

Emery & Garrett Groundwater Investigations, LLC

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February 16, 2015

Mr. Brian Goetz
Deputy Director
Public Works Department
Portsmouth, New Hampshire

Dear Mr. Goetz,

This letter serves as a brief summary of the results of the Phase II work efforts completed as part of the ongoing Haven Production Well Replacement Project. This Phase of work included conducting geophysical surveys in three Groundwater Development Zones; identified as PRD-2, PRD-SG1, and PRD-SG13 (Figures 1 and 2). Analyses of the geophysical data collected were used in conjunction with available hydrogeologic data and EGGI's field mapping to select 11 locations to test hydraulic characteristics (e.g., yield and water quality) of potential bedrock aquifers and four sites within potential sand & gravel aquifers (Figures 1 and 2; Table I).

Three geophysical methods were employed in this study within Zone PRD-2 (Figure 1); magnetic, electromagnetic, and electrical resistivity. The first two methods were conducted using a Scintrex ENVI magnetometer and VLF (Very Low Frequency) unit. Reconnaissance surveys were conducted using these two methods to locate potential geologic contacts and water-bearing structural discontinuities within the bedrock along 4.2 miles of surveys. Electrical resistivity (ABEM) surveys were conducted within all three Groundwater Development Zones investigated to provide insights into overburden thickness and to provide information regarding potential water-bearing zones within the bedrock (Figures 1 and 2).

Electrical resistivity measurements of the subsurface materials were obtained along approximately eight miles of surveys using ABEM SAS1000 automated resistivity equipment. Measured variations in electrical potentials (created by injecting DC current into the subsurface through stainless steel electrodes) were converted into pseudo-electrical resistivity measurements of the subsurface materials. Up to 101 stainless steel electrodes were spaced at 10-meter intervals along survey lines up to 1,000 meters (3,280 feet) long. The Dipole-Dipole, and Gradient methods of collecting electrical resistivity data were used to conduct the surveys, resulting in the collection of up to 1,728 electrical resistivity measurements for each completed survey line.

These electrical resistivity data were analyzed using computer modeling software. The results of the modeling are displayed in color contoured cross-sectional diagrams of the subsurface areas investigated (see Figure 3 for example). The higher resistivity values displayed in the models (generally shown as green to purple-brown color contour intervals) represent either unsaturated sand and gravel (when observed near the ground surface) or competent bedrock (when displayed in the middle to lower portions of the models). The blue colored contour

intervals have electrical resistivity values typical of saturated unconsolidated sediment deposits at shallow depths and geologic contacts or structural discontinuities (e.g., fractured bedrock and potential water-bearing zones) within the lower portion of the model.

The analysis of geophysical and geologic data collected during this study, and insights gained from analyses of the hydrologic characteristics of existing wells, led to the selection of 15 proposed sites for exploratory test well drilling (Figures 1 and 2). Additional work efforts, including the drilling and testing of the exploratory wells, will be required to determine the sustainable yield and long-term water quality characteristics of the proposed exploratory test well sites, and to determine if there are sufficient resources within the Groundwater Development Zones investigated to offset the loss of the Haven Production Well.

Therefore, we recommend proceeding with the next Phase of work for this project: exploratory test well drilling. The initial order of drilling will be dependent on a number of factors, including: hydrogeologic favorability, permission to drill, and whether access can be provided to the sites.

I hope that this summary letter meets your needs at this time. Please let me know if you have any questions regarding the information provided. Jamie and I look forward to meeting with you to discuss the specifics of the next Phase of work.

Sincerely,

A handwritten signature in black ink that reads "John Brooks". The signature is written in a cursive, flowing style.

John Brooks, Ph.D., P.G.
Vice President/Project Manager

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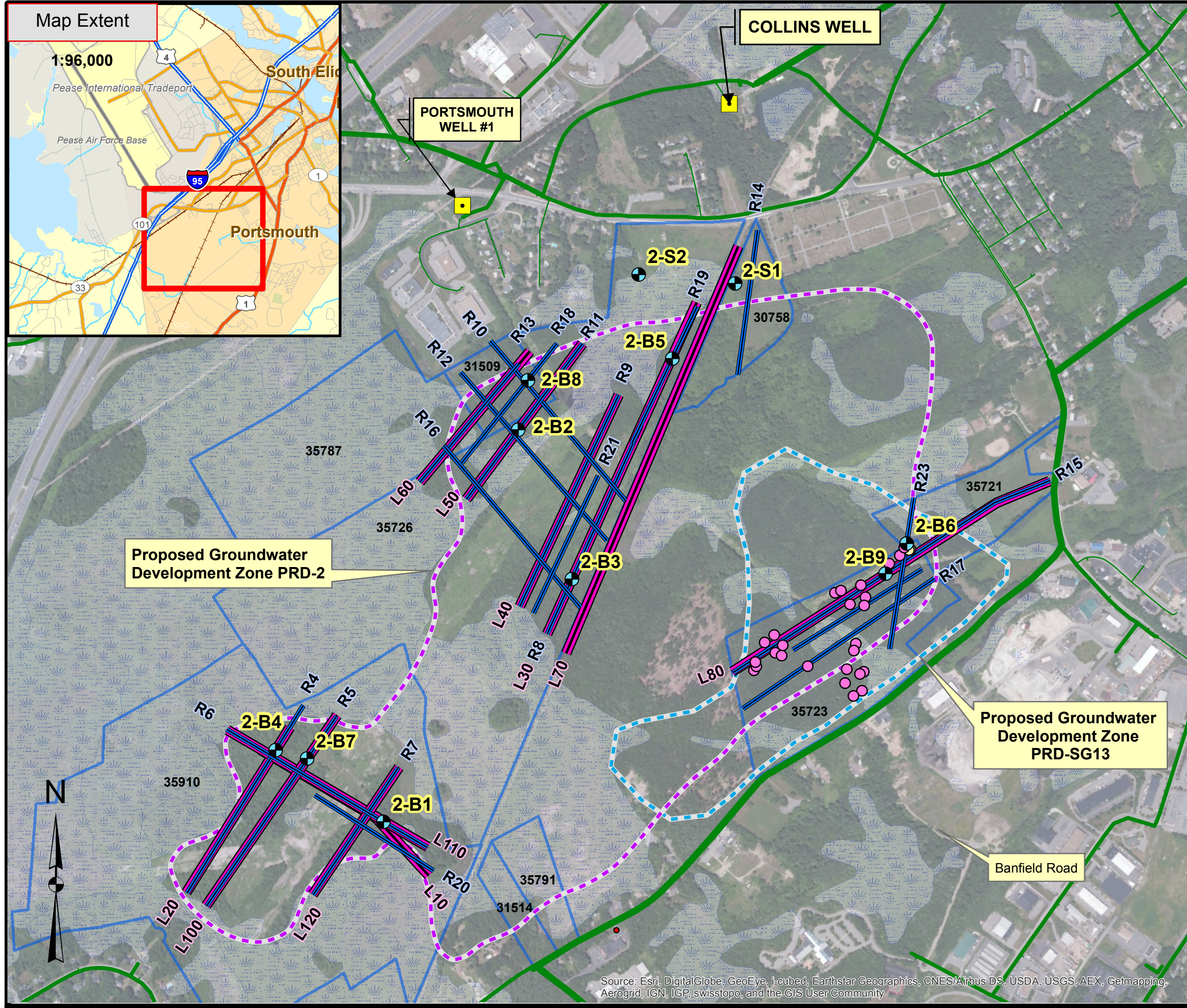


FIGURE 1
 Geophysical Surveys and Proposed
 Exploratory Test Well Targets
 Groundwater Development
 Zone PRD-2 (Bedrock Aquifer) and
 PRD-SG13 (Sand & Gravel Aquifer)
 City of Portsmouth, New Hampshire
 Groundwater Exploration Program

Legend

- 2-B1 Proposed Exploratory Test Well Site
- R6 Location and Name of Electrical Resistivity Survey Line
- L20 Location and Name of Magnetic/VLF Survey Line

Wells Operated by City of Portsmouth

- Portsmouth Groundwater Supply Wells

Portsmouth Water Pipelines
DIAMETER (inches)

- 6 and 8
- 10 to 14
- 16 to 24

Bedrock Aquifer Zone
Potential Groundwater Quality

- Less Favorable

Sand & Gravel Aquifer Zone
Potential Groundwater Quality

- Less Favorable

Property Boundary

- Access Granted for Surveys

NWI Wetlands

- Palustrine Wetlands

Scale is 1:9,600
 1 inch = 800 feet

0 170 340 680 Meters
 0 400 800 1,600 Feet

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

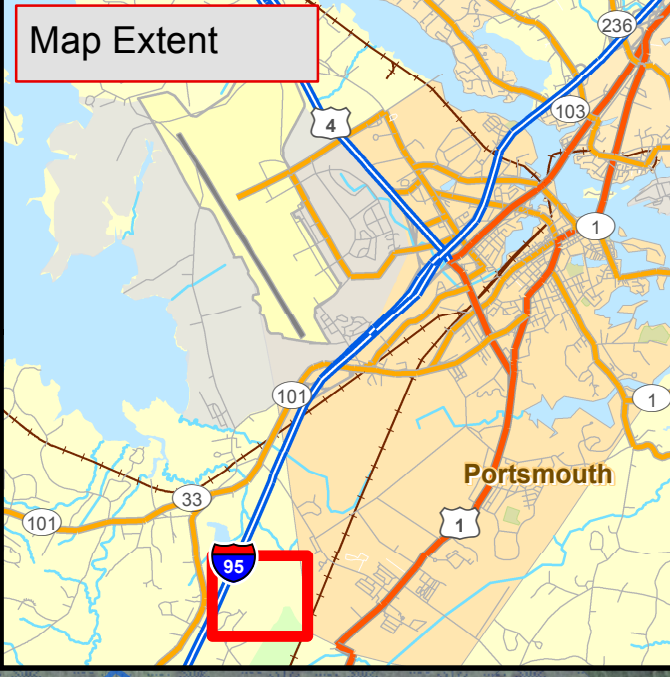


FIGURE 2
 Geophysical Surveys and Proposed
 Exploratory Test Well Targets
 Groundwater Development
 Zone PRD-SG1
 (Sand & Gravel Aquifer)
 City of Portsmouth, New Hampshire
 Groundwater Exploration Program

Legend

- SG1-S1 Proposed Exploratory Test Well Site
- R1 Location and Name of Electrical Resistivity Survey Line

Legend

Sand & Gravel Aquifer Zone
Potential Groundwater Quality

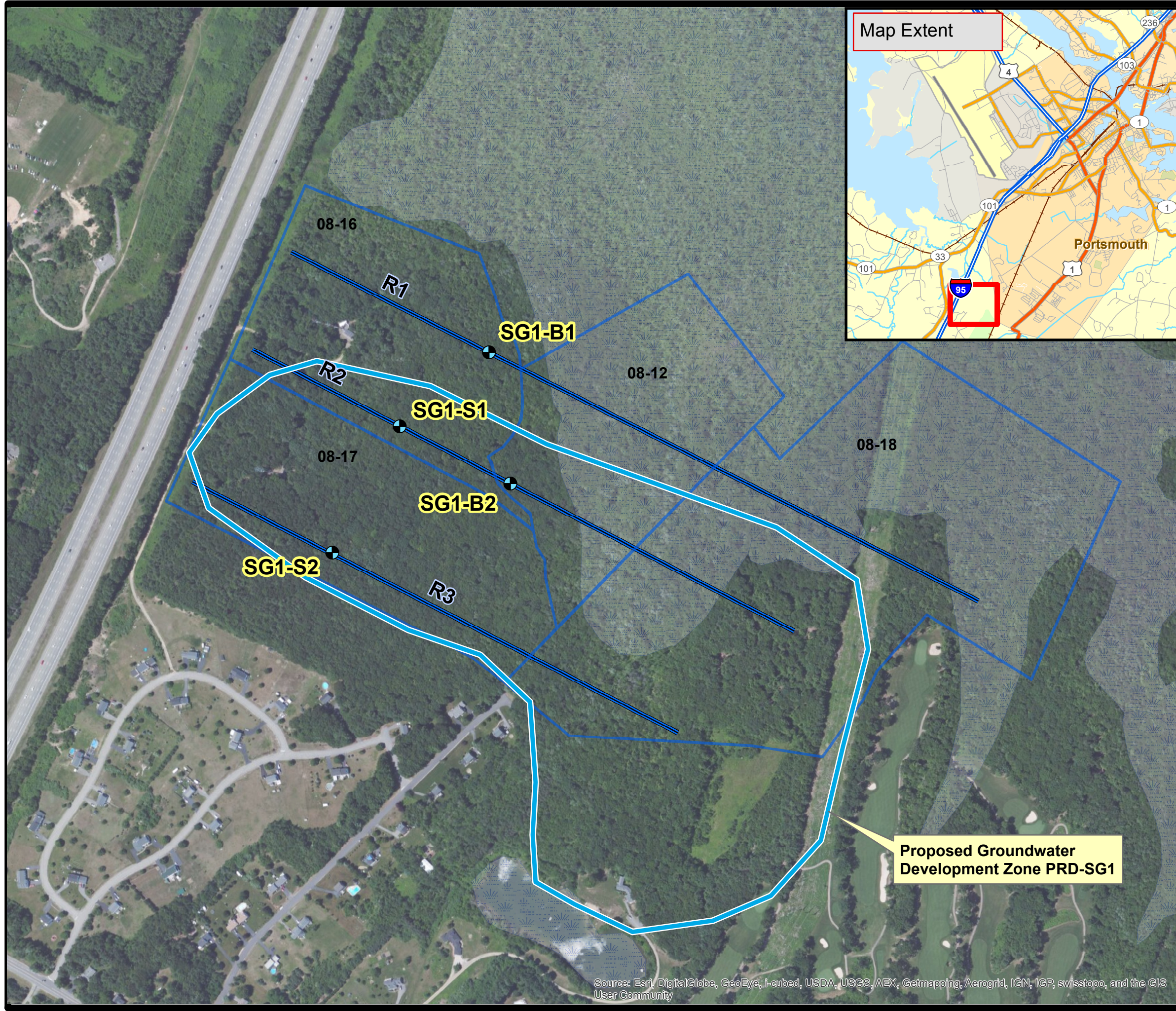
- More Favorable

NWI Wetland

- Palustrine Wetlands

N

Scale is 1:4,800
 1 inch = 400 feet



**Proposed Groundwater
 Development Zone PRD-SG1**

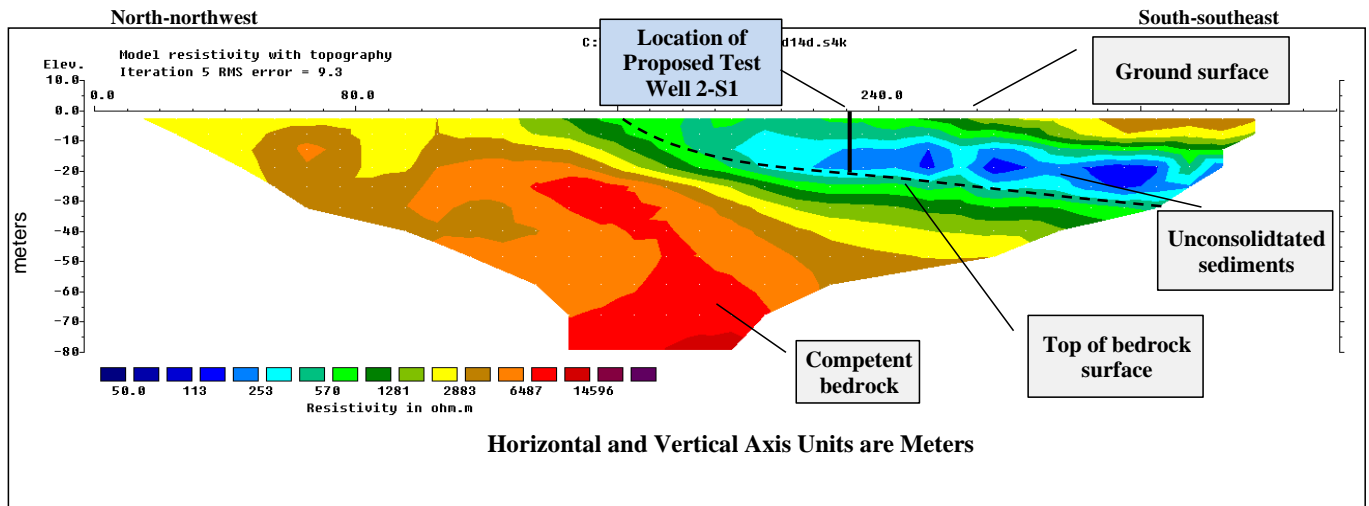
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure 3

Examples of Electrical Resistivity Models

Electrical Resistivity Survey Line R14 - Dipole Dipole Method



Electrical Resistivity Survey Line R6 - Gradient Method

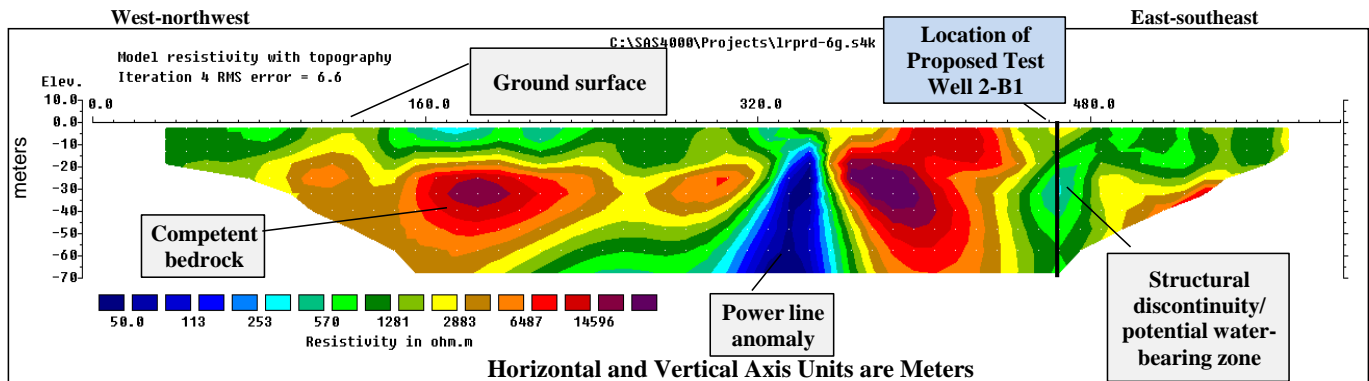


Table I
Proposed Exploratory Test Wells
City of Portsmouth Groundwater Development Project

Zone Name	Formation*	Property PIN	Property Lot #	Property Owner	Municipality
Potential Bedrock Aquifer Zone PRD-2					
2-B1	Kittery Fm	35910	0263-0002-0000	City of Portsmouth	Portsmouth
2-B2	Kittery Fm/Granite	35726	0282-0005-0000	State Fish and Game	Portsmouth
2-B3	Kittery Fm	35726	0258-0054-0000	State Fish and Game	Portsmouth
2-B4	Kittery Fm	35910	0282-0005-0000	City of Portsmouth	Portsmouth
2-B5	Kittery Fm	35726	0258-0054-0000	State Fish and Game	Portsmouth
2-B6	Rye Fm/Granite	35721	0256-0002-0000	Hett Maud Revocable Trust	Portsmouth
2-B7	Kittery Fm	35910	0282-0005-0000	City of Portsmouth	Portsmouth
2-B8	Kittery Fm	31509	0263-0002-0000	State Fish and Game	Portsmouth
2-B9	Rye Fm/Granite	35723	0256-0002-0000	Hett Maud Revocable Trust	Portsmouth
2-S1	Qmwd/Qp	30758	0258-0054-0000	State Fish and Game	Portsmouth
2-S2	Qmwd/Qp	35726	0258-0054-0000	State Fish and Game	Portsmouth
Potential Sand and Gravel Aquifer Zones PRD-SG1					
SG1-S1	Qmwd/Qp		8-16	Homeland Farm Trust c/o Paul Sanderson	Greenland
SG1-S2	Qmwd/Qp		8-17	Philbrick-Vickery Tower c/o Evelyn Whitten	Greenland
SG1-B1	Granite		8-16	Homeland Farm Trust c/o Paul Sanderson	Greenland
SG1-B2	Granite		8-12	Town of Greenland	Greenland

* Qmwd- Marine Delta; Qp- Presumpscot Formation;