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CMA
ENGINEERS

December 18, 2015

Mr. Frederick Welch, Town Manager
Town of Hampton
136 Winnacunnet Road
Hampton, NH 03842

Re: Review of Proposed Solar Energy Facility at the Hampton Landfill

Dear Mr. Welch:

In accordance with our letter agreement dated December 7, 2015, CMA Engineers has completed an initial review of the project documents submitted by SolarCity Corporation of San Mateo, CA for the installation and operation of a 2.4 MW, 9-10 acre photovoltaic solar array at the closed Hampton Landfill. The power generated by the solar facility is to be sold to the Town of Hampton for use in certain town facilities.

Our review has been completed by Robert Grillo, PE, a solid waste engineer, and Craig Musselman, an environmental engineer with experience in the negotiation and implementation of similar facility agreements. Our team has not included electrical engineers to date, although we provide comments herein on electrical matters from an overall project perspective.

Our review has consisted of the following:

1. Observe the project site
2. Review the available project documents consisting of:
    a. Record Drawings of the Hampton Landfill Closure, Underwood Engineers, May/June, 1997;
    b. SolarCity Power Purchase Agreement (*Revised December 4, 2014*);
    c. SolarCity Performance Guarantee Agreement, undated;
    d. SolarCity Proposal to the Town of Hampton dated August 10, 2015 in response to a Hampton RFP;
    e. Town of Hampton Request for Proposals
3. Provide comments on the project's potential impacts on the closed landfill from a technical perspective, on the design, permitting and construction inspection requirements likely to be needed from Town and NH Department of Environmental Services perspectives, and on both technical and business aspects of the project documents as presented by SolarCity on the Town's behalf.

A. Technical Comments

We address below in general terms the technical issues that merit evaluation in the installation of solar arrays at a solid waste landfill. We would note that this is a relatively new practice in the US, but it is becoming common. There are two facilities in New Hampshire that have started construction or are anticipating starting in the next several months, and there are a significant number of successful projects in other states that are in operation.

Wind – The Hampton landfill is at a high elevation with respect to its surroundings and will experience wind at full force, unimpeded by buildings and vegetation. A hurricane force wind of 110 miles per hour may be an appropriate design criterion, in our opinion. This is the threshold wind speed of a Category 3 hurricane. Hurricane Katrina that hit New Orleans in 2005 was a category 3, as was Hurricane Sandy in 2012 prior to its landfall in New York and New Jersey. The system manufacturer can produce design calculations and wind tunnel test data that show that the structural system of the arrays will not separate and the concrete supports of the arrays are of sufficient weight that tipping of the solar panels does not occur in these wind conditions. New Hampshire building codes are based on the 2009 version of the International Building Code, stipulating a building design wind speed of 100 mph for Hampton. Wind speeds in excess of a design wind speed can conceivably occur. The risk of damage to the system due to wind can and should be clearly the responsibility of SolarCity.

System Bearing on the Cap - Calculations can be prepared addressing sliding, overturning and structural integrity of the solar array system. The bearing weight of concrete supports can be calculated and compared to the bearing capacity of the membrane liner. Total loads of the solar array system can be assessed, if applicable, with respect to any settlement in the waste mass that might be induced. This is resolvable with adequate design and documentation.

Construction Traffic Impact on Landfill Cap – The cap at the Hampton Landfill consists of a 40 mil thick flexible membrane liner, with 24 inches of soil over the membrane cap. The design of the solar facility will need to include thickened traveled access road areas, and a construction sequencing plan to assure that any vehicular access over other areas of the cap will not impact the membrane liner. This requires typically that traffic on the cap will not result in an exceedance of a 4.5 psi ground pressure 12 inches above the membrane liner as equipment and small batches of concrete are ferried to the construction location using low ground pressure vehicles with a loaded weight. Heavier vehicles would need to travel only on thickened soil roads over the cap, and bulk concrete deliveries would likely need to be made to a location off the landfill cap. This is resolvable with proper design and construction methods.

Protection of Gas Vents – The conceptual design presented in the SolarCity proposal maintains a 15 foot clear swath around all gas vents. This clearance should be reviewed in final design to assure its adequacy.

Landfill Settlement – Closed solid waste landfills settle over time from the combined and iterative effects of physical consolidation and biological decomposition of the waste materials. This settlement is most significant in the first 20 or 30 years after closure (the Hampton Landfill was closed 18 years ago), but the gradual settlement continues for a very long time at a decreased rate. The settlement reported to date by Town staff, and evidenced by our site observations, has been generally uniform, as the entire landfill surface has settled. This typically has the effect of decreasing the gently sloping areas at the

crest of the landfill, in the area proposed for installation of the solar arrays. Although we do not have survey information since the facility was closed, visual observations indicated that the slopes at the top of the landfill remain sufficiently sloped to date, and no cap drainage problems are evident. We recommend that the design of the solar array facility include a current topographic survey of the solar facility footprint and a comparison of current elevations and slopes with the elevations and slopes indicated on the closure plan Record Drawings from 1997. The solar facility design should consider the rate of decrease in landfill cap top slopes from the initial 3% +/- top slopes to current slopes to confirm the observation that relatively uniform subsidence has occurred to date, and that areas of limited or no slope are not anticipated to occur with continued subsidence. Uniform subsidence of the landfill surface is not a problem for a solar array system as long as the structural system has the flexibility to accommodate expected minor settlement variations. The development of sinkholes of limited depth could occur due to the long term corrosion of large metal items in the waste mass. Town staff have not observed such sinkholes to date at the Hampton landfill, and we have not observed such sinkholes at any of the other closed New Hampshire landfills that CMA Engineers has monitored over the past 25 years.

Burrowing Animals – Animals such as groundhogs or other smaller subsurface animals can burrow in cover soils, and potentially impact the membrane liner below the cover soils. The Hampton staff monitors for obvious burrows and removes the animals when they infrequently are observed. To date, these have typically occurred on the southerly steeper slopes of the Hampton landfill. This is not a significant operational problem, but will need to be monitored in the soil beneath the solar arrays.

Drainage – Rain and snow falling on the solar panels will fall to the ground surface from the lower edge of the panels. The cap surface will likely be sufficiently vegetated to preclude erosion of the gently sloped areas beneath the solar arrays.

Landfill Maintenance - Mowing – The Hampton transfer station staff is responsible for mowing the landfill twice each year. This is done using a mower with a reported 12 foot width for efficient operations. The solar facility will require mowing by the solar facility operator between panels and likely beneath panels in some locations with smaller, perhaps hand, mowers to provide access to panels and to preclude high vegetation that might provide shade if not controlled. It is our opinion that the Town should continue to be responsible for mowing and surface maintenance of the steeper side slopes, while SolarCity should be responsible for mowing within the footprint of the solar facility.

Landfill Maintenance – Snow – The Town staff does not now manage snow on the landfill cap. Due to high wind velocities, much of the snow is reported to blow off the landfill surface. Snow accumulation on the solar panels will be limited by the severe wind conditions, and the heat generated both by the solar panels and the waste mass below the cap. Still, at times, snow blowing and removal of snow from the panels may be desired by the solar facility operator.

Security – The landfill has a six foot high chain link fence around the west, north and east perimeter. On the southerly side, there is a 1,600 foot gap without a fence. The southerly side is regularly accessed by all terrain vehicles (ATV's). The fenced area provides a wildlife barrier, but is not an effective barrier to access to the site by people, who can cut through or scale the chain link fence. The south side, without a fence, is accessed by hunters, ATV's and wildlife. Deer have been observed at the height of land on the landfill cap. The site is not currently secure, and is not posted for no hunting. If the solar facility operator is concerned about security of its equipment from damage or theft, a fence should be installed

on the south side, at a cost of about $40,000, and the site should be posted for no hunting. The fence perimeter should then be periodically inspected for breaches by the solar facility operator. There is reference in the Hampton Energy Committee's presentation to the Board of Selectmen in November that SolarCity plans to install the fence at their cost, but we did not notice a reference to that in SolarCity's agreement or proposal.

The above issues are resolvable with proper design and construction to allow a solar array to be installed on a capped landfill, and the Hampton landfill does not present any unusual site constraints in this regard.

B. Design and Permitting Considerations

CMA Engineers has recently represented the Town of Milton, NH in dealing with landfill cap design and permitting issues for the installation of a solar facility at the closed Milton landfill. NHDES will require the following of the Hampton landfill solar project.

1. Type 1.B. Permit Application – SolarCity (or the Town of Hampton) will need to retain the services of a professional engineer licensed in New Hampshire with solid waste management experience to prepare the landfill related aspects of the facility design and the Type 1.B permit application to modify the previously approved closure plan. If this is to be accomplished by SolarCity, the Town should request the qualifications information on the engineer selected. The Town could simply sign the Type 1.B permit application, or have the work reviewed by an engineer on behalf of the Town. The SolarCity proposal describes the design and NHDES permitting process properly. Since the design issues are relatively straightforward, a separate review by another engineer may not be necessary, at the option of the Town.
2. Construction Engineering Resident Inspection – To date, NHDES has required the following services of an engineer during construction for solar facility installations atop landfills:
    a. Prepare Notice of Intent to Construct application to NHDES. Prepare application and provide schedule, resumes of personnel and qualifications.
    b. Landfill engineer reviews/approves construction equipment use on cap, and need for thickened sections for heavy equipment as needed.
    c. Engineer observes construction with respect to any cap impacts or damage (NHDES is requiring full time coverage to date, but this may be more than is necessary).
    d. Construction progress meetings – with NHDES
    e. Bi-weekly progress reports to NHDES
    f. Construction certification report prepared by Engineer with as-built drawings provided by Developer.

We did not notice reference in the SolarCity proposal to this construction engineering role. In our opinion, full time observation is appropriate in the initial stages of installation to confirm means and methods of construction to assure protection of the landfill cap, transitioning to part time observation once appropriate means and methods are established. SolarCity should discuss the appropriate level of coverage with NHDES. The construction engineer could be retained by SolarCity or by the Town. The design and construction engineering should be budgeted by SolarCity regardless of how it is implemented.

C. Business Aspects of the SolarCity Project Documents

In our review of the project documents, we have commented on a variety of technical and business aspects of the documents. Some of these are on topics clearly beyond our areas of expertise (primarily electrical in nature), but that hasn't kept us from providing comments or posing questions. We recognize that these are draft agreements that have not yet been negotiated.

1. Solar Power Purchase Agreement (Commercial NH)
    a. Exhibit 1, Item 4. Contract Price – the Town should check the current retail price and reasonable projections of future retail electricity rates for comparison to the proposed $0.1020/kwh flat power price to confirm the magnitude of expected benefit to the Town. Is this AC current as delivered at the interconnection point near the Town's meter(s)?
    b. Exhibit 2, Item 6. Exclusions – Unforeseen groundwork is excluded. Is that at Town cost? "Upgrades or repair to customer or utility electrical infrastructure" is excluded, but should be included in SolarCity's scope and at SolarCity's cost regardless of the requirements.
    c. If payment bonds are not included, Town Counsel should assure that sufficient protection from Town liability due to non-payment of contractors and subcontractors is provided.
    d. Exhibit 2 Figure – The figure shows a second interconnection point at commercial buildings adjacent to the landfill. The powerpoint presentation by SolarCity to the Selectmen indicated a second connection point at the Transfer Station instead. Which is proposed?
    e. Exhibit 2 Figure – the transfer station (and the adjacent commercial buildings) have very limited power usage. Is this second interconnection location needed and properly located? We would note that the electricity use at the Transfer Station is very limited – lights and periodic use of a compactor motor. The average demand at the Transfer Station is less than 2% of the average demand at the wastewater treatment plant, and is trivial compared to the output of the solar facility. We presume that the two interconnection points are required due to legal, rather than technical, reasons. From an engineering standpoint, the interconnection at the Transfer Station doesn't appear necessary.
    f. Exhibit 3, Item 2 - Purchase and Sale of Electricity – Based on a cursory review of the facility electrical output and the annual demand of the wastewater treatment plant and other town facilities, it appears likely that there will be significant periods of time when solar facility output will exceed Town demand. Mid-day on sunny days, the solar facility output will be substantially higher than the demand at the wastewater treatment plant, with much of the solar facility electricity flowing to the grid during those periods. We have not reviewed the power sales arrangement proposed for the solar facility. We presume that this will be a net metering arrangement that allows application of that electricity flowing to the grid during the

day to apply against the wastewater treatment plant's electricity use at night. If that is the case, and If the facility output in total exceeds wastewater treatment plant and transfer station demand on a monthly or annual basis, is the Town still obligated to purchase all power generated by the solar facility at the stipulated price? Should the Town's obligation to purchase power generated by the solar facility be capped at either the Town's monthly or annual electricity use of the pertinent Town facilities? We would note that project planning should include consideration of future energy conservation measures at the Town's facilities that may reduce annual demand.

g. Exhibit 3, Item 2 – Purchase and Sale of Electricity - We note that the agreement does not specify the voltage at which AC power will be delivered, nor does it address variations and acceptable tolerances of electrical characteristics. The power input from the solar facility will be the sole or predominant source of power to the wastewater treatment plant on most days.

h. Exhibit 3, Item 4 – Is the solar facility exempt from local property taxes? There is reference in the Hampton Energy Committee's report to the Selectmen in November regarding a payment in lieu of taxes, but we did not notice reference to that in the SolarCity proposal.

i. Exhibit 3. Item 6.b. – Additional conditions to Purchaser's Obligations should be considered such as review and approval of design, NHDES review and approval of closure plan modifications, review of electrical interconnection agreements.

j. Exhibit 3, Item 8.c. The Town's obligation for maintaining the closed landfill should be limited to areas beyond the footprint of the solar facility, in our opinion. SolarCity should be responsible for mowing, snow removal and advising the town of any observations of active burrowing animals within the footprint of the solar facility. Further, the Town should not be responsible for ensuring "that the Facility remains interconnected to the local utility grid at all times and will not permit cessation of electric service to the Facility from the local utility". The Town should also not be responsible for "the maintenance and repair of the Facility's electrical system..." Those should be the responsibility of SolarCity, in our view.

k. Exhibit 3, Item 8.g. Security - This section places the responsibility for security of the facility on the Town. The Town has limited ability to provide that security. The Town should assure that its insurance coverage will apply to the full potential damage risk of the privately owned solar facility, or this risk should be assumed by SolarCity. We believe the latter is appropriate in that the Town has limited ability to assure the security of the solar facility.

l. Exhibit 3, Item 14 System Damage – This section indicates that SolarCity is not responsible for restoring the system in the event of landfill settling or subsidence. In the event of such settling or subsidence, the Town indemnifies SolarCity for all related liabilities under the provisions of Item 16.c. This is a financial risk that the Town is assuming by entering into this 20 year agreement. The Town and SolarCity might consider sharing this responsibility such that the Town is responsible for repairing the subsidence and cap, and SolarCity is responsible for repairing or replacing the solar equipment.

2. Performance Guarantee Agreement
    a. Item 1. Warranty – The Town should confirm whether kw referenced throughout these agreements is expressed in DC or AC current, as there is a difference between the two.
    b. Item 1.E Guaranteed Energy Price – As a general comment, we would note that this warranty provides that payments due from SolarCity in the event that the facility does not provide electricity in the guaranteed quantity each five years will be based upon the guaranteed energy prices specified in Section 1.E, which are less than the Town's expected savings.
    c. Item 2.D Operation and Maintenance – This section indicates that the warranty does not apply if the Town "fails to maintain the System as stated in the Solar Operation and Maintenance Guide". We were unable to locate that guide on-line, and believe that "maintaining the System" should not be a Town responsibility.
    d. Item 2.H. – Note that the warranty does not apply in the event of "Theft of the System". That may be an acceptable provision as long as the damages from "theft of the System" are either the responsibility of SolarCity or are otherwise accepted by the Town and properly insured.

All of the above issues are business matters that are resolvable through reasonable negotiation of project documents.

CMA Engineers has appreciated the opportunity to assist the Town of Hampton in this capacity. Should you have any questions or comments concerning the above, please do not hesitate to contact the undersigned at cmusselman@cmaengineers.com.

Very truly yours,

Craig N. Musselman, PE, BCEE

President