The Town of Amherst has reviewed a memorandum prepared by Roux Associates Inc. (Roux), dated December 31, 2015, regarding conditions at the Old Landfill and its suitability for a solar array. Amherst is confident in the permitting process for a solar array at this landfill, because the process will take numerous environmental factors, data sets, and quantitative analyses into account. The following is a response to the Roux memorandum with further explanation of certain issues. As described below, the monitoring program at the landfill is extensive in nature and provides a comprehensive set of data to characterize the nature and distribution of potential landfill impacts.

1. *Roux: The landfill cap final design thickness is substantially less than what was originally required by MassDEP and Amherst should not have requested a reduction in thickness*

   When the landfill was capped in the 1980s, MassDEP approved the cap specifications based on Amherst's consulting engineers' data and calculations. It is ineffectual to suggest, 30 years later, that Amherst was "irresponsible" to request a reduction in thickness or that Amherst's engineers should have incorporated data from a certain scientific paper into the cap design. It seems more appropriate to focus on what is being done now to ensure there is no risk to public health from the landfill. Amherst has presented current monitoring programs, and further explanation of the programs and results is provided in this document.

   Amherst reviewed the paper cited by Roux (Daniel, D.E., 1984, Predicting the hydraulic conductivity of clay liners, *Journal of Geotechnical Engineering,* 110(2), 285-300), and the focus of the paper seems to be reconciling laboratory permeability test results with field test results and observed liner performance, not a study of optimal clay liner thickness for landfills. Further, Daniel indicated, "there is no consensus as to what constitutes a reasonably thick liner." The four case studies presented in the paper are from arid regions (Texas and Mexico), so correlations about observed liner reliability between these areas and humid northeast seem inappropriate, given that arid regions have a higher potential for desiccation cracks. It is not clear from our review how this paper supports the assertion that Amherst's engineers were irresponsible to suggest a reduction in thickness.

2. *Roux: The relatively high hydraulic conductivity of the cap allows surface water to infiltrate into the landfill*

   Amherst has pointed out numerous times that if the cap was really leaking this much, significant downgradient impacts should have been observed by now. Extensive monitoring data does not support relatively high rates of leakage through the cap.

3. *Roux: Significant contamination has already been observed, demonstrating that the landfill cap is not effective in its current state.*
   Samples are collected from 15 wells on an annual basis, and Roux is correct that one well, MW 1-08 is located hydraulically upgradient of the landfill. This well was installed to provide background groundwater quality data. The remaining 14 well locations and depths were selected to provide a comprehensive monitoring network in potentially-downgradient locations.

   Amherst has indicated that exceedances of primary drinking water standards have been detected in five samples since CSA monitoring began in 2010. In this count, Amherst did not include Office of Research and Standards (ORS) guidance levels because it is our understanding that they are classified as guidance levels, not primary drinking water standards. The physical and chemical properties of 1,4-dioxane, as well as significant improvements in laboratory analytical methods in recent years, make explaining the nature and occurrence of 1,4-dioxane complicated and extensive.

   The potential sources and physical characteristics of 1,4-dioxane provide background and context for its nature and occurrence. 1,4-Dioxane is commonly used as a solvent stabilizer for chlorinated solvents (specifically 1,1,1-trichloroethane), and it is also used in many other products, including paint strippers, dyes, greases, antifreeze, and even some consumer products (deodorants, shampoos, and cosmetics). 1,4-Dioxane is miscible in water, and it will not readily volatilize out of water. It is slightly denser than water, does not readily sorb to soil particles, and migrates relatively easily in groundwater. These characteristics have made it difficult to identify and quantify using conventional laboratory analytical methods.

   Laboratory methodologies to detect and quantify 1,4-dioxane have improved greatly in recent years. With the advent of more advanced methodologies, 1,4-dioxane has been detected in more locations. Before 2012, Massachusetts laboratories were required to analyze for 1,4-dioxane to a level of 3 µg/l, and they generally used EPA Method 8260. This is the conventional method for volatile organic compounds, but it is not an ideal technique for detecting 1,4-dioxane due to the compound's low volatility. However, this was the method in use at that time, and it yielded results that met regulatory requirements. In 2012, the Massachusetts ORS guidance level was lowered to 0.3 µg/l, and many laboratories began using a modified EPA Method 8270 in addition to Method 8260, because 8270 could better analyze less volatile constituents like 1,4-dioxane. Now many laboratories analyze for 1,4-dioxane

using EPA Method 522, which is superior to 8270 for detecting 1,4-dioxane below 0.3 µg/l. This method can detect 1,4-dioxane down to levels as low as 0.02 µg/l. Our contract laboratories have used EPA Method 522 for 1,4-dioxane analysis of our solid waste samples since 2014.

Finally, it should be noted that in 2012, the MCP GW-1 standard for 1,4-dioxane was 3 µg/l, not 0.3 µg/l, so analyses prior to 2012 that reported a detection limit of 3 µg/l were consistent with regulatory requirements (and with widely available laboratory methods). MassDEP's website clearly indicates the groundwater and soil cleanup standards for 1,4-dioxane in the MCP were not promulgated until April 2014 (http://www.mass.gov/eea/agencies/massdep/toxics/sources/14-dioxane.html) . Prior to this promulgation, the MCP standard was 3 µg/l, and this indicates Amherst was actually having samples analyzed by a method with a detection limit that was an order of magnitude lower than the MCP standard for two years before the revised MCP level was promulgated.

In 2012, Amherst collected samples in July, and the laboratory analyzed them using EPA Method 8260. The results indicated 1,4-dioxane was detected in seven wells and four surface water samples. These detections were at higher concentrations and wider in distribution than had been observed previously, so Amherst contacted MassDEP, as required, upon learning of the results. To further assess these detections and ensure that Amherst's drinking water wells were safe, MassDEP directed Amherst to sample its drinking water supply wells and resample the monitoring wells in which 1,4-dioxane had been detected. The drinking water supply samples were sent to a specialty laboratory (ALS Environmental) in Pennsylvania for analysis by EPA Method 522. The monitoring well samples were sent to a local laboratory for analysis by EPA Method 8270, but one monitoring well sample (MW 4-08) was sent to ALS for analysis by EPA Method 522 because it is located in the Zone II water supply protection zone.

The follow-up sampling indicated that 1,4-dioxane was not detected in the water supply wells nor in MW 4-08. It was detected in only two monitoring wells and one surface water sample. Since the methods used for the follow-up sampling (EPA Methods 522 and 8270) are generally regarded as superior methods for detecting 1,4-dioxane, the most likely explanation for the July detection was a laboratory error, contamination of sampling equipment or chain of custody issues. This was supported by the extensive additional quality assurance/quality control samples (duplicate, replicate, equipment rinsate, trip blanks, lab blanks) performed with the August samples.

Furthermore, potential seasonal variations of 1,4-dioxane concentrations are irrelevant and/or unlikely for several reasons. The observed concentrations (and most of the detections) in July, 2012 could not be confirmed by the extensive August 2012 re-sampling, and seasonal variations between two consecutive summer months with similar climatic characteristics should be minimal or nonexistent. As described above and in the 2012 Environmental Monitoring Report, the preponderance of information related to the July and August 2012 sampling events indicates the August data are substantially more reliable than the July data. In addition, no other constituents were detected at unusual levels in July 2012. If seasonal variability was a factor, it would likely be reflected in other measured parameters. We are not aware of a hydrogeological process that could cause a seasonal variation for 1,4-dioxane, but none of the other ~90 constituents on the analyte list.

4. *Roux: Leachate impacts downgradient of the landfill indicate the cap is not effectively preventing the infiltration of contaminants into the groundwater.*
   Impacted areas downgradient of the landfill have been characterized, assessed, and analyzed for potential risks. These areas will continue to be monitored for possible changes in metals concentrations and, thus far, no changes have been observed.

5. *Roux: Ongoing contamination of the sediments and wetlands poses a risk to human health that may be going undetected due to inadequate monitoring.*
   Accumulation of metals in wetland sediments occurs over longer timescales than can readily be observed on an annual monitoring basis. It is Amherst's understanding that MassDEP will require periodic follow-up sampling of sediment in the future to assess potential metals concentrations in sediments.

   In September 2015, MassDEP directed Amherst to collect a sediment sample at the Gull Pond inlet (SED-1) to assess for potential changes in metals concentrations. The results are summarized below. As indicated, detected concentrations were well below sediment screening levels, and they do not indicate a problem with "ongoing contamination." In addition, the results indicate a lower arsenic concentration than that which was detected in 2008.

SUMMARY OF SEDIMENT ANALYTICAL DATA
TOTAL RCRA 8 METALS
GULL POND INLET
AMHERST, MASSACHUSETTS

SAMPLE ID:	SED-1 Gull Pond Inlet							Stage 1 Sediment Screening Criteria
DATE:	**11/8/05**	**5/22/08**	10/15/08				**9/29/15**	
METALS (mg/kg)				**A**	**B**	**C**		
Arsenic	28	**98**	**98**	**64**	18	**130**	9.7	33
Barium	430	760	--	--	--	--	370	--
Cadmium	<2.8	4.2	--	--	--	--	<0.72	5.0
Chromium	20	24	--	--	--	--	45	110
Mercury	0.098	<0.22	--	--	--	--	<0.064	0.18
Lead	16	16	--	--	--	--	19	130
Selenium	<21	<8.5	--	--	--	--	<14	--
Silver	<6.9	<8.5	--	--	--	--	<2.1	--

Bold type indicates exceedance of Stage 1 Sediment Screening Criteria.

An explanation regarding testing and laboratory detection levels of 1,4-dioxane is presented above. This constituent was not omitted during the CSA, it simply could not be detected at very low levels using the conventional analytical methods of that time. If MassDEP determines levels of 1,4-dioxane near the landfill could pose a significant risk to human health or the environment, then an additional risk assessment will be performed.

6. *Roux: Ongoing contamination of wetlands sediments continues to be an unresolved problem*
   See Item 5.

7&8. *Roux: The re-grading project on the landfill is still not complete*

The re-grading project was completed in December 2015. Positive drainage has been restored to the landfill surface. DPW staff were not able to seed it due to winter weather conditions, but it will be seeded this spring. If settlement is observed to have occurred in the recently-graded areas, then grading will be adjusted prior to seeding. The project has taken extensive time, but there were inherent scheduling challenges such as the need to work in dry weather with dry materials as well as seasonal limitations on when and where work could be performed. Amherst is proud to have performed this project in-house, as it required extensive permitting and coordination with multiple regulatory agencies in addition to the grading work itself.

The Roux memo included photos from a site visit to the Old Landfill. The memo did not include a map or description of where these photos were taken, so Amherst has made assumptions regarding the locations.

- Evidence of small animal(s) digging in two areas over the approximately 50-acre landfill does not seem adequate to demonstrate that the cap is deteriorating. These areas can be easily fixed and do not appear to have reached the clay barrier layer. Foxes, skunks, coyotes, rodents, and domestic dogs live in the vicinity of the landfill, and it is our understanding that all of these animals will dig shallow holes from time to time.
- The "destroyed monitoring well" is a soil gas point located in the black walnut tree farm west of the landfill. The inner tubing is still usable for monitoring, but the outer tubing needs to be repaired. Several soil gas points located in other areas have been damaged over the years, and these have either been repaired or replaced. Further, a small-diameter (~1 inch) soil gas point that extends less than five feet into the subsurface is not a good conduit for infiltration of contaminated surface water into groundwater, especially when groundwater in this area is approximately 80 feet below grade.
- The gas vents in the photos appear to have been damaged by the mower, but the damage does not appear to be affecting the functionality of the vents in any way. Amherst has replaced the missing cap.
- The drainage swale was improved with additional riprap in 2012. Invasive plants appear to have grown into the swale since the improvement. Amherst will perform more work in the future to control the invasive plants in this area.

The photos provided by Roux illustrate the difficulties in controlling the property in its current, unfenced state.

Wetlands and Natural Heritage & Endangered Species Program

Wetlands

Roux indicates that ponding on the landfill surface has created wetlands that are shown on Massachusetts Geographic Information Systems (MassGIS) layers, and these wetlands create a need for permitting from the Conservation Commission under the Wetlands Protection Act (WPA).

The MassGIS website indicates, "…wetlands shown… are for planning purposes only. Wetlands boundary determination for other purposes, such as the Wetlands Protection Act MA Act M.G.L. c. 131 or local by-laws, must use the relevant procedures and criteria" (http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-

serv/ office-of-geographic-information-massgis/datalayers/depwetlands112000.html). Clearly, the MassGIS website should be used for planning and guidance only- it cannot and should not be relied upon for definitive wetlands delineations.

Amherst DPW worked with the Conservation Commission on the applicability of the WPA to the landfill depressions during the permitting phase of the regrading project. In December, 2010, Amherst submitted a Request for Determination of Applicability requesting the Conservation Commission make the following determinations:

- whether the landfill surface depressions were subject to the jurisdiction of the WPA;
- whether the work associated with this regrading project was subject to the jurisdiction of the WPA; and
- whether the work and areas were subject to the jurisdiction on the Amherst Wetlands Protection Bylaw.

On February 16, 2011, after the required document review, site visit, and public hearing, the Amherst Conservation Commission issued a negative determination under the Massachusetts WPA M.G.L. c. 131, and The Town of Amherst Wetland Protection Bylaw. This determination indicated the area was not subject to protection under the WPA, and the regrading work was not within an area subject to protection under the WPA.

Natural Heritage and Endangered Species Program

As part of the permitting phase of the landfill regrading project, Amherst applied for and received a Massachusetts Endangered Species Act (MESA) permit allowing the landfill regrading work to proceed. The on-going minor maintenance work on the landfill surface by the Town is scheduled based on the migratory patterns, breeding activities, and nesting locations of the Grasshopper Sparrow.

Similar to the regrading project, future major work would also be reviewed by the NHESP for compliance with the state-listed rare species protection provisions of MESA (321 CMR 10.00) and/or the WPA (310 CMR 10.00), as applicable.

1,4-Dioxane

As discussed in Item 3, the history of 1,4-dioxane detections in the vicinity of the landfill is complex, but recent improvements in laboratory methodologies have enhanced our ability to detect and quantify this constituent. Roux mentions the elevated concentration (50 µg/l) of 1,4-dioxane detected in a well downgradient of the potential drum area in July 2012. Roux does not mention that follow-up sampling in August 2012, which was deemed substantially more reliable due to enhanced protocols and laboratory methodologies, failed to replicate the July results. In fact, the August results indicated

1,4-dioxane at a concentration of 1.1 µg/l in the well downgradient of the potential drum area. The reason the August sampling was done was because Amherst staff and state regulators were concerned about the apparently elevated levels and recognized the need for further assessment. (This was discussed under Item 3.)

The detection of 1,4-dioxane that Roux characterizes as “especially concerning” is the detection at well MW 4-08 in July 2012. The July 2012 results were reported to MassDEP, and it was under MassDEP’s guidance and directives that Amherst re-sampled this well and sent it to ALS for analysis. In August 2012, 1,4-dioxane was not detected in this well, and the laboratory detection limit was 0.07 µg/l. The detections of 1,4-dioxane in 2012 were handled by the solid waste and drinking water divisions of MassDEP, and therefore is considered “adequately regulated” under the MCP and not under the jurisdiction of the MassDEP division of waste site cleanup. Furthermore, 1,4-dioxane has not been detected in this well since the anomalous July 2012 result.

Likewise, 1,4-dioxane was detected in the other bedrock well, MW 5-08 during the anomalous sampling event in July, 2012. It was not detected in follow-up sampling during the following month, nor has it been detected in this well since then (using lower analytical detection limits). Further assessment would be warranted if 1,4-dioxane had been detected in these wells during subsequent sampling events, but this is not the case. (It should be noted that water supply wells are screened in the confined aquifer above bedrock.) Given the lack of concerning analytical data in these wells to date, further assessment of the bedrock aquifer water quality is not necessary at this time.

As stated multiple times above, the August 2012 sampling is considered vastly more reliable than the July 2012 data. By focusing on the July data, Roux presented an incomplete picture and neglected to mention the August data, nor differences in laboratory methodologies, nor the wider context of the sampling program.

Future Use

The addition of solar panels to the landfill will add additional weight to the landfill surface, but rigorous engineering calculations to analyze this issue will be required as part of the permitting process. The EPA website cited by Roux indicates settlement rates are largely a function of waste composition and age of landfill cap, and as the age of the landfill cap increases, the rate of settlement is likely to diminish or become negligible. Given that the landfill was capped approximately 30 years ago, most settlement is likely to have occurred by now.

The figure in the Roux memo showing potential photovoltaic system effects on settlement is irrelevant to this discussion, as it shows a plot with no axis labels that is, in

reality, a qualitative illustration. The engineers involved in permitting solar on the landfill will perform quantitative calculations to evaluate this potential concern.

In short, the monitoring program at the landfill is extensive and designed to be protective of human health and the environment. Amherst is confident both in the program itself and in the permit approval process for a solar array. Engineering analyses during the permitting process will quantitatively assess the suitability of the landfill for a solar array. The permitting process will take numerous environmental factors and data sets into account as the project progresses.