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ENVIRONMENT
& HEALTH

February 27, 2020

TECHNICAL MEMORANDUM

To: Steve Clough
Nevada Environmental Response Trust

From: Chris Ritchie, Ramboll
Sumit Ray, Ramboll
John Pekala, CEM#2347, Expires 9/20/2020, Ramboll

Re: Renewable Energy Assessment
Nevada Environmental Response Trust Site
Henderson, Nevada
Ramboll Project No. 1690011200-046

This technical memorandum presents a Renewable Energy Assessment for the Nevada Environmental Response Trust (NERT or the Trust) Site located in Henderson, Nevada. The purpose of the Renewable Energy Assessment is to provide a preliminary assessment of opportunities to reduce the energy and greenhouse gas (GHG) footprints of the Groundwater Extraction and Treatment System (GWETS) and the associated remedial performance monitoring program.

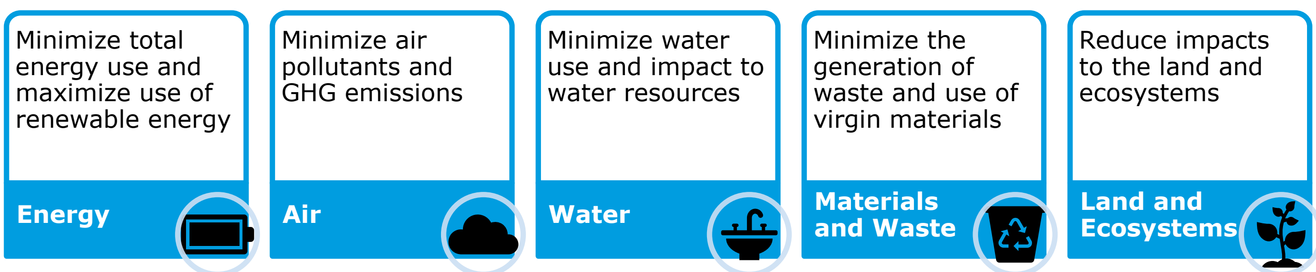
The Renewable Energy Assessment was identified as a recommended best management practice (BMP) established as part of the *2018 Greener Cleanup Best Management Practice Implementation Work Plan, Revision 1* (the "2018 BMP Work Plan") dated October 26, 2018. While the 2018 BMP Work Plan has not yet been approved by the Nevada Division of Environmental Protection (NDEP) and the United States Environmental Protection Agency (USEPA), comments were received in a letter dated November 12, 2019 and a revised deliverable was submitted on February 11, 2020. The comments did not affect this assessment and the preparation of this document in advance of revision and approval of the 2018 BMP Work Plan was discussed with NDEP.

The Renewable Energy Assessment is a first step towards implementing policies and practices to reduce energy use and GHG emissions at the NERT Site. This preliminary effort performs the following functions: 1) establishes goals to reduce the energy use and GHG emissions; 2) presents a baseline energy and GHG assessment; 3) evaluates opportunities for reducing energy use and GHG emissions; 4) presents a feasibility assessment for solar energy production, and 5) recommends next steps. It should be noted that, in accordance with the 2018 BMP Work Plan, this assessment focuses on the GWETS and the associated remedial performance monitoring program, which is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) removal action being re-evaluated along with other remedial approaches as part of the ongoing Remedial Investigation and Feasibility Study (RI/FS).

BACKGROUND

Since 2013, data has been compiled on the overall environmental footprint of the GWETS and associated remedial performance monitoring program. The environmental footprint data have been reported in the annual and semi-annual remedial performance deliverables since 2014 at the direction of NDEP and USEPA. In 2017, NDEP and USEPA requested that the Trust conduct an evaluation of alternatives to reduce the overall environmental footprint in accordance with the ASTM Standard Guide for Greener Cleanups (E2893-16).[1] This effort resulted in the submittal of the 2018 BMP Work Plan. In 2017, NDEP and USEPA also requested that the environmental footprint be quantified using USEPA's Spreadsheets for Environmental Footprint Analysis (SEFA) Excel workbooks.

ASTM E2893-16 defines five core elements to be considered in the BMP process to reduce the environmental footprint of a cleanup phase, as described in the diagram below. These core elements generally align with the environmental contributions quantified as part of the environmental footprint analyses performed for the GWETS and the associated remedial performance monitoring program. The recent environmental footprint results are therefore used to identify major environmental footprint contributors as they relate to the core elements and to prioritize BMPs accordingly.



For pump and treat removal actions like the GWETS system, the best opportunities for reducing the environmental footprint involve optimizing efficiency of long-term operations, particularly in terms of energy and other natural resource consumption.[2] The focus of this Renewable Energy Assessment is on the core elements of Energy and Air. Efforts to reduce the footprints of other core elements will be discussed in separate deliverables as specified in the 2018 BMP Work Plan and the forthcoming revision to that work plan.

ENERGY/GHG GOALS

This Renewable Energy Assessment establishes the following goals related to the core elements of energy and air:

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[1] ASTM, 2016. ASTM E2893-16e1, Standard Guide for Greener Cleanups, ASTM International, West Conshohocken, PA, www.astm.org.

[2] United States Environmental Protection Agency (USEPA), 2009. Green Remediation Best Management Practices: Pump and Treat Technologies. Office of Superfund Remediation and Technology Innovation, EPA 542-F-09-005. December.

1. To the extent practicable, maximize the use of renewable energy at the NERT Site.
2. Continually assess opportunities to reduce energy use and GHG emissions during subsequent cleanup phases as the final remedy is selected, designed, and implemented.[3]
3. Continue to measure the energy and GHG footprints on a semiannual basis through the use of USEPA's SEFA workbooks to provide a consistent means of measuring improvements related to energy use and GHG emissions.
4. Use estimated energy demand and GHG emissions as balancing criteria during remedy selection to optimize remedy effectiveness and energy/GHG efficiency.[3]
5. Coordinate efforts implemented under the Renewable Energy Assessment with the Greener Cleanup BMP Process for other core elements for overall reductions in the environmental footprint.

BASELINE ENERGY/GHG ASSESSMENT

This section presents a baseline assessment of energy demand, supply, and distribution for the existing GWETS, which is assumed to remain in its current configuration for approximately five years before changes are potentially made in preparation for a final remedy. It also presents an approach for focusing efforts for identifying renewable energy alternatives. The goal of this assessment is to identify energy source requirements and potential barriers or restrictions to using renewable energy.

Energy Demand

The GWETS has two main operations: 1) pump groundwater from one on-site well field and two off-site well fields and convey it to the Site via influent pipelines 2) treat extracted groundwater at the on-site fluidized Bed Reactors (FBRs) and the Groundwater Treatment Plant (GWTP) [4] and discharge treated water at the Las Vegas Wash outfall via effluent pipelines co-located with the influent pipelines. These are all-electric facilities with continuous operations. Figure A-1 shows a map of the primary components of the GWETS.

Because the GWETS involves many continuously-operating processes to extract, convey, and treat large volumes of groundwater, energy use has a large impact on the overall environmental footprint. The largest contributor to the energy footprint is electricity used for operation of the on-site groundwater extraction wells, on-site groundwater treatment systems, and office trailers for both the GWETS operator and the Trust. Site electricity is provided by the Colorado River Commission of Nevada (CRC), which provides electricity to all of the Black Mountain Industrial (BMI) Complex.

The second largest contributor to the energy footprint is electricity used for operation of off-site groundwater extraction wells and conveyance of extracted groundwater via the three off-site lift stations. This electricity is provided by NV Energy. The remainder of the energy footprint is comprised of non-electricity energy usage, including transportation, manufacture of treatment chemicals and materials, off-site laboratory analyses, on-site equipment usage, and other off-site activities (e.g. fuel processing, waste management).

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[3] This is a longer-term goal—one which will be considered during subsequent cleanup phases—therefore, measures to address this goal are beyond the scope of the current assessment.

[4] By convention, the "GWTP" consists of only the on-site hexavalent chromium treatment plant. The name pre-dates the installation of any of the other treatment systems and related components.

A summary of the results from the environmental footprint analysis for the period July 2018 through June 2019[5] using USEPA's SEFA workbooks is shown in the table below.

Core Element	Metric	Footprint	Units
Energy	Total annual energy used (on-site and off-site)	101,200	Million British Thermal Units (MMBTU)
	Off-Site Electricity Use - Groundwater Extraction (electricity supplied by NV Energy)	1,514	Megawatt Hours (MWh)
	On-Site Electricity Use – Groundwater Treatment (electricity supplied by Colorado River Commission)	5,323	MWh
Air	Total annual GHG emissions	1,910	Tons CO_2 equivalents

During the performance period from July 2018 through June 2019, on-site and off-site electricity use was 5,323 and 1,514 Megawatt-hours (MWh), respectively, indicating that on-site electricity use accounts for approximately 78% of total electricity use, which is generally consistent with the last three years of operation.

Energy Supply

Electricity used by the on-site groundwater extraction wells, on-site groundwater treatment systems, and on-site office trailers for both the GWETS operator and the Trust comes from the CRC, which supplies hydro-electric power from the Hoover Dam, a renewable energy source. Therefore, there are little to no contributions to the GHG footprint from these operations. In addition, the cost of the hydro-electric power (all inclusive) is $0.0281/kWh, which is a very low rate compared to other suppliers in the area.

Acknowledging the source of on-Site electricity, the main contributor to the GHG footprint is electricity use for operation of off-site groundwater extraction wells and conveyance of extracted groundwater via the three off-site lift stations. The July 2018 through June 2019 SEFA workbooks indicate that GHG emissions from off-site electricity use account for approximately 58.7% of total GHG emissions associated with the GWETS and GWM program. The source of this electricity is NV Energy, which reports that its southern Nevada operations obtain approximately 17% of their energy from renewable sources, with the remaining energy obtained from primarily natural gas (74%) and coal (9%).[6] The electricity provided to NERT's off-site facilities are under NV Energy's Large General Service (LGS-1) schedule. This schedule is applicable for non-residential service where consumption of energy exceeds 3,500 kWh in any one of the current or prior 11 months and where the billing demand is equal to or less than 299 kW in the current month. The cost of power from NV Energy ranges from $0.0803 to $0.0842/kWh, which is almost three times the cost of the hydro-electric power used on-site.

Energy Distribution

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[5] Ramboll, 2019. Annual Remedial Performance Report for Chromium and Perchlorate, Nevada Environmental Response Trust Site, Henderson, Nevada. Draft in progress.

[6] NV Energy, 2018. Nevada Power Company d/b/a NV Energy Power Content Label. January. https://www.nvenergy.com/publish/content/dam/nvenergy/bill_inserts/2018/01_jan/power-content-insert-south-2018-01_3_31.pdf

The electricity is provided at 480 Volts at the meter level at each of the three lift stations after being stepped down from the main primary line voltage.

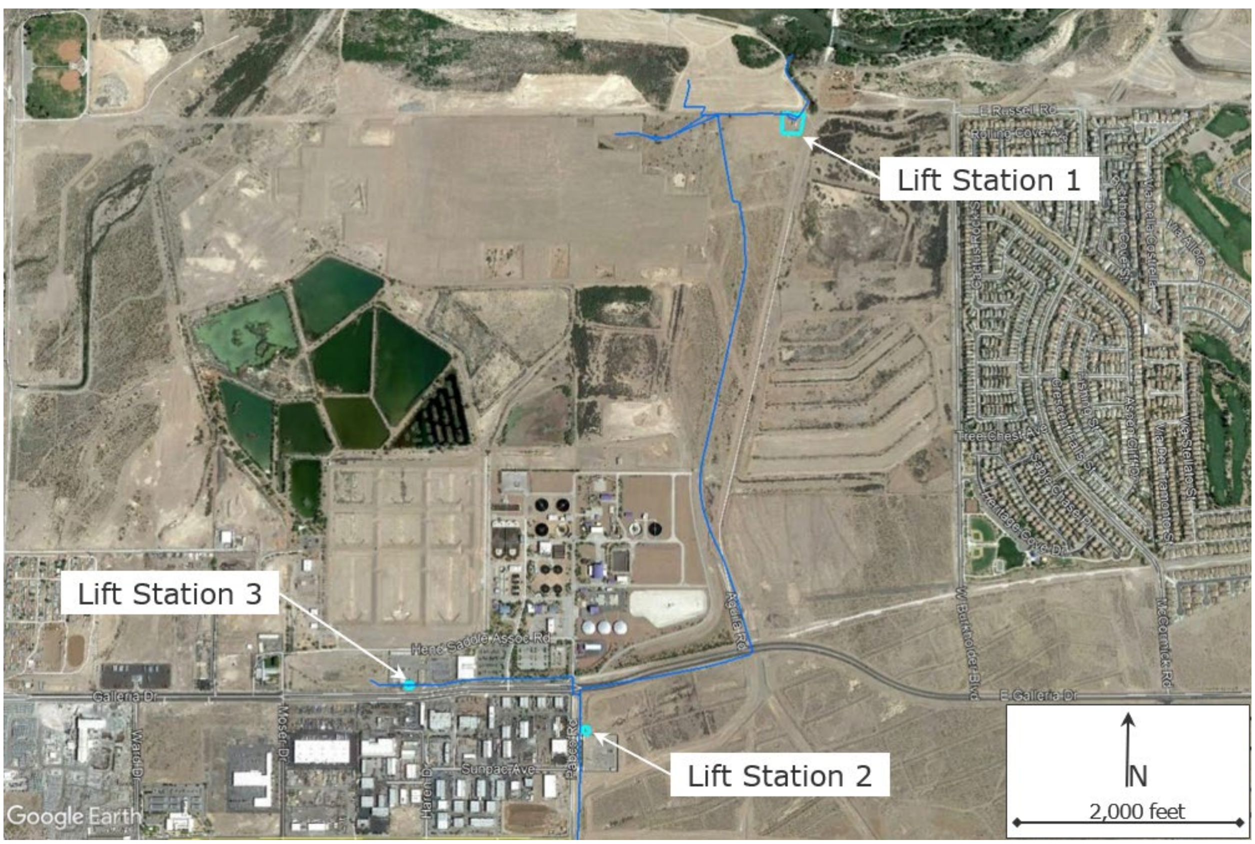
Approach for Baseline Energy/GHG Assessment

For this preliminary assessment, the focus was on off-site facilities as the best opportunity for energy and GHG reductions. On-site operations have already achieved the goal of being 100% renewable and the on-site energy is delivered at a relatively low cost, therefore on-site operations are excluded from this assessment.

The off-site locations where connections are made to the NV Energy grid are the following:

- *Lift Station-1 (LS-1):* Pabco Road at the Las Vegas Wash on a parcel of land (APN 16031101002) owned by Basic Environmental Company, LLC (BEC). Includes the Seep Well Field (SWF) pumps and a containerized ion exchange (IX) system treating a portion of the SWF flow.
- *Lift Station-2 (LS-2):* Pabco Road at Galleria Drive on a parcel of land (APN 17906101003) owned by BEC. No associated extraction well field.
- *Lift Station-3 (LS-3):* Galleria Drive on a parcel of land (APN 16136801004) owned by the City of Henderson (COH). Includes the Athens Well Field (AWF) pumps.

Extracted groundwater from the SWF and AWF is conveyed back on-site via the lift stations and pipelines. The layout of the lift stations, extraction well fields, and pipelines is shown on attached Figure A-1. The locations of the lift stations are also shown on the aerial image below.



Aerial image depicting the locations of the three lift stations (light blue boxes). The dark blue lines depict the layout of existing buried pipelines.

To develop the baseline, the most recent available 12 months of electric bills were used (July 2018 to June 2019). As previously discussed, all of the lift stations are served by NV Energy, which is a local electric utility distribution company. Each lift station has one electric meter which records the electric demand in kilowatts (kW) and energy usage in kilowatt-hours (kWh). Table A-1 (attached at end of report) summarizes the electric bills from NV Energy for each offsite lift stations (LS-1, LS-2 and LS-3). For this assessment, the average costs for the electricity ($/kWh) for each lift station and total annual electricity usage (kWh/yr) were used as follows:

Location	Total Billed Electricity Use	Avg. Electric Costs
LS-1	505,449 kWh/yr	$0.0821/kWh
LS-2	740,367 kWh/yr	$0.0842/kWh
LS-3	268,013 kWh/yr	$0.0842/kWh

Based on the utility bills, the total electricity used for all three lift stations combined was 1,513,829 kWh at a cost of $125,189 with average blended unit cost of $0.0827/kWh. Applying a GHG factor (tons of carbon dioxide produced per kWh) of 0.00057 (from the SEFA workbooks) provides an estimate of annual GHG emissions of approximately 863 tons of carbon dioxide (see Table A-1).

Equipment List & Energy Profile

Typically, the first step of a baseline assessment is a site survey to catalog all equipment and record nameplate data. In this case, the GWETS operator, Envirogen Technologies, Inc., was contacted and equipment information was transmitted electronically without a site survey by Ramboll. Using this information, Ramboll developed an energy usage profile which is the total energy use pattern for each of the off-site components in the system being assessed. This analysis provides a baseline measurement of the energy usage per component and provides an indication for potential energy saving opportunities. Horsepower (HP) ratings are recorded for each piece of equipment. In addition, the presence of variable frequency drives (VFDs) is also recorded to identify energy efficiency measures already implemented for qualified motors. Tables A-2, A-3, and A-4 summarize the equipment and energy profiles for each of the lift stations, LS-1, LS-2, and LS-3, respectively.

Based on the equipment specifications, maximum energy demand rating (kW) was calculated. To calculate the total annual energy usage for each piece of equipment, a utilization factor (UF) was established, which is the percentage (%) of the total possible hours per year (8760 hrs/yr) the equipment operates. The load factor (LF) was also established, which is the percentage (%) of the maximum rating (kW) the equipment runs while in operation.

In the case of the three lift stations, the pumps run continuously (24x7) which means the UF is very high (many pumps have a UF as high as 95%) and the LF is then adjusted to match the energy usage listed on utility bills. If there are redundant pumps (example: LS-1 Wet Well Pumps P-40011 and P-40012), it is assumed that they run equal time so the UF is 50% for each.

Once the energy usage (kWh/yr) was calculated for each piece of equipment, energy cost of operating the equipment was calculated by multiplying the usage with the average unit cost of electricity ($/kWh). Comparing the calculated total energy use versus total energy usage in the utility bills provides a check of the calculations. Less than 2% variance is generally acceptable. In addition, a GHG emission factor was also used to calculate the GHG emission from each equipment on an annual basis. The following sections present results of the baseline assessment for each of the three lift station facilities and the total for all off-site facilities.

Lift Station 1 (LS-1)

LS-1 is located on a dirt road extension of Pabco Road near Las Vegas Wash, and receives groundwater pumped from the SWF wells. LS-1 also includes a containerized IX system which treats a portion of the SWF groundwater extraction flow. LS-1 has a concrete wet well measuring approximately 32 feet by 14 feet by 7 feet, with a capacity of approximately 24,000 gallons. The water is pumped through a 10-inch diameter high-density polyethylene (HDPE) pipe to LS-2. Flow is controlled with a throttling valve. The GWETS operators report that the valve is approximately 50 percent open during regular operation. The transfer pumps in LS-1 are turned on and off by the signals from high and low liquid level switches in the wet well. When the liquid level in LS-1 reaches a high-level alarm, all well pumps in the SWF area are shut down. Table 2 summarizes the equipment comprising LS-1 and lists the baseline energy profile.

The total calculated annual energy usage for LS-1 is 503,593 kWh/yr. This represents less than 1% variance between the calculated energy usage and the actual energy usage as listed in the utility bills. The estimated annual GHG emissions from operation of LS-1 is approximately 287 tons of carbon dioxide or 33% of the total emissions by all lift stations (see Table A-2).

Lift Station 2 (LS-2)

LS-2, located at Pabco Road, has a wet well measuring approximately 21 feet by 22 feet by 14 feet, with a capacity of approximately 48,000 gallons which receives flow from both LS-1 and LS-3. There are no groundwater extraction wells directly connected to LS-2; all flow is received from LS-1 and LS-3. Water is pumped through a 12-inch diameter HDPE pipe to the on-site FBRs and flow is controlled with a throttling valve. The GWETS operators report that the valve is approximately 50% open during regular operations.

The transfer pumps in LS-2 are turned on and off by the signals from high and low liquid level switches. When the liquid level in LS-2 reaches a high-level alarm, the pumps in LS-1 are turned off. If the liquid level stays at the alarm level, the pumps in LS-3 are turned off. When discharging to the equalization (EQ) tanks, a high-level alarm in the EQ tanks turns off the pumps in LS-2.

The total calculated annual energy usage for LS-2 is 742,907 kWh/yr. This represents less than 1% variance between the calculated energy usage and the actual energy usage as listed in the utility bills. The estimated annual GHG emissions from operation of LS-2 is approximately 423 tons of carbon dioxide or 49% of the total emissions by all lift stations (see Table A-3).

Lift Station 3 (LS-3)

LS-3 is located on Galleria Drive adjacent to the COH Water Reclamation Facility (WCF) and receives groundwater pumped from the AWF wells. LS-3 has a wet well measuring approximately 8 feet by 25 feet by 8 feet, with a capacity of approximately 12,000 gallons. Water is pumped through an 8-inch diameter HDPE pipe to LS-2. Flow is controlled with a throttling valve, which the GWETS operators noted was normally “between 60 and 75 percent;” interpreted as percent closed based on subsequent load calculations.

The transfer pumps in LS-3 are turned on and off by the signals from high and low liquid level switches. When the liquid level in LS-3 reaches a high-level alarm, all well pumps in the AWF area are turned off.

The total calculated annual energy usage for LS-3 is 265,596 kWh/yr. This represents a 1% variance between the calculated energy usage and the actual energy usage as listed in the utility bills. The estimated annual GHG emissions from operation of LS-3 is approximately 151.4 tons of carbon dioxide or 18% of the total emissions by all lift stations (see Table A-4).

OPPORTUNITIES FOR ENERGY/GHG REDUCTIONS

This section discusses a range of opportunities considered for reducing energy use and GHG emissions with respect to the off-site energy usage of the Trust. With respect to the Renewable Energy Assessment, the 2018 Greener Cleanup Work Plan set forth eight specific objectives. These objectives are listed in the following matrix along with the results from the preliminary assessment.

Stated Objectives	Results of the Preliminary Assessment
Evaluate options (e.g. BMPs) for optimizing energy usage in order to maximize energy efficiency	The baseline energy assessment did not identify current opportunities for reducing energy use. For example, pump motors are not fully loaded and most of them have VFDs. Changes to LED pole lighting has already been implemented. This will be an ongoing objective during subsequent project phases, e.g., remedy selection.
Evaluate current and future alternatives (e.g. BMPs) for utilizing renewable energy sources, including potential for energy production from renewable resources	This assessment identified solar power production via photovoltaic (PV) electrical generation as a potential future alternative for utilizing renewable energy sources. A PV assessment can be found later in this technical memorandum.
Conduct a preliminary renewable energy assessment to evaluate the potential for production of solar power, including an economic and technical feasibility assessment	Solar power production to support the current GWETS and potential expansion of the remedy is technically feasible and potentially implementable. Barriers to implementation remain, e.g., easements and/or land acquisitions would be necessary for off-site facilities. A PV assessment can be found later in this technical memorandum.

Stated Objectives	Results of the Preliminary Assessment
Evaluate options (e.g. BMPs) for purchasing renewable power from off-site resources in the short-term and long-term, including options for purchasing renewable power from utilities	Options were evaluated for purchasing renewable power from off-site resources. Renewable Energy Certificates (RECs) can be purchased to offset the GHG emissions of grid purchased electricity. In Nevada, RECs are traded through Nevada Tracks Renewable Energy Credits (NVTREC) or the Western Renewable Energy Generation Information System (WREGIS). However, USEPA methodology encourages reduction of air emissions through generation or use of energy from renewable resources prior to considering air emission reductions through voluntary purchase of renewable electricity or RECs. [7] Therefore, purchase of RECs will only be considered following the further evaluation of solar power generation opportunities and are not discussed further in this technical memorandum.
For all BMPs evaluated within the Renewable Energy Assessment, identify potential benefits associated with BMP implementation to the environmental footprint of the GWETS and GWM program	Solar power production to support off-site GWETS facilities could result in reduction of GHG emissions by 100%. A PV assessment can be found later in this technical memorandum.
Define goals for decreasing fossil fuel usage and develop methodology to assess progress	The Renewable Energy Assessment establishes goals and recommendations. Additional goals may be defined during subsequent phases of the NERT RI/FS and later remedial design and remedial action. The GHG emissions calculated semi-annually as part of the environmental footprint will be used to assess progress.
Establish short-term and long-term timelines for reducing fossil fuel dependence at the Site	Developing specific timelines require additional information that will be collected as part of the implementation of the Renewable Energy Assessment.
Recommend BMPs for implementation based on the results of these evaluations, propose timeframes for implementation, and evaluate expected benefits of implementation to the environmental footprint of the GWETS and GWM program	This assessment identifies opportunities to potentially replace off-site power with self-generated renewable energy in the form of PV solar power as discussed in the following sections of this technical memorandum.

Based on this preliminary assessment, solar power production via photovoltaic (PV) electrical generation with net metering appears to be the best opportunity for utilizing renewable energy sources to reduce GHG emissions with respect to the off-site energy usage of the Trust. Henderson, Nevada is an ideal location for solar power production due to the duration and intensity of sunlight as measured by “specific yield,” which is a measure of how much energy (kWh) is produced for every kilowatt peak (kWp) of module capacity over the course of a typical or actual year. In other words, specific yield is a measure of how efficient solar energy production is on a per unit (i.e., solar panel) basis, and it is higher in areas with more frequent and intense sunlight. The specific yield for Henderson is approximately 1,965 kilowatt hour per kilowatt peak (kWh/kWp), which is at the highest end of the range for the United States, likely within the 95th percentile for US locations.

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[7] USEPA, 2012. Methodology for Understanding and Reducing a Project’s Environmental Footprint, EPA 542-R-12-002. February.

This specific yield makes Henderson ideal for solar PV installations. However, there are barriers to implementation that need to be considered, e.g., availability of land to house solar facilities. A solar feasibility assessment is the subject of the subsequent sections of this Renewable Energy Assessment.

SOLAR FEASIBILITY ASSESSMENT

This section presents a preliminary feasibility assessment of generating solar power to support the off-site GWETS facilities. This assessment was performed as a "desktop study" consisting of reviews of readily available data, discussions with Site and utilities representatives, and modeled scenarios.

The primary objectives of the solar feasibility assessment were as follows:

- Evaluate load profile over 10 years for load growth scenarios of 0%, 25%, 50%, 75%, and 100% for LS-1, LS-2, and LS-3;
- Evaluate solar PV options to reduce GHG emissions to zero; and
- Include NV Energy net metering option.

The purpose of this assessment is to provide preliminary information to better understand the technical and cost feasibility; it is not intended as a cost estimate for implementation. It should also be noted that at this point in time it is difficult to predict with any accuracy what energy demand might be once a final remedy is implemented; therefore, the load profiles for the lift station assumed herein are for illustration purposes only. No site visits were conducted by Ramboll staff, which would be a necessary next step to confirm the findings. Therefore, the results and cost estimates provided through this analysis should be considered preliminary and for purposes of evaluating feasibility only.

Methodology of Solar PV Feasibility Assessment

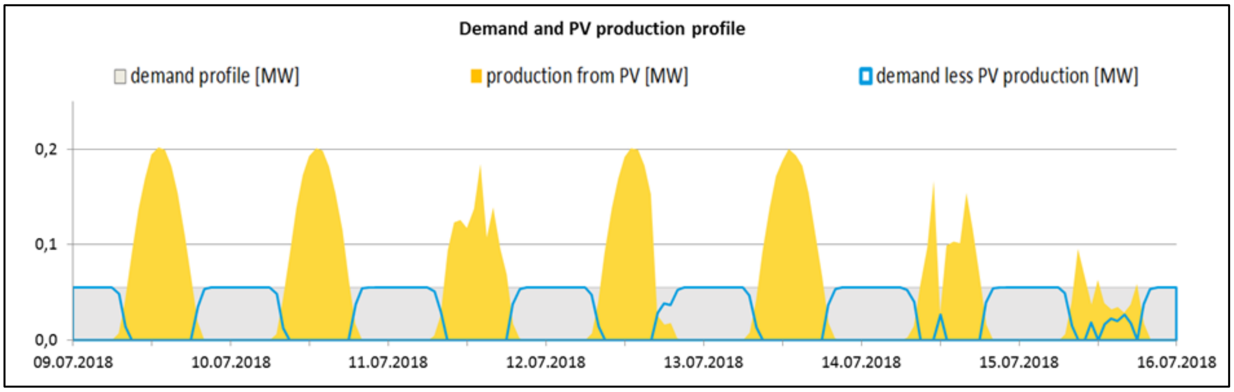
For the assessment of the solar PV potential, Ramboll generally conducts this analysis using four development stages. The first stage is to identify available area for the implementation of PV systems, the three following stages relate to the conceptual design of mechanical systems, electrical systems, and energy output. Because this is a preliminary feasibility-level assessment, the same steps were followed, but the analyses were streamlined to answer basic questions of technical and cost feasibility.

Solar PV installations can be designed with or without battery storage depending on the application. Initially, parallel alternatives with and without battery energy storage were considered. However, after initial conversations with NV Energy, battery storage was eliminated because NV Energy allows "net metering" where additional power can be exported to the grid during the day and imported from the grid at night. This avoids the added cost and complexity of battery energy storage.

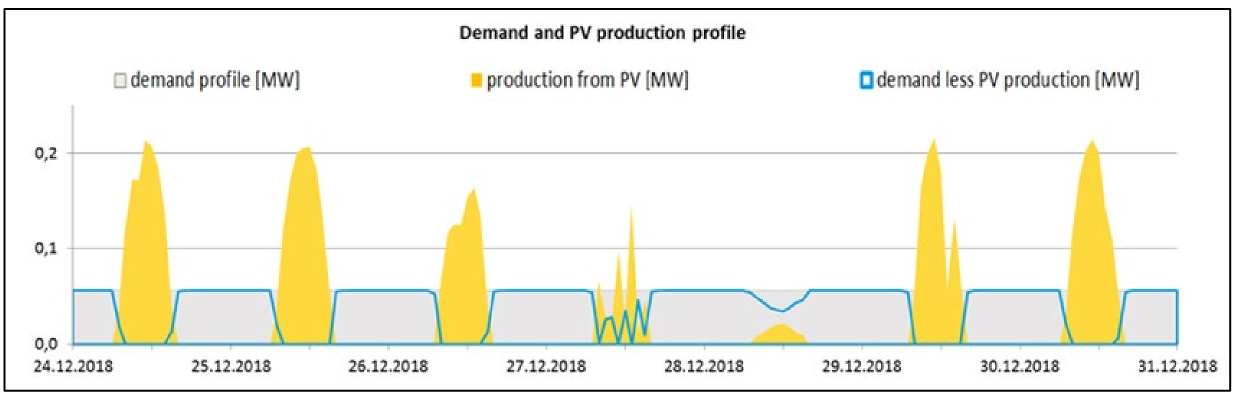
The primary strategy of net metering is to size and install solar PV systems which will produce excess power during the day. The excess power is exported to the grid. A balanced amount of power is then imported at night from the grid to support continuous operations. The net metering tracks the exporting/importing of power and at the end of the year the net will be approximately zero.

The feasibility assessment of solar PV with net metering was accomplished through the use of the software package Helioscope, which is a web-based software developed by Folsom Labs. Helioscope allows the user to design a PV plant layout on the project location and to specify the PV module type, the array size, and the spacing between modules as well as mounting structures. Moreover, it is capable of rapidly analyzing inter-row shading, as well as shading that might be caused by surrounding objects. The meteorological data used by Helioscope for the project location is imported from the US National Solar Radiation Database and the US Department of Energy for the available location closest to the NERT Site.

The solar model uses actual weather data and simulates over a whole year. To illustrate the model, the charts below show a typical summer week versus a typical winter week for LS-1. These charts show demand, the PV production, and the demand less PV production all in megawatts over a one-week period for LS-1.



Typical summer week energy demand and PV production profile for LS-1.



Typical winter week energy demand and PV production profile for LS-1.

These modeled outputs are used in the analysis to anticipate the changes in production and demand. In this output from LS-1, the demand is almost constant (grey) and during the day power is produced (yellow) usually in excess of the daytime demand. At night, power is imported from the grid (blue line), whereas during the day the excess energy is exported to the grid. The solar PV production at any given time will not match the demand at a given time. The net meter will track the actual power imported and exported from the grid on a real time basis. The model predicts that, for a given PV design, the net power imported will be zero on an annual basis.

This feasibility-level analysis was performed for each of the three off-site lift stations. Each off-site location is simulated as a ground-mounted rack system of PV cells adjacent to the lift station it serves. For each lift station, five scenarios were modelled representing the following conditions:

- Baseline annual usage and peak demand simulating current conditions;
- Baseline annual usage and peak demand plus 25% additional usage;
- Baseline annual usage and peak demand plus 50% additional usage;
- Baseline annual usage and peak demand plus 75% additional usage; and
- Baseline annual usage and peak demand plus 100% additional usage.

The scenarios are intended to account for potential expansion of the GWETS, or additional sub-systems, if determined to be integral to the final remedy. Since the final remedy is not likely to be selected for several years this is a conservative assumption. The percentages are arbitrary at this point, therefore, before any subsequent steps toward solar PV implementation occur, a more rigorous energy demand forecast would be necessary.

Results of Solar PV Feasibility Assessment

Table A-5 presents a detailed summary of the solar PV configurations with future load growth scenarios for each of the lift stations. For all lift stations, the preferred configuration of the panels is to be facing south. The solar PV size requirements for LS1, LS-2, and LS-3 for each of the five modeled scenarios are summarized below.

LS-1	Baseline	+25%	+50%	+75%	+100%
PV Panels (#)	736	920	1,104	1,288	1,471
PV Area (square ft)	32,000	40,000	48,000	55,000	63,000
PV Area (Acres)	0.73	0.92	1.1	1.26	1.45

LS-2	Baseline	+25%	+50%	+75%	+100%
PV Panels (#)	1,078	1,347	1,617	1,886	2,155
PV Area (square ft)	46,000	58,000	69,000	81,000	92,000
PV Area (Acres)	1.06	1.33	1.58	1.86	2.11

LS-3	Baseline	+25%	+50%	+75%	+100%
PV Panels (#)	390	488	585	683	780
PV Area (square ft)	17,000	21,000	25,000	30,000	34,000
PV Area (Acres)	0.39	0.48	0.57	0.69	0.78

To demonstrate the scale of the areas, the following mock-ups of LS-1, LS-2, and LS-3 show the lift stations with outlined areas depicting the baseline plus 100% additional usage. The areas shown below represent the maximum-size modeled scenarios with 3% additional area for panel spacing and access.

Depiction of the area needed for solar PV located immediately west of LS-1 (green outline) assuming baseline plus 100% usage increase (1.5 Acres). LS-1 is outlined in blue (0.83 Acres). Shown only for the purpose of demonstrating scale, not for construction. NERT understands that this area is intended for development as a future park and cannot be used for development of a solar field.

Depiction of the area needed for solar PV located immediately north of LS-2 (green outline) assuming baseline plus 100% usage increase (2.2 Acres). LS-2 is outlined in blue (0.1 Acres). Shown only for the purpose of demonstrating scale, not for construction.

Depiction of the area needed for solar PV located immediately north of LS-3 (green outline) assuming baseline plus 100% usage increase (0.80 Acres). LS-3 is outlined in blue (0.1 Acres). Shown only for the purpose of demonstrating scale, not for construction.

Cost-Benefit Analysis

Tables A-6, A-7, A-8, and A-9 present the solar PV cost-benefit analyses (CBA) for LS-1, LS-2, LS-3, and all three lift stations, respectively. The CBA tables summarize the simulation results, PV sizing, energy savings, implementation costs, and the payback including incentives and/or any applicable credits. As noted above, the costs provided herein are feasibility-level costs not for implementation.

The import power cost from the grid is $80.34/MWh and the export power to the grid is $65.07/MWh. This is according to NV Energy's fee schedule, which stipulates that the power sellback will be at 81% of the grid power cost.[8] Generally, solar projects can benefit from a Federal investment tax credit (ITC). The ITC, also known as the federal solar tax credit, allows owners of solar systems to deduct a percentage (26% in 2020) of the cost of installing a solar energy system from your federal taxes. The ITC applies to both residential and commercial systems, and there is no cap on its value. However, in the case of NERT, this ITC is not applicable because NERT does not pay Federal taxes. Therefore, the CBA performed for NERT does not consider the ITC.

The baseline annual electricity costs for each lift station is calculated as part of the baseline assessment discussed previously. For the various modeled solar PV systems, total import grid power costs and the revenue to export (sellback) is also calculated. Net energy costs savings are calculated as follows:

Net energy costs [$/yr] = Baseline energy costs [$/yr] – (Imported energy costs [$/yr] – Exported energy revenue [$/yr]).

For implementation, costs are estimated based on similar-scale systems and include solar PV modules, inverters, net meter, racks cables, breakers, disconnects and relays for grid parallel connections. For the solar PV systems, it is assumed that they will be connected to the load side of the existing panel through a main new "AC Disconnect". For systems of this type, costs are estimated to be $2,500/kW based on a quote from a local solar installation contractor, Sol-Up, located in Las Vegas, Nevada. This also includes testing and commissioning as per NV Energy's solar PV installation requirement. In addition, the permit fee is estimated to be $50,000. These costs do not include engineering and consulting costs, but generally these are assumed to be 5-10% of capital costs. The annual O&M costs for the solar PV system is estimated to be $40/kW. This assumes annual check-up, cleaning the PV modules, and routine repair/replacement as required. Implementation costs do not include land acquisition or long-term leasing of property to accommodate the solar PV infrastructure.

The time until payback[9] considering applicable incentives then calculated. The simple payback is calculated as follows:

Simple Payback [yr] = (Total implementation cost [$]) / (Net cost savings [$/yr]).

Capital expenditures (CAPEX), operational expenditures (OPEX), and payback for each lift station and for all lift stations combined are summarized below. See attached Tables A-6, A-7, A-8, and A-9 for detailed CBA calculations.

[8] https://www.energysage.com/net-metering/nv-energy/

[9] This preliminary assessment does not include a net present value (NPV) analysis to calculate payback therefore, this calculation is for "simple payback." Analysis of NPV and evaluation of applicable incentives will be incorporated into subsequent assessments as needed.

LS-1	Baseline	+25%	+50%	+75%	+100%
CAPEX	$693,778	$854,723	$1,015,667	$1,176,612	$1,337,557
OPEX	$10,300/yr	$12,876/yr	$15,451/yr	$18,026/yr	$20,601/yr
Payback	27yr	27yr	26yr	26yr	26yr

LS-2	Baseline	+25%	+50%	+75%	+100%
CAPEX	$992,988	$1,228,735	$1,464,482	$1,700,229	$1,935,975
OPEX	$15,088/yr	$18,860/yr	$22,632/yr	$26,404/yr	$30,176/yr
Payback	26yr	26yr	26yr	26yr	26yr

LS-3	Baseline	+25%	+50%	+75%	+100%
CAPEX	$391,362	$476,702	$562,043	$647,383	$732,724
OPEX	$5,462/yr	$6,827/yr	$8,193/yr	$9,558/yr	$10,924/yr
Payback	29yr	28yr	27yr	27yr	27yr

LS-1, 2, and 3	Baseline	+25%	+50%	+75%	+100%
CAPEX	$1,978,128	$2,460,160	$2,942,192	$3,424,224	$3,906,256
OPEX	$30,850/yr	$38,563/yr	$46,275/yr	$53,988/yr	$61,700/yr
Payback	26yr	26yr	25yr	25yr	25yr

To put the payback numbers into perspective, PV modules typically come with 20-year warranties guaranteeing that the panels will produce at least 80% of the rated power after 20 years of use. Therefore, considering the payback terms presented above, significant return on investment may be realized before large-scale out-of-warranty replacement would be necessary, assuming the annual O&M specified above was performed.

FINDINGS AND RECOMMENDATIONS

The sections above established goals to reduce the energy use and GHG emissions, presented a baseline energy and GHG assessment, evaluated opportunities for reducing energy use and GHG emissions, and presented a feasibility assessment for solar production. The baseline assessment found that while many energy reduction efforts have already been implemented at the NERT Site, and the on-site power used is 100% renewable hydro-electric, there remain opportunities to reduce GHG emissions by focusing on the off-site energy use at the three lift stations. A preliminary solar PV feasibility assessment indicates that this option is feasible, but that land acquisition or long-term property leasing would need to be explored. Purchase of RECs is an option to reduce GHG emissions, but USEPA's methodology encourages reduction of air emissions through generation or use of energy from renewable resources prior to considering air emission reductions through voluntary purchase of RECs. However, at this time the final remedy has not been selected and it is uncertain how the existing GWETS may be modified to support the final remedy to be implemented across the NERT RI Study Area. Therefore, future evaluations such as developing a more detailed conceptual design of a solar PV system (or systems) should be completed after the FS has been approved by NDEP and USEPA. These activities can be completed as part of the remedial design process.

Attachments

Figure A-1: Groundwater Extraction and Treatment System (GWETS) Location Map

Table A-1: LS-1, LS-2 and LS-3 Baseline Energy Usage from Utility Bills

Table A-2: LS-1 Baseline Energy Usage Profile

Table A-3: LS-2 Baseline Energy Usage Profile

Table A-4: LS-3 Baseline Energy Usage Profile

Table A-5: Solar PV System Configuration and Future Load Growth

Table A-6: Solar PV Cost-Benefit Analysis for LS-1

Table A-7: Solar PV Cost-Benefit Analysis for LS-2

Table A-8: Solar PV Cost-Benefit Analysis for LS-3

Table A-9: Solar PV Cost-Benefit Analysis for LS-1, LS-2 & LS-3

RAMBOLL

ENVIRONMENT
& HEALTH

Renewable Energy Assessment

Nevada Environmental Response Trust Site
(Former Tronox LLC Site)
Henderson, Nevada

Nevada Environmental Response Trust (NERT) Representative Certification
I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of NERT. Based on my own involvement and/or my inquiry of the person or persons who manage the system(s) or those directly responsible for gathering the information or preparing the document, or the immediate supervisor of such person(s), the information submitted and provided herein is, to the best of my knowledge and belief, true, accurate, and complete in all material respects.

Office of the Nevada Environmental Response Trust

Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Signature: Jay A Steinberg
Not Individually, but Solely as President of the Trustee

Name: Jay A. Steinberg, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

Title: Solely as President and not individually

Company: Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Date: 2/27/2020

RAMBOLL

ENVIRONMENT
& HEALTH

Renewable Energy Assessment

Nevada Environmental Response Trust
(Former Tronox LLC Site)
Henderson, Nevada

Responsible Certified Environmental Manager (CEM) for this project
I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state and local statutes, regulations and ordinances.

John M. Pekala, PG	February 27, 2020
Principal	**Date**

Certified Environmental Manager
Ramboll US Corporation
CEM Certificate Number: 2347
CEM Expiration Date: September 20, 2020

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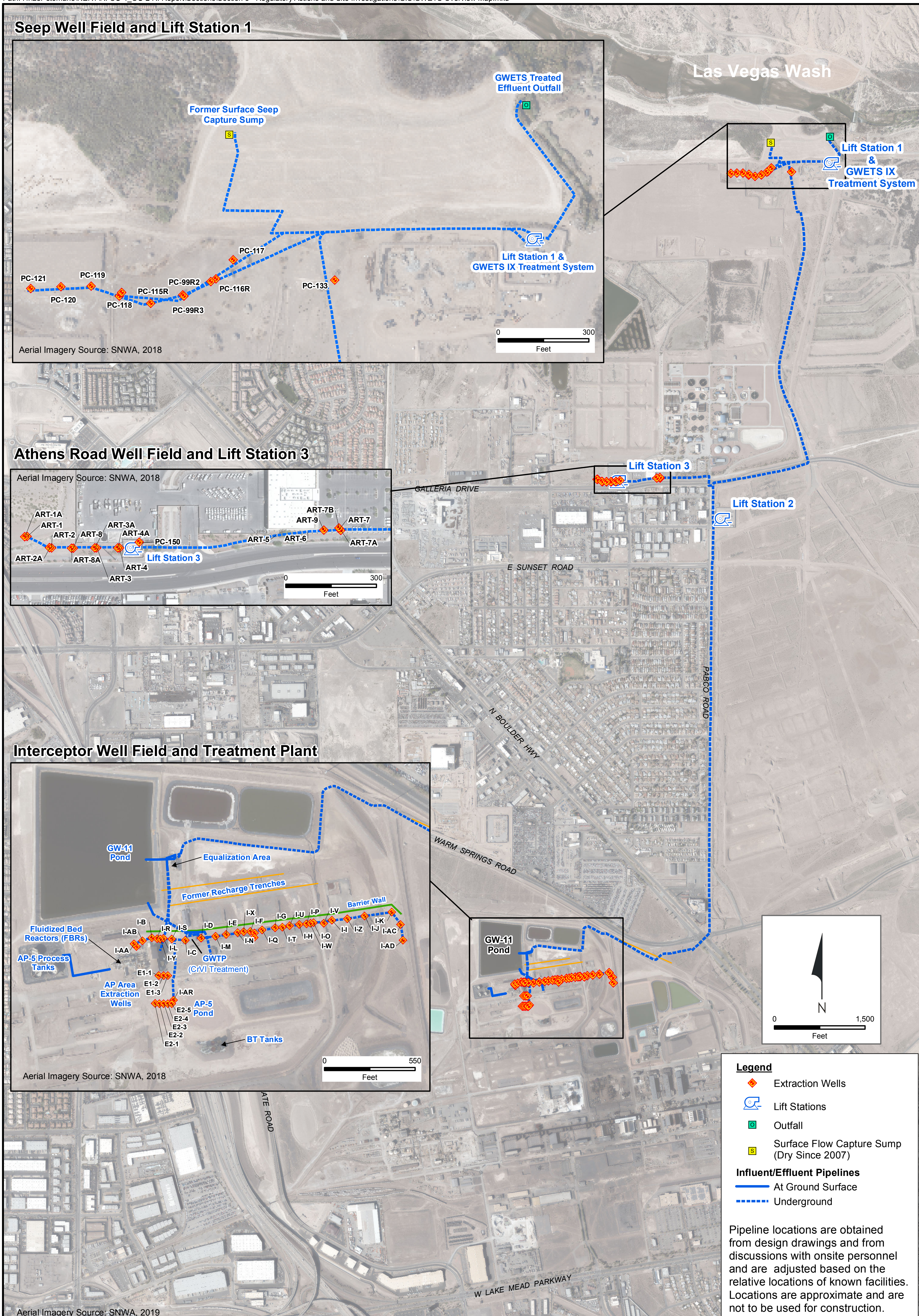

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Groundwater Extraction and Treatment System (GWETS) Components Location Map

Nevada Environmental Response Trust Site; Henderson, Nevada

Figure **A-1**

Drafter: RS	Date: 12/19/2019	Contract Number: 1690011198-008	Approved by:	Revised:

Table A-1: LS-1, LS-2 and LS-3 Baseline Energy Usage from Utility Bills
Nevada Environmental Response Trust; Henderson, Nevada

Month	Energy Use for LS-1, LS-2, LS-3			
	Total kWh	Total kW	Total $	Total $/kWh
Jul-18	125,008	168	$10,359	$0.0829
Aug-18	134,394	181	$10,943	$0.0814
Sep-18	127,122	177	$10,483	$0.0825
Oct-18	122,809	165	$10,085	$0.0821
Nov-18	137,626	191	$10,991	$0.0799
Dec-18	125,282	168	$10,159	$0.0811
Jan-19	134,009	180	$10,787	$0.0805
Feb-19	119,859	178	$9,838	$0.0821
Mar-19	116,324	156	$9,608	$0.0826
Apr-19	129,955	180	$11,015	$0.0848
May-19	126,321	170	$10,831	$0.0857
Jun-19	115,120	160	$10,090	$0.0876
Total	**1,513,829**	**191**	**$125,189**	**$0.0827**
GHG Factor (tons/kWh)	0.00057			
GHG Emission (tons of CO_2/yr)	**863**			

Notes:

kW = kilowatts

kWh = kilowatt hours

$/kWh = dollars per kilowatt hours

CO_2/yr = carbon dioxide per year

GHG = green house gas

Table A-2: LS-1 Baseline Energy Usage Profile
Nevada Environmental Response Trust; Henderson, Nevada

Item	Type	Calculated kw	Estimated Load Factor (LF)	Estimated Utilization Factor (UF)	Calculated (kWh/yr)	Electricity Unit Cost ($/kWh)	Total Electricity Costs ($/yr)	GHG Emission (tons CO_2/yr)
Seep Well Field	PC-115R	3.73	51%	95%	15,831	$ 0.0821	$ 1,300	9.0
Seep Well Field	PC-116R	14.92	51%	95%	63,324	$ 0.0821	$ 5,200	36.1
Seep Well Field	PC-117	3.73	51%	95%	15,831	$ 0.0821	$ 1,300	9.0
Seep Well Field	PC-118	3.73	51%	95%	15,831	$ 0.0821	$ 1,300	9.0
Seep Well Field	PC-119	3.73	51%	95%	15,831	$ 0.0821	$ 1,300	9.0
Seep Well Field	PC-120	3.73	51%	95%	15,831	$ 0.0821	$ 1,300	9.0
Seep Well Field	PC-121	3.73	51%	95%	15,831	$ 0.0821	$ 1,300	9.0
Seep Well Field	PC-133	3.73	51%	95%	15,831	$ 0.0821	$ 1,300	9.0
Seep Well Field	PC-99R3	14.92	51%	95%	63,324	$ 0.0821	$ 5,200	36.1
LS-1 Wet Well Pump	P-40011	37.30	51%	50%	83,321	$ 0.0821	$ 6,842	47.5
LS-1 Wet Well Pump	P-40012	37.30	51%	50%	83,321	$ 0.0821	$ 6,842	47.5
IX A Pump	P-100A	18.65	51%	50%	41,660	$ 0.0821	$ 3,421	23.7
IX B Pump	P-100B	18.65	51%	50%	41,660	$ 0.0821	$ 3,421	23.7
LS-1 A/C unit 5000 btu	VFD MCC	1.47	51%	95%	6,218	$ 0.0821	$ 511	3.5
LS-1 A/C unit 8000 btu	VFD MCC	2.34	51%	95%	9,948	$ 0.0821	$ 817	5.7
Total		**116**			**503,593**		**$ 41,356**	**287**

Actual Bill	**505,449**	kWh/yr
% Variance	**0%**	

Notes:

CO_2/yr = carbon dioxide per year

GHG = green house gas

kW = kilowatts

kWh/yr = kilowatt hours per year

$/kWh = dollars per kilowatt hours

$/yr = dollars per year

Table A-3: LS-2 Baseline Energy Usage Profile
Nevada Environmental Response Trust; Henderson, Nevada

Item	Type	Calculated kw	Estimated Load Factor (LF)	Estimated Utilization Factor (UF)	Calculated (kWh/yr)	Electricity Unit Cost ($/kWh)	Total Electricity Costs ($/yr)	GHG Emission (tons CO_2/yr)
LS-2 to FBR	P-200N	74.60	55%	95%	341,452	$ 0.0842	$ 28,743	194.6
LS-2 to FBR	P-200S	74.60	55%	95%	341,452	$ 0.0842	$ 28,743	194.6
LS-2 A/C unit 8000 btu	HVAC	2.3	55%	95%	10,729	$ 0.0842	$ 903	6.1
LS-2 Lighting & Misc	Lighting	15.0	50%	75%	49,275	$ 0.0842	$ 4,148	28.1
		167			**742,907**		**$ 62,537**	**423**

Actual Bill	**740,367**
% Variance	**0%**

Notes:

CO_2/yr = carbon dioxide per year

GHG = green house gas

kW = kilowatts

kWh/yr = kilowatt hours per year

$/kWh = dollars per kilowatt hours

$/yr = dollars per year

Table A-4: LS-3 Baseline Energy Usage Profile
Nevada Environmental Response Trust; Henderson, Nevada

Item	Type	Calculated kw	Estimated Load Factor (LF)	Estimated Utilization Factor (UF)	Calculated (kWh/yr)	Electricity Unit Cost ($/kWh)	Total Electricity Costs ($/yr)	GHG Emission (tons CO_2/yr)
LS3 east turbine pump	Pump	7.5	75%	50%	24,506	$ 0.0809	$ 1,983	14.0
LS3 west turbine pump	Pump	7.5	75%	50%	24,506	$ 0.0809	$ 1,983	14.0
LS 3 A/C unit 3000 btu	HVAC	0.9	75%	83%	4,793	$ 0.0809	$ 388	2.7
LS 3 A/C unit 1500 btu	HVAC	0.4	75%	83%	2,399	$ 0.0809	$ 194	1.4
LS 3 A/C unit 1500 btu	HVAC	0.4	75%	83%	2,399	$ 0.0809	$ 194	1.4
LS 3 A/C unit 1500 btu	HVAC	0.4	75%	83%	2,399	$ 0.0809	$ 194	1.4
LS 3 A/C unit 1500 btu	HVAC	0.4	75%	83%	2,399	$ 0.0809	$ 194	1.4
ART Well Pumps	ART-1	1.49	75%	50%	4,901	$ 0.0842	$ 413	2.8
ART Well Pumps	ART-1A	1.12	75%	50%	3,676	$ 0.0842	$ 309	2.1
ART Well Pumps	ART-2	1.49	75%	50%	4,901	$ 0.0842	$ 413	2.8
ART Well Pumps	ART-2A	1.12	75%	50%	3,676	$ 0.0842	$ 309	2.1
ART Well Pumps	ART-3	1.49	75%	50%	4,901	$ 0.0842	$ 413	2.8
ART Well Pumps	ART-3A	1.12	75%	50%	3,676	$ 0.0842	$ 309	2.1
ART Well Pumps	ART-4	1.49	75%	50%	4,901	$ 0.0842	$ 413	2.8
ART Well Pumps	ART-4A	1.12	75%	50%	3,676	$ 0.0842	$ 309	2.1
ART Well Pumps	ART-6	0.56	75%	50%	1,838	$ 0.0842	$ 155	1.0
ART Well Pumps	ART-9	2.24	75%	50%	7,352	$ 0.0842	$ 619	4.2
ART Well Pumps	ART-7	0.56	75%	50%	1,838	$ 0.0842	$ 155	1.0
ART Well Pumps	ART-7B	0.56	75%	50%	1,838	$ 0.0842	$ 155	1.0
ART Well Pumps	ART-8	5.60	75%	50%	18,380	$ 0.0842	$ 1,547	10.5
ART Well Pumps	ART-8A	5.60	75%	50%	18,380	$ 0.0842	$ 1,547	10.5
LS 3 Lighting & Misc	Lighting	18.0	75%	100%	118,260	$ 0.0809	$ 9,570	67.4
Notes:		**61.1**			**265,596**		**$ 21,766**	**151.4**

Actual Bill	**268,013**
% Variance	**1%**

CO_2/yr = carbon dioxide per year
GHG = green house gas
kW = kilowatts
kWh/yr = kilowatt hours per year
$/kWh = dollars per kilowatt hours
$/yr = dollars per year

Table A-5: Solar PV System Configuration and Future Load Growth
Nevada Environmental Response Trust; Henderson, Nevada

		LS-1 Energy Use					LS-2 Energy Use					LS-3 Energy Use					Combined Lift Station Energy Use				
	Units	Current Use	+ 25% Growth	+ 50% Growth	+ 75% Growth	+ 100% Growth	Current Use	+ 25% Growth	+ 50% Growth	+ 75% Growth	+ 100% Growth	Current Use	+ 25% Growth	+ 50% Growth	+ 75% Growth	+ 100% Growth	Current Use	+ 25% Growth	+ 50% Growth	+ 75% Growth	+ 100% Growth
Variant																					
PV Orientation		South	South	South	South	South	South	South	South	South	South	South	South	South	South	South	South	South	South	South	South
Lift station		LS1	LS1	LS1	LS1	LS1	LS2	LS2	LS2	LS2	LS2	LS3	LS3	LS3	LS3	LS3	all	all	all	all	all
Pump Operation		24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7	24/7
Demand																					
Electricity Demand	[MWh/yr]	505.4	631.8	758.2	884.5	1,010.9	740.4	925.5	1,110.6	1,295.6	1,480.7	268.0	335.0	402.0	469.0	536.0	1,513.8	1,892.3	2,270.7	2,649.2	3,027.7
Peak Electricity Demand	[MWp/yr]	0.064	0.081	0.097	0.113	0.129	0.098	0.122	0.147	0.171	0.196	0.038	0.047	0.057	0.066	0.075	0.200	0.250	0.300	0.350	0.400
Photovoltaic Details																					
PV Size (Power)	[MWp]	0.258	0.322	0.386	0.451	0.515	0.377	0.471	0.566	0.660	0.754	0.137	0.171	0.205	0.239	0.273	0.771	0.964	1.157	1.350	1.543
PV Size (Area)	[ft²]	31,369	39,211	47,053	54,895	62,738	45,948	57,435	68,922	80,409	91,896	16,633	20,792	24,950	29,108	33,266	93,950	117,437	140,925	164,412	187,900
PV Size (Area)	[m²]	2,914	3,643	4,371	5,100	5,829	4,269	5,336	6,403	7,470	8,537	1,545	1,932	2,318	2,704	3,091	8,728	10,910	13,092	15,274	17,456
Number of PV panels	#	736	920	1,104	1,288	1,471	1,078	1,347	1,617	1,886	2,155	390	488	585	683	780	2,204	2,754	3,305	3,856	4,407
Produced Electricity	[MWh/yr]	505.4	631.8	758.2	884.5	1010.9	740.4	925.5	1110.6	1295.6	1480.7	268.0	335.0	402.0	469.0	536.0	1513.8	1892.3	2270.7	2649.2	3027.7
Exported Electricity	[MWh/yr]	300.8	376.0	451.2	526.4	601.6	440.8	550.9	661.1	771.3	881.5	159.7	199.6	239.5	279.5	319.4	901.2	1,126.5	1,351.8	1,577.1	1,802.4
Self-Consumed Electricity	[MWh/yr]	204.6	255.8	307.0	358.1	409.3	299.6	374.5	449.4	524.3	599.2	108.3	135.4	162.5	189.6	216.6	612.6	765.8	918.9	1,072.1	1,225.2
Self-Consumption Rate	[%]	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
Grid																					
Imported Electricity	[MWh/yr]	300.8	376.0	451.2	526.4	601.6	440.8	550.9	661.1	771.3	881.5	159.7	199.6	239.5	279.5	319.4	901.2	1,126.5	1,351.8	1,577.1	1,802.4
Exported Electricity	[MWh/yr]	300.8	376.0	451.2	526.4	601.6	440.8	550.9	661.1	771.3	881.5	159.7	199.6	239.5	279.5	319.4	901.2	1,126.5	1,351.8	1,577.1	1,802.4
Balance	[MWh/yr]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Battery Sizing																					
daily surplus (annual average)	[MWh/d]	0.824	1.030	1.236	1.442	1.648	1.208	1.509	1.811	2.113	2.415	0.438	0.547	0.656	0.766	0.875	2.469	3.086	3.704	4.321	4.938
daily shortfall (annual average)	[MWh/d]	0.824	1.030	1.236	1.442	1.648	1.208	1.509	1.811	2.113	2.415	0.438	0.547	0.656	0.766	0.875	2.469	3.086	3.704	4.321	4.938

Notes

ft^2 = cubic feet

m^2 = cubic meters

MWp to be CO_2-neutral

MWp = megawatt peak

MWh/d = megawatt hours per day

MWh/yr = megawatt hours per year

MWp/yr = megawatt peak per year

PV = photovoltaic

Table A-6: Solar PV Cost-Benefit Analysis for LS-1
Nevada Environmental Response Trust; Henderson, Nevada

	Baseline (24x7)	Baseline + 25%	Baseline + 50%	Baseline + 75%	Baseline + 100%
BASELINE					
Purchase Electricity (Baseline) kWh/yr	505,449	631,811	758,174	884,536	1,010,898
Purchase Electricity (Baseline) MWh/yr	505	632	758	885	1,011
Purchase Electricity (Baseline) $/yr	**$ 40,606**	**$ 50,757**	**$ 60,908**	**$ 71,060**	**$ 81,211**
Annual CO2 Emission (US tons/yr)	**288**	**360**	**432**	**504**	**576**
Grid Electricity cost ($/MWh)	$ 80.34	$ 80.34	$ 80.34	$ 80.34	$ 80.34
Electricity sale price to grid ($/MWh)	$ 65.07	$ 65.07	$ 65.07	$ 65.07	$ 65.07
SOLAR					
PV Capacity installed (MWp)	**0.258**	**0.322**	**0.386**	**0.451**	**0.515**
Battery Storage Capacity Installed (MWh)	**-**	**-**	**-**	**-**	**-**
Total Produced Solar Energy (MWh/yr)	505	632	758	885	1,011
Self-consumed Energy (MWh/yr)	205	256	307	358	409
exported to grid (MWh/yr)	301	376	451	526	602
Import from Grid (MWh/yr)	301	376	451	526	602
Avoided CO2 Emissions	288	360	432	504	576
% Avoided CO2 Emission	**100%**	**100%**	**100%**	**100%**	**100%**
ENERGY COSTS WITH SOLAR PV SYSTEM					
Exported grid revenue ($/yr)	$ 19,574	$ 24,468	$ 29,362	$ 34,255	$ 39,149
Import from Grid power costs ($/yr)	$ 24,166	$ 30,207	$ 36,249	$ 42,290	$ 48,332
Net Annual Utility Cost	$ 4,592	$ 5,739	$ 6,887	$ 8,035	$ 9,183
Energy Costs Savings (Baseline - PV Solar)	**$ 36,014**	**$ 45,018**	**$ 54,021**	**$ 63,025**	**$ 72,028**
% savings	89%	89%	89%	89%	89%
COSTS					
CAPEX Solar PV	$ 643,778	$ 804,723	$ 965,667	$ 1,126,612	$ 1,287,557
Permit & Misc Costs	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
CAPEX BES (Battery Storage)	$ -	$ -	$ -	$ -	$ -
Total CAPEX $	**$ 693,778**	**$ 854,723**	**$ 1,015,667**	**$ 1,176,612**	**$ 1,337,557**
OPEX Solar PV ($/yr) $40/kWhp/yr	$ 10,300	$ 12,876	$ 15,451	$ 18,026	$ 20,601
OPEX BES (Battery) $5/kWh/yr	$ -	$ -	$ -	$ -	$ -
Total OPEX $/yr	**$ 10,300**	**$ 12,876**	**$ 15,451**	**$ 18,026**	**$ 20,601**
PAYBACK					
Simple Payback (yr)	**27**	**27**	**26**	**26**	**26**
Other Incentives					
Investment Tax credit (Federal) 26% (NA)	**$ 693,778**	**$ 854,723**	**$ 1,015,667**	**$ 1,176,612**	**$ 1,337,557**
NV Renewable Incentive ($)	$ -	$ -	$ -	$ -	$ -
Simple Payback with Fed tax credit & incentives	**27**	**27**	**26**	**26**	**26**

Notes:

NA = tax credit not applicable

yr = year

kWh/yr = kilowatt hours per year

MWh/yr = megawatt hours per year

$/yr = dollars per year

PV = photovoltaic

Table A-7: Solar PV Cost-Benefit Analysis for LS-2
Nevada Environmental Response Trust; Henderson, Nevada

	Baseline (24x7)	Baseline + 25%	Baseline + 50%	Baseline + 75%	Baseline + 100%
BASELINE					
Purchase Electricity (Baseline) kWh/yr	740,367	925,459	1,110,551	1,295,642	1,480,734
Purchase Electricity (Baseline) MWh/yr	740	925	1,111	1,296	1,481
Purchase Electricity (Baseline) $/yr	**$ 59,478**	**$ 74,347**	**$ 89,217**	**$ 104,086**	**$ 118,956**
Annual CO2 Emission (US tons/yr)	**422**	**528**	**633**	**739**	**844**
Grid Electricity cost ($/MWh)	$ 80.34	$ 80.34	$ 80.34	$ 80.34	$ 80.34
Electricity sale price to grid ($/MWh)	$ 65.07	$ 65.07	$ 65.07	$ 65.07	$ 65.07
SOLAR					
PV Capacity installed (MWp)	**0.377**	**0.471**	**0.566**	**0.660**	**0.754**
Battery Storage Capacity Installed (MWh)	**-**	**-**	**-**	**-**	**-**
Total Produced Solar Energy (MWh/yr)	740	925	1,111	1,296	1,481
Self-consumed Energy (MWh/yr)	300	375	449	524	599
exported to grid (MWh/yr)	441	551	661	771	882
Import from Grid (MWh/yr)	441	551	661	771	882
Avoided CO2 Emissions	422	528	633	739	844
% Avoided CO2 Emission	**100%**	**100%**	**100%**	**100%**	**100%**
ENERGY COSTS WITH SOLAR PV SYSTEM					
Exported grid revenue ($/yr)	$ 28,681	$ 35,851	$ 43,021	$ 50,191	$ 57,362
Import from Grid power costs ($/yr)	$ 35,408	$ 44,261	$ 53,113	$ 61,965	$ 70,817
Net Annual Utility Cost	$ 6,728	$ 8,410	$ 10,091	$ 11,773	$ 13,455
Energy Costs Savings (Baseline - PV Solar)	**$ 52,750**	**$ 65,938**	**$ 79,126**	**$ 92,313**	**$ 105,501**
% savings	89%	89%	89%	89%	89%
COSTS					
CAPEX Solar PV	$ 942,988	$ 1,178,735	$ 1,414,482	$ 1,650,229	$ 1,885,975
Permit & Misc Costs	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
CAPEX BES (Battery Storage)	$ -	$ -	$ -	$ -	$ -
Total CAPEX $	**$ 992,988**	**$ 1,228,735**	**$ 1,464,482**	**$ 1,700,229**	**$ 1,935,975**
OPEX Solar PV ($/yr) $40/kWhp/yr	$ 15,088	$ 18,860	$ 22,632	$ 26,404	$ 30,176
OPEX BES (Battery) $5/kWh/yr	$ -	$ -	$ -	$ -	$ -
Total OPEX $/yr	**$ 15,088**	**$ 18,860**	**$ 22,632**	**$ 26,404**	**$ 30,176**
PAYBACK					
Simple Payback (yr)	**26**	**26**	**26**	**26**	**26**
Other Incentives					
Investment Tax credit (Federal) 26% (NA)	**$ 992,988**	**$ 1,228,735**	**$ 1,464,482**	**$ 1,700,229**	**$ 1,935,975**
NV Renewable Incentive ($)	$ -	$ -	$ -	$ -	$ -
Simple Payback with Fed tax credit & incentives	**26**	**26**	**26**	**26**	**26**

Notes:

NA = tax credit not applicable

yr = year

kWh/yr = kilowatt hours per year

MWh/yr = megawatt hours per year

$/yr = dollars per year

PV = photovoltaic

Table A-8: Solar PV Cost-Benefit Analysis for LS-3
Nevada Environmental Response Trust; Henderson, Nevada

	Baseline (24x7)	Baseline + 25%	Baseline + 50%	Baseline + 75%	Baseline + 100%
BASELINE					
Purchase Electricity (Baseline) kWh/yr	268,013	335,016	402,020	469,023	536,026
Purchase Electricity (Baseline) MWh/yr	268	335	402	469	536
Purchase Electricity (Baseline) $/yr	**$ 21,531**	**$ 26,914**	**$ 32,297**	**$ 37,679**	**$ 43,062**
Annual CO2 Emission (US tons/yr)	**153**	**191**	**229**	**267**	**306**
Grid Electricity cost ($/MWh)	$ 80.34	$ 80.34	$ 80.34	$ 80.34	$ 80.34
Electricity sale price to grid ($/MWh)	$ 65.07	$ 65.07	$ 65.07	$ 65.07	$ 65.07
SOLAR					
PV Capacity installed (MWp)	**0.137**	**0.171**	**0.205**	**0.239**	**0.273**
Battery Storage Capacity Installed (MWh)	**-**	**-**	**-**	**-**	**-**
Total Produced Solar Energy (MWh/yr)	268	335	402	469	536
Self-consumed Energy (MWh/yr)	108	135	162	190	217
exported to grid (MWh/yr)	160	200	240	279	319
Import from Grid (MWh/yr)	160	200	240	279	319
Avoided CO2 Emissions	153	191	229	267	306
% Avoided CO2 Emission	**100%**	**100%**	**100%**	**100%**	**100%**
ENERGY COSTS WITH SOLAR PV SYSTEM					
Exported grid revenue ($/yr)	$ 10,391	$ 12,989	$ 15,587	$ 18,185	$ 20,782
Import from Grid power costs ($/yr)	$ 12,829	$ 16,036	$ 19,243	$ 22,450	$ 25,657
Net Annual Utility Cost	$ 2,437	$ 3,047	$ 3,656	$ 4,266	$ 4,875
Energy Costs Savings (Baseline - PV Solar)	**$ 19,094**	**$ 23,867**	**$ 28,640**	**$ 33,414**	**$ 38,187**
% savings	89%	89%	89%	89%	89%
COSTS					
CAPEX Solar PV	$ 341,362	$ 426,702	$ 512,043	$ 597,383	$ 682,724
Permit & Misc Costs	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
CAPEX BES (Battery Storage)	$ -	$ -	$ -	$ -	$ -
Total CAPEX $	**$ 391,362**	**$ 476,702**	**$ 562,043**	**$ 647,383**	**$ 732,724**
OPEX Solar PV ($/yr) $40/kWhp/yr	$ 5,462	$ 6,827	$ 8,193	$ 9,558	$ 10,924
OPEX BES (Battery) $5/kWh/yr	$ -	$ -	$ -	$ -	$ -
Total OPEX $/yr	**$ 5,462**	**$ 6,827**	**$ 8,193**	**$ 9,558**	**$ 10,924**
PAYBACK					
Simple Payback (yr)	**29**	**28**	**27**	**27**	**27**
Other Incentives					
Investment Tax credit (Federal) 26% (NA)	**$ 391,362**	**$ 476,702**	**$ 562,043**	**$ 647,383**	**$ 732,724**
NV Renewable Incentive ($)	$ -	$ -	$ -	$ -	$ -
PAYBACK Payback with Fed tax credit & incentives	**29**	**28**	**27**	**27**	**27**

Notes:

NA = tax credit not applicable
yr = year
kWh/yr = kilowatt hours per year
MWh/yr = megawatt hours per year
$/yr = dollars per year
PV = photovoltaic

Table A-9: Solar PV Cost-Benefit Analysis for LS-1, LS-2 & LS-3
Nevada Environmental Response Trust; Henderson, Nevada

	Baseline (24x7)	Baseline + 25%	Baseline + 50%	Baseline + 75%	Baseline + 100%
BASELINE					
Purchase Electricity (Baseline) kWh/yr	1,513,829	1,892,286	2,270,744	2,649,201	3,027,658
Purchase Electricity (Baseline) MWh/yr	1,514	1,892	2,271	2,649	3,028
Purchase Electricity (Baseline) $/yr	**$ 121,615**	**$ 152,018**	**$ 182,422**	**$ 212,826**	**$ 243,229**
Annual CO2 Emission (US tons/yr)	**863**	**1,079**	**1,294**	**1,510**	**1,726**
Grid Electricity cost ($/MWh)	$ 80.34	$ 80.34	$ 80.34	$ 80.34	$ 80.34
Electricity sale price to grid ($/MWh)	$ 65.07	$ 65.07	$ 65.07	$ 65.07	$ 65.07
SOLAR					
PV Capacity installed (MW)p	**0.771**	**0.964**	**1.157**	**1.350**	**1.543**
Battery Storage Capacity Installed (MWh)	-	-	-	-	-
Total Produced Solar Energy (MWh/yr.)	1,514	1,892	2,271	2,649	3,028
Self-consumed Energy (MWh/yr.)	613	766	919	1,072	1,225
exported to grid (MWh/yr.)	901	1,127	1,352	1,577	1,802
Import from Grid (MWh/yr)	901	1,127	1,352	1,577	1,802
Avoided CO2 Emissions	863	1,079	1,294	1,510	1,726
% Avoided CO2 Emission	**100%**	**100%**	**100%**	**100%**	**100%**
ENERGY COSTS WITH SOLAR PV SYSTEM					
Exported grid revenue ($/yr)	$ 58,644	$ 73,305	$ 87,966	$ 102,627	$ 117,288
Import from Grid power costs ($/yr)	$ 72,400	$ 90,500	$ 108,600	$ 126,700	$ 144,800
Net Annual Utility Cost	$ 13,756	$ 17,195	$ 20,634	$ 24,073	$ 27,512
Energy Costs Savings (Baseline - PV Solar)	**$ 107,859**	**$ 134,823**	**$ 161,788**	**$ 188,753**	**$ 215,717**
% savings	89%	89%	89%	89%	89%
COSTS					
CAPEX Solar PV	$ 1,928,128	$ 2,410,160	$ 2,892,192	$ 3,374,224	$ 3,856,256
Permit & Misc Costs	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
CAPEX BES (Battery Storage)	$ -	$ -	$ -	$ -	$ -
Total CAPEX $	**$ 1,978,128**	**$ 2,460,160**	**$ 2,942,192**	**$ 3,424,224**	**$ 3,906,256**
OPEX Solar PV ($/yr) $40/kWhp/yr	$ 30,850	$ 38,563	$ 46,275	$ 53,988	$ 61,700
OPEX BES (Battery) $5/kWh/yr	$ -	$ -	$ -	$ -	$ -
Total OPEX $/yr	**$ 30,850**	**$ 38,563**	**$ 46,275**	**$ 53,988**	**$ 61,700**
PAYBACK					
Simple Payback (yr)	**26**	**26**	**25**	**25**	**25**
Other Incentives					
Investment Tax credit (Federal) 26% (NA)	**$ 1,978,128**	**$ 2,460,160**	**$ 2,942,192**	**$ 3,424,224**	**$ 3,906,256**
NV Renewable Incentive ($)	$ -	$ -	$ -	$ -	$ -
Simple Payback with Fed tax credit & incentives	**26**	**26**	**25**	**25**	**25**

Notes:

NA = tax credit not applicable to Trust

yr = year

kWh/yr = kilowatt hours per year

MWh/yr = megawatt hours per year

$/yr = dollars per year

PV = photovoltaic