GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.

October 17, 2016

James McCarthy, Chair
Planning Board
City of Newburyport
60 Pleasant Street
Newburyport, MA 01950

Dr. Robin Blair, O. D., Chair
Board of Health
City of Newburyport
60 Pleasant Street
Newburyport, MA 01950

RE: Professional Opinion Letter
Water Resources Impact Evaluation Report
Proposed Subdivision by Evergreen Commons, LLC
Boyd Drive, Newburyport, MA

Dear Mr. McCarthy and Mr. Blair,

I am a principal hydrogeologist at Geosphere Environmental Management, Inc. (GEOSPHERE). I have a Bachelors of Science in Geology from the University of Massachusetts, Amherst, a Masters of Science in Geology from the University of New Hampshire, and a Doctorate in Geology from Memorial University of Newfoundland. I hold active Professional Geologist licenses in several states, including Maine, Pennsylvania, Tennessee, Kentucky and New Hampshire, as well as the Certified Professional Geologist distinction from the American Institute of Professional Geologists. I have close to 25 years of professional experience providing technical assistance on complex geotechnical issues, including many public water supply projects. My full curriculum vitae is attached as Exhibit A.

On behalf of the Boyd Drive Residents Group, GEOSPHERE prepared this Opinion Letter after a review of the report titled "Water Resources Impact Report" (NGI Report) prepared by Northeast Geoscience, Inc. (NGI) dated September 2016, Supplemental Report dated October 12, 2016, and certain historic reports and development proposals regarding the project area listed in Exhibit B. The NGI Report has been prepared in support of the proposed conversion of the 36.4 acre, 9-hole Evergreen Golf Course on Boyd Drive in Newburyport, MA to a 38 lot Open Space Residential Development (ORSD) by Evergreen Commons, LLC. According to the NGI Report, the proposed cluster type housing development will be serviced by both water and wastewater provided by the City of Newburyport. GEOSPHERE understands that as an alternative to the 38 lot OSRD proposal, Evergreen Commons, LLC has submitted a Preliminary Subdivision Plan for a conventional 44 lot residential subdivision on the same property. Both

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proposals include multiple residences located in close proximity (within approximately 700 feet) to the City of Newburyport's public drinking water supply Well No. 2.

The purpose of this Professional Opinion Letter is to review the NGI Report and address the potential impact either residential development may have on the groundwater and aquifer that supplies public drinking water to all of the homes and businesses in Newburyport, as well as, the Old Town portion of Newbury, Plum Island, and the Town of West Newbury (Newburyport DPS Water Division Webpage).

In addition to the NGI Reports and other current and historic documents listed in Exhibit B, I am familiar with this site because along with other GEOSPHERE (formerly Talkington Edson Environmental Management, LLC ("TEEM")) personnel, I performed the Zone II delineation and analysis for the City of Newburyport's public water supply Wells 1 and 2 in 1999 as part of a project funded by the Massachusetts Department of Environmental Protection (MA DEP) and the U.S. Environmental Protection Agency (EPA). The principal purposes of the MA DEP and EPA Wellhead Protection Study were to accurately delineate the boundaries of the primary recharge area (Zone II) for each well and to identify potential contamination sources within the wellhead protection area.

NGI Conclusions

The principal conclusions put forth by NGI in their September 2016 Report for the proposed 38 lot subdivision are:

1. The proposed 38 lot subdivision "…by Evergreen Commons, LLC is not a significant or obvious water quality threat to Newburyport Well No. 2;" and
2. "Replacing the existing golf course with the proposed residential development will eliminate an existing identified potential source of contamination in Zone II and eliminate an existing irrigation withdrawal in Zone II."

These conclusions do not satisfy the requirements set forth in Section XIX - A of the Water Resource Protection District in the Newburyport Zoning Ordinance. The Ordinance reads that the purposes of this Water Resource Protection District are:

1. To promote the health, safety, and general welfare of the community by ensuring an adequate quantity and highest quality of water possible for residents, institutions and businesses of the City of Newburyport.
2. To preserve and protect existing and potential watersheds and aquifers for drinking water supplies.
3. To prevent temporary and permanent contamination in the water resource protection district.
4. To protect the community from the detrimental use and development of land and water within the water protection district.

Zone I and Zone II Wellhead Protection Areas

Zone I is the protective radius required by MA DEP around a public water supply well or wellfield. For public water system wells with an approved withdrawal rate of 100,000 gallons per day (gpd) or greater, the protective radius is 400 feet. Only activities associated with the operation of the well are allowed within in this protective zone (see Water Resource Protection District XIX – F, -G, and -H). Residential development is prohibited within Zone I (XIX-H). This has not always been the case, especially for wells installed decades ago before some of the current regulations.

Zone II is the area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions (not unlike what we have been experiencing in the summer of 2016) that can be realistically anticipated (180 days of pumping at the approved withdrawal rate, with no recharge from precipitation). The activities that are permitted within a Zone II are highly regulated by MA DEP and the local community in order to preserve and protect this natural resource. Zone II can be calculated using mathematical solutions based on aquifer and pumping test data for a well, on the locations of watershed boundaries, by numerical computer modelling, or a combination of these methods. The Zone II for Well 2 was calculated using aquifer and pumping test data and a mathematical solution to the Todd (1980) Uniform Flow Equation. The Zone II for Well 2 was reviewed, approved, and accepted by MA DEP.

Background – Newburyport's Well 2

Well 2 is located off Ferry Road approximately 700 feet northeast of the proposed 38 lot subdivision. It is a 24-inch diameter, gravel-packed well that was installed in 1958 (58 years old). The well is 56 feet deep and has a 10-foot long screen from 46 to 56 feet below ground surface.

An aquifer pumping test was performed in 1958 on an 8-inch diameter test well at a withdrawal (= pumping) rate of 204 gallons per minute (gpm). Upon the installation of the final 24-inch diameter, gravel-packed well, a 24-hour acceptance (= pumping) test was performed on the final production well at a pumping rate of 701 gpm. Drawdown of the groundwater table in the production well after 24 hours was 13 feet at a pumping rate of 710 gpm. In 2000, a 16-day pumping test was also performed on Well 2 at 400 gpm. Upon review of all of the pumping test data, MA DEP approved a pumping rate for Well 2 of 408 gpm based on a 1957 pumping test on the well. This is the pumping rate that was used by TEEM in the calculation of the Zone II capture zone (Appendix F of the TEEM, 1999 Report).

From the several pumping tests performed on Well 2 prior to 1976, the transmissivity of the aquifer was estimated to be in the range of 90,000 - 100,000 gallons per day per foot of drawdown (gpd/ft) (GZA, 1976). The transmissivity of 64,778 gpd/ft used by TEEM (1999) in their calculations for the Zone II delineation for Well 2 was based on the evaluation of the pumping test performed in 2000 (Appendix F), which is slightly lower than the GZA (1976) value.

Transmissivity is the rate at which water is transmitted through an aquifer. It equals the hydraulic conductivity of the aquifer times the thickness of the aquifer. The larger the value for the transmissivity, the faster groundwater is able to flow through the sand and gravel aquifer.

It is important to understand the characteristics of an aquifer when evaluating potential sources of contamination that may enter a well. In addition, the pumping of a well locally increases the velocity of groundwater within the capture zone of the well. Indeed, by definition, any particle of water that enters the Zone II of a well will eventually be captured by the well at some time.

The pumping of groundwater from a typical public water supply well forms a "cone of depression" that may have the appearance in cross-section of a funnel. Groundwater flows into the well screen from all directions when the well pump is in operation. It is not uncommon for public water supply wells to be operating for 16 – 24 hours per day pumping water.

When designing a subsurface disposal system (SDS), the MA DEP requires that the time of travel for a particle of groundwater to move from the SDS to a pumping well must be two (2) years or greater. Although there are no SDSs proposed for this 38 or 44 lot subdivision, there will be subsurface wastewater pipes. These pipes will originate from each of the 38 or 44 homes and connect to a central collection pipe passing through the proposed subdivision. These pipes will not only carry human waste, but whatever is disposed of "down the drain" or in the toilet. This could include unused medical prescriptions of all types, household chemicals, caffeine, perfumes, etc. When a leak occurs in these numerous subsurface pipes with many subsurface connections, the contaminants will enter the groundwater system and aquifer. Based on the characteristics of this aquifer and the hydraulic gradient of the groundwater table, the average linear groundwater velocity will be 10 – 20 feet per day. With a minimum distance to Well 2 from the edge of the proposed subdivision of 700 feet, the time of travel to Well 2 will be between 35 days (20 feet per day) and 70 days (10 feet per day).

Given this travel time rate, semi-annual or annual sampling of Well 2 will not be adequate to identify contamination at the well. Instead, monthly sampling and testing will be necessary. Even with monthly sampling and testing, there will be risks from the proposed residential development. For prescription chemicals (i.e. blood pressure pills, blood thinners, estrogen, Viagra, etc.) and emerging contaminants, there are few, if any, EPA-approved testing methods that the water supplier is required to test for at the present time. Furthermore, animal waste associated with household pets and roadway runoff from the proposed development constitute multiple, low to moderate risk non-point potential sources of contamination.

Newburyport Water Works has performed water quality tested for unregulated contaminants as required by EPA.[1] These contaminants do not have a drinking water standard established by EPA. They are being monitored to see if they should have public health protection standard. These results showing the presence of some emerging contaminants is significant because it

[1] http://www.cityofnewburyport.com/sites/newburyportma/files/file/file/important_information_about_your_drinking_water.pdf

demonstrates that there can be contaminants in the aquifer and groundwater system that could place the public drinking water system in jeopardy. These potential contaminants make it very important for the City to maintain maximum flexibility to deal with such threats. Conversion of the well-regulated golf course to a residential development will limit the City's ability to relocated Well No. 2 and will foreclose the opportunity to develop the existing irrigation wells on the golf course as supplemental or alternative sources of public drinking water. If this land is converted to residences, the City will lose the access to this natural resource and will lose flexibility to respond to future impacts to the public drinking water supply.

What also must be taken into consideration for this property is the depth to groundwater. This portion of Massachusetts and southeastern New Hampshire is experiencing extreme drought conditions. This means that the groundwater table is lower than normal for this time of year. We strongly recommend that the applicant identify the seasonal high groundwater table elevations across the site as part of any further work. Without this knowledge, basements and in-ground pools may be placed in the water table. With such a disruption to the water table, the distance from ground surface to ground water is decreased, and the ability of the aquifer to buffer contamination before it reaches the water table is decreased.

As stated earlier, this project is within the Water Resource Protection District (Section XIX) established by the Newburyport Zoning Ordinance. In Section XIX-A, the Ordinance states that the purpose of the Water Resource Protection District is:

1. To promote the health, safety, and general welfare of the community by ensuring an adequate quantity and highest quality of water possible for residents, institutions and businesses of the City of Newburyport.
2. To preserve and protect existing and potential watersheds and aquifers for drinking water supplies.
3. To prevent temporary and permanent contamination in the water resource protection district.
4. To protect the community from the detrimental use and development of land and water within the water protection district.

The construction of a 38 or 44 lot subdivision in place of a golf course that is highly regulated (i.e. Special Conditions listed in the Lally, 1985 and related reports) with 38 or 44 potential and "unregulated" points of potential contamination is in conflict with the language and intent of MA DEP regulations, the Newburyport Water Resource Protection District, and in direct opposition to the delivery of the "…highest quality of water possible for residents, institutions and businesses of the City of Newburyport."

An appropriate way to minimize potential contamination to Well 2 is either keep the existing golf course with the stringent turf management plan or designate the property as conservation and/or undeveloped land in order to preserve this natural resource for the City of Newburyport. Preservation of a natural resource and prevention of the contamination of groundwater at Well 2 should be emphasized, as prevention is less costly than the remediation of the aquifer.

Groundwater Flow

As shown in TEEM (1999) Zone II analysis of Wells 1 and 2, the BSC (1985) report and the NGI (2016) report, groundwater flows from the golf course toward Well 2. Figure 8 from the NGI (2016) report is consistent with the groundwater contours provided in BSC's August 22, 1985 letter regarding the proposed Evergreen development. In particular, both figures show considerable direct contribution to Well 2 from the northeast portion of the lot.

In addition to the direct flow to Well 2 from the northeast portion of the golf course, there is some question whether a bedrock high located within the northwest portion of the golf course that creates a "groundwater divide" that diverts some of the groundwater from that portion of the existing course away from Well 2.

This groundwater divide is depicted and interpreted differently in the BSC Report and the NGI Report. According to the BSC Report, the bedrock high diverts groundwater more extremely. As indicated in the Lally (1985) Report, this bedrock as interpreted by "…BSC to be an indication of the continuance of the ridge to the south across the Evergreen Estates, but it may be a function of hydrology controlled by sedimentation or stratigraphic changes more than by a bedrock high." The Lally (1985) Report goes on to say that "[t]his raises the possibility that the bedrock ridge is not always an effective barrier and may sometimes fail to divert the ground water from the western half of the golf course away from Well No. 2."

To fully understand the significance, if any, of the "bedrock high," along with changes in the direction of groundwater flow and pathways toward Well 2, additional subsurface exploration is required in order to develop a clear three-dimensional picture of the aquifer between the golf course and Well 2. Included in this analysis should be an understanding of the vertical and horizontal extent of the subsurface stratigraphy as depicted in geological cross-sections. Groundwater flow paths and time of travel estimates to Well 2 should also be included in this analysis.

Regardless of the impact of the bedrock high in the northwest portion of the site, it is without question that the northeast portion of the existing golf course, which would be developed under either the OSRD or traditional subdivision plan, is within the direct catchment area for Well 2. The significant contribution from this area, as opposed to other portions of the Zone II area is shown in "Groundwater Contour and Groundwater Flow Overlay Evergreen Commons LLC" figure prepared by GEOSHPERE attached as Exhibit C.

In contrast to the tightly regulated golf course uses, the unregulated residential development use will likely result in household chemicals, petroleum hydrocarbons, gasoline additives, fertilizer chemicals (i.e. Roundup), de-icing chemicals, and animal waste reaching the public drinking water supply well. Simulation of the transport times for these contaminants should be performed in order to understand the environmental risk associated with the approving an unregulated use in close proximity to a public water supply well. In my professional opinion, the proposed 38 or 44

lot residential subdivision near Well 2 will result in a degradation of groundwater quality and likely cause or contribute to the contamination of the City's public water supply.

NGI discussed, but did not provide sufficient detail on the potential impact the irrigation wells at the golf course have on Well 2. This issue is not clear and needs to be clarified by NGI. For example, does the capture zone for these two irrigation wells extend to or in the direction of Well 2?

The information and water quality analysis results presented in the NGI Report dated October 12, 2016, indicates that there is no impact to the groundwater from groundwater samples collected from the onsite irrigation well (IW-1) and two onsite groundwater monitoring wells (MW-6 and MW-7). This is to be expected because of the highly regulated nature of the golf course and application of fertilizers, pesticides, herbicides, and fungicides by a licensed pesticide applicator. This will not be the case for the 38 or 44 individual home owners in the proposed subdivision.

Until these questions are fully addressed, the proposed 38 or 44 lot residential subdivision may end up being an unregulated cluster of multiple, moderate risk potential sources of contamination to Well 2 instead of a highly regulated, single, moderate risk potential source of contamination (golf course). Based on information submitted to the Planning Board (Lisa Mead, Esq. letter dated September 13, 2016), it appears that the developer does not intend to carry forward the strict controls mandated by the Lally (1985) Report governing land management techniques including the application of fertilizers, pesticides, and herbicides. Under no circumstance should the Planning Board approve a conversion of the regulated golf course to a residential development without extensive and specific land management controls tailored to a residential use. Though in my professional opinion, even with such restrictions, with a 38 or 44 different residences it will be impossible to regulate uses effectively – even with a homeowners' association as proposed by the developer.

Proposed Site Grading

The "RESIDENTIAL DEVELOPMENT PRELIMINARY SUBDIVISION OF LAND" for the proposed 38 or 44 lot subdivision appears to indicate that there will be a significant amount of grading of overburden material at the site. Specifically at Lot 9 (Sheet C3), Lot 10 (Sheet C3), Lot 11 (Sheet C3), Lot 12 (Sheet C3), Lot 36 (Sheet C2), and Lot 37 (Sheet C2). Although it is difficult to read the contours at these lots there appears to be an average slope exceeding fifteen (15) percent across the lot. If the lots do have such a pitched slope, the developer would have to obtain a special permit and provide an acceptable plan for site stabilization and control of erosion and sedimentation pursuant to Section XIX-I (7).

Although the groundwater testing as reported by NGI in their October 12, 2016 report does not indicate groundwater contamination associated with the operation of the golf course, the apparently large amount of grading and soil movement across the property may be problematic. The chemicals applied to the turf are not leaching out of the soils and organic layer as demonstrated in the groundwater testing. However, as the soils and turf are disturbed during

construction, the turf chemicals bound up in the organic layer may become mobilized and leached from this soil horizon and migrate downward into the groundwater. In addition, given the comments of Mr. Zinck, from the Newburyport Inspection Services Department, regarding historic unregulated dumping at the site, including 5 feet of dirt from salt marsh peat which caused Well 2 to be taken out of service due to groundwater contamination (Exhibit D), we recommend that a soil testing program be required to ensure that no residual contamination bound up in the organic layer or fill be introduced in the groundwater during construction activities for the proposed subdivision.

Alternative to the Proposed 38 Lot Residential Subdivision

As indicated above, Well 2 was constructed in 1958. The "typical" lifespan of a groundwater well is 50 – 75 years before it begins to show signs of poor performance along with difficulties in efforts to rehabilitate the well. Well 2 is almost 60 years old. The design of water wells has advanced over the past decades with improved construction materials and design of well screens. Well 2 is within this lifespan, but in the near future, Newburyport will have to replace this well. The new well will be located in close proximity to the existing well. The new well will likely be within a few hundred feet of so existing well, but it may be significantly closer to the proposed development. This new replacement well will be necessary to ensure the continued delivery of clean drinking water to all of the homes and businesses in serviced by the Water Division of the Newburyport Department of Public Services, including the City of Newburyport, the Old Town portion of Newbury, Plum Island, and the Town of West Newbury.

In addition to drilling a new and improved well in the near future, Newburyport may need to develop new sources of groundwater or surface water. This new groundwater source could be in the form of a redundant well that would be used should Well 1 or Well 2 be out of service or as a new source used in conjunction with the two existing wells. As noted above, the existing irrigation wells on the golf course might provide this source. There are very limited groundwater sources within Newburyport, and the City should exercise good judgment to preserve this potential public drinking water supply.

As shown on the well logs attached as Exhibit E, the two irrigation wells located on the golf course each yield 100 gpm for a total of 200 gpm. Although these wells are not deep (27 feet and 30 feet), the aquifer is clearly capable of yielding large quantities of groundwater. The attached well logs support the findings that the aquifer at Well 2 is highly transmissive. Such a groundwater well is a valuable natural resource that is difficult to find given the large amount of development above high-yielding sand and gravel aquifers in many communities.

In addition to serving as a potential source of groundwater for the public drinking water supply, the groundwater resource beneath the golf course that provides vital recharge to the City of Newburyport's public water supplies. This resource must be protected. Allowing either the 38 or 44 lot residential subdivision will leave this resource vulnerable to degradation.

In my professional opinion, approval of the proposed residential development is likely to cause or contribute to the contamination of the public water supply and does not satisfy the Water

Resource Protection District's goals for preservation and protection of the City's existing and future water supplies.

Sincerely,
GEOSPHERE ENVIRONMENTAL MANAGEMENT, INC.

Raymond Talkington, Ph.D, P.G., C.P.G.
President/Principal Hydrogeologist

ATTACHMENTS

Exhibit A - Curriculum Vitae
Exhibit B - References Cited
Exhibit C – Figure 1 – Groundwater Contour and Groundwater Flow Overlay
Exhibit D – Zinck Email dated October 4, 2016
Exhibit E - Well Logs

PROFESSIONAL PROFILE

RAYMOND W. TALKINGTON, Ph.D., P.G., C.P.G.
President/Principal Hydrogeologist

As Principal Hydrogeologist, Dr. Raymond Talkington is responsible for providing direction to **GEOSPHERE**'s non-engineering environmental and hydrogeologic/geologic efforts for all projects as well as personnel training and development. He serves as the lead person in keeping abreast of pertinent technological developments and regulatory changes.

Dr. Talkington's extensive experience involves an array of environmental issues and groundwater supply exploration and development projects. This has included investigating commercial and industrial properties for the presence of hazardous materials and groundwater and aquifer contamination, from directing many remedial investigations and feasibility studies to determining remedial action at contaminated properties. He also performed dozens of groundwater supply exploration and development projects, as well as landfill hydrogeological investigations and the first permitted landfill mining/reclamation projects.

Professional History

Geosphere Environmental Management, Inc.
Talkington Edson Environmental Management, LLC.
Ransom Environmental Consultants, Inc.
Dufresne-Henry, Inc.
Falconbridge Limited

Education

Ph.D., Geology and Geochemistry, Memorial University of Newfoundland, Canada, 1981
M.S., Geology and Geochemistry, University of New Hampshire, 1976
B.S., Geology, University of Massachusetts, 1973

Professional Registrations/Certifications

AIPG – CPG 7935
Maine – P.G. 275
Tennessee – P.G. TN 1287
Pennsylvania - PG-325-G
Kentucky – P.G. 1209
New Hampshire – P.G. 86
Completed 40-Hour Training Course for Hazardous Materials Site Training, OSHA 29CFR1910.120, New England Consortium

Professional Affiliations/Citations

Recipient – Patriotic Employer Award, National Committee for Employer Support of the Guard and Reserve
Past President – The American Institute of Professional Geologists (AIPG) (2014)
Past Editor - *The Professional Geologist* a publication of the American Institute of Professional Geologists (AIPG) (2004 – 2006)
Instructor – New England Water Works Association: Groundwater Supply Exploration and Development (1990 – present).
Instructor – New England Water Works Association: Bedrock Wells (1997 – present).
Instructor – New England Water Works: Well Rehabilitation and Maintenance (1994 – present).

Academic Positions

Lecturer – Department of Earth Sciences, University of New Hampshire, 1978
Post Doctoral Fellow – Department of Geology, Carleton University, Ottawa, 1980 - 1982
Assistant Professor of Geology – Stockton College, Pomona, New Jersey, 1982 – 1987
Adjunct Professor – University of New Hampshire, Department of Earth Sciences: Course titles: Environmental

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PROFESSIONAL PROFILE

RAYMOND W. TALKINGTON, Ph.D., P.G., C.P.G.
President/Principal Hydrogeologist

Geology and Advanced Hydrogeology (1998 – present).

Project Experience

Non-Hazardous Waste Investigations

Project Hydrogeologist for designing, coordinating, and implementing a groundwater dewatering system at a manufacturing facility in Littleton, Massachusetts. The purpose for the dewatering operation was to allow for the hydraulic jacking of corrugated metal pipe beneath a shared Massachusetts Bay Transit Authority (MBTA) Commuter and Boston and Maine Rail Line.

Project Hydrogeologist for a groundwater quality impact investigation at the Martha's Vineyard Airport, Edgartown, Massachusetts. A groundwater monitoring and aquifer evaluation of a section of the Martha's Vineyard Airport was performed in order to evaluate the environmental impacts from the application of wastewater from a proposed 100,000 gallons per day wastewater treatment facility.

Project Manager for a hydrogeologic investigation that was designed to determine the characteristics of leachate contaminated groundwater derived from adjacent landfills in Duxbury, Massachusetts. The design included the installation of monitoring wells, groundwater sampling and analysis, and a three-dimensional computer model of the groundwater flow system between the two landfills and nearby municipal water supply well.

Landfill-Related Investigations

Hydrogeologist for numerous landfill sitings, closures, and monitoring in the United States. These hydrogeologic projects have typically involved the installation of monitoring wells, excavation of test pits, application of various types of geophysical methods, groundwater sampling and testing, and computer models to simulate groundwater flow regimes.

Hazardous Pesticide/Herbicide Contamination Investigations

Project Hydrogeologist for the design and implementation of a hydrogeologic investigation of groundwater contamination at municipal water supply wells 3 and 4 in Westfield, Massachusetts. These municipal water supply wells were voluntarily removed from service by the City in order to determine the areal extent and source of the ethylene dibromide (EDB) contamination in the wells. The investigation involved the installation of numerous deep and shallow monitoring wells in order to define the horizontal and vertical extent of the EDB, groundwater sampling and analysis, and analytical groundwater modeling to determine the groundwater capture zones of each of the municipal wells.

Representative Groundwater Resource Projects

Principal Hydrogeologist for numerous groundwater exploration and development projects in unconsolidated deposits and fractured bedrock for municipal water supplies, irrigation wells, and process water wells in the Northeastern United States. These projects involve the examination of U.S. Geological Survey topographic maps,

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aerial photographic interpretation, surficial and geological map interpretation, application of various surface and downhole geophysical methods, and watershed analysis to locate favorable areas for the installation of ground water test wells.

MA DEP Zone II	Source Water Assessment Program contract with the MA DEP to perform Conceptual Zone II (capture zone) delineations for 37 public water supply wells in Massachusetts.
Maine DEP	Technical review of groundwater monitoring reports for permitted public water supply wells in Maine.
Acton Water District	Aquifer pumping test design and performance and Zone II (capture zone) delineation.
Alton, NH	Development and permitting under Large Groundwater Withdrawal Regulations of 500 gpm sand and gravel public water supply for the Town of Alton.
Ayer, MA	Evaluation of bedrock aquifer for new public water supply.
Auburn, NH	Fracture trace analysis and selection of drilling locations for the development of 15 residential bedrock water supply wells.
Auburn, NH	Fracture trace analysis and selection of drilling locations for the development of 51 residential bedrock wells on Mt. Miner.
Bridgewater, MA	Groundwater exploration and aquifer pumping test design and performance, Beech Street well.
Boothbay Harbor, ME	Test well exploration and development of a sand and gravel well for an irrigation supply (169 gpm).
Chelmsford, MA	Test well exploration and aquifer pumping test design, Elm Street.
Concord, MA	Development and permitting of three sand and gravel wells for a new public water supply (1 mgd).
Democratic Republic of the Congo	Groundwater exploration and installation of bedrock water supply wells in Bakwa Tshileu, East Kasai Province
Derry, NH	Performance of an aquifer pumping test or an existing well and selection of new location for the development of a community bedrock water supply well.
Derry, NH	Test well exploration for the development of a new groundwater supply for a private community.
Epping, NH	Groundwater exploration and fracture trace analysis for the development of a high-yielding bedrock groundwater public water supply.
Epping, NH	Perform fracture trace analysis, very low frequency geophysics, and electromagnetotellurics (EMT) for the development of 3 high yielding (125 gpm – 400 gpm) bedrock wells.
Exeter, NH	Fracture trace analysis, very low frequency geophysics, selection of drilling

	locations, and NH DES permitting for the development of a bedrock well community water supply.
Grafton, MA	Evaluation of streamflow conditions in Cronin Brook and induced infiltration from the pumping of the Follette Street Well.
Hampton, NH	Groundwater exploration and development of bedrock public water supplies.
Hampton, NH	Development and permitting under Large Groundwater Withdrawal Regulations of two new bedrock wells for public water supply.
Hampton, NH	Development of aquifer monitoring plan for 14 public water supply wells.
Hampton, NH	Source of Supply Study for 10 sand and gravel and four bedrock public water supply wells.
Hampton, NH	Development of Well Owner Response Policy as part of the permitting process for one sand and gravel well in the Town of Stratham (predecessor of Large Groundwater Withdrawal Regulations).
Hampton, NH	Development of Well Owner Response Policy as part of the permitting process for three bedrock wells in the Town of North Hampton (predecessor of Large Groundwater Withdrawal Regulations).
Hanover, MA	Fracture trace analysis and hydrogeological evaluation for the siting of new bedrock irrigation well for the new Hanover High School.
Hartford, VT	Test well exploration for new groundwater source near Wilder, VT.
Hingham, MA	Conceptual Zone II (capture zone) delineation of existing wells.
Hopedale, MA	Performed fracture trace analysis for area selected for new public water supply wells.
Hooksett, NH	Development and permitting under Large Groundwater Withdrawal Regulations of 400 gpm sand and gravel public water supply.
Hooksett, NH	Replacement/Backup sand and gravel well in accordance with NH DES Rules.
Hopkinton, MA	Groundwater exploration, development and permitting of sand and gravel Alprilla Wells.
IBM Corporation	Hydrogeological evaluation of aquifer pumping test data, Essex Junction, Vermont.
Littleton, MA	Fracture trace analysis, exploration, development and permitting of three new bedrock wells at Cobb's Pond area.
Littleton, NH	Fracture trace analysis and exploration for a new bedrock public water supply well.
Mashpee, MA	Re-delineation of Zone II (capture zone) for Mashpee Well 6.
Millbury, MA	Conceptual Zone II (capture zone) delineation of existing wells.
Nashville, TN	Groundwater exploration for bedrock irrigation well.

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PROFESSIONAL PROFILE

RAYMOND W. TALKINGTON, Ph.D., P.G., C.P.G.
President/Principal Hydrogeologist

New London, NH	Performed fracture trace analysis of selected area to be assessed for bedrock water supply development.
New Durham, NH	Development and permitting under Large Groundwater Withdrawal Regulations of bedrock water supply for private golf course.
New Durham, NH	Development of new bedrock public water supply (community well) for private golf course.
Nottingham, NH	Aquifer pumping test and permitting of bedrock water supply wells and spring for a bottled water company using Large Groundwater Withdrawal Rules.
Norfolk, MA	Aquifer pumping test analysis (600 gpm) and Zone II (capture) delineation, Spruce Road well.
North Hampton, NH	Replacement sand and gravel well in accordance with NH DES Rules.
North Hampton, NH	Permitting and development of wetlands and river monitoring plans for three bedrock public water supply wells (119, 150, and 200 gpm).
North Hampton, NH	Groundwater exploration and development of new bedrock public water supplies.
North Hampton, NH	Replacement bedrock well in accordance with NH DES Rules.
North Springfield, VT	Evaluate test well locations for additional water supply.
Orleans, MA	Identify the depth to the saltwater/freshwater interface and performed computer model based on field-verified data to predict that the municipal water supply well (Well 7) would not pump salt water under normal operating conditions and MA DEP-approved safe yield.
Plainfield, NH	Analysis of aquifer pumping test data for two new public water supply wells.
Raynham Center Water District, MA	Aquifer pumping test design and performance (175 gpm) and Zone II (capture zone) delineation, Johnson Pond Wellfield.
Rutland, VT	Test well exploration program for sand and gravel water supply wells.
Salisbury, MA	Groundwater exploration, development, permitting, and Zone II delineation for a new sand and gravel municipal water supply well (Well 8).
Seabrook, NH	Fracture trace analysis and exploration for new bedrock public water supply wells.
Southwick, MA	Aquifer pumping test design and analysis (700 gpm) and Zone II (capture zone) delineation.
South Deerfield, MA	Groundwater exploration for new sand and gravel or bedrock public water supply.
Stratham, NH	Permitting, aquifer pumping test review, and development of aquifer, wetlands, and river monitoring plans for a sand and gravel public water supply well (242 gpm).
Stratham, NH	Fracture trace analysis, very low frequency geophysics, and selection of drilling

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	locations for the development of a bedrock well community water supply.
Sutton, MA	Development of new bedrock public water supply (community well) for private golf course.
Swansea Water District	Test well exploration and expansion of wellfield.
Swansea Water District	Aquifer pumping test and analysis (175 gpm) and Zone II (capture zone) delineation (bedrock well).
Topsfield, MA	Zone II (capture zone) delineation and water management act application.
Turners Falls, MA	Aquifer pumping test design and performance (1,600 gpm) and Zone II (capture zone) delineation for an artesian aquifer with a positive 30 foot hydrostatic condition.
Upton, MA	Hydrogeological investigation including water budget analysis and bedrock aquifer pumping test for the siting of 61 residential bedrock water supply wells.
Uxbridge, MA	Test well exploration for the development of a new groundwater source for the Town. Located three potential sites of 1 mgd (2) and 2 mgd (1).
Walpole, MA	Re-delineated water resource boundary using subsurface soil conditions, groundwater flow data, and subsurface geophysical information.
Westfield, MA	Water supply exploration, Brickyard area, Westfield.
Westfield, MA	Approved Conceptual Zone II (capture zone) delineations for Wells 1, 2, 7, and 8.
Westfield, MA	Approved Conceptual Zone II (capture zone) delineations for Wells 5 and 6.
Westfield, MA	Aquifer pumping test (2,800 gpm) and Conceptual Zone II (capture zone) delineations for Wells 3 and 4.
Westfield, MA	Hydrogeological evaluation of Wells 3 and 4 for contamination by EDB.
Westfield, MA	Development of new sand and gravel public water supply well, Well 9A (1,300 gpm).
Westford, MA	Aquifer pumping test design and performance and Zone II (capture zone) delineation, Wells 7 and 11.
West Springfield, MA	Aquifer pumping test design and performance (4,200 gpm) and Zone II (capture zone) delineation.
West Springfield, MA	Evaluation of groundwater contamination at municipal Wells 1, 2, 3, and 4 for EDB and 1,2-Dichloropropane.
Winchendon, MA	Fracture trace analysis to identify drilling location for an irrigation well for the Massachusetts Veterans Memorial Cemetery.

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PROFESSIONAL PROFILE

RAYMOND W. TALKINGTON, Ph.D., P.G., C.P.G.
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Selected Publications

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PROFESSIONAL PROFILE

RAYMOND W. TALKINGTON, Ph.D., P.G., C.P.G.
President/Principal Hydrogeologist

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EXHIBIT B

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PROPOSED DEVELOPMENT DOCUMENTS REVIEWED

Evergreen OSRD Subdivision

Documents available from City of Newburyport Planning Department website, including, but not limited to:

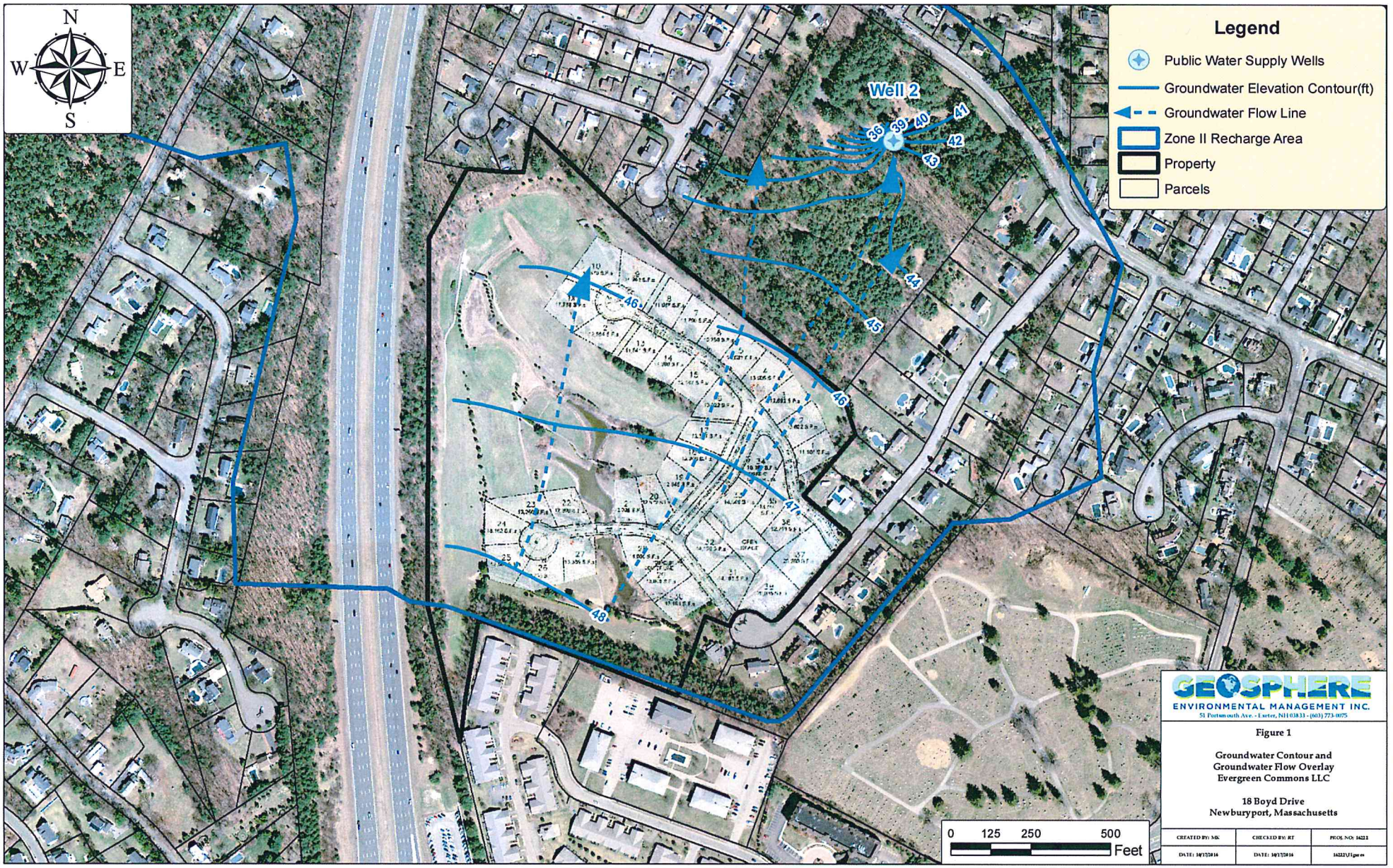
- OSRD Special Permit Application and Memo filed by Petitioner, Evergreen Commons, LLC, dated July 20, 2016
- Yield Plan and OSRD Sketch Plan prepared for Evergreen Commons, LLC by Design Consultants, Inc. (unstamped), dated July 20, 2016
- 9/13/16 cover letters, revised OSRD Sketch Plan (9/14/2016 - unstamped) and revised Existing Conditions Plan (9/14/2016), prepared for Evergreen Commons, LLC by Design Consultants, Inc.

Evergreen Preliminary Subdivision

Documents available from City of Newburyport Planning Department website, including, but not limited to:

- Preliminary Subdivision Plans – "Residential Development Preliminary Subdivision of Land, Newburyport, Massachusetts", prepared for Evergreen Commons LLC by Design Consultants, Inc., 23 pages, dated September 20, 2016
- Draft Environmental and Community Impact Analysis for Evergreen Commons, 18 Boyd Drive, Newburyport, Massachusetts, prepared for Evergreen Commons LLC by Design Consultants, Inc., September 20, 2016.

EXHIBIT C



GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave. - Exeter, NH 03833 - (603) 773-0075

Figure 1

Groundwater Contour and
Groundwater Flow Overlay
Evergreen Commons LLC

18 Boyd Drive
Newburyport, Massachusetts

CREATED BY: MK	CHECKED BY: RT	PROJ. NO: 16221
DATE: 10/17/2016	DATE: 10/17/2016	16221\Figure

EXHIBIT D

Kathryn Newhall-Smith

From: David Zinck
Sent: Tuesday, October 04, 2016 8:58 AM
To: Andrew Port; Molly Ettenborough; Kathryn Newhall-Smith
Cc: Anthony Furnari; Wayne Amaral
Subject: RE: Request for Comments - Preliminary Subdivision Plan, Evergreen Commons

Hi Andrew,
Here are my opinions of the proposed development and how it is going to affect Newburyport.

This used to be called "Poor's Pit" . In the '60's it was sold to Vitale. Vitale was doing excavation at the pit under strict regulation that he could only dig down to a certain level. He dug too deep and was right in the aquafer. One of the excavators told me that the water was up to the middle of the wheels on the backhoes. The city put a stop to it and made him fill it is again.

The dirt used for the fill was Salt March Peat from a dredging operation in Revere. The entire area was raised about 5' higher than what Vitale had dug down to. The city started getting salt in the water supply and it took them a while to figure out that it was coming from the fill used to bring Vitale's pit up 5'. The well was poisoned and shut down for about 8 or 9 years. Apparently after that span of time the salt had leached out of the fill enough to be safe again.

This leads me to several concerns regarding the proposed development. First we have to understand the infrastructure of the city's water system. The bulk of the water comes from the Artichoke Reservoir and goes to the Spring Lane filtration plant. It is filtered, treated, tested, etc. and once clean, it is pumped to the water towers. The well on Ferry Rd. (the one closest to the pit that was shut down) sucks the water out of the ground and pumps it directly into the clean water supply pipe that runs up Ferry Rd. There is no treatment facility treating this water. I have no doubt that there is a means to tap this water and test it but if it is bad, you do not know that it is bad until it is already has already poisoned our entire water supply. This is a huge concern.

These houses being built are going to be digging 10' down to put the foundations in. They are going to be digging and installing them right into the aquafer. You cannot sell $1M homes and tell them that they cannot put in a swimming pool so these also are going right into the aquafer. The plans show retention ponds being built for the run-off of the roads, roofs, etc. which will also be right in the aquafer. They may be ½ full the day that they are dug. The city cannot put the snow it removes from the roads directly into the river because it picks up oil, rubber, and antifreeze from the cars, trash, litter, and the sand, Rock Salt, and Calcium Chloride used for road maintenance in the winter. This snow is put in huge piles at parking lots like Cashman Park and other places like it so that the snow can melt naturally. The water runs in to the river and, in the spring, we clean up what is left behind when the snow is gone. In this development, the road salt, calcium chloride, sand, oil and antifreeze from the cars, and chlorinated pool water when they pump down the pools for closing at summer's end, will all be going onto these retention ponds that are directly in the aquafer. There is no way to stop this from going into the aquafer and no way to stop this from going directly into our clean water supply.

When they talk about a separation from the well they only talk about the horizontal distance from the nearest house to the well. The critical dimension here is the vertical distance from the aquafer. I am also leery of the results from the test pits because we are in the worst drought that we have seen in 30 years. That has to skew the results. The only way that I can see to put this development in and still be secure in the water supply is to build a small treatment plant at the site of the well. You pull water up from the ground, put it through filtration, testing, treatment, and when it is assured that it is clean, pump it into the water supply. This is a facility that will have to be manned 24/7. I don't see any other way to catch a problem before it is pumped into our clean water.

In the interest of disclosure, I live on Laurel Rd.

David Zinck

From: Andrew Port
Sent: Thursday, September 29, 2016 8:07 PM
To: Molly Ettenborough; Kathryn Newhall-Smith
Cc: David Zinck; Anthony Furnari; Wayne Amaral
Subject: RE: Request for Comments - Preliminary Subdivision Plan, Evergreen Commons

Molly – No details yet on street lights. Too early in the permitting. But we will circle back on that issue. Bottom line is that no City departments believe the proposed roadways should be accepted by the City. In order to avoid the usual issue years down the road the Planning Board should place a condition requiring subsequent Planning Board approval for a change from Private to Public Ways within the project. Covenants, Homeowner's Association, etc. That would add another layer to the basic City Council request and approval. (This assumes the project is approved for construction of course.)

Kate – Please add this to your notes for proposed conditions...

Andrew R. Port, AICP
Director of Planning & Development

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Web www.cityofnewburyport.com

From: Molly Ettenborough
Sent: Thursday, September 29, 2016 6:45 PM
To: Kathryn Newhall-Smith
Cc: Andrew Port; David Zinck; Anthony Furnari; Wayne Amaral
Subject: RE: Request for Comments - Preliminary Subdivision Plan, Evergreen Commons

Kate- will the road ways be public or private? I know that it may start as a private way but what is the long term plan with them for city services. Also do they plan to put in street lights and who pays for them to be installed and maintained?

Thanks,
Molly

Molly M. Ettenborough

MassDEP
Well Completion Report

10/6/2016 2:51:55 PM

WELL LOCATION

GPS North: **GPS West:** **Assessors Map:**
Address: 19 Boyd Drive **Assessors Lot #:**
Subdivision Name: **Permit number:**
City/Town: Newburyport **Date Issued:**
Board of Heath permit obtained: NR

Work Performed	Proposed Use	Drilling Method Overburden	Drilling Method Bedrock
New Well	Irrigation	Air Rotary	

ADDITIONAL WELL INFORMATION

Developed :
Disinfected :
Total Well Depth : 20
Fracture Enhancement :
Well Seal Type : Cement/Bentonite
Depth to Bedrock :

PERMANENT PUMP (IF AVAILABLE)

Pump description :
Type :
Nominal Pump Capacity :
Intake Depth :
Horsepower :
Comments : Well is located 1500' North West of Boyd Drive, .4 miles South West of Ferry Road. Steel Casing Type actually 26 pounds.

CASING

From (ft)	To (ft)	Type	Thickness	Diameter
0	11	Steel		8

SCREEN

From (ft)	To (ft)	Type	Slot Size	Diameter
11	20		0.02	

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From (ft)	To (ft)	Material Description	Purpose

STATIC WATER LEVEL (ALL WELLS)

Date Measured	Depth Below Ground Surface (ft)
09/01/1990	6

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield (GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & Min)	Recovery (Ft. BGS)
09/01/1990	Core	100	2:00	8		

OVER BURDEN

From (ft)	To (ft)	Lithology	Color	Comment	Water Zone	Loss/Add of fluid	Drill Stem Drop	Drill Rate
0	8	Gravel			No			
8	11		Brown	Sand	No			
11	20		Brown	Sand	Yes			
20	30	Clay		& Sand	No			

BEDROCK

From (ft)	To (ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss/Add of fluid	# of Fract per ft

MassDEP

Well Completion Report

10/6/2016 2:56:28 PM

WELL LOCATION

GPS North: **GPS West:** **Assessors Map:**
Address: 19 Boyd Drive **Assessors Lot #:**
Subdivision Name: **Permit number:**
City/Town: Newburyport **Date Issued:**
Board of Heath permit obtained: NR

Work Performed	Proposed Use	Drilling Method Overburden	Drilling Method Bedrock
New Well	Irrigation	Air Rotary	

ADDITIONAL WELL INFORMATION

Developed :
Disinfected :
Total Well Depth : 27
Fracture Enhancement :
Well Seal Type : Cement/Bentonite
Depth to Bedrock :

PERMANENT PUMP (IF AVAILABLE)

Pump description :
Type :
Nominal Pump Capacity :
Intake Depth :
Horsepower :
Comments : Well is located 1500' from Boyd Drive, .4 miles South West of Ferry Road.

CASING

From (ft)	To (ft)	Type	Thickness	Diameter
0	11	Steel	17#	6

SCREEN

From (ft)	To (ft)	Type	Slot Size	Diameter
16	27		0.02	

WELL SEAL / FILTER PACK / ABANDONMENT MATERIAL

From (ft)	To (ft)	Material Description	Purpose

STATIC WATER LEVEL (ALL WELLS)

Date Measured	Depth Below Ground Surface (ft)
07/10/1989	6.666670

WELL TEST DATA (ALL SECTIONS MANDATORY FOR PRODUCTION WELLS)

Date	Method	Yield (GPM)	Time Pumped (hrs & min)	Pumping Level (Ft. BGS)	Time To Recover (Hrs & Min)	Recovery (Ft. BGS)
07/10/1989	Core	100	2:00	8.1667	3:00	6.666670

OVER BURDEN

From (ft)	To (ft)	Lithology	Color	Comment	Water Zone	Loss/Add of fluid	Drill Stem Drop	Drill Rate
0	8	Gravel			No			
8	23			Light Sand	No			
23	27		Brown	Sand	No			

BEDROCK

From (ft)	To (ft)	Lithology	Comment	Water Zone	Drill Stem Drop	Extra Large	Drill Rate	Rust Stain	Loss/Add of fluid	# of Fract per ft