Remediation of Petroleum Contamination at Brooks Camp in Katmai National Park and Preserve, Alaska

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Presentation Agenda

- Brooks Camp
  - Location
  - Features/History
  - Logistical Challenges
  - Spill History
  - Accomplishments
  - Lessons Learned

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Brooks Camp Location

- Katmai National Park and Preserve
  - Southcentral Alaska on Alaska Peninsula
- No road system
- Floatplane or boat access
- Naknek Lake to east, Brooks River to south, Brooks Lake to west

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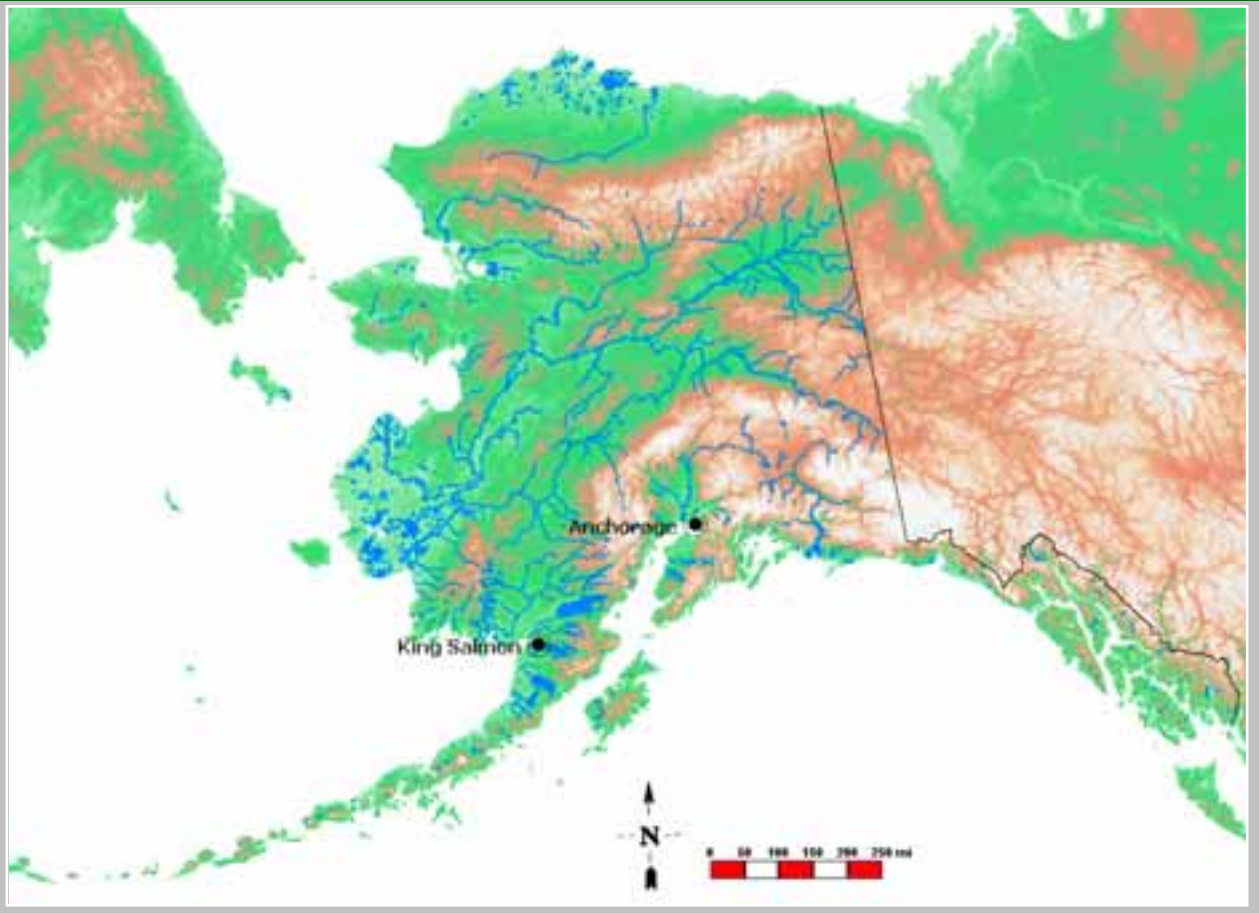
Brooks Camp Location



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Brooks Camp Location

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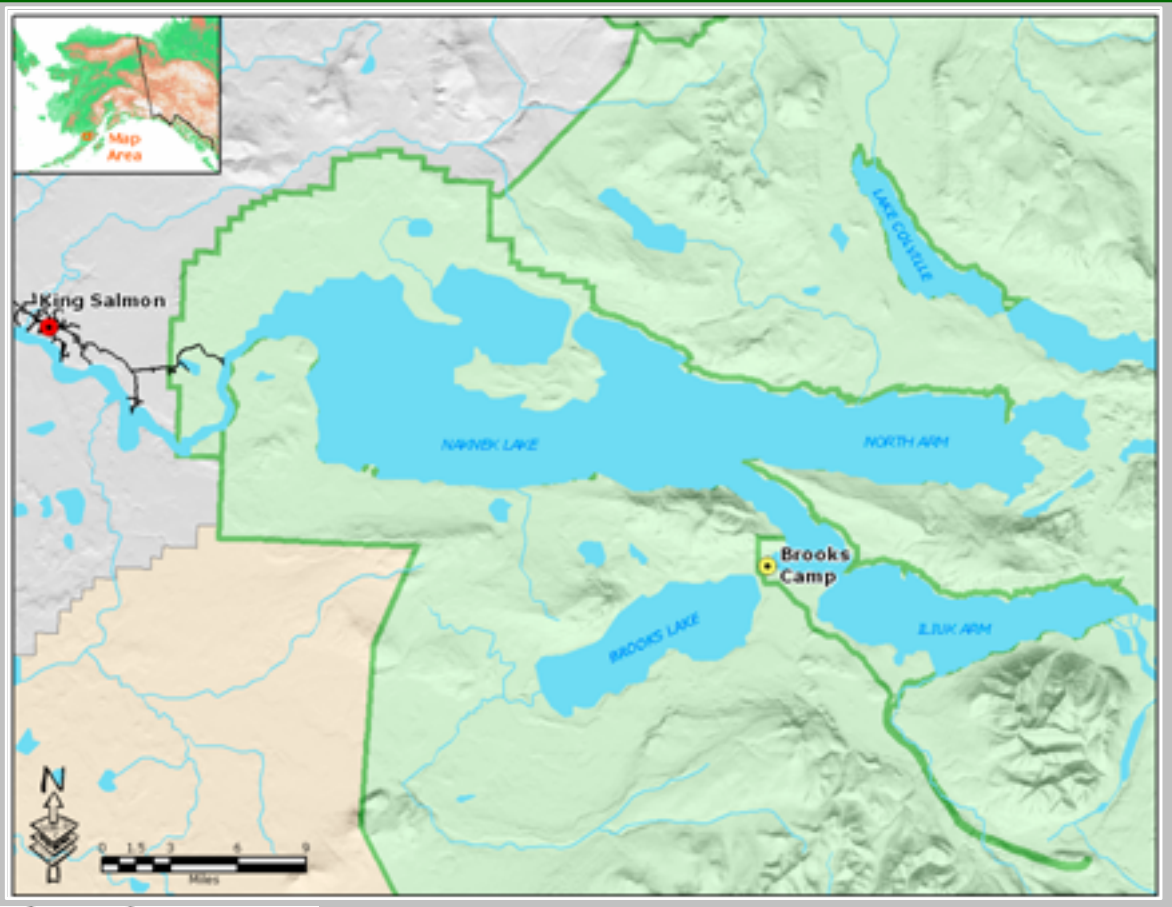
Brooks Camp Location



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Features/History of Brooks Camp

- Human habitation of Native people for more than 4,500 years
- Site of one of world's largest sockeye salmon runs

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Features/History of Brooks Camp

- Popular bear-viewing site
- Brooks Lodge
  - Associated cabins
  - Visitor center
  - Ranger station
  - Generator and incinerator building

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Features/History of Brooks Camp

- Several thousand visitors each season
- Open seasonally (June through September)

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Logistical Challenges

- High mobilization/ demobilization cost
- Fly or barge freight from Anchorage

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Logistical Challenges

- Limited communication
  - No phones; National Park Service radio
  - Required careful logistics planning, backup instruments
- Archeologically sensitive area
  - Archeological clearance before each boring/trench
- Time delays/constraints
  - Archeological clearance
  - No work during peak tourism season
  - Limited season (weather)

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Logistical Challenges

- Time delays/ constraints (cont.)
  - Low water in Naknek Lake limited barge run times
  - Bear delays, bear watch

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Spill History

- 1975 – Fuel distribution system at Brooks Camp constructed
- 1982 – Diesel odor and taste in drinking water well
  - Diesel leak in 2,000-gallon UST piping
  - Annual sand point well installed in Naknek Lake
- 1992 – Diesel contamination in sand point well
  - Upgradient drinking water wells installed
  - UST and portion of contaminated soil removed

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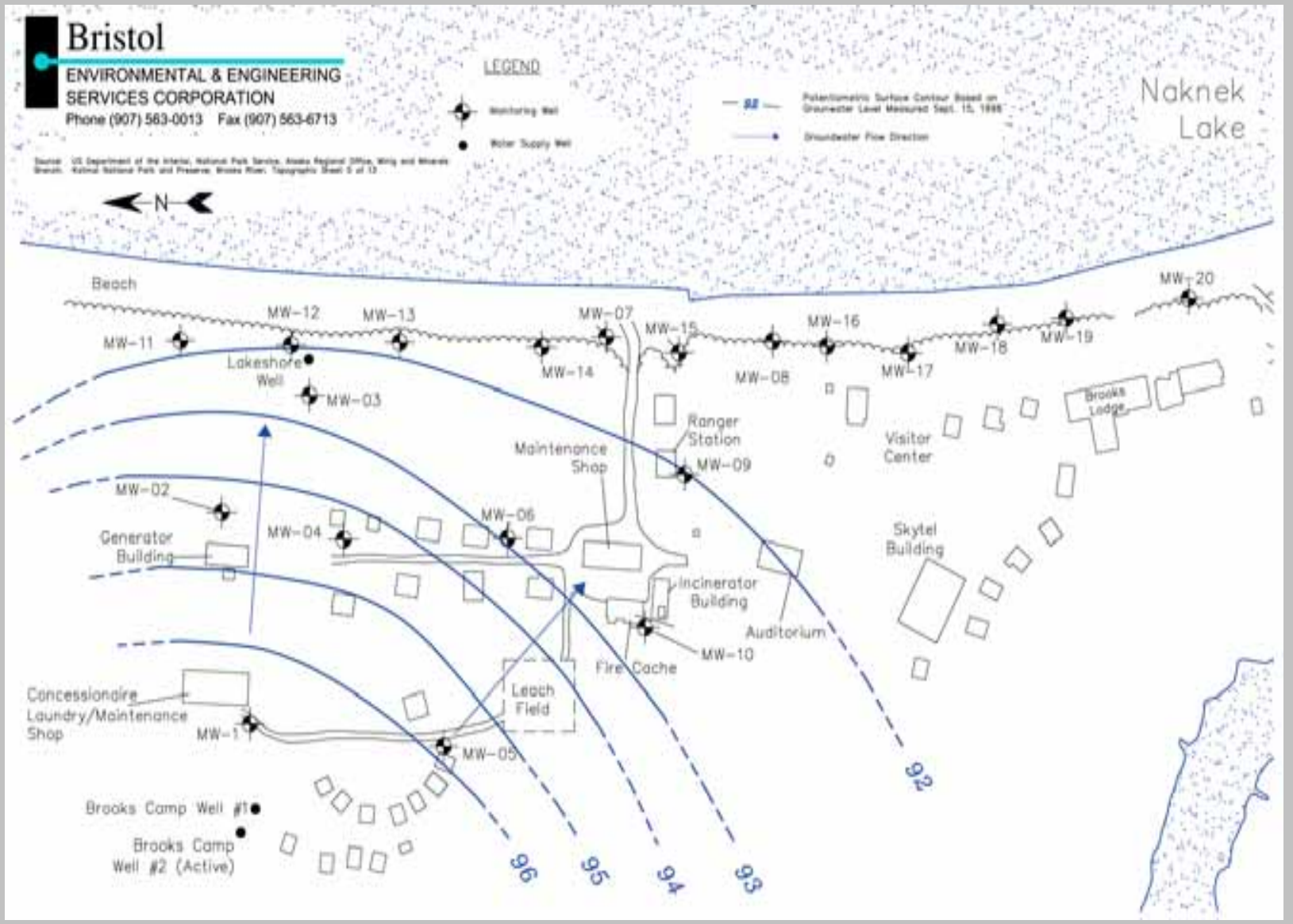
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LEGEND
Monitoring Well
Water Supply Well
92
Potentiometric Surface Contour Based on Groundwater Level Measured Sept. 15, 1998
Groundwater Flow Direction
Naknek Lake
N
Beach
MW-11
MW-12
MW-13
MW-14
MW-07
MW-15
MW-08
MW-16
MW-17
MW-18
MW-19
MW-20
Lakeshore Well
MW-03
MW-02
MW-04
MW-06
MW-09
MW-10
MW-1
MW-05
Maintenance Shop
Ranger Station
Visitor Center
Brooks Lodge
Skytel Building
Auditorium
Incinerator Building
Fire Cache
Leach Field
Generator Building
Concessionaire Laundry/Maintenance Shop
Brooks Camp Well #1
Brooks Camp Well #2 (Active)
92
93
94
95
96

Pre-remediation Contaminant Concentrations

- Diesel-range Organics (DRO) main contaminant
  - Soil cleanup level 250 mg/kg
  - Groundwater cleanup level 1.5 mg/L
- 1997 (pre-remediation) concentrations
  - Soil to 5,000 mg/kg
  - Groundwater to 48 mg/L
    - Downgradient wells
      - MW-2 – 48 mg/L
      - MW-3 – 87 mg/L
      - MW-12 – 10 mg/L
      - MW-13 – 5 mg/L

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Remediation System – Generator Powered

- 1998 – Installed and started air sparge (AS)/soil vapor extraction (SVE) system
  - Approach chosen by NPS based in part on archeological sensitivity

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Remediation System – Generator Powered

- Powered by camp generator
- 2 AS, 1 SVE wells
- Groundwater 10-13 feet below ground surface (bgs)
- Confining layer 15.5 feet bgs
- AS wells to 16 feet bgs, SVE to 15 feet bgs
- 1.5 HP GAST compressor for AS wells

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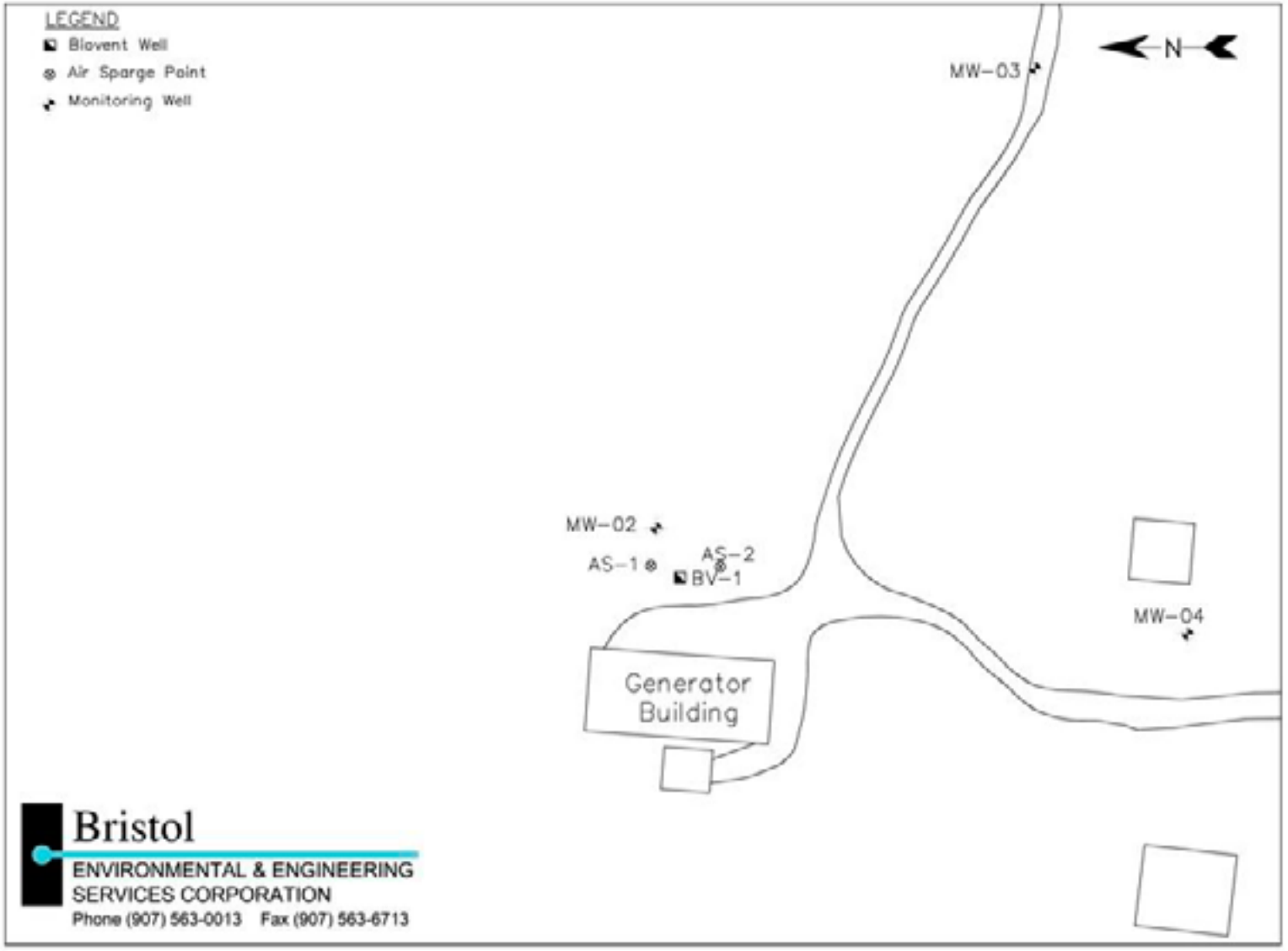

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Remediation System – Generator Powered

- 1.5 HP Rotron blower for SVE well
- 4 hours run time for AS; 4 hours for SVE

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Remediation System – Solar Powered

- Camp and generator were to be moved
- Alternate energy source for system was needed
- Solar power would not require petroleum fuel and would eliminate potential spills
- Solar panels installed in 2000
- Panels located on Incinerator Building

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Remediation System – Solar Powered

- 44 solar panels attached to metal frame
- Reinforced building truss system

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Remediation System – Solar Powered

- Incinerator stack flame deflector

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Remediation System – Solar Powered

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Remediation System – Solar Powered

- Solar Pump Controller
  - Direct current to 230-volt, 3-phase, alternating current for blower motor
- 270 volts required before motor activates
- Panels capable of 500 volts

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Remediation System – Solar Powered

- SVE well removed from system
  - Not necessary
  - Helped with power requirements
- AS pump runs when sun is shining
- No batteries to freeze during winter
- Constant on/off of motor shortened motor life and necessitated annual replacement

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Solar Panel Specifications

- Manufacturer: BP Solar (Solarex)
- Product name: Solarex SX60
- Weight: 16 lbs. per panel
- Size: Approximately 19” X 44”

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Solar Panel Specifications

	BP SX 55	BP SX 60	BP SX 65
Maximum power (P_{max})[2]	55W	60W	65W
Voltage at P_{max} (V_{mp})	16.5V	16.8V	17.2V
Current at P_{max} (I_{mp})	3.33A	3.56A	3.77A
Guaranteed minimum P_{max}	50W	55W	60W
Short-circuit current (I_{sc})	3.69A	3.87A	4.06A
Open-circuit voltage (V_{oc})	20.6V	21.0V	21.5V
Temperature coefficient of I_{sc}		(0.065±0.015)%/°C	
Temperature coefficient of V_{oc}		-(80±10)mV/°C	
Temperature coefficient of power		-(0.5±0.05)%/°C	
NOCT[3]		47±2°C	

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Post-remediation Contaminant Concentrations in Groundwater

Pre-remediation	Post-remediation
–MW-2 – 48 mg/L	MW-2 – 1.13 mg/L
–MW-3 – 87 mg/L	MW-3 – 2.02 mg/L
–MW-12 – 10 mg/L	MW-12 – 2.39 mg/L
–MW-13 – 5 mg/L	MW-13 – 1.62 mg/L

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Accomplishments

- Quickly reduced contamination levels and significantly reduced risks to the environment
- Use of solar panels allowed a remediation system to be run in a remote location, without the use of outside fuels, using a renewable energy source
- Following remediation, solar panels can be used in other locations for same or other purposes
- Determined in 2002 that it was no longer necessary to run the system; began monitoring natural attenuation

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Lessons Learned

Storing electricity generated by the solar panels would have allowed the blower motors to last longer

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