



The  
NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES

hereby issues

LARGE GROUNDWATER WITHDRAWAL PERMIT

NO. LGWP-2009-0002

to the permittee

HAMPSTEAD AREA WATER COMPANY  
54 SAWYER AVENUE  
ATKINSON, NH 03811  
(603-362-4299)

for the withdrawal of the following volumes of groundwater from the following wells for the purpose of community water supply:

Fieldstone Well Field

HWC-FS1	56,160 gallons over any 24-hour period
HWC-FS1 and FS-4E	a combined total of 57,600 gallons over any 24-hour period

Settlers Ridge Well Field

HWC-SR3	136,800 gallons over any 24-hour period
HWC-SR4 and EPA 10	a combined total of 154,080 gallons over any 24-hour period from November 1 <sup>st</sup> through April 30 <sup>th</sup>
	a combined total of 56,160 gallons over any 24-hour period from May 1 <sup>st</sup> through October 31 <sup>st</sup>

Date of Issuance: December 18, 2009  
Date of Amendment: October 1, 2013  
Date of Expiration: December 18, 2019

Pursuant to authority in N.H. RSA 485-C:21, the New Hampshire Department of Environmental Services (NHDES), hereby grants this permit to withdraw groundwater from wells HWC-FS1, FS-4E, HWC-SR3, and HWC-SR4 subject to the following conditions:

1. The permittee shall comply with the requirements of Env-Wq 403 (formerly Env-Ws 388) and RSA 485-C at all times.
2. Water Conservation: The permittee shall implement the approved Water Conservation Plan, dated May 8, 2008, in accordance with Env-Wq 2101 (formerly Env-Ws 390) and NHDES' approval dated June 5, 2008.
3. Metering Requirements: Withdrawals from all sources must be metered at all times. All meters must be selected, installed, tested, and maintained in accordance with the AWWA M6 manual as referenced in Env-Wq 2101. The permittee shall provide NHDES with a certificate of calibration and performance specifications for each meter. The permittee shall document and maintain records of all meter maintenance and calibration activities and submit this information to NHDES in an annual report by January 31 of each year. The permittee shall read source water meters to adequately report the following volumes to the reporting program referenced in condition No. 6 of this permit:
  - a) The 24-hour peak day volume withdrawn from each source during each month and the date the water use occurred; and
  - b) The cumulative total volume withdrawn from each source during each month.
4. Monitoring and Reporting Requirements: The permittee shall establish and maintain the monitoring and reporting program as described below:
  - a) Groundwater Level Monitoring
    - i. Off-site Private Bedrock Well: The permittee shall install a pressure transducer and data logger and measure water levels at a frequency of at least once every four hours in the private bedrock well serving the following property. Water level monitoring shall commence six months prior to initiating a withdrawal from HWC-SR3 and shall continue indefinitely as a condition of this permit.

Property Identification Number	Property Address
20090002DW01	

- ii. Off-site Public Water Supply Well: The permittee shall install a pressure transducer and data logger and measure water levels at a frequency of at least once every four hours in the following public water supply well. Water level monitoring shall commence three months prior to increasing the withdrawal from HWC-SR4 and shall continue indefinitely as a condition of this permit.

Water System Name	Source
Commons of Atkinson (PWS ID 0112060)	20090002PWSW01

- iii. On-site Production Wells: The permittee shall install pressure transducers and data loggers and measure water levels at a frequency of at least once every four hours in HWC-SR3 and HWC-SR4. Water level monitoring shall commence upon initiating a withdrawal from HWC-SR3 or HWC-SR4 and shall continue indefinitely as a condition of this permit. HWC-SR3 = 20090002PWSR3  
HWC-SR4 = 20090002PWSR4

Wells that supply drinking water shall be sampled for coliform bacteria [in accordance with Env-Wq 403.14(e)(5) and Env-Wq 403.14(g)] prior to and after the installation of any monitoring equipment.

If a well owner denies permission to monitor water levels or if the identified well cannot be monitored due to a structural limitation, then the permittee shall propose an alternative monitoring location to NHDES for approval. Upon receiving approval from NHDES, the permittee shall install the monitoring well, if a suitable alternative well is not already available, and monitor water levels at the alternative location at the same frequency required at the original monitoring well.

b) **Surface Water Monitoring:** The permittee shall implement the surface water monitoring program of Stewart Farm Pond and its outlet stream as described in the submittal titled "Large Groundwater Withdrawal Permit 2009-0002 HWC-SR4 Proposed Permit Modifications," prepared by Hampstead Area Water Company (HAWC), dated August 13, 2013, incorporated herein by reference, subject to the following conditions:

- i. Surface water level and flow measurements shall be collected using the methods described, and at the frequency described, at station HWC-SW1 in Stewart Farm Pond and the weir proposed in the outlet stream. 20090002SWSFPST
- ii. The permittee shall perform a minimum of two consecutive years of surface water monitoring prior to seeking approval for the year-round use of HWC-SR4 at a production rate of 154,080 gallons over any 24-hour period.

The surface water monitoring program shall continue indefinitely as a condition of this permit. All work shall be conducted under the direct oversight of a qualified professional. Results of the surface water monitoring must provide a determination as to whether or not an adverse impact has occurred, may occur, or has not occurred over the monitoring period.

c) **Wetlands Monitoring:** The permittee shall implement the wetlands monitoring program as described in the above-referenced submittal, incorporated herein by reference, subject to the following conditions:

- i. Monitoring shall occur using the methods described, and at the frequency described, at wetland monitoring plots HWC-WT Plot 1, HWC-WT Plot 2, and HWC-WT Plot 3, established by Meridian Land Services, Inc.
- ii. During the first year of monitoring, three surveys of the wetland plots shall be completed at the following times: when the plots are established, between August 1 and August 30, and near the end of the growing season.
- iii. As part of the first annual wetlands monitoring report submitted to NHDES, the permittee shall submit the following: 1) a site plan depicting the locations of the wetland plots; 2) a functions and values assessment of plots HWC-WT Plot 1 and HWC-WT Plot 2; and 3) results of the initial surveys of the wetland plots, performed in accordance with Env-Wq 403.25.
- iv. During subsequent years of monitoring, one survey of the three wetland plots shall be completed annually between August 1 and August 30.

- v. The permittee shall perform a minimum of two consecutive years of wetlands monitoring prior to seeking approval for the year-round use of HWC-SR4 at a production rate of 154,080 gallons over any 24-hour period.

The wetlands monitoring program shall continue indefinitely as a condition of this permit. All work shall be conducted under the direct oversight of a New Hampshire Certified Wetland Scientist. Results of the wetlands monitoring and surveys must provide a determination as to whether or not an adverse impact has occurred, may occur, or has not occurred over the monitoring period.

- d) All monitoring shall be completed by a person who can demonstrate, by education or experience, competency in collecting and reporting hydrogeologic measurements.

Monitoring locations and frequencies may be added or changed if the data obtained contradict the information provided in the permittee's application, or if additional data points are required to assess the potential for adverse impacts to occur.

An annual monitoring report and all monitoring data shall be submitted to NHDES annually by January 31 of each year. The annual monitoring report shall note any relevant observations that may affect the measurements and include all field notes documenting the monitoring activities for the preceding year.

The annual monitoring report shall be submitted in an electronic format and hard copy format. All groundwater level monitoring data collected under condition No. 4a and surface water monitoring data collected under condition No. 4b shall be submitted in an electronic format only.

## 5. Mitigation Requirements

- a) In the event that an adverse impact occurs, the permittee shall comply with all of the requirements below and with the impact mitigation and source replacement requirements of Env-Wq 403.
- b) Prior to initiating the large groundwater withdrawal, the permittee shall notify in writing via certified mail the owners of all properties served by private wells or public wells not owned by the permittee within the areas estimated to be the influence areas of wells HWC-FS1, FS-4E, HWC-SR3, and HWC-SR4, as illustrated on Figure 1, titled "Maximum 180-Day Zone of Influence and Projected Drawdown, Fieldstone Well Field," and Figure 2, titled "Maximum 180-Day Zone of Influence and Projected Drawdown, Settlers Ridge Well Field," included in the Final Report Addendum titled "Response to NHDES Comments (June 29, 2009), Final Well Siting Report, Hampstead Area Water Company, Walnut Ridge Water System, Groundwater Development at the Fieldstone and Settlers Ridge Well Fields," prepared by Emery & Garrett Groundwater, Inc., dated August 18, 2009. The permittee shall provide a copy of the notification letter and copies of the certified mail return receipts to NHDES. The permittee shall explain to property owners with wells in the identified areas that their well may be influenced by the withdrawal at either HWC-FS1, FS-4E, HWC-SR3, or HWC-SR4 and that a Source Replacement Plan is available and that a copy could be provided to them

at their request. The Source Replacement Plan, titled "Groundwater Development at the Fieldstone and Settlers Ridge Well Fields, Source Replacement Plan," dated October 27, 2009, was prepared by HAWC, and submitted to NHDES as part of HAWC's November 4, 2009 response to NHDES' review letter dated October 29, 2009. The permittee shall provide the property owners with contact information for both the permittee and NHDES in the event they believe they may be adversely impacted by the withdrawal.

- c) The permittee shall maintain the Emergency Well Services Contract included in the letter submitted to NHDES by HAWC, dated November 4, 2009, or an equivalent contract with a company capable of providing pump- and well-related services, including the drilling of new wells, for the term of this permit, so that in the event of an adverse impact to a public or private well, mitigation steps can be undertaken expeditiously.
- d) Where the status of an unanticipated impact is not clear, the permittee shall gather information needed to quantify the impact and determine its status relative to the adverse impact criteria defined under RSA 485-C:21 V-c and provide this information to NHDES within 48 hours of being notified by NHDES. A verified adverse impact shall be mitigated in accordance with Env-Wq 403.
- e) NHDES will routinely review the results of all monitoring data, and if water level monitoring data indicate that groundwater is being extracted at a rate that exceeds natural recharge on average, then NHDES will modify the permit in accordance with Env-Wq 403 in order to prevent adverse impacts from occurring. In addition, the permittee shall operate HWC-SR4 in accordance with the management procedures described below.

#### MANAGEMENT PROCEDURES

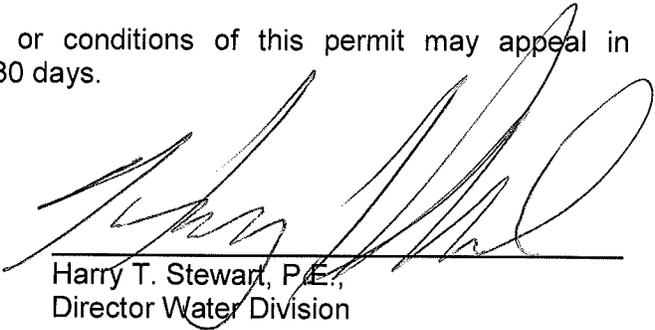
As part of these management procedures, the permittee shall obtain and review the water level monitoring data collected in HWC-SR4 and Well #1 serving the Commons of Atkinson public water system per condition No. 4a of this permit during the last calendar week of each month. The permittee shall submit the water level monitoring data, associated data plots, and combined daily production volumes from HWC-SR4 and EPA 10 electronically to NHDES by the last calendar day of each month.

In the event that the water level measurements submitted to NHDES as part of these management procedures indicate that production from HWC-SR4 is adversely impacting the Commons of Atkinson public water supply well and the adverse impacts will continue, the combined withdrawal from HWC-SR4 and EPA 10 shall be reduced to 56,160 gallons over any 24-hour period until an NHDES-approved impact mitigation program is implemented.

- 6. The permittee shall register its new sources of water with the NHDES Water Use Registration and Reporting Program and maintain the water use reporting requirements established by RSA 488, Env-Wq 2102 and this permit.
- 7. The permittee shall apply for renewal of this permit at least 365 days prior to its expiration date in accordance with Env-Wq 403. The permittee shall continue to comply with all conditions in this permit until the permit is renewed or the facility is

closed in accordance with all applicable requirements, regardless of whether a renewal application is filed.

Any person aggrieved by any terms or conditions of this permit may appeal in accordance with RSA 21-O:7, IV within 30 days.



Harry T. Stewart, P.E.,  
Director Water Division

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## DECISION STATEMENT AND PROJECT NARRATIVE

### Large Well Siting Approval/Large Groundwater Withdrawal Permit LGWP-2009-0002 Walnut Ridge/Bryant Woods Water System, Hampstead Area Water Company, EPA ID 0112080 Wells HWC-FS1, FS-4E, HWC-SR3, and HWC-SR4 Atkinson, New Hampshire

December 18, 2009

#### 1.0 BACKGROUND

Hampstead Area Water Company (HAWC) has submitted an application to the New Hampshire Department of Environmental Services (the Department) requesting approval of four large community production wells and issuance of a large groundwater withdrawal permit for the withdrawal of up to 194,400 gallons per day (gpd) or 135 gallons per minute (gpm) over a 24-hour period to serve the Walnut Ridge/Bryant Woods water system (EPA ID 0112080) in Atkinson, New Hampshire. HAWC is requesting approval for: the combined withdrawal of up to 57,600 gpd (40 gpm) from wells HWC-FS1 and FS-4E; the withdrawal of up to 136,800 gpd (95 gpm) from well HWC-SR3; and the use of well HWC-SR4 as a mechanical back-up to existing production well EPA 10 at a production volume of 56,160 gpd (39 gpm).

HWC-FS1 and FS-4E are located in southwestern Atkinson west of Fieldstone Lane in the proposed Fieldstone well field approximately 300 feet north of the Salem-Atkinson town line in an area of undeveloped woodland adjacent to the Atkinson Resort and Country Club (ARCC) golf course.

HWC-SR3 and HWC-SR4 are located in central Atkinson between West Side Road and NH Route 121 in the existing Settlers Ridge well field approximately 600 feet northwest of Pope Road in an undeveloped open-space area associated with the Settlers Ridge development approximately 840 and 350 feet west of Stewart Farm Pond, respectively.

The purpose of developing the new community production wells is to: 1) address chronic water shortages experienced by the water system over the last 5+/- years; 2) offset recorded losses in yield from the system's other groundwater sources; 3) provide source redundancy for production wells that currently serve the water system; and 4) accommodate potential increases in water demand based on historic water use trends and projected future growth in areas served by the water system.

The wells are located within the upper reaches of the Lower Spicket River watershed. The Spicket River drains the western portions of Atkinson via Hog Hill Brook and Providence Hill Brook, flowing southward through Salem, New Hampshire eventually flowing into the Merrimack River in Lawrence, Massachusetts. The potential impact area for the withdrawals from the wells encompasses approximately 5.2 square miles of the western-facing slopes of the Spicket River watershed and is bounded on the west, south, and east by Providence and Hog Hill Brooks, Captain Pond, and a regional watershed divide, respectively. The northern limit of the potential impact area is defined by a topographic divide. In the down-gradient direction, the potential impact area extends to the confluence of Providence Hill Brook and Captain Pond Brook in Salem.

Moderate topographic relief and thin soils characterize the areas proximal to the well fields. Small wetlands are scattered throughout the watershed within which the well fields are located, with more extensive wetlands occurring near the Settlers Ridge well field.

Emery & Garrett Groundwater, Inc. (EGGI's) mapping and geologic well logs show that large portions of the areas proximal to the wells are underlain by granites or granite gneisses, and that pegmatite dikes are locally abundant and highly fractured. The water-bearing capacity of the bedrock units underlying the area is dependent on the presence of fractures, faults, or other brittle bedrock structures. The glacial geology of the area largely consists of a relatively thin veneer of glacial till over shallow bedrock.

At the Fieldstone well field, results of geophysical surveys and drilling indicate that bedrock occurs at or generally within 10 feet of the ground surface. Well FS-4E was completed as part of a previous exploration program undertaken by HAWC, as such, little was initially known about the depths of individual water-bearing fracture zones within the well; however, subsequent packer testing of the well undertaken by EGGI indicates that a significant water-bearing fracture zone is not present within the upper 189 feet of the borehole. HWC-FS1 encountered bedrock at 6 feet below ground and was completed in bedrock to a depth of 450 feet; water-bearing fracture zones were intercepted at depths of 95, 250, 378, and 418 feet.

At the Settlers Ridge well field, results of geophysical surveys and drilling indicate that bedrock occurs at depths ranging from 0 to 35 feet beneath the ground surface; surficial materials at the site consist of till and weathered bedrock. It is reported that HWC-SR3 encountered 30 feet of glacial till, and was completed in bedrock to a depth of 500 feet; four water-bearing fracture zones were intercepted at depths between 152 and 275 feet. HWC-SR4 penetrated 50 feet of glacial till and weathered bedrock and was completed in bedrock to a depth of 450 feet; two main water-bearing fracture zones were intercepted at depths of 123 and 144 feet.

## **2.0 WITHDRAWAL TESTING AND CONCLUSIONS**

Withdrawal testing programs were conducted by EGGI at the Fieldstone and Settlers Ridge well fields from September 8 through October 22, 2008 and October 29 through November 22, 2008, respectively. The purpose of withdrawal testing is to provide data to estimate long-term sustainable water quantity and quality; observe the response of the aquifers to pumping; evaluate the degree of hydraulic connection with overlying deposits and, assess the potential for adverse impacts to water resources and users that may result from the proposed withdrawals. Details and results of the withdrawal testing program conducted at each well field are summarized below.

### Fieldstone Well Field

The withdrawal testing program at the Fieldstone well field included monitoring during pre-pumping, pumping, and water level recovery periods, during two separate tests as follows:

- Test 1 – HWC-FS1 was pumped between September 16 and 23, 2008; the pumping rate during the final 6 days of the test was 40 gpm. FS-4E was not pumped during this test; and

- Test 2 – FS-4E was pumped at 40 gpm from October 6 through 14, 2008 and HWC-FS1 was pumped at 20 gpm from October 7 through 14, 2008, resulting in the wells being pumped simultaneously for seven consecutive days.

Production from the wells during the pumping portion of the test was maintained at a constant rate and water quality samples were collected to characterize the quality of the water derived from the wells.

During the withdrawal testing program, water level measurements were collected at: HWC-FS1 and FS-4E; one off-site bedrock well that previously served the water system but is inactive; one off-site bedrock well that the ARCC uses as a source of irrigation water; three on-site bedrock monitoring wells; and nine off-site private bedrock water supply wells including eight in the town of Salem and one in the town of Atkinson. The private water supply wells are located mostly to the south and southeast of the well field, with one well to the southwest of the well site, at distances ranging from approximately 540 feet to 2,600 feet from HWC-FS1 and FS-4E. No private wells were identified north of the well site for a distance in excess of one mile due to the expanse of the golf course in the area and the water system's service area.

Water level measurements collected during the withdrawal testing program indicate that the three on-site bedrock monitoring wells responded to pumping of HWC-FS1 and FS-4E. During the second pumping test, the pumping-induced drawdown of water levels ranged from approximately 2 to 80 feet in these wells and was greatest in wells closest to the production wells. Water levels in HAWC's inactive production well, ARCC's irrigation well, and the private water supply wells did not show any apparent response to the pumping of HWC-FS1 and FS-4E.

Based on graphical projections of water level responses that assume 180-days with no net recharge to the bedrock aquifer, and inference from the revised geologic model for the site, pumping-induced drawdown is estimated to extend approximately 1,200 to 1,600 feet [southeast/west to northwest] of the well field. Areas where the greatest amount of pumping-induced drawdown is estimated to occur underlie the ARCC property.

Given the amount of pumping-induced drawdown observed in HWC-FS1 and FS-4E, the hydraulic connection between the two wells, and the depth of the water-bearing fractures in FS-4E; EGGI revised its recommended capacity of the combined yield from the well field from 60 gpm to 40 gpm to ensure that water levels in the wells remain above water-bearing zones. Based on water level observations made during the withdrawal testing program and projected drawdowns, withdrawals from HWC-FS1 and FS-4E do not present the potential to cause an adverse impact, and a production rate of 57,600 gpd (40 gpm) is a production rate that the wells and the geologic formation can sustain.

Results of the water quality sampling conducted during the withdrawal testing program indicate that each parameter, with the exception of arsenic, iron, manganese, and pH, was below the applicable Maximum Contaminant Level (MCL) or Secondary Maximum Contaminant Level (SMCL). Results of the water quality sampling program also indicate that the concentration of radon is elevated in water derived from HWC-FS1 and FS-4E.

### Settlers Ridge Well Field

The withdrawal testing program at the Settlers Ridge well field included monitoring during pre-pumping, pumping, and water level recovery periods. During the withdrawal testing program, HWC-SR3 was pumped at 95 gpm from November 6 through 14, 2008 and HWC-SR4 was pumped at 107 gpm from November 7 through 14, 2008, resulting in the wells being pumped simultaneously for seven consecutive days. Production from the wells during the pumping portion of the test was maintained at a constant rate and water quality samples were collected to characterize the quality of the water derived from the wells.

During the withdrawal testing program, water level measurements were collected at: HWC-SR3 and HWC-SR4; three (two off-site and one on-site) bedrock wells that serve the water system; two off-site bedrock wells that previously served the water system but are inactive; two off-site bedrock wells that serve another community water system; two on-site bedrock monitoring wells; four on-site piezometers; three on-site surface water staff gages; one stream flow weir in the outlet stream of Stewart Farm Pond; and nine off-site private water supply wells including eight bedrock wells and one dug well.

Piezometer and surface water level and flow measurements were recorded to assess the degree of hydraulic connection between the bedrock aquifer, shallow overburden, and Stewart Farm Pond and associated wetlands. The private water supply wells are located at distances ranging from approximately 800 to 3,100 feet from HWC-SR3 and HWC-SR4.

Based on observations made during the withdrawal testing program, it was determined that HWC-SR3 and HWC-SR4 are not hydraulically connected to each other and do not appear to capture groundwater from different bedrock fracture networks that are not hydraulically connected, as evidenced by relatively distinct water level responses at the production wells and monitoring locations. As such, the monitoring locations can be grouped by whether the observed water level response was the result of pumping HWC-SR3 or HWC-SR4.

#### *Well HWC-SR3*

Based on the monitoring results, the pumping of HWC-SR3 resulted in pumping-induced drawdown in five private bedrock water supply wells monitored. Water level drawdown in the two most influenced (and closest) private wells ranged between 14 and 33 feet, with projected drawdown estimates, assuming 180-days of continuous pumping of HWC-SR3 with no recharge, ranging between 22 and 79 feet. Water level influences on the other three private wells were slight, with projected drawdowns generally less than approximately 4.5 feet. In general, the private wells influenced by HWC-SR3 were located to the east of the well site.

Relative to available information about the private wells, projected drawdowns on the order of that observed under an assumed condition of constant pumping of HWC-SR3, do not cause an adverse impact as defined by RSA 485-C:21-V. To verify this assessment, long-term monitoring of water levels in private wells is required as a condition of the large groundwater withdrawal permit for the use of HWC-SR3 [see attached].

*Well HWC-SR4*

Based on the monitoring results, the pumping of HWC-SR4 resulted in pumping-induced drawdown in the on-site bedrock well that serves the water system (EPA 10); two off-site bedrock wells that serve the neighboring water system; two on-site bedrock monitoring wells; one on-site piezometer; a private water supply well approximately 2,500 feet to the north-northwest of the well site; and flow leaving Stewart Farm Pond.

Drawdown of water levels ranged from approximately 35 to 51 feet in the on-site wells influenced by pumping of HWC-SR4. In each of the two wells serving the neighboring water system, pumping-induced drawdown was approximately 9 and 14 feet; based on graphical projections of the water level responses, pumping-induced drawdown in these wells after 180-days with no net recharge to the bedrock aquifer, is estimated to be approximately 20 and 29 feet. Approximately 0.5 feet of pumping-induced drawdown was observed in the private well influenced by HWC-SR4; based on a graphical projection of its water level response, pumping-induced drawdown in this well after 180-days with no recharge is estimated to be approximately 2 feet. In the on-site piezometer, approximately 0.10 feet of pumping-induced drawdown was observed.

Observations of surface water flow in the stream outletting Stewart Farm Pond during the withdrawal testing program indicate that the withdrawal from HWC-SR4 did affect flow leaving the pond. A hydrograph analysis of the stream flow data suggests that on the order of 37 gpm was captured by pumping HWC-SR4 as induced infiltration or captured groundwater discharge; a value which represents greater than 50% of flow leaving the pond during the withdrawal testing program.

Based on the results of the withdrawal testing program, specifically, impacts to water levels in wells serving the neighboring water system and flow in the Stewart Farm pond outlet stream; HAWC revised its request to permit HWC-SR4 at this time as a new large groundwater withdrawal well. Alternatively, HAWC requested approval for use of the well as a mechanical backup to existing production well EPA 10.

No responses to pumping HWC-SR3 or HWC-SR4 were observed in the two off-site bedrock wells that serve the water system; the three other on-site shallow piezometers; and the three on-site surface water staff gages in the pond.

Based on graphical projections of water level responses at the monitoring points that responded to pumping HWC-SR3 (assuming 180-days of continuous pumping at 95 gpm with no recharge), pumping-induced drawdown is estimated to extend approximately 1,500 to 2,400 feet to the south and northeast of the well with the most influence at points closest to well.

Results of the water quality sampling conducted during the withdrawal testing program indicate that each parameter, with the exception of iron, manganese, and pH, was below the applicable MCL or SMCL.

### **3.0 PUBLIC INVOLVEMENT**

Pursuant to RSA 485-C:21, II through V-a, materials submitted in support of the large groundwater withdrawal permit (the preliminary application, final report, and supplemental materials) were sent (via certified mail) to municipalities and public water suppliers in the potential impact area of the withdrawals. Municipalities that were sent copies of the above-referenced materials are the towns of Atkinson and Salem. Public water suppliers that were sent copies of the above-referenced materials are Water Wheel Estates, Wright Farm Condominiums, the Commons of Atkinson, Camp Hadar, and Camp Otter.

On April 8, 2008, the town of Atkinson requested a public hearing following submittal of the preliminary application; the Department subsequently held a public hearing on the application in Atkinson on May 7, 2008. At the hearing, a summary of the regulations governing large groundwater withdrawals was presented by the Department, a project summary was presented by EGGI, a question and answer session was held, and oral testimony was recorded. After the public hearing, the 45-day written comment period on the application commenced, and closed on June 21, 2008. Testimony and comments received during the public hearing and written comment period related to the issue of one permit application being submitted for withdrawals from multiple well fields; the water system's need for additional water supply capacity; potential impacts on the quantity and quality of water derived from private wells and wells serving other community water systems; how adverse impacts would be mitigated; potential impacts on water-dependent natural resources; and whether groundwater recharge is adequate to sustain the withdrawals. Oral and written comments were considered during the Department's review of the preliminary application and proposed withdrawal testing program.

On April 1, 2009, the town of Atkinson requested a public hearing following submittal of the final report; the Department subsequently held a public hearing on the report in Atkinson on April 28, 2009. At the hearing, a summary of the regulations governing large groundwater withdrawals was presented by the Department, results of the withdrawal testing program were presented by EGGI, a question and answer session was held, and oral testimony was recorded. After the public hearing, the 45-day written comment period on the report commenced, and closed on June 15, 2009. Testimony and comments received during the public hearing and comment period related to the water system's need for additional water supply capacity; the water system's use of the water and water conservation efforts; land uses in close proximity to the well sites; potential impacts on the quantity and quality of water derived from private wells; adequacy of the duration and timing of the withdrawal testing programs; potential impacts on water-dependent natural resources; and long-term monitoring requirements. Oral and written comments were considered during the Department's review of the final report.

Section 5.0 below presents the Department's responses to comments received as part of the hearings held pursuant to RSA 485-C:21 V, and during the associated written comment periods.

### **4.0 LARGE GROUNDWATER WITHDRAWAL PERMIT PUBLIC NOTIFICATION, MONITORING, REPORTING AND WITHDRAWAL REQUIREMENTS**

To provide a means for notification in the event of an unforeseen impact, the large groundwater withdrawal permit requires HAWC to notify any property owner with a private or public well within the estimated zones of influence of HWC-FS1 and FS-4E and HWC-SR3 prior to initiating

a large groundwater withdrawal from the wells. As part of the notification, HAWC must explain to each property owner that their well may be influenced by the withdrawals at the production wells and provide them with contact information at HAWC and the Department in the event they believe their well may be impacted by the withdrawal. More information concerning this requirement is provided in the large groundwater withdrawal permit under condition No. 5.

In association with the use of HWC-SR3, the large groundwater withdrawal permit requires HAWC to conduct a water level monitoring program that includes monitoring of the production well and off-site private bedrock water supply wells. General monitoring requirements are summarized as follows:

- On-site well – The permit requires that water levels in HWC-SR3 be monitored so that water level fluctuations in off-site monitored wells can be compared to the operation of the production well.
- Off-site wells – The permit requires that water levels in the two private bedrock water supply wells which responded most significantly to pumping HWC-SR3, be monitored to assess the potential for or detect the occurrence of an adverse impact.

The large groundwater withdrawal permit requires a reduction in the withdrawal from HWC-SR3 if:

- Trigger water levels are met or exceeded in off-site monitored wells; or
- The Department determines that the withdrawal is not sustainable based on a review of the monitoring data.

In the event that an adverse impact is reported and verified, an impact mitigation program would be implemented in accordance with conditions of the large groundwater withdrawal permit and Env-Wq 403. The program would implement actions necessary to mitigate the impact including reducing the withdrawal volume or ceasing the withdrawal from the production well(s), establishing water use restrictions for customers of the water system, modifying or replacing an impacted source at no initial capital cost to the user, and expanding (or establishing) a monitoring network to assess the effectiveness of the mitigation program. More information concerning these requirements is provided in the large groundwater withdrawal permit under condition No. 5.

HAWC is required to submit an annual monitoring report in hard copy and electronic format to the Department by January 31<sup>st</sup> of each year. As stipulated in the permit, the annual report shall include a summary of trends and variability observed in the monitoring data, all monitoring data and records required by the permit, and an assessment of the potential impacts associated with the withdrawal from HWC-SR3. Regarding well HWC-SR4, a large groundwater withdrawal permit was not issued for the well due to the fact that use of the well at large groundwater withdrawal rates would require further evaluation of impacts. The annual report will be available to the public for review. A complete description of monitoring and reporting requirements is presented in more detail in the large groundwater withdrawal permit under condition No. 4.

In regard to the use of HWC-FS1 and FS-4E, monitoring of water levels in private water supply wells or water resources is not incorporated into the permit due to the lack of substantial influence of the withdrawals from the wells on these entities.

In regard to the use of HWC-SR4, since HAWC has only requested approval of the well as a back-up supply to production well EPA 10 at a production volume of 56,160 gpd (39 gpm), monitoring of groundwater levels in the wells serving the neighboring water system, the surface water level in Stewart Farm Pond, and stream flow in the tributary of Hog Hill Brook outletting Stewart Farm Pond is not incorporated into the permit at this time. If, in the future, HAWC would like to use HWC-SR4 at a greater production volume, any work necessary to evaluate the effects of the withdrawal on these water users and water resources must be undertaken prior to finalizing the permitting process for the well.

## 5.0 DEPARTMENT RESPONSE TO PUBLIC INPUT

The Department has received several letters and verbal testimony from individuals, one town commission and two homeowners associations, relating to HAWC's application for a large groundwater withdrawal permit. Many of the letters submitted present general questions about the permitting process and do not cite specific items related to this individual permit; refer to and describe other local requirements or approvals that may apply to this application but are unrelated to the groundwater permitting process administered by the Department; or provide statements of opposition to HAWC's application but do not refer to or state any specific concerns or deficiencies with the application or provide any technical reasons as to why the permit should be denied. A subset of the letters submitted to the Department; however, do provide comments that refer to information or data collected as part of the technical evaluation portion of the process, and make statements or recommendations that are contrary to the final decision of the Department to issue a large groundwater withdrawal permit. In accordance with RSA 485-C:21, V, the Department specifically considered legally and technically relevant comments and recommendations made and issues the additional findings below in support of its decision.

Note that some of the comments and recommendations submitted to the Department regarding HAWC's large groundwater withdrawal permit application presented similar items, issues or concerns. Where appropriate, the Department groups the comments into generally similar topic areas and specifically cites comments or recommendations from the input received that presented the most detail, as needed.

### a.) Application and report submittal process

Mr. Bill Bennett (Atkinson resident) provided the following written comment referencing the format of HAWC's preliminary application for a large groundwater withdrawal permit:

*Three geographically distinct well fields were combined into one application for large groundwater withdrawal. We are concerned that this may not have been proper, and the decision to combine those three fields into one application had a perhaps unseen and adverse consequence for citizens of Atkinson:*

*Had there been three separate applications, HAWC would need to justify a planned withdrawal from each site. We question HAWC's ability to adequately justify ANY need*

*for new supply. However, had HAWC been able to justify one such need, the granting of that application would negate the need for the other two applications?*

Mr. Jon Longchamp (Atkinson resident) provided verbal testimony at the public hearing for the preliminary large groundwater withdrawal application stating that he was *concerned about the grouping of multiple well fields and large production wells in one application* and that each well or well field *should be broken out into multiple applications.*

Amendments made to the Groundwater Protection Act in 2007 established that the large groundwater withdrawal permitting process and its requirements apply to instances where multiple wells are proposed to be used by an entity for a given purpose [see RSA 485-C:21,I.]. Specifically, the amendment defined a large groundwater withdrawal as one that is from a well or wells at the same property or for the same place of business. In this instance, the place of business is HAWC's Walnut Ridge/Bryant Woods water system with the intended use for the provision of water to customers of the system. The rationale for the amendment was to avoid an instance where an applicant might consider developing numerous, small volume withdrawals (<40 gpm) within the same aquifer, watershed or impact area and; therefore, circumvent the requirement to adequately assess the impact that this large number of small withdrawals may have on other water users and water-related natural resources. In effect, such an approach would avoid the requirements and evaluation necessary under the large groundwater withdrawal permitting program, even though, in aggregate, the wells or well fields would withdraw more than the large groundwater withdrawal threshold of 57,600 gallons per day which may have overlapping impact areas and/or source water areas.

The Department finds that HAWC's application adequately addresses the application submittal requirement of RSA 485-C:21 by including and considering all of its proposed wells and well fields, and developing a potential impact area based on the aggregate proposed withdrawal volume; in this instance, that 'aggregated' impact area largely incorporates the eastern portion of the Spicket River watershed.

#### **b.) Groundwater well siting issues**

Mr. Bill Bennett (Atkinson resident), the Town of Atkinson Conservation Commission and the Settlers Ridge Condominium Association each submitted comments pertaining to the area immediately surrounding the proposed new wells at the Settlers Ridge well field (inclusive of proposed wells HWC-SR3 and HWC-SR4). Each comment letter provided a concern with, or recommendation to disapprove, the location of the well(s) due to the fact that some portions of the 350 foot protective radius for the proposed wells overlie either surface water [Stewart Farm Pond], the Slade Town Forest, or open space within the common area of the Settlers Ridge Condominium subdivision. Collectively, the comments noted that these areas are not fully under the control of the water system and, as such, may, in the future, be subject to a modification of use.

The purpose for a sanitary protective area (SPA) around a well that is proposed for use in a community water system is to establish an area in the immediate vicinity of the well within which there is minimal risk of groundwater contamination. The requirement to establish an SPA for a community production well comes from administrative rule Env-Dw 302, *Large Production Wells for Community Water Systems* and not the large groundwater withdrawal permitting rules.

Therefore, the Department makes no findings relative to the large groundwater withdrawal permitting process and the location of the wells.

In reference to the community well siting rules and the attached approval for the new community water supply wells issued by the Department for the Settlers Ridge wells, the Department issued a waiver to HAWC for ownership of the SPAs for proposed well HWC-SR3 and HWC-SR4 due to meeting the requirements of Env-Dw 302.31 *Waivers*. The Department finds that the current status of the neighboring parcels as largely non-developed areas meets the intent of Env-Dw 302.06, *Sanitary Protective Area* and approves the locations. The Department finds that the likelihood of those parcels presenting a risk to groundwater quality near the wells is low, and that general developmental limitations for these parcels [designated open space for a nearby subdivision, an open surface water body, and a designated town forest] is a favorable conjunctive use for land near a community water supply well. In addition, HAWC submitted supporting information on the developmental restrictions on the subject parcels in its submittal of June 2008 (preliminary report addendum) and August 2009 (final report addendum).

**c.) Demonstration of Need and appropriateness of application for new sources of water**

Mr. Bill Bennett (Atkinson resident) submitted the following comments pertaining to the basis for HAWC's application for a large groundwater withdrawal permit:

*Justification for the large groundwater withdrawal:*

*...HAWC has applied to DES to produce up to 648,000 gallons per day from new wells. For the year 2007, HAWC's Atkinson metered sales were around 200,000 gallons per day (gpd), and historically had been increasing by only approximately 1000 gpd per year.*

*In light of HAWC's approximately 33% water loss, or approximately 66,000 gallons per day, it would seem that finding and fixing the system leaks would be the most responsible way in which to increase HAWC's effective water supply. At the current growth rate of 1000 gallons/day/year (representing the addition of 5 new customers per year), that "new found" water would supply them for at least the next 50 years. Given Atkinson's state of development, it is unlikely HAWC could experience growth in Atkinson at any faster rate.*

*And in an additional submittal: HAWC's customer-demand growth rate in Atkinson can in no way be interpreted to justify their LGW volume request. Atkinson has little undeveloped land, so the potential for any increase in new customers for HAWC is limited.*

Mr. John Wolters (Atkinson resident), similarly presented a summary of information related to HAWC's unaccounted-for water estimate it provided to the New Hampshire Public Utilities Commission as part of public utility filing requirements, and submitted the following comment relating to the reason for HAWC's large groundwater withdrawal permit application:

*The Department of Environmental Services responded to HAWC's need for additional water because of a shortage at the peak seasonal demand. DES then determined that a*

*large water withdrawal was necessary. The following points were not adequately evaluated in accepting the large water withdrawal application.*

- 1. No large water withdrawal was required to meet the peak seasonal demand.*
- 2. For 2008 HAWC had a 25.97% water loss rate for its entire system.*
- 3. In recent years, the Town of Atkinson had a 36% and 38% water loss rate which currently has not been corrected.*
- 4. DES uses 15% water loss as a reasonable factor. DES has not made a demand to require HAWC to comply with its standard. Instead, DES is authorizing pumping more water to a system filled with leaks, old pipes and a substandard method of distributing water. Perhaps implementing the 15% water loss standard would be expensive to HAWC, however, that would eliminate the need to have a large water withdrawal for the peak demand shortfall.*
- 5. The approved application for a large water withdrawal is being justified, based on faulty estimates. The number of new customers' projected for 2008 to 2014 is 350. For the past 6 years there is no history during high growth periods to reasonably project 50 new customers a year when history shows 6 to 8 new customers a year is the reality.*

RSA 485:61, Rules for Water Conservation requires that all new permit applications for water withdrawals implement water conservation practices. The Department adopted rules (Env-Wq 2101) which establishes the requirement for applicants for a large groundwater withdrawal permit to submit and receive approval for a water conservation plan to meet the requirement of RSA 485:61. The water conservation plan requirements of Env-Wq 2101 are more extensive than and supersede the conservation management plan and demonstration of need requirements under Env-Ws 388.05. The Department finds that the information provided in HAWC's March 24, 2008 preliminary application and May 8, 2008 water conservation plan demonstrates the need for the withdrawal and meets the requirements under the water conservation rules.

As noted in the preliminary application and presented at the public meetings, HAWC's Walnut Ridge/Bryant Woods water system is classified as a large community water system and, as such, is required to meet the design standards of Env-Ws 374, Design Standards for Large Public Water Systems which state that the water system must develop sufficient water source capacity to meet both its peak demand and its average day demand with its largest source out of service. According to water use records submitted by HAWC to the Department's water use reporting program, the water system's average day demand (by month) commonly fluctuates between 190,000 (spring) and 510,000 (summer) gallons per day.

In reference to Section C, Table II (Table Appendix), Table III (page 8), and the existing source evaluation presented in the March 2008 preliminary application, the basis for HAWC's request to develop new sources does not solely include demand from new connections; much of the need for the withdrawal comes from the fact that many of the water system's existing source wells in Atkinson have exhibited a decrease in yield over time and new sources are needed to make up for that lost yield, as well as meet the design standard for a large community water system referenced above. This decrease in capacity of the water system is evidenced by HAWC issuing system-wide exterior water-use bans in the summer of 2002 and the summer of 2007, and implementing a discretionary water use restriction in the summer of 2006 that remains in effect today.

The water conservation plan submitted by HAWC in conjunction with their preliminary application included an estimate of unaccounted-for water at the system of approximately 36% (inclusive of both apparent losses and real losses). HAWC's water conservation plan that was approved by the Department on June 5, 2008 meets the requirements of the water conservation rules by including provisions to conduct annual estimates of unaccounted-for water by comparing source meter readings to service meter readings, implement an ongoing leak detection program, establish a system water pressure management plan, and initiate an educational and outreach program encouraging water conservation practices. Additionally, and in accordance with the requirements of Env-Wq 2101, a condition of the attached large community well approval requires that HAWC submit a response plan within 60-days of the new source approval contained herein to the Department to reduce the percent of unaccounted-for water at the system to below 15% within the next two years. Condition No. 2 of the large groundwater withdrawal permit also requires HAWC to implement the provisions of their approved water conservation plan.

Mr. Jon Longchamp (Atkinson resident) submitted the following comment pertaining to the Department's position on consideration of potential new service connections to the water system due to the fact that these potential connections, in-part, establish the need for the large groundwater withdrawal permit:

*Although not directly stated in the application the majority of the 395 new service connections are related to the proposed Atkinson's Heights Project (388 units) being developed by the parent company of the HAWC, Lewis Builders. This raises serious conflict of interest concerns in my mind with the builder and the water company being one in the same. How is this viewed by NHDES?*

RSA 485-C:21 does not require the Department to conduct a review of individual developers and/or owners of any or all potential future consumers or connections to a water system that is requesting approval for a new large groundwater withdrawal. Additionally, the statute does not give the Department authority to make a subjective determination as to the appropriateness of individual connections to a water system that, when connected, may increase the demand for water supply. Therefore, the Department did not consider the issue of connection ownership in its permit decision, nor does the Department make any findings regarding this issue.

**d.) Impacts on water levels in private water supply wells**

A number of comment letters were received from residents of the town of Atkinson expressing concern that private wells would be dewatered by HAWC's operation of its new wells if permitted. Commonly these letters cited a range of depths for private wells in town being on the order of 300 to 500 feet, and the idea that HAWC's wells, being deeper, would deplete water levels in shallower wells such that they will become dry, or to the point where they are non-usable. None of the letters referred to deficiencies or other aspects of the geologic conceptual model for the impact area or the evaluation program for the proposed withdrawals, or provided other specific technical reasons for the idea that other water supply wells over a broad area would consequently be impacted beyond use as a function of HAWC's use of the new wells. Emblematic of the comments received is the following comment submitted by Mr. Bill Bennett (Atkinson resident):

*People in Atkinson, the large majority of whom get their water from private wells, are concerned about the effect of HAWC's large groundwater withdrawal (LGW) and Hampstead interconnection on their private wells. Most private wells in town are 150 to 400 feet deep; HAWC's wells, 600 to 800 feet deep, have the potential to deplete the water-bearing strata currently accessed by our private wells.*

In a related comment, Mr. Lou Farrell (Atkinson resident) provided verbal testimony following submission of HAWC's final report and presentation of the proposed withdrawal's effects on water levels in private wells near the Settlers Ridge well field. Mr. Farrell stated that he felt that it was not correct or appropriate to approve any groundwater withdrawal if any long-term monitoring related to the effects of the withdrawal is determined to be necessary.

The large groundwater withdrawal permitting process requires an applicant to assess the relative impact that the withdrawal may cause on other water users (Env-Ws 388.16). In reference to the conceptual geologic model developed for the withdrawal site and surrounding area (Env-Ws 388.06), the applicant must estimate a zone of influence and potential impact area of the withdrawal based on the conservative assumption of continuous operation of the withdrawal for a period of 180-days (RSA 485-C:21, V-e.) with no net recharge to groundwater from precipitation. The applicant must inventory water users within the potential impact area, and offer to monitor all water users within 1,000 feet of the withdrawal and representative water users within an area that extends a distance of 1,000 feet from its estimated zone of influence (Env-Ws 388.08 and 388.09), during the withdrawal testing program required by Env-Ws 388.13. The withdrawal testing program thereby collects data and measurements that quantify the actual level of impact that the withdrawal has on other water users and serves to refine the zone of influence of the withdrawal based on observed water level influences.

Following the withdrawal testing program, the applicant gauges the impacts observed against the adverse impact criteria of RSA 485-C:21, V-c, inclusive of those for private water supply wells. To address any remaining uncertainties related to the observed impacts from the proposed withdrawals and the extent of the observed influence area, the applicant must develop a long-term impact monitoring program in accordance with Env-Ws 388.20, to ensure adverse impacts do not occur, provided that available information does not suggest that an impact is irreversible or will occur immediately. In the event that a confirmed adverse impact occurs that is related to the permitted withdrawal, the permittee must implement a source replacement program to mitigate the impact in accordance with Env-Ws 388.21 and Env-Ws 388.22.

The estimated zones of influence presented in HAWC's March 2008 preliminary application and addendums submitted through November 4, 2009 extended to a distance of approximately 2,000 feet at certain geologically controlled orientations from the proposed withdrawals for both the Settlers Ridge and Fieldstone well fields. Although proposed, HAWC did not test or request final approval for the Midpoint well field [see below]. In addition to those water users within 1,000 feet of the proposed new wells, HAWC extended 'offer to monitor' requests to all (~90) lot owners with developed properties not connected to the water system, up to a distance of 3,000 feet from the proposed new wells (as opposed to limiting their offer to monitor to representative locations only). Based on affirmative well owner responses, the proximity to the proposed wells and the conceptual model for the well fields, HAWC monitored water levels in 18 private water supply wells and 6 active public water supply wells during the withdrawal testing program.

As summarized above, water levels in five private bedrock wells and two public wells were influenced in response to pumping of the Settlers Ridge wells HWC-SR3 and HWC-SR4. As HAWC is not pursuing a final approval for HWC-SR4 as a new large groundwater withdrawal well at this time [see below], the discussion below focuses on the evaluation of the influence area of HWC-SR3 only. Based on observed influences at five private wells from pumping at HWC-SR3, the revised estimate for the zone of the influence of the well extends on the order of 1,500 to 2,400 feet from the well and is elongated along an inferred bedrock fracture zone. The greatest water level drawdown observed at the private wells that were influenced after eight days of continuous pumping was approximately 33 feet. The estimate for the projected drawdown in this well, assuming 180-days of continuous pumping of HWC-SR3 and no recharge, was approximately 78 feet, a depth that maintains a sufficient volume of water above the pump in the well. The projected drawdown at the other four private wells influenced by HWC-SR3 were all less than about 22 feet. The proposed new wells tested at the Fieldstone well field (FS-4E and HWC-FS1) had no apparent influence on any of the private wells monitored during the withdrawal testing program.

The Department finds that the impact assessment and evaluation program completed by HAWC meets the requirements of Env-Ws 388. The Department finds that water levels in private water supply wells will be impacted by the withdrawal from HAWC's new well HWC-SR3, however those impacts to private wells are not irreversible or immediate, and do not meet the definition of adverse impact in RSA 485-C:21, V-c. Further, the Department finds that the long-term impact monitoring and reporting program for water levels in private wells proposed by HAWC meets the requirements of Env-Ws 388.20, and that the source replacement program developed by HAWC to mitigate an unanticipated occurrence of an adverse impact meets the requirements of Env-Ws 388.21 and 388.22.

Condition No. 5e. of the large groundwater withdrawal permit requires HAWC to reduce the production rate from HWC-SR3 based on specified water levels being encountered in the private wells monitored as part of the long-term monitoring program to ensure that adverse impacts do not occur. Condition No. 5b. of the large groundwater withdrawal permit requires HAWC to notify all lot owners with private wells within the revised zone of influence of HWC-SR3 and provide appropriate contact information should they experience a problem with their private well that they believe is attributable to HWC-SR3. Condition No. 5a. of the permit requires HAWC to implement the provisions of their source replacement plan and mitigate a confirmed adverse impact in the event that one occurs.

**e.) Recharge to the Bedrock and the related matter of Groundwater Age Dating**

Mr. Bill Bennett (Atkinson resident) submitted the following comments pertaining to the concept of recharge limits to the bedrock aquifer in which the proposed withdrawals are being installed and the role that isotope-based age dating of groundwater may play in the evaluation of aquifer [formation] capacity:

*Insufficiency of knowledge about, and understanding of, southern New Hampshire hydrogeology.*

*While we do not know with certainty that LGW activity in Atkinson would adversely impact private wells, we are concerned that no one knows with reasonable certitude that*

*it would not. DES feels that isotope ratio determination of groundwater "age" (the time since the water was last in free exchange with the atmosphere) would only confuse the issue; as an engineer I have never found it harmful to have more data. Any particular piece of information may turn out to be the key to furthering one's understanding of a problem.*

*When water is pumped up from 800 feet below the surface in Atkinson, does anyone know from whence it came?*

The matter of withdrawals from 'deep strata' exceeding the available recharge to fractured bedrock based on ambient groundwater flow, in addition to stable isotope age-dating of groundwater, was also referenced in verbal input.

In the field of hydrogeology, determination of the sustainable yield of a well or potential available capacity of its water-bearing formation based on an assessment of potential recharge under ambient, non-pumping conditions is not a technically viable approach nor is it standard practice. Under a pumping condition, groundwater withdrawal wells, by design, change the hydraulic gradient and remove water from storage in the aquifer thereby altering the vertical and horizontal component of groundwater flow in the saturated fracture network intersected by the well. Recharge to such a pumping well and its formation is then induced from other parts of the formation or other reservoirs of water which may include shallow saturated fractures, saturated overburden deposits (soil units), surface water features or any combination thereof. Therefore the volume of water available to the well or wells in a well field under pumping conditions can be much greater than what may be available assuming ambient or non-stressed conditions only. The effects of induced recharge are evidenced by water level observations at both the production wells and observation wells presented on plots provided in the March 2009 final report and subsequent data submittals. These plots depict decreases in the slope of the declining water levels in the wells during the long-term pumping test and reflect the fact that the steepened gradient caused by pumping at the wells and the associated expansion of the zone of influence was slowly equilibrating in response to induced recharge.

In reference to the above, the concept of using age-dating of groundwater from a production well (a single spot in the formation) and establishing the sustainability of the withdrawal or its formation, and otherwise determining the 'time' of recharge to the formation under a pumping scenario from sampling results is not a viable approach nor technically justifiable. In light of the fact that induced recharge to the wells will occur under pumping conditions, an incidental sample of old water in the wells would not mean that the withdrawals are not sustainable. Establishing a recharge rate to a bedrock aquifer would require a broader spectrum of study that would include many sampling points throughout the regional fractured bedrock aquifer at varying depths. Interpretation of the results of such an assessment would be difficult and costly, and it would have questionable value to evaluating the effects from HAWC's proposed withdrawal wells due to the fact that the groundwater age present in production well water would represent mixed age signals from specific fractures and source areas that are intersected by the withdrawal wells and would likely change over time as the wells are pumped. The complexity of flow through the fractured bedrock aquifer would make the interpretation of sampling results and their applicability to the HAWC's withdrawal lack certainty. In addition, such an evaluation would not be useful or relevant to the requirement to assess for adverse impacts caused by the withdrawals

under RSA 485-C:21, nor is age-dating of groundwater a requirement under Env-Ws 388 or Env-Dw 302.

The Department finds that HAWC's withdrawal wells will not cause an adverse impact by withdrawing groundwater at a rate that exceeds the long-term recharge rate to the formation in accordance with RSA 485-C:21, V-c. Condition Nos. 4 and 5.e. of the permit requires HAWC to implement a program of water level monitoring in the bedrock aquifer that is source to the HWC-SR3 and reduce the volume of water pumped from the well based on observed water levels [trigger levels] at those bedrock monitoring wells. Further, the Department finds that withdrawal testing program meets the requirements of Env-Ws 388.13.

**f.) Comments pertaining to the Withdrawal Testing Program and Impact Evaluation**

Withdrawal Test Duration

Mr. Andrew Earley (Atkinson resident) submitted the following comment pertaining to the duration of the withdrawal testing program specifically conducted at the Settlers Ridge well field:

*...I am even more concerned that decisions regarding whether or not to allow the Hampstead Water Company to withdraw large amounts of water from local well fields, are being based on a "30 Day testing period". This 30 day test appears to be accepted in the industry and considered a valid testing period. I do not believe this test period properly reflects the full impact over a prolonged period of time. In other words, general conclusions should not be accepted from the "30 day analysis" conducted by Emery & Garrett, because, in my opinion they do NOT truly reflect the true impact that large water removal will have on residential wells. The testing period is simply too short and should extend for at least 1 full calendar year (if not longer), in order to accurately illustrate the impact water removal will have on residential wells during various times of the year when the water table will be higher (spring) and lower (summer). I do not feel the testing is valid or credible based on the short testing period conducted from October 29 – November 22, 2008.*

As stated above, the applicant for a large groundwater withdrawal must conduct a withdrawal testing program to assess the impacts caused by the withdrawal and evaluate its influence area. The applicant must then develop a long-term monitoring and testing program based on the observed influence area and projected drawdown based on the assumption of 180-days of continuous pumping with no net recharge from precipitation or snowmelt. The withdrawal testing program required by Env-Ws 388.09 and Env-Dw 302.11 consists of three periods

- a. The antecedent period, during which non-pumping hydrologic conditions are monitored for 7 days immediately preceding the start of pumping;
- b. The pumping period, which, for large bedrock water supply wells is at least 7 days, or, 72 hours if the water level in the well has stabilized and projected drawdown does not exceed available drawdown in the well; and

- c. The recovery period, which follows shut down of the pump and continues until the water level in the test well or the nearest well within 5 feet of the pumping well has recovered to 95% of the pre-pumping level.

The Department does not concur that a one-year(+) evaluation/testing program is needed prior to issuance of a large groundwater withdrawal permit. The method of using data collected through the existing testing program and projecting drawdown assuming six months of continuous pumping from the withdrawal while recharge to groundwater ceases due to evaporation and plant uptake, is adequately conservative to estimate a worst-case influence area of the well within the context of the observations collected. Moreover, based on the Department's experience with many bedrock water supply wells used for community water systems in southeast New Hampshire, the existing drawdown projection method coupled with both the implementation of a long-term monitoring program (under Env-Ws 388.20) and the mitigation/source replacement criteria (under Env-Ws 388.21 and Env-Ws 388.22) adequately positions the permit holder to observe the effects of the withdrawal over time, proactively reduce the volume of water withdrawn to reduce the effects of the withdrawal if needed, and mitigate a confirmed adverse impact should one occur. As such, the Department finds that HAWC has met the requirements of the withdrawal testing program required by Env-Ws 388.09 and Env-Dw 302.11, and impact evaluation required by Env-Ws 388.16.

#### Impacts on wetlands and other water-related natural resources

In response to the final report, the town of Atkinson conservation commission provided both verbal and written testimony pertaining to concerns over the potential to impact Stewart Farm pond and its associated wetlands near the Settlers Ridge well field. Specifically, the commission referenced the fact that in March 2009, the town of Atkinson voted to nominate Stewart Farm pond as a prime wetland under RSA 482-A:15 and stated that the pond *is directly impacted by the HAWC withdrawal* referring to production from proposed wells HWC-SR3 and HWC-SR4. The commission also suggested that *...a prime wetlands hearing is needed before any water withdrawal from this well is approved...* The Department's Wetlands Bureau received the prime wetland designation request from the town on May 1, 2009, and accepted the designation request on October 10, 2009.

RSA 485-C:21 and the large groundwater withdrawal permitting rules require that an applicant evaluate the impacts on water-related natural resources caused by a large groundwater withdrawal and requires that no unmitigated adverse impact results from the withdrawal. Env-Ws 388.07 requires that an applicant inventory water resources within the estimated impact area of the withdrawal and Env-Ws 388.08 requires the applicant to estimate the effect on water resources that may result from the withdrawal. RSA 485-C:21, V-c. establishes the criteria for adverse impacts to wetlands and surface water caused by a large groundwater withdrawal. Specifically, no large groundwater withdrawal shall cause an unmitigated impact as determined by the following:

(f) Reducing surface water levels or flows that will, or do, cause a violation of surface water quality rules adopted by the department; and

g) Causing a net loss of values for submerged lands under tidal and fresh waters and its wetlands as set forth in RSA 482-A;

HAWC's preliminary application of March 24, 2008 and addendum of July 30, 2008 described the monitoring network for the Settlers Ridge withdrawal testing program to include water level monitoring at four overburden piezometers and two shallow bedrock wells along the periphery of the pond and wetland area, three surface water staff gages installed in the pond, and one weir installed in the pond's outlet stream [a tributary stream to Hog Hill Brook].

Based on the results presented in HAWC's March 13, 2009 final report, no influence on water levels in the pond were caused by the withdrawal from either HWC-SR3 or HWC-SR4. The report discusses the fact that the surface elevation of the pond and surrounding wetland areas appears 'fixed' by the height of the beaver dam that is impounding its outlet, and that the influence of production from the wells are characterized through changes in flow in the pond outlet stream flowing over/through the dam. Based on flow records at the weir in the outlet stream for the pond [Figure 19, Final Report], the groundwater withdrawal from proposed well HWC-SR4 is estimated to have caused a 37 gallons per minute reduction in stream flow, which equates to approximately 50% of the estimated ambient stream flow occurring at the time of the test.

In response to the Department's comment letter requiring further evaluation of flow impacts to the stream in light of the adverse impact criterion related to stream flow impacts, in their addendum to the final report dated August 18, 2009, HAWC retracted its request for approval of HWC-SR4 as a new large groundwater withdrawal well at this time and reduced their request to use the well as a mechanical backup to a nearby, pre-existing well in accordance with Env-Ws 302.29, pending possible additional data collection.

Since HAWC has withdrawn its request to permit HWC-SR4 as a new large groundwater withdrawal at this time, the Department has made no finding pertaining to impacts to the outlet stream to Stewart Farm pond meeting the definition of an adverse impact under RSA 485-C:21. In the event that HAWC requests approval for HWC-SR4 as a new large groundwater withdrawal well at a later date, the Department would make a determination at that time regarding the adequacy of the impact evaluation and any mitigation strategy proposed, as necessary. Based on the data collected, however, a net loss in values to Stewart Farm pond (i.e., an adverse impact) does not appear likely due to the fact that the beaver dam controls the elevation of pond and wetland areas regardless of withdrawal from HWC-SR4.

In reference to the conservation commission's reference to the need for a prime wetland, the Department notes that this large groundwater withdrawal permit only addresses the requirements of RSA 485-C and does not make findings or approval relative to the requirements of other state statutes.

#### Discharge of groundwater during the withdrawal test at Settlers Ridge

Mr. Bill Bennett (Atkinson resident) provided the following comment pertaining to the discharge location for the Settlers Ridge pumping test:

*... On page 20, the report details the installation of instrumentation to monitor the water level of Stewart Farm Pond during the pump testing of wells SR3 and SR4. However, during the actual pump tests, the effluent was discharged into Stewart Farm Pond ... The*

*inconsistency of those two approaches is not explained in the Report. The effluent from SR3 and SR4, when discharged into the Pond, would likely return promptly to the aquifer accessed by SR3 and SR4, possibly invalidating pump test results...*

In reference to the discussion above, in the preliminary report addendum of July 30, 2008, HAWC proposed a method to evaluate potential impacts on flow from the pond by deducting metered flow of the withdrawal test discharge line from the weir stream flow measurement record. This approach was based on the assumption that the beaver dam at the pond's outlet fixed the pond's surface elevation.

As described in the impact description discussion in the final report dated March 13, 2009 (Section XV, page 34), this method did not preclude the ability to evaluate and quantify stream flow reductions caused by withdrawal from well HWC-SR4 [see the discussion above]. Further, the assumption that the beaver dam established the elevation of the pond was validated by water level observations collected before, during and after the pumping test. In the addendum to the final report dated August 18, 2009, HAWC further acknowledged reductions in stream flow of the outlet stream for Stewart Farm pond caused by withdrawals at HWC-SR4, and recognized the need for a qualified professional to further assess impacts to stream flow before proceeding with permitting of HWC-SR4 as a new large groundwater withdrawal well.

In reference to the above, the Department finds that the withdrawal testing program design meets the requirement Env-Ws 388.09 and did adequately provide for the ability to evaluate impacts to water resources potentially influenced by the withdrawal. Further, the evaluation completed in response to observations collected during the withdrawal testing program adequately identified and quantified impacts to water-related natural resources, and the proposed large groundwater withdrawal well the imparted those impacts was not permitted as a new large groundwater withdrawal.

#### Water level fluctuations and precipitation effects on the well capacity estimates

Mr. Bill Bennett (Atkinson resident) provided the following comment pertaining to the effects of precipitation on drawdown evaluation:

*...Pump tests were carried out during the Fall wet season. The contribution of rain events during the pump tests to water levels in the test wells was not insignificant. Perhaps I missed it, but in reading the report, I did not find where correction for that was made in the well sustainable capacity numbers. Does the Report accurately reflect well capacities in time of limit precipitation?*

As described in sections V and X. of HAWC's final report of March 13, 2009, the planned start of the withdrawal tests at both the Fieldstone and Settlers Ridge well fields were postponed by nine and 11 days due to the occurrence of significant pre-test rain events. These rain events caused substantial water level increases (>1 foot) in the background (ambient) monitoring wells used for each of the well fields, and the pumping tests were not started until water levels at these background monitoring locations stabilized at near pre-event levels. Postponing of the tests was required in order to comply with Env-Ws 388.09, which requires that an applicant for a new large production well postpone a pumping test if a high recharge event occurs that will prohibit the

ability to use the test data to evaluate capacity of the proposed new wells and their potential impact.

Relatively minor rainfall events on day three of the Fieldstone withdrawal test and day two of the Setters Ridge withdrawal test caused generally less than 0.2 feet of water level rise in the background wells which largely dissipated and re-stabilized over the following day. As shown on the water levels plots [Figures 9 through 13 and Figures 20 through 23] in the final report, the effect of these precipitation events on water levels was insignificant and non-discernable in the production wells. As such, no offset or correction was necessary to remove incidental recharge effects in the 180-day drawdown projection required by Env-Ws 388, an analysis which is standard practice for conservatively estimating the capacity of a production well relative to available drawdown even at low recharge times of the year.

The Department finds that HAWC meets the requirements of Env-Ws 388 for projection of drawdown in the production wells, and that HAWC met the requirement to perform the withdrawal tests at times when recharge events did not preclude adequate evaluation of pumping test data.

#### Production rate for the Fieldstone Well Field

Mr. Bill Bennett (Atkinson resident) provided the following comment pertaining to the capacity of the Fieldstone wells HWC-FS1 and FS-4E:

*In the report, E&G recommends a combined limit of 40 gpm for wells FS1 and FS-4E. However, the water chemistry data for water withdrawn near the end of the pump testing show that, even at 40 gpm, the well is beginning to draw upon deoxygenated "old" water of which the replenishment rate is unknown. Further, the well draw-down depth at the end of the pump test is 175 feet (at 42 gpm). This is deeper than many private wells in Atkinson, some of which are on a little more than 100 feet deep. (there may be some dug wells in the area with depth considerably less than that.) It would appear that the Fieldstone well field cannot safely sustain 40 gpm and should, if permitted at all, be restricted to a production rate considerably less.*

Env-Dw 302.11(c)(1)b.2 requires that an applicant for a new large production well demonstrate that the 180-day projected drawdown in the well does not exceed 90% of its available drawdown. Env-Dw 302 defines available drawdown as:

(e) "Available drawdown" means the distance between the water level in the well casing and the uppermost productive water bearing zone, the pump intake, or the top of the screen, whichever distance is least.

The combined withdrawal test of HWC-FS1 and FS-4E at the Fieldstone well field was performed at 60 gpm and resulted in 180-day projected drawdowns in the wells of 167 and 214 feet below ground surface [Final report, section VII]. Initial drilling records of HWC-FS1 indicated its uppermost significant water bearing zone was located at a depth of 250 feet, sufficiently below projected drawdown. HAWC's final report addendum of August 18, 2009 presented in Section II [page 6] the results of a program of borehole characterization efforts and 'packer' tests in FS-4E that indicated the no significant flow enters the well above a depth of 189

feet, a depth that is exceeded under a 60 gpm pumping rate projection. As a result, and in consideration of observations from pre-test pumping of HWC-FS1 alone, HAWC revised its requested production rate from the well field downward to 40 gpm to keep the projected drawdown in the well above the uppermost water-bearing zone. The Department finds that the method used to evaluate drawdown in the context of water-bearing zones in the well, and the resultant reduction in requested production rate meets the requirements stipulated in Env-Dw 302.11(c.)

The Department finds that simply using pumping water levels from the production well to assess impacts to water levels in private wells is not a hydraulic valid approach and does not meet the requirements under Env-Ws 388. As groundwater is pumped from a bedrock well, the increase in vertical gradient in the well induces significant turbulent flow through the water-bearing fracture network within the immediate vicinity of the borehole; such flow produces significant frictional losses in formation hydraulic head which imparts its greatest effect at the borehole wall itself. The result is that the greatest drawdown occurs within the production well, and it is significantly more drawdown than that which occurs within the formation. This turbulent flow/frictional head loss effect significantly diminishes with distance from the well as the well's zone of influence equilibrates with induced recharge [see prior discussion], and groundwater flow to the well becomes laminar, and horizontal. In order to assess the potential to impact water levels in private wells and meet the requirements of the withdrawal testing program of Env-Ws 388, an applicant shall offer to conduct *actual* monitoring of water levels in private wells that may be influenced by the withdrawal. As previously described, HAWC conducted water level monitoring in nine of the private wells that were closest to the Fieldstone well field, and no apparent effect was observed in any of the private wells monitored as part of the test. The Department refers to its response above [item d.)] for additional discussion pertaining to the effect of the withdrawals on water levels in private wells.

The Department does not concur that reduction in dissolved oxygen in pumped water during the withdrawal test at the Fieldstone well field implies that the production is exceeding the 'replenishment' rate, as cited. The dissolved oxygen content of bedrock groundwater is commonly low, and the values observed in the initial portion of the pumping test may be artificially high due to the fact that the water column in the well was exposed to air in the wellhead and equilibrated with atmospheric levels of oxygen prior to the test. In this scenario, the oxygen levels dropped as the well was purged of the aerated water and displaced by water from the formation.

Moreover, changes in dissolved oxygen in water produced from a pumping well are not necessarily a function of water age or indicative of a source that can not otherwise produce a sustainable volume of water. The amount of dissolved oxygen in groundwater can be governed by the parent chemistry of the bedrock unit (or units) that is source for water to the well, whereby the mineral assemblage in the parent rock consumes available oxygen and enriches the water in iron and manganese through chemical oxidation/reduction reactions. In addition, as a pumping well operates, it may induce recharge of water that is depleted in oxygen by capturing water from shallow units or surface water after it has interacted with organic rich deposits at the bottom of surface water features. The Department refers to its response above in item e.) pertaining to the value of age determination when assessing the sustainability of well or its formation.

**g.) Comments related to Midpoint Well field**

The Department received numerous comments and questions strictly pertaining to the new source well proposed at the existing Midpoint Well field. The questions submitted related to the discharge of pumping test water, the recharge rate to well field, impacts on private water supply wells near the well field, water quality sampling, and monitoring of the surrounding wetlands during pumping. In the final report of March 13, 2009, HAWC stated that they were not pursuing approval of the proposed well at Midpoint well field at this time, as such, the Department makes no findings with respect to the comments it received about this well field.

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