

2018 Source Water Assessment: NORTH KINGSTOWN WELLHEAD PROTECTION AREAS: Northern Hunt, Annaquabucket, Wickford Junction, and Saunderstown

SUMMARY

This Source Water Assessment focuses on four community wellhead protection areas (WHPAs) located primarily in North Kingstown within the Hunt-Annaquabucket-Pettaquamscut sole source aquifer. The assessment was originally completed in 2008 and updated in 2018 to identify pollution risks and provide information for local land use planning and protection of the water supplies.

The North Kingstown Water Department and Quonset Point Industrial Park own and operate these wellfields. The Saunderstown, Annaquabucket, and Wickford Junction WHPAs are located entirely in North Kingstown; the Northern Hunt WHPA extends into East Greenwich and Warwick. The WHPAs have a total of 14 wells as summarized in Table 1. Given the span of the WHPAs across municipalities, coordination among the three communities in WHPA planning and protection is even more important.

The WHPAs range in size from 998 acres to 16110 acres and the land uses are summarized in Table 2. Results of the pollution risk assessment for the WHPAs are summarized in Tables 3 to 6.

Overall, the WHPAs were given scores between 15 and 55. The table below summarizes those ratings. Note that a LOW ranking does not mean the source is free from contamination risk. Without sufficient protection, any water supply can become contaminated. A MODERATE ranking means that the water is more likely to become contaminated one day. Regardless of score, protection efforts are important to assure continued water quality.

For further information please contact the North Kingstown Water Department located at 80 Boston Neck, North Kingstown, RI 02852 (401) 294-3331. Additional information on this assessment is included below.

WHPA Rating Summary			
WHPA	Ranking	Rating	Notes
Saunderstown	25	Moderate	
Annaquabucket	55	Moderate	A ranking of 60 is considered High Risk and indicates need for protection.
Wickford Junction	15	Low	
Northern Hunt	50	Moderate	A ranking of 60 is considered High Risk and indicates need for protection.

Table 1. Well Summary by WHPA

WELL NAME	SOURCE ID	WHPA NAME	Well Owner
Gravel Packed Well #7	1559517-09	Saunderstown	
Gravel Packed Well #8	1559517-10	Saunderstown	
Gravel Packed Well #3	1559517-03	Saunderstown	
Gravel Pack Well #11	1559517-12	Annaquaticket	
Gravel Packed Well #5A	1559517-11	Annaquaticket	
Gravel Packed Well #1	1559517-01	Annaquaticket	
Gravel Packed Well #4	1559517-04	Annaquaticket	
Gravel Packed Well #2	1559517-02	Annaquaticket	
Gravel Packed Well #6	1559517.06	Wickford Junction	
Well #3	1592025-02	Northern Hunt	Quonset Ind.Park
Gravel Dev Well #10	1559517-08	Northern Hunt	(NK but in E.G.)
Well #14A	1592025-03	Northern Hunt	
Well #9A	1592025-01	Northern Hunt	Quonset Ind.Park
Gravel Dev Well #9	1559517-07	Northern Hunt	(NK but in Warwick)

Table 3. Risk Rating for Saunderstown WHPA

Wellhead Protection Area RISK INDICATOR	SAUNDERSTOWN RATING				UPDATE	
	LOW	MEDIUM	HIGH	EXTREME	INPUT	RATING
	0	5	10	25		
Wellhead Protection Area land use						
1. High intensity	<10%	10-24%	25-40%	40%	4.8%	0
Existing or Potential Pollution Sources						
2. Pollution sources within inner protective radius (400' or 200') of well.	0	1	2-3	>3		0
3. Pollution sources per acre throughout WHPA, excluding inner protective radius. Multiply this number by 10.	<0.1	0.1-0.5	0.5-1	>1		0
Water Quality						
4. History of Contaminant detects within last 5 years	Trace1	<1/2 MCL	>1/2 MCL	Violation	*a	25
5. Source water Bacteria detects within 5 years.	none	Total coliform detection	Fecal Coliform detected: cause identified and corrected	Fecal coliform violation	Bacteria have not been detected	0
6. Maximum nitrate-nitrogen (NO ₃ -N) concentration in last 5 years.	<.5 mg/l	.5-2 mg/l	2-5 mg/l	>5 mg/l	Nitrate levels in ground-water have been consistently low	0
MAXIMUM						
Overall Ranking - Sum of all risk ratings.	0-19	20-59	60-100	>100		25

Notes:

*a-There was a violation of the chloroform and radium standards. A violation indicates that the sample exceeded the amount deemed acceptable. For more information, contact the system identified.

Table 4. Risk Rating for Annaquaticket WHPA

Wellhead Protection Area RISK INDICATOR	ANNAQUATCKET RATING				UPDATE	
	LOW	MEDIUM	HIGH	EXTREME	INPUT	RATING
	0	5	10	25		
Wellhead Protection Area land use						
1. High intensity	<10%	10-24%	25-40%	40%	22.80%	5
Existing or Potential Pollution Sources						
2. Pollution sources within inner protective radius (400' or 200') of well.	0	1	2-3	>3		0
3. Pollution sources per acre throughout WHPA, excluding inner protective radius. Multiply this number by 10.	<0.1	0.1-0.5	0.5-1	>1		0
Water Quality						
4. History of Contaminant detects within last 5 years	Trace1	<1/2 MCL	>1/2 MCL	Violation	*B	25
5. Source water Bacteria detects within 5 years.	none	Total coliform detection	Fecal Coliform detected: cause identified and corrected	Fecal coliform violation	Bacteria have not been detected	0
6. Maximum nitrate-nitrogen (NO3-N) concentration in last 5 years.	<.5 mg/l	.5-2 mg/l	2-5 mg/l	>5 mg/l	GP Well 11	25
MAXIMUM						
Overall Ranking - Sum of all risk ratings.	0-19	20-59	60-100	>100		55

Notes:

*B - There was a violation of the chromium standards. A violation indicates that the sample exceeded the amount deemed acceptable. For more information, contact the system identified.

Table 5. Risk Rating for Wickford Junction WHPA

Wellhead Protection Area RISK INDICATOR	WICKFORD JUNCTION RATING				UPDATE	
	LOW 0	MEDIUM 5	HIGH 10	EXTREME 25	INPUT	RATING
Wellhead Protection Area land use						
1. High intensity	<10%	10-24%	25-40%	40%	21.82%	5
Existing or Potential Pollution Sources						
2. Pollution sources within inner protective radius (400' or 200') of well.	0	1	2-3	>3		0
3. Pollution sources per acre throughout WHPA, excluding inner protective radius. Multiply this number by 10.	<0.1	0.1-0.5	0.5-1	>1		0
Water Quality						
4. History of Contaminant detects within last 5 years	Trace1	<1/2 MCL	>1/2 MCL	Violation	*A	0
5. Source water Bacteria detects within 5 years.	none	Total coliform detection	Fecal Coliform detected: cause identified and corrected	Fecal coliform violation	Bacteria have not been detected	0
6. Maximum nitrate-nitrogen (NO3-N) concentration in last 5 years.	<.5 mg/l	.5-2 mg/l	2-5 mg/l	>5 mg/l	*B	10
MAXIMUM						
Overall Ranking - Sum of all risk ratings.	0-19	20-59	60-100	>100		15

Notes:

*A-There has been non detection of regulated contaminants (excluding bacteria and nitrates).

*B-Nitrate levels in groundwater are higher than background levels which may indicate contribution from human activity.

Table 6. Risk Rating for Northern Hunt WHPA

Wellhead Protection Area RISK INDICATOR	NORTHERN HUNT RATING				UPDATE	
	LOW	MEDIUM	HIGH	EXTREME	INPUT	RATING
	0	5	10	25		
Wellhead Protection Area land use						
1. High intensity	<10%	10-24%	25-40%	40%	33.73%	10
Existing or Potential Pollution Sources						
2. Pollution sources within inner protective radius (400' or 200') of well.	0	1	2-3	>3		0
3. Pollution sources per acre throughout WHPA, excluding inner protective radius. Multiply this number by 10.	<0.1	0.1-0.5	0.5-1	>1		0
Water Quality						
4. History of Contaminant detects within last 5 years	Trace1	<1/2 MCL	>1/2 MCL	Violation	*A	25
5. Source water Bacteria detects within 5 years.	none	Total coliform detection	Fecal Coliform detected: cause identified and corrected	Fecal coliform violation	*B	5
6. Maximum nitrate-nitrogen (NO3-N) concentration in last 5 years.	<.5 mg/l	.5-2 mg/l	2-5 mg/l	>5 mg/l		10
MAXIMUM						
Overall Ranking - Sum of all risk ratings.	0-19	20-59	60-100	>100		50

Notes:

*A-There was a violation of the radium standards. A violation indicates that the sample exceeded the amount deemed acceptable. For more information, contact the system identified.

*B-Fecal coliform were not detected. Coliform bacteria were detected 3 times during this period. However, re-sampling revealed that the problem had been corrected.

UNDERSTANDING THE ASSESSMENT

WHY WAS THE ASSESSMENT DONE?

The Safe Drinking Water Act (SDWA) Amendments of 1996 required states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. Using these programs, most states have completed source water assessments for every public water system -- from major metropolitan areas to the smallest towns. Even schools, restaurants, and other public facilities that have wells or surface water supplies have been assessed. A source water assessment is a study and report, unique to a water system that provides basic information about the water used to provide drinking water. States are working with local communities and public water systems to identify protection measures to address potential threats to sources of drinking water.

In Rhode Island, RI HEALTH's Office of Drinking Water Quality administers the Source Water Assessment Program.

WHAT AREA WAS EVALUATED FOR THIS ASSESSMENT?

The source water protection area, the area evaluated for this assessment, is the critical area surrounding a public water supply well or an intake on a surface source. For a public water supply well, this is the wellhead protection area (WHPA). The WHPA is the estimated area from which groundwater and surface water will flow from under severe pumping conditions. This can also be stated as the maximum estimated area that water withdrawn from the well will ever be drawn from. For most bedrock wells, this area is a volume dependent circle. For wells in sand and gravel this area is generally not a circle, but an irregular shape determined by sedimentary deposits and pumping rate. The source protection area for surface water sources is generally the watershed of the surface waterbody.

WILL THE POTENTIAL CONTAMINATION SOURCES IDENTIFIED IN THE SANITARY SURVEY CONTAMINATE MY SOURCE?

Potential contamination sources identified in sanitary surveys are facilities that typically use, produce, handle or store contaminants of concern, which, if improperly managed, could find their way to a source of public drinking water. It is important to understand that a release may never occur from a potential contamination source, provided it is using good management practices. Many potential contamination sources are regulated at the federal level, the state level, or both, to reduce the risk of a release. There are a number of methods that waster systems can use to work cooperatively with potential contamination sources. These often involve educational visits and inspections of stored materials.

HOW SHOULD THIS ASSESSMENT BE USED?

This assessment should be used to plan for improved protection of public drinking water sources. Additional information may also be useful such as identification of the 100-year flood plain, tax map information, soils information or high-density development areas. This assessment is a good starting place for planning protection programs. **Communities should act now to protect valuable water supply resources; once contamination occurs clean-up is costly and sometimes technically infeasible. Additionally, unprotected watersheds and wellheads can lead to deterioration of water quality that may eventually lead to higher treatment costs.**

EXPLANATION & DETERMINATION OF POLLUTION RISK FACTORS

Overview

This Source Water Assessment was completed using the "Guide to Updating Source Water Assessments and Protection Plans, Version 3 – 2010". All risk indicator ratings were obtained from the "Guide". A summary of methods as well as calculated risks is presented here.

Risk Factor 1. High Intensity Land Use

High intensity land use was determined using Rhode Island GIS (RIGIS) land use data (2003/2004 data). Land uses within the WHPA were calculated using ArcView 9.3 (ESRI) and then aggregated based on land use categories defined in the MANAGE model. The MANAGE model is a GIS based tool that informs decisions about environmental risks associated with land use. (Technical documentation for the MANAGE model can be requested from Lorraine Joubert at ljoubert@uri.edu.)

The MANAGE model assigns RIGIS land use types into a reduced number of categories, 11 of which are identified as High Intensity Land Use (Table 8). The percentage of high intensity land use in the WHPA under study is then compared to the rating scale for risk indicator 1, High intensity land use.

A summary of all land uses found within the North Kingstown WHPA for Wells 3, 7 and 8 reveals that 8% of the WHPA is considered to be developed as high intensity land use, corresponding with a risk rating of low.

Risk Indicator	Rating (Score)			
	Low (0)	Medium (5)	High (10)	Extreme (25)
1. High intensity land use	<10%	10-24%	25-50%	>40%

Table 7. Land Use Summary

		Saunderstown Area (Ac) Percent		Annaquaticket Area (Ac) Percent		Wickford Junction Area (Ac) Percent		Lower Hunt Area (Ac) Percent	
111	High Density Residential (<1/8 acre lots)			7.23	0.31%			80.02	3.77%
112	Medium High Density Residential (1/4 to 1/8 acre lots)			40.35	1.73%	57.77	7.80%	274.99	12.94%
113	Medium Density Residential (1 to 1/4 acre lots)	2.18	0.81%	216.85	9.28%	119.61	16.15%	374.70	17.63%
114	Medium Low Density Residential (1 to 2 acre lots)	0.56	0.21%	43.37	1.86%	1.94	0.26%	33.64	1.58%
115	Low Density Residential (>2 acre lots)	7.61	2.83%	25.45	1.09%	2.34	0.32%	4.39	0.21%
120	Commercial (sale of products and services)			22.21	0.95%	40.32	5.44%	126.73	5.96%
130	Industrial (manufacturing, design, assembly, etc.)			18.78	0.80%	7.74	1.05%	46.58	2.19%
141	Roads (divided highways >200' plus related facilities)	12.70	4.73%	19.67	0.84%	35.11	4.74%	98.26	4.62%
143	Railroads (and associated facilities)			12.45	0.53%			17.36	0.82%
145	Waste Disposal (landfills, junkyards, etc.)			9.06	0.39%			16.59	0.78%
146	Waste Disposal (landfills, junkyards, etc.)			42.54	1.82%	10.26	1.39%	14.00	0.66%
161	Waste Disposal (landfills, junkyards, etc.)			20.14	0.86%	32.75	4.42%	47.76	2.25%
162	Vacant Land	1.09	0.41%	7.33	0.31%	5.55	0.75%	30.85	1.45%
163	Cemeteries							22.96	1.08%
170	Institutional (schools, hospitals, churches, etc.)	0.26	0.10%	1.66	0.07%	7.23	0.98%	33.03	1.55%
210	Pasture (agricultural not suitable for tillage)	9.58	3.57%	43.07	1.84%	14.68	1.98%	9.13	0.43%
220	Pasture (agricultural not suitable for tillage)			318.14	13.61%	3.17	0.43%	9.32	0.44%
230	Pasture (agricultural not suitable for tillage)			40.85	1.75%				
300	Pasture (agricultural not suitable for tillage)	3.20	1.19%	47.45	2.03%	4.13	0.56%	16.63	0.78%
410	Deciduous Forest (>80% hardwood)	204.68	76.22%	662.37	28.34%	307.35	41.49%	510.53	24.02%
420	Deciduous Forest (>80% hardwood)	4.50	1.67%	61.20	2.62%	29.55	3.99%	95.96	4.51%
430	Deciduous Forest (>80% hardwood)	4.57	1.70%	307.63	13.16%	47.79	6.45%	220.53	10.38%
500	Water	11.03	4.11%	90.40	3.87%	5.52	0.74%	12.98	0.61%
600	Wetlands	6.28	2.34%	40.53	1.73%	5.99	0.81%	22.14	1.04%
740	Mines, Quarries and Gravel Pits			222.63	9.52%		0.00%	3.42	0.16%
750	Transitional Areas (urban open)	0.31	0.12%	16.26	0.70%	1.97	0.27%	2.84	0.13%
Grand Total		268.55	100.00 %	2337.60	100.00 %	740.79	100.00 %	2125.34	100.00 %
High Intensity		12.96	4.83%	0532.93	22.80%	161.61	21.82%	716.89	33.73%

Table 8. Land Use Aggregations Utilized in SWAP Reports (Updated to correspond with RIGIS 2003/2004 Land Use Data)

MANAGE Code	Category	RIGIS Category and Code	High Intensity Land Use
1	HDR	High Density Residential (111) Commercial/Residential Mixed (151)	x x
2	MHDR	Medium High Density Residential (112)	x
3	MDR	Medium Density Residential (113)	
4	MLDR	Medium Low Density Residential (114)	
5	LDR	Low Density Residential (115)	
6	COMMERCIAL	Commercial & Services (120) Other (147) Commercial/Industrial Mixed (152)	x x x
7	INDUSTRIAL	Industrial (130)	x
8	ROADS	Roads (141)	x
9	AIRPORTS	Airports (142)	x
10	RAILROADS	Railroads (143)	x
11	JUNKYARDS	Waste Disposal Areas (145)	x
12	RECREATION	Developed Recreation (161) Urban Open Space (162) Cemeteries (163)	
13	INSTITUTION	Water and Sewage Treatment Facilities (144) Institutional (170)	x x
14	PASTURE	Power Lines (146) Pasture (210)	
15	CROPLAND	Cropland (220) Confined Feeding Operations (240)	x x
16	ORCHARDS	Orchards, Groves, Nurseries (230)	x
17	BRUSH	Idle Agriculture (250) Brushland (300)	
18	FOREST	Deciduous Forest (410) Softwood Forest (420) Mixed Forest (430)	
19	BARREN	Beaches (710) Sandy Areas other than Beaches (720) Rock Outcrop (730) Strip Mines, Quarries, Gravel Pits (740) Mixed Barren (760)	
20	WETLAND	Wetland (600)	
21	WATER	Water (500)	
22		Assigned to MD Res. Unless otherwise specified Transitional Areas (750)	

Notes:

Manage code: The numeric category that MANAGE method groups land use data by.

Manage category: The descriptive category that MANAGE method groups land use data by.

RIGIS category and code: The RIGIS land use category and associated code number

High Intensity Land Use: land uses designated in MANAGE as having a greater potential pollution load. The designations as presented above were used in the SWAP reports and are provided here for reference.

Risk Factors 2 & 3: Pollution Sources Within Inner Protective Radius and Per Acre Throughout the WHPA

Information on the presence or absence of pollution sources within the inner protective radius of the well can usually be obtained through the Rhode Island Department of Health (RIDOH) Sanitary Surveys and Waivers. The most recent community public water system was completed on October 3, 2007. The Sanitary Survey provided a very basic summary of pollution sources within the inner protective radius of all the wells in the North Kingstown Water Department system. There was no information on pollution sources for each well, therefore the data were not useful in determining the rating for this risk factor. The sanitary survey did not provide a per acre count of potential sources throughout the WHPA. Therefore, Risk Factor 2 – Pollution Sources Within Inner Protective Radius and Risk Factor 3 – Pollution Sources Per Acre Throughout the WHPA—were both set at Medium.

Risk Indicator	Rating (Score)			
	Low (0)	Medium (5)	High (10)	Extreme (25)
2. Pollution sources within inner protective radius (400 ft of 200 ft of well)	0	1 (set by default)	2-3	>3
3. Pollution sources per acre throughout WHPA, excluding inner protective radius (multiply by 10)	<0.1	0.1 - 0.5 (set by default)	0.5 - 1	>1

Risk Factor 4, 5 & 6: History of Contaminant, Bacteria and Nitrate-Nitrogen Detections

Laboratory results for samples collected from the wells were obtained from Rhode Island Department of Health (RIDOH) and used to determine risk factors 4, 5 and 6. Wells that are less than 1,000 feet apart were assessed as one for the purposes of this analysis and only one risk rating score is provided for risk factors 4, 5 and 6. Tables below show detected contaminant in each WHPA and are discussed below.

Table 9. Saundertown

FAC NAME	COLL DATE	SAMP#	ANALYTE NAME	CONCEN-TRATION	UNITS
GRAVEL PACKED WELL #3	24-Mar-14	1401936-03_WL68	BARIUM	0.023	MG/L
GRAVEL PACKED WELL #3	27-Mar-17	1701637-08_WL68	BARIUM	0.021	MG/L
GRAVEL PACKED WELL #3	24-Mar-14	1401936-03_WL68	CHROMIUM	0.003	MG/L
GRAVEL PACKED WELL #3	24-Mar-14	1401936-03_WL68	NICKEL	0.007	MG/L
GRAVEL PACKED WELL #3	18-Mar-13	1300693-04_WL16	NITRATE	0.11	MG/L
GRAVEL PACKED WELL #3	24-Mar-14	1401936-03_WL16	NITRATE	0.13	MG/L
GRAVEL PACKED WELL #3	27-Mar-17	1701637-08_WL16	NITRATE	0.06	MG/L
GRAVEL PACKED WELL #3	23-Mar-15	1501619-04_WL16	NITRATE-NITRITE	0.1	MG/L
GRAVEL PACKED WELL #3	14-Mar-16	1601471-04_WL16	NITRATE-NITRITE	0.07	MG/L
GRAVEL PACKED WELL #3	18-Mar-13	1300693-04_WL71	SODIUM	52.9	MG/L
GRAVEL PACKED WELL #3	24-Mar-14	1401936-03_WL71	SODIUM	34.5	MG/L
GRAVEL PACKED WELL #3	23-Mar-15	1501619-04_WL71	SODIUM	46.6	MG/L
GRAVEL PACKED WELL #3	14-Mar-16	1601471-04_WL71	SODIUM	39	MG/L
GRAVEL PACKED WELL #3	27-Mar-17	1701637-08_WL71	SODIUM	33.8	MG/L

Table 10. Annaquatucket

FAC NAME	COLL DATE	SAMP#	ANALYTE NAME	CONCENTRATION	UNITS
GRAVEL PACKED WELL #1	24-Mar-14	1401936-09_WL68	BARIUM	0.007	MG/L
GRAVEL PACKED WELL #1	27-Mar-17	1701637-03_WL68	BARIUM	0.01	MG/L
GRAVEL PACKED WELL #1	24-Mar-14	1401936-09_WL68	CHROMIUM	0.002	MG/L
GRAVEL PACKED WELL #1	26-Jun-13	1301945-01_WL51	CHROMIUM, HEX	0.07	UG/L
GRAVEL PACKED WELL #1	18-Mar-13	1300693-09_WL16	NITRATE	1.27	MG/L
GRAVEL PACKED WELL #1	18-Mar-13	1300693-10_WL16	NITRATE	1.26	MG/L
GRAVEL PACKED WELL #1	24-Mar-14	1401936-10_WL16	NITRATE	1.31	MG/L
GRAVEL PACKED WELL #1	24-Mar-14	1401936-09_WL16	NITRATE	1.3	MG/L
GRAVEL PACKED WELL #1	27-Mar-17	1701637-03_WL16	NITRATE	1.78	MG/L
GRAVEL PACKED WELL #1	23-Mar-15	1501619-01_WL16	NITRATE-NITRITE	1.25	MG/L
GRAVEL PACKED WELL #1	23-Mar-15	1501619-02_WL16	NITRATE-NITRITE	1.25	MG/L
GRAVEL PACKED WELL #1	14-Mar-16	1601471-10_WL16	NITRATE-NITRITE	1.36	MG/L
GRAVEL PACKED WELL #1	14-Mar-16	1601471-09_WL16	NITRATE-NITRITE	1.34	MG/L
GRAVEL PACKED WELL #1	18-Mar-13	1300693-10_WL71	SODIUM	35.1	MG/L
GRAVEL PACKED WELL #1	18-Mar-13	1300693-09_WL71	SODIUM	35	MG/L
GRAVEL PACKED WELL #1	24-Mar-14	1401936-10_WL71	SODIUM	30.7	MG/L
GRAVEL PACKED WELL #1	24-Mar-14	1401936-09_WL71	SODIUM	29.9	MG/L
GRAVEL PACKED WELL #1	23-Mar-15	1501619-02_WL71	SODIUM	44.5	MG/L
GRAVEL PACKED WELL #1	23-Mar-15	1501619-01_WL71	SODIUM	43.5	MG/L
GRAVEL PACKED WELL #1	14-Mar-16	1601471-10_WL71	SODIUM	32.9	MG/L
GRAVEL PACKED WELL #1	14-Mar-16	1601471-09_WL71	SODIUM	13.7	MG/L
GRAVEL PACKED WELL #1	27-Mar-17	1701637-03_WL71	SODIUM	48.7	MG/L

FAC NAME	COLL DATE	SAMP#	ANALYTE NAME	CONCEN-TRATION	UNITS
GRAVEL PACKED WELL #11	22-Apr-14	1402398-03_WL68	BARIUM	0.006	MG/L
GRAVEL PACKED WELL #11	25-Apr-17	1701959-03_WL68	BARIUM	0.007	MG/L
GRAVEL PACKED WELL #11	22-Apr-14	1402398-03_WL68	CHROMIUM	0.003	MG/L
GRAVEL PACKED WELL #11	26-Jun-13	1301945-08_WL51	CHROMIUM, HEX	0.09	UG/L
GRAVEL PACKED WELL #11	22-Apr-14	1402398-03_PE21	DCPA	13	UG/L
GRAVEL PACKED WELL #11	10-Nov-14	1405628-01_PE21	DCPA	14	UG/L
GRAVEL PACKED WELL #11	25-Apr-17	1701959-03_PE21	DCPA	8.1	UG/L
GRAVEL PACKED WELL #11	07-Nov-17	1704908-02_PE21	DCPA	4.5	UG/L
GRAVEL PACKED WELL #11	18-Mar-13	1300693-03_WL16	NITRATE	5.34	MG/L
GRAVEL PACKED WELL #11	22-Apr-14	1402398-03_WL16	NITRATE	5.95	MG/L
GRAVEL PACKED WELL #11	12-Dec-16	1605536-01_WL16	NITRATE	4.4	MG/L
GRAVEL PACKED WELL #11	25-Apr-17	1701959-03_WL16	NITRATE	4.42	MG/L
GRAVEL PACKED WELL #11	23-Apr-13	1301131-01_WL16	NITRATE-NITRITE	5.38	MG/L
GRAVEL PACKED WELL #11	12-Sep-13	1303300-03_WL16	NITRATE-NITRITE	5.72	MG/L
GRAVEL PACKED WELL #11	12-Sep-13	1303300-02_WL16	NITRATE-NITRITE	5.59	MG/L
GRAVEL PACKED WELL #11	26-Nov-13	1304308-01_WL16	NITRATE-NITRITE	5.87	MG/L
GRAVEL PACKED WELL #11	24-Mar-14	1401936-01_WL16	NITRATE-NITRITE	5.76	MG/L
GRAVEL PACKED WELL #11	25-Aug-14	1404689-10_WL16	NITRATE-NITRITE	6.02	MG/L
GRAVEL PACKED WELL #11	25-Aug-14	1404689-09_WL16	NITRATE-NITRITE	5.95	MG/L
GRAVEL PACKED WELL #11	10-Nov-14	1405628-01_WL16	NITRATE-NITRITE	5.93	MG/L
GRAVEL PACKED WELL #11	23-Mar-15	1501619-08_WL16	NITRATE-NITRITE	5.54	MG/L
GRAVEL PACKED WELL #11	28-Apr-15	1502000-03_WL16	NITRATE-NITRITE	5.65	MG/L
GRAVEL PACKED WELL #11	21-Sep-15	1504185-03_WL16	NITRATE-NITRITE	4.86	MG/L
GRAVEL PACKED WELL #11	09-Dec-15	1504935-01_WL16	NITRATE-NITRITE	5.41	MG/L
GRAVEL PACKED WELL #11	09-Dec-15	1504935-02_WL16	NITRATE-NITRITE	5.2	MG/L
GRAVEL PACKED WELL #11	14-Mar-16	1601471-03_WL16	NITRATE-NITRITE	4.88	MG/L
GRAVEL PACKED WELL #11	27-Apr-16	1601980-02_WL16	NITRATE-NITRITE	4.64	MG/L
GRAVEL PACKED WELL #11	29-Sep-16	1604816-02_WL16	NITRATE-NITRITE	4.14	MG/L
GRAVEL PACKED WELL #11	27-Mar-17	1701637-01_WL16	NITRATE-NITRITE	3.74	MG/L
GRAVEL PACKED WELL #11	21-Aug-17	1703965-07_WL16	NITRATE-NITRITE	4.34	MG/L
GRAVEL PACKED WELL #11	07-Nov-17	1704908-02_WL16	NITRATE-NITRITE	4.66	MG/L
GRAVEL PACKED WELL #11	18-Mar-13	1300693-03_WL71	SODIUM	10	MG/L
GRAVEL PACKED WELL #11	24-Mar-14	1401936-01_WL71	SODIUM	8.83	MG/L
GRAVEL PACKED WELL #11	23-Mar-15	1501619-08_WL71	SODIUM	12.1	MG/L
GRAVEL PACKED WELL #11	14-Mar-16	1601471-03_WL71	SODIUM	10.3	MG/L
GRAVEL PACKED WELL #11	27-Mar-17	1701637-01_WL71	SODIUM	10.3	MG/L

FAC NAME	COLL DATE	SAMP#	ANALYTE NAME	CONC-TRATION	UNITS
WELL #5A	24-Mar-14	1401936-06_PE21	DCPA	4.4	UG/L
WELL #5A	25-Aug-14	1404689-01_PE21	DCPA	1.1	UG/L
WELL #5A	27-Mar-17	1701637-05_PE21	DCPA	2.4	UG/L
WELL #5A	21-Aug-17	1703965-06_PE21	DCPA	2.3	UG/L
WELL #5A	18-Mar-13	1300693-07_WL16	NITRATE	2.54	MG/L
WELL #5A	24-Mar-14	1401936-06_WL16	NITRATE	2.8	MG/L
WELL #5A	27-Mar-17	1701637-05_WL16	NITRATE	2.82	MG/L
WELL #5A	23-Mar-15	1501619-09_WL16	NITRATE-NITRITE	2.38	MG/L
WELL #5A	14-Mar-16	1601471-07_WL16	NITRATE-NITRITE	3.11	MG/L
WELL #5A	18-Mar-13	1300693-07_WL71	SODIUM	12.5	MG/L

Table 11. Wickford Junction

FAC NAME	COLL DATE	SAMP#	ANALYTE NAME	CONC EN-TRATI ON	UNITS
GRAVEL PACKED WELL #6	22-Apr-14	1402398-01_WL68	BARIUM	0.009	MG/L
GRAVEL PACKED WELL #6	25-Apr-17	1701959-02_WL68	BARIUM	0.011	MG/L
GRAVEL PACKED WELL #6	25-Apr-17	1701959-02_WL21	FLUORIDE	0.23	MG/L
GRAVEL PACKED WELL #6	25-Apr-17	1701959-02_WL68	NICKEL	0.01	MG/L
GRAVEL PACKED WELL #6	22-Apr-14	1402398-01_WL16	NITRATE	1.94	MG/L
GRAVEL PACKED WELL #6	25-Apr-17	1701959-02_WL16	NITRATE	2.53	MG/L
GRAVEL PACKED WELL #6	23-Apr-13	1301131-03_WL16	NITRATE-NITRITE	2.17	MG/L
GRAVEL PACKED WELL #6	23-Apr-13	1301131-04_WL16	NITRATE-NITRITE	2.16	MG/L
GRAVEL PACKED WELL #6	28-Apr-15	1502000-01_WL16	NITRATE-NITRITE	2.11	MG/L
GRAVEL PACKED WELL #6	27-Apr-16	1601980-01_WL16	NITRATE-NITRITE	2.18	MG/L
GRAVEL PACKED WELL #6	23-Apr-13	1301131-04_WL71	SODIUM	22.6	MG/L
GRAVEL PACKED WELL #6	23-Apr-13	1301131-03_WL71	SODIUM	22.4	MG/L
GRAVEL PACKED WELL #6	22-Apr-14	1402398-01_WL71	SODIUM	23.7	MG/L
GRAVEL PACKED WELL #6	28-Apr-15	1502000-01_WL71	SODIUM	28.8	MG/L
GRAVEL PACKED WELL #6	27-Apr-16	1601980-01_WL71	SODIUM	31.8	MG/L

Table 12. Northern Hunt

FAC NAME	COLL DATE	SAMP#	ANALYTE NAME	CONCENTRATION	UNITS
WELL #3	26-Sep-13	1303496-02_TOS33	1,4-DIOXANE	0.19	UG/L
WELL #3	15-Jan-14	E401997-2_IOC	BARIUM	0.0099	MG/L
WELL #3	24-Jan-17	E701J35-1_IOC	BARIUM	0.012	MG/L
WELL #3	16-Jul-14	E407F205	COLIFORM (TCR)	1	
WELL #3	18-Jul-14	E4071141	COLIFORM (TCR)	1	
WELL #3	06-Feb-13	E302306-2_RAD	COMBINED RADIUM (-226 & -228)	0.34	PCI/L
WELL #3	15-Jan-14	E401998-2_WL21	FLUORIDE	0.22	MG/L
WELL #3	15-Jan-14	E401997-2_IOC	FLUORIDE	0.21	MG/L
WELL #3	24-Jan-17	E701J35-1_IOC	FLUORIDE	0.24	MG/L
WELL #3	06-Feb-13	E302306-2_RAD	GROSS BETA PARTICLE ACTIVITY	1.98	PCI/L
WELL #3	06-Feb-13	E302305-2_WL16	NITRATE	1.4	MG/L
WELL #3	21-Jan-14	E401C20-2_WL16_WL56	NITRATE	1.5	MG/L
WELL #3	13-Jan-15	E501723-2_WL16	NITRATE	1.6	MG/L
WELL #3	25-Jan-16	E601J48-2_WL16	NITRATE	1.5	MG/L
WELL #3	24-Jan-17	E701J35-1_IOC	NITRATE	1.3	MG/L
WELL #3	21-Jan-14	E401C20-2_WL16_WL56	NITRATE-NITRITE	1.5	MG/L
WELL #3	24-Jan-17	E701J35-1_IOC	NITRATE-NITRITE	1.3	MG/L
WELL #3	06-Feb-13	E302306-2_RAD	RADIUM-226	0.29	PCI/L
WELL #3	06-Feb-13	E302306-2_RAD	RADIUM-228	0.05	PCI/L
WELL #3	15-Jan-14	E401997-2_IOC	SODIUM	30	MG/L
WELL #3	24-Jan-17	E701J35-1_IOC	SODIUM	34	MG/L
WELL #3	15-Jan-14	E401997-2_IOC	SULFATE	11	MG/L
WELL #3	24-Jan-17	E701J35-1_IOC	SULFATE	8.5	MG/L

FAC NAME	COLL DATE	SAMP#	ANALYTE NAME	CONCENTRATION	UNITS
GRAVEL DEV. WELL #9	26-Jun-13	1301945-05_TOS33	1,4-DIOXANE	0.07	UG/L
GRAVEL DEV. WELL #9	24-Mar-14	1401936-08_WL68	BARIUM	0.011	MG/L
GRAVEL DEV. WELL #9	27-Mar-17	1701637-02_WL68	BARIUM	0.014	MG/L
GRAVEL DEV. WELL #9	24-Mar-14	1401936-08_TO12	CHLOROFORM	0.73	UG/L
GRAVEL DEV. WELL #9	23-Mar-15	1501619-10_TO12	CHLOROFORM	0.69	UG/L
GRAVEL DEV. WELL #9	14-Mar-16	1601471-08_TO12	CHLOROFORM	0.76	UG/L
GRAVEL DEV. WELL #9	27-Mar-17	1701637-02_TO12	CHLOROFORM	0.82	UG/L
GRAVEL DEV. WELL #9	24-Mar-14	1401936-08_WL68	CHROMIUM	0.002	MG/L
GRAVEL DEV. WELL #9	26-Jun-13	1301945-05_WL51	CHROMIUM, HEX	0.06	UG/L
GRAVEL DEV. WELL #9	27-Mar-17	1701637-02_WL21	FLUORIDE	0.21	MG/L
GRAVEL DEV. WELL #9	18-Mar-13	1300693-08_WL16	NITRATE	2.25	MG/L

GRAVEL DEV. WELL #9	24-Mar-14	1401936-08_WL16	NITRATE	2.34	MG/L
GRAVEL DEV. WELL #9	27-Mar-17	1701637-02_WL16	NITRATE	2.15	MG/L
GRAVEL DEV. WELL #9	23-Mar-15	1501619-10_WL16	NITRATE-NITRITE	2.46	MG/L
GRAVEL DEV. WELL #9	14-Mar-16	1601471-08_WL16	NITRATE-NITRITE	2.44	MG/L
GRAVEL DEV. WELL #9	18-Mar-13	1300693-08_WL71	SODIUM	37.5	MG/L
GRAVEL DEV. WELL #9	24-Mar-14	1401936-08_WL71	SODIUM	31.3	MG/L
GRAVEL DEV. WELL #9	23-Mar-15	1501619-10_WL71	SODIUM	43.4	MG/L
GRAVEL DEV. WELL #9	14-Mar-16	1601471-08_WL71	SODIUM	44.6	MG/L
GRAVEL DEV. WELL #9	27-Mar-17	1701637-02_WL71	SODIUM	42	MG/L

FAC NAME	COLL DATE	SAMP#	ANALYTE NAME	CONCENTRATION	UNITS
WELL #14A	26-Sep-13	1303496-03_TOS33	1,4-DIOXANE	0.1	UG/L
WELL #14A	15-Jan-14	E401997-3_IOC	BARIUM	0.0098	MG/L
WELL #14A	24-Jan-17	E701J35-3_IOC	BARIUM	0.017	MG/L
WELL #14A	09-Jul-13	E3075067	COLIFORM (TCR)	1	
WELL #14A	11-Jul-13	E3079271	COLIFORM (TCR)	1	
WELL #14A	06-Feb-13	E302306-3_RAD	COMBINED RADIUM (-226 & -228)	0.48	PCI/L
WELL #14A	24-Jan-17	E701J39-3	COMBINED RADIUM (-226 & -228)	1.33	PCI/L
WELL #14A	15-Jan-14	E401998-3_WL21	FLUORIDE	0.23	MG/L
WELL #14A	15-Jan-14	E401997-3_IOC	FLUORIDE	0.22	MG/L
WELL #14A	24-Jan-17	E701J35-3_IOC	FLUORIDE	0.2	MG/L
WELL #14A	06-Feb-13	E302306-3_RAD	GROSS BETA PARTICLE ACTIVITY	1.52	PCI/L
WELL #14A	15-Jan-14	E401997-3_IOC	NICKEL	0.0082	MG/L
WELL #14A	24-Jan-17	E701J35-3_IOC	NICKEL	0.01	MG/L
WELL #14A	06-Feb-13	E302305-3_WL16	NITRATE	0.59	MG/L
WELL #14A	21-Jan-14	E401C20-3_WL16_WL56	NITRATE	1.3	MG/L
WELL #14A	13-Jan-15	E501723-1_WL16	NITRATE	0.97	MG/L
WELL #14A	25-Jan-16	E601J48-1_WL16	NITRATE	2	MG/L
WELL #14A	24-Jan-17	E701J35-3_IOC	NITRATE	1.8	MG/L
WELL #14A	21-Jan-14	E401C20-3_WL16_WL56	NITRATE-NITRITE	1.3	MG/L
WELL #14A	24-Jan-17	E701J35-3_IOC	NITRATE-NITRITE	1.8	MG/L
WELL #14A	06-Feb-13	E302306-3_RAD	RADIUM-226	0.18	PCI/L
WELL #14A	06-Feb-13	E302306-3_RAD	RADIUM-228	0.3	PCI/L
WELL #14A	24-Jan-17	E701J39-3	RADIUM-228	1.33	PCI/L
WELL #14A	15-Jan-14	E401997-3_IOC	SODIUM	26	MG/L
WELL #14A	24-Jan-17	E701J35-3_IOC	SODIUM	40	MG/L
WELL #14A	15-Jan-14	E401997-3_IOC	SULFATE	17	MG/L
WELL #14A	24-Jan-17	E701J35-3_IOC	SULFATE	13	MG/L

Risk Factor 4 - History of contaminant detections within the last five years

This was determined by reviewing all contaminant detections in the laboratory records (excluding bacteria, nitrogen, sodium, calcium and magnesium). A risk rating for each contaminant above the detection limit was then assigned based on the Maximum Contaminant Level (MCL). The MCL is based on either Rhode Island or EPA drinking water standards and advisory levels. The highest risk rating observed was used to set the total risk rating for the WHPA. No violations of the standards for regulated contaminants (excluding bacteria and nitrates) were identified. However, there have been detections greater than half the levels considered acceptable by USEPA. This indicates the need for continued monitoring and may indicate the need for future management and/or treatment.

Barium, chromium, DCPA, sodium, nickel, fluoride, and radium-226 were detected in well samples. Levels of chromium, barium, chloroform, and radium were exceeded in several wells and may need continued monitoring.

Additionally, sodium levels have exceeded 20 mg/L in all WHPAs. Calcium, sodium, and magnesium data are not analyzed as contaminants (risk factor 4) as they are naturally occurring. However, sodium is reviewed when levels consistently approach or exceed 20 mg/L because sodium and chloride are indicators of contamination from road salt and can also indicate the presence of other runoff pollutants. The EPA listed sodium on the "drinking water advisory" list with 20 mg/L as the guidance level for those on a restricted sodium diet (EPA 822-R-09-011, 2009 Edition of the Drinking Water Standards and Health Advisories, October 2009). This is not an official contamination level; however, sodium concentrations approaching or exceeding 20 mg/L should be reported.

Risk Factor 5 - Source Water Bacteria Detections within the last five years

This was determined by viewing all available bacteria data for each well. The number of bacteria sample detections was used to determine the risk rating. Risk factor 5 for North Kingstown Wells 3, 7 and 8 was set at High - Fecal coliform bacteria was detected 1 times. Corrective action was taken and re-sampling revealed that the problem has been corrected.

Risk Factor 6 - Maximum nitrate-nitrogen (N03-N) concentration in the last five years

This was determined by viewing all detections of nitrate-nitrogen in the laboratory record for all the wells in the WHPA. The maximum observed nitrate-nitrogen value was 0.08 mg/L N03-N. This nitrate-nitrogen value corresponds with a risk rating of low - nitrate levels in groundwater have been consistently low.

The yearly maximum and average nitrogen values for the WHPA were plotted and the data reviewed for trends. There does not appear to be an observable upward or downward trend in nitrate-nitrogen values in the WHPA.

Risk Indicator	Rating (Score)			
	Low (0)	Medium (5)	High (10)	Extreme (25)
4. History of contaminant detections within the last 5 years	Trace (Maximum value is less than 10% of MCL)	Less than ½ MCL	Greater than Y MCL	Greater than MCL (violation)
5. Source water bacteria detections within the last 5 years	Less than 5% of samples have detected total coliform	Greater than 5% of samples have detected total coliform	One or more Fecal coliform samples exhibit a detection	One or more Fecal coliform samples is above water quality standards*
6. Maximum nitrate-nitrogen (N03-N) concentration in the last 5 years	< 0.5 mg/L N03-N	0.5-2 mg/L N03-N	2-5 mg/L N03-N	>5 mg/L N03-N

*It is assumed for the purposes of the SWAP that if fecal coliform samples are found to be in violation that the cause of the contamination was identified and corrected. Therefore, no bacterial samples are ranked in the extreme category.

Additional Optional Assessment Steps: Impervious Surface Analysis

Although an impervious cover analysis is not included as a risk assessment indicator it is an important consideration when performing a pollution risk assessment. A high amount of impervious surface generally is associated with higher amounts of stormwater runoff.

Stormwater runoff can transport harmful contaminants into surface water bodies as it flows over impervious surfaces such as roads, parking lots and commercial facilities. Impervious surfaces also impede precipitation from reaching groundwaters, reducing recharge. The risk rating scale for percentage of impervious surface is as follows:

Risk Indicator	Rating			
	Low	Medium	High	Extreme
Percentage of impervious surface in WHPA	<10%	10-14%	15-25%	>25%

Impervious surface coverage for the WHPAs protecting North Kingstown was calculated in ArcView 9.3 (ESRI) using the Rhode Island Impervious Surface Coverage available from RIGIS (Rhode Island Geographic Information System). The percentage of impervious surface found in the WHPA protecting North Kingstown is shown below.

WHPA NAME	Percent Impervious Area	Risk Rating
Saunders	4.75%	Low
Annaquabucket	8.83%	Low
Wickford Junction	17.71%	High
Northern Hunt	25.22%	Extreme

REFERENCES

Friesz, P.J, 2012, Evaluating Prediction Uncertainty of Areas Contributing Recharge to Well Fields of Multiple Water Suppliers in the Hunt- Annaquabucket, Pettaquamscutt River Basins, Rhode Island: U.S. Geological Survey Scientific Investigations Report 2012-5114, 46p, at <http://pubs.usgs.gov/sir/2012/5114/>.

Rhode Island Geographic Information Systems (RIGIS), Geospatial Data, Available at <http://www.edc.uri.edu/RIGIS/>.

Rhode Island Department of Health, 2007, Sanitary Survey Report for the Westerly Water Department. Obtained from Rhode Island Department of Health.

Rhode Island Department of Health and URI NEMO Program, 2010, Guide to Updating Source Water Assessments and Protection Plans.

Rhode Island and Providence Plantations, Rules and Regulations Pertaining to public Drinking Water, as Amended April 2009, R46-13-DWQ

USEPA National Primary Drinking Water Regulations (Factsheet), EPA 816-F-09-004, May 2009

2009 Edition of the Drinking Water Standards and Health Advisories, October 2009, EPA 822-R-09-011

ATTACHMENT 1: EXPLANATION OF RISK RATING SYSTEM (from 2010 Guide to Updating SWAPs).

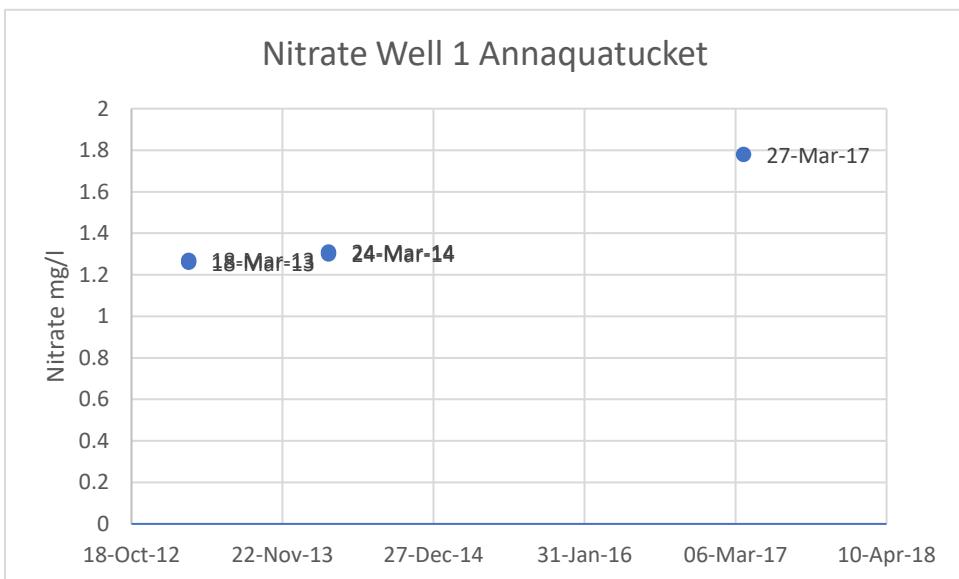
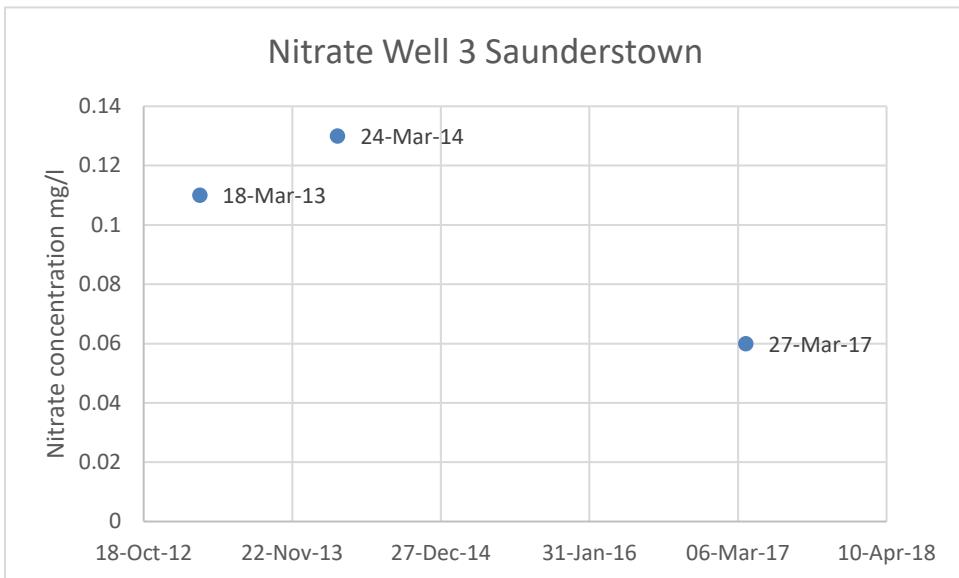
Wellhead Protection Area RISK INDICATOR	RATING				Wells 3, 7 & 8 Results	Wells 3, 7 & 8 Rating
	Low 0	Medium 5	High 10	Extreme 25		
Wellhead Protection Area land use						
1. High intensity land use.	< 10%	10 - 24%	25 - 40%	> 40%	8%	0
Existing or potential pollution sources						
2. Pollution sources within inner protective radius (400' or 200') of well.	0	1	2 - 3	> 3	Nd ²	5
3. Pollution sources per acre throughout WHPA, excluding inner protective radius. Multiply this number by 10.	< 0.1	0.1 • 0.5	0.5 - 1	> 1	Nd ²	5
Water quality						
4. History of contaminant detects within last 5 years.	Trace ¹	≤1/2 MCL	>1/2 MCL	Violation	>1/2 MCL	10
5. Source water Bacteria detects within 5 years.	none	Total coliform detection	Fecal coliform detected; cause identified and corrected	Fecal coliform violation	1 Fecal coliform detection	10
6. Maximum nitrate-nitrogen (NO ₃ -N) concentration in last 5 years.	≤.5 mg/l	.5 - 2 mg/l	> 2 - 5 mg/l	> 5 mg/l	0.08 mg/L	0
Maximum	0	30	60	150		
Overall Ranking - Sum of all risk ratings.	0 - 19	20 - 59	60 - 100	> 100		30

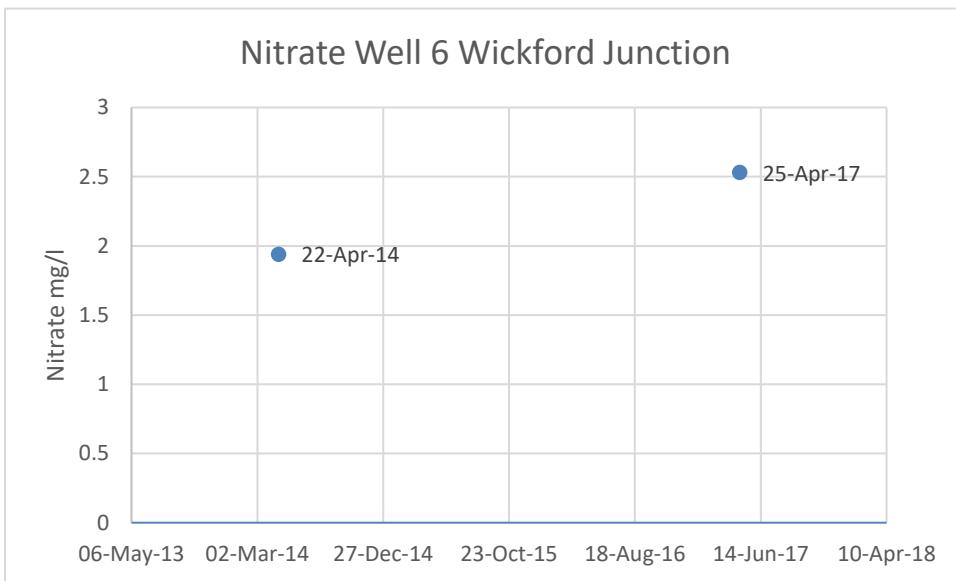
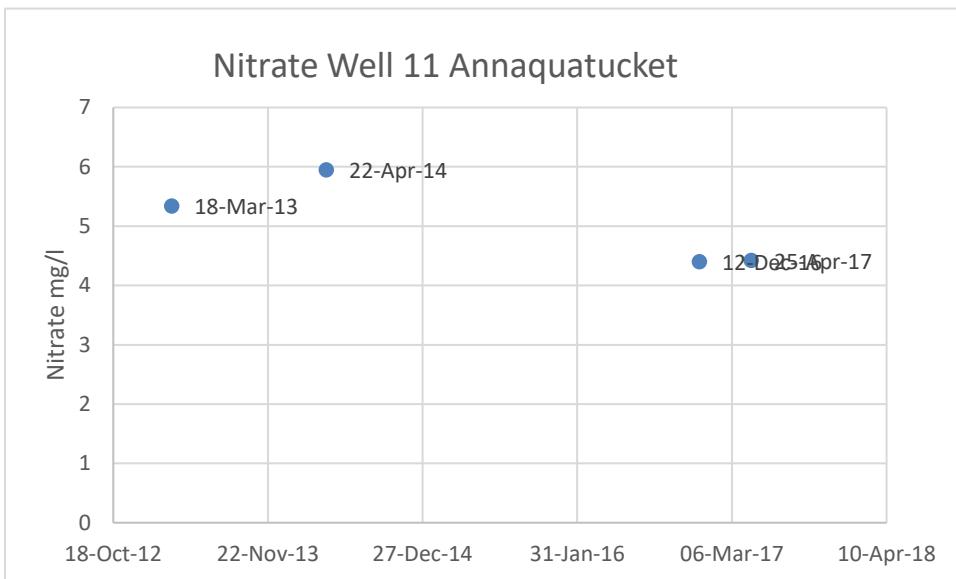
Notes:

¹ Trace = Less than 10% contaminant MCL

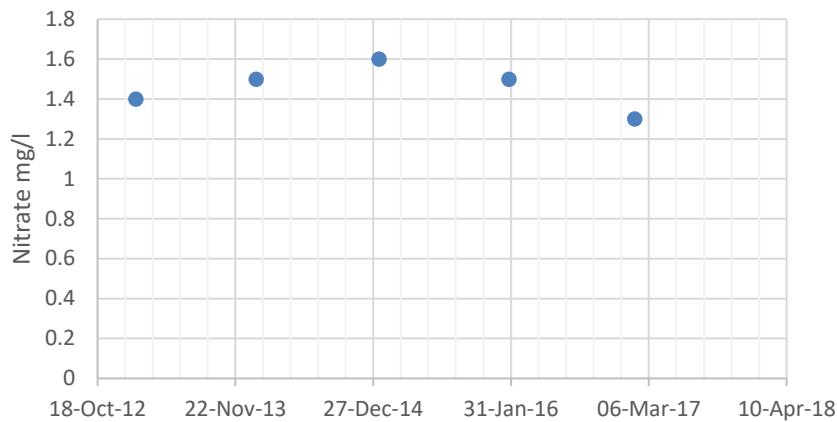
² Indicates that no data is present for this risk indicator, therefore the risk rating of moderate is automatically assigned. Although the data is not available there may still be pollution sources present

**ATTACHMENT 2: DEPARTMENT OF HEALTH RECORDS FOR
CONTAMINANTS, BACTERIA, AND NITRATES**

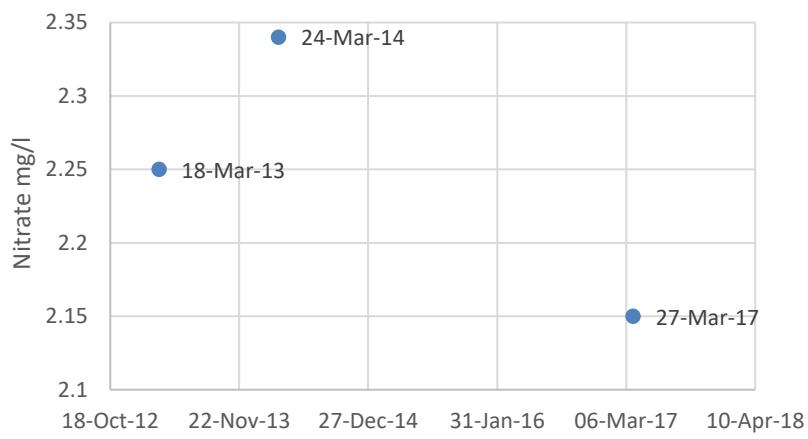




Nitrate Well 3 Northern Hunt



Nitrate Well 9 Northern Hunt



Nitrate Well 14A Northern Hunt

