2014

Water Balance Analysis and Wastewater Treatment Plant Tie-in Analysis Banta-Davis Land and Adjoining Land at 338 Bedford Road Carlisle, MA

Richard A. Moore, PE

City Point Partners LLC

1/30/2014

CITY POINT
PARTNERS

April 14, 2014

Ms. Elizabeth DeMille Barnett
Town of Carlisle Affordable Housing Trust
66 Westford Street
Carlisle, MA 01741

Dear Ms. Barnett,

We are pleased to submit this final report on the Water Balance and Wastewater Treatment Plant Tie-In Analysis for the Banta-Davis Land and Adjoining Land at 338 Bedford Road, Carlisle, MA.

Very truly yours,

Richard A. Moore

Richard A. Moore, P.E.

CITY POINT PARTNERS LLC
11 Elkins Street, Suite 470
Boston, MA 02127
617 315 7832 office
www.citypointpartners.com

Contents

INTRODUCTION

The purpose of this report is to analyze the development potential of the town-owned Banta-Davis land and the adjacent parcel at 338 Bedford Road (the former Goff property) with respect to water supply and wastewater disposal. The report is divided into the following sections:

- Existing conditions
- Potential development plans
- Water demands and wastewater flows
- Water balance / water budget
- Water infrastructure and permitting
- Wastewater infrastructure and permitting
- Conclusions and recommendations

EXISTING CONDITIONS

The Banta Davis land, located on Bedford Road (Route 225) is approximately 38 acres in area, of which approximately 6 to 7 acres are playing fields, a paved and gravel road, and gravel parking. Two of the ball fields and a small dug pond and irrigation well are located in the middle of the property, roughly half way between Bedford Road and Baldwin Road. The third field, a Little League field, is located toward the front and eastern edge of the Banta Davis property. The wastewater treatment plant (WWTP) and leaching field that serve the Carlisle public schools are situated among the playing fields on the Banta Davis property and collectively occupy approximately one-half acre of land. A paved road *off* Bedford Road, which becomes gravel after the Little League field, is used to access the parking, fields and wastewater treatment facilities.

The adjacent 338 Bedford Road property, to the east, contains approximately 5 acres and currently includes a single-family home with a private well and septic system.

The Banta-Davis and 338 Bedford Road properties are shown on Figure 1.

Except for the first 150 to 200 feet along the entry road, both sites are relatively flat, rising generally from west to east from approximately 160 to 200 feet in elevation (NGVD Billerica USGS Quadrangle map). Wetlands were flagged on the Banta Davis site in 2006 and on the 338 Bedford Road site in 2013. The Banta Davis wetlands include an isolated wetland near the irrigation pond and a wetland running along the rear, southwestern property line. According to a report by Stamski & McNary (April 2012), there are no rare or endangered species or habitat on the Banta Davis site nor are there any certified vernal pools. The 338 Bedford Road property adjoins wetlands on the Fox Hill Conservation Land near Bedford Road, and contains a wetland area in the back of the property.

The subsurface conditions on both the Banta Davis and the adjoining 338 Bedford Road land change from the front portion near Bedford Road to the rear. The front portion of the combined sites, an area that includes the subsurface wastewater disposal field and the Little League field on the Banta Davis property, and an area that consists of upland fields on the 338 Bedford Road land, has a layer of sand

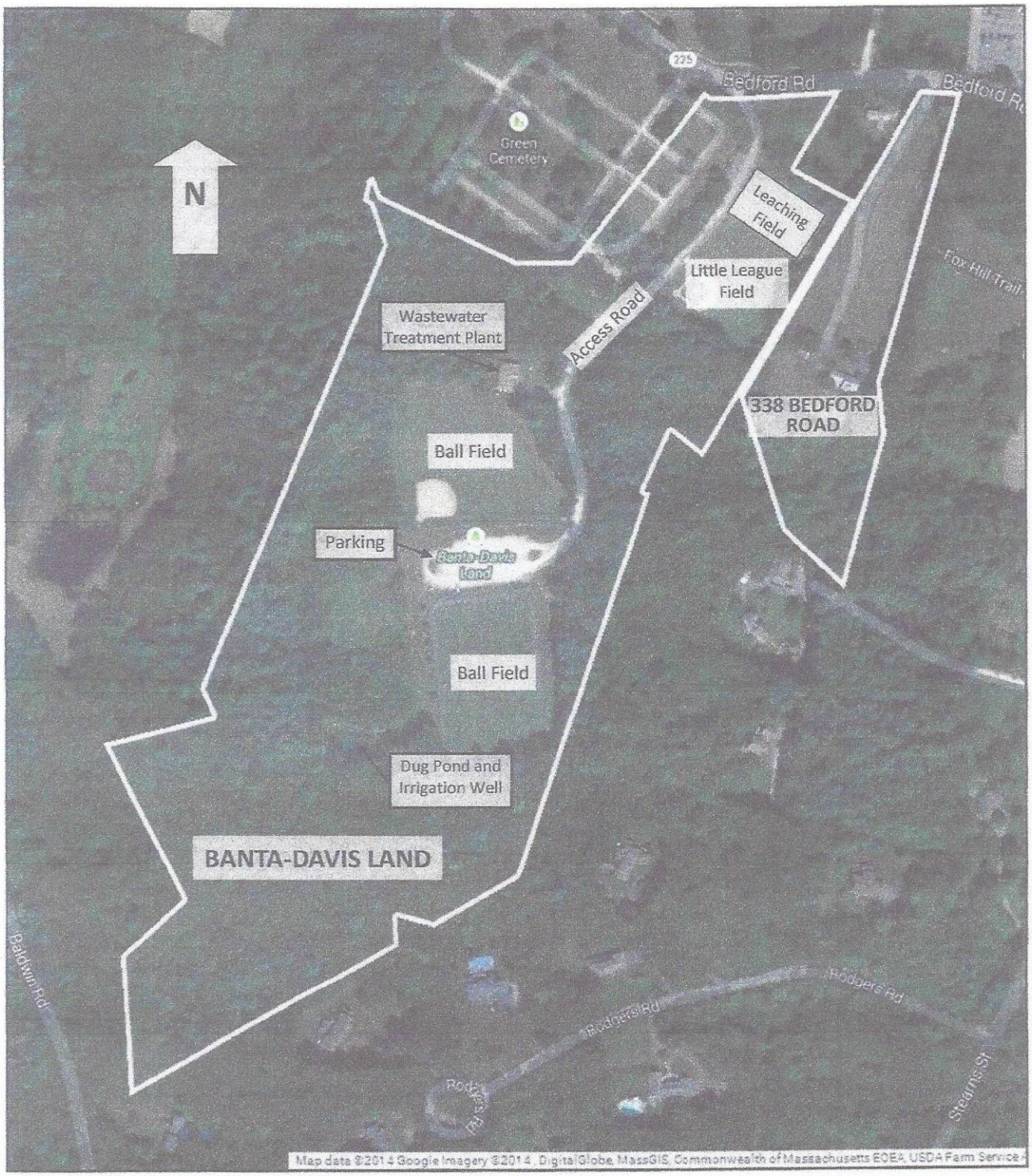


Figure 1. Existing Conditions
Banta Davis and 338 Bedford Road Properties

lin = 350 ft

approximately 25 to 35 feet thick over till and bedrock. Groundwater is approximately 15 feet below the surface and generally flows toward the north (Bedford Road). Because water flows readily through the sand and the groundwater table is deep, this is a good location for the existing or a future wastewater disposal field.

The layer of sand narrows and disappears further into the site to the south where bedrock rises toward the surface.There is a thin layer of till over the bedrock and in places rock outcrops appear in the rear, undeveloped portion of the Banta Davis site, south of the multi-purpose playing field, as well as in the far westerly portion of the Banta Davis land, between the softball field and the western property line.

According to the USGS Hydrologic Atlas HA-662, crystalline bedrock underlies the site, and well yields in such crystalline bedrock are commonly 2 to 10 gallons per minute (gpm). According to the USGS Water Recourse Report 90-4144 bedrock wells in the area are typically 100 to 300 feet deep and can have yields up to 200 gpm. The water is typically low in dissolved solids (120 mg/l), moderately hard (90 mg/l as calcium carbonate), slightly alkaline (PH 7.8) and may have traces of iron.

The USGS Investigation Report 5155 (2010) evaluates the yield of bedrock wells in the Neshoba Terrane, which is the zone of bedrock underlying large portions of central and eastern Massachusetts. The data in the report suggest that the bedrock under the site is either granite or schist and gneiss and that wells in these types of materials have average yields of 10 to 12 gpm, based on over 3,000 reporting wells. (Appendix A)

POTENTIAL DEVELOPMENT PLANS

In terms of providing water and disposing of wastewater, potential development on the Banta Davis land and 338 Bedford Road property needs to account for the existing and future water consumption and wastewater disposal needs for the Carlisle Public School. Water to the existing school, on another parcel, is provided separately by a well at the school, but wastewater is treated and disposed on the Banta-Davis land. Wastewater flows from the existing school are discussed in the next section. It is anticipated that water for a future school on the Banta Davis land would come from a new water supply well on the Banta Davis site.

The potential development of the Banta-Davis and 338 Bedford Road properties are subject to future public approvals, including Town Meeting votes for land use and/or funding. Accordingly, the potential development for which the water and wastewater capacities of the combined Banta Davis and 338 Bedford Road sites are analyzed includes the following, in addition to maximizing the use of the existing Carlisle Public School, as shown in Figure 2:

Banta Davis Property

1. Up to 50 Units of Multi-family Rental Housing (up to 79 bedrooms)
2. New K-8 School (400 students)
3. Existing three playing fields plus, per the 2013 Carlisle Open Space and Recreation Plan, one additional multi-purpose playing field and four tennis courts.

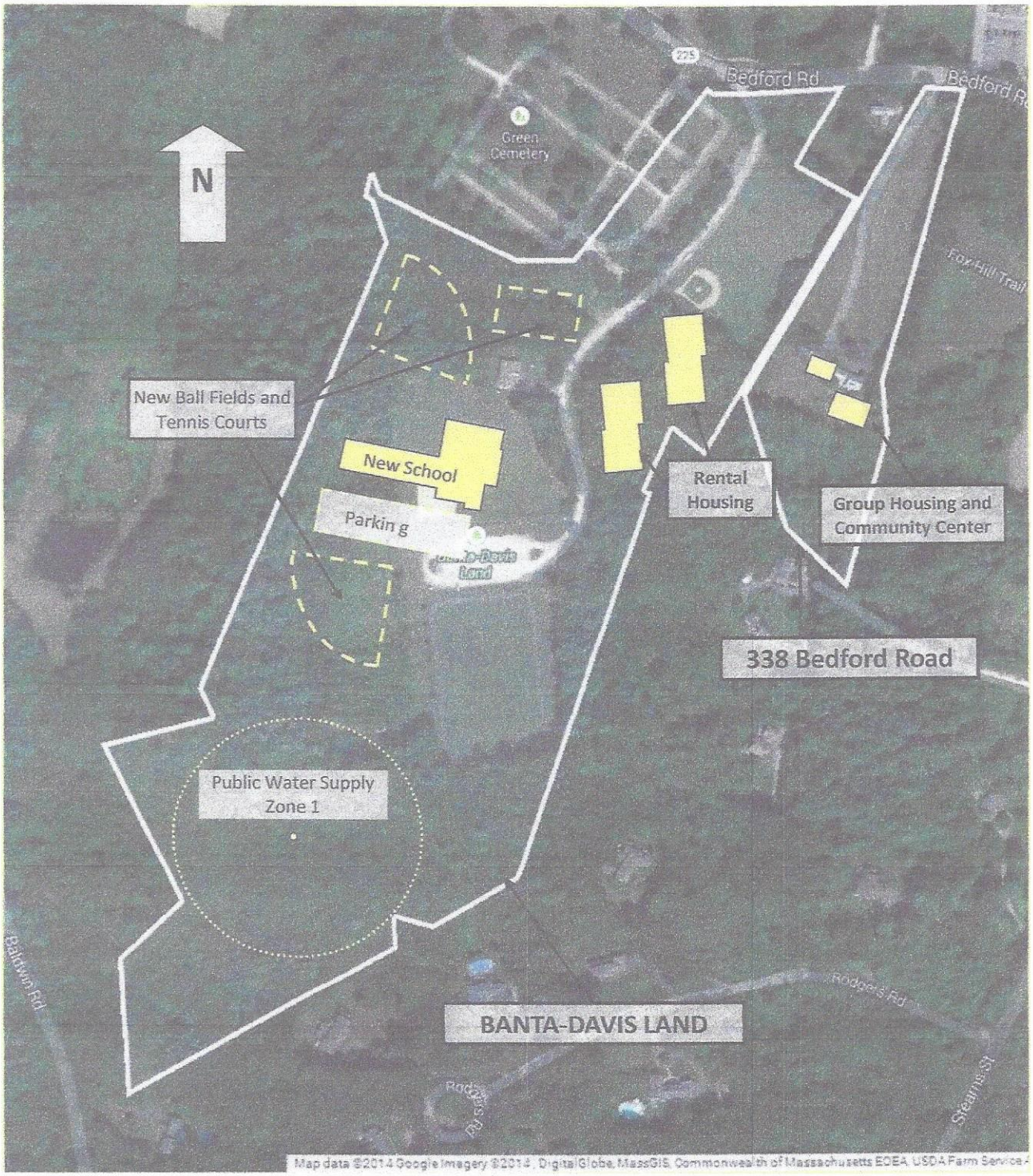


Figure 2. Proposed Development
Banta Davis and 338 Bedford Road Properties

lin = 350 ft

4. Based on input from Carlisle Public School representatives, a second K-8 school serving up to 400 students is not expected to be needed for at least two or three decades, and by that time the current mechanical and electrical equipment in the WWTP will need to be replaced. There is also available land at the 338 Bedford Road property to expand the existing leachfield for an expanded WWTP if necessary. Accordingly, on the assumption that land at 338 Bedford Road will be reserved for a leachfield for a second public school and that a second school could be served by an expanded WWTP, this analysis does not reserve capacity in the existing WWTP for a second school in the distant future. As stated in the recommendations, however, it would be advisable for a portion of the 338 Bedford Road property to be reserved now for a potential leachfield for treated wastewater from a second school.

338 Bedford Road Property. Community Center for up to 400 people (up to 10,000 sq. ft.) Based on recent advice given by Massachusetts DEP to the 338 Bedford Road Master Planning consulting team, group homes at the 338 Bedford Road property would not be required by DEP to tie wastewater flows into the existing WWTP, but instead could use an on-site septic system, provided that the group homes are developed and operated by a party other than the Town under a ground lease. As this is the plan for the group homes and based on this advice from DEP, this report has not allocated capacity in the WWTP for flows from the group homes. Also, to allow for a stand-along project, the group homes would be served by a private well on the 338 Bedford Road property.

We were asked to assume that use of the existing WWTP by the existing Carlisle school might increase in the future, if and when student enrollment increases. Available capacity in the existing WWTP will be allocated first to this increased enrollment in the existing school, and only then to other potential development. Accordingly, the analysis in this report contemplates that the existing school enrollment might increase to as many as 800 students, which we understand to be approximately 110% of the design population for the Carlisle Public School. Because we have robust wastewater data sets from the existing school over a number of years, we can determine expanded school population wastewater flows with a high degree of confidence.

WATER DEMANDS AND WASTEWATER FLOWS

Water demands and wastewater flows are typically reported in terms of average annual and peak day conditions, each in gallons per day (gpd). The average day flows are the total volume of water or sewage over a year divided by 365 days. The peak is the highest single day during the year. The peak condition for small wastewater treatment systems, similar to the one in Carlisle, is typically between 2 and 3 times the average. In Massachusetts, because there are State-approved published standards for wastewater flows and not for water demands, typically wastewater flows are calculated first and then water demands are estimated, rather than the other way around. So, the first step in this process is to develop wastewater flows.

Wastewater Flows. The existing flows from the school are based on actual data recorded at the treatment plant. Further, for public schools, Mass DEP has modified the definition of peak flow to account for the specific nature of school operations. For Carlisle, DEP has approved a peak design flow based on the average of the maximum day flow during each month except July and August (MassDEP letter dated April 17, 2012). Further, weekend data are not used to calculate average day conditions for school flows. Based on this definition, which includes only weekdays when school is in session, Stamski and McNary summarized, and MassDEP concurred in, the flow data for 2011. Updated data for 2012 and 2013 (less December) were obtained from David Flannery of the Carlisle Public School and the WWTP operator, Weston & Sampson. The flow data are summarized in Table 1.

Table 1. Wastewater Flows from Carlisle Schools (gpd)

	Year		
Condition (1)	2011	2012	2013
Average day	2,266	1,956	2,314
Average of max day each month	4,324	3,460	4,103
Max day	6,210	3,930	5,000
WWTP Capacity	13,500	13,500	13,500
Available Capacity, per DEP guidance			9,397

(1) Data represents flows on weekdays and excludes July and August.

(2) WWTP capacity less the average of the max day each month, except July and August.

As the data show, the average of the max day flows decreased from 2011 to 2012, then increased in 2013, but remained below 2011 levels. The last data that DEP reviewed in April 2012 were from 2011. In its April 17, 2012 letter, DEP called for updating data prior to adding non-school flows to the WWTP. Based on the relatively consistent school flows over multiple years, the WWTP continues to have at least the excess capacity recognized by DEP in its April 2012 letter. As noted in the April 2012 DEP letter, the WWTP was constructed with a 7,000 gallon equalization tank, further reducing the impact of peak flows on the system.

To account for the potential maximum utilization of the existing school in the future, the average maximum day flow per pupil was calculated and applied to the potential additional enrollment. Clearly

additional pupils also entail additional teachers, staff, parents and other visitors, but by using the more• readily-available pupil counts to calculate a per-pupil-flow rate, wastewater generated by adults at the school are incorporated into per-pupil flow figures. In 2012-13 there were 645 students enrolled in the Carlisle Public School. Thus, the per-pupil average maximum flow in 2013 was 6.36 gpd.

We understand the current Carlisle Public School was designed for a comfortable occupancy of approximately 725 pupils. We further understand that the current physical school might be pushed to accommodate as many as 800 pupils for a limited number of years during peak student demographics, approximately 110% of the comfortable design capacity. This is approximately 155 more students than are currently enrolled in the school. Adding the flow from these additional students to the existing design flow of 4,100 gpd would increase the design flow by 985 gpd to 5,085 gpd.

The existing WWTP permitted capacity is 13,500 gpd. Reserving 5,100 gpd for the existing school at an expanded occupancy of 800 students, the available capacity or wastewater budget for other development is approximately 8,400 gpd.

The wastewater flows for the potential development are summarized as follows:

Table 2. Daily Wastewater Flows for Future Development (gpd)

Use	Peak (1)		Average (2)	
	Title 5	LEED	Title 5	LEED
Banta Davis Property				
SO Units of Multi-family Rental Housing (up to 79 bedrooms)	8,690	6,083	4,345	3,042
338 Bedford Road Property				
Community Center for up to 400 people (10,000 sf)	2,400	1,680	1,200	840
Total	11,090	7,763	5,545	3,882

Based on 110 gals/bedroom, 8 gals/student, and 6 gals/person per Title 5 of the State Sanitary Code. LEED flows are 70% of Title 5 based on water conservation for housing and the community center and school flows are based on 6.36 gpd per student from existing data.
Average flows are 50% of design flows.

The current WWTP does not have the capacity to treat the Title 5-derived peak design flows for all the proposed development within the available, 8,400 gpd wastewater treatment budget based on Title 5 peak flows. However, as discussed below under Wastewater Infrastructure and Permitting, there are opportunities to accommodate more development in the treatment plant using a combination of the following approaches:

Use more realistic flows, based on LEED development principles for water conservation.
Schedule development in a step-wise fashion so it is clear to DEP that actual flows do not approach Title 5 peaks.
Reduce the size of one or more of the development elements.

Water Demand. The water demand for the existing school is served by a separate well that is at the school. The existing school well pumped approximately 3,000 gpd on an average school day during 2013. School water withdrawals have not resulted in any reported loss of water to abutting residences or churches over many years of operation. The water demand for the potential development, including a second school, would be served by a new bedrock well located on the undeveloped land in the rear of the Banta Davis site.

Water demand is normally higher than the wastewater flows because of losses in the system, consumptive uses and outdoor uses that do not enter the sewer system. An increase in the wastewater flows of 10% is typical to account for these conditions.

Increasing wastewater flows for all potential development by 10% gives the estimated water demands as follows based on Title 5 and based on LEED building principles with water conservation:

Average day = 6,100 gpd (4,270 gpd with LEED water conservation)

Peak day = 12,199 gpd (8,539 gpd with LEED water conservation)

To put these numbers in perspective, the average day demand before water conservation of 6,100 gpd would equal approximately 4.2 gpm. A garden hose typically flows at 6 to 10 gpm.

See Appendix B for wastewater and water data.

WATER BALANCE/WATER BUDGET

A water balance (sometimes referred to as a water budget analysis) is useful to understand if the annual precipitation over an area (input) is sufficient to sustain the uses that export water (output) from the same area. This can be a concern when water is drawn from one part of a watershed and transported to a distant part, or outside of the watershed, via municipal sewers. Carlisle is a largely residential community with large lots and no sewers and therefore has a highly conservative water budget in that most of the water withdrawn from wells is returned to the ground through nearby septic systems. This will also be the case for the Banta Davis land, made more so by the added recharge of treated wastewater from the existing school.

Because of the configuration of the Banta Davis land, the likely location of the new well, the location of the wastewater disposal field and the geology, water would be moved only about 400 yards from the well location, through the treatment plant, to the soil absorption field, but would stay within the same watershed. Nonetheless, to be conservative, it is useful to look at a 'worst case' condition comparing only the localized precipitation around the well (input) with the well withdrawal (output).

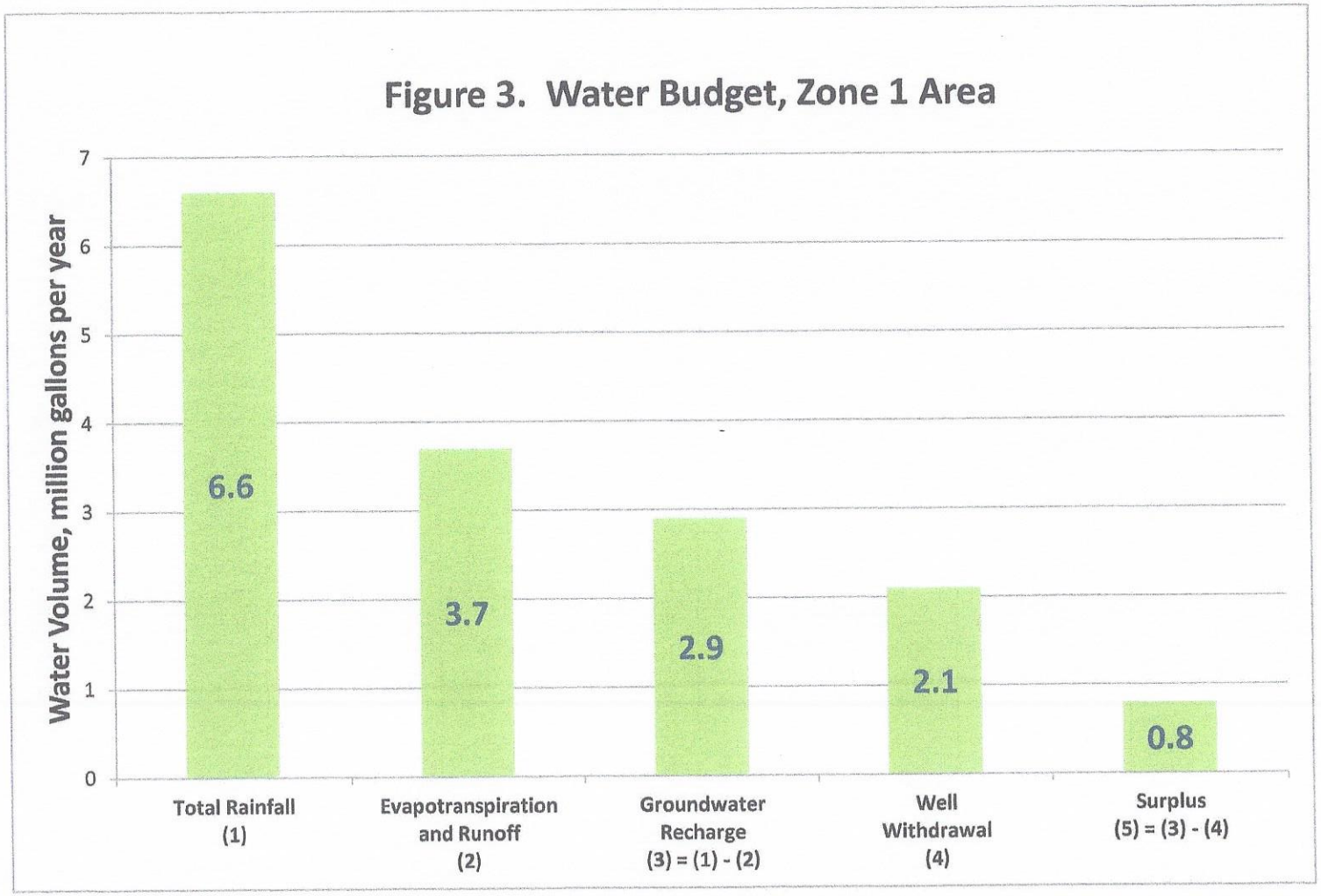
The estimated average day water use for the combined potential development elements is 4,270 gpd, using the 110% of average wastewater flows method for calculating water demand and LEED water conservation. After adding approximately 1,400 additional gpd for average water use for a second school (again, using 110% of average wastewater flows from a 400-student school with LEED water conservation to calculate water demand), the new well would draw 5,670 gpd on average and will require a Zone 1protective radius of approximately 273 feet, where no development can occur (see next section for an explanation of the Zone 1). The recharge (input) to groundwater from precipitation in the 5.4-acre Zone 1area alone (disregarding additional recharge from precipitation falling on other portions of the Banta Davis land) averages approximately 8,030 gpd. See Figure 3 and Appendix C for calculations.

In short, the annual groundwater recharge from precipitation in Zone 1alone will be greater than the amount of the water pumped from the well by about 42%, even after a second school ties into the well in the distant future. The localized recharge from precipitation within the Zone 1is more than adequate to permanently sustain the potential well withdrawal, including water for a second school that is not likely to be built for several decades.

If water demand for only the potential community center and rental housing are considered (i.e., the future second school water demand is not included), then the water budget /water balance analysis becomes even more favorable. Prior to a second school drawing water from the new well, the annual groundwater recharge in the Zone 1alone, 8,030 gpd, will be 188% of the amount of water pumped from the well (4,270 gpd).

In addition, treated wastewater from on-site development, plus treated wastewater from the existing school will be returned to groundwater within a relatively short distance, and additional areas of Banta Davis also receive precipitation, all of which add to groundwater recharge.

Figure 3. Water Budget, Zone 1 Area



WATER INFRASTRUCTURE AND PERMITTING

As noted above, a new well and an associated Zone 1protected area would be needed in the rear of the Banta Davis property to serve the potential development. The State will classify the well as a public water supply since it would serve more than 25 year-round residents. The State Drinking Water Regulations (310 CMR 22.00) and Guidelines for Public Water Supplies (MassDEP, May 2010) cover land use, capacity, water quality, engineering, O&M and financial matters related to the well. The Guidelines describe a 25-step process for the approval of a new public water supply. Two early steps are critical and if not satisfied will end the process. These two steps are: (1) siting the well and control of surrounding land uses, and (2) proving the actual capacity or safe yield of the well after drilling and conducting a pumping test, but before the well can be used as a source of potable water. If these two issues are resolved satisfactorily, the remaining steps consist of demonstrating safe water quality, engineering the facilities, financial planning and administrative tasks. It is not uncommon for the process of permitting a public water supply well to take between 9 months and a year.

Siting and Land Uses. There is only one option in siting a potential well on the Banta Davis property and that is in the undeveloped rear portion of the site. This is due to the DEP requirement to protect the quality of the water drawn from the well. To insure this protection, the State will require an undeveloped Zone I area around the well. The Zone I is a circle around the wellhead with a radius defined by the maximum well use, using the peak design flow from Title 5.

As shown in Table 2 under Title 5, the peak day wastewater flows from all potential development elements, including a new school, would be 14,290 (9.9 gpm). As noted above, this yields a Zone I radius of approximately 273 feet, using MassDEP calculation guidelines. The Zone I land must be owned or controlled by the water supplier and the uses in Zone I must be limited to those associated with the water system and have no significant impact on water quality.

Only the rear, undeveloped portion of the Banta Davis land (land that is almost certain to remain undeveloped due to the fact that it is interspersed with ledge and wetland and has the most restricted physical access of any portion of the property) is adequate to contain the Zone I area. Based on the 273 foot required radius, the Zone I contains approximately 5.4 acres. As shown on Figure 2, a well can be sited in the rear of the Banta Davis property and comply with Zone I requirements.

In addition to the Zone I, MassDEP regulations also create a larger, Interim Wellhead Protection Area (IWPA) around public water wells. The IWPA is a surrogate for a Zone II which is the "cone of influence" area of the aquifer that may contribute water to the well under prolonged pumping at the design rate for 180 consecutive days without precipitation. The land uses in the IWPA are less restrictive than in the Zone I, and effectively exclude hazardous and industrial uses noted in the regulations. There is also a restriction on nitrate loading rates in the IWPA, such that nitrate concentrations in the well water do not exceed 5 milligrams per liter (mg/l). Carlisle zoning already complies with the IWPA requirements both with respect to hazardous and industrial uses and nitrate loadings by virtue of the minimum 2-acre residential lot size.

Capacity or Safe Yield. The capacity of a well is often listed as the safe yield. The safe yield is the amount of water, typically given in gallons per day (gpd), that can be pumped for sustained periods and not adversely impact groundwater resources. This doesn't mean the well can't be pumped at higher rates for short periods, but these situations rarely arise or are necessary based on the conservative procedures set by the State in setting safe yield rates.

The safe yield of a well is calculated based on the results of a prolonged pumping test. The State requires that water well sources be designed based on the maximum day demand for the design year. Further, for bedrock wells, MassDEP requires that the pumping test be run at 133% of the Title 5 maximum day demand (14,290 gpd, which includes 11,090 gpd for the Rental Housing and Community Center and 3,200 gpd for the new 400 student school). This would require that a pumping test on a well on Banta Davis property be performed at approximately 19,000 gpd (13.2 gpm). If the pumping test shows stable drawdown and recovery conditions in the test well over a minimum of 48 hours of pumping and projected over 180 days, this flow will be approved as the well's safe yield. It would be useful to monitor the irrigation pond well during the pumping test to provide data showing the impact of pumping at the proposed well.

Pumping at 133% of the maximum day demand is a conservative requirement, very unlikely to be exceeded during actual well use. Moreover, MassDEP has increasingly moved from a 48-hour continuous pump test to a 7-consecutive-days pump test for proving well safe yield.

It is possible that a well in the rear of the Banta Davis property will yield 10.9 gpm based on the history of wells in similar fractured bedrock conditions. A pumping test according to DEP guidelines, as described above, will be needed to establish the safe yield of the well, early in the permitting process.

In addition to the control of Zone I and proving safe yield, the quality of the groundwater is important. Because the land uses on and in the vicinity of the Banta Davis property are benign, water quality is anticipated to be good. As a precautionary measure, there may be a need to disinfect, depending of the results of water samples taken during the pumping test. The results of the water sampling will also determine if additional treatment (e.g., water softening) is needed.

The potential water supply system would include the well and pump(s), storage tankage, standby power, distribution piping, valves and meters.

WASTEWATER INFRASTRUCTURE AND PERMITTING

One of the advantages of the Banta Davis property is the treatment plant located on-site with significant available capacity. According to DEP's letter of April 17, 2012, the treatment plant has a design capacity of 13,500 gpd and only 4,324 gpd of that capacity was being used based on an average of the maximum day flows for each month during 2011, excluding July and August. As noted above, the average of the maximum day flows have slightly decreased in 2012 and 2013 from the 2011flows. DEP acknowledged available capacity at the WWTP of approximately 9,200 gpm as of April 2012. DEP went further to say that more recent data should be used to up-date available capacity before connecting new flows from

non-school sources. Using the 2013 data give a slightly larger available capacity of 9,400 gpd, subject to approval by DEP. "Grossing up" the existing school flows to 800-pupil enrollment levels (approximately 110% of school architectural design capacity}, to allow for future school population growth, yields a design flow (calculated per DEP's April 2012 letter) of 5,090 gpd. This leaves available, long-term capacity in the existing WWTP of approximately 8,400 gpd.

Using Title 5 design flows, the total potential development would generate 11,090 gpd (see Table 2). This is in excess of the available WWTP capacity of 8,400 gpd, after accounting for the existing school at a maximum capacity of 800 students. However, there are several options, which together can take maximum advantage of the available WWTP capacity in the short term and plan for a new school in the long term.

First, the flows in Title 5 of the State Sanitary Code are conservatively high, especially considering the latest Plumbing Code requirements and available conservation measures. LEED requirements for sustainable buildings have credits for reducing water use by 30% to 50%, which is possible with available conservation measures. As an example, the school's water use was reduced by 19% from 2012 to 2013 in part with low flow fixtures and water-saving devices installed as part of a major reconstruction. Water conservation should be taken advantage of as it is an accepted industry practice acknowledged by DEP. Appendix C contains information on potential water reductions using existing proven conservation methods.

If a savings of 30% were realized in the new development, the 11,090 gpd would be reduced to 7,763 gpd. This is less than the available 8,400 gpd wastewater capacity. Except for schools (310 CMR 15.416) however, these savings are not accepted by DEP until after the buildings are operational and the flows measured and confirmed. But because rental housing wastewater flows would be connected to the WWTP before any community center flows, the actual lower flow figures from rental housing would exist before community center flows were added. In addition, the fact that the 8,400 gpd available capacity includes over 155 students who are not expected to actually be in the existing school for at least the remainder of this decade, there is nearly 1,000 gpd of additional capacity to add flows on the basis of Title 5 design figures, and then demonstrate that actual peak flows are substantially lower. This would allow a more realistic wastewater flow budget for the WWTP during DEP review.

A second option would be to reduce the size of the rental housing in order to preserve the allocation for the 155 new students.

The third option is to recognize that the new school is far off in the future and may require an expansion of WWTP capacity. This could be accomplished by expanding the WWTP and the leaching field. The additional field would most likely be located in the front portion of the 338 Bedford Road property, where soils are similar to the existing leaching field site on the Davis Bacon property. Alternatively, if water conservation measures are aggressive and documented for the Rental Housing and Community Center, additional capacity may not be needed. In essence, this approach postpones a final decision on wastewater disposal needs for a new school.

Combining these three approaches (water conservation, reducing the size of the Rental Housing and recognizing that a new school will not be built for decades to come) gives the following plan:

Phase 1

1. 155 additional students in the existing school (full wastewater allocation preserved)
2. 50 Rental units with 76 bedrooms, Banta Davis property (reduction of 3 bedrooms to meet Title 5 requirements)
3. Community Center for 400 people, 338 Bedford Road property (documented reduction in Rental Housing flows from water conservation will free up capacity for the Community Center at Title 5 flows)

Phase 2

1. New school for 400 students, Banta Davis property (documented reduction in Rental Housing and Community Center flows from aggressive water conservation could free up enough capacity in the WWTP. Otherwise additional WWTP capacity will need to be constructed.)

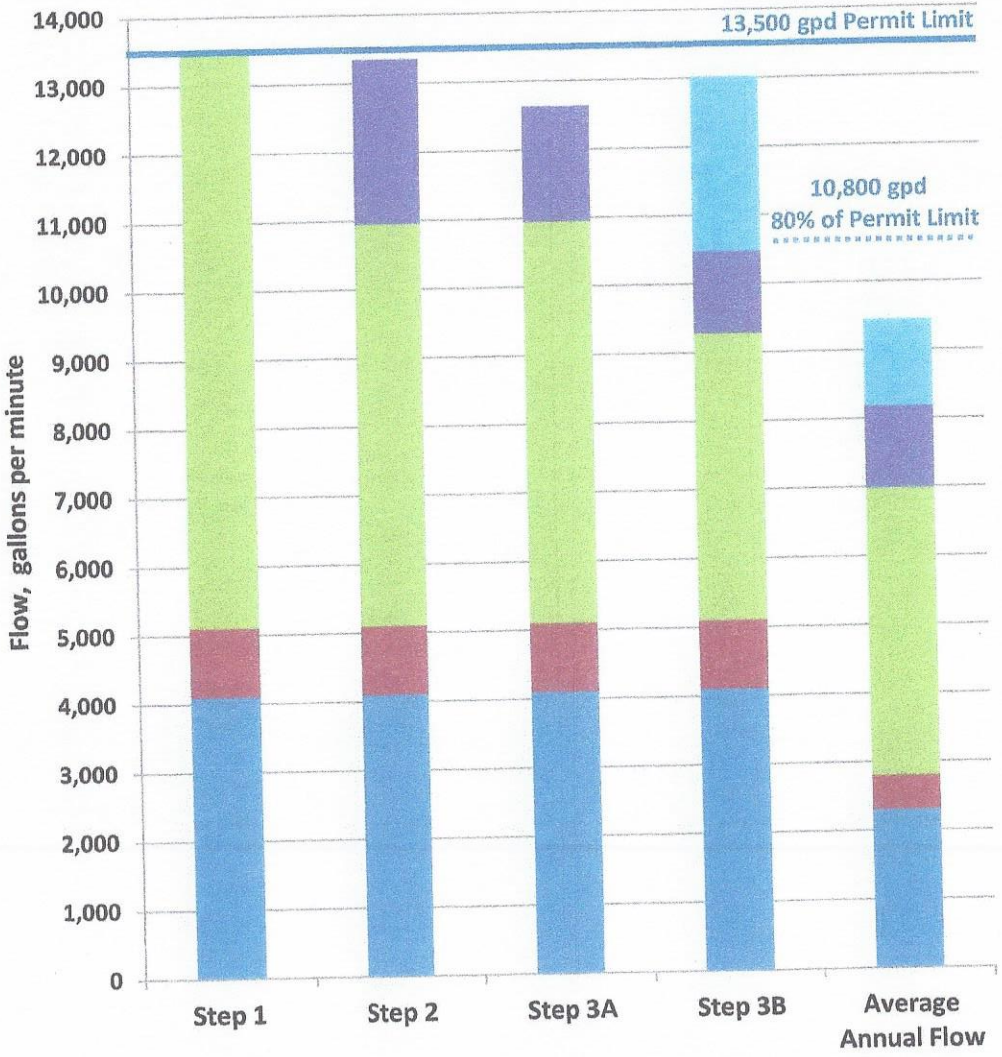
The flows for this plan are shown in Figure 4 in a step wide fashion based on Title 5 flows and water conservation reductions. As previously noted, the housing and community center can only be connected to the WWTP if enough capacity is available based on Title 5 flows. However, after they are built and water conservation reductions are documented, the savings can then be allocated to the next development element. This requires that, in Phase 1, the housing be built and operated for at least 2 years before the Community Center can be built.

Once Phase 1is complete and operating, the actual water reductions due to conservation will become clear. To illustrate the potential benefits, two levels of water conservation are given, a 30% and a 50% reduction from peak Title 5 design conditions. The 30% reduction is considered achievable by simply following the plumbing code and the 50% reduction is considered aggressive, going beyond the code using best available conservation measures. As shown in Figure 4, an aggressive water conservation plan would free up enough WWTP capacity for a new school.

There is also a requirement in the WWTP permit that DEP be notified when the actual average annual flow reaches 80% of the permitted peak design flow of 13,500 gpd. Figure 4 also shows these average flow conditions based on Title 5, to illustrate that the development plan, even with the new school in Phase 2, does not exceed this permit threshold.

The permitting process for adding flows to the WWTP for developments that are under different ownership (School, Trust) would require legal agreements between or among the different owners that identify the basis for cost contributions (e.g., metered water use), the operation and maintenance responsibilities and easements. A new Ground Water Discharge Permit would not be needed. If an expanded or replacement WWTP and additional leaching field were needed to accommodate a new school, a new or amended Groundwater Discharge Permit would also be needed. Since the new school

Figure 4. Use of Available WWTP Capacity, gpd



Step 1. Rental Housing (76 bedrooms) allowed to connect to WWTP based on Title 5 flows.

Step 2. 30% reduction in flow from Rental Housing documented over 2 years and 400 person Community Center allowed to connect to WWTP based on Title 5 flows.

Step 3A. 30% reduction in flow from Rental Housing and Community Center documented over two years. Additional WWTP capacity needed for new school.

Step 3B. 50% reduction in flow from Rental Housing and Community Center documented, which allows for a new school of 400 students to be connected to the WWTP.

Annual Average Flow. The total from all development elements does not exceed 80% permit limit

- New School
- Community Center
- Rental Housing
- Additional 155 Students
- Existing School

would be located on the Banta Davis property and the best location for the leaching field is likely on 338 Bedford Road, an agreement with easements would be needed between the interested parties.

The Group Housing would be permitted separately and locally, for a new septic system and well.

CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis described above, the following conclusions can be made:

1. Based on wastewater flow data from the school and industry standards, the peak design flows given in Title S of the State Sanitary Code are high and this condition has been recognized by DEP.
2. With reasonable water conservation measures using existing technology there is adequate capacity in the existing WWTP to support 800 students in the existing school, a SO-unit, 76-bedroom rental development, and a 400-person Community Center.
3. A future, second school serving an additional 400 students likely would require an expanded WWTP, depending on the documented success of water conservation measures in Phase 1, but the second school is not expected for two decades or more, when extensive up-grades to the existing WWTP are also likely.
4. There is adequate land on the Banta Davis property to locate a Zone 1protective area around a new well which would provide water for the potential development, including the potential future second school.
5. A pumping test will need to be run to prove that a new well has adequate capacity to serve the potential development. If a lower safe yield is determined, then the development elements would need to be reduced in kind.

Based on these conclusions, the following development plan is recommended.

1. Take advantage of DEP's ruling that Group Homes at 338 Bedford Road can be served by their own separate septic system using a ground lease to a private developer/operator. Similarly, provide water for the Group Homes with a new well on 338 Bedford Road to allow for a stand• along project where permitting can be expedited.
2. Schedule the potential Rental Housing and Community Center development projects in a phased approach such that flow data from each can be collected and documented over at least a 2-year period, demonstrating to DEP that actual capacity continues to exist in the WWTP for the next development.
3. Develop a phased wastewater plan that maximizes the use of the WWTP and allows for the following projects to be connected to the WWTP in Phase 1.

- An additional SS students in the existing school
- Rental Housing (SO units with 76 bedrooms)
- Community Center serving 400 people

4. Reserve a protective Zone 1well area in the rear of the Banta Davis property to ensure that any future second school, as well as any other potential development requiring a public water supply well, will have access to potable water.
5. Begin the process for DEP approval of a public water supply well on the Banta Davis property and as an early action conduct a pumping test at the proposed well site to determine safe yield, and adjust the development program, as necessary, based on safe yield.

Appendix A

Subsurface Data

1. Report 5155, Figure 14 Page 31
2. USGS Geology Map
3. USGS Topographic Map (Billerica Quad)

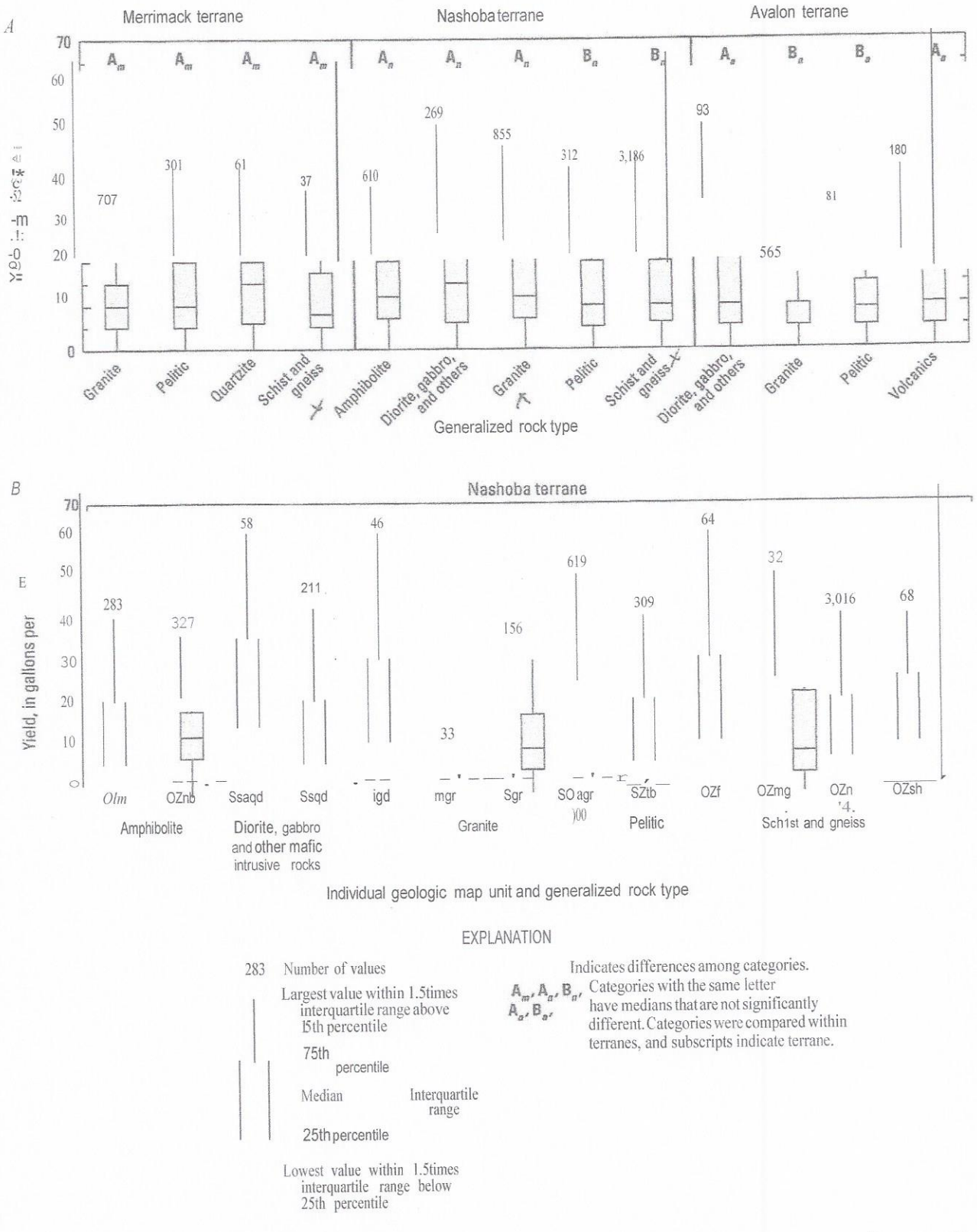
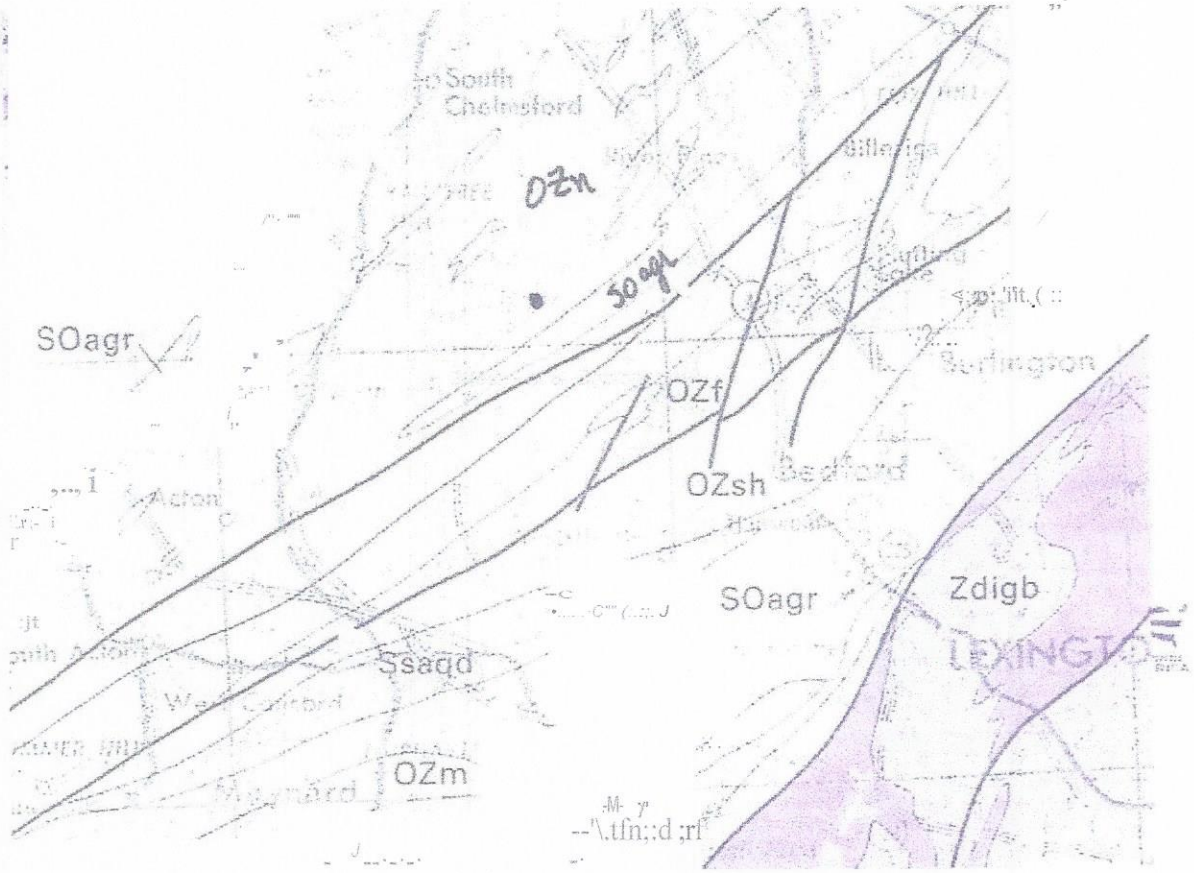


Figure 14. Well yield by bedrock geology. *(A)*Well yield by generaliz ed rock type in the Nashoba terrane and surrounding area. *(B* Well yield by individual geolog ic map unit in the Nashoba terrane. See table 1 and appendix 2 for explanation of individual geolog ic map unit abbreviations .


South
Chelmsford
OZm
SOagr
SOagr
OZf
OZsh
Bedford
SOagr
Zdigb
Ssaqd
OZm

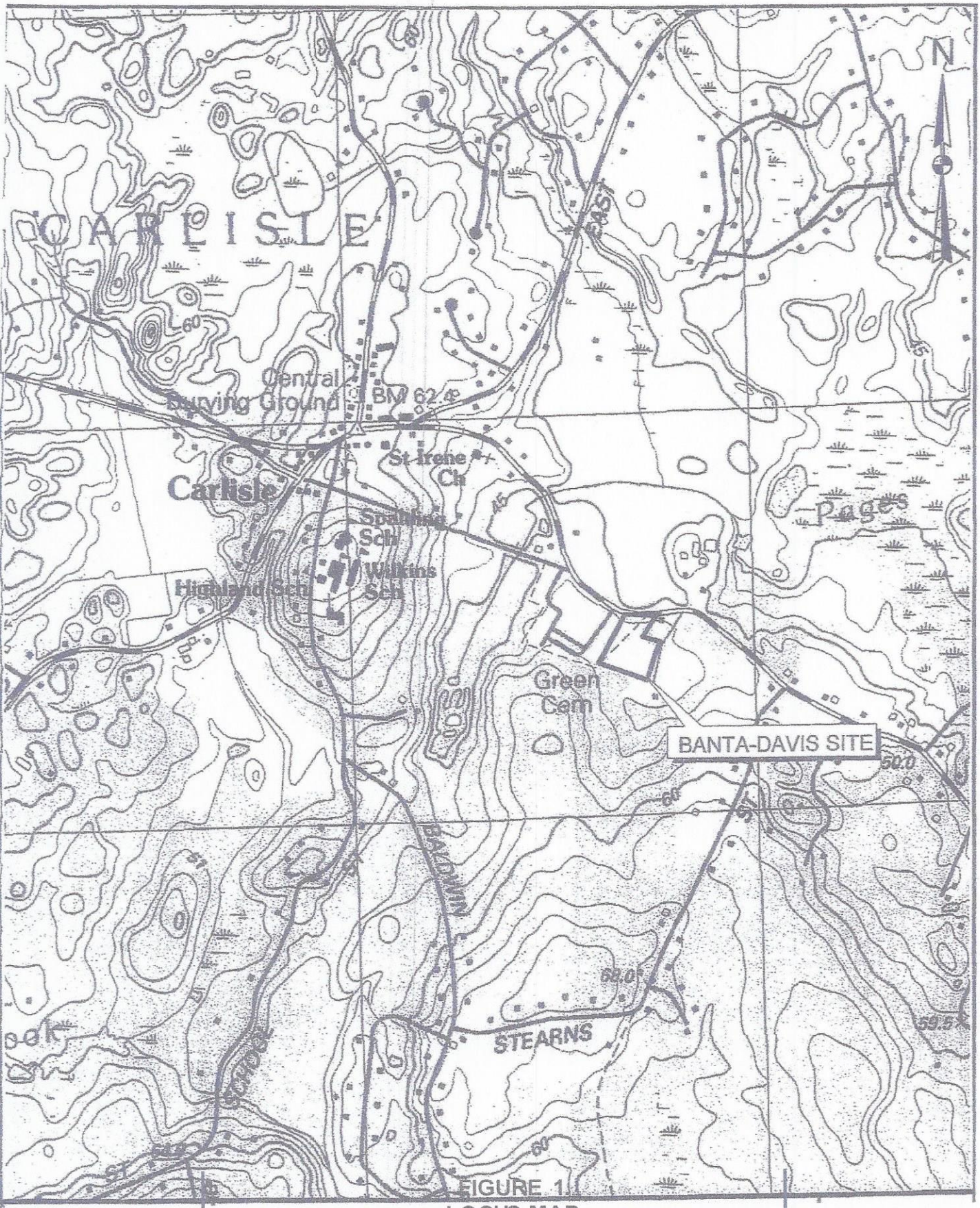


FIGURE 1
LOCUS MAP

Sr.At F OIIRCE: la I

Appendix B

Flow Data

1. Carlisle Public School Water Withdrawals
2. Carlisle Public School Enrollment
3. Wastewater Flows (2012, 2013)
4. Groundwater Discharge Permit, August 21,2009
5. DEP Letter on Flow Allocation, April 17, 2012

CARLISLE PUBLIC SCHOOL
83 School Street
Carlisle, MA 01741

Water Flows

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Jan	77,100	78,100	88,600	84,300		69,800	55,400	80,000	65,800
Feb	64,200	67,400	61,900	66,500	61,400	53,700	48,900	70,400	47,100
Mar	99,100	103,600	92,800	82,600	76,900	79,800	79,900	101,300	64,200
Apr	74,600	67,200	68,600	72,200	66,800	64,500	66,300	73,000	55,500
May	93,800	95,000	93,700	89,900	82,800	77,100	79,400	86,000	74,200
Jun	82,700	72,300	58,300	61,300	70,700	52,700	79,300	62,300	54,200
Jul	26,300	17,700	14,400	16,200	15,200	15,300	31,400	21,500	9,300
Aug	17,700	18,200	14,700	13,900	23,800	13,700	22,600	38,100	12,800
Sep	93,100	83,700	80,800	81,800	85,300	67,600	77,600	71,600	66,800
Oct	95,900	89,400	92,000	88,000	88,400	70,600	75,800	66,200	71,200
Nov	111,200	83,800	77,400	66,600	74,100	67,300	75,900	61,800	56,800
Dec	67,800	65,600	53,500	62,600	62,400	57,600	64,600	33,500	46,100
	903,500	842,000	796,700	785,900	773,700	689,700	757,100	765,700	624,000

Annual Water Flows	
1989	685,616
1990	560,326
1991	519,936
1992	514,623
1993	554,914
1994	352,909
1995	347,695
1996	583,100
1997	631,100
1998	620,900
1999	739,000
2000	754,500
2001	786,900
2002	829,400
2003	805,400
2004	835,400
2005	903,500
2006	842,000
2007	796,700
2008	785,900
2009	773,700
2010	689,700
2011	757,100
2012	765,700
2013	624,000
2014	

Construction on New Spalding starts
Project ends Oct, 2012

Water Flows are from Drinking Water Monthly Chlorination Reports
UOM (Gallons)

CARLISLE PUBLIC SCHOOL
83 School Street
Carlisle, MA 01741

Enrollment PreK-8	
Fiscal Year	CPS
2003-2004	807
2004-2005	810
2005-2006	799
2006-2007	770
2007-2008	750
2008-2009	705
2009-2010	687
2010-2011	656
2011-2012	650
2012-2013	645
2013-2C i	642
2014-2015	654
2015-2016	652
2016-2017	643
2017-2018	650
2018-2019	641
2019-2020	650

YEAR	Actual Births*
1999	58
2000	44
2001	45
2002	46
2003	32
2004	41
2005	24
2006	24
2007	29
2008	29
2009	22
2010	33
2011	23
2012	24
2013	
2014	
2015	

** Source: Carlisle Town Clerk's Records*

Actual
NESDEC 10/10/13 Projections

Appendix B Flow Data
Wastewater, 2012

Month	Volume, gal		Flow/Weekdays	Max Day
	Total	Weekdays	gpd (days)	gpd
January	49,560	34,350	2,021 (17)	3,290
February	38,290	23,990	1845 (13)	3,310
March	56,650	38,540	2,267 (17)	3,610
April	60,450	36,130	2125 (17)	3,850
May	51,440	35,690	1,983 (18)	3,570
June	31,830	14,190	1,774 (8)	3,140
July	3,010	-	-	-
August	3,890	-	-	-
September	30,670	21,990	1,833 (12)	3,460
October	26,430	18,520	1,684 (11)	3,030
November	40,540	28,750	2,053 (14)	3,406
December	42,980	23,770	1,981 (12)	3,930
Totals	435,740		Average 1,956	3,460

Appendix B Flow Data
Wastewater, 2013

Month	Volume, gal		Flow/Weekdays	Max Day
	Total	Weekdays	gpd (days)	gpd
January	47,250	28,810	1,801 (16)	3,540
February	43,970	26,910	2,243 (12)	4,170
March	65,210	36,270	2,267 (16)	4,220
April	55,540	36,070	2,576 (14)	4,400
May	62,770	38,290	2,252 (17)	2,790
June	59,390	33,010	2,751 (12)	4,820
July	8,510	-	-	-
August	4,640	-	-	-
September	35,550	25,900	1,619 (16)	3,980
October	71,140	51,910	2,732 (19)	5,000
November	57,280	29,419	2,451 (12)	4,150
December	-	-	2,444 (12)	3,960
Totals	511,250		Average 2,314	4,103

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
NORTHEAST REGIONAL OFFICE
205B Lowell Street, Wilmington, MA 01887 • (978) 694-3200

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

IAN A. BOWLES
Secretary

LAURIE BURT
Commissioner

August 21, 2009

David Flannery,
Facility Manager
Carlisle Public Schools
83 School Street
Carlisle, MA 01741

RE: GROUNDWATER DISCHARGE PERMIT NO. 783-1
DEP Transmittal No.X223902 – Carlisle Public Schools
Carlisle Public Schools, Bedford Road, (Banta-Davis Site)

Dear Mr. Flannery:

In response to your application for a permit to discharge into the ground, treated effluent from the existing on-site wastewater treatment facility located off of Bedford Road in Carlisle, Massachusetts, and after due public notice, the MassDEP hereby issues the attached final permit. The public notice appeared in the Carlisle Mosquito on June 5, 2009. The notice in the Central Register of the Secretary of State was also published on June 5, 2009.

No comments objecting to the issuance or terms of the permit were received by the Division of Wastewater Management during the public comment period. Therefore, in accordance with 314 CMR 2.08, the permit becomes effective upon issuance.

Parties aggrieved by the issuance of this permit are hereby advised of their right to request an Adjudicatory Hearing under the provision of Chapter 30A of the Massachusetts General Laws and 314 CMR 1.00, Rules for the Conduct of Adjudicatory Proceedings. Unless the person requesting the adjudicatory hearing requests and is granted a stay of the terms and conditions of the permit, the permit shall remain fully effective.

If you have any questions on any of the information discussed in this letter, please contact Lisa Dallaire of my staff at (978) 694-3238.

Very truly yours,

for Eric Worrall
Deputy Regional Director
Bureau of Resource Protection

Enclosure (final permit)

cc: Carlisle Board of Health, 66 Westford St. Carlisle, MA 01741
Marybeth Chubb, DEP/BRP/Watershed Permitting/Boston

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

L<\.N A. BO\\-'LES
Secretary

LAURIE BURT
Commissioner

GROUNDWATER DISCHARGE PERMIT

Name and Address of Applicant: Carlisle Public Schools
83 School Street, Carlisle, MA 01741

Date of Application: December 16, 2008

Application/Permit No. X223902/ 783-1

Date oflssuance: August 21, 2009

Date of Expiration: August 21, 2014

Effective Date: August 21, 2009

AUTHORITY FOR ISSUANCE

Pursuant to authority granted by Chapter 21, Sections 26-53 of the Massachusetts General Laws, as amended, 314 CMR 2.00, and 314 CMR 5.00, the Massachusetts Department of Environmental Protection {the Department or MassDEP) hereby issues the following permit to: Carlisle Public Schools (hereinafter called "the permittee") authorizing discharges from the rotating biological contactor {RBC) treatment facility located at Bedford Road, Carlisle, MA to the ground such authorization being expressl y conditional on compliance by the permittee with all terms and conditions of the permit hereinafter set forth.

L._ Eric w:rratt:Deputy Regional Director
"'7-. Bureau of Resource Protection

Date 8/21/09

I. SPECIAL CONDITIONS

A. Effluent Limits

The permittee is authorized to discharge into the ground from the wastewater treatment facilities for which this permit is issued a treated effluent whose characteristics shall not exceed the following values:

Effluent Characteristics	Discharge Limitations
Flow	13,500gpd
Biochemical Oxygen Demand (BODs) (5 Day at 20°C)	30 mg/l
Total Suspended Solids (TSS)	30 mg/l
Nitrate Nitrogen	10 mg/l
Total Nitrogen (N02 + N03 + TKN)	I 0 mg/l
Oil & Grease	15 mg/l

a) The pH of the effluent shall not be less than 6.5 nor greater than 8.5 at any time or not more than 0.2 standard units outside the naturally occurring range.

b) The discharge of the effluent shall not result in any demonstrable adverse effect on the groundwater or violate any water quality standards that have been promulgated.

c) The monthly average concentration of BOD and TSS in the discharge shall not exceed 15 percent of the monthly average concentrations of BOD and TSS in the influent into the permittee's wastewater treatment facility.

d) When the average annual flow exceeds 80 percent of the permitted flow limitations, the permittee shall submit a report to the Department describing what steps the permittee will take in order to remain in compliance with the permit limitations and conditions, inclusive of the flow limitations established in this permit.

B. Monitoring and Reporting

1) The permittee shall monitor and record the quality of the influent and the quality and quantity of the effluent prior to discharge to the leaching facilities according to the following schedule and other provisions:

INFLUENT:

Parameter	Minimum Frequency of Analysis	Sample Type
BOD5 TSS	Monthly	24-Hr. Composite 24-Hr.
Total Solids (TS)	Monthly	Composite 24-Hr.
Ammonia Nitrogen	Monthly	Composite 24-Hr.
	Monthly	Composite

EFFLUENT:

Parameter	Minimum Frequency of Analysis	Sample Type
Flow	Daily	Reading Report Max-Min-Avg
pH	Daily	Grab
BODs	Monthly	24-Hr. Composite
TSS	Monthly	24-Hr. Composite
TS	Monthly	24-Hr. Composite
Nitrate Nitrogen	Monthly	24-Hr. Composite
Total Nitrogen (N02 + N03 + TKN)	Monthly	24-Hr. Composite
Oil & Grease	Monthly	Grab
Total Phosphorus* (as P)	Quarterly	Grab
Orthophosphate* (as P)	Quarterly	Grab
Volatile Organic Compounds (US EPA Method #624)	Annually	Grab

* After one full year of monitoring the Total Phosphorus and Orthophosphate results, MassDEP may determine, upon the request of the permittee, that the frequency of monitoring may be reduced if, in the judgment of MassDEP, the results of the sampling indicate that existing phosphorus levels will not adversely impact downgradient receptors.

2) The permittee shall sample the upgradient monitoring well(s), GZ-3 (UG) and the downgradient monitoring wells MW-1 (DG) and MW-2 (DG) as shown on the approved plan entitled "Monitoring Well Sketch Plan", prepared by Stamski and McNary, Inc. and dated April 17, 2009. Labels identifying each monitoring well's identification in accordance with the above-referenced approved plan shall be affixed to the steel protective casing of each monitoring well.

The permittee shall monitor, record and rep011the quality of water in the monitoring wells according to the following schedule and other provisions:

Parameter	Minimum Frequency of Analysis
pH	Monthly
Static Water Level*	Monthly
Specific Conductance	Monthly
Nitrate Nitrogen	Quarterly
Total Nitrogen (N02 + N03 + TKN)	Quarterly
Total Phosphorus** (as P)	Quarterly
Orthophosphate** (as P)	Quarterly
Volatile Organic Compound (US EPA Method #624)	Annually

* Static Water Level shall be expressed as an elevation and be referenced to the surveyed datum established for the site. It shall be calculated by subtracting the depth to the water table from the surveyed elevation of the top of the monitoring well's PVC well casing/riser.

** After one full year of monitoring the Total Phosphorus and Orthophosphate results, MassDEP may determine, upon the request of the permittee, that the frequency of monitoring may be reduced if, in the judgment of MassDEP, the results of the sampling indicate that existing phosphorus levels will not adversely impact downgradient receptors.

3) Any grab sample or composite sample required to be taken less frequently than daily shall be taken during the period of Monday through Friday inclusive. All composite samples shall be taken over the operating day.

The permittee shall submit all monitoring reports within 30 days of the last day of the reporting month. Reports shall be on an acceptable form, properly filled and signed and shall be sent to: the Deputy Regional Director, Bureau of Resource Protection, Department of Environmental Protection, '.'Jortheast Regional Office, 2058 Lowell Street, Wilmington, MA 01887, and to the Program Director, Watershed Permitting, Bureau of Resource Protection,

Department of Environmental Protection, One Winter Street/5th Floor, Boston, MA 02108, and to the **Carlisle Board of Health, 66 Westford Street, Carlisle, MA 01741**

Submission of monitoring reports in electronic format is available through eDEP and serves as data submission to both the Regional and Boston offices. To register for electronic submission go to: *http://w\.vw.mass.gov/deplservice/complianceledeponlf. htm*

C. Supplemental Conditions

1) The permittee shall notify the Department at least thirty (30) days in advance of the proposed transfer of ownership of the facility for which this permit is written. Said notification shall include a written agreement between the existing and new permittees containing a specific date for transfer of pennit, responsibility, coverage and liability between them.

2) A staffing plan for the facility shall be submitted to the Department once every two years and whenever there are staffing changes. The staffing plan shall include the following components:

   a) The operator(s)'s name(s), operator grade(s) and operator license number(s);
   b) The number of operational days per week;
   c) The number of operational shifts per week;
   d) The number of shifts per day;
   e) The required personnel per shift;
   f) Saturday, Sunday and holiday staff coverage;
   g) Emergency operating personnel

3) The permittee is responsible for the operation and maintenance of all sewers, pump stations, and treatment units for the permitted facility, which shall be operated and maintained under the direction of a properly certified wastewater operator.

4) Operation and maintenance of the proposed facility must be in accordance with 314 CMR 12.00, "Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges", and, 257 CMR 2.00, "Rules and Regulations for Certification of Operators of Wastewater Treatment Facilities."

   a) The facility has been rated (in accordance with 257 CMR 2.00), to be a Grade **4** facility. Therefore, the permittee shall provide for oversight by a Massachusetts Certified Wastewater Treatment plant operator (Chief Operator) Grade **4** or higher. The permittec will also provide for a backup operator who shall possess at least a valid Grade 3 license.

   b) The date and time of the operator's inspection along with the operator's name and certification, and notes on plant operations shall be recorded on log books kept on site at the treatment facility, and available for inspection by MassDEP staff at any time.

5) Ifthe operation and maintenance of the facility is contracted to a private concern, the permittee shall submit a copy of the contract, consistent with what is required by the approved Operation & Maintenance manual and signed only by the contractor, to the appropriate MassDEP Regional Office within thirty days of permit issuance. Along with the contract, a detailed listing of all contract operation obligations of the proposed contractor at other facilities shall also be submitted.

6) Any additional connections to the sewer system, beyond the existing permitted flows from the school shall be approved by MassDEP and the local Board of Health prior to the connection.

7) All tests or analytical determinations to determine compliance with permit standards and requirements shall be done using tests and procedures found in the most recent version of *Standard Methods for the Examination of Water and Wastewater* and shall be performed by a Massachusetts Certified laboratory.

8) The permittee shall notify the appropriate MassDEP Regional Office, in writing, within thirty (30) days of the following events:

a) Any interruption of the treatment system operation, other than routine maintenance.
b) Final shutdown of the treatment system.

9) The permittee shall contract to have any and all solids and sludges generated by the treatment system for which this permit is issued removed off site by a properly licensed waste hauler for disposal at an EPA/MassDEP approved facility. The name and license number of the hauler along with the quantity of wastes removed and the date(s) of removal shall be reported by the permittee in writing to the appropriate MassDEP Regional Office.

10) Simultaneously with the permit renewal application at year fifteen, ***2019,*** following the initiation of plant operations, the permittee shall submit two reports to the Department for its review and approval:

a. An engineering report, prepared by a registered professional engineer, that outlines in sufficient detail what modifications (if any) to the facility or other changes are required to insure that the facility can remain in compliance with its GWDP and other applicable requirements through the next 5 year permit term (year 20) and beyond; and

11) In the event that effluent limits are not met, or the groundwater quality in the down• gradient monitoring wells does not meet the groundwater quality standards for Class I groundwaters, the permittee may be obligated to modify, supplement or replace the permitted treatment process so as to ensure compliance with the groundwater quality standards

D. Appeal Rights

This Permit is an action of the Department. Any person aggrieved by this action, may request an Adjudicatory Hearing. A request for a hearing must be made in writing and postmarked within thirty (30) days of the Permit issuance date. Under 310 CMR 1.01(6)(b), the request must state clearly and concisely the facts, which are the grounds for the request, and the relief sought.

The Hearing request along with a valid check payable to the Commonwealth of Massachusetts in the amount of one hundred dollars ($100.00) must be mailed to:

Commonwealth of Massachusetts
Department of Environmental Protection
P.O. Box 4062
Boston, MA 02211

The request will be dismissed if the filing fee is not paid, unless the appellant is exempt or granted a waiver as described below. The filing fee is not required if the appellant is a city or town (or municipal agency), county, or district of the Commonwealth of Massachusetts, or a municipal housing authority. The Department may waive the adjudicatory hearing filing fee for a person who shows that paying the fee will create an undue financial hardship. A person seeking a waiver must file, together with the hearing request as provided above, an affidavit setting forth the facts believed to support the claim of undue financial hardship.

IL GENERAL PERMIT CONDITIONS (314 CMR 5.16)

The following conditions apply to all permits:

(1) No discharge authorized in the permit shall cause or contribute to a violation of the Massachusetts Surface Water Quality Standards (314 CMR 4.00) or any amendments thereto. Upon promulgation of any amended standard, this permit may be revised or amended in accordance with such standard and 314 CMR 2.10 and 3.13 or 5.12. Except as otherwise provided in 314 CMR 5.10 (3) (c), 310 CMR 5.10(4) (a) 2 and 314 CMR 5.10(9), no discharge authorized in the permit shall impair the ability of the ground water to act as an actual or potential source of potable water. Evidence that a discharge impairs the ability of the ground water to act as an actual or potential source of potable water includes, without limitation, analysis of samples taken in a downgradient well that shows one or more exceedances of the applicable water quality based effluent limitations set forth in 314 CMR 5.10. In those cases where it is shown that a measured parameter exceeds the applicable water quality based effluent limitations set forth in 314 CMR 5.10 at the upgradient monitoring well, evidence that a discharge impairs the ability of the ground water to act as an actual or potential source of potable water is deemed to exist if a measured parameter in any downgradient well exceeds the level of that same measured parameter in the upgradient well for the same sampling period . . A statistical procedure approved by the Department shall be used in determining when a measured parameter exceeds the allowable level.

(2) Duty to comply. The permittee shall comply at all times with the terms and conditions of the permit, 314 CMR 5.00, M.G.L. c. 21, §§ 26 through 53 and all applicable state and federal statutes and regulations.

(3) Standards and prohibitions for toxic pollutants. The permittee shall comply with effluent standards or prohibitions established under § 307(a) of the Federal Act, 33 U.S.C § 1317(a), for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

(4)Proper operation and maintenance. The perrnittee shall at all times properly operate and maintain all facilities and equipment installed or used to achieve compliance with the terms and conditions of the permit, and the regulations promulgated at 314 CMR 12.00 entitled "Operation and Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Discharges, and 257 CMR 2.00, Rules and Regulations for Certification of Operators of Wastewater Treatment Facilities".

(5) Duty to halt or reduce activity. Upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production or discharges or both until the facility is restored or an alternative method of treatment is provided. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

(6) Power Failure. In order to maintain compliance with the effluent limitations and prohibitions of this permit, the permittee shall either:

(a) provide an alternative power source sufficient to operate the wastewater control facilities; or

(b) halt, reduce or otherwise control production and/or all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

(7) Duty to mitigate. The permittee shall take all reasonable steps to minimize or prevent any adverse impact on human health or the environment resulting from non-compliance with the permit.

(8) Duty to provide information. The permittee shall furnish to the Department within a reasonable time as specified by the Department any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating the permit, or to determine whether the permittee is complying with the terms and conditions of the permit.

(9) Inspection and entry. The permittee shall allow the Department or its authorized representatives to:

(a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records required by the permit are kept;

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit;

(c) Inspect at reasonable times any facilities, equipment, practices, or operations regulated or required under the permit; and

(d) Sample or monitor at reasonable times for the purpose of determining compliance with the terms and conditions of the permit.

(9A) The permittee shall physically secure the treatment works and monitoring wells and limit access to the treatment works and monitoring wells to those personnel required to operate, inspect and maintain the treatment works and to collect samples.

(9B) The permittee shall identify each monitoring well by permanently affixing to the steel protective casing of the well a tag v. rith the identification number listed in the permit.

(10) Monitoring. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136 unless other test procedures are specified in the permit.

{ill Recordkeeping. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and all records of all data used to complete the application for the permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time. Records of monitoring information shall include:

(a) The date, exact place, and time of sampling or measurements;
(b) The individual(s) who performed the sampling or measurement;
(c) The date(s) analyses were performed;
(d) The individual(s) who performed the analyses;
(e) The analytical techniques or methods used; and
(t) The results of such analyses.

(12) Prohibition of bypassing. Except as provided in 314 CMR 5.16(13), bypassing is prohibited, and the Department may take enforcement action against a permittee for bypassing unless:

(a) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(c) The permittee submitted notice of the bypass to the Department:

1. In the event of an anticipated bypass, at least ten days in advance, if possible; or
2. Inthe event of an unanticipated bypass, as soon as the permittee has knowledge of the bypass and no later than 24 hours after its first occurrence.

(13) Bypass not exceeding limitations. The permittee may allow a bypass to occur which does not cause effluent limitations to be exceeded, but only if necessary for the performance of essential maintenance or to assure efficient operation of treatment facilities.

(14) Permit actions.The permit may be modified, suspended, or revoked for cause. The filing of a request by the pennittee for a permit modification, reissuance, or termination, or a notification of planned changes or anticipated non-compliance does not stay any permit condition.

(15) Duty to reapply. Ifthe permittee wishes to continue an activity regulated by the permit after the expiration date of the permit, the permittee must apply for and obtain a new permit. The permittee shall submit a new application at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the Department in \Vriting.

(16) Property rights.The permit does not convey any property rights of any sort or any exclusive privilege.

(17) Other laws. The issuance of a permit does not authorize any injury to persons or property or invasion of other private rights, nor does it relieve the permittee of its obligation to comply with any other applicable Federal, State, and local laws and regulations.

(18) Oil and hazardous substance liability. Nothing in the permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities,liabilities, or penalties to which the permittee is or may be subject under § 311 of the Federal Act, 33 U.S.C. § 1321, and M.G.L. c. 21E.

(19) Removed substances. Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed in a manner consistent with applicable Federal and State laws and regulations including, but not limited to, the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53 and the Federal Act, , 33 U.S.C. § 1251 *et seq,* the Massachusetts Hazardous Waste Management Act, M.G.L. c. 21C, and the Federal Resource Conservation and Recovery Act, 42 U.S.C. § 6901, *et seq.,* 310 CMR 19.000 and 30.000, and other applicable regulations.

(20) Reporting requirements.

(a) Monitoring reports. Monitoring results shall be reported on a Discharge Monitoring Report (DMR) at the intervals specified elsewhere in the permit. Ifthe permittee monitors any pollutant more frequently than required by the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.

(b) Compliance schedules. Reports of compliance or non-compliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of the permit shall be submitted no later than 14 days following each schedule date.

(c) Planned changes. The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility or activity which could significantly change the nature or increase the quantity of pollutants discharged. Unless and until the permit is modified, any new or increased discharge in excess of permit limits or not specifically authorized by the permit constitutes a violation.

(d) Anticipated non-compliance. The perrnittee shall give advance notice to the Deparlment of any planned changes in the permitted facility or activity which may result in non-compliance with permit requirements.

(e) 24 hour reporting. The permittee shall report any non-compliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the non-compliance, including exact dates and times, and if the non-compliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the non-compliance. The following shall be included as information which must be reported within 24 hours:

1. . Any unanticipated bypass which exceeds any effluent limitation in the permit.
2. Violation of a maximum daily discharge limitation for any of the pollutants listed by the Department in the permit to be reported within 24 hours.

(f) Other non-compliance. The pennittee shall report all instances of non-compliance not reported under 314 CMR 5.16(20) (a), (b), or (e) at the time monitoring reports are submitted. The reports shall contain the information listed in 314 CMR 5.16(20) (e).

(g) Toxics. All manufacturing, commercial, mining, or silvicultural dischargers must notify the Department as soon as they know or have reason to believe:

1. That any activity has occurred or wi ll occur which would result in the discharge of any toxic pollutant listed in 314 CMR 3.17 which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:

a. 100 micrograms per liter (l00 ug/l);

b. 200 micrograms per liter (200 ug/l) for acrolein and acrylonitrile; 500 micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6- dinitrophenol; and one milligram per liter (1 mg/l) for antimony;

c. Five times the maximum concentration value reported for that pollutant in the permit application; or

2. That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application.

(h) Indirect dischargers. All Publicly Owned Treatment Works shall provide adequate notice to the Department of the following:

1. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to § 301 or 306 of the Federal Act, 33 U.S.C. § 1311 or 1316, if it were directly discharging those pollutants; and

2. Any substantial change in the volume or character of pollutants being introduced into the POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

(i) Information. Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information.

(21) Signatory requirement. All applications, reports, or information submitted to the Department shall be signed and certified in accordance with 314 CMR 3.15 and 5.14.

(22) Severability. The provisions of the permit are severable, and if any provision of the permit, or the application of any provision of the permit to any circumstance, is held invalid, the application of such provision to other circmnstances, and the remainder of the permit, shall not be affected thereby.

(23) Reopener clause. The Department reserves the right to make appropriate revisions to the permit in order to establish any appropriate effluent limitations, schedules of compliance, or other provisions which may be authorized under the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53 or the Federal Act, 33 U.S.C. §1251 *et seq* in order to bring all discharges into compliance with said statutes.

(24) Approval of treatment works. All discharges and associated treatment works authorized herein shall be consistent with the terms and conditions of this permit. Any modification to the approved treatment works shall require written approval of the Department prior to the construction of the modification.

(25) Transfer of Permits.

(a) RCRA facilities. Any permit which authorizes the operation of a RCRA facility which is subject to the requirements of 314 CMR 8.07 shall be valid only for the person to whom it is issued and may not be transferred.

(b) Transfers by modification. Except as provided in 314 CMR 5.16(25)(a) and (c), a permit may be transferred by the permittee to a new owner or operator provided that the permit has been modified or revoked and reissued or a minor modification is made to

identify the new permittee in accordance with 314 CMR 5.12(3) and (4).
(c) Automatic transfers. For facilities other than Privately Owned Wastewater Treatment Facilities (PWTFs) that treat at least some sewage from residential uses, hospitals, nursing or personal care facilities, residential care facilities, and/or assisted living facilities, PWTFs that have been required to establish financial assurance mechanism(s) pursuant to 314 CMR 5.15(6), and RCRA facilities subject to the requirements of 314 CMR 8.07, a permit may be automatically transferred in accordance with 314 CMR 5.12(5).

(26) Permit Compliance Fees and Inspection Information.Except as otherwise provided, any perminee required to obtain a surface water or ground water discharge permit pursuant to M.G.L. c. 21, §43 and 314 CMR 3.00 and 5.00, shall be required to submit the annual compliance assurance fee established in accordance with M.G.L. c. 21A, § 18 and 310 CMR 4.00 as provided in 314 CMR 2.12. The requirement to submit the annual compliance fee does not apply to any local government unit other than an authority. Any permittee required to obtain a surface water or ground water discharge permit pursuant to M.G.L. c. 21, §43 and 314 CMR 3.00 and 5.1 may be required to submit inspection information annually as a condition of the permit as provided in 314 CMR 2.12.

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

April 17, 2012

Joseph March, P.E.
Stamski and McNary, Inc.
1000 Main Street
Acton, MA 01720

Re: Carlisle
Banta-Davis Housing Study
GW Discharge Permitting

Dear Mr. March:

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed your letter dated April 5, 2012, requesting MassDEP input on issues related to use of available capacity at the wastewater treatment facility currently owned and operated by the Carlisle Public School System. This matter was also the subject of a meeting at MassDEP on April 6, 2012.

Based on historical flow records, the Town has indicated that the Carlisle Public School wastewater treatment plant has extensive additional capacity under the terms and conditions of the associated MassDEP groundwater discharge permit, permit no. 783 issued on August 21, 2009. The permit has a flow limit of 13,500 gallons per day (gpd). In support of this position, Stamski and McNary, on behalf of the Town, provided the following information:

- Documentation of Existing Flows: Stamski and McNary provided documentation of existing discharge flows at the Carlisle Public School WWTP, including average day flows, average day flows for periods when school is session, and peak day flows from each month.
- Future Projection for School Enrollment: Information was provided on the number of current students and staff, and projections of student populations over the next 8 years, which indicates that the school enrollment is continuing to decline, and remains well under the enrollment numbers used in the design for the facility.

- Equalization Tank: The letter indicates that the design of the WWTP includes a 7,000 gallon Flow Equalization Tank, which can be operated to address both low flow and peak flow conditions for existing and future connections to the WWTP.

The Town provided a flow balance for the plant, based on the documentation of existing flows, and the estimated flows from the proposed connection of the public library, and the proposed affordable housing project being advanced by the Town. Flows from the library are based on applying a peaking factor of 200% to existing average daily flows. Flows from the proposed affordable housing project are based on the estimate of 110 gpd/bedroom, in accordance with the requirements of 310 CMR 15.000. The development of flow estimates for the library and proposed housing development are consistent with MassDEP regulations.

In regard to the calculation of available capacity at the existing Carlisle Public School WWTP, the critical issue is to develop a reasonable estimate of existing peak flows, since the flow limit of 13,500 gpd in the permit is a maximum day flow, and not based on average daily flows. MassDEP typically renders these determinations on a case-by-case basis, based on a number of factors, such as occupancy status, treatment plant conditions, factors influencing peak flows (e.g. infiltration/inflow), and any other issues relevant to establishing representative peak flows. Based on the information provided by the Town for the Carlisle Public School WWTP, MassDEP has determined that use of an average of the peak day flow each month, during the periods when school is session, is an appropriate method for determining peak flows, and thus available capacity at the WWTP. From the information provided, the peak flows allotted to the Carlisle Public School flows was determined to be 4,324 gallons per day, which reflects the average of the maximum day flows for all months except July and August, for the year 2011. This determination is made contingent on the following conditions:

1. Further Flow Documentation: Since the housing project may not be implemented for a number of years, updated average day and peak flow information for flow to Carlisle Public School WWTP will be needed to incorporate up to date data to support establishing peak flows in the future.

2. BRP WP 68 Permit Application: The Town, through the permittee, the Carlisle Public School District, will need to file a BRP WP 68 application for modification of existing groundwater treatment facilities. An approval must be issued by MassDEP under this category for connection of new collection system facilities and wastewater flows before any new facilities can be connected to the Carlisle Public School treatment works. As an element of this review, the Town will be required to document that the treatment works are in satisfactory operating condition to accept and treat the new flows under the terms and conditions of the

groundwater discharge permit, and that the existing peak flows and estimated new flows are properly developed as noted above.

MassDEP trusts that this information satisfies the Town's request for guidance on this matter. If you have further questions, please contact Kevin Brander at (978) 694-3236.

Sincerely,

Eric Worrall
Deputy Regional Director
Bureau of Resource Protection

Cc:

Greg Peterson, Banta Davis Task Force
Marybeth Chubb, DEP/Boston/BRP
David Flannery, Carlisle Public Schools

Appendix C

Water Budget

1. Zone 1
   a. Design Flow — 14,290 gpd (Based on Tille 5)
   b. Radius — 273 ft [(150 x log 14,290) - 350] (from DEP Guidance)
   c. Area — 234,458 ft^2
      5.4 acres
   d. Annual Precipitation — 45 inches (Natural Weather Service)
   e. Annual Evapotranspiration & Runoff — 25 inches (See attached maps & publications)
   f. Annual Recharge — 20 inches (d-e)
   g. Annual Recharge in Zone 1 — 2.9 million gallons
      = 8,029 gpd
   h. Average Withdrawal (5,670 gpd) based on water conservation
   i. Withdrawals will not stress water resources
   j. Annual Recharge on entire 43 acre (Banta-Davis and 338 Bedford Road) equals 64,150 gpd

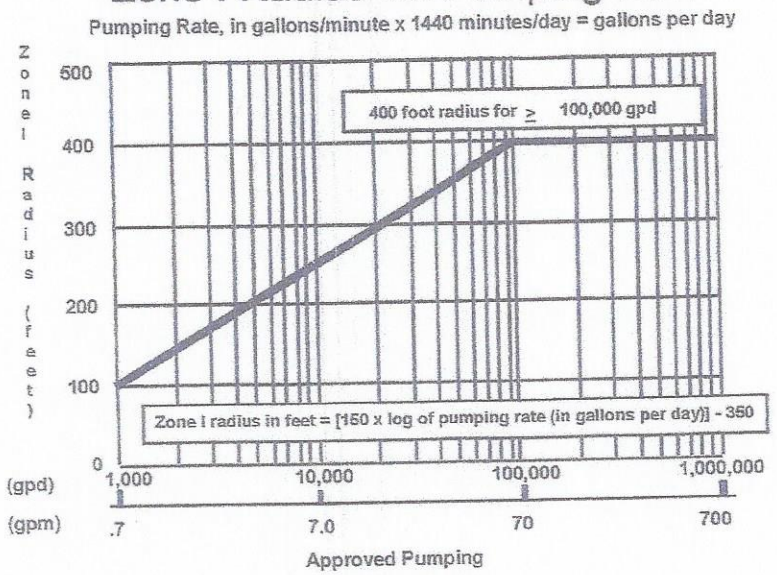
2. IWPA
   a. Design Flow — 14,290 gpd (9.9gpm)
   b. Radius — 718 ft [(10.7gpm) 32 + 400] (from DEP Guidance)
   c. Area — = 37 Acres

3. Water Conservation
   a. Water Efficiency Data (See Attached)
   b. LEED Requirements (See Attached)

4. Local Well Data, Rodgers Road (See Attached)

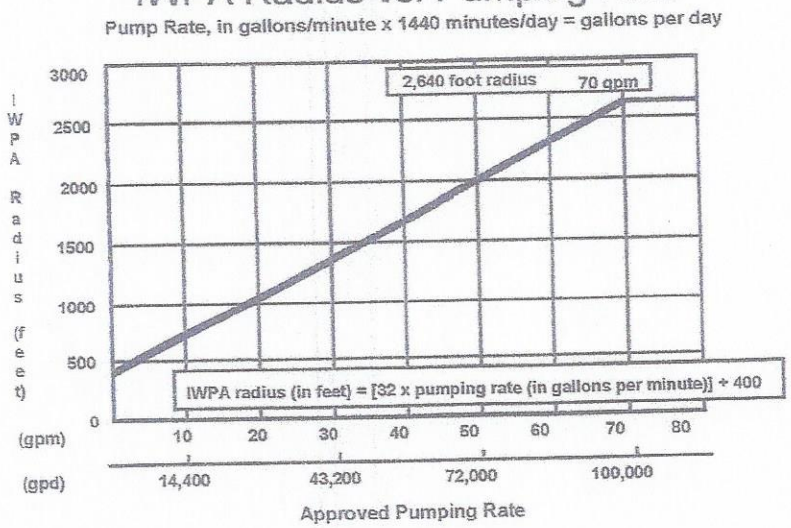
Appendix D

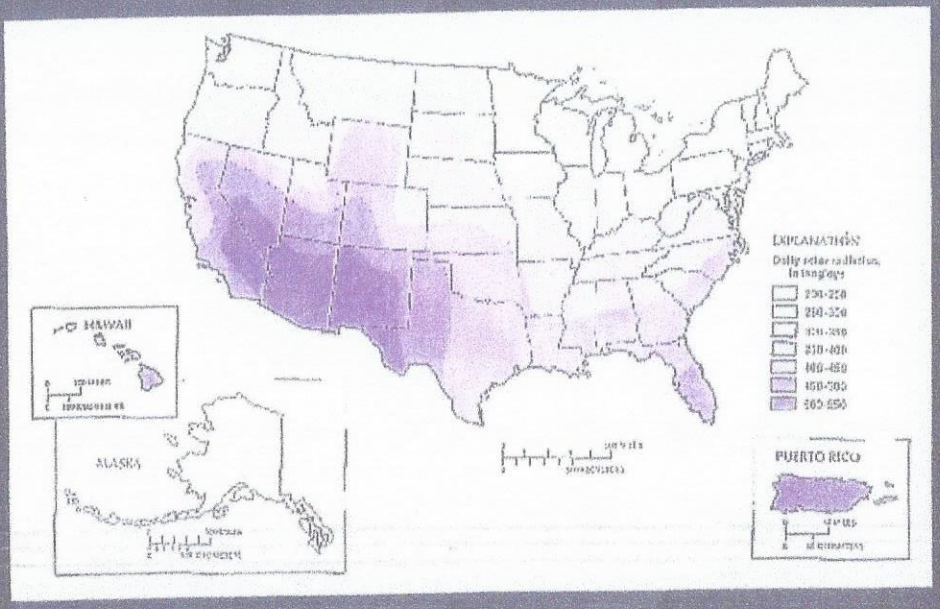
Zone I Radius vs. Pumping Rate



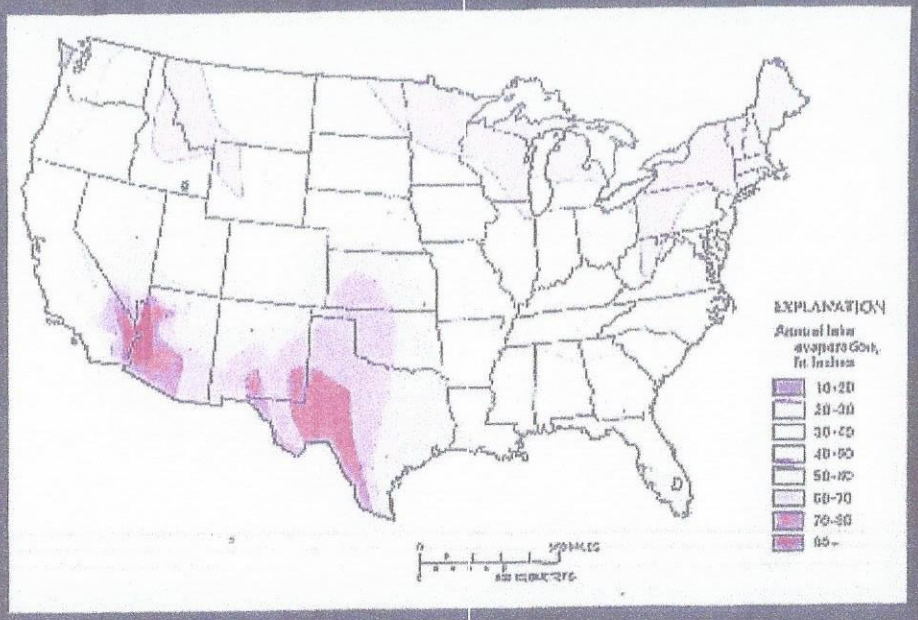
A minimum Zone I radius of 100 feet shall be applied to all groundwater sources with Approved Yields of 1,000 gallons per day or less.

IWPA Radius vs. Pumping Rate

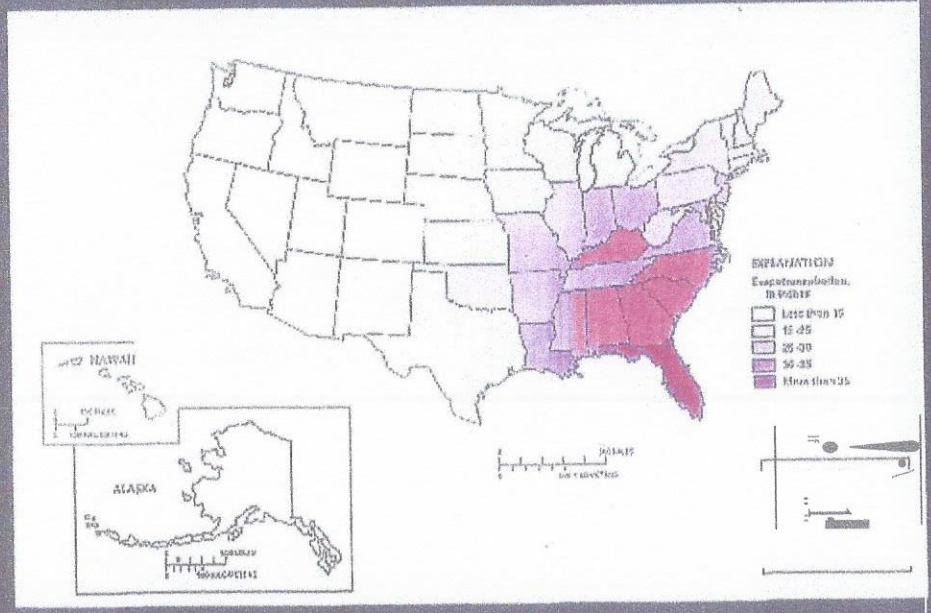




Mean daily solar radiation



Mean annual lake evaporation



Mean annual ET

the inflows, outflows, changes in storage, movement ohvater in the system, and possibly other important features. As a mathematical representation of the system, the model can be used to estimate the response of the system to various development options and provide insight into appropriate management strategies. However, a computer model is a simplified representation of the actual system, and the judgment of water-management professionals is required to evaluate model simulation results and plan appropriate actions. We return to the use of models in the final chapter of this report, "Meeting the Challenges of Ground-Water Sustainability."

f/ecau :<te a1 ly use of ground water changes the subsurface and mr.fac:e environment (that is.the water mu'>! come from :<iomcw!tcre), the public s/wulll determine the tradeoff between ground-water use and change:; to the e11viro11me111 and <;et a thresltold for what level t!f change hewme:<; undesirahlc.

Field Examples of How Ground-Water Systems Change in Response to Pumping

LONG ISLAND, NEW YORK

Long Island is bounded on the north by Long Island Sound, on the east and south by the Atlantic Ocean, and on the west by New York Bay and the East River. Long Island is divided into four counties-• Kings, Queens, Nassau, and Suffolk. The nvo western counties, Kings and Queens, are part of New Y0 lk City.

Precipitation that infiltrates and percolates to the water table is Long Island's only natural source of freshwater because the ground-water system is bounded on the bottom by relatively impenneable bedrock and on the sides by saline ground water or saline bays and the ocean (Figure 9). About one-half the precipitation becomes recharge to the ground-water system; the rest flows as surface runoff to streams or is lost through evapotranspiration (Cohen and others, 1968). Much of the precipitation that reaches the uppennost unconfined aquifer moves laterally and discharges to streams and surrounding sal1vater bodies; the remainder seeps downward to recharge the deeper aquifers. Water enters these deeper aquifers very slowly in areas where confining units are present but enters freely in other areas where confming units are absent. Water in the deeper aquifers also moves seaward and eventually seeps into overlying aquifers. Predevelopment \Vater budgets for most of Nassau and Suffolk Counties on Long Island are shmvn in Figure 9.

Over the past three centuries, the island's ground water has been developed through three distinct phases. In the first, which began \Vith the arrival of European settlers in the mid-17th century, virtually every house had its own shallow well, which tapped the uppermost unconsolidated geologic deposits, and also had its Own cesspool, which returned wastewater to these same deposits. Because population was sparse, this mode of operation had little effect on the quantity and quality of shallow ground water. During the next two centuries, the population increased steadily, and, by the end of the 19th century, the individual wells in some areas had been abandoned in favor of shallow public-supply wells.

The second phase began with the rapid population growth and urban development that occurred during the first half of the 20th century. The high permeability of Long Island's deposits encouraged the widespread use of domestic wastewater-disposal systems, and the contamination resulting from increased wastewater discharge led to the eventual abandonment of many domestic wells and shallow public-supply wells in favor of deeper, high-capacity wells. In general, pumping these deep wells had only a small effect on the quantity of shallow ground water and related surface-water systems because most of the water was returned to the ground-water reservoir through domestic wastewater-disposal systems.

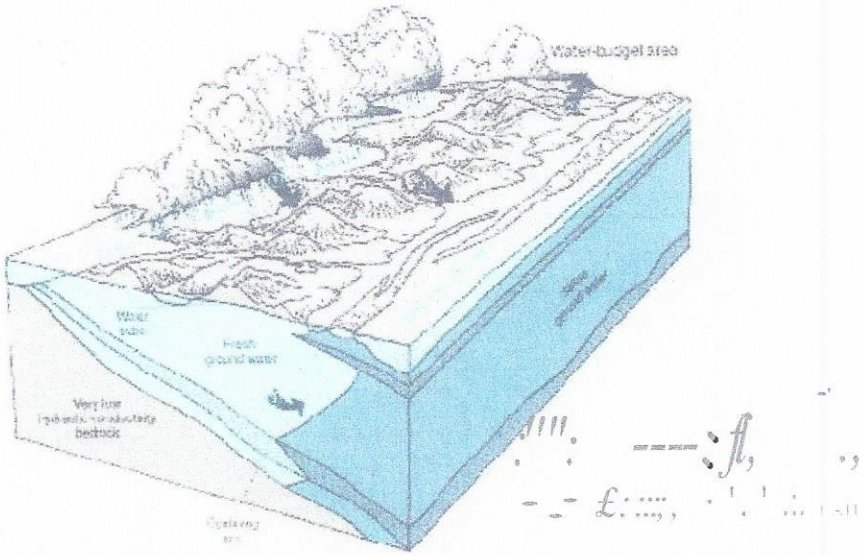


Figure 9. Ground-water budget for part of Nassau and Suffolk Counties, Long Island, New York (Modified from Cohen and others, 1968-)

Block diagram of Long Island, New York, and tables listing the overall water budget and ground-water budget under predevelopment conditions. Both water budgets assume equilibrium conditions with little or no change in

A comparison of recharge rates in aquifers of the United States based on groundwater-age data

P. B. McMahon · L. N. Plummer · J. K. Bohlke · S. D. Shapiro • S. R. Hinkle

Abstract An overview is presented of existing ground• water-age data and their implications for assessing rates and timescales of recharge in selected unconfined aquifer systems of the United States. Apparent age distributions in aquifers determined from chlorofluorocarbon, sulfur hexafluoride, tritium/helium-3, andradiocarbon measurements from 565 wells in 45 networl<s were used to calculate groundwater recharge rates. Timescales of recharge were defined by 1,873 distiibuted tritium measurements and 102 radiocarbon measurements from 27 well netwotks. Recharge rates ranged from<10 to 1,200mm/yr in selected aquifers on the basis of measured vertical age distributions and assuming exponential age gradients. On a regional basis, recharge rates based on tracers of young grmmdwaier exhibite<l a significant inverse correlation with mean annual air temperature and a significant positive correlation with mean annual precipitation. Comparison of recharge derived from groundwater ages with recharge detived from stream base-flow evaluation showed similar overall patterns but substantial local differences. Results from this compilation demonstrate that age-based recharge estimates can provide useful insights into spatial and temporal variability in recharge at a national scale and factors controlling thatvariability. Local age-base<l recharge estin late-S provide empirical data and process information that are needed for testing and improving more spatially complete model-based methods.

Keywords Groundwater age · Grom1dwaterrecharge/ water budget · USA

Received: 16 July 2010 /Accepted: 2 March 2011
Published online: 8 April 2011

Electronic supplementary material Tue online version of this article (doi: 10.1007/sl0040-01!-0722-5) contains supplementary material , which is available to authorized users_

P_ B. McMahon (!8:i)
US Geological Survey, Mail Stop 415, Denver, CO 80225, USA e-mail: pmcmahon @usgs.gov
Tel.: +303-236-4882

L. N_ Plummer · 1 K. Bohlke· S. D. Shapiro
US Geological Survey,
12201 Sunrise Valley Dr., Reston, 20192, VA, USA

S. R. Hinkle
US Geological Survey,
2130 SW 5th Ave., Portland, 97201, OR, USA

Introduction

Well-constrained water budgets are needed to assess groundwater availability and manage aquifers sustaiuably throughout the world (Healy et al. 2007; Reilly et al. 2008). Recharge is perhaps the most difficult water-budget component to quantify because of its spatial and temporal variability (Tyler et al. 1996; Wolock 2003; Scanlon et al. 2006; Crosbie et aL 2010). Several tools, including environmental tracers of groundwater age, are available for quantifying recharge and each has advantages and limitations (see review by Scanlon et aL 2002). Ground• water-age distributions giving vertical grom ldwater velocities provide relatively direct measure-s of recharge (Solomon and Sudicky 1991), whereas many other techniques for estimating recharge such as environmental and applied tracers in the unsaturated zone, numerical hydraulic modeling, water-table fluctuations, stream base-flow separation, and vaiious other types of water-budget analyses, are relatively indirect measures of recharge. Groundwater ages also define time• scales of recharge processes that could be used as relative measures of aquifer sustainability (Darling et al. 1997; Douglas et al 2007; Bethke and Johnson 2008; Gates et al. 2008) or aquifer susceptibility (Bohlke 2002; Manning et al. 2005; Osenbriick et al. 2006; Burow et al. 2007; McMahon et al. 2008a). The interpretation of environmental-tracer data can be complicated by processes that affect tracer concen• trations in recharge and groundwater along flow paths such as degradation, contamination, sorption, degassing, mixing, gas and water transport in thick unsaturated zones, rock-water interactions, and a decline or variability in atmospheric concentrations of tracers (Solomon and Cook 2000 : Kalin 2000; International Atomic Energy Agency 2006). A further limitation is the lack of readily available methods for measuring groundwater ages between about 50 and

DOI 10.1007/s10040-011-0722-5

Table 1 Rechargi;; rates bast:d on gruundw:ll1;r-age data from st:leded nt:slt:d-wd l networks in unconfined aquifers. Map n:fi::renct: numbers rdi::r to Fig. 1. St:e Tab lt: f'.SM I for appart:nt ages and snppor1ing inf01mation. *JL4P* mean annual precipitation, 1971-2000; National Climatic Data Center 2010

Map reference number	Principal aquifer system	General land use[a]	Age tracer	Recharge rate[b] (mm/yr)	Recharge as percentage of MAP	Mean residence time (yr)	Data source
1	Alluvium	2	CFC	620	64[c]	7	McMahon and Bohlke 19%
2	Ci:ntral Valley	2	CFC	580	52[c]	39	Burow et al. 1999, 2007
3	Central Vnlley	2	SF_{6}, CFC	420	28[c]	28	Green et al. 2008a, b
4	Glucial Deposits (ct1stern glaciakd region)	1	SFr.. CFC, $^{3}H/^{3}He$	470	38	24	Bohlke et al. 2009
5	Glacial Deposits (eastern glaciated region)	3	$^{3}H/3He$	'-1·2"	56	17	Solomon et :11. J 995
6	Glacial Deposits (eastern glaciated region)	3	$^{3}H!3J$-le	520 *l.tJ.*	44	13	Mullaney and Grady 1997
7	Glacial Deposits (central glaciated region)	3	H/ He	750	75	23	Shapiro et al. J 998
8	Glacial Deposits (central glaciated region)	3	$^{3}H/3He$, SF6	170	22	62	USGS unpublished data; Thomas 2000
9	Glai.;ial Deposits (i.;entral glaciated region)	I	CFC	95-180	14-27	40-76	Puckett et al. 2002; Puchtt and Cowdery 2002
10	Glacial Deposits (central glaciated region)	I	CFC	230	34	17	Delin ct al. 2000; Bohlke et al. 2002
11	Glacinl Deposits (central glaciated region)	I	CFC	120	18	38	Delin et al. 2000; Bohlke et al. 2002
12	Glacial Deposits (central glaciated region)	1	SF_{6}, CFC	72	9.5	180	Green et al. 2008a, b
13	High Plains (northern)	3	SFr,, CFC	100--160	14-23	42-68	Landon et al. 2008
14	High Pl1tins (northern)	5	^{14c}	20	3.9	2,700	McMahon et al. 2007
15	High Plains (northern)	2	$^{3}H!3He$	380-1.200	-	6-20	Bohlke et al. 2007a
16	High Plains (central)	5	I4C	7	1.4	3.800	McMnhon et al. 2004n
17	Northern Atlantic Coastal Plain	1	CFC	100	8.3	33	Tesoriero et al. 2005, 2007
18	Northern Atlantic Coastal Plain	1	SF_{6}, CFC	270	24	13	Lindsey et al. 2003
19	Northern Atlantic Coastal Plain	1,4	CFC	64	5.6	39	Bohl ke et al. 2007b
							Denver 1995
21	Northern Atlantic Coastal Plain	I	SFr, CFC	270	24	22	Green et al. 2008a, b
22	Northern Atlantic Coastal Phiin	3	$^{3}H/'$:lHe	400	35	31	Szabo et al. 1996; Stai.:kelberg et al. 2000; Kautfuian et al. 200 I
23	Pucifit.: Northwest basin till	2	SF_{6}, CFC	200	21[c]	190	Green d al. 2008a, b
24	Pacific Nmthwest basin fill	6	CFC	54	18	210	Hinklt: t:t al. 2007
25	Puget-Willamette Lowland	I	$^{3}H/3$lJe	650	56	12	Wassenaar et al. 2006
26	Puget-Willamdk Lowhind	3		290	31	80	Hinkle 2009
	front, Albuquerque vicinity)						
28	Rio Grande (eastern motmtain front, south of Tijeras Arroyo)	5	J 4c	2d	0.3	-	Plummer et al. 2004
29	Surlicial	I	CFC	150	13	26	Puckett and Hughes 2005

[a] *1* pn::cipitation-dominakd agrii.;nlture; *2* irrigation-domi mited agric l 11t lrt:; *3* n;sidential/commen;ial; *4* forest; 5 rungeland: *6* rnrnl rt:sidt:ntial

[b] Culculati:d usjng Eq. (1), except where noted

[c] Mean annual precipittition pins applied irrigation water. Amounts of applied i1Tigation water from the indicated references

[d] Assumes linear agti grndient

Water Conservation

WATER CONSERVATION STANDARDS

D) Tables and Figures

Table 1. Average indoor water use in nonconserving and conserving North American single-family homes.

Water Use Type	Nonconserving Home*	Conserving Home 2001*	Conserving Home 2005**	Nonconserving Home	Conserving Home 2001	Conserving Home 2005
Units	*Average gpcd*	*Average QJJCd*	*Average QJJCd*	*Percent of total*	*Percent of total*	*Percent of total*
Dishwasher	1	0.7	0.7	1.4%	1.5%	1.9%
Baths	1.2	1.2	1.2	1.7%	2.7%	3.3%
Leaks	9.5	4	4.0	13.7%	8.8%	11.0%
Faucets	J 0.9	10.8	10.8	15.7%	23.9%	29.8%
Showers	11.6	8.8	7.0	16.8%	19.5%	19.4%
Clothes Washer	15	10	5.2	21.7%	22.1%	14.3%
Toilets	18.5	8.2	5.6	26.7%	18.0%	15.6%
Other Domestic	1.6	1.6	1.6	2.2%	3.4%	4.4%
TOTAL	**69.31mcd**	**45.2 •med**	**36.2imcd**	**100%**	**100%**	**100%**

**Source: Vickers, 2001 (Adaptedfrom Mayer et al, 1999)*

***Substituting 1.1 gpf High Efficiency Toilets, a 14 gpl front-load washing machine, and 2.0 gpm showerheads for Vickers' J. 6gpf toilets, 27 gpl washing machine and 2.5 gpm showerheads*
gpcd = gallons per capita daily, gpf=gallons per flush, gpl=gallons per load, and gpm=gallons per minute

Table 2. Federal and Massachusetts maximum water-use requirements for plumbing fixtures and selected anoll ances

Fixture or Appliance	Conservation Standard	Reference
Toilet, gravity tank	1.6 gpf	U.S. Energy Policy Act, 1992 (EPAct), MA Plumbing Code
Urinals, any type	1.0 gpf	EPAct, MA Plumbing Code
Shower heads, any type (except those used for safety reasons)	2.5 gpm (at 80 psi) or 2.2 gpm (at 60 psi)	EPAct, MA Plumbing Code
Lavatory faucets and replacement aerators	2.5 gpm (at 80 psi) or 2.2 gpm (at 60 psi)	EPAct, MA Plumbing Code
Kitchen faucets and replacement aerators		EPAct, MA Plumbing Code
Dishwashers	4.5 gpl	National Appliance Energy Conservation Act, Vickers
Clotheswashers	Water Factor of 9 or less, 27 gpl	National Appliance Energy Conservation Act, Vickers

gpf = gallons per flush
psi = pounds per square inch
gpl = gallons per load
gpm = gallons per minute
gpc =gallons per cycle
Water Factor = a measure of the gallons of water used per cycle per cubic foot
Source: Adapted from Vickers, 2001

WE Credit 3: Water Use Redution

2-4 Points

Intent

To further increase water efficiency within *uildings to reduce the burden on municipal water supply and wastewater systems.

Requirements

Employ strategies that in aggregate use less rater than the water use baseline calculated for the building (not including irrigation). The minimum water svings percentage for each point threshold is as follows:

Percentage Reduction	Points
30%	2
35%	3
40%	4

Calculate the baseline according to the commercial and/or residential baselines outlined below.' Calculations are based on estimated occupant usage and must include onlythe following fixrures and fixture fittings (as applicable to the project scope): water closets, urinals, lavatory faucets, showers, kitchen sink faucets and pre-linse sprayvalves.

Commercial Fixtures, Fittings, and Appliances	Current Baseline (Imperial Units)	Current Baseline (Metric units)
Commercial toilets	1.6 gallons per flush (gpf)* Except bfow--Out fixtures: 3.5 (gpf)	6 liters per flush (!pf) Except blow--0ut fixtures: 13 lpf
Commercial urinals	1.0(gpt)	4 lpf
Commercial lavatory (restroom) faucets	2.2 gallons per minute (gpm) at 60 pounds per square inch (psi), private applications only (hotel or motlguest rooms, hospital patient rooms) 0.5 (gdml at 60 (psi)** all others except private applications 0.25 g?llons per cycle for metering faucets	8.5 liters per minute (!pm) at 4 bar (58 psil, private applications only (hotel or motel guest rooms, hospital patient rooms) 2.0 !pm at 4 bar (58 psil. all others except private applications lliter per cycle for metering faucets
Showerheads	2.5 (gpm) at 80 (psi) per shower stall '***	9.5 lpm at 5.5 bar (80 psi)
For projects with commercial pre-rinse spray valves, the flow rate must comply with the ASME Al 12.18.lstandard of 1.6 gpm (6 lpm) or less.		

Residential Fixtures, Fittings, and Appliances	Current Baseline (Imperial units)	Current Baseline {Metric units)
Residentiaf toilets	1.6 (gP,f)'**	6.1 liters per flush (!pf)
Residential lavatory (bathroom) faucets	2.2 CgP,ml at 60 psi	8.5 !pm at 4 bar (58 psi)
Residential kitchen faucet		
Residential showerheads	2.5 (gRml at 80 {psi) per shower staw•• *	9.5 lpm at 5.5 bar (80 psi) per shower stall

Residential Fixtures, Fittings, and Appliances	Current Baseline (Imperial units)	Current Baseline (Metric units)

EPAct 1992 standard for toilets app ies to both commercial and residential models.

** Inaddition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (2.0 lpm at 4 bar (58 psi)) (ASME All2.18.1-Z005). This maximum has been incorporat!>d into the national Uniform Plumbing Code and the International Plumbing Code.

'" EPAct 1992 standard for toilets applies to both commercial and residential models.

....Residential shower compartment (stall) in dwelling units, The total allowable ilow rare from all flowing showerheads at any given time, including rain systems, waterfalls, bodysprays, bodyspas and jets, muse be limited to the allowable showerhead flow rate as specified above (2.5 gpm/9.5 lpm) per shower compartment, where the floor area of the shower compartment is less than 2,500 square inches (1.5 square meters). For each increment of 2,500 square inches 11.5 square meters) of floor area thereafter or part thereof, an additional showerhead with total anowable flow rzte from alt flowing devices equal to or less than the allowable :low rate as specified above must be allacted. Exception: Showers that emit recircuiated nonpatable water originating from within the shower compartment while operating are allowed to exceed the maximum as long as the total potable water flow does not exceed the flow rate as specified above.

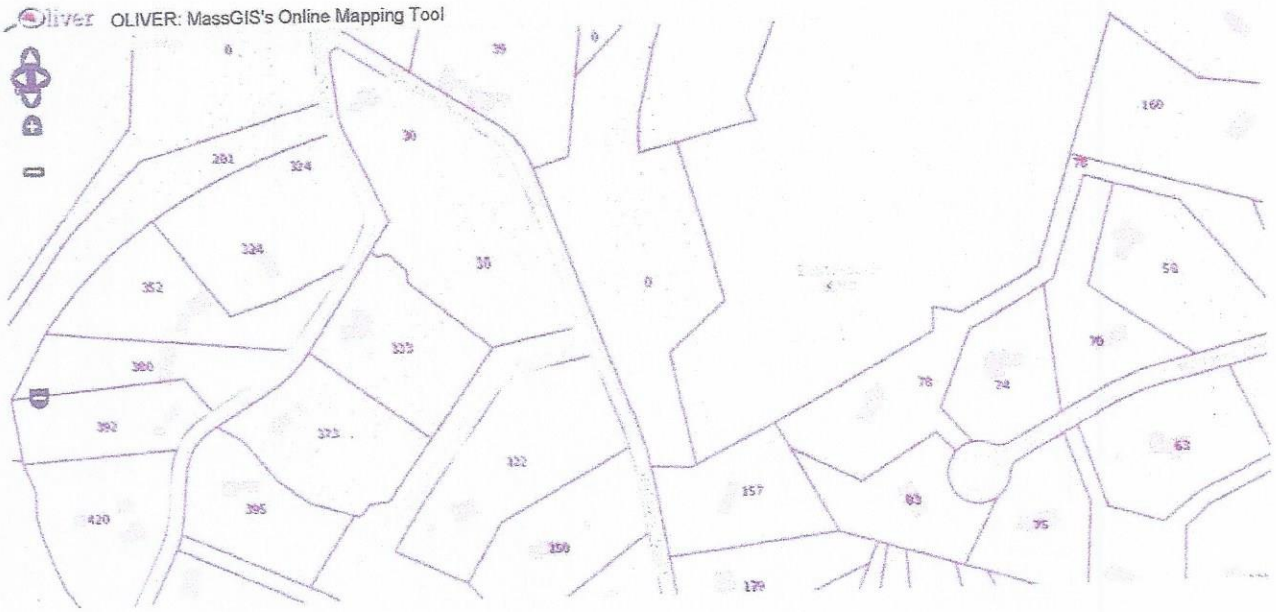
The following fixtures, fittings and appliances are outside the scope of the water use reduction calculation:

- Commercial Steam Cookers
- Commercial Dishwashers
- Automatic Commercial Ice Makers
- Commercial (family-sized) Clothes Washers
- Residential Clothes Washers
- Standard and Compact Residential Dishwashers

Potential Technologies & Strategies

Use WaterSense-certified fixtures and fixture fittings where available. Use high-efficiency fixtures (e.g., water closets and urinals) and dry fixtures, such as toilets attached to composting systems, to reduce the potable water demand. Consider using alternative on-site sources of water (e.g., rainwater, storm water, and air conditioner condensate, gray water) for nonpotable applications (e.g., toilet and urinal flushing, custodial uses). The quality of any alternative source of water being used must be taken into consideration based on its application or use.

Local Well Data



Rodgers Rd. Carlisle MA.

LOT LOCATION

70 Rodgers Rd

Town of Carlisle

MASSACHUSETTS 01741

PD. CK# 10515

Office of

BOARD OF HEALTH

Permit No. 8707 70 Rogers Fee 50—

APPLICATION FOR WELL PERMIT

Application is hereby made for a permit to drill (✓) or repair ( ) a well.

Location: Address #15 ROGERS RD. Lot No. 15

Owner C+D ASSOC. BLD.

Owner's Address ROBIN WOOD RD. Acton

Well Contractor E.R. SULLIVAN INC. License No. 173

Contractor's Address BOLTON MA. 01740

WELL CONTRACTOR (To be filled in at time of pump test.)

Type of Well ARTESIAN Well Used For DOMESTIC

Diameter of Well 6" Size of Casting 6 5/8 SCHED. 40

Depth of Bed Rock 29 Ft. Depth of Casing into Bed Rock 14 Ft.

Was Seal Tested? Yes (✓) No ( ) Date of Testing 3/3/87

Depth of Well 225 Ft. Well ended in what material? LEDGE

Depth to Water 12 Ft. Delivers 20 GPM

Drawdown _____ Feet After Pumping _____ Hours at _____ GPM

Sketch a map of the well location with tie down lines from building on the back of this form.

Date of Completion 3/3/87

_____ E.R. Sullivan INC.

Health Inspector's Signature Well Company's Signature

Town of Carlisle 74 Rodgers Rd.

MASSACHUSETTS 01741

Office of
BOARD OF HEALTH

APPLICATION FOR WELL PERMIT

Fee $50.00

Permit No._____ $50. Fee Paid_____

Application is hereby made for a permit to drill ( ) or repair ( ) a well.

Location: Address LOT 14 RODGRS RD Lot Number 14

Owner/Developer: JIM MARCHANT

Address:_____ Tel:_____

Well Driller: ER SULLIVAN

Type of Well: 6" ROCK Well used for:_____

Depth to Bedrock:_____ Cased Depth:_____

Drilled Depth: 425' Static Water Level:_____

Well Ended in What Material:_____

Grouted/Sealed:_____ Yield:_____ G.P.M.

Change of well location from that shown on an approved Septic Design Plan must have prior approval of the Board of Health or its Agent and be noted on the plan.

Date of Completion_____ Inspection Signoff:_____
Board of Health Agent

****

APPLICATION FOR PUMP PERMIT

Fee $50.00 #1662

Permit No: 1093 $50. Fee Paid:_____

Pump Installer: NEED PUMP CO.

Size and name of pump: 3/4 HP Jacuzzi Size of Tank:_____

Depth of Pump: 300 feet.

Results of flow test: 12328 (Hart Miller) 14501 (Sprinkler)

Drawdown 280' feet after pumping 5 hours at 7 G.P.M.

Date of Completion:_____ Inspection Signoff: James Dawe
Board of Health Agent

Revised 3/31/87

78 Rodgers Rd Lot 29

Town of Carlisle

MASSACHUSETTS 01741

Office of

BOARD OF HEALTH

√W8712

Permit No. 87 (Ellie took ck)

Fee 50 —

APPLICATION FOR WELL PERMIT

Application is hereby made for a permit to drill (X) or repair ( ) a well.

Location: Address #13 Rogers Rd. Lot No. L3

Owner C.D Assoc. Bld.

Owner's Address 3 Robinwood Rd Acton

Well Contractor E.R. Sullivan Inc License No. 4173

Contractor's Address Bolton MASS

WELL CONTRACTOR (To be filled in at time of pump test.)

Type of Well ARTEISIAN Well Used For Domestic

Diameter of Well 6" Size of Casting 6 5/8 sch 40

Depth of Bed Rock 25 Ft Depth of Casing into Bed Rock 16 Ft.

Was Seal Tested? Yes (X) No ( ) Date of Testing MAY 4 1987

Depth of Well 145 Ft. Well ended in what material? LEDGE

Depth to Water 10 Ft. Delivers 50 GPM

Drawdown _____ Feet After Pumping _____ Hours at _____ GPM

Sketch a map of the well location with tie down lines from building on the back of this form.

Date of Completion MAY 4/87

_____ E.R. Sullivan INC.

Health Inspector's Signature Well Company's Signature

83 Rod gravel 3/4/87

Town of Carlisle ~~Boards~~

MASSACHUSETTS 01741

Office of

BOARD OF HEALTH

Permit No. 8708 Fee 50 —

APPLICATION FOR WELL PERMIT

Application is hereby made for a permit to drill (✓) or repair ( ) a well.

Location: Address #12 Rogers Lot No. 12

Owner MET TRUST Development Inc.

Owner's Address 329 Boston Post Rd. Sudbury

Well Contractor E.R. Sullivan Inc. License No. 125

Contractor's Address Bolton MA

WELL CONTRACTOR (To be filled in at time of pump test.)

Type of Well ARTESIAN Well Used For DOMESTIC

Diameter of Well 6" Size of Casting 6" SCHED. 40

Depth of Bed Rock 27 Ft. Depth of Casing into Bed Rock 14 Ft.

Was Seal Tested? Yes (✓) No ( ) Date of Testing 3/5/87

Depth of Well 125 Ft. Well ended in what material? LEDGE

Depth to Water 20 Ft. Delivers 35 GPM

Drawdown _____ Feet After Pumping _____ Hours at _____ GPM

Sketch a map of the well location with tie down lines from building on the back of this form.

Date of Completion 3/5/87

James A. Davis
Health Inspector's Signature

E. R. Sullivan Inc.
Well Company's Signature

Nashoba Analytical, LLC Tel: 978-391-4428 Fax: 978-391-4643
31A Willow Road, Ayer MA 01432 Website: http://www.NashobaAnalytical.com

LabNumber: **114251**

Use this number with all correspondence

Client:

Carlisle Board of Health Town of Carlisle

66 Westford Street

Carlisle, MA 01741

ReportDate: 6/21/2010

RECEIVED JUN 24 2010

BOARD OF HEALTH CARLISLE

Certificate of Analysis

David & Sara Dolin

- Sample Tap

Sampled: 6/5/2010 10:55:00 AM by Lab staff

Parameter		Result	MCL	MRL	Date of Analysis	Analyst
Total Coliform Bacteria, 1OOML	MF-SM9222B	0	O/Absent	0	6/5/2010 1:15:00 PM	M-MA1118
Arsenic, Total, MG/L	SM 31138	ND	0.01	0.002	6/7/2010	M-MA1118
Calcium, MG/l	EPA 200.7	ND	Not Spec		6/8/2010	M-MA1118
Copper, MG/l	EPA 200.7	ND	1.3	0.01	6/8/2010	M-MA1118
Iron, MG/L	EPA 200.7	0.12	0.3	0.01	6/8/2010	M-MA1118
Lead, MG/L	SM 31138	ND	0.015	0.002	6/8/2010	M-MA1118
Magnesium, MG/L	EPA 200.7	ND	Not Spec		6/8/2010	M-MA1118
Manganese, MG/l	EPA 200.7	ND	0.05	0.005	6/8/2010	M-MA1118
Potassium, MG/L	EPA 200.7	ND	Not Spec		6/8/2010	M-MA1118
Sodium, MG/L	EPA 200.7	44.8	See Note		6/8/2010	M-MA1118
Alkalinity, MG/l	SM 2320B	44	Not Spec		6/7/2010	M-MA1118
Ammonia, MG/L	SM4500-NH3-D	ND	Not Spec	0.1	6/8/2010	M-MA1118
Chloride, MG/l	EPA 300.0	23.4	250		6/5/2010	M-MA1118
Chlorine, Free Residual, MG/L	SM4500-CL-G	ND	Not Spec	0.02	6/5/2010	M-MA1118
Color Apparent, CU	SM 21208	ND	15		6/5/2010	M-MA1118
Conductivity, UMHOS/CM	SM 25108	263	Not Spec		6/5/2010	M-MA1118
Fluoride, MG/l	EPA 300.0	ND	4	0.1	6/5/2010	M-MA1118
Hardness, Total, MG/l	SM 23408	ND	Not Spec	2	6/8/2010	M-MA1118
Nitrate as N, MG/L	EPA 300.0	ND	10	0.05	6/5/2010	M-MA1118
Nitrite as N, MG/L	EPA 300.0	ND		0.01	6/5/2010	M-MA1118
Odor, TON	SM 21508	0	3	0	6/5/2010	M-MA1118
pH, PH AT 25C	SM 4500-H-B	7.5	6.5 - 8.5	NA	6/5/2010	M-MA1118
Sediment, pos/neg		NEG		NEG	6/5/2010	M-MA1118
Sulfate, MG/l	EPA 300.0	17.6	250		6/5/2010	M-MA1118
Turbidity, NTU	EPA 180.1	2	Not Spec	0.1	6/5/2010	MMA1118
Gross Alpha, PCI/L	EPA 900.0	0.0 +/- 0.6	15	1.5	6/21/2010	KNL
Radon, PCI/L	EPA 913.0	1900	10000	100	6/8/2010	NEHA103216

MCL=Maximum Contaminant Level (EPA Limit), MRL = Minimum Reporting Level
Sodium Guidelines- Mass 20, EPA 250, # = Result Exceeds Limit or Guideline
ND = None Detected (<MRL), • = Background Bacteria Noted

Massachusetts Certified
Laboratory #MA1118

David Kravitz
Laboratory Director

~~58 Apple Lodges Rd~~

REPORT NO.

The Water Works Laboratories

of MASSACHUSETTS .NC.
59 MAIN STREET. LEOMINSTER. MA 01453

(617) 534.1444
800·LAB·0094

(In Mass.)
800-LAB·0081
(Outside Mass.)

SAMPLE INFORMATION

Requested by:

Address:

Sample Location:

Sampled by:

Phone No.

Time: Date:

Mass. Cert. #16251

Water Quality Test Results

	Test	Results	Limits	Brief Explanation
Bacteria	Coliform Bacteria	4/100	4/100	The # of Coliform Bacteria found in 100 milliliters
	Fecal Bacteria		0/100	Bacteria from human waste
	Standard Plate Count		200/100	Determines total bacteria
Minerals/Metals	Arsenic		0-0.05 mg/l	Toxic metal contaminant
	Sodium		0-250 mg/J	A component of "salt" (In Mass. 20 mg/I)
	b Copper		0-1 mg/I	May indicate pipe corrosion
	-t- Iron		0-0.3 mg/I	Brown stains, bitter taste
	Lead		0-0.05 mg/!	Toxic metal contaminant
	Manganese	0.00	0-0.05 mg/I	May cause laundry staining
	Magnesium	2.30	0-200 mg/!	A component of hardness
	Calcium		0-200 mg/!	A component of hardness
Chemical	Alkalinity	35.00	NO LIMIT	Ability to neutralize acids
	Chlorine	0.00	0-0.05 mg/!	A disinfectant (bleach), kills bacteria
	Chloride	1.00	0::-50 mg/I	A component of "salt", salty taste
	Hardness	45.00	0-160 mg/!	Ability to form soap bubbles, 0-75 soft
	Nitrate	0.00	0-10 mg/I	Indicator of biological waste
	Corrosiveness	Corr	NO LIMIT	A calculation of water/metal interaction
	Sulfate	0.00	- 0"250 mg/I	A common mineral - may cause odor
	Total Solids	81.00	0-500 mg/I	Total minerals present
Physical	pH		6.5-8.5	The acidic or basic condition
	Conductivity	102.00	0-550	Resistance to electricial current (umhos/cm)
	Color	3.00	0-15 cu	Clarity (0) or discoloration (15)
	Dissolved Oxygen	8.90	1-15 mg/!	Amount of oxygen present
	Odor	0.00	0-3 TON	Odors due to contamination
	Turbidity	Sr (:)	0-5 NTU	Presence or absence of particles

For those items tested, this sample meets the following EPA criteria for drinking water.

(') Primary) Secondary ( ) Neither

NT – Not Tested

Reported by:
CHEMIST

Date:

The Water Works .Laboratories
of MASSACHUSETIS. INC.
59 MAIN STHEET. LEOI'v!INSTER. Mi\ 01 5:i

(617) 534-1444
800-LAB-0094
(In Mass.)
800 -LAB-0081
(Outside Mass.)

SAMPLE INFORMATION

Need Pump Co.
Req,uestedua.rt Rd. Sterling, Ma.
Adoress:

Phone No.

Jim Mat' shaf(T
Sample Location: Lot tt14 Rogers Rd. Carlisle
Need Pump Co,

Sampled by:

Time: 5:00 pm Date: Dec 23, 1987

Mass. Cert. # 16251

\\later Quality Test R"'r-ul+"",

	Test	Results	Limits	Brief Explanation
Bacteria	Coliform Bacteria	0/100	4/100	The rt of Coliform Bacteria found in 100 milliliters
	Ft:>cal Bacteria	NT	0/100	Bacteria from human waste
	Standard Plate Count	NT	200/100	Determines total bacteria
Minerals/Metals	Arsenic	NT	0-0(I)rnu..-I	Toxic metal contaminant
	Sodium	8.50	0-250 mB/I	A component of "si:llt" (111 Mass. 20 n1g/li
	Copper	0.00	0-1 mg/I	May indicate pipe corrosion
	Iron	2.00	0-0.3 mg/I	Brown stains. bitter taste
	Lead	NT	0-0.05 mg/l	Toxic metal contaminant
	Manganese	0.00	0-0.05 mg/l	May cause laundry staining
	Magnesium	1. 00	0-200 mg/I	A component of hardness
	Calcium	10.20	0-200 mg/I	A component of hardness
Chemical	Alkalinity	28.50	NO LIMIT	Ability to neutralize acids
	Chlorine	0.00	0-0.05 mg/I	A disinfectant (bleach), kills bacteria
	Chloride	6.00	0-250 mg/I	A component of "salt". salty taste
	Hardness	20.40	0-160 mg/I	Ability to form soap bubbles, 0-75 soft
	Nitrate	0.. 00	0-10 mg/!	!ndic.::ltor of bio1ogcul waste
	Corrosiveness	Corr	NO LIMIT	A calculation of water/metal interaction
	Sulfate	0. 00	0-250 mg/I	A common mineral - may cause odor
	Total Solids	42.00	0-500 mg/I	Total minerals present
Physical	pH	7.02	6.5-8.5	The Kidic or basic condition
	Conductivity	84.00	0-550	Resistance to electricial current (umhos/cm)
	Color	5. 00	0-15 cu	Clarity (0) or discoloration (15)
	Dissolved Oxygen	5.30	0-15 mg/I	Amount of oxygen present
	Odor	0.00	0-3 TON	Odors due to contamination
	Turbidity	8.40	0-5 NTU	Presence or absence of particles

For those items tested. this sample meets the following EPA criteria for drinking waler.

( ) Primary) Secondary (xl Neither

NT – Not Tested

Reported by: —Eric J. Kas1misk,.-.—
CHEMIST

Date: -----Dec.:-28r-J..5'-B-7