

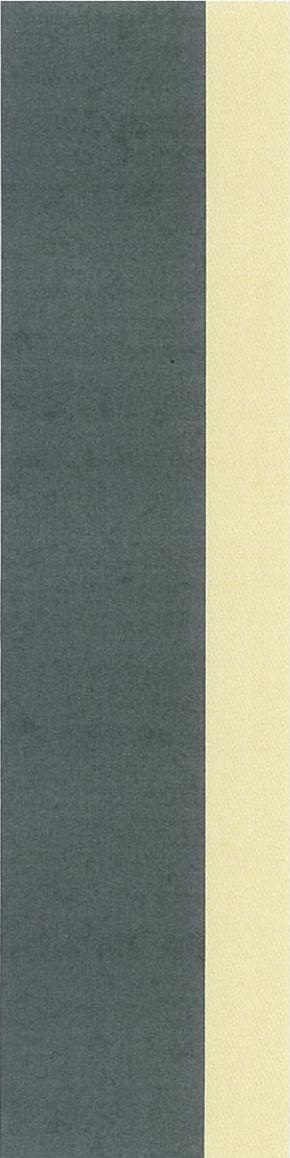
**Carlisle ZBA  
Carlisle, Massachusetts  
October 4, 2016**

# **INDEPENDENT HYDROGEOLOGIC STUDY, 100 LONG RIDGE ROAD *PHASE 4 – 2016 REVISED PROPOSAL***

*Presenter:*

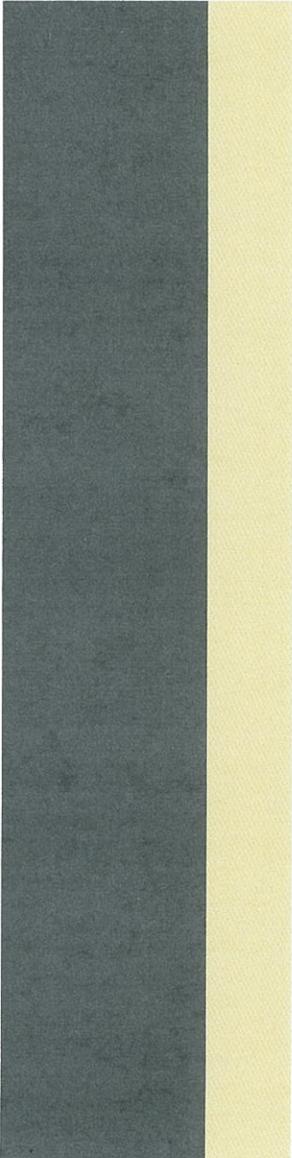
James H. Vernon, Ph.D., P.G.  
Nobis Engineering, Concord, NH





# Key Hydrogeologic Questions

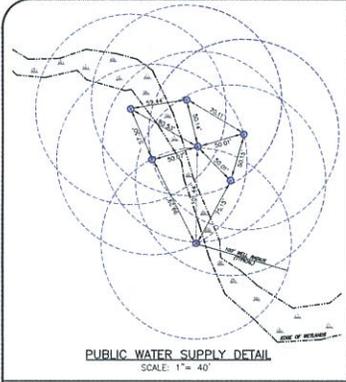
- Effect of proposed septic system on wells – on-site and neighbors?
- Effect of PWS wells on neighbors' wells?
- Effect of PWS wells on each other?



# Objectives of Nobis Study

- Use conceptual hydrogeologic model of overburden & bedrock groundwater to evaluate proposed changes:
  - *PWS instead of private wells*
  - *Septic Area 2 moved*
- Groundwater mounding analysis
- Nitrate mass balance analysis
- PWS implications
- *Not: critiquing work of others; Not: recommending permit granting or denial*



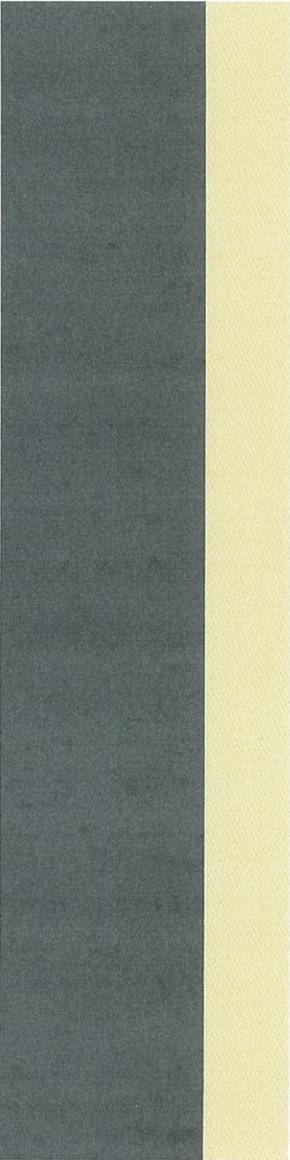


**LEGEND**

EXISTING	DESCRIPTION	PROPOSED
100	2 FOOT CONTOUR	100
100	10 FOOT CONTOUR	100
---	EDGE OF PAVEMENT	---
-----	CURBING	-----
	STONE WALL	
IP	IRON PIN	T.B.S.
IR	IRON ROD	T.B.S.
DH	DRILL HOLE	D.H.S.
SDBH	STONE BOUND W/ D.H.	D.H.S.
7h0	SPOT GRADE	7h0
---	TREE LINE	---
---	DRAIN PIPE - HOPE	---
---	DRAIN MANHOLE	---
---	CATCH BASIN	---
---	UNDERGROUND UTILITIES (CABLE, TELE, ELEC)	---
---	WELL	---
---	WATER LINE (4" PVC; SDR 21)	---
---	SEWER FORCE MAIN (E-ONE)	---
---	STOP SIGN	---
---	STREET LIGHT	---
---	BUILDING SETBACK	---
UP #72	UTILITY POLE	UP #72
---	EROSION CONTROL (AS SPECIFIED)	---
---	TREE	---
---	PROPANE TANK	---
---	CUL-TECH ROOF DRAIN	---
---	SNOW STORAGE	---
---	FAR FIRE ACCESS ROAD	---

REVISION - 1 8-18-2016 UTILITY / TOWN CHANGES LAW  
**PLAN P - PUBLIC WATER SUPPLY - UTILITY**  
**"The Birches"**  
 100 LONG RIDGE ROAD  
 CARLISLE, MASSACHUSETTS  
 PREPARED FOR:  
 LIFETIME GREEN HOMES, LLC  
 142 LITTLETON ROAD  
 WESTFORD, MA 01886  
 FEBRUARY 2, 2016 SCALE: 1" = 40'

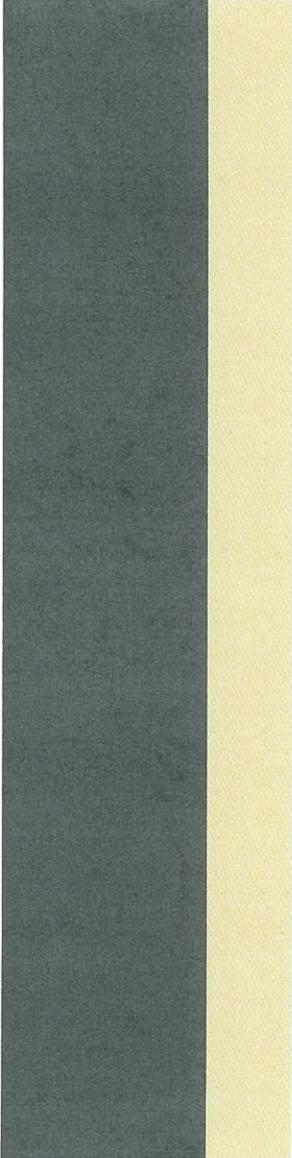
**MEISNER BREM CORPORATION**  
 145 LITTLETON ROAD, STE. 16, WESTFORD, MA 01886 (978) 862-1371  
 202 MAIN STREET, SALEM, NH 03079 (603) 863-3333  
 JOB NUMBER: 2066P  
 ACAD FILE: 2066Pm-publicwiththeatyourid.dwg



# 2016 Revised 40B Proposal

- Septic Disposal Area 2 moved south, along western boundary
- Public Water System
  - 7 equal wells near brook/wetland
  - Farther from SDAs
  - Approved/regulated by DEP

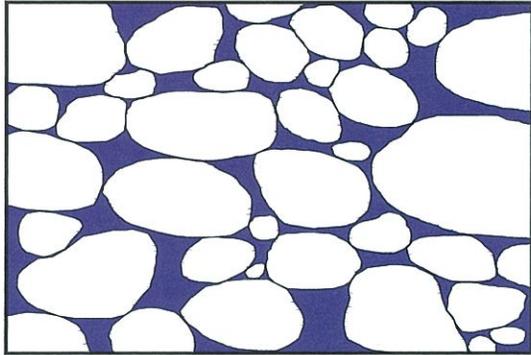




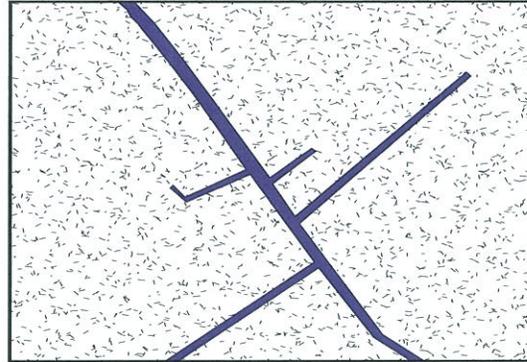
# Simplified Hydrogeology at Site

- Overburden
  - Soil and swamp deposits
  - Sandy Glacial Till (will receive septic discharge)
  - Dense, low permeability glacial till may or may not blanket the bedrock
- Fractured Bedrock
  - Schist (metamorphic) is predominant rock type
  - Water found in fractures only
  - All wells in area are bedrock wells
  - Overburden can be a source of recharge

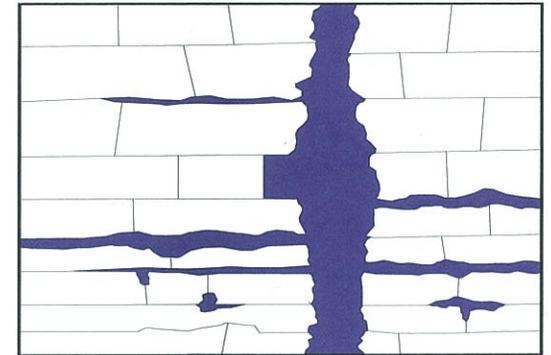
# Types of Aquifers



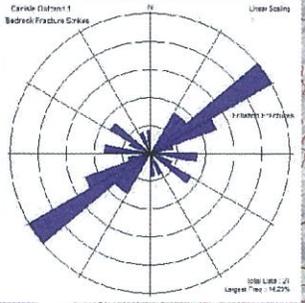
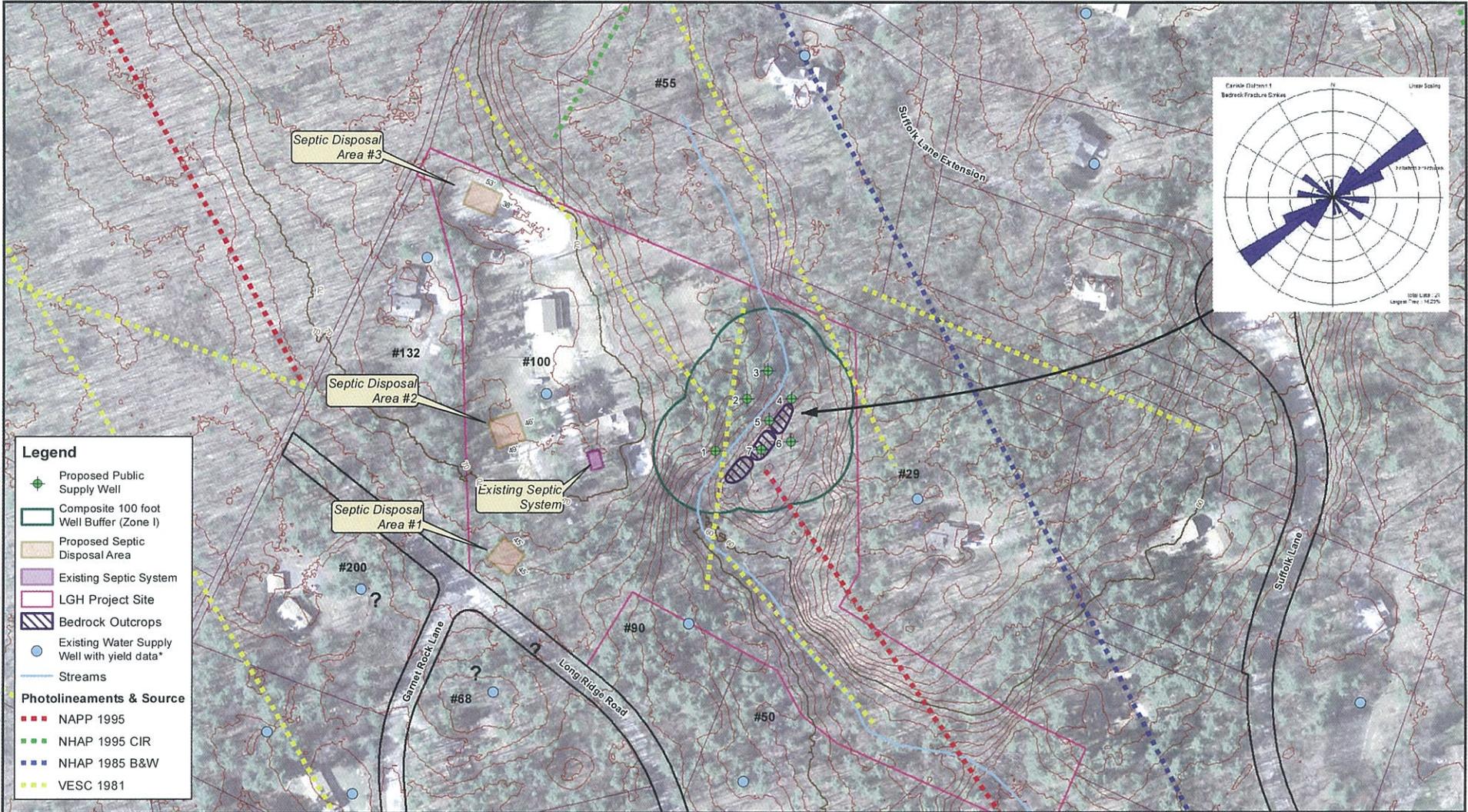
Sand & Gravel  
Aquifers



Fractured Bedrock  
Aquifers

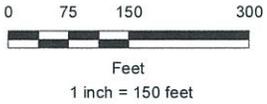


Karst Aquifers



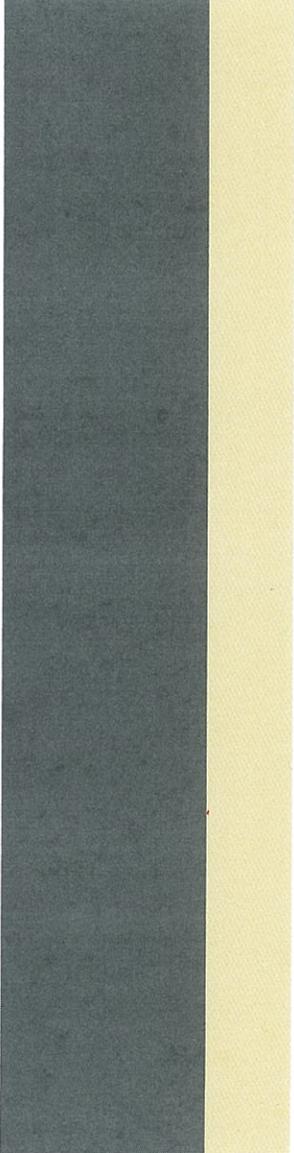
**FIGURE 2**  
BEDROCK CHARACTERISTICS  
PROPOSED SEPTIC DISPOSAL  
AREAS AND WELLS  
100 LONG RIDGE ROAD  
CARLISLE, MASSACHUSETTS

PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 89220.00	DATE: SEPTEMBER 2016



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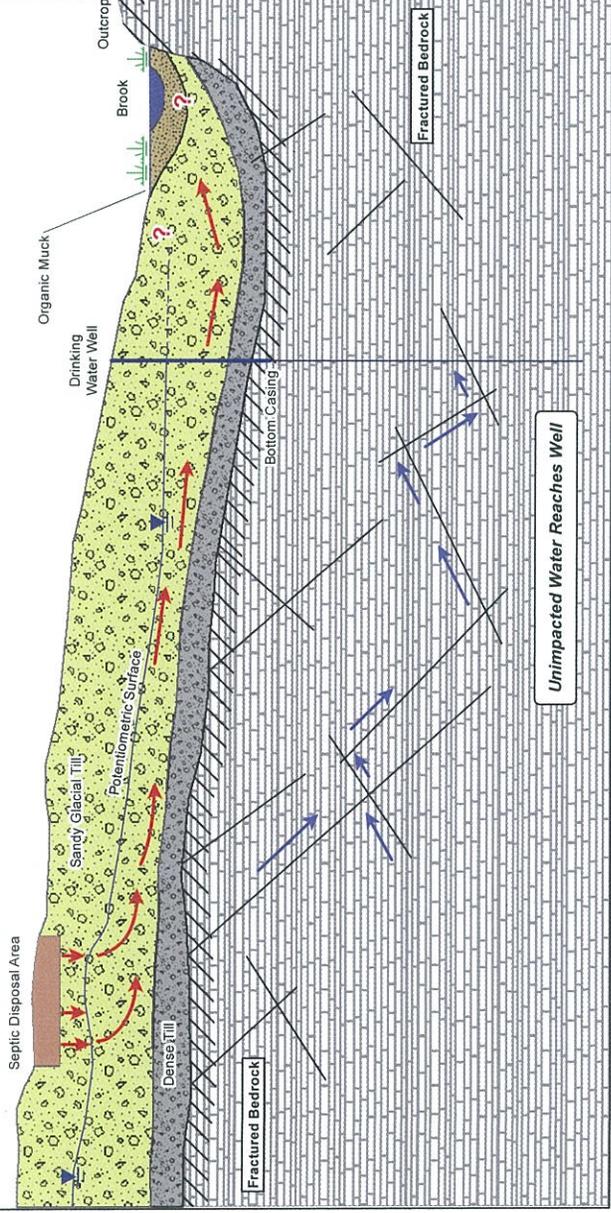
Path: J:\9220\00 - Carlisle Hydrogeol. Evaluation\_2016\GIS\Figures\Figure 2\_Cradle Bedrock\_Simplified.mxd Date Printed: 10/2/2016



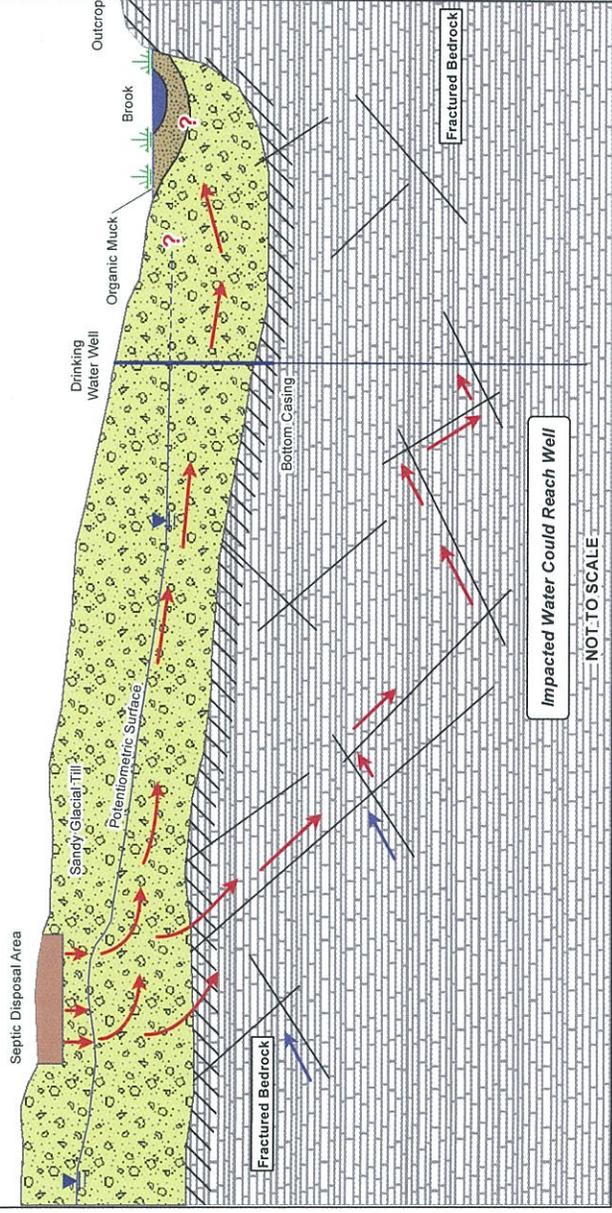
# Conceptual Model (1)

- Schist
- Outcrop fractures primarily NE; also NW; steep
- Photolineaments primarily NW
- NE and NW most likely groundwater flow directions in bedrock
- Degree of connection with overburden unknown.
- All water supply wells in bedrock

Scenario A - Low-Permeability Till Layer



Scenario B - NO Low-Permeability Till Layer

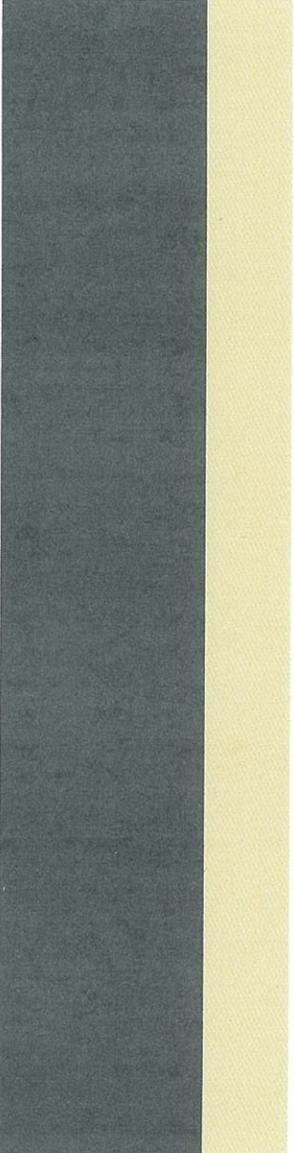


Legend

- Impacted Groundwater Flow
- Unimpacted Groundwater Flow



**FIGURE 4**  
CONCEPTUAL CROSS SECTION  
100 LONG RIDGE ROAD  
CARLISLE, MASSACHUSETTS  
PREPARED BY: JH      CHECKED BY: JV  
PROJECT NO. 889220      DATE: OCTOBER 2016



## Conceptual Model (2)

- About 2 Mgal of water can be expected to recharge site in an average year.
- Overburden is sandy glacial till, 0 – 25 feet thick
- Water table: 0 – >11 feet deep
- Saturated thickness @ Septic Areas: 3 – 13 feet; unknown at new Area 2
- All MWs in overburden

# Groundwater Mounding

- Model assumptions
- Predicted mound heights
  - Septic Area 1: 0.81 ft after 180 days (5.8 ft depth to top)
  - Septic Area 2: 1.79? ft after 180 days (4? ft depth to top)
  - Septic Area 3: 1.76 ft after 180 days (3.3 ft depth to top)
  - *Note: results vary with assumptions*

# Nitrate Mass Balance

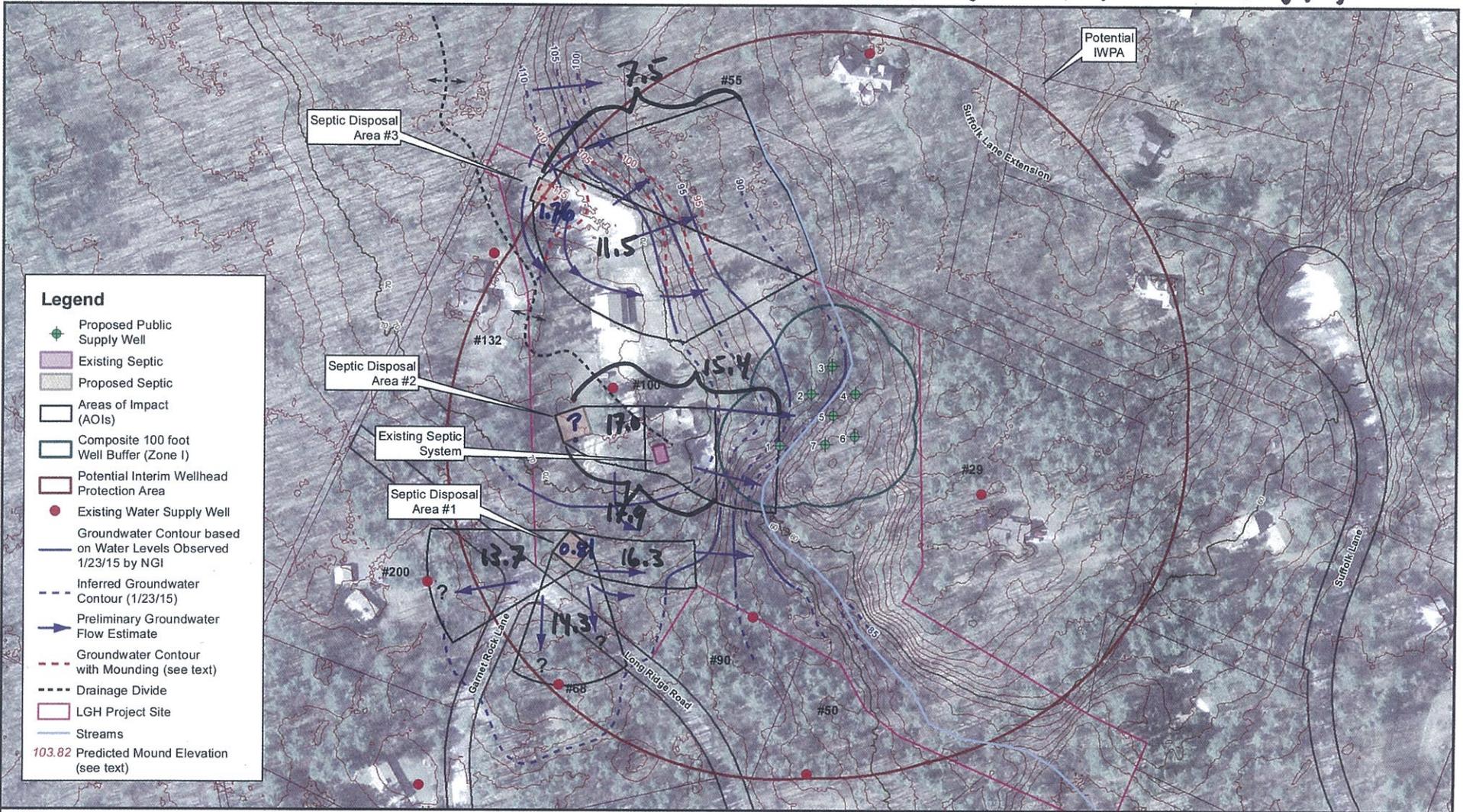
- Use 2016 DEP Guidance
- Use applicant design parameter of 110 gpd per bedroom
- Regulatory, not “scientific” estimate
- Average for an area (AOI), not a point location
- Mass balance yearly dilution suggests nitrate load too great to be diluted below 10 mg/L for some AOIs

# Nitrate Dispersion

- Complex equation with many assumptions
- Diffusion and advection only
- Results useful for relative comparison
- Results apply to overburden only
- Done by Applicant's consultant

# Title 5 Mass Balance Calculations

# Area Averages for Nitrate (mg/L)



**Legend**

- ◆ Proposed Public Supply Well
- Existing Septic
- Proposed Septic
- Areas of Impact (AOIs)
- Composite 100 foot Well Buffer (Zone I)
- Potential Interim Wellhead Protection Area
- Existing Water Supply Well
- Groundwater Contour based on Water Levels Observed 1/23/15 by NGI
- - - Inferred Groundwater Contour (1/23/15)
- Preliminary Groundwater Flow Estimate
- - - Groundwater Contour with Mounding (see text)
- - - Drainage Divide
- LGH Project Site
- Streams
- 103.82 Predicted Mound Elevation (see text)

- Notes:**
1. See text for explanation of Interim Wellhead Protection Area.
  2. Proposed well and septic locations from a plan titled 'Plan P - Public Water Supply' by Meisner Brem Corp., February 2, 2016.

3. Assessor's parcels are from the Town of Carlisle. Aerial photography provided by ESRI. Lot line for #90 Long Ridge Road is Approximate.
4. All elevations are based on a relative datum, not sea level.
5. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

0.81 = Predicted Mound Height

0 75 150 300  
Feet  
1 inch = 150 feet

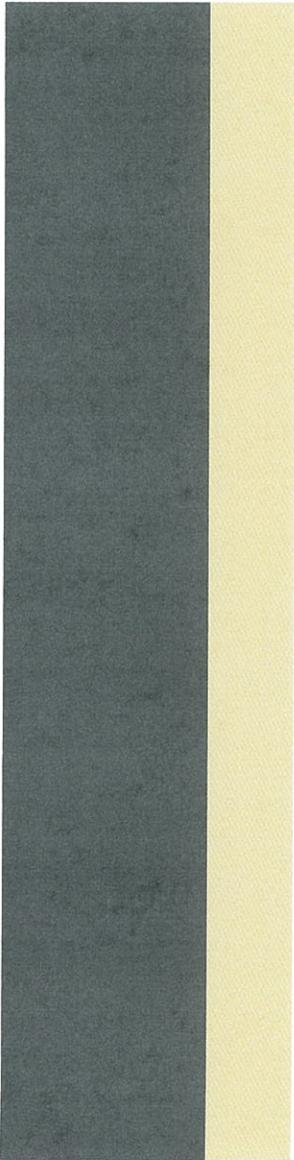
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FIGURE 3	
AREAS OF IMPACT PROPOSED SEPTIC DISPOSAL AREAS AND WELLS 100 LONG RIDGE ROAD CARLISLE, MASSACHUSETTS	
PREPARED BY: JH	CHECKED BY: JV
PROJECT NO. 89220.00	DATE: SEPTEMBER 2016

Path: \\01722020 - Carlisle Hydrogeology Evaluation 2016\GIS\MapServer\Figure 3 Carlisle AOB\_Simplified.mxd Date Printed: 10/3/2016

# Public Water Supply Considerations (1)

- Maximum Day Demand must be met
- Applicant assumes 7 equal wells, 50 ft apart – spacing & yield may vary
- Composite Zone I (100 ft) may change
- Zone I may not be allowed for nitrate equivalency
- IWPA either 420 ft or 542 ft – Nitrogen Sensitive Area



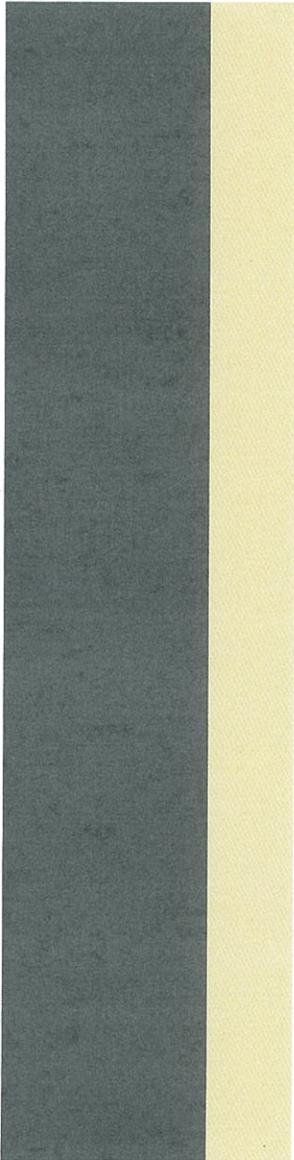
# Public Water Supply Considerations (2)

- PWS wells will likely interfere with each other
- Unknown whether PWS wells will interfere with neighboring wells
- Possible wetland effects:
  - *Drilling*
  - *Pumping*
- Proposed PWS Well 1 downgradient of Septic Area 2 & existing leachfield



# Recommendations

- Need site-specific info at new SDA 2
- New water level measurements
- Investigate whether bedrock and overburden hydraulically connected
- Determine whether Zone I counts for nitrogen equivalency
- Town should be informed during PWS permitting



# Questions??



# Communication

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