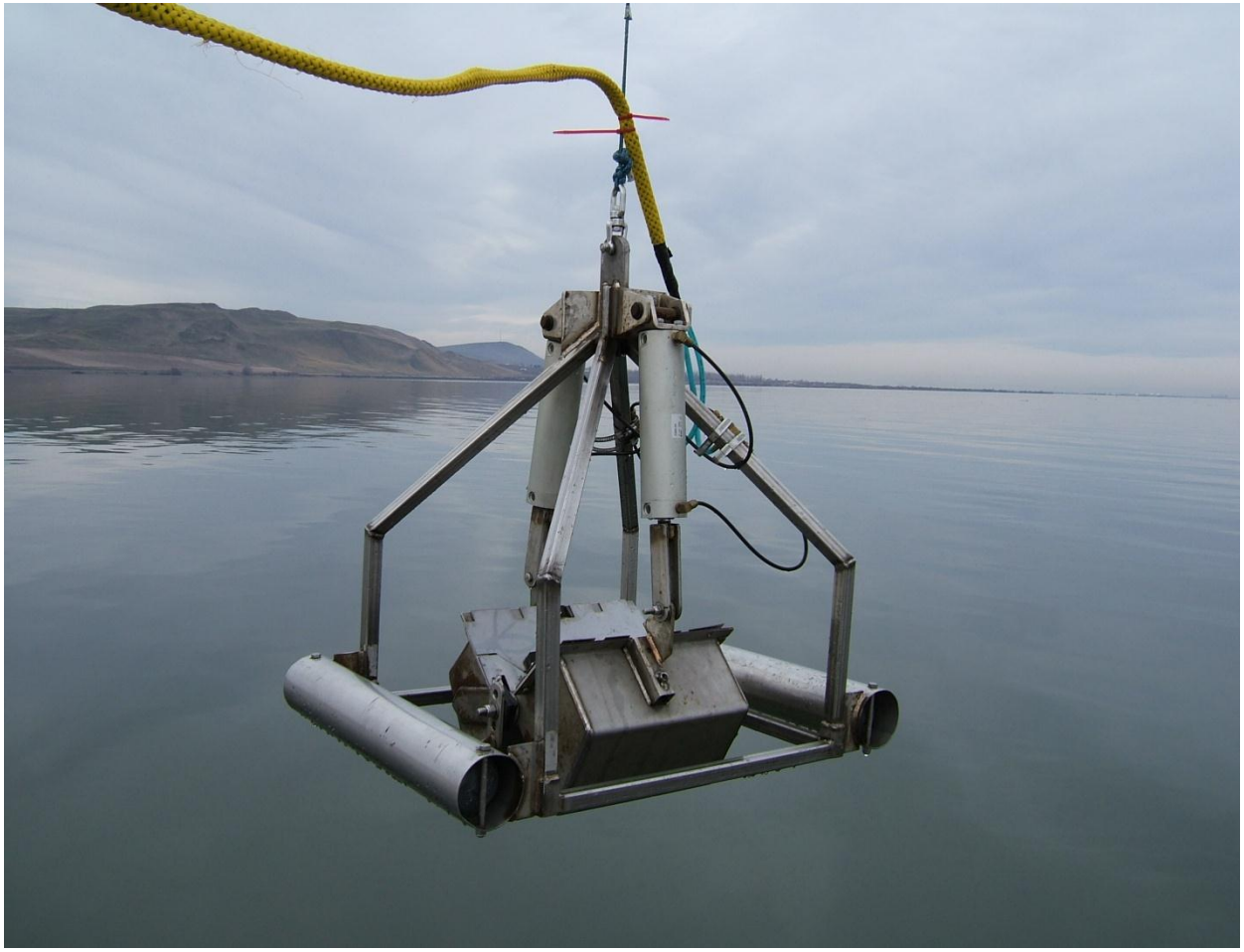
Pore Water probe depth (1 ft.) (range 8 to 13 in.) below riverbed surface

Surface Water probe depth = 1ft. above riverbed

Footnote 1: Patent Pending – Coastal Monitoring Associates

Split-Spoon Core Barrel on Trident Probe Frame

Power Grab



Sediment Cores - Vibratory Drilling

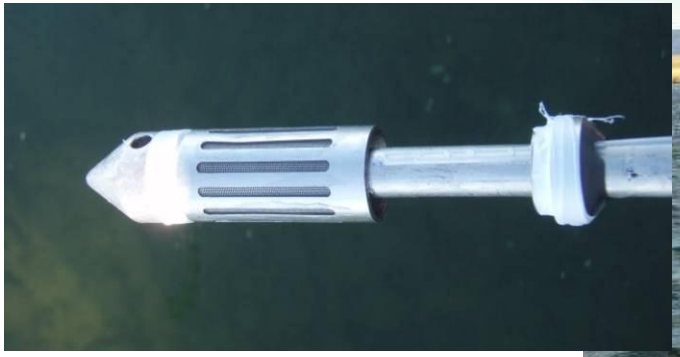
Summary Results

- Hanford primary contaminants in groundwater (i.e. Cr^{+6}, Sr-90, U, tritium) found upwelling in river
- Hanford radionuclides found in deep cores (sediment) within Lake Wallula at expected concentrations
- 7of 8 Islands sampled had no detectable radionuclides
- Total Chromium found in sediment throughout study area
  - Including Snake and Yakima Rivers
- Primary contaminants measured in fish
  - Arsenic, cadmium, PCBs, Pesticides (DDD and DDT)

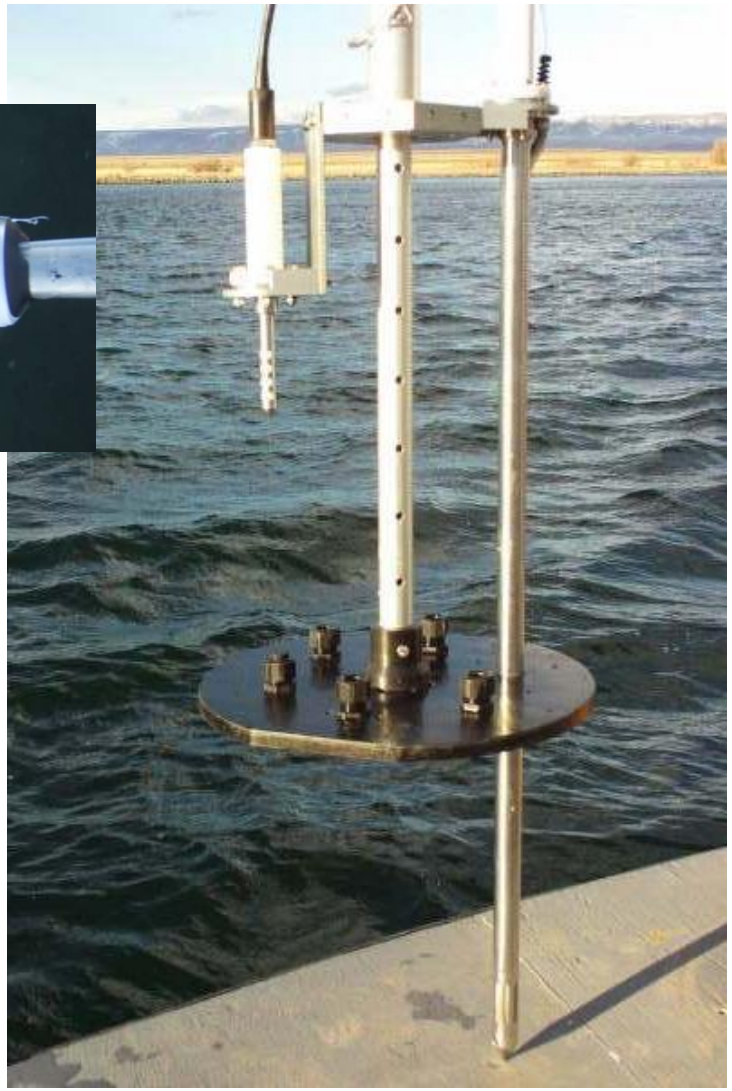
Methods to Map Groundwater Upwelling

- Specific Conductivity
  - Conductivity is a measure of a material's ability to conduct an electric current.
  - Differences in conductivity between groundwater and river water can be used to identify points where groundwater enters (upwells) into the river.
- Temperature
  - Temperature is another parameter that can be used, especially when river water is cooler than groundwater during the winter months
- Measurements taken in late Fall and Winter time periods when upwelling is greatest

Liquid-Phase Trident Probe[1]



Pore-Water (PW) Probe
- Measures pore-water specific conductivity and temperature
- Obtain samples of pore-water

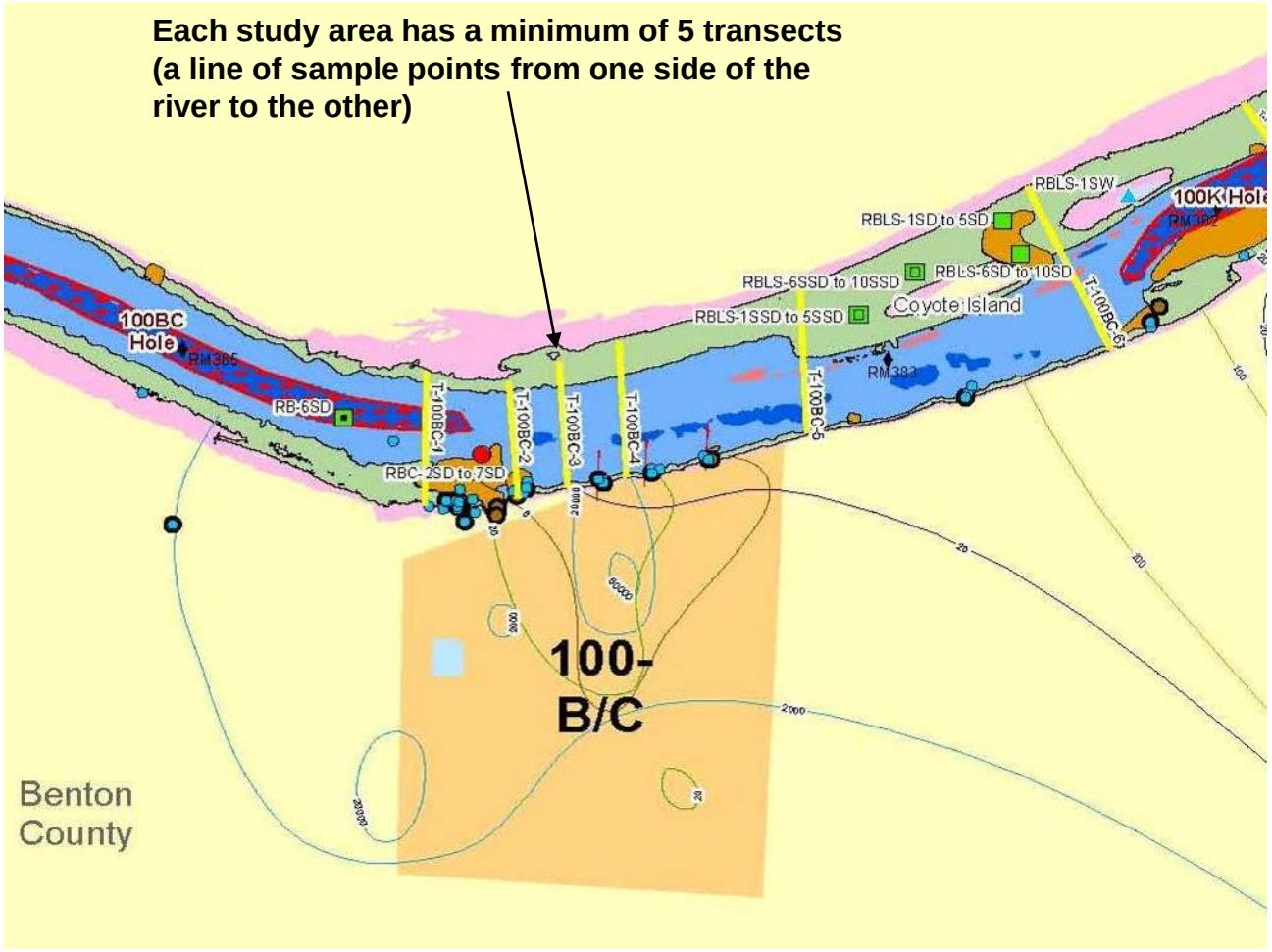


Pore Water probe depth (1 ft.) (range 8 to 13 in.) below riverbed surface

Surface Water probe depth = 1ft. above riverbed

Footnote 1: Patent Pending – Coastal Monitoring Associates

General Conductivity Mapping [Phase II(a)] Approach

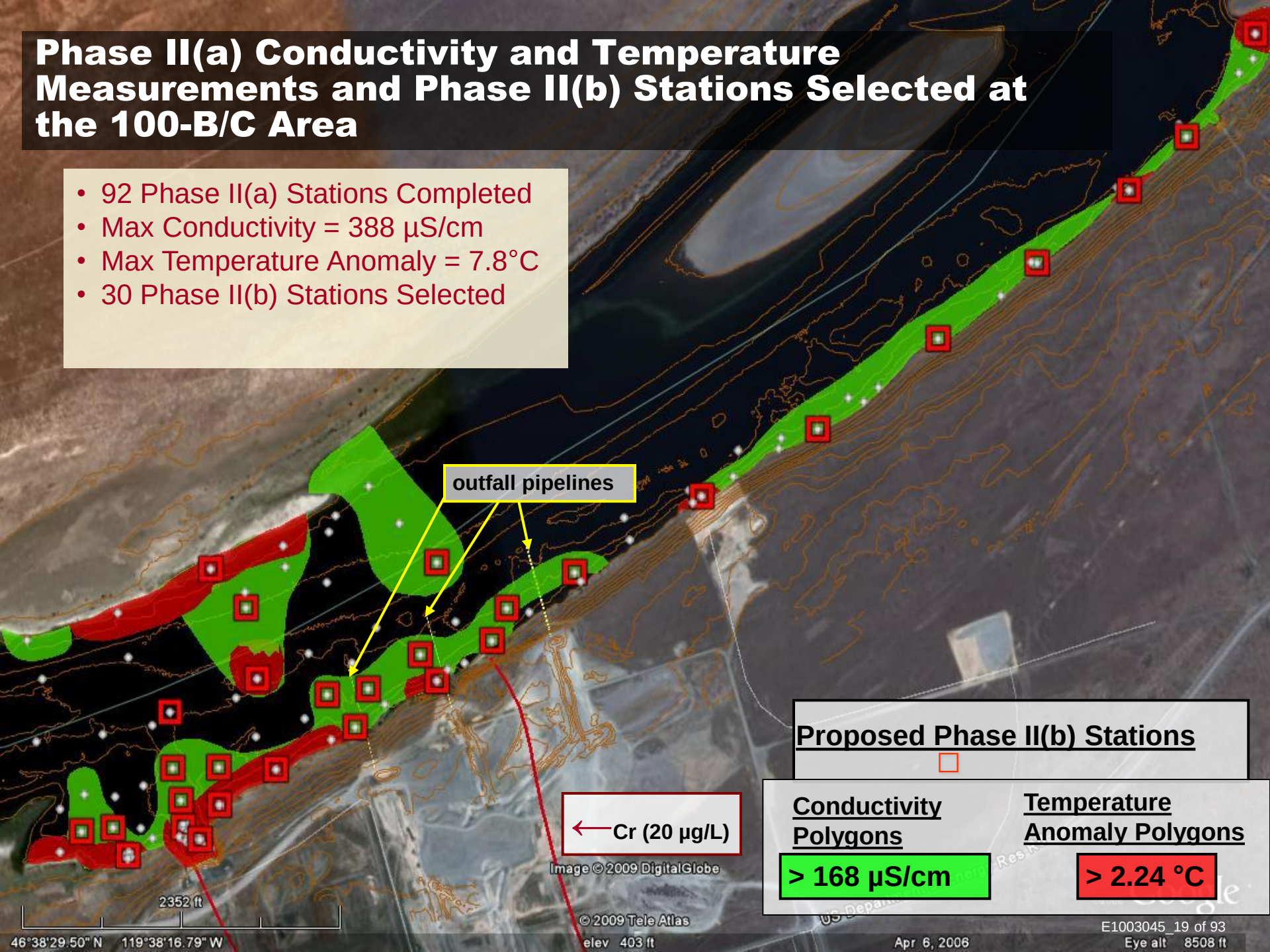


Phase II(a) Conductivity and Temperature Measurements and Phase II(b) Stations Selection

Summary from All Study Areas

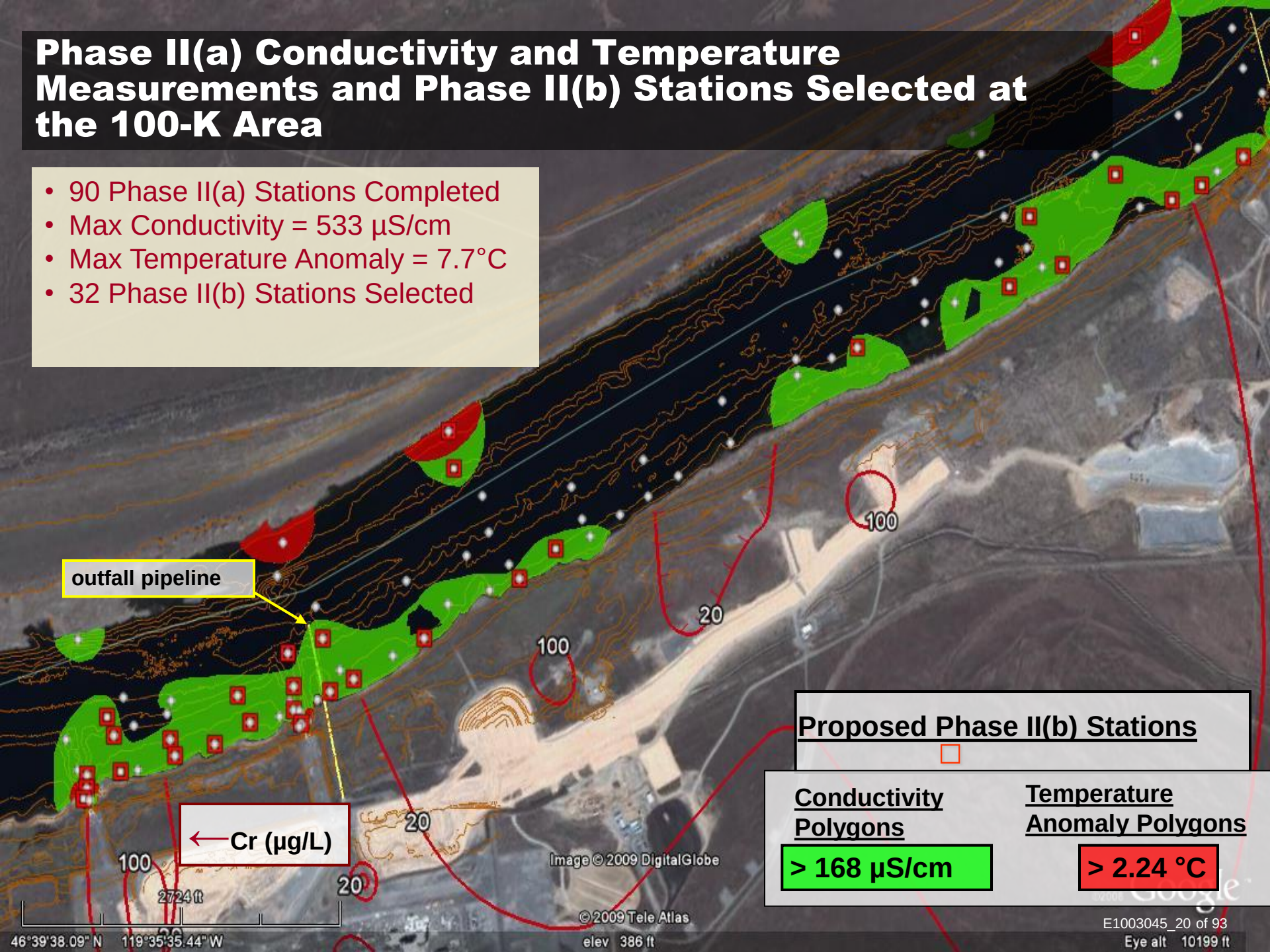
Phase II(a) Conductivity and Temperature Measurements and Phase II(b) Stations Selected at the 100-B/C Area

- 92 Phase II(a) Stations Completed
- Max Conductivity = 388 µS/cm
- Max Temperature Anomaly = 7.8°C
- 30 Phase II(b) Stations Selected



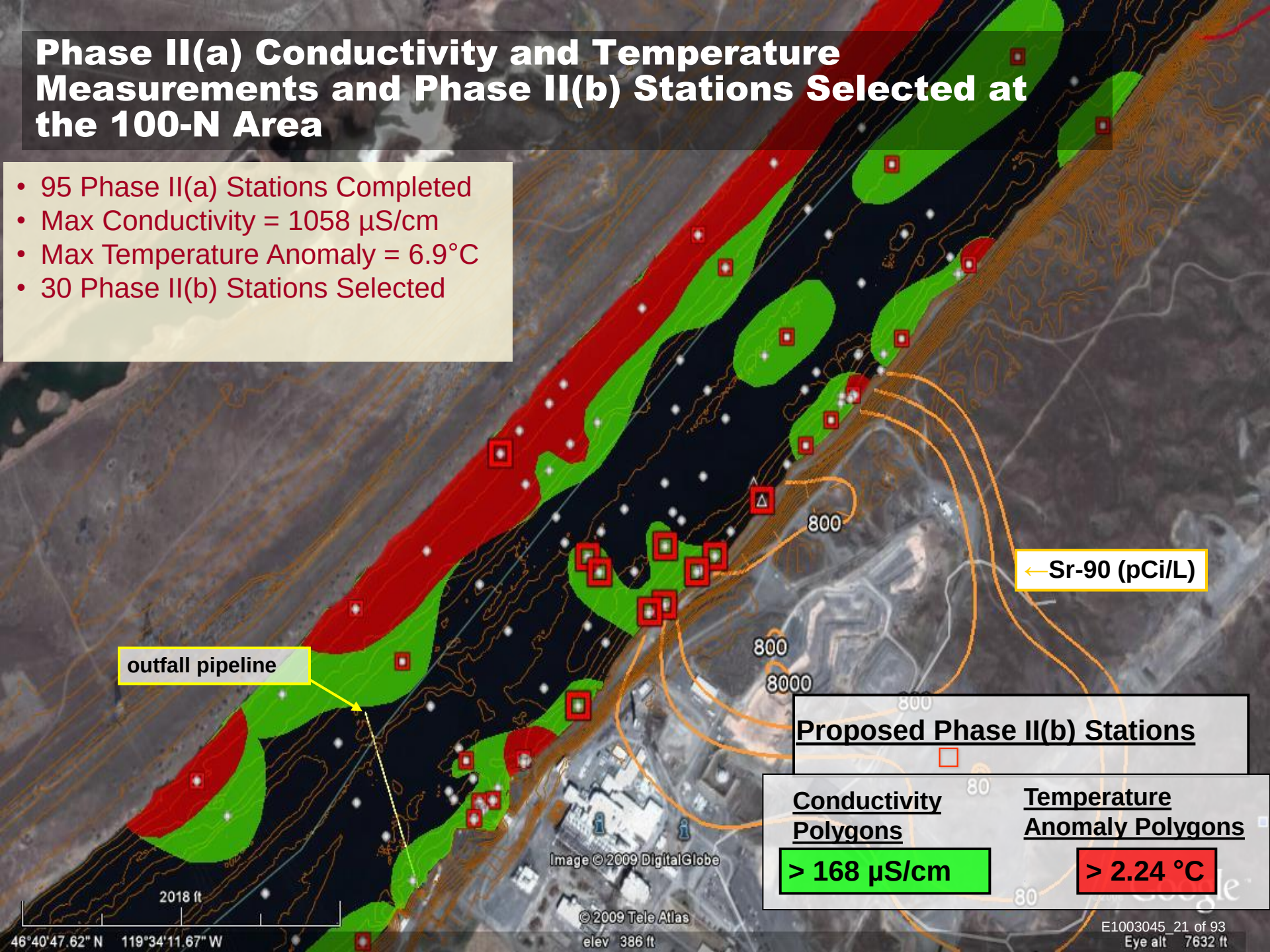
Phase II(a) Conductivity and Temperature Measurements and Phase II(b) Stations Selected at the 100-K Area

- 90 Phase II(a) Stations Completed
- Max Conductivity = 533 µS/cm
- Max Temperature Anomaly = 7.7°C
- 32 Phase II(b) Stations Selected



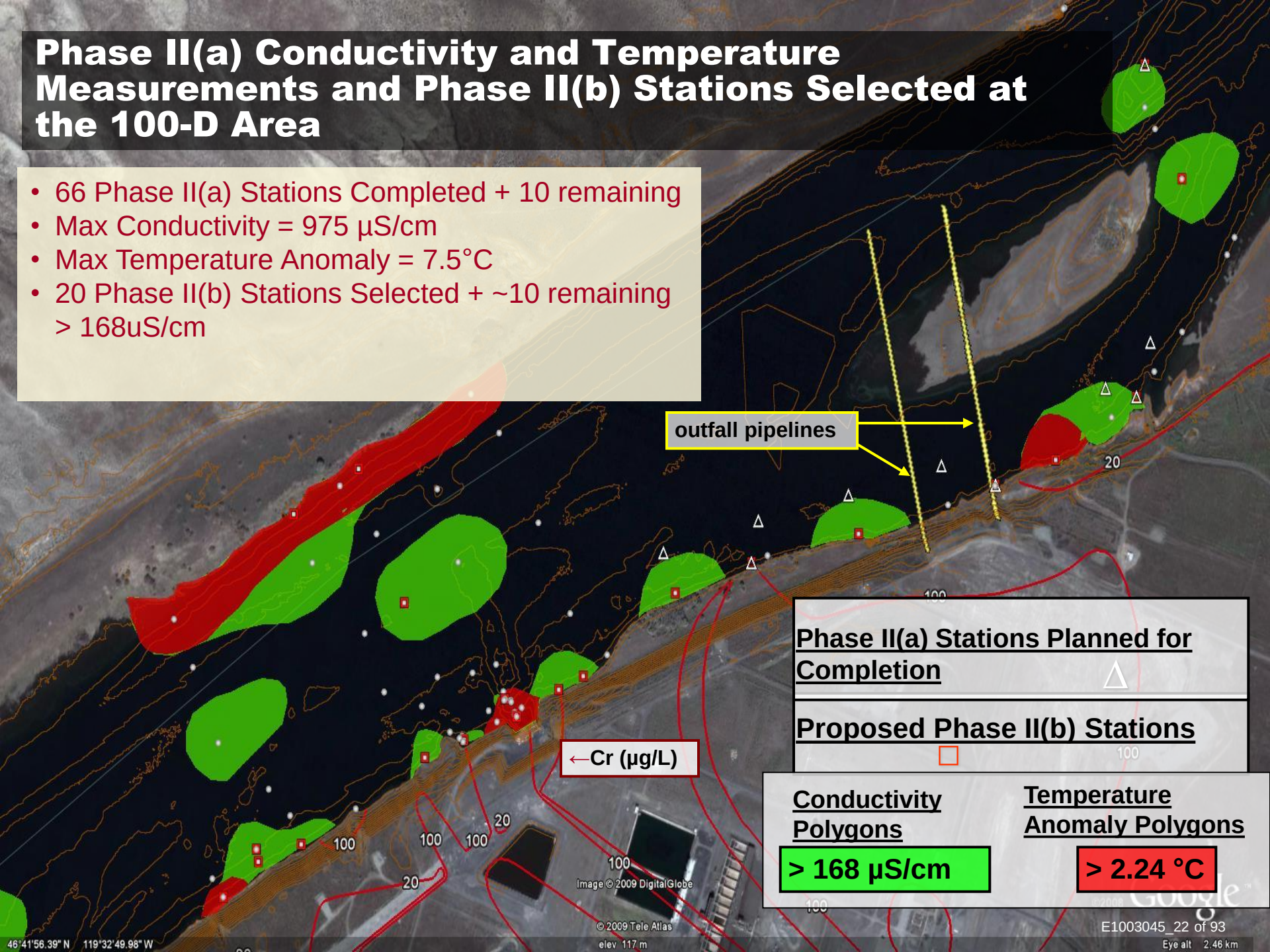
Phase II(a) Conductivity and Temperature Measurements and Phase II(b) Stations Selected at the 100-N Area

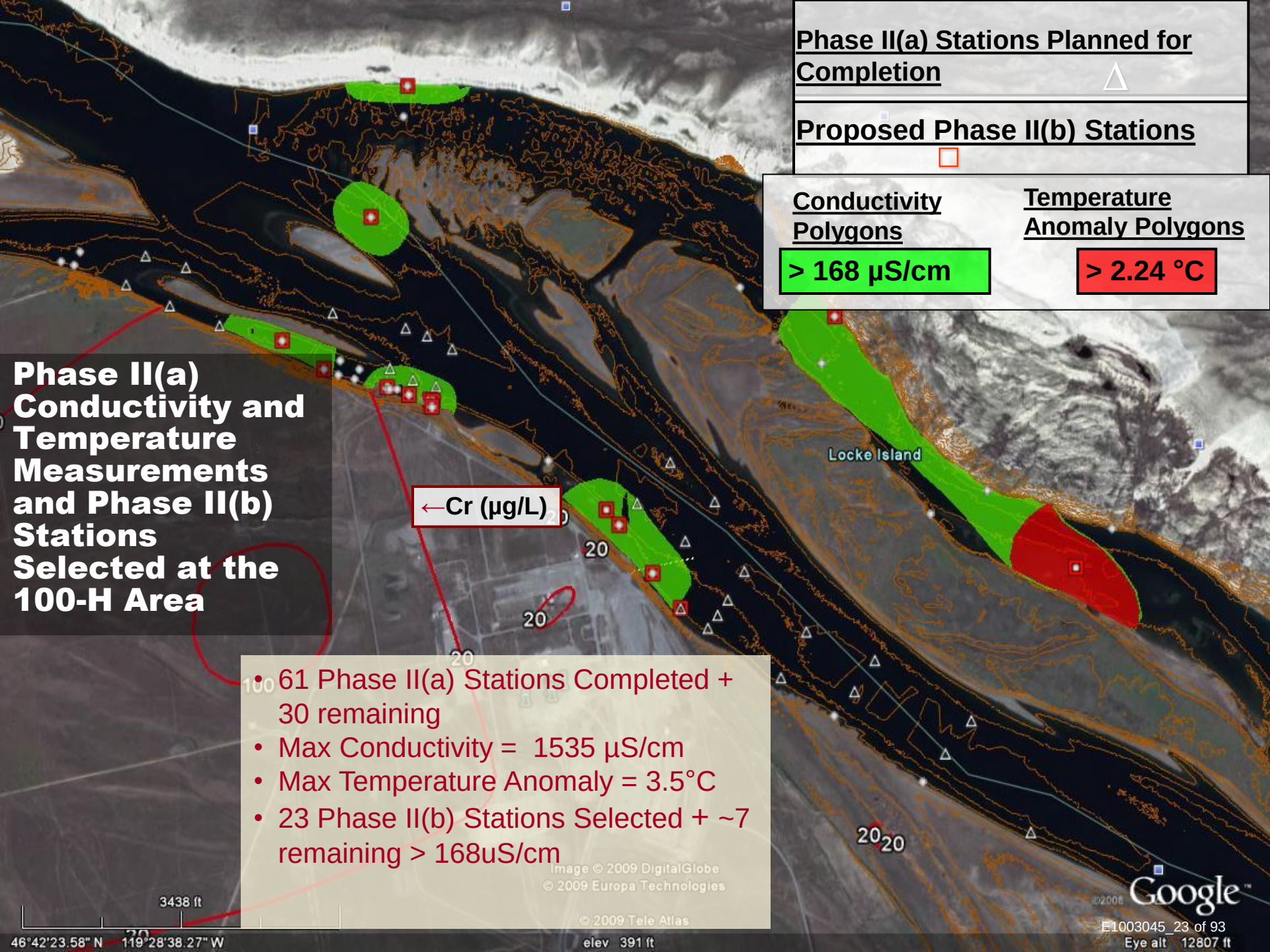
- 95 Phase II(a) Stations Completed
- Max Conductivity = 1058 µS/cm
- Max Temperature Anomaly = 6.9°C
- 30 Phase II(b) Stations Selected



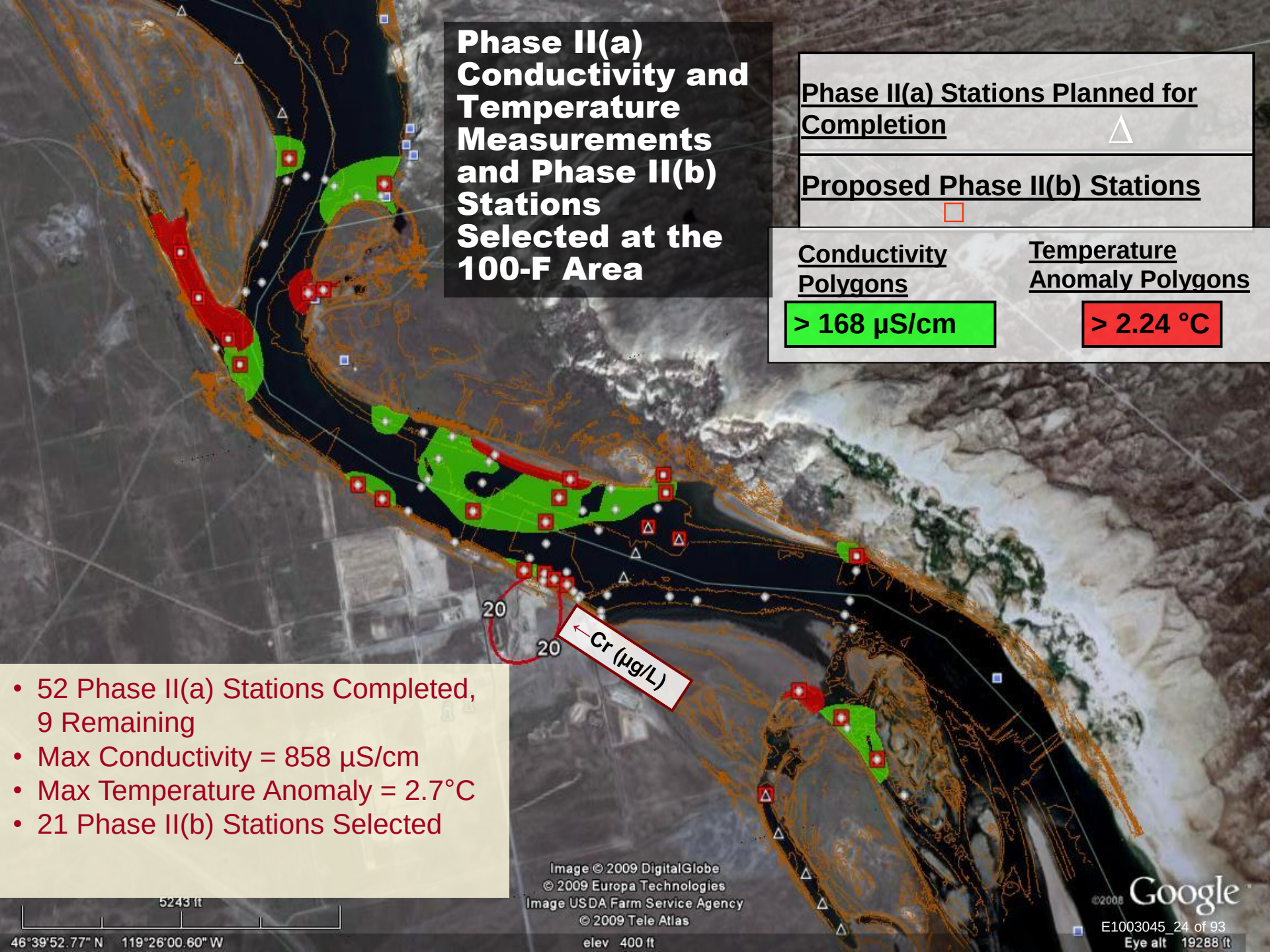
Phase II(a) Conductivity and Temperature Measurements and Phase II(b) Stations Selected at the 100-D Area

- 66 Phase II(a) Stations Completed + 10 remaining
- Max Conductivity = 975 µS/cm
- Max Temperature Anomaly = 7.5°C
- 20 Phase II(b) Stations Selected + ~10 remaining > 168uS/cm

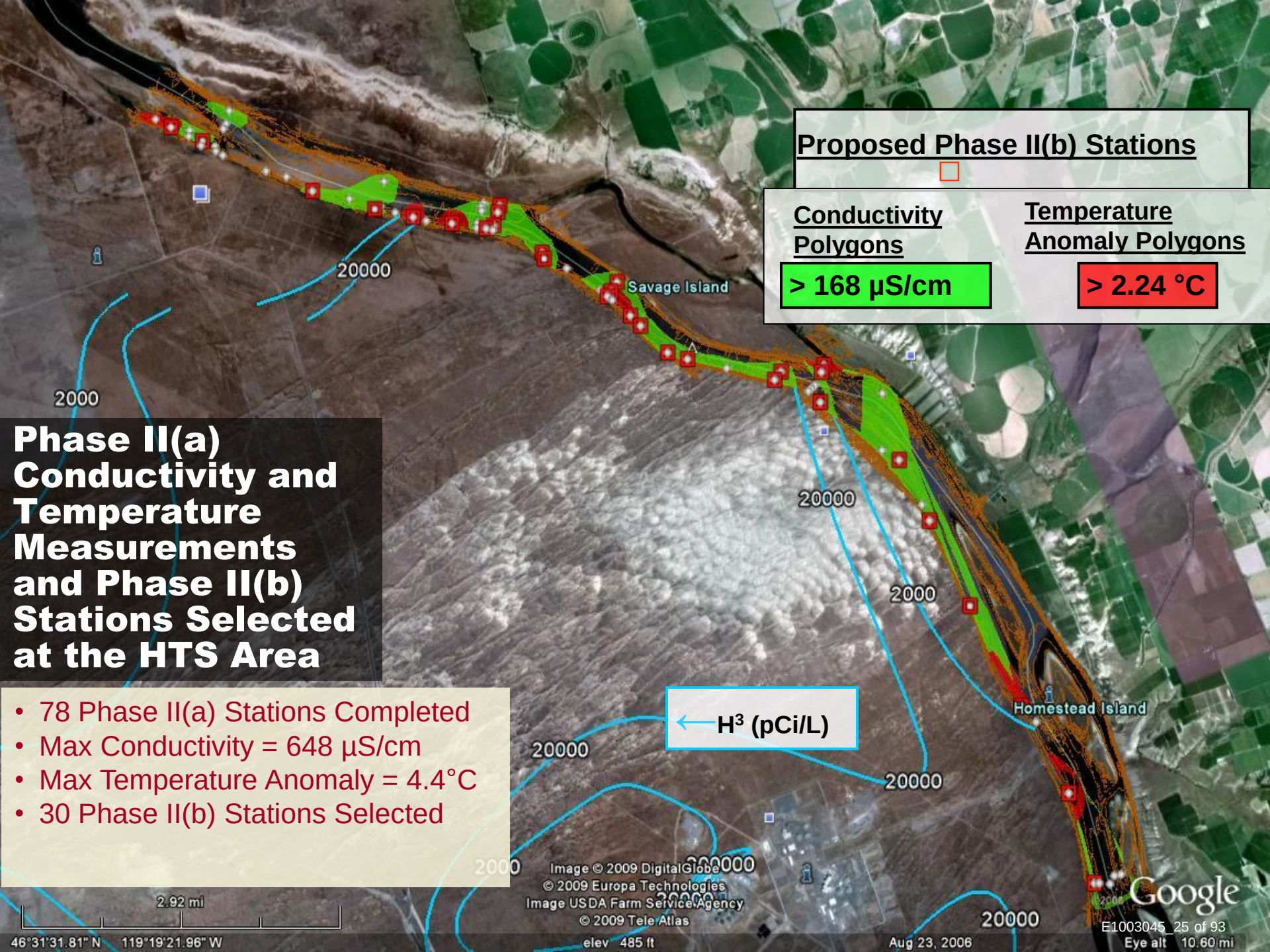



Phase II(a) Stations Planned for Completion
Proposed Phase II(b) Stations
Conductivity Polygons
> 168 µS/cm
Temperature Anomaly Polygons
> 2.24 °C
Phase II(a) Conductivity and Temperature Measurements and Phase II(b) Stations Selected at the 100-H Area
←Cr (µg/L)
Locke Island
20
20
20
20
20
100
• 61 Phase II(a) Stations Completed + 30 remaining
• Max Conductivity = 1535 µS/cm
• Max Temperature Anomaly = 3.5°C
• 23 Phase II(b) Stations Selected + ~7 remaining > 168uS/cm
Image © 2009 DigitalGlobe
© 2009 Europa Technologies
© 2009 Tele Atlas
3438 ft
46°42'23.58" N 119°28'38.27" W
elev 391 ft
Google
E1003045_23 of 93
Eye alt 12807 ft

Phase II(a) Conductivity and Temperature Measurements and Phase II(b) Stations Selected at the 100-F Area

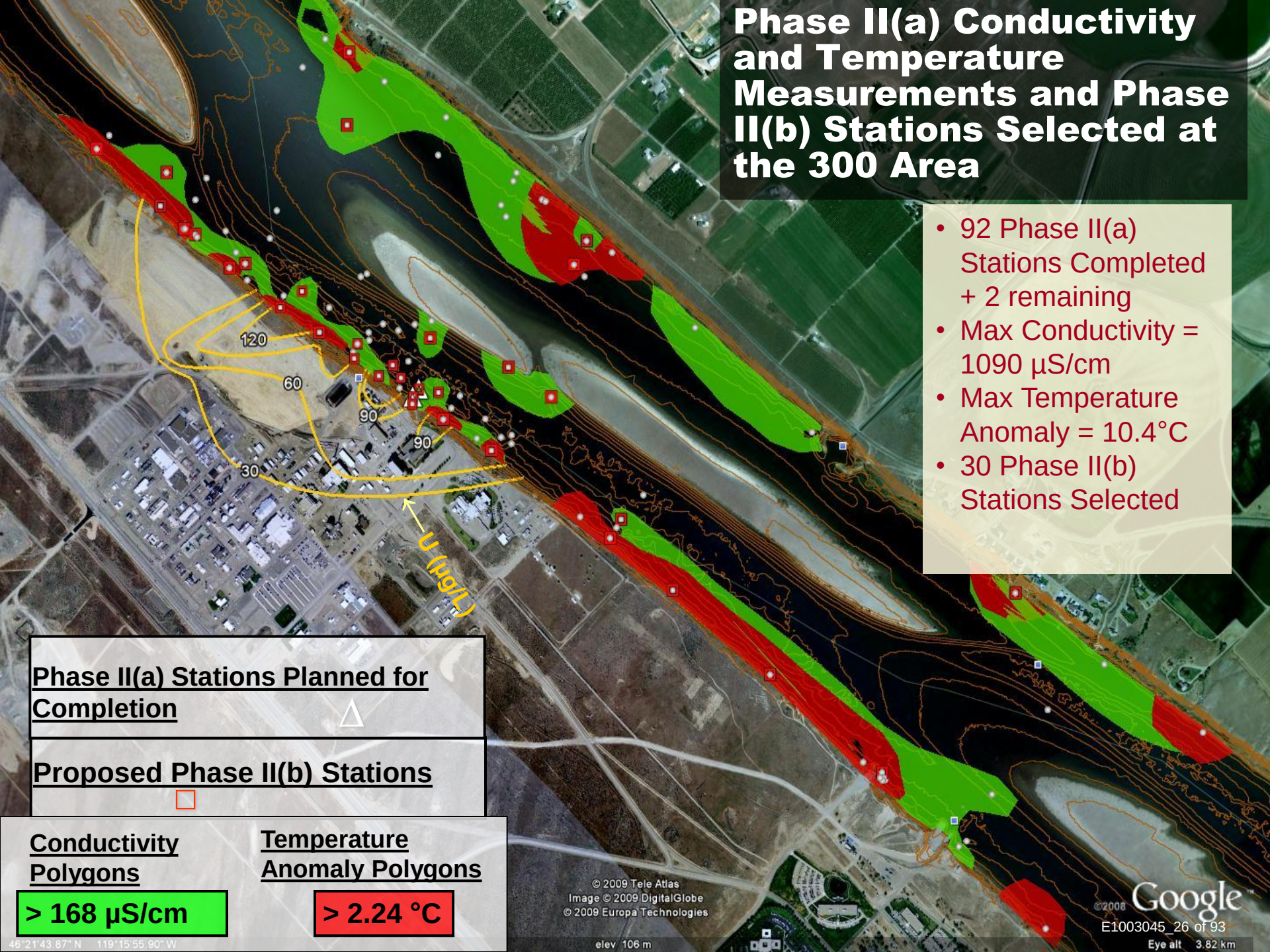


- 52 Phase II(a) Stations Completed, 9 Remaining
- Max Conductivity = 858 µS/cm
- Max Temperature Anomaly = 2.7°C
- 21 Phase II(b) Stations Selected


Proposed Phase II(b) Stations
Conductivity Polygons
> 168 µS/cm
Temperature Anomaly Polygons
> 2.24 °C
Phase II(a) Conductivity and Temperature Measurements and Phase II(b) Stations Selected at the HTS Area
• 78 Phase II(a) Stations Completed
• Max Conductivity = 648 µS/cm
• Max Temperature Anomaly = 4.4°C
• 30 Phase II(b) Stations Selected
H³ (pCi/L)
Savage Island
Homestead Island
20000
2000
Image © 2009 DigitalGlobe
© 2009 Europa Technologies
Image USDA Farm Service Agency
© 2009 Tele Atlas
Google
2.92 mi
46°31'31.81" N 119°19'21.96" W
elev 485 ft
Aug 23, 2006
Eye alt 10.60 mi
E1003045_25 of 93

Phase II(a) Conductivity and Temperature Measurements and Phase II(b) Stations Selected at the 300 Area

- 92 Phase II(a) Stations Completed + 2 remaining
- Max Conductivity = 1090 µS/cm
- Max Temperature Anomaly = 10.4°C
- 30 Phase II(b) Stations Selected



Upwelling Overview (continued)

- Phase II(b) – Sampling for Key Contaminants
  - Locations were selected from Phase II(a) mapping results; pore water collection and analysis for key contaminants (e.g., hexavalent chromium, strontium-90, uranium, tritium)
- Phase III – Characterization
  - Locations were selected from Phase II(b) results (focus on elevated indicator contaminant concentrations)
  - Sediment, pore water, and surface water collection
  - Broad suite of analysis for each media

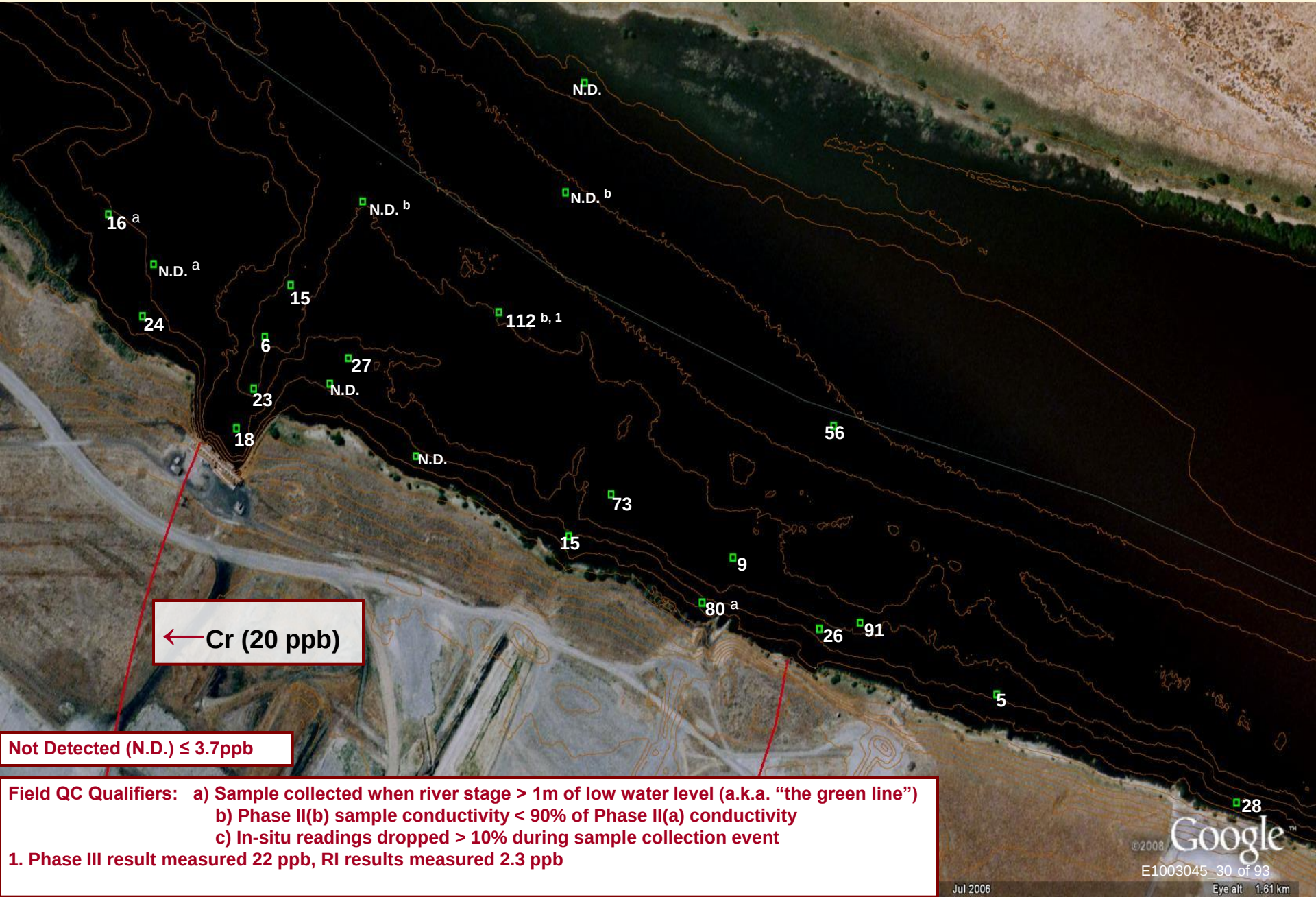
Groundwater Mapping and Sampling Summary: Phase II(b) Results

- **100BC:** 14 of 17 pore water sample exceed EPA Ambient Water Quality Criteria (10 ppb) (results ranged between 15 and 112 ppb)
- **100K:** 9 of 12 pore water sample results exceed ambient water quality criteria (results ranged between 10 and 44 ppb)
- **100N:** 5 of 30 pore-water Sr-90 sample results were reported above the average minimum detectable activity (MDA = 3.25 pCi/L). All five of these exceed the 8 pCi/L drinking water standard and were collected near-shore. Values ranged from 10.7 to 72.3 pCi/L.
- **100D:** 11 of 15 pore water sample results equal or exceed ambient water quality criteria (results ranged between 10 and 331 ppb)

Groundwater Mapping and Sampling Summary: Phase II(b) Results

- **100H:** 15 of 17 pore water sample results exceed ambient water quality criteria (results ranged between 12 and 46 ppb)
- **100F:** Only 1 of 19 pore water sample Cr^{+6} results was detected (8 ppb)
- **Hanford Town Site:** 7 of 29 pore-water tritium sample results ranged from 675 to 64,600 pCi/L.
  - Two of these exceed the 20,000 pCi/L drinking water standard.

Phase II(b) Cr^{+6} Results (ppb): 100BC Area



Not Detected (N.D.) ≤ 3.7ppb

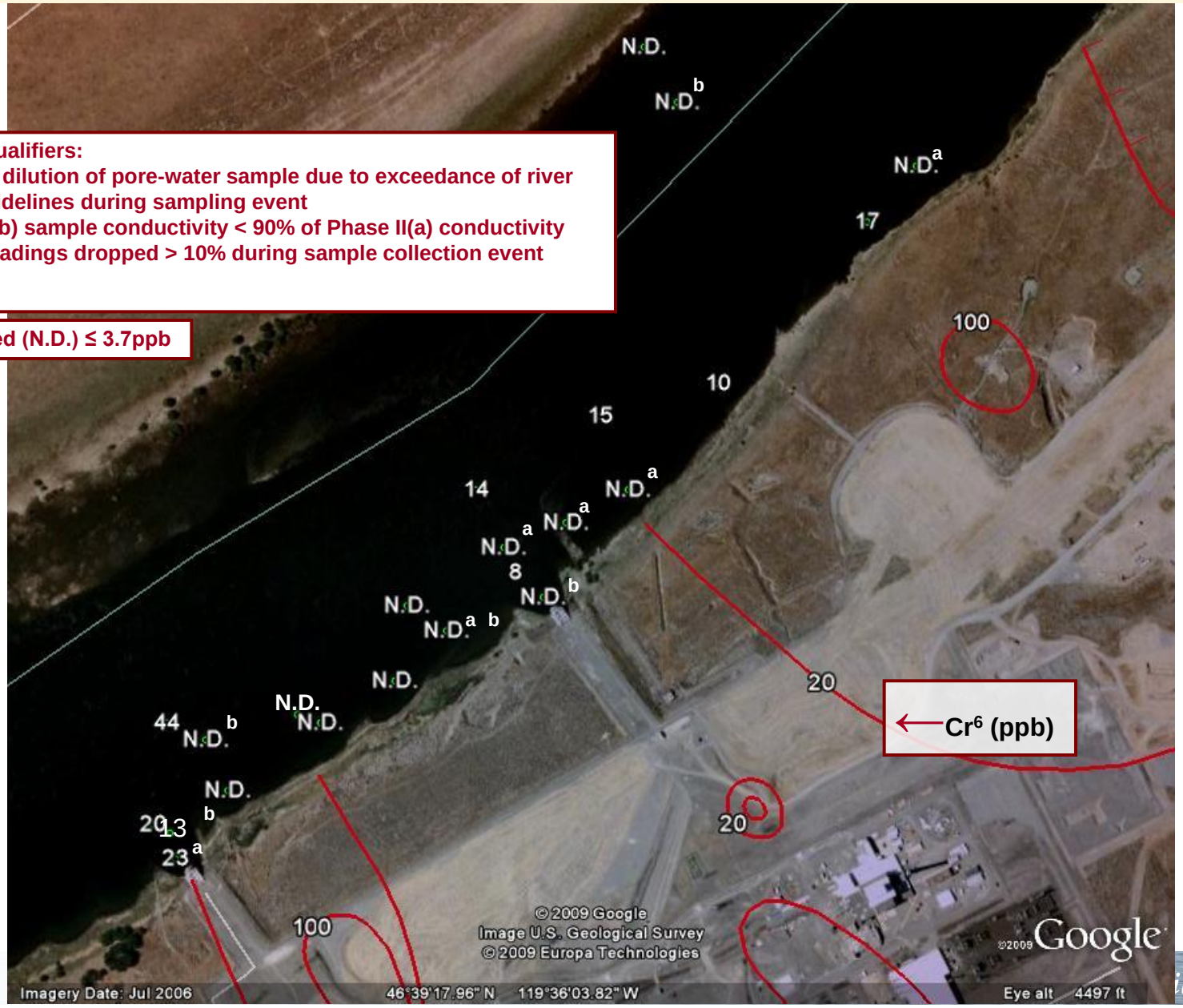
Field QC Qualifiers: a) Sample collected when river stage > 1m of low water level (a.k.a. "the green line")
b) Phase II(b) sample conductivity < 90% of Phase II(a) conductivity
c) In-situ readings dropped > 10% during sample collection event

1. Phase III result measured 22 ppb, RI results measured 2.3 ppb

Phase II(b) Cr+6 Results (ppb): 100K Area

Field QC Qualifiers:
a) Possible dilution of pore-water sample due to exceedance of river stage guidelines during sampling event
b) Phase II(b) sample conductivity < 90% of Phase II(a) conductivity
c) In-situ readings dropped > 10% during sample collection event

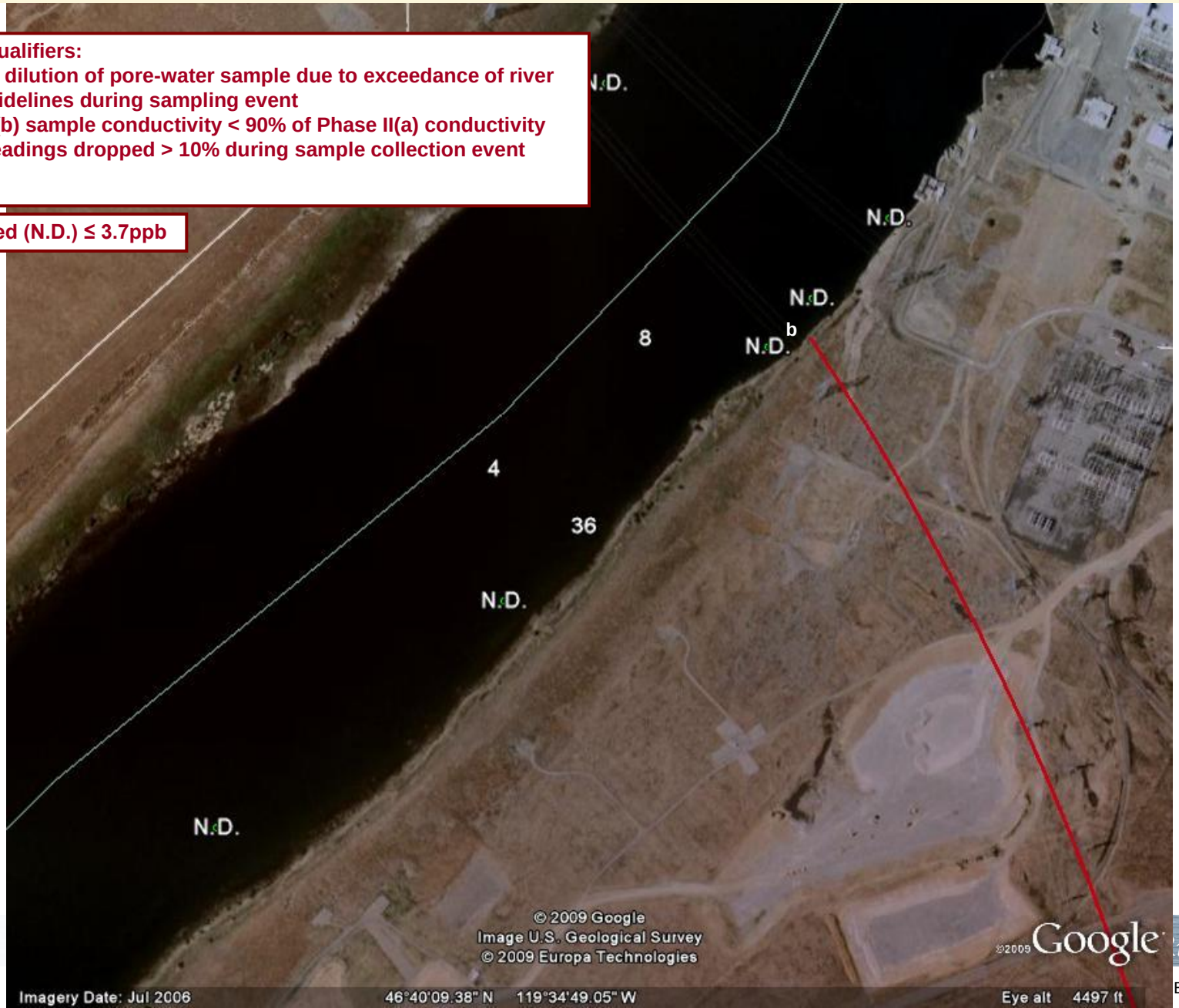
Not Detected (N.D.) ≤ 3.7ppb



Phase II(b) Cr^{+6} Results (ppb): 100K Area

Field QC Qualifiers:
a) Possible dilution of pore-water sample due to exceedance of river stage guidelines during sampling event
b) Phase II(b) sample conductivity < 90% of Phase II(a) conductivity
c) In-situ readings dropped > 10% during sample collection event

Not Detected (N.D.) ≤ 3.7ppb

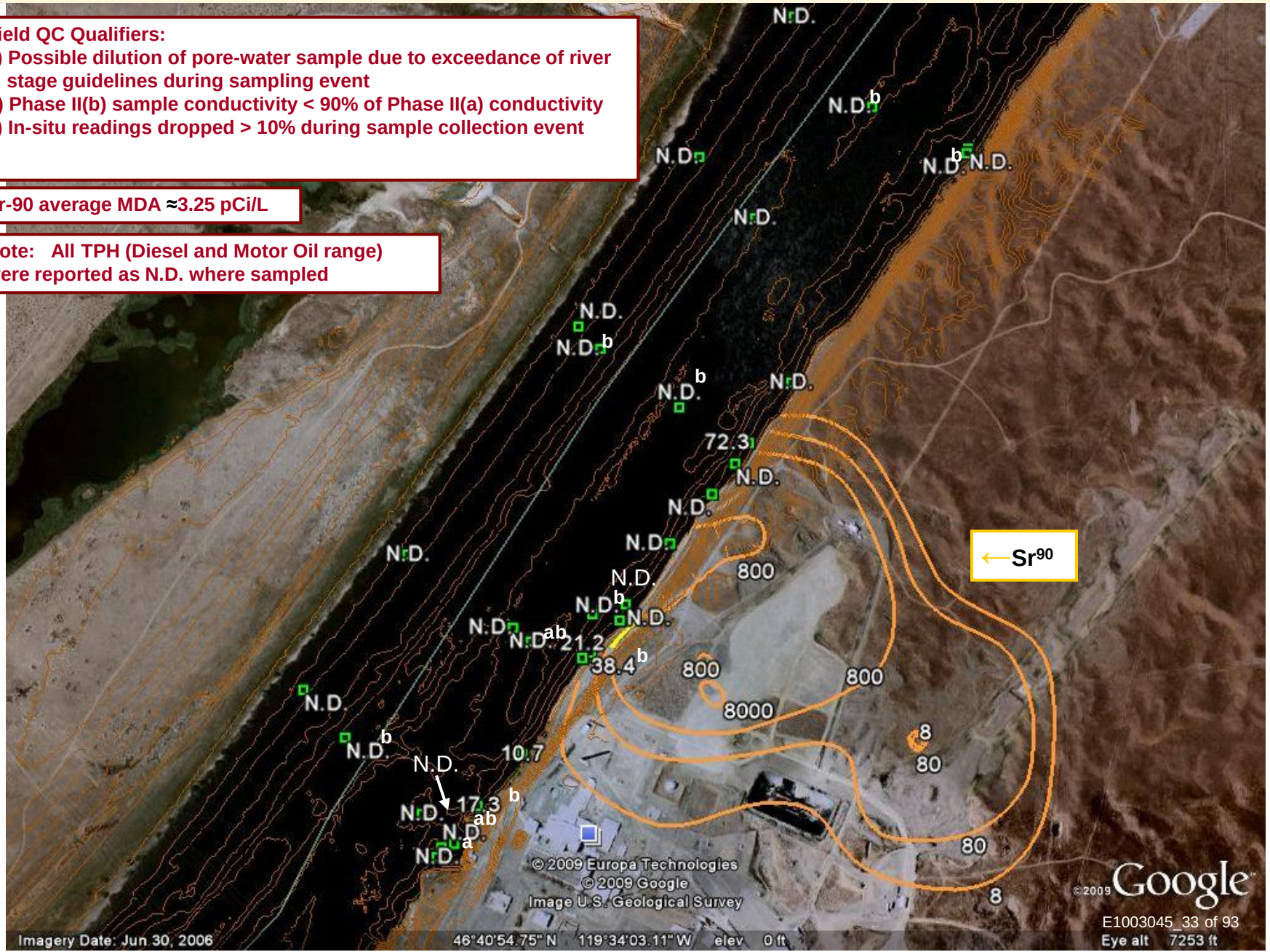


Phase II(b) Sr-90 Results (pCi/L): 100N Area

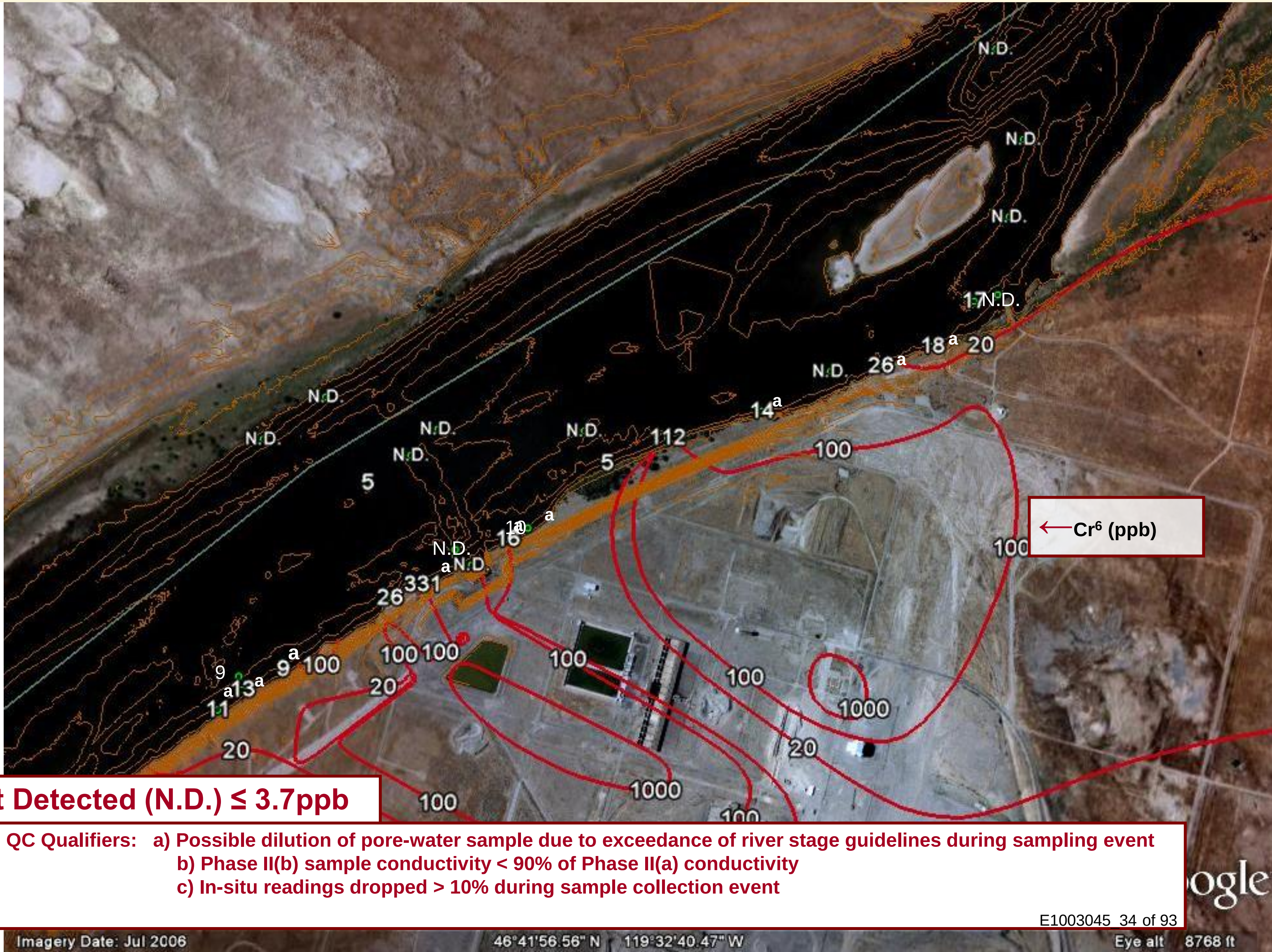
Field QC Qualifiers:
a) Possible dilution of pore-water sample due to exceedance of river stage guidelines during sampling event
b) Phase II(b) sample conductivity < 90% of Phase II(a) conductivity
c) In-situ readings dropped > 10% during sample collection event

Sr-90 average MDA ≈3.25 pCi/L

Note: All TPH (Diesel and Motor Oil range) were reported as N.D. where sampled



Phase II(b) Cr^{+6} Results (ppb): 100D Area



Not Detected (N.D.) ≤ 3.7ppb

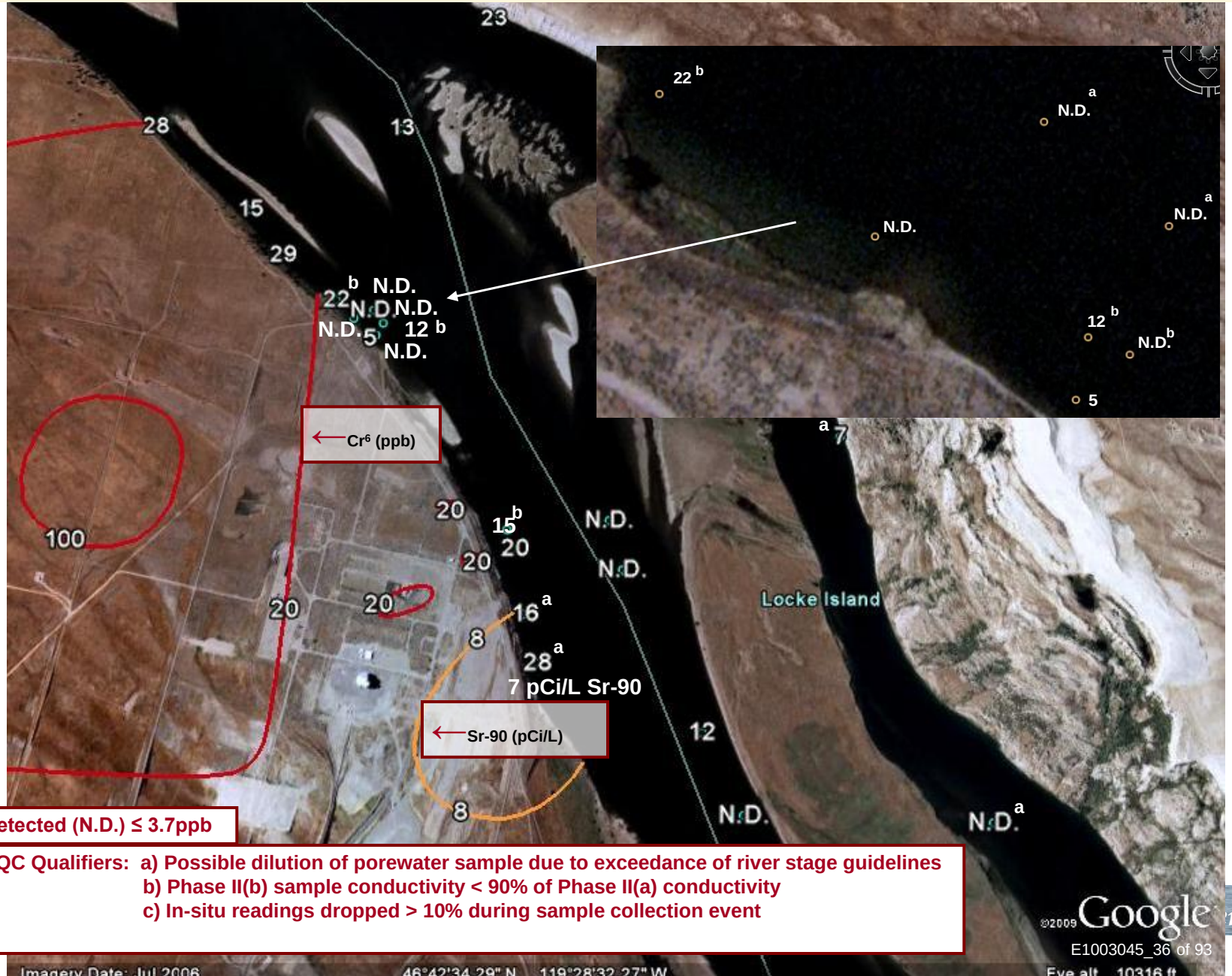
Field QC Qualifiers: a) Possible dilution of pore-water sample due to exceedance of river stage guidelines during sampling event
b) Phase II(b) sample conductivity < 90% of Phase II(a) conductivity
c) In-situ readings dropped > 10% during sample collection event

Phase II(b) Cr^{+6} Results (ppb): 100D Area

Not Detected (N.D.) ≤ 3.7ppb

Field QC Qualifiers:
- **a) Possible dilution of pore-water sample due to exceedance of river stage guidelines during sampling event**
- **b) Phase II(b) sample conductivity < 90% of Phase II(a) conductivity**
- **c) In-situ readings dropped > 10% during sample collection event**

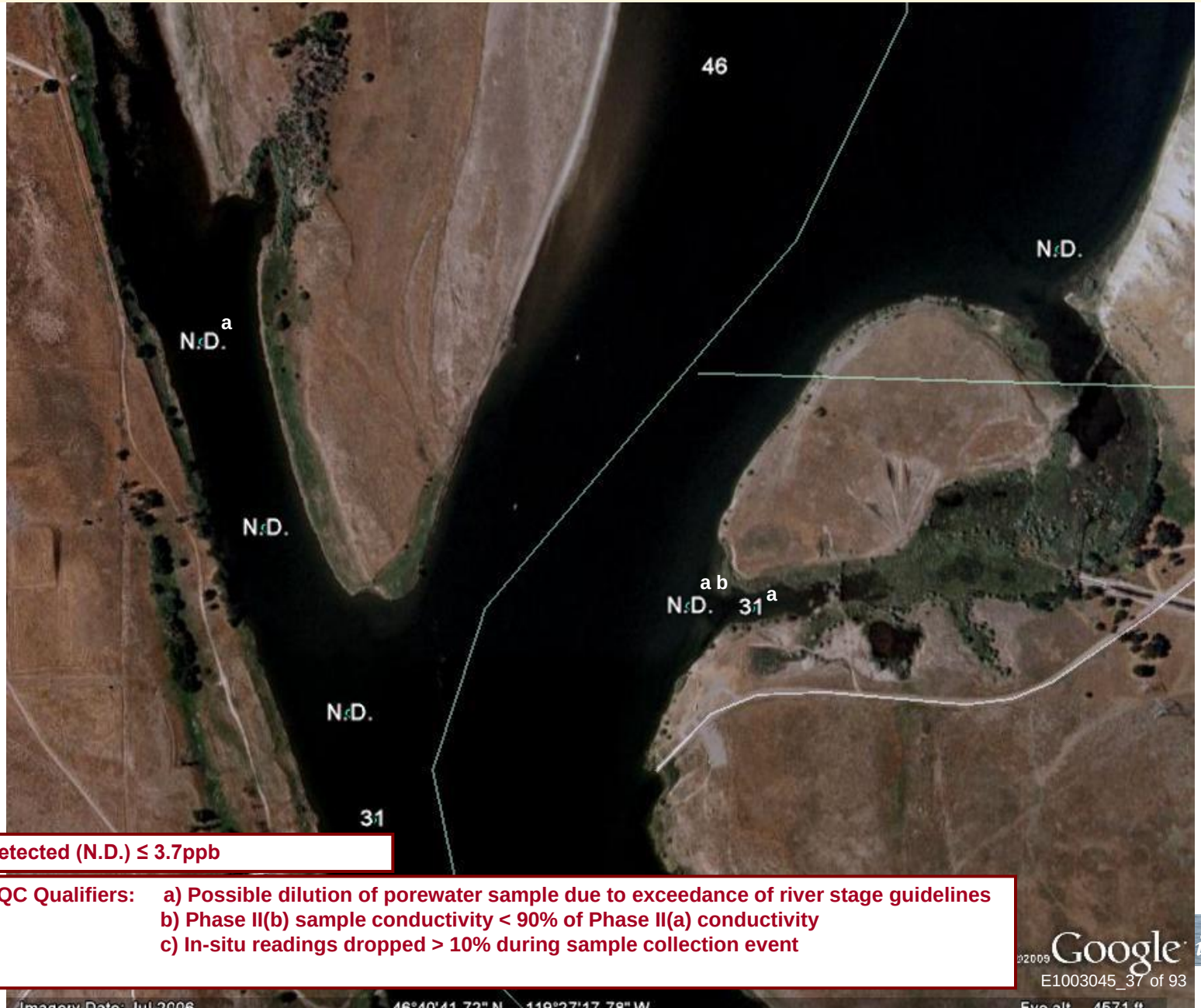
Phase II(b) Cr^{+6} Results (ppb): 100H Area



Not Detected (N.D.) ≤ 3.7ppb

Field QC Qualifiers: a) Possible dilution of porewater sample due to exceedance of river stage guidelines
b) Phase II(b) sample conductivity < 90% of Phase II(a) conductivity
c) In-situ readings dropped > 10% during sample collection event

Phase II(b) Cr^{+6} Results (ppb): 100H Area



Not Detected (N.D.) ≤ 3.7ppb

Field QC Qualifiers:
a) Possible dilution of porewater sample due to exceedance of river stage guidelines
b) Phase II(b) sample conductivity < 90% of Phase II(a) conductivity
c) In-situ readings dropped > 10% during sample collection event

Phase II(b) Cr+6 Results (ppb): 100F Area