Riverside Station

Response to Charles River Watershed Association Comment Letter

June 19, 2020

The following is a summary of the notable comments or concerns expressed in the letter from the Charles River Watershed Association to the Massachusetts Environmental Policy Act (MEPA) Office dated April 20, 2020:

Comment 9.01

There are no sizing calculations or estimates for phosphorus reductions estimates included in the DEIR. In fact, there is no mention of any of the above BMP's except for the infiltration chambers in the Stormwater Management Plan dated December 2019.

Response

The Project fully meets the TMDL required phosphorous removal rate of 65% by proposing subsurface infiltration systems, as previously demonstrated in the Special Permit application and associated Stormwater Report submitted to the City of Newton in December 2019. Any phosphorous removed by supplemental BMPs and LID features provide an additional benefit and have not been accounted for in the baseline calculation. These features are also intended to provide an opportunity to increase public awareness of the benefits of green infrastructure.

Below are three tables that summarize the phosphorous removal provided by the currently proposed subsurface infiltration systems.

Table 1: Existing Conditions Phosphorus Loading

Site Use	*Land Cover within Use*	*Phosphorus Load Export Rate (lbs/ac/year)**	*Area (acres)***	*Existing Phosphorus Load Export (lb/yr)*
Commercial and Industrial	Directly Connected Impervious	1.78	12.76	22.71
	Pervious (HSG A)	0.03	2.68	0.08
Totals			**15.44**	**22.79**

* Per MA MS4 General Permit, Table 3-1 - Average annual distinct phosphorus load (P Load) export rates for use in estimating phosphorus load reduction credits the MA MS4 Permit.

**Site Area includes only the proposed area of redevelopment and excludes the MBTA Rail Yard.

Table 2: Proposed Conditions Phosphorus Loading

Drainage Area ID	*Site Use*	*Land Cover within Use*	*Phosphorus Load Export Rate (lbs/ac/year)*	*Area (acres)*	*Proposed Phosphorus Load Export (lb/yr)*
1S	High Density Residential	Directly Connected Impervious	2.32	10.99	25.49
		Pervious (HSG A)	0.03	0.55	0.02
2S	High Density Residential	Directly Connected Impervious	2.32	0.31	0.72
		Pervious (HSG A)	0.03	0.25	0.01
3S	High Density Residential	Directly Connected Impervious	2.32	0.26	0.60
		Pervious (HSG A)	0.03	0.00	0.00
116	Commercial	Directly Connected Impervious	1.78	1.47	2.62
		Pervious (HSG A)	0.03	0.23	0.01
200	Commercial	Directly Connected Impervious	1.78	0.81	1.44
		Pervious (HSG A)	0.03	0.60	0.02
	Totals			**15.45**	**30.93**

Table 3: Proposed Conditions Phosphorus Reduction*

Drainage Area ID	*Drainage Area BMP Type*	*Phosphorus Load to BMP (lbs/yr)*	*BMP Removal %***	*Proposed Phosphorus Load after BMP (lbs/yr)*
1S	Subsurface Infiltration	25.52	100%	0.00
2S	Subsurface Infiltration	0.73	97%	0.02
3S	N/A	0.60	0%	0.60
116	Existing	2.82	0%	2.62
200	Existing	1.46	0%	1.46
Totals		**30.93**		**4.70**

*Detailed calculations for the analysis of phosphorus reduction is included in Attachment 1 - *Weighted Phosphorous Removal Calculation.*
**Per MA MS4 General Permit Appendix F Attachment 3, Table 3-15.

From Table 1 above, the total phosphorus load for the site under existing conditions is 22.79 lbs/yr. From Table 2 above, the total phosphorus load directed to the BMPs under proposed conditions is equal to 30.93 lbs/yr. The use of the BMPs on the Project Site provide a dramatic decrease of loading with a removal rate of 26.27 lbs/yr for a final total of 4.70 lbs/yr. This removal equates to an 85% phosphorous removal provided by the subsurface infiltration systems without accounting for pavers and other LID BMPs, which exceeds the required 65% as established by the Final Pathogen TMDL for the Charles River Watershed.

Comment 9.02

The stormwater report is missing key site data and analysis and although it purports to show improvements in stormwater quality will occur as a result of the project they are not demonstrated or quantified.

Response

The Project provides the required water quality, as established by the MassDEP Stormwater Standards, as previously demonstrated in the Special Permit application and associated Stormwater Report submitted to the City of Newton in December 2019. The Project also proposes to remove more than 80% of the Total Suspended Solids (TSS) from the Site utilizing catch basins with deep sumps and hoods, proprietary separators, and subsurface infiltration systems. Refer to Attachment 2 – TSS Removal Calculations for detailed TSS removal calculations.

The stormwater BMPs were sized based on the 1-inch water quality volume due to soil conditions with rapid infiltration. Therefore, the proposed management systems implement a treatment train of BMPs that has been designed to provide 80% TSS removal for stormwater runoff from all proposed impervious surfaces as well as 44% pretreatment prior to infiltration. Table 4 below summarizes the proposed TSS removal based on the current stormwater management design.

Table 4: Proposed TSS Removal

BMP ID	*Required TSS Pre-Treatment*	*Provided TSS Pre-Treatment*	*Required TSS Removal*	*Provided TSS Removal*
P101	44%	58%	80%	92%
P102	44%	75%	80%	95%

The required water quality volume, based on 1-inch of runoff over the impervious area, for systems P101 and P102 are 39,930 CF and 1,118 CF, respectively. Using the Simple Dynamic Method, system P101 provides 45,914 CF and system P102 provides 1,964 CF of volume to treat the required 1-inch water quality volume.

Required recharge of stormwater has been provided by the structured subsurface infiltration systems. Most of the Project Site is directed through infiltration BMP P101 located beneath the garage at proposed Building 9, with an infiltration rate of 8.27 inches per hour. The remainder of the Project Site is directed through BMP P102, with an infiltration rate of 1.02 in/hr. Each infiltration BMP has been designed to drain completely within 72 hours. Table 5 below provides a summary of the proposed recharge provided by the Project.

Table 5: Summary of Recharge Calculations

Infiltration BMP	*Provided Recharge Volume (cubic feet)*
P101 – Doubletrap	36,266
P102 – SC-740	1,797
Total Provided Recharge	**38,063**
Total Required Recharge	**5,750**

Comment 9.03

Some new access roadway supports appear to be within 200 feet of a wetland and the project will involve new connections to the existing Runaway Brook underdrain discharging to wetlands and subject to Conservation Commission jurisdiction and oversight. The plan should identify all the aspects of the work that trigger Conservation Commission notifications and oversight.

Response

A figure will be added to the SDEIR, called Off-Site Wetland Resources, highlighting where the Project Boundary and Grove Street improvements fall within 100-feet of a wetland associated with the Runaway Brook, and the off-site improvements that will trigger notifications to the Newton Conservation Commission, including off-site roadway improvements along Recreation Road and the open space trail improvements within the DCR land bordering the Charles River.

Comment 9.04

The proponent has not evaluated what happens when the stormwater discharge to Runaway Brook is severely cut back by rerouting existing stormwater to the infiltration system. This may be a very important impact as Runaway Brook (which currently receives nearly all the stormwater flow) drains the Woodland Gold Course and is probably laden with eutrophication chemicals such as ammonia and nitrogen and chemicals that cause low dissolved oxygen contents. By removing the Riverside contribution under low flow conditions these discharges will be at much higher concentrations and poorly flushed and may lead to algal blooms with low dissolved oxygen in the exposed wetlands along the Charles River.

Response

The stormwater management system components exceed all performance standards for the site development. The comment above requests an investigation of the up-gradient contributory watershed that contributes stormwater runoff to the Runaway Brook and to the area of the Charles River as a means to quantify the watershed's water quality, contributing pollution concentrations, and biological effects of the stormwater improvements made within the Project Site. This investigation is well outside the Project's scope and will not be performed.

The existing Riverside Site and associated surface parking areas provide very limited stormwater controls prior to discharging to the Runaway Brook culvert. Accordingly, substantial water quality treatment enhancements are provided in the proposed conditions. While it is possible that removing that existing flow from the culvert will change the concentration in contaminants, it does not seem reasonable to burden this development with the practices of existing uses outside their control. Furthermore, the Site is a small fraction of the overall contributory watershed of the Charles River Basin. We are not in a position to speculate on the source of off-site contaminants nor does it seem reasonable to request the Proponent to change their stormwater improvement plan which focuses on the development site only and is intended to incrementally improve the conditions within the overall watershed (i.e., a net reduction in the phosphorous load to the receiving water body).

The proposed stormwater management system meets all state and local performance standards relating to water quality improvements; the required phosphorous removal, TSS removal, and the required recharge volume are designed in conformance with the MassDEP Stormwater Standards. The Project provides a major stormwater improvement compared to the existing Site. Any stormwater discharged to the Runaway Brook culvert will be much cleaner under proposed conditions compared to existing. The Project is a benefit to the surrounding watershed.

Comment 9.05

The project proponent needs to model the proposed groundwater table and gradients prior to and following the proposed subsurface infiltration systems to understand how groundwater will be impacted at the site and downgradient rail maintenance facility.

Response

It is anticipated that the Project will not have any no negative impacts to the groundwater. Based on Sanborn Head's analysis, the impact of the subsurface infiltration systems "downgradient fill soil contamination is not anticipated to be impacted by the proposed system." The existing fill under the proposed infiltration systems will be removed and replaced with clean material. The groundwater mound will not impact the surrounding fill. Refer to Attachment 3 - Mounding Analysis Memorandum, dated March 24, 2020, written by Sanborn Head to the Proponent explaining that no negative impacts to the groundwater is anticipated by the Project.

Comment 9.06

The report provides no description of the current regulatory environment of the affected existing discharge. The proponents did not describe that outfalls as a MS4 stormwater sewer regulated by Newton Public Works. The report does not indicate that the outfalls are within the MS4 program as outfalls NEW-44B, NEW-47 and NEW-48. It does not discuss meeting any of the MS4 requirements for BMPs or the city ordinances (Newton Ordinance No Z-45 30-5(c) and required treatment requirements. The facility stormwater system should be compliant with Newton's Stormwater Management plan for MS4 discharges because the Riverside discharge is to these outfalls.

Response

The two applicable Total Maximum Daily Loads (TMDLs) for the Charles River watershed enforced by the U.S. Environmental Protection Agency (EPA) are:

- Final Pathogen TMDL for the Charles River Watershed, CN 0156.0 (January 2007)
- Final TMDL for Nutrients in the Upper/Middle Charles River, CN 272.0 (May 2011)

The Final Pathogen TMDL will be largely addressed through the City of Newton's required Inflow and Infiltration (I&I) mitigation work. In addition to mitigating the pathogen TMDL through the implementation of a new stormwater management network, the Project will also comply with nutrient TMDL, specifically phosphorus. Per Table ES-3 of the TMDL Technical Report (CN 272.0), Commercial/Industrial and High Density/Multi-Family residential uses require a 65-percent reduction in annual phosphorus loading. The particular combination of stormwater BMP techniques to be implemented have the ability to remove phosphorus at the levels demonstrated in the following tables. The specific combination of BMPs will provide more than the required minimum 65% reduction in phosphorous from stormwater runoff. As such, the stormwater management plan addresses the Final TMDL for Nutrients. Refer to response to Comment 9.01 demonstrating phosphorous removal compliance.

Comment 9.07

In addition to that we expect to see appropriate documentation of the design of all the green infrastructure BMPs that will be used with corresponding drainage calculations and demonstrated compliance with the TMDL.

Response

Refer to response to Comment 9.01.

Phosphorus Loading - Existing Conditions

Project Name: Riverside Station
Project Location: Newton, MA

Proj. No.: 10865.03
Date: June 2020
Calculated by: PTM
Checked by: KSS

Subcatchment Number	Land Cover within Use	Phosphorus Load Export Rate (lbs/ac/year)*	Area** (acre)	Phosphorous Loading to BMP per Area (lb/yr)	Total Phosphorus Loading to BMP (lb/yr)
Commercial (Indigo Hotel)	Directly Connected Impervious	1.78	2.19	3.90	3.92
	Pervious (HGS A)	0.03	0.72	0.02	
Industrial (MBTA Parking Lot)	Directly Connected Impervious	1.78	10.57	18.81	18.87
	Pervious (HGS A)	0.03	1.96	0.06	
Totals =			15.44	---	22.79

* Per MA MS4 General Permit, Table 3-1, Average Annual Disttinct Phosphorus Load (P Load) export rates for use in exstimating phosphorus load reduction credits the MA MS4 Permit.
** Site Area includes only the proposed area of redevelopment and excludes the MBTA Rail Yard

Phosphorus Loading to BMPs - Proposed Conditions

Project Name: Riverside Station
Project Location: Newton, MA

Proj. No.: 10865.03
Date: June 2020
Calculated by: PTM
Checked by: KSS

Subcatchment Number	Land Cover within Use	Phosphorus Load Export Rate (lbs/ac/year)*	Area (acre)	Phosphorous Loading to BMP per Area (lb/yr)	Total Phosphorus Loading to BMP (lb/yr)	Phosphorous Removal	Total Phosphorus Removal (lb/yr)
1S	Impervious (High-Density Residential)	2.32	10.99	25.50	25.51	100%	25.51
	Pervious (HGS A)	0.03	0.55	0.02			
2S	Impervious (High-Density Residential)	2.32	0.31	0.72	0.73	97%	0.70
	Pervious (HGS A)	0.03	0.25	0.01			
3S	Impervious (High-Density Residential)	2.32	0.26	0.60	0.60	0%	0.00
	Pervious (HGS A)	0.03	0.00	0.00			
116	Impervious (Commercial)	1.78	1.47	2.62	2.62	0%	0.00
	Pervious (HGS A)	0.03	0.23	0.01			
200	Impervious (Commercial)	1.78	0.81	1.44	1.46	0%	0.00
	Pervious (HGS A)	0.03	0.60	0.02			
Totals =			15.47	---	30.93	---	26.22

Existing Phosphorus Load	22.79
Proposed Phosphorus Load	30.93
Total Phosphorus Removed	***26.22***
	85%

* Per MA MS4 General Permit, Table 3-1, Average Annual Distinct Phosphorus Load (P Load) export rates for use in exstimating phosphorus load reduction credits the MA MS4 Permit.

Weighted Phosphorous Removal Calculation

Project Name: Riverside Station
Proj. No.: 10865.03
Project Location: Newton, MA
Date: June 2020
Calculated by: PTM
Checked by: KSS

Subcatchment Number	Impervious Area (sf)	Infiltration Rate (in/hr)	Phosphorous Removal	A x PR
1S	10.99	8.27	100%	10.99
2S	0.31	1.02	97%	0.30
3S	0.26	N/A	0%	0.00
116	1.47	N/A	0%	0.00
200	0.81	N/A	0%	0.00
Totals =	13.84		---	11.29

Weighted Phosphorous Removal:	**S(AxPR) / SA =**	**81.6%**

Note: Phosphorous removal based on EPA "Stormwater Best Management Practices (BMP) Performance Analysis" assuming commercial and high density land uses. Phosphorous removal rate based on 1.0 inch Depth of Runoff Treated.

TSS Removal Calculation Worksheet

101 Walnut Street
Post Office Box 9151
Watertown, MA 02471
P 617.924.1770

Project Name:	**Riverside Redevelopment**	Sheet:	**1 of 2**
Project Number:	**10856.03**	Date:	**June 2020**
Location:	**Newton, MA**	Computed by:	**PTM**
Discharge Point:	**DP-1**	Checked by:	**KSS**
Drainage Area(s):	**1S**		

1. Pre-Treatment prior to Infiltration

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**100%**	**25%**	**75%**
Proprietary Separator	**44%**	**75%**	**33%**	**42%**
	0%	**42%**	**0%**	**42%**
			Pre-Treatment TSS Removal =	**58%**

2. Total TSS Removal including Pretreatment 1.

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**100%**	**25%**	**75%**
Proprietary Separator	**44%**	**75%**	**33%**	**42%**
StormTrap Infiltration System	**80%**	**42%**	**34%**	**8%**
	0%	**8%**	**0%**	**8%**
			Treatment Train TSS Removal =	**92%**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1. The proprietary separator has been sized to treat 56% per manufacturer's sizing calculations. A TSS Removal Rate for Proprietary Separator of 44% is used instead.
** Equals remaining load from previous BMP (E)

vhb
101 Walnut Street
Post Office Box 9151
Watertown, MA 02471
P 617.924.1770

TSS Removal Calculation Worksheet

Project Name:	**Riverside Redevelopment**	Sheet:	**2 of 2**
Project Number:	**10865.03**	Date:	**June 2020**
Location:	**Newton, MA**	Computed by:	**PTM**
Discharge Point:	**DP-1**	Checked by:	**KSS**
Drainage Area(s):	**2S**		

1. Pre-Treatment prior to Infiltration

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**100%**	**25%**	**75%**
Isolator Row*	**66%**	**75%**	**50%**	**26%**
	0%	**26%**	**0%**	**26%**

Pre-Treatment TSS Removal = **75%**

2. Total TSS Removal including Pretreatment 1.

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**100%**	**25%**	**75%**
Isolator Row*	**66%**	**75%**	**50%**	**26%**
Subsurface Infiltration Structure	**80%**	**26%**	**20%**	**5%**
	0%	**5%**	**0%**	**5%**

Treatment Train TSS Removal = **95%**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
** Equals remaining load from previous BMP (E)
*** TSS removal for Isolator Row is based on Manufacturer's removal efficiency per MA STEP Performance Evaluation

SANBORN HEAD
Building Trust. Engineering Success.

MEMORANDUM

To: David Roache, P.E. ~Mark Development, LLC

From: Matthew Heil, P.E., LSP and Kevin Stetson, P.E. ~ Sanborn, Head & Associates, Inc.

File: 4575.00

Date: 3/24/2020

Re: Groundwater Mounding Analysis – Proposed Stormwater Infiltration System
Riverside Station Redevelopment
325-333 and 399 Grove Street
Newton, Massachusetts

Sanborn, Head & Associates, Inc. (Sanborn Head) has prepared this memorandum to summarize the groundwater mounding analysis performed for three proposed infiltration systems (101, 102 and 103) at the proposed Riverside Station Redevelopment project in Newton, Massachusetts (the Site). Our mounding analysis was completed based on stormwater design volumes provided by the project civil engineer, Vanasse Hangen Bruslin, Inc. (VHB), on February 11, 2020.

SUBSURFACE CONDITIONS

Based on subsurface investigations performed by others and Sanborn Head in September 2019, subsurface conditions at the Site generally consist of topsoil and a 2 to 11-foot thick layer of granular urban fill soil. The fill layer is generally underlain by a sand layer with varying amounts of silt and gravel. For the purposes of this mounding analysis, we have broken the sand unit up into two units: silty sand and sand and gravel. Where observed, the sand and gravel layers range in thickness from at least 10 feet to over 40 feet thick and are underlain by glacial till and eventually bedrock. Intermittent organic silt and peat layers have been observed at several borings at the site. However, for the purposes of this mounding analysis, the organic silt and peat layer has been excluded based on its relatively limited intermittent extent on the northernmost portion of the Site. In addition, the proposed plan for the Site includes over-excavation of excessively silty soils within the proposed infiltration systems. This will allow stormwater to recharge directly to the more permeable and transmissive underlying sands and gravels. Based on observations made by Sanborn Head, bedrock at the site is variable in depth and has been observed as shallow as 3 feet below ground surface in the western portion of the Site and has not been encountered at depths greater than 49 feet below grade. Groundwater at the Site is generally anticipated to flow to the north/northwest toward the Charles River based on existing grades and groundwater gauging data and is generally deep (greater than 15 below ground surface).

The fill soil at each proposed infiltration system will be removed and replaced with permeable imported soils as noted below. For infiltration system 101, the proposed bottom of the system is at approximate elevation (El.) 51.0 feet. Based on the nearest borings (SH-106 and SH-107), we anticipate that the area of the proposed system will be over-excavated to remove the less favorable silty sand layer to approximately El. 47 feet. Following over-excavation, we anticipate that the system 101 will infiltrate directly into the underlying natural sand and gravel deposit. For infiltration systems 102 and 103, the bottoms of the proposed systems are at approximate El. 54.1 and 54.8 feet, respectively. Based on the nearest borings (SH-111, SH-103, and HA09-4), the systems are anticipated to infiltrate into existing granular fill or sand deposits after removal of the overlying fill soils. Additional borings will be required in the western end of system 103 to confirm soil conditions based on the shallow bedrock at SH-103.

Hydraulic conductivity represents the soils relative ability to transport water and is a key parameter required for the groundwater mounding analysis. Grain size data were used to estimate the assumed hydraulic conductivities at the Site based on typical values published by the United State Department of Agriculture (USDA) Natural Resources Conservation service. Based on the soil descriptions and grain size analyses, the assumed hydraulic conductivities for each unit are described in the table below. These values were used in the groundwater mounding analysis described below.

Geologic Unit	Estimated Hydraulic Conductivity (feet per day)	Notes
Bed Area	200	Assumed imported permeable soil below proposed system footprint
Granular Fill	10	Above receiving layer and above groundwater table
Silty Sand	5	Receiving layer (To be removed below System 101)
Sand and Gravel	20	Receiving layer (Systems 102 and 103)
Glacial Till	0.01	Bottom Layer

As a conservative modeling step, bedrock was excluded from the numerical groundwater model. Further, based on the available information, significant areas of shallow bedrock are not located near the largest proposed stormwater system (101) and are not anticipated to materially impact groundwater flow at the Site as it relates to the proposed stormwater systems.

CONCEPUTAL SITE MODEL AND GROUNDWATER MOUNDING RESULTS

A mounding analysis was performed using Visual MODFLOW software (Version 4.6.0.167) developed by the Waterloo Hydrogeologic, Inc. of Ontario, Canada and the information obtained during the subsurface exploration programs. The Site conceptual model is based on infiltrated stormwater applied to the proposed bed area and receiving layer soils downward to the groundwater table, then to the north/northeast based on ambient groundwater elevation data. The assumed fill, silty sand and sand and gravel receiving layers and underlying glacial till layer, considered a restrictive, lower-permeability layer, were input into the model based on the boring data. Constant head boundaries were assumed on the upgradient side (southeast) and downgradient side (northwest) to model groundwater flowing onto and across the Site from southeast to northwest. The hydraulic conductivities assumed for the different layers and soil types in the models are described in the table above. A specific yield (drainable porosity) of 0.2 and an overall porosity of 0.3 were also assumed. The model structure is shown on Figure 1. Modeled ambient groundwater conditions prior to loading of the proposed stormwater systems are shown on Figure 3, and a cross-section through system 101 is shown as Figure 4.

Based on stormwater design information provided by the project's civil engineer, VHB, the design storm and loading for each proposed stormwater system is shown in the table below. According to VHB, the infiltration capacities for systems 101 and 102 were designed to recharge at least the 1-inch storm to provide water quality treatment through infiltration. System 102 provides capacity for the 2-year design storm based on VHB's calculations; therefore, the 2-year frequency rainfall event was used for design. Because system 103 is unable to be connected to an overflow drain line due to elevation conflicts, the system has been designed to infiltrate the design storm listed below.

Infiltration Feature	Design Storm	Numerical Model Recharge Loading Rate (ft/day) over 72 hours
System 101	1-inch (water quality)	1.7
System 102	2-year	0.6
System 103	100-year	0.4

The results of our mounding analysis, including the groundwater conditions 72 hours after the design storms described above are shown on the attached Figure 4, and cross-sections of each proposed system are included as Figures 5 through 7. Our findings based on the mounding analysis following the design storm event are described below.

System 101

The maximum mound height at system 101 is estimated to be as high as approximately 5 feet in the bed area 72 hours after the design storm (after the system has been emptied in accordance with the stormwater design requirements). Although the maximum change in groundwater elevation may be up to 5 feet in the bed area, groundwater in this area of the Site is anticipated to be at approximately El. 43 feet (i.e. a maximum mounded groundwater elevation of El. 48 feet using superposition). Based on information reviewed, groundwater on this portion of the Site is anticipated to be located approximately 20 feet below ground surface or greater based on actual monitoring data. Fill on this portion of the Site has been observed at depths up to 8 feet below ground surface. Therefore, although groundwater will likely mound above the existing groundwater table, the increased groundwater surface will not impact overlying fill material as up to 10 feet of vertical separation will still remain between the mounded groundwater height and the fill unit. Further, groundwater at monitoring wells located at the immediately downgradient property indicate groundwater is consistently located approximately 20 feet below ground surface or greater, and fill soil are generally less than 15 feet thick.

Based on the results of the groundwater model, the maximum mound height decreases to approximately less than 6 inches approximately 100 feet downgradient of system 101 And becomes negligible approximately 140 feet downgradient of system 101. The mounded groundwater surface cross-section for system 1 is included as Figure 5. Based on the relatively limited extent of elevated groundwater surface caused by the proposed system 101, downgradient fill soil contamination is not anticipated to be impacted by the proposed system.

System 102 and 103

Similar to system 101, maximum groundwater mounds below systems 102 and 103 are observed directly below the systems and are estimated to have a maximum change in water table elevation up to 2 feet. Using superposition of the maximum mound to on top of observed groundwater elevations, mounded groundwater elevations at system 102 and 103 are anticipated to rise to approximate El. 50 feet and 54 feet, respectively. The mounds become negligible approximately 60 feet downgradient of each proposed system. Following similar logic presented above, since groundwater at each proposed system is anticipated to diminish relatively close to each system, impacts to downgradient fill soil are not anticipated given the lateral proximity as well as the elevation.

DMD/MPH/KPS: dmd

Encl. Figure 1 – Exploration Location Plan
Figure 2 – Model Boundary Conditions
Figure 3 – Modeled Ambient Groundwater Conditions
Figure 4 – Modeled Ambient Groundwater Conditions – Cross Section A-A’ through System 101
Figure 5 – Modeled Loaded Groundwater Contours
Figure 6 – Modeled Loaded Groundwater Conditions – Cross Section A-A’ through System 101
Figure 7 – Modeled Loaded Groundwater Conditions – Cross Section B-B’ through System 102
Figure 8 – Modeled Loaded Groundwater Conditions – Cross Section C-C’ through System 103

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NOTES:

1. THE BASE MAP WAS DRAWN FROM A PLAN ENTITLED, "EXHIBIT PLAN - SUPPLEMENTAL TOPO", PREPARED BY FELDMAN LAND SURVEYORS (FELDMAN) OF BOSTON, MA, DATED MAY 14, 2009 WITH AN ORIGINAL SCALE OF 1" = 20'.

2. THE PROPOSED SITE FEATURES WERE DRAWN FROM A PLAN ENTITLED, "GRADING, DRAINAGE AND EROSION CONTROL PLAN", PREPARED BY VANASSE HANGEN BRUSTLIN, INC. (VHB) OF WATERTOWN, MA, DATED DECEMBER 9, 2019 WITH AN ORIGINAL SCALE OF 1" = 40'.

3. EXPLORATIONS BY HALEY & ALDRICH AND TEST PITS EXCAVATED BY J.MARCHESE AND SONS WERE TAKEN FROM AN ELECTRONIC PLAN ENTITLED, "SITE AND SUBSURFACE EXPLORATION LOCATION PLAN", PREPARED BY HALEY & ALDRICH (H&A) OF BOSTON, MA, DATED OCTOBER 29, 2009 AND SHOULD BE CONSIDERED APPROXIMATE.

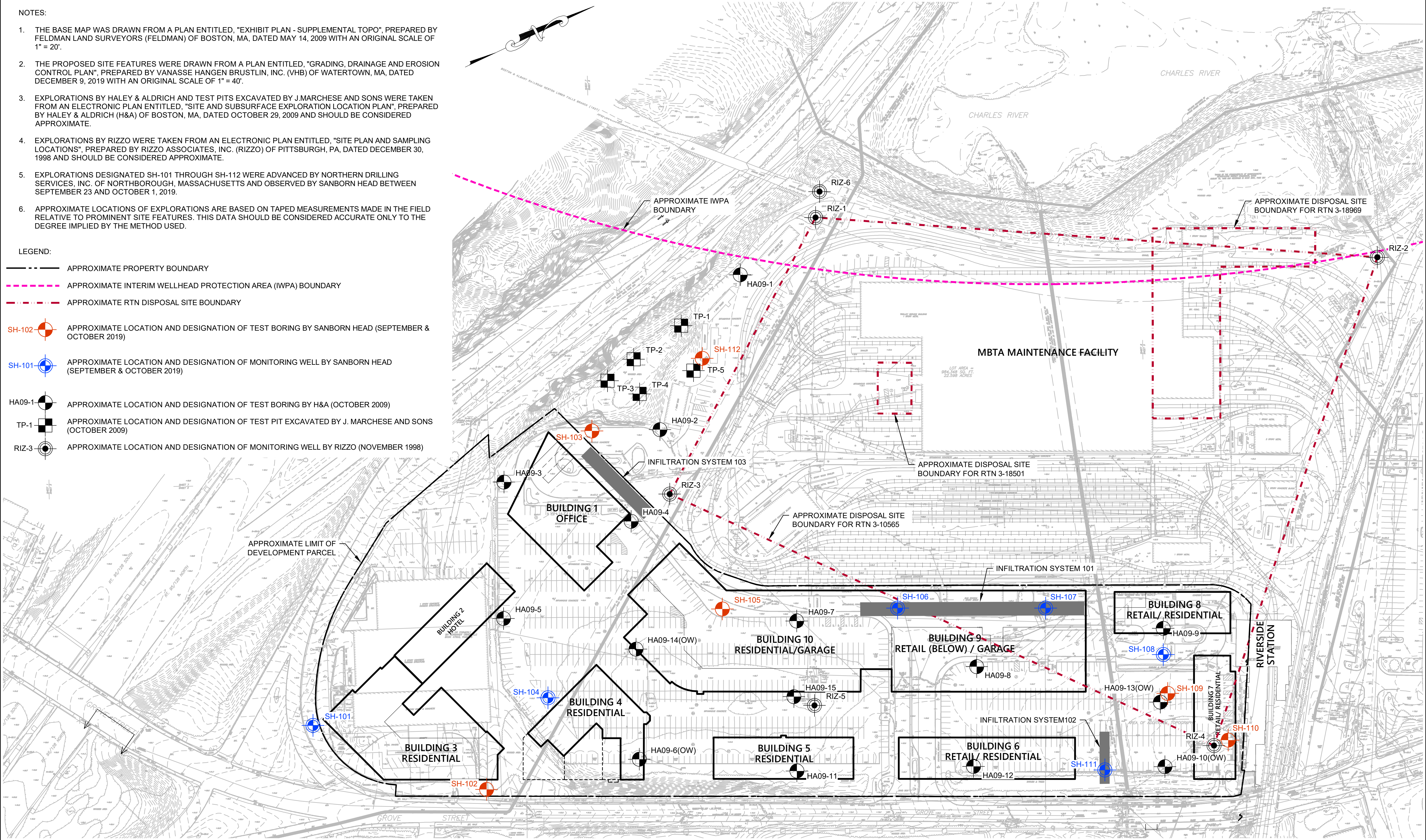
4. EXPLORATIONS BY RIZZO WERE TAKEN FROM AN ELECTRONIC PLAN ENTITLED, "SITE PLAN AND SAMPLING LOCATIONS", PREPARED BY RIZZO ASSOCIATES, INC. (RIZZO) OF PITTSBURGH, PA, DATED DECEMBER 30, 1998 AND SHOULD BE CONSIDERED APPROXIMATE.

5. EXPLORATIONS DESIGNATED SH-101 THROUGH SH-112 WERE ADVANCED BY NORTHERN DRILLING SERVICES, INC. OF NORTHBOROUGH, MASSACHUSETTS AND OBSERVED BY SANBORN HEAD BETWEEN SEPTEMBER 23 AND OCTOBER 1, 2019.

6. APPROXIMATE LOCATIONS OF EXPLORATIONS ARE BASED ON TAPED MEASUREMENTS MADE IN THE FIELD RELATIVE TO PROMINENT SITE FEATURES. THIS DATA SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- APPROXIMATE INTERIM WELLHEAD PROTECTION AREA (IWPA) BOUNDARY
- APPROXIMATE RTN DISPOSAL SITE BOUNDARY
- SH-102 — APPROXIMATE LOCATION AND DESIGNATION OF TEST BORING BY SANBORN HEAD (SEPTEMBER & OCTOBER 2019)
- SH-101 — APPROXIMATE LOCATION AND DESIGNATION OF MONITORING WELL BY SANBORN HEAD (SEPTEMBER & OCTOBER 2019)
- HA09-1 — APPROXIMATE LOCATION AND DESIGNATION OF TEST BORING BY H&A (OCTOBER 2009)
- TP-1 — APPROXIMATE LOCATION AND DESIGNATION OF TEST PIT EXCAVATED BY J. MARCHESE AND SONS (OCTOBER 2009)
- RIZ-3 — APPROXIMATE LOCATION AND DESIGNATION OF MONITORING WELL BY RIZZO (NOVEMBER 1998)



SANBORN | HEAD

GRAPHICAL SCALE

70' 35' 0' 70' 140'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: D.DOMBROWSKY
DESIGNED BY: M.RUBERTI
REVIEWED BY: M.HEIL
PROJECT MGR: M.RUBERTI
PIC: K.STETSON
DATE: MARCH 2020

ENVIRONMENTAL ENGINEERING SERVICES

RIVERSIDE STATION

NEWTON, MASSACHUSETTS

EXPLORATION LOCATION PLAN

PROJECT NUMBER: 4575.00

SHEET NUMBER: 1

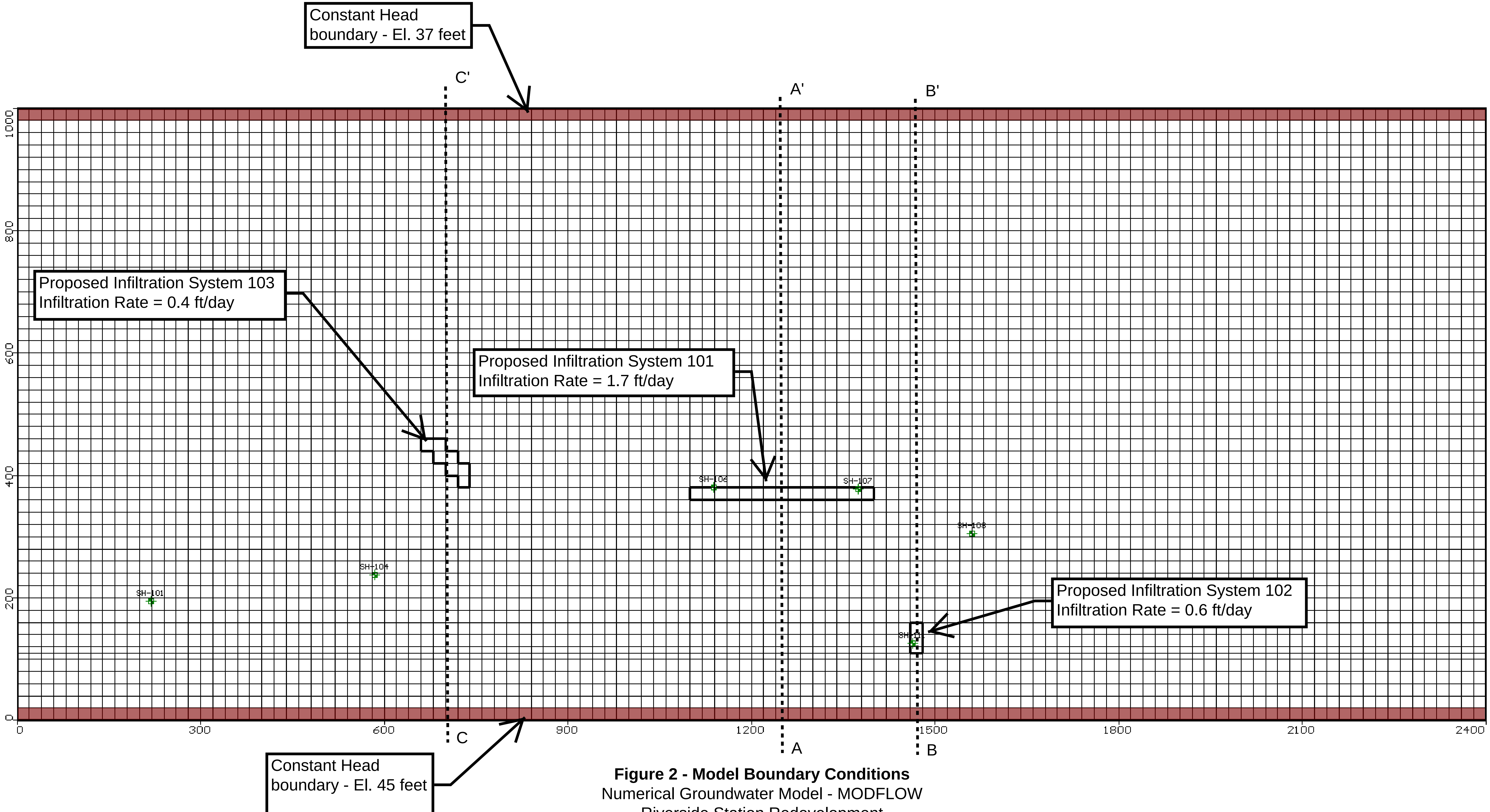


Figure 2 - Model Boundary Conditions
Numerical Groundwater Model - MODFLOW
Riverside Station Redevelopment
Newton, Massachusetts

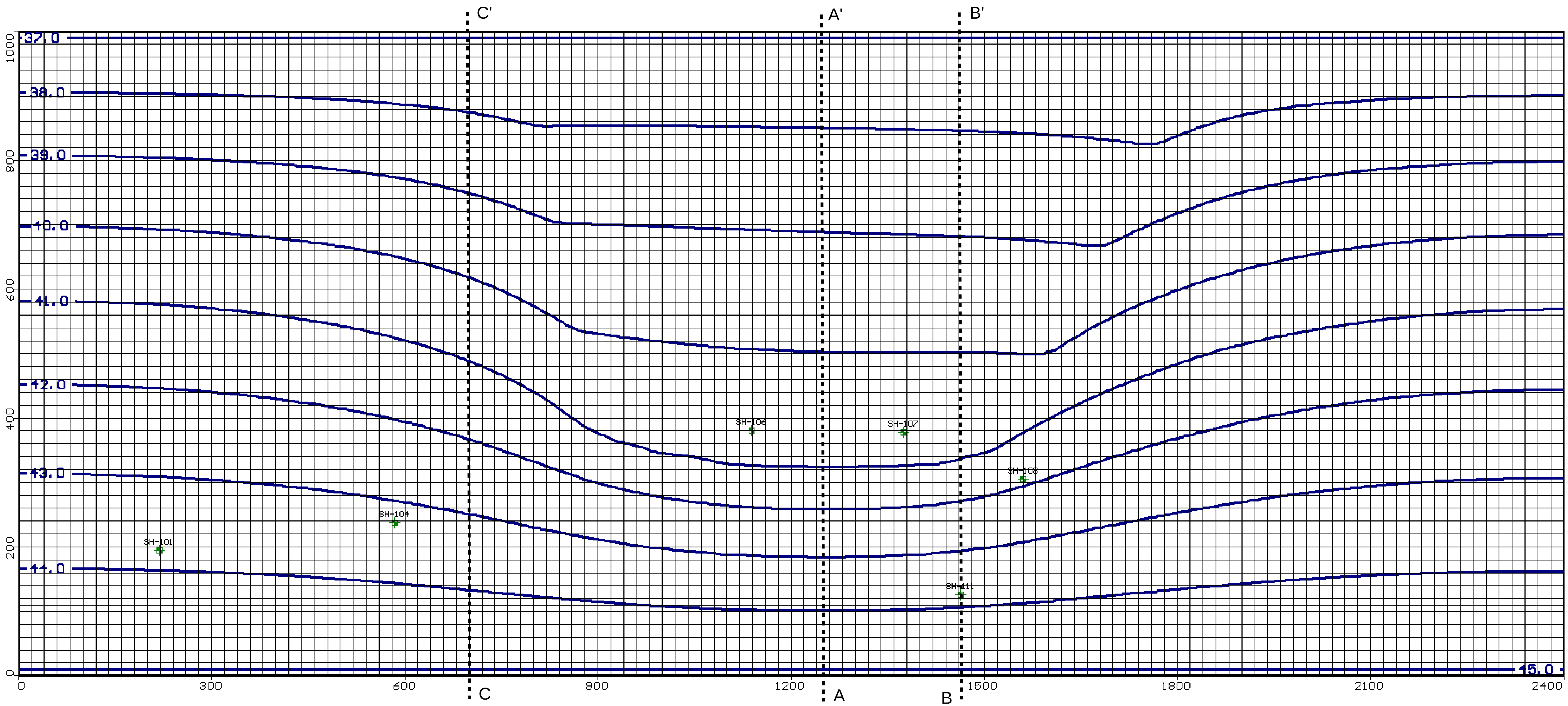


Figure 3 - Modeled Ambient Groundwater Contours
Numerical Groundwater Model - MODFLOW
Riverside Station Redevelopment
Newton, Massachusetts

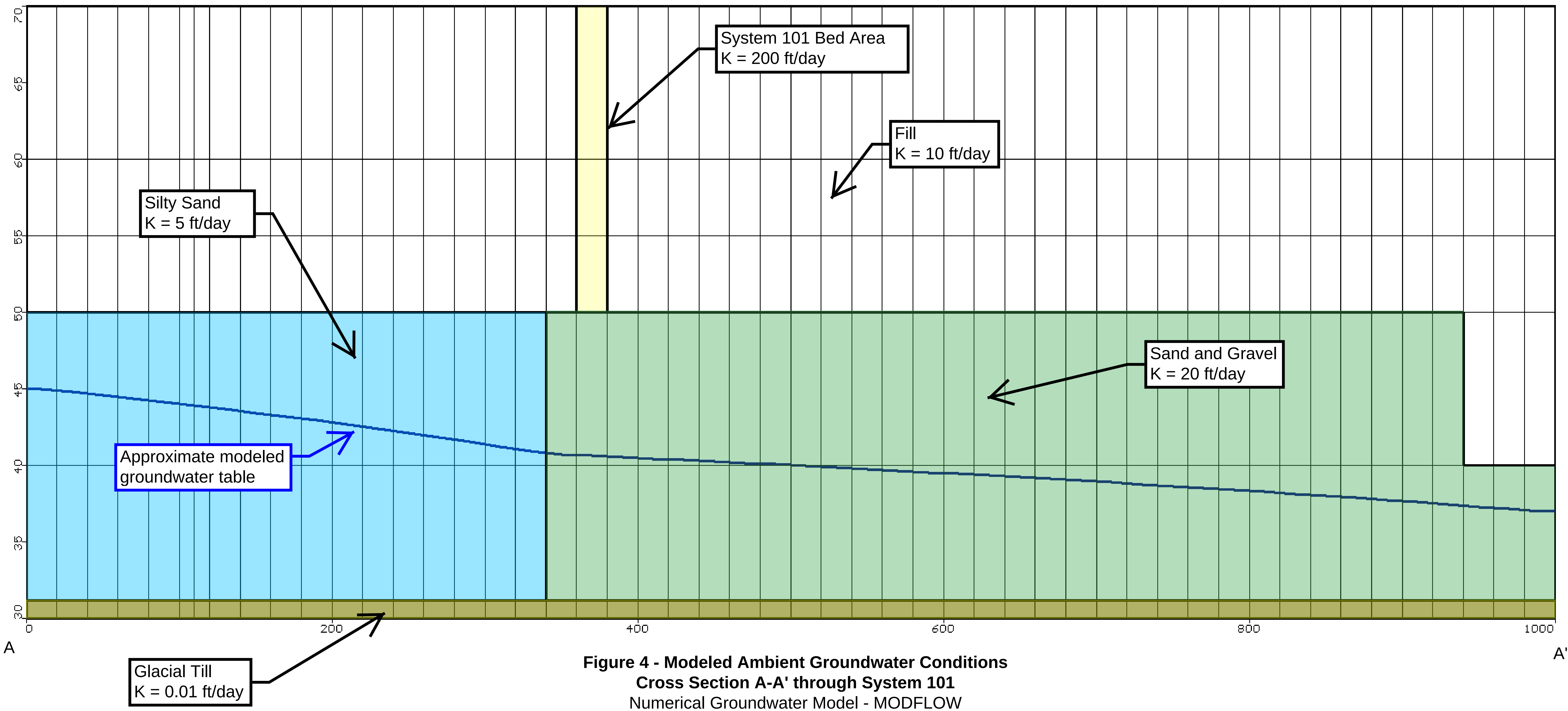


Figure 4 - Modeled Ambient Groundwater Conditions
Cross Section A-A' through System 101
Numerical Groundwater Model - MODFLOW
Riverside Station Redevelopment
Newton, Massachusetts

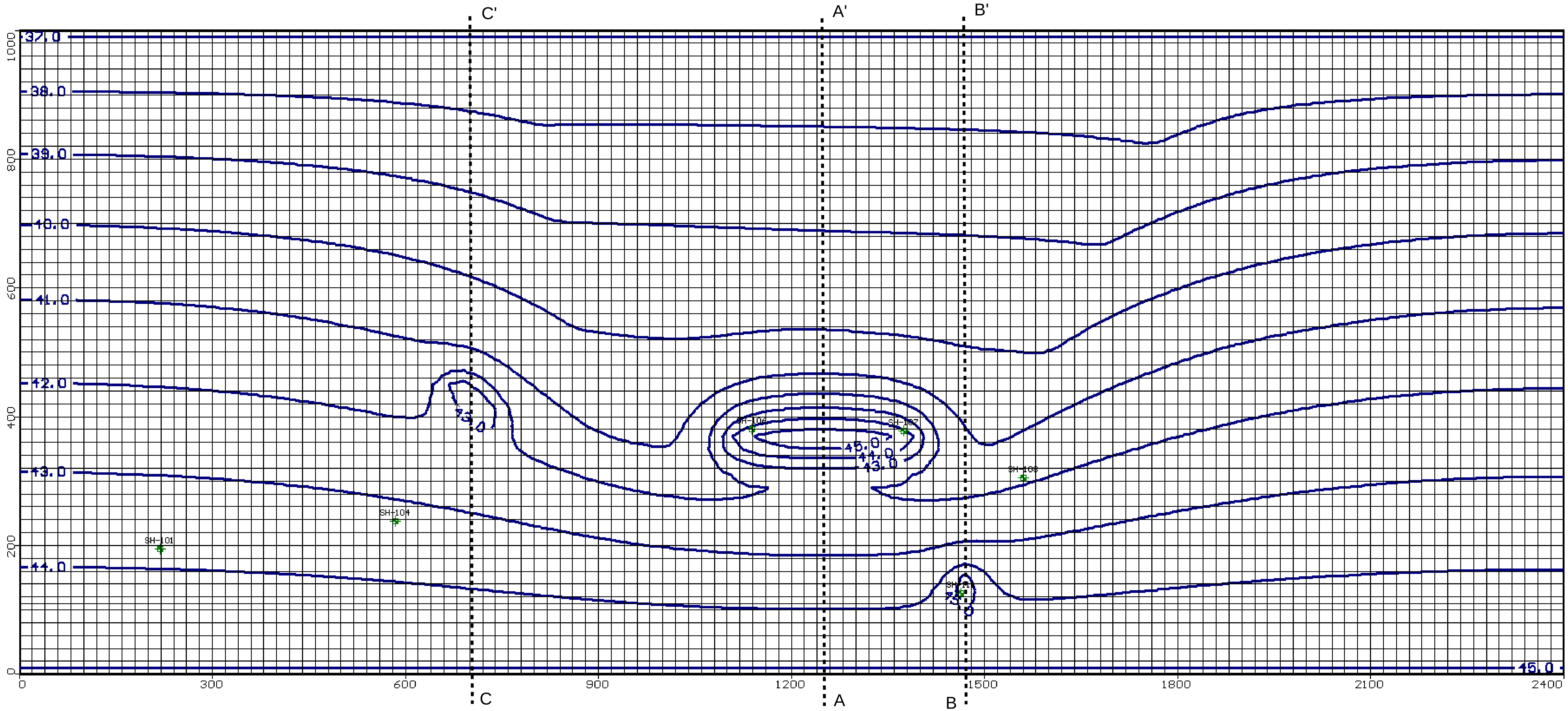


Figure 5 - Modeled Loaded Groundwater Contours
72 Hours of Design Storm Loading
Numerical Groundwater Model - MODFLOW
Riverside Station Redevelopment
Newton, Massachusetts

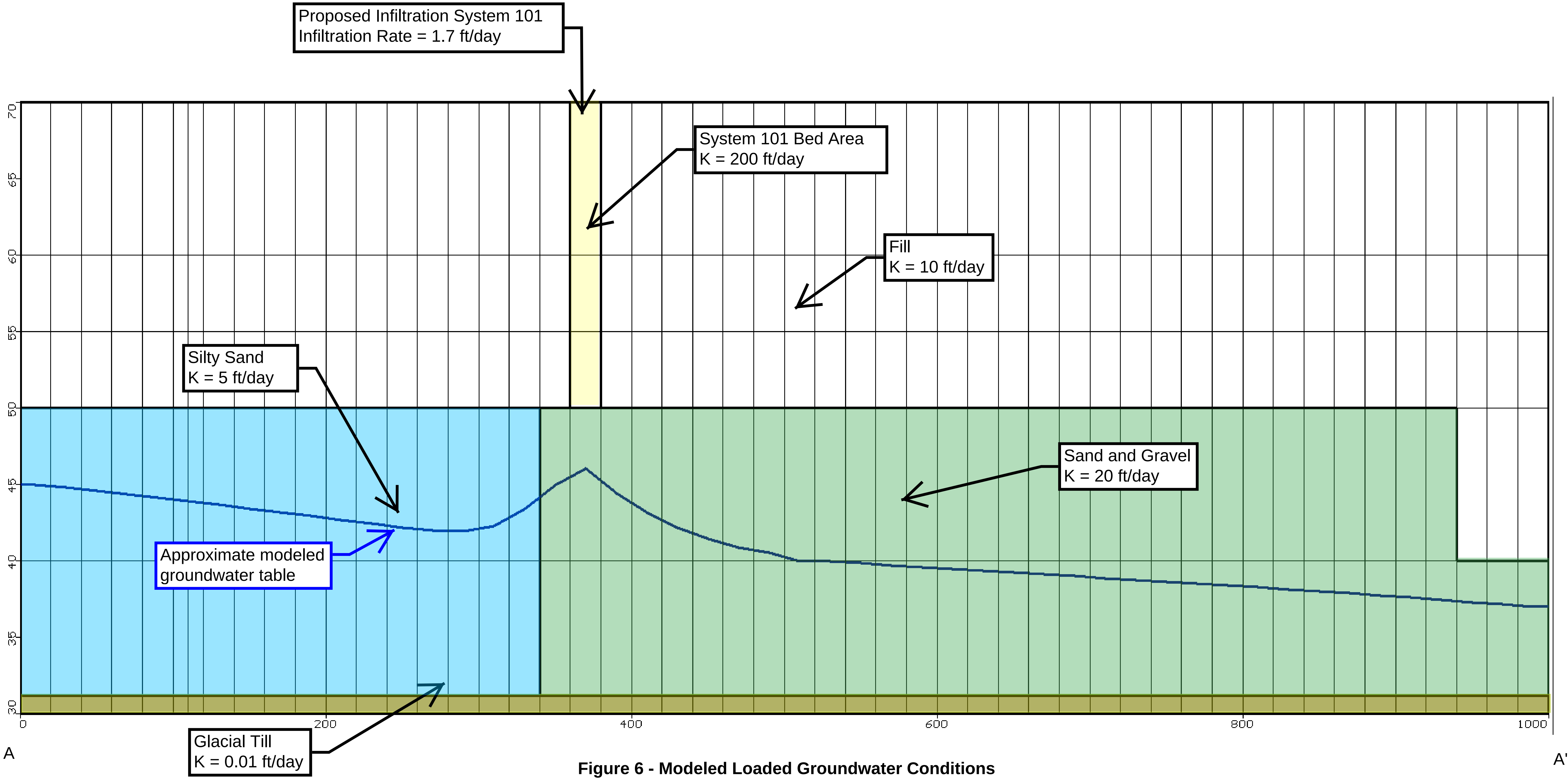


Figure 6 - Modeled Loaded Groundwater Conditions
72 Hours of Design Storm Loading
Cross Section A-A' through System 101
Numerical Groundwater Model - MODFLOW
Riverside Station Redevelopment
Newton, Massachusetts

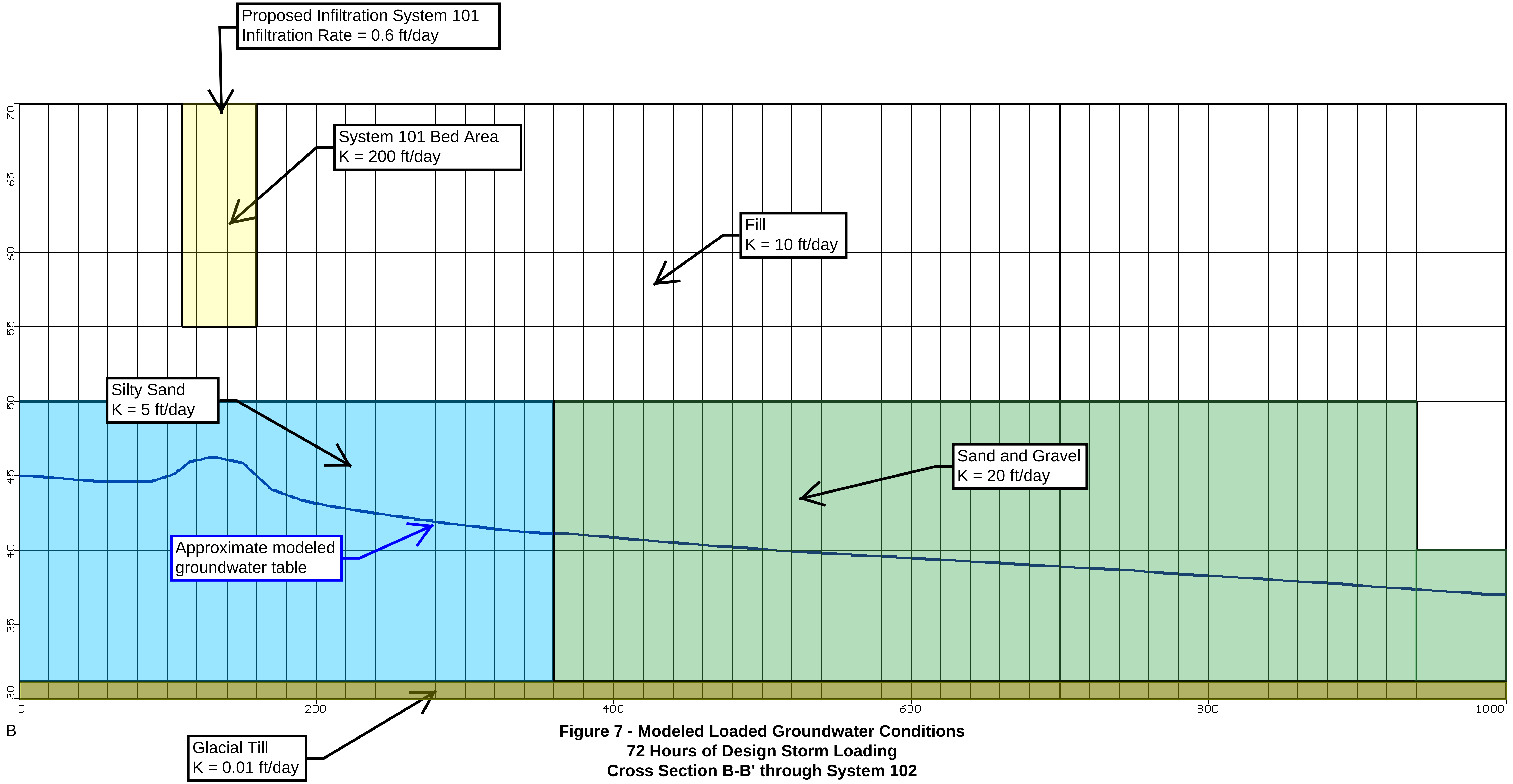


Figure 7 - Modeled Loaded Groundwater Conditions
72 Hours of Design Storm Loading
Cross Section B-B' through System 102
Numerical Groundwater Model - MODFLOW
Riverside Station Redevelopment
Newton, Massachusetts

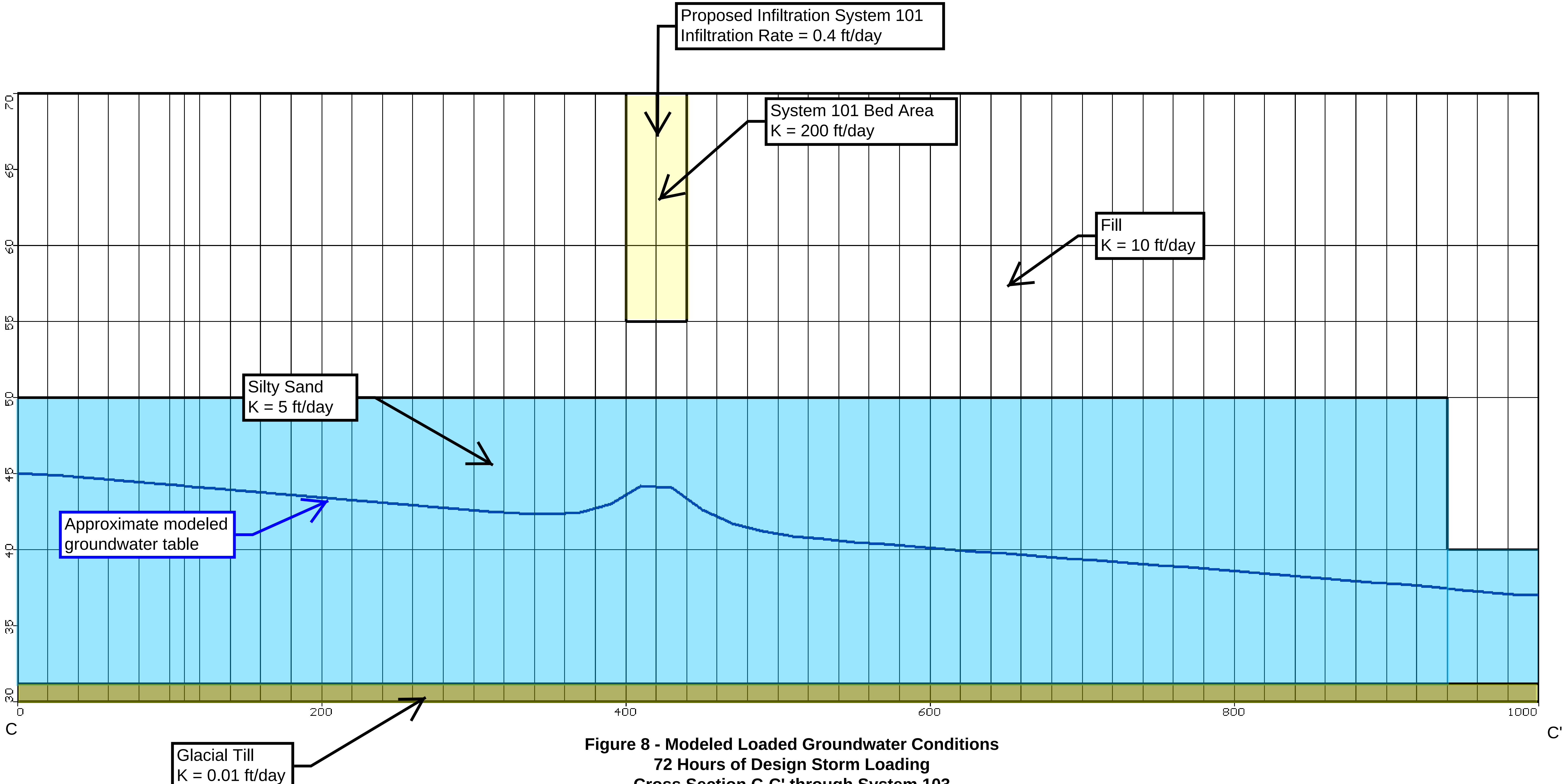


Figure 8 - Modeled Loaded Groundwater Conditions
72 Hours of Design Storm Loading
Cross Section C-C' through System 103
Numerical Groundwater Model - MODFLOW
Riverside Station Redevelopment
Newton, Massachusetts