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NSY PORTSMOUTH
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LETTER REGARDING THE TRANSMITTAL OF DRAFT GROUNDWATER MONITORING PLAN FOR RADIONUCLIDES NSY PORTSMOUTH ME
6/8/1998
PORTSMOUTH NAVAL SHIPYARD

NAVSHIPYD-TSMH-5216/9 (REV 8-84)

DEPARTMENT OF THE NAVY
PORTSMOUTH NAVAL SHIPYARD
PORTSMOUTH, N. H. 03804-5000

IN REPLY REFER TO
4341c
Ser 105.5/272

8 Jun 1998

FILE
Checked by
NB 5/28/98
105.51
JAB 6/5/98
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JAB for
105

Meghan F. Cassidy
U.S. Environmental Protection Agency
Region I
John F. Kennedy Federal Building (RAA)
Boston, MA 02203-0001

Iver McLeod
Maine Department of Environmental Protection
State House Station No. 17
Augusta, ME 04333-0017

Dear Ms. Cassidy/Mr. McLeod:

During the initial review of the Groundwater Monitoring Plan for Portsmouth Naval Shipyard, the Environmental Protection Agency (EPA) Region I inquired as to whether samples or sample analyses for radionuclides should be performed during a round of groundwater monitoring. The Navy responded that although there are no indications of residual radioactivity in soils at Portsmouth Naval Shipyard that would affect groundwater, one round of sampling would be conducted in the future as a matter of comity. This project was necessarily held in abeyance so work on the Historical Radiological Assessment (HRA) could be completed. Now that the HRA is in the final review stage, the Shipyard is moving forward with this sampling project.

Attached is a draft groundwater monitoring plan for radionuclides for review and comment. The draft plan also includes sampling of the two freshwater ponds on Portsmouth Naval Shipyard, in response to an EPA comment made during the review of the HRA. The Navy requests that the EPA and State of Maine review the enclosed draft groundwater sampling protocol, and provide any comments within 30 days of receipt of this letter.

Following agreement between the Navy, the EPA, and State on the sampling protocol, Portsmouth Naval Shipyard will hire contractors as necessary to collect groundwater samples. Freshwater pond samples will be collected by Portsmouth Naval Shipyard personnel. The Shipyard will analyze all samples; split samples will be taken when requested by EPA or the State, to support their own analyses.

Sincerely,

Jeffrey Brann
Director, Radiation Health

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STOCK #0102-LLFRM-0425

Enclosure: Groundwater Sampling for Radionuclides (Draft)

Copy to:
NAVFACENGCOM (Code 1823/FE)
Restoration Advisory Board Members

Blind Copy to:
NAVSEA 07R
NAVSEA 08R
NRRO PTSMH (J. Solich)
105/105.1
105.51
106.3 (M. Raymond)
862
2350

Writer: R. Tucci, Code 105.51, Ext. 2687
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GROUNDWATER SAMPLING FOR RADIONUCLIDES

Appendices: A) Monitoring Well Information
B) Background Monitoring Well Locations
C) Map of Portsmouth Naval Shipyard Low Flow Pilot Study Wells

1. Purpose: Although there are no indications of residual radioactivity in the soils at Portsmouth Naval Shipyard (PNS) that would affect groundwater, one round of sampling will be conducted for informational purposes. Limited surface water sampling in Upper and Lower Meade ponds will also be conducted. This protocol defines the methods:

a. To obtain and analyze water samples from test wells which have been drilled at PNS.

b. To establish how the water samples will be collected.

c. To establish a means of apportioning sample material between PNS and the EPA or State of Maine so that independent analyses may be performed by each agency.

d. To establish a mechanism for marking and handling of the samples.

e. To describe how PNS intends to analyze their portion of the split samples for gamma-emitting radionuclides, and for gross alpha and gross beta activity.

f. To describe quality assurance methods which PNS has established for the analysis of water samples.

g. To describe the contents of the report containing the PNS results of the water sample analyses.

2. Equipment and Procedures:

a. Sample Containers: New one and two-liter poly bottles will be provided by PNS for sample collection.

b. Gamma Analyzing Equipment: PNS will use the following equipment when analyzing the water samples for gamma-emitting radionuclides:

(1) Detector: CANBERRA HPGe Coaxial, 48 x 48 mm.

(2) Counting Vault: 4" of lead, Cd/Cu lining.

(3) Multichannel Analyzer: CANBERRA Series 35+ MCA.

Encl (1)

(4) High Voltage: CANBERRA Model 3105.

(5) Amplifier: CANBERRA Model 2020.

(6) Controller: IBM PC with CANBERRA MCA interface card.

(7) Analyzing Software: CANBERRA SPECTRAN-AT Version 4.3.

c. Gamma Analyzing Methods: Environmental samples are analyzed at PNS under a Naval Sea Systems Command (NAVSEA) approved procedure as discussed in the Historical Radiological Assessment, Portsmouth Naval Shipyard. Liquid environmental samples shall be counted to a minimum detectable concentration (MDC) for cobalt-60 of <10 pCi/l with a peak identification confidence level of 95% and a statistical confidence interval of 95%. Data reduction is performed by industry standard gamma analysis software (CANBERRA SPECTRAN-AT) with quantitative analysis of cobalt-60 and radium-226 (even when not identified by the peak search algorithm), and quantitative analysis of natural and non-natural radionuclides (other than cobalt-60 and radium-226) when identified at the 95% confidence level by the peak search algorithm.

(1) Volume reduction techniques will be employed to achieve an MDC for cobalt-60 of <10 pCi/l. This involves reducing each two liter sample to a 500 milliliter sample.

(2) 15 ml of 1N HNO_3 will be added per liter of sample material to preserve the sample.

d. Gross Alpha/Beta Analyzing Equipment: PNS will use a CANBERRA Model 2400 automatic alpha/beta counter to analyze the water samples for gross alpha and beta emitters. The detector for this system is a sealed-cell proportional counter with a guard detector to reduce the background count rate. Samples counted for gross alpha and beta emitters will be prepared in accordance with EPA-600 4-80-032, "Prescribed Procedures for Measurement of Radioactivity in Drinking Water". One-liter samples for alpha/beta analysis will be drawn and treated with 15 ml of 1N HNO_3 per liter of sample material. Water samples will be counted to an MDC of 5 pCi/l for gross alpha and gross beta activity.

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3. Sample Collection:

a. A contractor certified for low flow sampling will draw the groundwater samples.

b. The EPA or State will identify the well spouts or pond location(s) for which the water samples will be split, so that independent analyses can be performed by PNS and by EPA or the State.

c. The contractor will draw one one-liter and two two-liter samples from well spouts identified for independent analyses by the EPA or State, (one two-liter sample for EPA/State, the remainder for PNS), and one one-liter sample and one two-liter sample for each remaining well spout. PNS will analyze samples from every well spout. The two-liter EPA/State sample size may be changed at their request.

d. PNS will obtain surface water samples of the same sizes near the edges of the two on-site ponds (near the extreme east and west edges of each pond). The same protocol as for well samples will be used for the water samples after collection.

e. In addition to water samples, PNS will collect biota (plant) and sediment samples at each pond water sampling location (four locations total). PNS will collect two 500 ml samples in Marinelli beakers for each biota and sediment sampling point identified for independent analyses by the EPA or State, (one 500 ml biota sample and one 500 ml sediment sample for EPA/State, the remainder for PNS), and one 500 ml biota sample and one 500 ml sediment sample for each remaining fresh water pond site. The biota and sediment samples will be collected and analyzed using the procedure discussed in Section 6 of the Historical Radiological Assessment, Portsmouth Naval Shipyard. The 500 ml Marinelli beaker EPA/State sample size may be changed at their request.

4. Marking/Handling of Samples:

a. PNS personnel from the Radiation Health Division will be present to oversee all sampling and to ensure that all sample labeling is correct.

b. EPA/State personnel will be invited to send a representative to observe sampling at PNS.

c. Sample chain-of-custody is proposed to be in accordance with the contractor's procedures. Upon receipt of the samples, PNS will apply and complete sticker labels for sample identification, and follow Shipyard chain-of-custody procedures thereafter.

d. PNS will also provide a logbook with a listing of all sample locations, using it to log the identification information and ensuring that all of the necessary samples have been obtained.

e. If not done by the contractor, PNS will tape over the top of the sample containers immediately after sample collection to prevent loss of sample material.

f. After sample collection, PNS will enter their samples into the Radiation Health Division's sample inventory control system, and proceed to analyze the samples by the methods outlined in paragraphs 2 and 3 above.

5. Data Analysis and Comparison to Background Levels: Data obtained from groundwater monitoring must be compared to data obtained from well spouts with the least potential to contain radioactivity resulting from industrial operations, because at least one isotope of interest, radium-226, is a naturally-occurring isotope which has also been used previously in Shipyard work:

a. Appendix A is a list of all of the groundwater monitoring wells. Appendix B is the list of appropriate "background" wells chosen from the Appendix A list based on a very low potential to be impacted by Shipyard radiological operations. Appendix C is a site map depicting the locations of all of the groundwater monitoring wells.

b. An adequate number of background wells needed to be chosen to provide sufficient statistical power for the Wilcoxon Rank Sum (WRS) test, discussed in paragraphs 5.b and 5.d.(3), below. Several factors were considered in choosing these wells. Not all of the chosen wells exhibited each of the following attributes, but these wells were deemed to be the most appropriate. Selection criteria were:

(1) The well is located on an original island, not on fill areas.

(2) The screened portion of the monitoring well is in bedrock.

(3) The water level in the well typically is not tidally influenced.

(4) The background wells are located as far as reasonable from wells showing exceedences of hazardous chemical constituents on previous sampling rounds.

(5) Previous sampling rounds show only exceedences for elements which would be expected to be found in tidal areas (e.g., calcium).

b. For purposes of radiological characterization only, groundwater monitoring wells at PNS have been grouped into three "sites": (1) the Jamaica Island Landfill (JILF); (2) background wells; and (3) all other wells. This grouping for radiological characterization purposes is necessary because previous administrative site groupings (for purposes of evaluating chemical contaminant migration patterns) do not have sufficient numbers of wells at each site to support the desired power for the WRS statistical test for radium-226. The Appendix A list of monitoring wells reflects the site grouping as arranged for radiological characterization purposes.

c. Cobalt-60 does not exist in nature, so no comparison to background is necessary when characterizing the environmental impact of the Naval Nuclear Propulsion Program.

d. For isotopes associated with Shipyard industrial operations which may also be present in natural background samples (i.e., radium-226), additional measures will be employed to determine if the isotope is present in elevated levels or is simply present at levels consistent with natural background radioactivity:

(1) If samples from a designated site have detectable radioactivity, simple statistical tests (to include the results from background wells) will be performed to interpret the data. These simple statistical tests include calculation of the mean, standard deviation, and median of the data set by site and as a whole. From these simple statistical tests, it may be possible to easily characterize the sites.

(2) If samples from a designated site have detectable levels, the results will also be compared to samples from well spouts drilled into similar rock formations as the suspect sample well spouts. This is necessary because background levels of naturally-occurring isotopes can vary significantly.

(3) If samples from a designated site have an indication of an increase above samples from background wells, but the increase is not clearly significant, more rigorous statistical tests will be performed to interpret the data. The appropriate statistical test for the case where the contaminant is a result of natural background radioactivity is the WRS Test.

6. Quality Control Samples: The following quality control sample criteria shall apply:

a. Field blanks, rinsate blanks, and trip blanks are not appropriate to this sampling plan and will not be taken.

b. Field duplicates will be collected to assess the overall precision of the sample and analysis program. Ten percent of all samples collected will be duplicated. This criteria yields: three duplicates from Site 1 (Jamaica Island landfill); two duplicates from Site 2 (background wells); and four duplicates from Site 3 (all other wells).

c. Results from analyzing duplicates will be compared to the original sample results. This comparison will be performed in accordance with the reproducibility checks in the NAVSEA approved procedure discussed in paragraph 2.c above.

7. Gamma-Analysis Quality Control Measures: PNS has established quality control procedures to ensure the accuracy of the sample analyses. This program includes the following measures:

a. The germanium detector is calibrated for system response annually using radioactive sources traceable to the National Institute of Standards and Technology (NIST).

b. System energy calibration is established initially at the time of the annual system response calibration and is checked daily when the system is in use. A daily check of at least two gamma energies is acceptable if the analyzer readout is within ±1 keV of the known gamma energies.

c. Two system response checks are performed daily (at the beginning and at the end of each shift/day) and must fall within the acceptable limits for operation. The limits for operation are based on at least 10 counts and are established at the time of the annual response calibration. The limits shall not exceed the control values required by an approved NAVSEA counting procedure.

d. The detector resolution numerical value is checked weekly. If the resolution is more than 20% different from previous checks, the cause shall be investigated and corrected.

e. Environmental sample analysis and system calibrations are performed only by health physicists trained in the use of the gamma analysis system.

f. Results of system calibrations and sample analyses are reviewed only by senior health physicists/nuclear engineers trained in the use of the gamma analysis system.

g. PNS participates in an independent quality assurance program which involves the analysis of samples containing radioactivity in quantities unknown to the facility, as discussed in the Historical Radiological Assessment. Additionally, ten percent of environmental samples are recounted by PNS and an outside laboratory. The results are verified and certified by the independent Department of Energy laboratory.

h. All results are reviewed by a health physicist certified by the American Board of Health Physics and the laboratory manager.

i. The alpha/beta counter is calibrated for system response annually using NIST-traceable sources. System response checks and background checks are performed prior to and at the end of each day's use of the counter.

8. Reporting of Results: The final report will be organized as follows:

a. A copy of this sampling and analysis protocol.

b. Tabulated results, including results of the EPA or State duplicate analyses.

c. Conclusions based on the results.

EPA and State agreement with a draft of the report will be solicited prior to issuing the final report.

Appendix A

Groundwater Sampling at Portsmouth Naval Shipyard
Monitoring Well Information

Site	Well #	In Original Island?	Tidally Influenced?	Ground Elevation (Ft above MSL)	Top/Bottom of Screen (ft BGS)	Screened Formation	Substrata of Well (Paraphrased from Monitoring Well Log Book) (Distances are depths from ground surface, ft.; last value is depth of well)	Geologist Remarks (excerpts from Monitoring Well Log Book)
Radiological	JW-5	Yes	Yes	106.96	10/15	TF, BE, WB	Fill to 10', TF from 10' to 10.6', BE from 10.6 to 12', WB from 12' to 15', BR from 15' to 20'	
Characterization	JW-6	No	No	108.31	11/21	F, TF, BE	Fill to 15', Alternating BE and TF from 15' to 26.3', WB from 26.3' to 28', BR from 28' to 33'	
Site 1	JW-8B	No	No	111.12	20/25	BR	Beach Deposits to 11', Tidal Flat Deposits from 11' to 12', WB from 12' to 14.5', BR from 14.5' to 25.5'	
(Jamaica Island	JW-9	No	No	105.09	7/15	F	Sand & Silt to 15.5', Bedrock from 15.5' to 19.5'	
landfill area)	JW-10	No	Yes	106.43	7/12	F	Silt & Sand & Clay to 19', Bedrock from 19' to 21.7'	
	JW-12S	No	Yes	106.66	8/13	F	Well bored to 13', No samples collected.	
	JW-12D	No	Yes	106.71	18/23	F	Sand and gravel to 4', Boulders, silt, sand & gravel from 4' to 25'	concrete, red brick
	JW-12B	No	Yes	106.49	36/41	BR	G and S to 12', BO 12' to 16', F 16' to 24', TF from 24' to 25', WB from 25' to 25.5', BR from 25.5' to 41'	
	JW-13S	No	Yes	108.66	7/12	F	Well bored to 12', No samples collected.	
	JW-13D	No	Yes	[illegible]8.67	[illegible]/20	F	Sand [illegible]ilt & gravel to 22'	oily sheen
	JW-13B	No	Yes	[illegible]8.46	3[illegible]/38	[illegible]	Sand [illegible]ravel, silt & clay to [illegible], Bedrock from 28' to 40'	petroleum odor
	JW-13DB	No	Yes	[illegible]	13[illegible]/151	[illegible]BR	[illegible] to [illegible]5', gravel and clay [illegible]m 15' to 21.5', Bedrock from 21.5' to 152'	wood, metal, screwdriver blade
	JW-14	No	Yes	109.57	10/15	F	Bored to 15' (Bedrock at 15"), No samples collected	
	JW-14B	No	Yes	109.38	20.5/25.5	BR	Sand, gravel & silt to 14.5', Bedrock from 14.5' to 25.5'	metal, brick
	JW-15	No	Yes	107.6	7/12	F	Silt, sand, gravel & rock fragments to 12.5'(end of boring), Weathered Bedrock encountered at 12.5'	tar/coal, brick, oil, petroleum odor
	JW-15B	No	Yes	107.47	19.5/24.5	BR	Fill to 14.5', Bedrock from 14.5' to 24.5'	black solidified tar
	JW-16	No	No	106.7	5/10	F	Sand, gravel & silt to 11' (end of boring)	asphalt, petroleum odor
	JW-16B	No	No	106.73	14.5/19.5	BR	Sand, gravel & silt to 10.5', Bedrock from 10.5' to 20.5'	asphalt, petroleum odor
	JW-17B	No	No	107.87	21/26	BR	Silt, sand, gravel & clay to 17', Bedrock from 17' to 26.5'	
	JW-18	No	No	108.54	8/13	F	Silt, sand, gravel & clay to 25' (end of boring)	sandblast grit
	JW-18B	No	No	108.56	24.7/29.7	BR	Silt, sand, gravel & clay to 20.1', Bedrock from 20.1' to 30.2'	sandblast grit
	JW-19	No	No	111.88	12/22	F, TF	Silt, sand, gravel & clay to 28.75' (end of boring)	

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Appendix A

Site	Well #	In Original Island?	Tidally Influenced?	Ground Elevation (Ft above MSL)	Top/Bottom of Screen (ft BGS)	Screened Formation	Substrata of Well (Paraphrased from Monitoring Well Log Book) (Distances are depths from ground surface, ft.; last value is depth of well)	Geologist Remarks (excerpts from Monitoring Well Log Book)
Radiological Characterization Site 3 ("Other areas")	DW-1	Yes	Yes	109.42	7/12	F, WB	Fill to 11.5', Bedrock from 11.5' to 16.5'	minor metal debris, wood pieces
	DW-2	No	Yes	108.84	10/15	F	Damaged (Not sampled)	black cinders, wood fragments
	DW-2B	No	Yes	109.93	21/26	BR	Fill to 14', Bedrock from 14' to 26'	
	DW-3	No	Yes	108.48	10/20	F	Fill to 26.3', Weathered Bedrock from 26.3' to 35', Bedrock from 35' to 36.5'	
	DW-4	Yes	Yes	110.16	10/15	WB	Sand to 4', Rock Fragments from 4' to 9.5', Weathered Bedrock from 9.5' to 15', Bedrock from 15' to 18.5'	metal shavings
	DW-5	Yes	Yes	109.09	7/12	F, BR	Fill to 11', Bedrock from 11' to 16'	
	DW-6	Yes	Yes	110.17	8/15	F, WB	Fill to 10', Weathered Bedrock from 10' to 15.5', Bedrock from 15.5' to 20.5'	
	DW-7	No	Yes	109.93	10/20	F	Fill to 23', Bedrock from 23' to 28'	black cinders
	DW-7B	No	Yes	110.41	28/33	BR	Fill to 17', Weathered Bedrock from 17' to 22', Bedrock from 22' to 33'	black cinders, metal debris
	DW-7DB	No	Yes	110.2	130/150	BR	Fill to 8.5', Bedrock from 8.5' to 150'	asphalt
	DW-8	No	Yes	107.38	[illegible]	[illegible]	Fill to 20.5'	metal, glass, wood
	DW-8B	No	Yes	107.39	48 [illegible]/53.7	[illegible]R	[illegible]ll to 34.[illegible] Be[illegible]h Depo[illegible]s from 34.5' to 42', [illegible]drock from 42' to 54.5'	metal, bolt, wood, nuts, wire, screws
	DW-9	No	Yes	108.42	1[illegible]/20	[illegible]F	Fill to 2[illegible]	glass, metal, wood, wire, nails, screws, rubber, nuts
	MW-2	No	No	115.98	1[illegible]	[illegible]F	[illegible] to [illegible]2' (end of b[illegible]ng)	metal, wood, sandblast grit, herculite, paint chips
	MW-3	No	No	116.41	10/20	F	Fill to 21' (end of boring)	wood, sandblast grit
	MW-4	No	No	111.45	8.9/18.9	F	Fill to 22' (end of boring)	concrete, petroleum odor
	MW-5	No	No	111.57	10/20	F	Fill to 22' (end of boring)	wood, petroleum odor
	MW-6	No	No	116.50	20/25	F, TF	Fill to 22.2', Tidal Flat from 22.2' to 28'	sndblst grt, cncrt, rope, wood, metal, ptrlum odr
	MW-7	No	No	111.66	16.5/21.5	F	Fill to 21.5', Tidal Flat from 21.5' to 22'	lead, rubber, wood, graphite
	FW-2	No	Yes	104.91	10/15	F, BR	Fill to 12', Bedrock from 12' to 17'	
	FW-3	No	Yes	104.73	8/13	F, BR	Fill to 11', Bedrock from 11' to 13.5'	
	FW-5	No	Yes	105.07	11/16	BR	Fill to 10', Bedrock from 10' to 17'	
	FW-6	No	Yes	105.32	5/15	F, BR	Fill to 10', Weathered Bedrock from 10' to 17', Damaged (Not sampled)	
	HW-3	Yes	No	106.28	7/12	BR	Fill to 4.5', Sand from 4.5' to 8', Bedrock from 8' to 12'	
	WOT-2	No	No	106.59	3/8	F	Silt, sand, clay and gravel to 8' (end of boring)	
	WOT-3	No	No	106.65	3/12	F	Sand, silt and gravel to 12' (end of boring)	
	WOT-4	No	No	105.91	4/14	F	Fill to 14' (end of boring)	
	WOT-5	No	No	108.05	8/15	F	Fill to 15' (end of boring)	wood, oily stains
	HW-2	Yes	No	106.16	7/12	BR	Fill to 7', Silt from 7' to 12'	
	DI-01DB	Yes	No	113.06	79/94	BR	Silt, sand & gravel to 5', Bedrock from 5' to 95', Damaged (Not sampled)	
	FA-01	No	No	107.13	4/14	F	Fill to 14' (end of boring)	
	FA-01B	No	Yes	107.05	40/55	BR	Fill to 23.5', Bedrock from 23.5' to 55'	
	FA-01DB	No	Yes	107.03	137.5/157.5	BR	Fill to 22', Bedrock from 22' to 157.5'	wood

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Appendix A

Site	Well #	In Original Island?	Tidally Influenced?	Ground Elevation (Ft above MSL)	Top/Bottom of Screen (ft BGS)	Screened Formation	Substrata of Well (Paraphrased from Monitoring Well Log Book) (Distances are depths from ground surface, ft.; last value is depth of well)	Geologist Remarks (excerpts from Monitoring Well Log Book)
Radiological Characterization Site 2 (Background wells)	JW-3	Yes	No	108.46	7/17	BR	Fill to 5', Tidal Flat Deposits from 5' to 6.3', Bedrock from 6.3' to 17'	
	JW-4	Yes	No	106.13	7/12	WB, BR	Fill to 5.1', Beach Deposits from 5.1 to 7', Weathered Bedrock from 7' to 8', Bedrock from 8' to 13'	
	JW-7	No	No	107.14	6.8/11.8	BE, WB, BR	Fill to 5', Beach Deposits from 5' to 8', Weathered Bedrock from 8' to 10', Bedrock from 10' to 15'	
	JW-7B	No	No	107.32	18/23	BR	Fill to 2', Beach Deposits from 2' to 4.3', Bedrock from 4.3' to 23'	
	JW-8	No	No	111.06	9/14	BE	Beach Deposits to 10.3', Fill and Beach Deposits from 10.3' to 14.5', Bedrock from 14.5' to 19.5'	
	JW-9B	No	No	105.07	19/29	BR	Fill to 8', Bedrock from 8' to 30.5'	
	DW-1B	Yes	Yes	109.53	17/22	BR	Fill to 11.5', Bedrock from 11.5' to 22'	
	DW-10B	Yes	Yes	111.62	13/18	BR	Fill to 5.3', Bedrock from 5.3' to 21'	cables, asphalt
	FW-1	Yes	Yes	106.22	10.5/15.5	F, BR	Fill to 5.5', silt, sand, clay & gravel from 5.5' to 12', Bedrock from 12' to 17.5'	
	FW-4	No	Yes	105.69	10/15	F, BR	Fill to 11', Bedrock from 11' to 16'	sandblast grit
	DI-01B	Yes	No	112.4	24/34	BR	Silt & sand to 3.5', Bedrock from 3.5' to 35'	
	SI-01B	Yes	No	117.89	20.5/35.5	BR	Silt & sand to 5', Bedrock from 5' to 35'	
	SI-01DB	Yes	No	118.25	130/150	BR	Silt & sand to 3.5', Bedrock from 3.5' to 150'	

Key:
BE - Beach Deposits
BGS - Below Ground Surface
BO - Boulder
BR - Bedrock
F - Fill
G - Gravel
MSL - Mean Sea Level
S - Sand
TF - Tidal Flat Deposits
WB - Weathered Bedrock

Key to Well Prefixes:
JW: Jamaica Island Landfill (JILF) (OU3-Site 8)
DW: DRMO Salvage Yard (OU2-Site 6)
MW: Mercury Burial Sites MBI & MBII (OU3-Site 9)
FW: Berth 6 Industrial Area (OU5-Site 27)
HW, WOT: Former Waste Oil Tanks (OU3-Site 11)
DI, FA, SI: Non Site-Related Wells

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Appendix B

Groundwater Sampling at Portsmouth Naval Shipyard
Background Monitoring Well Locations

Well	Associated Site	In Original Island?	Tidally Influenced?	Screened Formation	Round 7 Exceedences	Round 8 Exceedences
DI-01B	None	Yes	No	BR	Calcium	Calcium
SI-01B	None	Yes	No	BR	Calcium, Iron, Manganese	Calcium, Iron, Manganese
SI-01DB	None	Yes	No	BR	Aluminum, Iron	Aluminum, Iron
DW-10B	OU2-Site 6	Yes	Yes	BR	Calcium	Calcium
DW-1B	OU2-Site 6	Yes	Yes	BR	Calcium	Calcium
JW-3	OU3-Site 8	Yes	No	BR	Aluminum, Calcium	Thallium
JW-4	OU3-Site 8	Yes	No	WB, BR	None	Aluminum
JW-7	OU3-Site 8	No	No	BE, WB, BR	Calcium	Calcium
JW-7B	OU3-Site 8	No	No	BR	Calcium	Calcium
JW-8	OU3-Site 8	No	No	BE	Calcium	Calcium
JW-9B	OU3-Site 8	No	No	BR	Calcium	Calcium
FW-1	OU5-Site 27	Yes	Yes	F, BR	Aluminum, Calcium, Iron, Manganese	Calcium, Manganese
FW-4	OU5-Site 27	No	Yes	F, BR	Calcium	Calcium

Key:		
	BR	Bedrock
	WB	Weathered Bedrock
	BE	Beach Deposits
	F	Fill

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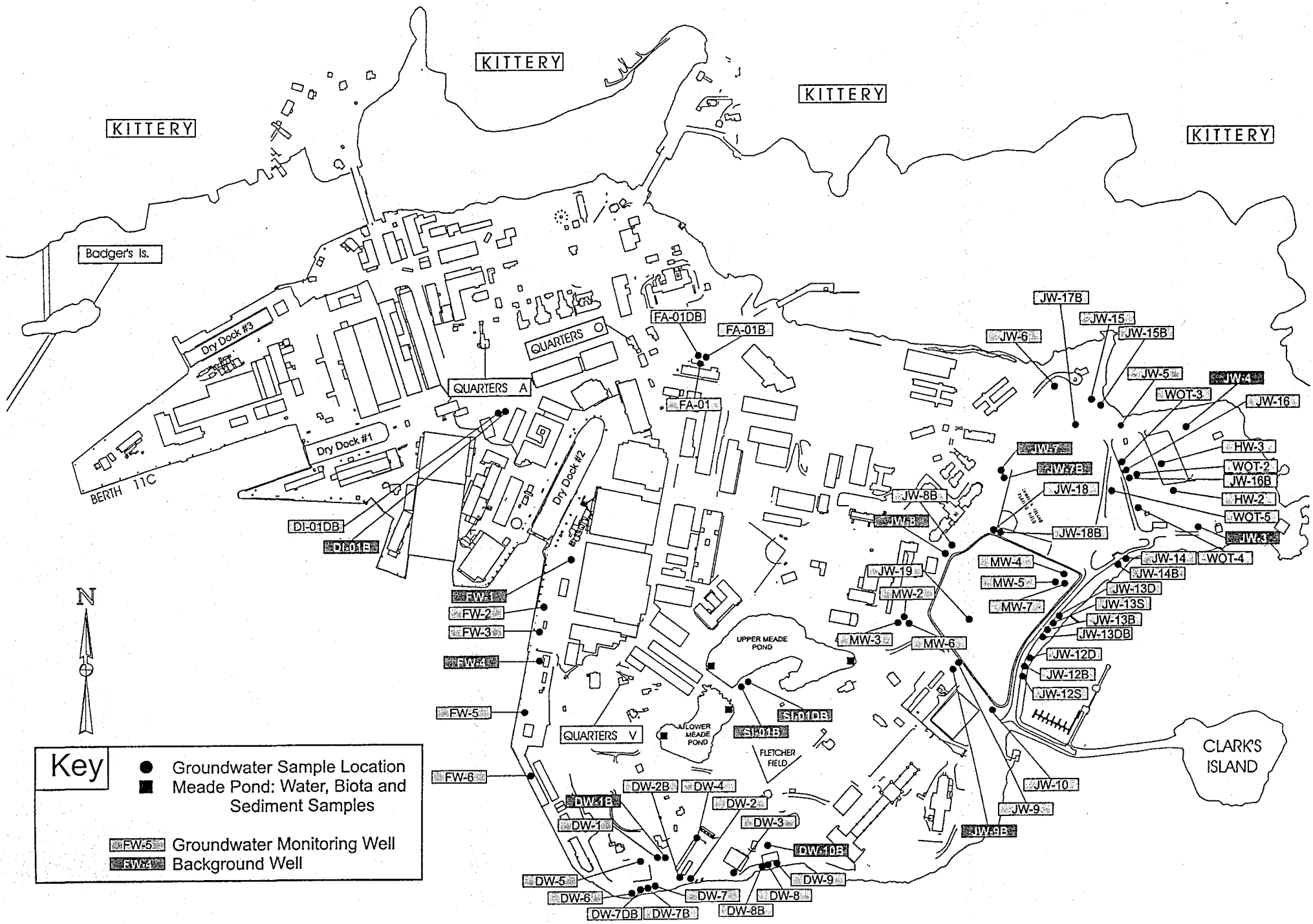
APPENDIX C

MAP OF PORTSMOUTH NAVAL SHIPYARD LOW FLOW PILOT STUDY WELLS