The

NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES

hereby issues

LARGE GROUNDWATER WITHDRAWAL PERMIT

NO. LGWP-2014-0001

to the permittee

UNIVERSITY OF NEW HAMPSHIRE/DURHAM WATER SYSTEM
TOWN OF DURHAM PUBLIC WORKS DEPARTMENT
100 STONE QUARRY DRIVE
DURHAM, NH 03824
(603-868-5578)

for the withdrawal of the following volume of groundwater from the following well for the purpose of community water supply:

Well DGD-PW2	1,044,000 gallons over any 24-hour period subject to the annual withdrawal limitation established by Condition No. 4 of this permit

Date of Issuance: October 31, 2014
Date of Expiration (if the withdrawal is not activated): October 31, 2019
Date of Expiration (if the withdrawal is activated): October 31, 2024

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 Well DGD-PW2 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, signed July 8 and 9, 2014, in accordance with Env-Wq 2101 and NHDES' approval dated September 8, 2014.

3. Metering Requirements: Withdrawals from Well DGD-PW2 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. 7 of this permit:

   a) The 24-hour peak day volume withdrawn from the source during each month and the date the water use occurred; and

   b) The cumulative total volume withdrawn from the source during each month.

4. Annual Withdrawal Limitation: The total volume of groundwater withdrawn from Well DGD-PW2 in any calendar year shall be limited to 63 million gallons plus the volume of water artificially recharged to the aquifer under NHDES Groundwater Discharge Permit No. GWP-201111101-L-001 in the same calendar year, subject to the monitoring and mitigation requirements of conditions No. 5 and 6 of this permit.

5. Monitoring and Reporting Requirements: The permittee shall establish and maintain the monitoring and reporting program as described below:

   a) Water Level Monitoring: The permittee shall install pressure transducers and data loggers and measure water levels at the following sites, as specified:

	Monitoring Site	Monitoring Period	Measurement Frequency
20140001MWARW1	Well DGD-ARW1*	Starting at least 30 days prior to initiating a withdrawal from Well DGD-PW2 and continuing indefinitely	At least twice daily
20140001MWARW2	Well DGD-ARW2*		
20140001MWM6	Well DGD-M6*		
20140001MWM7	Well DGD-M7*		
20140001MWMB1B	Well DGD-MB1b*		
20140001MWMB2B	Well DGD-MB2b*		
20140001MW104	Well DGD-MW104		
20140001MW108	Well DGD-MW108		
20140001MW202M	Well DGD-MW202M*		
20140001SWSW1	Surface Water Station DGD-SW1*		

20140001PWPW2	Well DGD-PW2	Starting upon initiating a withdrawal from Well DGD-PW2 and continuing indefinitely	At least once every four hours

**Monitoring is also required under the Groundwater Discharge Permit referenced in condition No. 4 of this permit.*

b) Surface Water Monitoring: The permittee shall implement the surface water monitoring program of Chesley Brook as described in the Final Report Addendum titled "Final Hydrogeologic Investigation, Town of Durham-University of New Hampshire, Groundwater Development, UNH/Durham Production Well DGD-PW2, Durham, New Hampshire" prepared for the permittee by Emery & Garrett Groundwater, Inc. (EGGI), dated January 29, 2013, incorporated herein by reference, subject to the following conditions:

20140001SWCHSLY i. Monitoring shall occur using the methods described, and at the frequency described, at the Chesley Brook surface water monitoring station established by EGGI, described in a report titled "Long-Term Water Level, Streamflow, and Wetland Monitoring Programs, 2013 Annual Report, Public Supply Well DGD-PW2, UNH/Durham Water System, Durham, New Hampshire" prepared for the permittee by EGGI, dated January 31, 2014. This report included the results of baseline monitoring performed in 2012 and 2013 and a description of monitoring to be performed in 2014.

ii. During subsequent years of monitoring, on an annual basis, the permittee shall perform manual stream gauging at the surface water monitoring station at least three times between August 1 and September 30. Stream gauging shall be conducted during periods of low flow, preferably when stream discharge is less than 500 gallons per minute (1.11 cubic feet per second). The permittee shall update the rating curve created for the monitoring station using this data.

iii. The permittee shall perform a minimum of three consecutive years of surface water monitoring prior to initiating a withdrawal from Well DGD-PW2.

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. The annual assessment of the monitoring data shall incorporate the water quality monitoring data collected in Chesley Brook by the New Hampshire Volunteer River Assessment Program (VRAP) at the Packers Falls Road Bridge [Station ID 01-CSB].

c) Wetlands Monitoring: The permittee shall implement the wetlands monitoring program as described in the Final Report Addendum, incorporated herein by reference, subject to the following conditions:

i. Monitoring shall occur using the methods described, and at the frequency described, at the Chesley Brook (WP-1) and Little River (WP-2; reference wetland) wetland monitoring sites established by Oak Hill Environmental Services, Inc. (OHES), described in a report titled "UNH/Durham Production

Well (DGD-PW2) Long-Term Biological Monitoring Program, Report for 2013 Monitoring Baseline Year" prepared for EGGI by OHES, dated January 2014 and included in Appendix B of the 2013 annual report prepared for the permittee by EGGI, dated January 31, 2014. This report included the results of the initial wetland surveys and baseline monitoring performed in 2013 and a description of monitoring to be performed in 2014.

ii. During subsequent years of monitoring, one survey of the wetland plots shall be completed annually between August 1 and September 30.

iii. The permittee shall perform a minimum of two consecutive years of wetlands monitoring prior to initiating a withdrawal from Well DGD-PW2.

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 water level monitoring data collected under condition No. 5a and surface water monitoring data collected under condition No. 5b shall be submitted in an electronic format only.

6. 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 and the Source Replacement Plan, titled "Groundwater Development UNH-Durham Water System Production Well DGD-PW2, Source Replacement Plan," prepared for the permittee by EGGI, dated June 16, 2014.

b) Prior to initiating a withdrawal from Well DGD-PW2, the permittee shall complete the installation of a replacement water supply well for , in accordance with the Source Replacement Plan referenced above and the requirements of Env-Wq.403.30. The permittee shall notify NHDES upon completion of the installation of the replacement well, and

shall provide NHDES with copies of the following: 1) the well completion report filed with the NH Water Well Board by the NH-licensed water well contractor that constructed the well; 2) water quality testing results of samples collected prior to and following source replacement activities and analyzed for the parameters listed in Env-Wq 403.30(e) by a laboratory accredited in accordance with Env-C 300; and 3) a list of the water quality treatment equipment alternatives proposed to meet the requirements of Env-Wq 403.30(f), in accordance with Env-Wq 403.30(i), if applicable.

c) 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.

d) 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 available recharge on average, then NHDES will modify the permit in accordance with Env-Wq 403 in order to prevent adverse impacts from occurring.

7. The permittee shall register its new sources and destinations 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.

8. 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.

Eugene J. Forbes, P.E.,
Director Water Division

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PROJECT NARRATIVE

Large Well Siting Approval/Large Groundwater Withdrawal Permit LGWP-2014-0001
University of New Hampshire/Durham Water System, PWS ID 0691010
Well DGD-PW2
Lee, New Hampshire

October 31, 2014

BACKGROUND

The University of New Hampshire/Durham Water System (UDWS) has submitted an application to the New Hampshire Department of Environmental Services (NHDES) requesting approval of a large community production well and issuance of a large groundwater withdrawal permit for the withdrawal of up to 1,044,000 gallons per day (gpd) or 725 gallons per minute (gpm) over a 24-hour period. UDWS is requesting approval for this new well to be used in combination with its existing sources for the purposes of municipal water supply.

The purpose of developing the new community production well (designated Well DGD-PW2) is to: 1) provide additional water supply capacity to meet current maximum day demand; and 2) accommodate potential increases in water demand based on historic water use trends and projected future growth in areas served by the system. Well DGD-PW2 will be used in conjunction with UDWS' artificial recharge operation, whereby surface water withdrawn from the Lamprey River will be used to artificially supplement natural recharge to the aquifer from which DGD-PW2 withdraws groundwater (herein referred to as the "Spruce Hole Aquifer").[1]

Well DGD-PW2 is located in the town of Lee just west of the Durham-Lee town line, east of Packers Falls Road and west of Spruce Hole Bog. The potential impact area for the withdrawal from DGD-PW2 encompasses approximately 6.9 square miles of the lower portion of the Oyster River watershed from Great Bay, upstream to a point near the U.S. Geological Survey's Oyster River stream gaging station in Lee.

The well site is underlain by glacial sand and gravel deposits that range in thickness from approximately 20 feet to 150 feet. These deposits comprise the Spruce Hole Aquifer. Well DGD-PW2 is screened from a depth of 95 feet to 130 feet below ground surface in fine- to coarse-grained sands and gravels. These deposits are underlain by bedrock of the Berwick Formation which occurs at approximately 135 feet in depth.

WITHDRAWAL TESTING AND CONCLUSIONS

A withdrawal testing program was conducted by Emery & Garrett Groundwater, Inc. (EGGI) from August 9, 2010 through September 8, 2010. The purpose of withdrawal testing is to provide data to estimate long-term sustainable water quantity and quality; observe the response of the aquifer 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 withdrawal. The withdrawal testing program included monitoring during pre-pumping, pumping, and water level recovery periods, where DGD-PW2 was pumped at approximately 725 gpm between August 19, 2010 and August 27, 2010.

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[1] Permitted under NHDES Groundwater Discharge Permit No. GWP-201111101-L-001.

Discharge from DGD-PW2 was measured using an orifice weir during the withdrawal testing program to maintain a constant pumping rate, and water quality samples were collected during the pumping period to characterize the quality of the water derived from the well.

During the withdrawal testing program, water level measurements were collected at: Well DGD-PW2; 1 overburden exploration well; 18 monitoring wells; 5 piezometers; 5 surface water stations (stream flow was also measured at 4 of these stations); 2 bedrock wells that serve two other community water systems; and 6 private water supply wells (1 overburden well and 5 bedrock wells). The 6 private water supply wells serve properties located to the north, south, and west of DGD-PW2, and are located at distances ranging from approximately 680 feet to 2,440 feet from the well site. Groundwater and surface water measurements were recorded to assess the degree of hydraulic connection between the overburden aquifer, bedrock, Spruce Hole Bog, Chesley Brook, and other surrounding streams and wetlands.

Groundwater level measurements collected during the withdrawal testing program indicate that the overburden exploration well, 12 monitoring wells, and 2 private water supply wells (1 overburden well and 1 bedrock well) responded to pumping of DGD-PW2. Water levels in the piezometers and public water supply wells did not respond to pumping of DGD-PW2. Pumping-induced drawdown of water levels in the monitoring wells ranged from approximately 0.2 feet to 6.1 feet and was greatest in wells located closest to DGD-PW2. Pumping-induced drawdown of the water level in the private overburden well that responded to pumping of DGD-PW2 was approximately 1.5 feet; drawdown in the private bedrock well was on the order of 3.4 feet.

Surface water level measurements collected in Spruce Hole Bog confirmed that this wetland system is perched above the water table in the Spruce Hole Aquifer; because the bog is hydrologically (and hydraulically) independent of the groundwater system, pumping of DGD-PW2 did not affect water levels in the bog. No pumping-induced changes were observed at three of the stream flow monitoring sites. A reduction in stream flow was observed at the surface water station in Chesley Brook downgradient of the well site during the recovery period of the withdrawal testing program; however, quantifying the reduction was confounded by the influence of a rainfall event near the end of the pumping period and subsequent stream flow recession during the recovery period.

Based on a distance-drawdown analysis of graphical projections of water level responses in the monitored wells that assume 180 days of continuous pumping of DGD-PW2 at 725 gpm with no net recharge from precipitation to the aquifer, and inference from the refined conceptual hydrologic model of the withdrawal, pumping-induced drawdown is estimated to extend on the order of 2,000 feet to the north, south, and east of DGD-PW2 and 1,200 feet to the west of DGD-PW2.

Based on the monitoring results, conceptual hydrologic model, and water budget analysis presented in the final report, a production rate of 1,044,000 gpd (725 gpm) is a production rate that DGD-PW2 and the Spruce Hole Aquifer can only sustain on a fixed-term basis; EGGI's evaluation indicated that there is sufficient natural recharge to the aquifer to sustain a total annual groundwater withdrawal from DGD-PW2 of 63 million gallons. EGGI also found that continuous pumping of DGD-PW2 at this rate could interfere with the use of the shallow overburden private well that was monitored during the pumping test program, causing a violation of the adverse impact criterion of RSA 485-C:21, V-c.(a), and that mitigation would be required. Additionally, EGGI concluded that the pumping of DGD-PW2 would also reduce the amount of groundwater that normally discharges from the Spruce Hole Aquifer to Chesley Brook resulting in a reduction of stream flow that could potentially result in a violation of the State's surface water quality standards specified in Env-Wq 1700 or negatively affect riparian wetlands adjacent to Chesley Brook, which are criteria for adverse impacts under RSA 485-C:21, V-c.(f) and (g). These issues are addressed through conditions of the large groundwater withdrawal permit as described below.

Additionally, the use of artificial recharge to supplement the total amount of groundwater available in the Spruce Hole Aquifer will likely serve to mitigate any potential adverse impacts to some degree.

Results of the water quality sampling conducted during the withdrawal testing program indicate that each parameter was below the applicable Maximum Contaminant Level (MCL) or Secondary Maximum Contaminant Level (SMCL). Results of the water quality sampling program did indicate that the concentration of radon is elevated in water derived from DGD-PW2.

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 withdrawal. Copies of the above-referenced materials were sent to the towns of Durham and Lee and the Emiritus at Spruce Wood, Oyster River Condos, and Packers Falls Village community public water systems. No public hearings were requested, and no public meetings were held regarding the application for this large groundwater withdrawal permit.

LARGE GROUNDWATER WITHDRAWAL PERMIT MONITORING, REPORTING, MITIGATION AND WITHDRAWAL REQUIREMENTS

The large groundwater withdrawal permit limits the total volume of groundwater that UDWS may withdraw from DGD-PW2 in any calendar year to 63 million gallons plus the volume of water artificially recharged to the Spruce Hole Aquifer in the same calendar year.

The permit also requires UDWS to install a replacement water supply well for the shallow overburden private well that was monitored during the pumping test program prior to initiating a withdrawal from DGD-PW2 to mitigate adverse impacts.

UDWS is also required to implement an impact monitoring and reporting program that includes water level, surface water, and wetlands monitoring. General monitoring requirements are summarized as follows:

- Water levels – The permit requires that on-site and off-site locations be monitored to assess the effects of the artificial recharge operation and the groundwater withdrawal from DGD-PW2 on water levels in and around the Spruce Hole Aquifer.

- Surface water and wetlands – The permit requires that UDWS establish a surface water and wetlands monitoring program at off-site locations downgradient of DGD-PW2 to assess the potential for and/or detect the occurrence of an adverse impact on Chesley Brook and its riparian wetlands via observations of surface water levels, flows, and temperature and wetland characteristics.

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, 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. 6.

UDWS is required to submit an annual monitoring report in hard copy and electronic format to NHDES by January 31st 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 DGD-PW2. 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. 5.

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