



City of Louisville

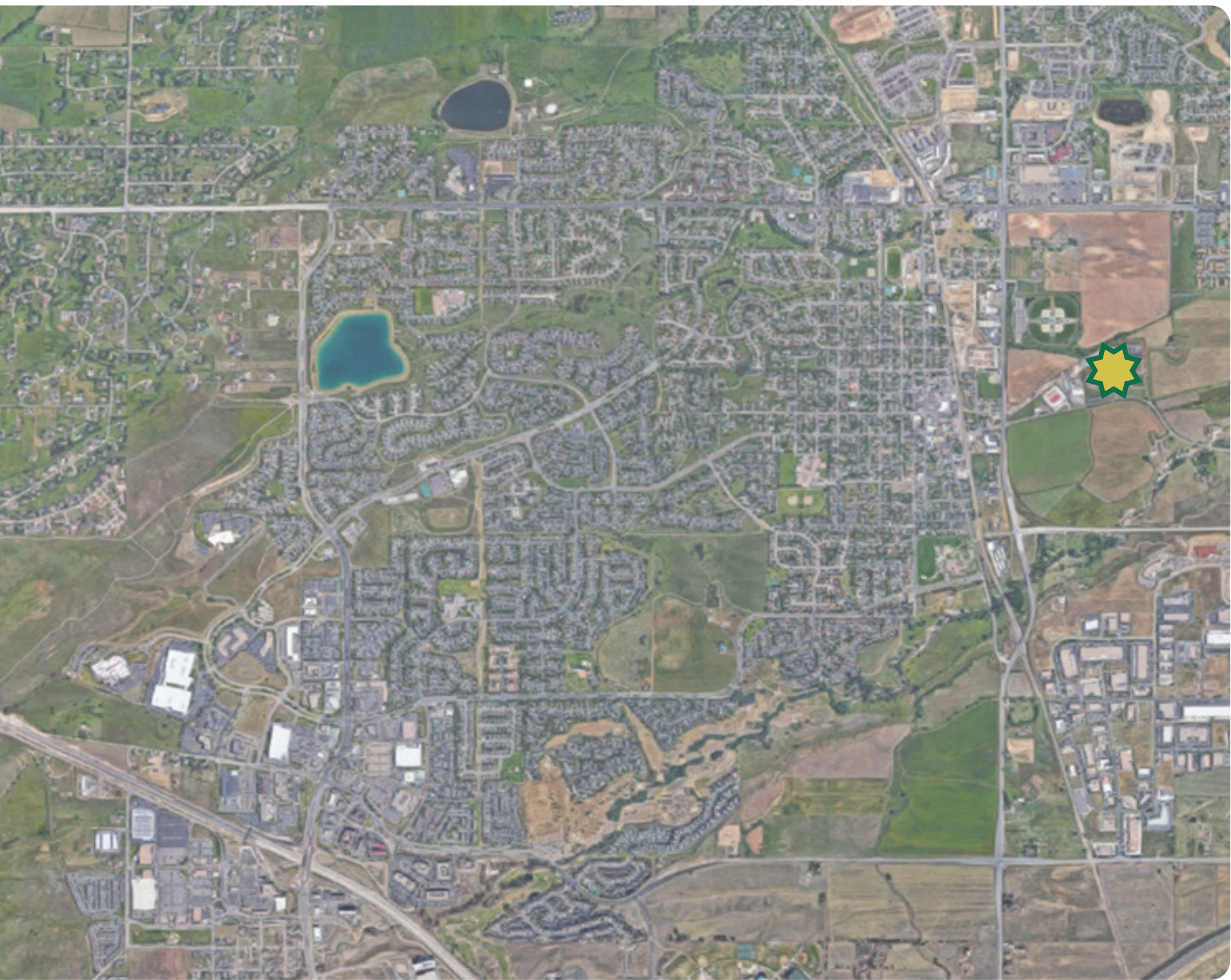
Internal Decarbonization Plan

WASTEWATER TREATMENT PLANT DECARBONIZATION AUDIT REPORT

1601 EMPIRE ROAD
LOUISVILLE, COLORADO
AUGUST 18, 2023



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Date	Version History
5/12/2023	Version 1 - Issued for City Review and Input
8/18/2023	Version 2 - Issued to City

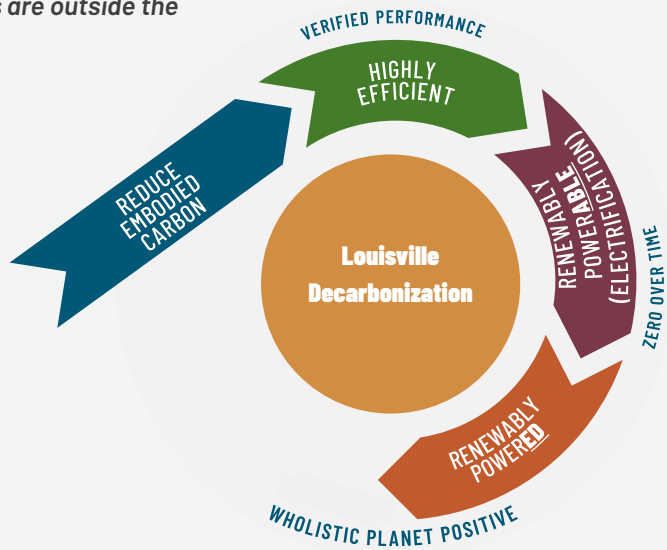
Background

In August of 2019, City Council passed Resolution 25, Series 2019, which set clean energy and carbon emission reduction goals for the municipality and larger community. This resolution sets goals to meet all of Louisville’s municipal electric needs with 100% carbon-free sources by 2025, and to reduce core municipal greenhouse gas emissions annually below the 2016 baseline through 2025. The City of Louisville has demonstrated its commitment toward creating a healthy and sustainable environment for its residents, evident through Resolution 25-2019 (Setting Clean Energy and Carbon Emission Reduction Goals), as well as their Sustainability Action Plan (adopted in October 6, 2020). In support of these goals, McKinstry was contracted to identify a strategic roadmap for electrification and decarbonization of all City buildings, fleet, equipment and operations* by 2030, and recommend an alternative target if appropriate.

This is an interim report, providing initial directions, findings, as well as a draft set of detailed decarbonization approaches for the Wastewater Treatment Plant.

**Process water treatment energy, process wastewater energy, and street lighting/signals are outside the scope of this study.*

There are many possible pathways for decarbonizing Louisville. With guidance from City staff, this report focuses on identification of strategies that provide the highest value, most fiscally responsible path forward to achieve Louisville’s decarbonization goals.



Decarbonization Recommendation

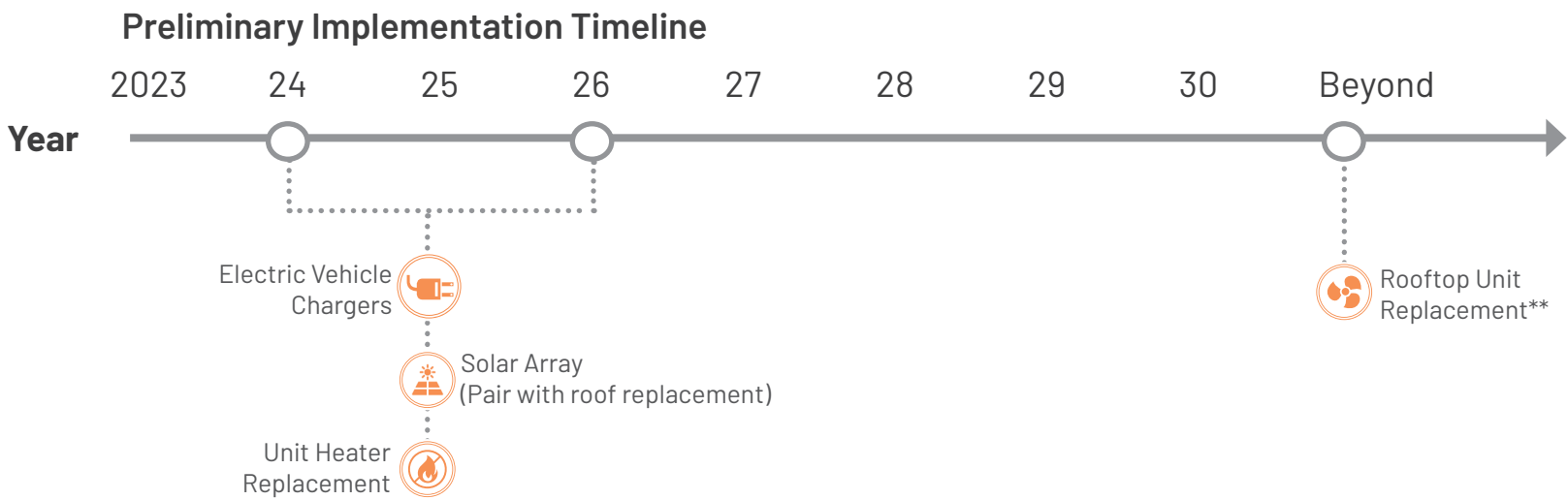
The table below outlines the findings of the study and highlights the opportunity towards a viable and cost-effective path towards carbon neutrality. The total cost is the total amount of money that will need to be allocated for budgetary purposes. The net cost is the total construction costs minus the replacement costs that would’ve been spent to replace the existing units with like-for-like fossil fuel units. The net cost represents the true cost of this decarbonization effort. All information included in this table is explained in greater detail in this report. **These are “all-in costs” and represent the total cost of construction. They are also Rough Order of Magnitude (ROM) numbers, with a +/-20% range.** See “Construction Pricing Context” section for more detail.

	Scenario	Life Cycle Carbon Reduced	Life Cycle Carbon % Reduction	Total First Cost	Net First Cost Over Business as Usual Cost
	Full Electrification	100 tons	100%	\$390k	\$190k
	Renewables	N/A	N/A	\$2.1M*	N/A
	EV Charging	N/A	N/A	\$140k	N/A

**Renewable costs do not account for funding from the Inflation Reduction Act (IRA).*

Implementation

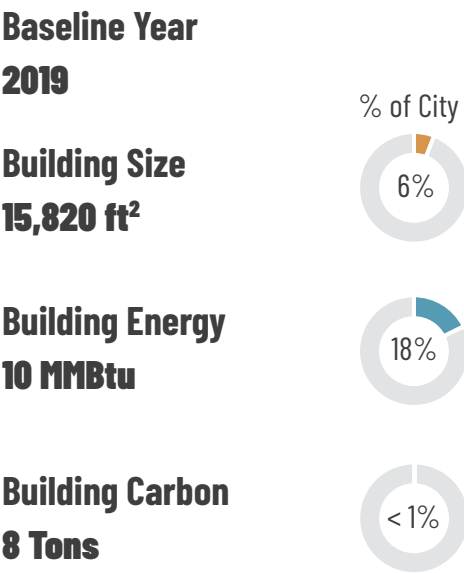
A preliminary implementation timeline is shown below, based on the 2023 Capital Improvement Plan (CIP).



***Existing equipment was installed in 2016. Replace at end-of-life.*

Baseline | Building Use & Energy and Carbon Analysis

Baseline Building Use

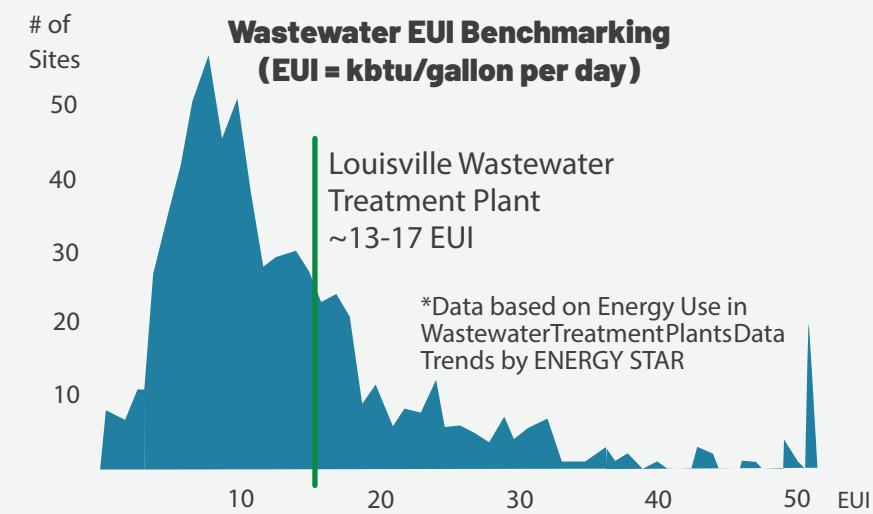


- Building Information
- Primary Wastewater Treatment Plant for Louisville.
 - Consists of multiple small support buildings.
 - The Administration Building and Dewatering Buildings are the only buildings with gas use. Other buildings utilize electric freeze protection.
 - Located at eastern border of the city.
 - Not open to public.
- Recent Renovations and Energy Improvements
- To be determined.



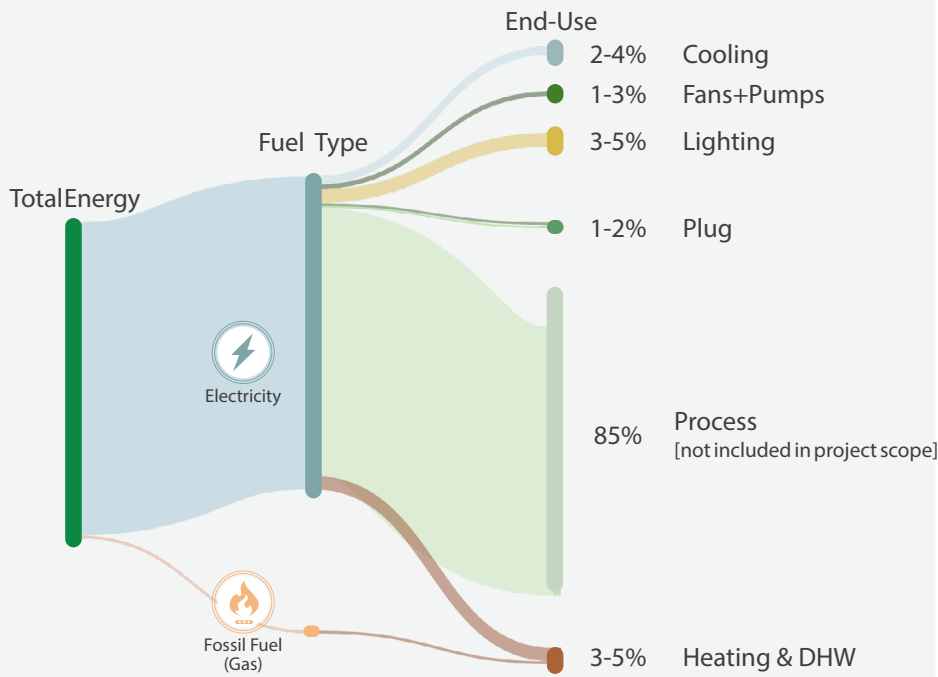
Baseline Energy Use

The Wastewater Treatment Plant performs average when compared to the Portfolio Manager Benchmark for wastewater treatment facilities. Note that performance for wastewater treatment plants can vary significantly by the specific treatment processes of each plant.



Baseline Energy End-Use

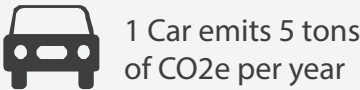
Energy end-use estimates are based on most recent available 2018 Commercial Building Energy Consumption Survey (CBECS) benchmarking data and site audit information.



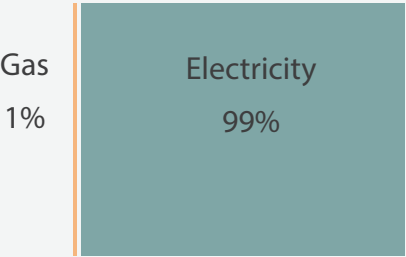
Baseline Carbon Use

The City of Louisville participates in programs to offset their existing electrical consumption with renewable sources. **Therefore, for the purposes of this study the total carbon emissions at Louisville will be solely driven by on-site fossil fuel combustion and emissions associated with electric consumption will be zero.**

The amount of electric consumption offset needed for zero carbon will be addressed in future phases of this study, and will be evaluated at the portfolio level. The offset will be a function of post-decarbonization electrical consumption considering carbon and load reduction measures, on-site renewable energy provided, and the grid emissions of Xcel Energy and zero-carbon utility subscription programs.



Baseline Energy



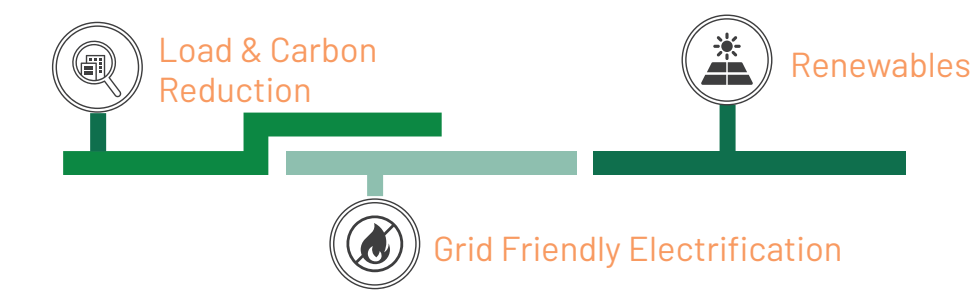
Baseline Carbon



Decarbonization Measures | Decarbonization Process, Load & Carbon Reductions

Decarbonization Process

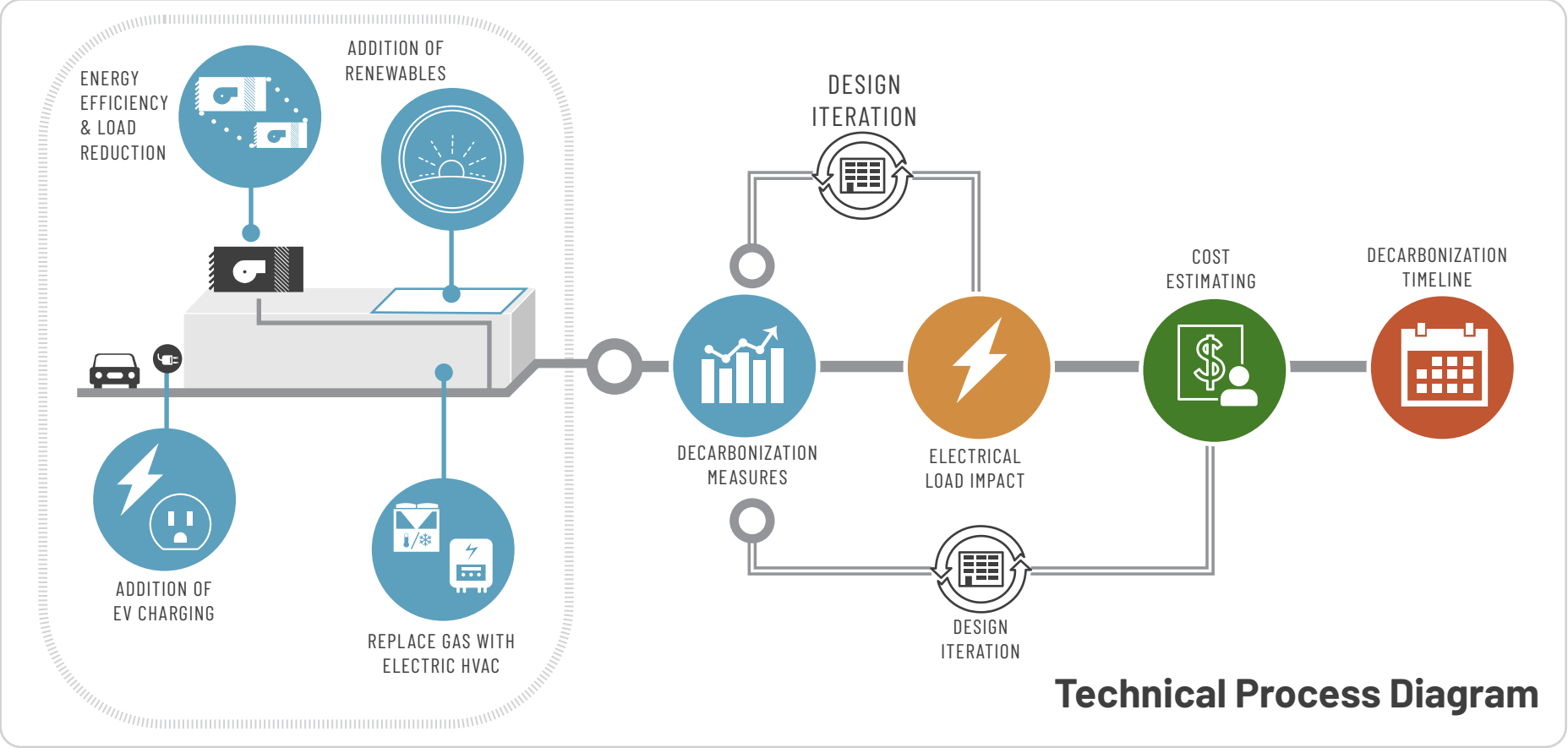
There are a host of measures to employ on the path of decarbonization, ranging from time-tested traditional energy efficiency measures to the more aggressive electrification measures. The key to decarbonization is finding the right balance between measures, as indicated by the graphic below. With this approach, Louisville will find the most cost-effective path to full decarbonization.



The decarbonization solution starts by identifying measures at the building, and continues with design iteration to arrive at the final timeline, as seen in the Technical Process Diagram.

Load & Carbon Reduction

The recent shift towards decarbonization still operates on the core foundation of reducing building’s overall energy use. Measures can have two functions: reducing annual energy/carbon consumption and reducing peak building demand load. These measures are often incentivized by Xcel and may have shorter paybacks. **Note that a large portion of the electrical load at the site is associated with treatment processes, which are outside the scope of this study.**

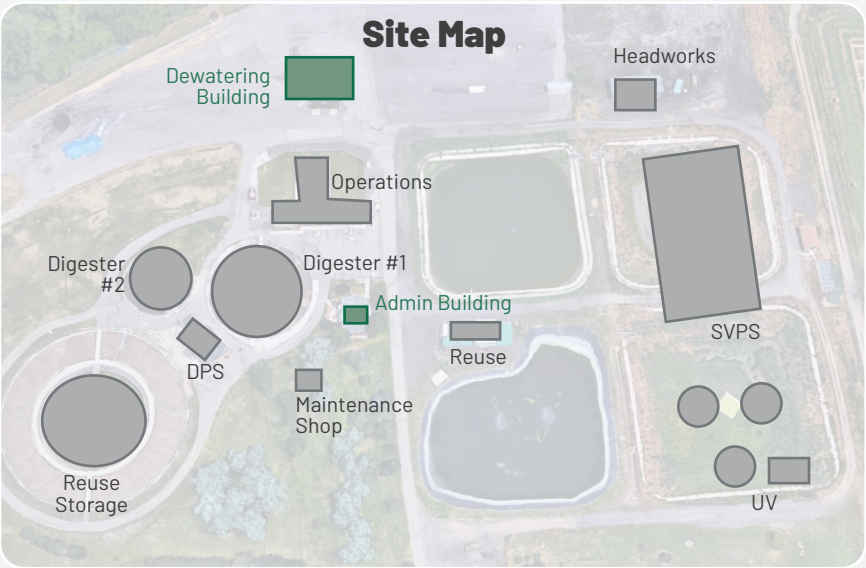


Load	Carbon	Measure	Description
■	■	ENVELOPE AIR SEALING	Older buildings are often remarkably leaky – the wall/parapet junction being a frequent culprit. Ensuring a building is tight and ventilated right is an effective efficiency measure that also has durability benefits (condensation often occurs at air leakage points) and improves air quality (mold reduction and limiting outside air infiltration during wildfire events).
□	■	LIGHTING CONTROLS/VACANCY SENSORS	LED light replacements typically are the most cost effective way for saving electricity in the lighting arena, but adding lighting controls (which turn off lights with vacancy and vary based on available daylight) provide additional savings and better user experience (avoiding over-lighting).

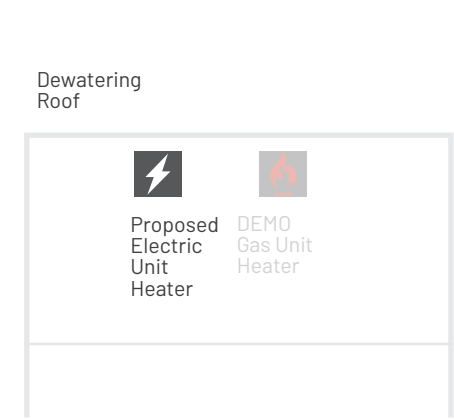
Decarbonization Measures | Mechanical Electrification

Proposed Electrification

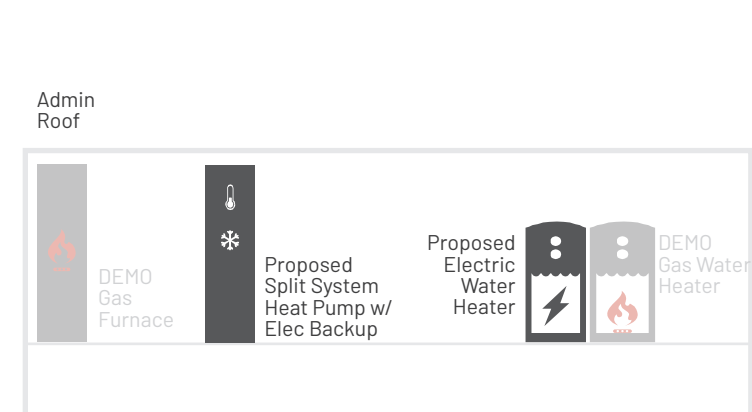
The Wastewater Treatment Plant facility is composed of several buildings, most of which do not contain gas-fired equipment. The Dewatering building and the Admin building, shown below in green on the site map, are the only ones that contain gas-fired equipment.



Dewatering Bldg Diagram



Admin Bldg Diagram



AIRSIDE

The Dewatering building contains one gas unit heater. The purpose of these heaters is to avoid freezing temperatures for protection to the buildings and equipment, and not to provide full space heating. Typically these units run significantly less than space conditioning units. The decarbonized solution would entail replacing the gas unit heater with an electric unit heater.

Ventilation, heating, and cooling for the Wastewater Treatment Plant’s Admin building are supplied through a furnace, which provides cooling via packaged refrigerant and heating via gas-fired burner. The decarbonized system will replace the gas fired furnace with a new 3-ton heat pump with full electric resistance backup heat. Backup heat is utilized to supplement the heat pump as temperatures drop and heat pump capacity is reduced or when temperatures drop below the heat pump operation limit. This is typically a small amount of time in the year and has minor energy impacts (described in results section).

DOMESTIC HOT WATER

There is no domestic hot water (DHW) scope in the Dewatering building.

DHW in the Admin building is currently served by a gas water heater, to be replaced with a new electric water heater. A heat pump water heater was considered, but is not cost-effective since the domestic hot water load in this building is small.

ADDITIONAL SUPPORT BUILDINGS

The remaining support buildings at the Wastewater treatment plant are already all-electric. See the table below for a summary. System upgrades were not recommended because existing systems are already electric and relatively low loads compared to the rest of the site energy.

DPS	Headworks	Maintenance	Operation	Re-use	SVPS	UV
Electric Unit Heaters	Electric Air Handling Units with Energy Recovery	Electric Unit Heaters	Heat Pump RTUs	Electric Unit Heaters	Electric Unit Heaters	Electric RTUs

All Electric vs Hybrid Systems

Based on the sizes of the mechanical equipment and the load profile of the building, there is no need for a Hybrid option for the Wastewater Treatment Plant. All of the proposed electrification measures are within the available capacity of the existing electrical service and would not require an electrical service upgrade.

Beneficial Electrification

Electrification of mechanical systems provides value beyond energy and carbon savings. This includes, but is not limited to:

- Enhanced ventilation control (outside-air supply, CO₂ Control, etc.)
- Improved thermal comfort with right-sized equipment and updated controls
- Improved resiliency of newer units

Decarbonization Measures | Renewables & Electric Vehicle Chargers

Renewables

At the Wastewater Treatment Plant, Louisville could install two solar arrays on the northeast and southeast corners of the site that would total to a ~690 kW-DC fixed-tilt ground mount solar PV system.

Renewable energy plays the important role of offsetting remaining carbon emissions after building load reductions and electrification are complete. This can be handled through a variety of avenues – behind-the-meter systems, Community Solar Gardens, and utility subscriptions. Since City of Louisville already offsets its current electricity with renewable utility subscriptions, we focused on customer-owned, behind-the-meter systems that would provide more value to the City of Louisville.

When evaluating this site, the following factors were considered:

AVAILABLE SPACE & RACKING MODALITY

Solar systems benefit from economies of scale – generally, the larger the system, the cheaper it is per kW. The first constraint on system size is the available space on the property. Since ground mounts are typically the least expensive racking modality, we evaluate this first. Wastewater Treatment Plants are constructed with many buried water lines that reduces the land available for ground mounted solar. Of the available land space, we were able to find a suitable contiguous location that could fit a 348.8kW-DC South facing ground mount array towards the Northeast of the property. There is an additional 376.4kW array potential in a planned building expansion area in the Southern Central portion of the property.

SIMPLE PAYBACK

Payback is an easy way to determine the value of a solar system. Solar PV systems last around 25–30 years. McKinstry typically only recommends systems that – including Inflation Reduction Act credits, utility incentives, and/or other funding sources – will pay back within the system lifetime. At this stage of evaluation, simple payback is used. However, if the project advances, more detailed cash flows and paybacks can be calculated.

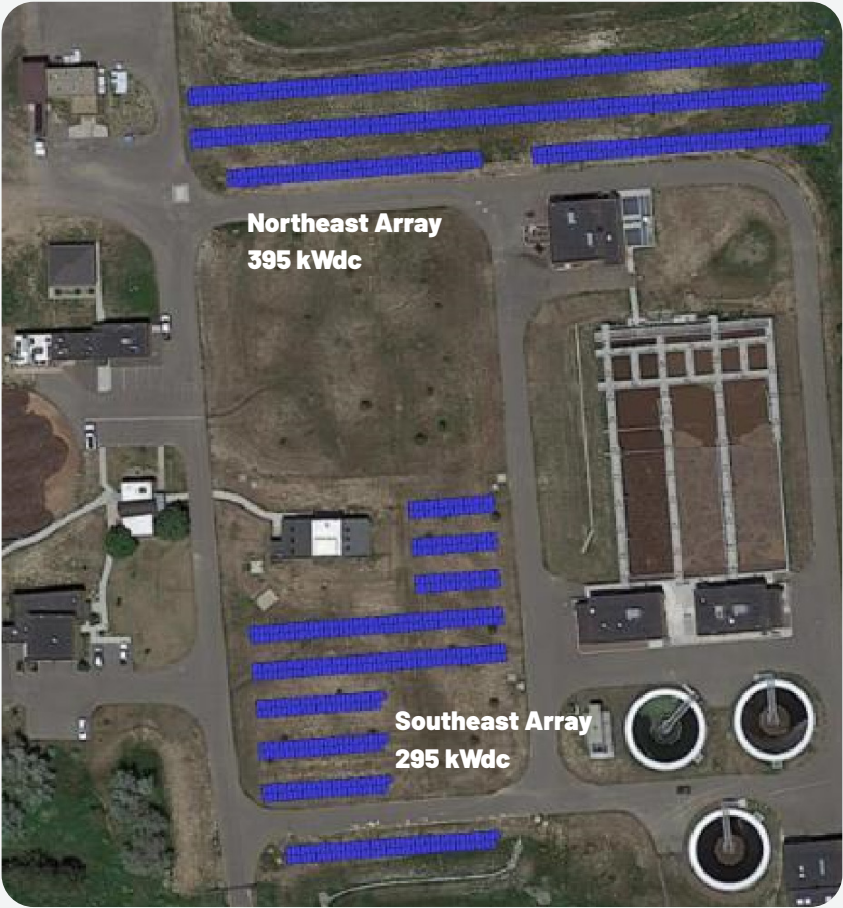
INTERCONNECTION METHOD & INCENTIVES

Due to size and value of utility savings, the WWTP array would interconnect behind the utility meter and would qualify for Xcel’s Solar*Rewards C&I Tier 1. These arrays were not considered for Community Solar since those gardens must typically be much larger (500kW-AC+) to make financial sense. Additionally, this solar project would be eligible for the Inflation Reduction Act incentives, giving 25–30% of the solar cost back to City of Louisville depending on the chosen financing mechanism. Further savings can be generated by transitioning from Utility Rate Secondary General (SG) to Utility Rate Secondary Photovoltaic Time of Use (SPVTOU).

ON-SITE VERSUS GRID PURCHASE

Some of the benefits of on-site solar vs renewables purchased from the grid are listed below.

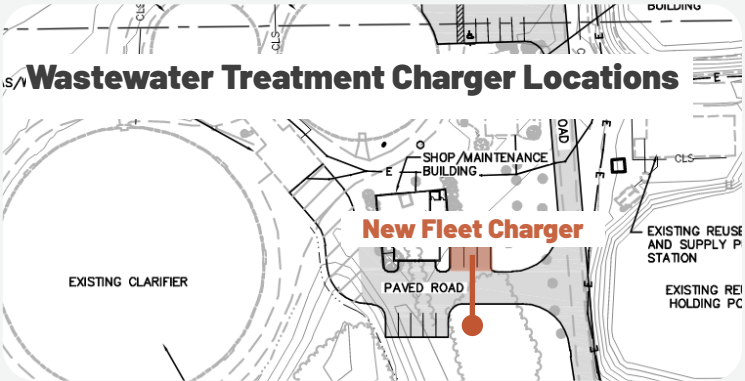
- Avoid solar sprawl at scale - avoiding offsetting of impacts to rural areas
- Avoid electrical energy loss due to transmitting power over long distances
- Dispersed approach is typically grid beneficial, especially when on-site renewables are a small percentage of the total usage of building - most solar on this building would be self used
- Enable future resiliency through addition of batteries and storage
- Demonstrate decarbonization to local Louisville community



Electric Vehicle (EV) Chargers

The Wastewater Treatment Plant has three vehicles. These vehicles are primarily used at the Wastewater Treatment Plant. We recommend installing 2 chargers and the supporting electrical infrastructure.

Make	Model	Type	Qty
Ford	Escape	Light	1
Ford	F-150	Light	1
Ford	F-250	Medium	1



Existing Public Charging Stations	Existing Public Charger Level	Quantity of New Level 2 Public Chargers	Quantity of New Level 3 Public Chargers	Quantity of New Level 2 Fleet Chargers	Quantity of New Level 3 Fleet Chargers
0	N/A	0	0	2	0

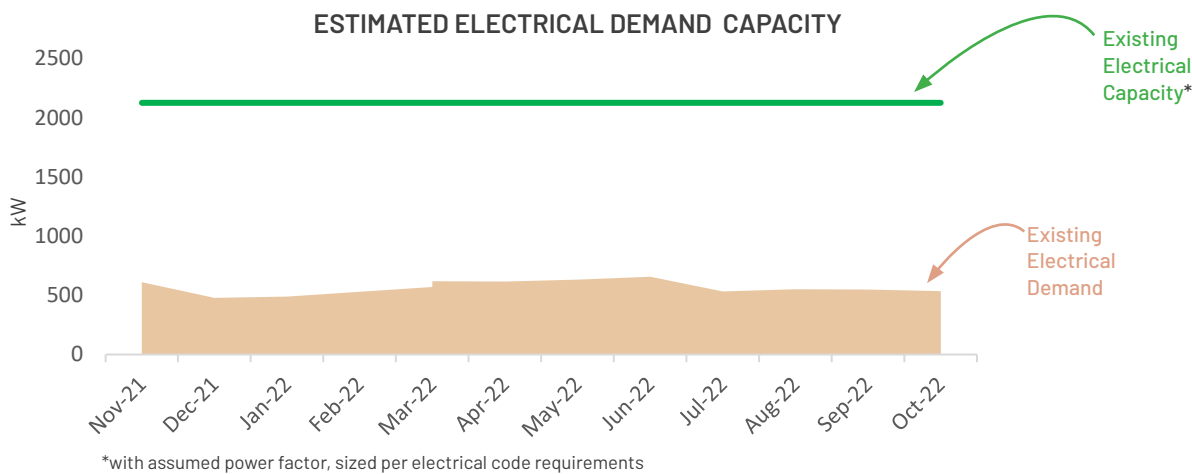
The number of recommended fleet chargers corresponds with the number of fleet vehicles. This is separate from the placeholder EV chargers currently in design for the Solid Handling Project. Public chargers are not recommended for this site because there is limited public visitation at the site.

Decarbonization Measures | Electrical and Structural Impacts

Electrical Impacts

The existing service to the Wastewater Treatment Plant is 480 Volts (V), 3 phase, 4000 Amps (A).

Utility data was analyzed for the date range 11/2021 – 10/2022. This data shows the existing annual maximum demand of the Wastewater Treatment Plant is 657kW, and the maximum demand during heating season as 618kW. Remaining service capacity available for electrification projects (building HVAC or EV) is approximately 2770A, equating to approximately 1,850kW of additional equipment.



Observed peak demand occurred in Summer, so for added heating only equipment the winter values can be used if needed. It should be noted that future changes in building occupancy or consumption patterns from the date range where data was provided may impact the service demand and available capacity for electrification.

The Wastewater Treatment Plant has an existing diesel backup generator, indicated as 1250kW on the drawings. This generator supplies the entire facility via an automatic throw-over scheme built into switchboard MSB.

Electrically, there is sufficient service and generator capacity to support the proposed HVAC electrification.

Structural Impacts

No structural upgrade is triggered from replacement mechanical equipment. All equipment is located at ground level.

Decarbonization Measures | Proposed Electrification

Electrification



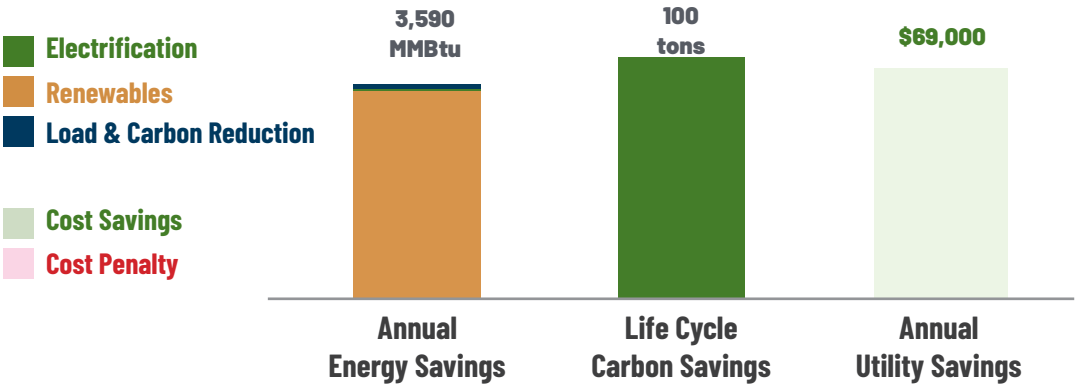
FULL ELECTRIFICATION – Full electrification at the Wastewater Treatment Plant, including all-electric RTUs, electric resistance unit heaters and domestic water heaters. EV charging costs are not included in this option. This option does not require an electrical service upgrade.

	Load & Carbon Reduction	Grid Friendly Electrification	Renewables
	Envelope Air Sealing Lighting Controls	Electrification Full	On-Site Ground Mount PV
Total Cost	\$15k	\$390k	\$2.1M
Base Cost	N/A	\$200k	N/A
Net Cost of Electrification	N/A	\$190k	N/A

*Renewable costs do not account for funding from the Inflation Reduction Act (IRA).

Proposed Annual Measure Savings

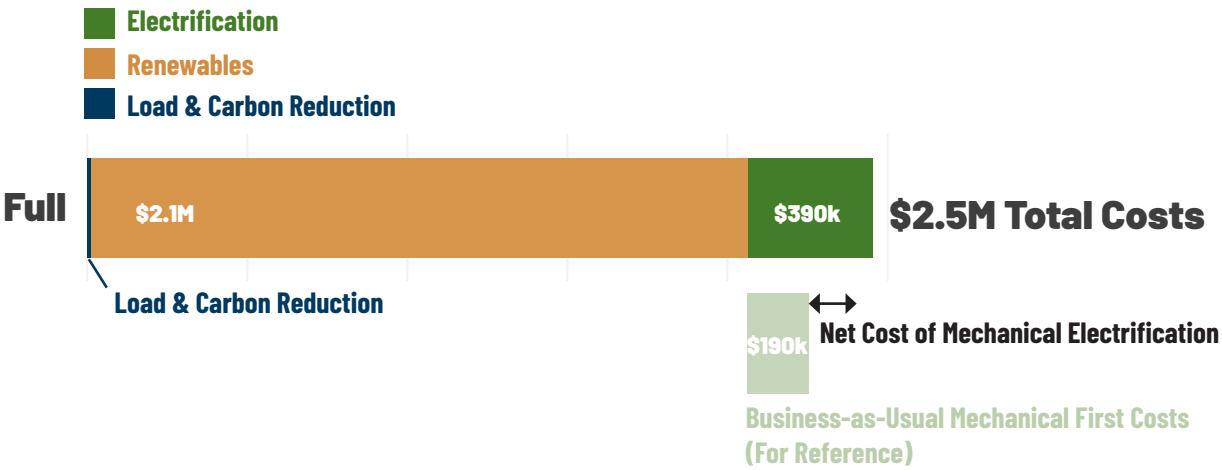
Energy, carbon, and utility cost savings for the full electrification project are shown here. Note that the majority of the energy and utility savings come from the renewable PV system and all of the carbon savings comes from the electrification measures.



Proposed Total Measure Costs

Proposed measure costs are shown below, including any structural and electrical upgrades needed for each option. They are also Rough Order of Magnitude (ROM) numbers, with a +/- 20% range.

The total cost is the total amount that will need to be allocated for budgetary purposes. The net cost represents the total cost minus the replacement cost that would’ve been spent to replace the existing units with like-for-like fossil fuel units.



Decarbonization Measures | Construction Pricing Context & Constructibility

Construction Pricing Context

The MEP scope narratives described in previous sections and included in the appendices were used by McKinstry’s construction division to provide Rough Order of Magnitude (ROM) pricing. This early ROM budgeting process sought to be reasonable but conservative wherever possible. **Typically for ROM-level pricing a range of +/- 20% is applied to the total construction and start up costs.** This range can be reduced, and the pricing further refined, via a deeper understanding of existing building conditions and detailed design. Note this does not account for escalation, which is addressed separately. This pricing represents the total construction and startup cost to Louisville, including:

- General contractor markup
- Design fees
- Engineering energy analysis
- Controls
- Equipment startup, commissioning, testing, and balancing
- Placeholders for miscellaneous trades (e.g. carpentry).
- Allowances specific to each building for construction conditions (e.g. crane time)

All construction costs are in 2023 dollars unless noted otherwise.

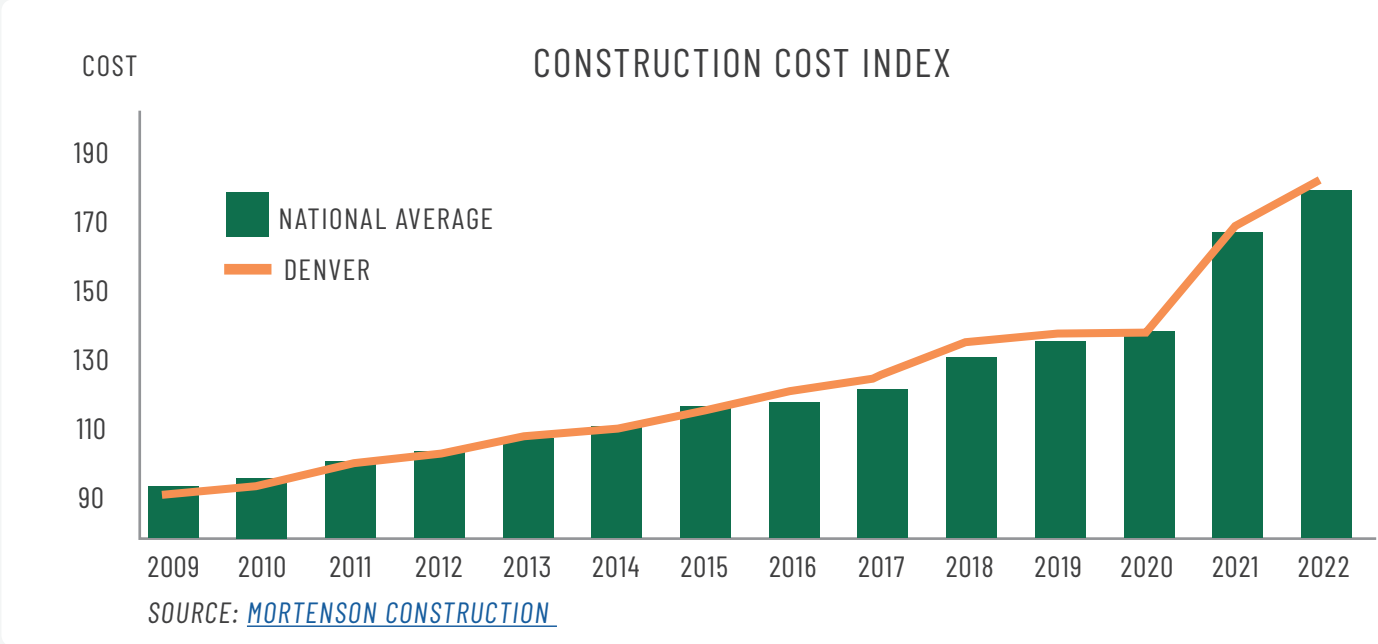
Using These Construction Costs

Throughout this report, differentiation is made between “total construction costs” and “net cost over business-as-usual fossil fuel systems”The distinction between the two is:

- Total costs: these are the total construction costs. This is the total amount of money that will need to be allocated for budgetary purposes.
- Net Cost: these are the total construction costs minus the replacement costs that would’ve been spent to replace the existing units with like-for-like fossil fuel units. These numbers represent the true cost of this decarbonization effort.

Note the numbers in the 2023 City Budget are budget numbers, and do not represent all costs for replacing the existing units. As such, they should not be used when determining the costs of decarbonization. In addition, the cost estimates in this report assume miscellaneous equipment (e.g. expansion tanks, domestic hot water storage tanks) need to be replaced. This assumption should be validated in detailed design, and could result in the total construction cost being lower if equipment can be reused.

As shown in the graph by the Mortenson, construction costs have been steadily rising since 2009. However, costs rose drastically from 2020 to 2022 (approximately 35%) due to global supply chain issues and unforeseen consequences of the COVID-19 pandemic.



Constructibility

Recent upheavals in the global supply chain and labor workforce have caused uncertainty in the construction market. Our construction teams are seeing the following trends as of March, 2023:

ELECTRICAL LEAD TIMES:

- Most commodity items, such as conduit, wire, fittings, etc. are readily available.
- Lead times for Switchboards are being quoted 50-80 weeks. Panel-boards can be 20-40 weeks depending on complexity.

MECHANICAL LEAD TIMES:

- Equipment needs to be ordered earlier in detailed design process to accommodate long lead times. Requires additional coordination earlier in design.

In order to combat these lead time challenges, design teams may need to be flexible with their specifications and the products/manufacturers they are selecting.

LABOR MARKET:

While we are seeing a general relaxing of labor shortages in other markets around the country, the contractor and labor shortages continue to persist in the Denver market.

Next Steps | Implementation

Implementation

A preliminary implementation timeline is shown below, based on the 2023 Capital Improvement Plan (CIP). Given the CIP replacement schedule, the Wastewater Treatment Plant will likely implement measures beyond 2030, at equipment end of life. The summary below is the implementation recommendation based on age of equipment as well as additional thoughts on emerging technologies and sequence of upgrades.

AIRSIDE

- As RTUs reach end of life, replace with all-electric heat pump alternatives. These replacements can be made over time as they will not trigger electrical or structural upgrades.

UNIT HEATERS

- As unit heaters reach end of life, replace with electric resistance options. Upgrades can be made over time without triggering electrical upgrade impacts.

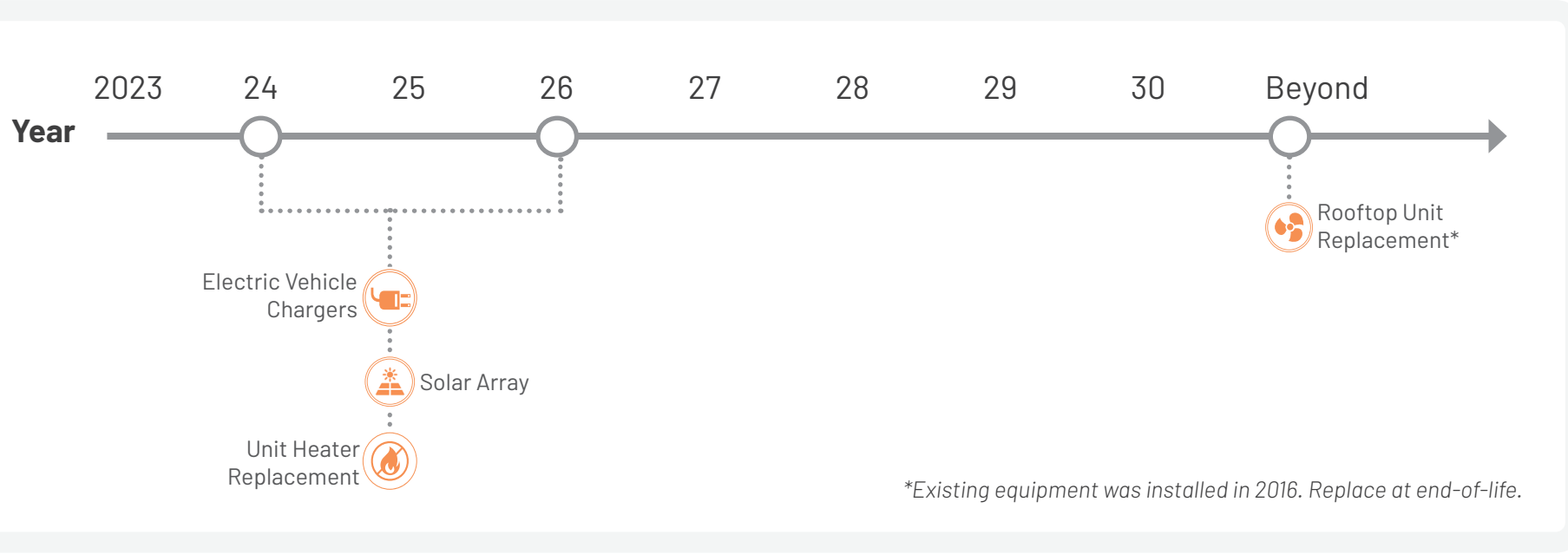
RENEWABLES

- Install 690 kW ground-mounted PV system.
(NE Array - 395 kWdc)
(SE Array - 295 kWdc)

ELECTRIC VEHICLE CHARGER

- Provide EV chargers for fleet.

Preliminary Implementation Timeline





Appendix

1. Mechanical System Matrix Options
2. Mechanical Decarbonization Scoping
3. Electrical Decarbonization Scoping
4. Structural Scoping (N/A for this Building)
5. Electric Vehicle Charging Narrative
6. Renewables Scoping
7. Cost Estimating



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HVAC System Options Matrix: Wastewater Treatment Plant

	Existing System: DEWATERING BLDG		Existing System: ADMIN BLDG		Recommendation: DEWATERING BLDG		Recommendation: ADMIN BLDG		High Performance Alternate: DEWATERING		High Performance Alternate: ADMIN	
General	Gas Unit Heater		Gas Furnace		Electric Unit Heater		Heat Pump w/ Elec Backup		Split System		DOAS with ACVRF throughout - full system replacement	
	Dewater Roof 		Admin Roof 				 Proposed Split System Heat Pump w/ Elec Backup		 Split System		 DOAS  VRF	
Plant Equipment	None		None		None		None		Split System		Air-cooled VRF condenser farm located on roof	
	-		-		-		-		See Above		See Above	
Water Heating	-	Gas Water Heater	-	Electric Water Heater	-	Electric Water Heater	-	Electric Water Heater	-	Electric Water Heater	-	Electric Water Heater
Extent of Retrofit	-	-	Minimal		Minimal		Maintain existing ductwork, piping, and downstream equipment.		Extensive.		Extensive.	
									New terminal equipment and refrigeration piping to condenser.		Remove existing VAV boxes and electric reheat coils. Reuse existing medium pressure ductwork for ventilation air.	
Electrical Impacts	-	-	Minor		Minor		Recommended measures fit within the existing electrical service.		Minor		Minor	
									Recommended measures fit within the existing electrical service.		Recommended measures fit within the existing electrical service.	
Limiting Factor	-	-	None		None		None		Cost Prohibitive		Cost Prohibitive	
									Annual heating load is too small.		Building is too small.	
Verdict	-	-	Proceed w/ Detailed Scoping		Proceed w/ Detailed Scoping		Proceed w/ Detailed Scoping		Fast Fail		Fast Fail	



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WWTP – Mechanical Scope Narratives

Full Electrification

Demo Scope of Work:

- Includes removal and disposal of (1) gas furnace with DX cooling, and (1) gas-fired unit heater.
 - Assumes cut, cap and make safe gas piping for each RTU and GUH
 - Includes demo of existing GUH flue ducts
- Includes removal and disposal of (1) gas-fired domestic water heater, (1) recirc pump, (1) expansion tank, and associated DHW piping.
 - Includes removal of existing flue and patch and seal of roof
 - Assumes flue is accessible for demo, excludes demo/reinstalling of any shaft walls.
 - Assumes cut, cap and make safe gas piping from gas DWH.

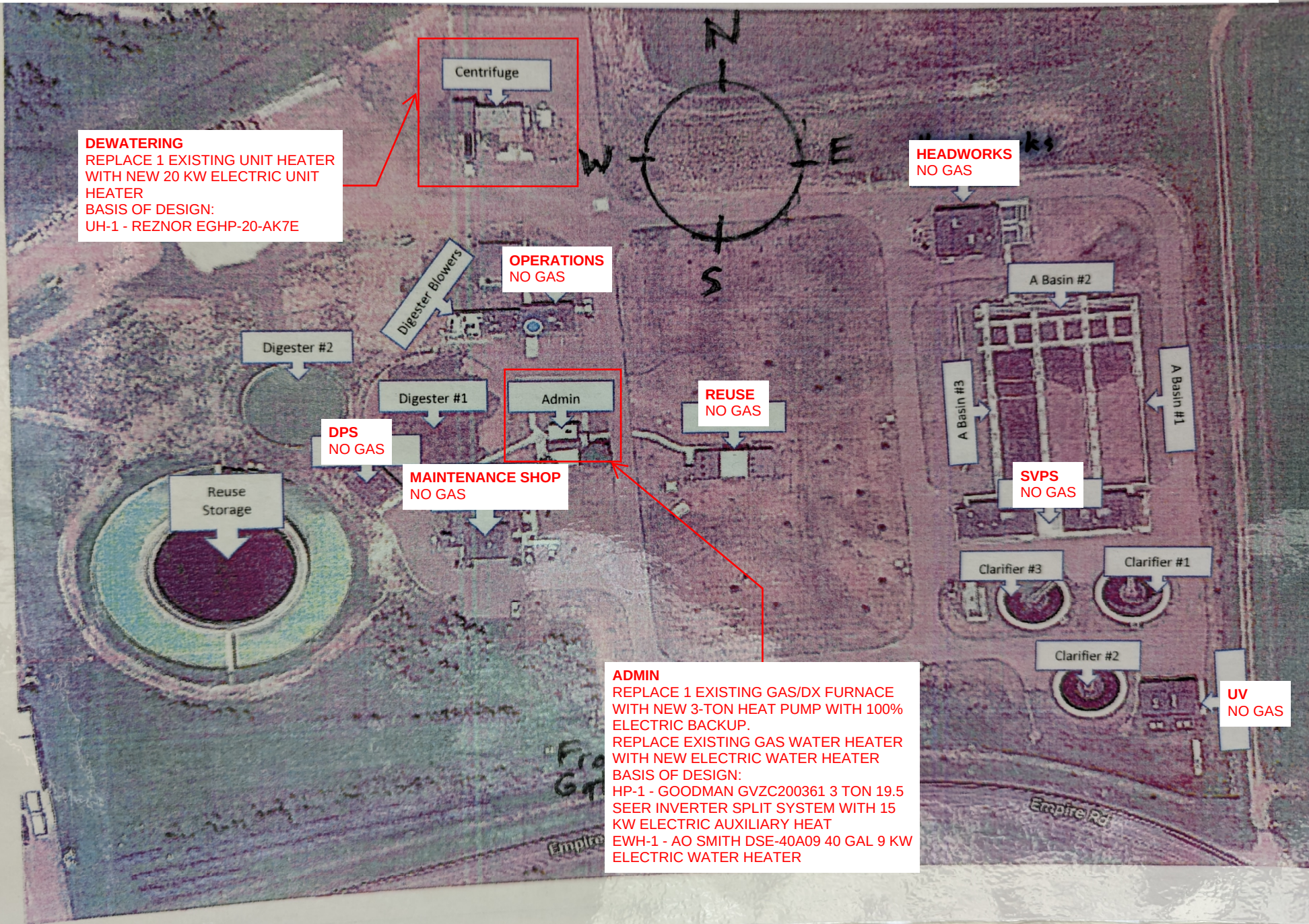
New Scope of Work:

- Includes (1) new 3-ton split system heat pumps.
 - Includes new refrigerant piping.
 - Assumes existing ductwork and any sound attenuation to remain and be reused.
 - Assumes any condensate off RTUs may drain to existing roof receptors.
- Includes (1) new 20 kW electric unit heater.
- Includes (1) 40-gal, 9 kW electric water heater, (1) recirc pump, (1) expansion tank, and associated DHW piping.
 - Includes seismic support.

Mechanical General Inclusions, Clarifications, & Exclusions

- Includes allowance for crane/rigging
- Includes allowance for permits
- Includes allowance for carpentry
- Carrying Seattle labor rates
- Pricing in today's dollars
- Excludes temp HVAC and plumbing
- Excludes overtime work
- Excludes parking
- Excludes any new sound attenuation scope. Assumes ductwork and existing sound attenuation to remain.
- Excludes duct smoke detectors and wiring
- Excludes any heat tracing
- Excludes good faith survey
- Excludes demolishing gas distribution lines/piping back to meter
- Excludes condensate drain piping to roof drains. Assumes piping directly down onto roof.

LOUISVILLE WASTE WATER TREATMENT PLANT - MECHANICAL PRICING DOCUMENT
OPTION 1 - FULL ELECTRIFICATION





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WWTP – Electrical Scope Narratives

Full Electrification – Admin Building

- General: Replacement of existing gas-fired dx furnace with new heat pump with 100% electric heat backup. Replacement of existing gas water heater with new electric water heater. Requires electrical upgrades, including:
 - Replacement of existing transformer feeding this building. Drawings and photos do not indicate size of existing transformer so 30kVA is presumed.
- 30 Day Metering Plan: Required for:
 - Admin 100A panel “PP”. Refer to drawings PDF sheet E-100 for panel locations.
 - Verify existing blower building SWB-1 customer metering data is available. If not then 30-day metering of 1200A Switchboard “SWB-1” (Blower Building) will be required.
- Electrical Demo:
 - Demolish existing transformer. Retain existing primary conduit and wire for re-use.
 - Demolish existing conduit and wire from transformer to panel “Admin PP”.
 - Demolish existing panel “Admin PP”
 - Demolish circuit powering existing furnace (20A/120V/1 phase) wiring. Believed served from Admin panel “PP” circuit 4 20A circuit breaker. Evaluate existing conduit for reuse.
 - Demolish circuit powering existing GWH-1 (120V/1 phase) wiring and conduit. Believed served from Admin panel “PP” but not clearly identified on panel schedule.
- Electrical New Work
 - Install new 3 phase 75kVA 480:208Y/120V power transformer at the location of the demolished existing transformer (location to be field verified). Conduit and wire from SWB-1 to be re-used.
 - Install 200/4 feeder from new 75kVA transformer to new panel “Admin PP”.
 - Install new 200A MCB 30 pole panelboard “Admin PP”. Location to be field verified. Panel shall contain:
 - (1) 60A/3P
 - (2) 35A/3P
 - (1) 30A/2P
 - (16) 20A/1P
 - Install new 2#10, 1#10G branch circuit to location of new HP-1A located on building exterior space. Assume 40 feet circuit. Reuse existing conduit if in acceptable condition.
 - Install new 1”-3#6, 1#10G branch circuit to location of new HP-1B located on building crawl space. Assume 40 feet circuit.
 - Install new 3/4”-3#10, 1#10G (35A) branch circuit to location of new EWH-1 electric water heater (replacement for demolished gas water heater).

Full Electrification – Dewatering Building

- General: Replacement of gas unit heater with electric unit heater.
- 30 Day Metering: Required for 600A “MCC-SF”. Refer to drawings PDF sheet E-100 for panel locations.

- Electrical Demo:
 - Demolish existing spare MCC Bucket and faceplate in existing Westinghouse Five Star Motor Control Center “MCC-SF” (Dewatering building). Refer elevation on drawing sheet E-17 for bucket location.
 - Demolish circuit and conduit (120V/1 phase) powering existing GUH. Believed served from Dewatering panel “LP” but not clearly identified on panel schedule.
- Electrical New Work:
 - Within Dewatering “MCC-SF” replace existing spare MCC bucket and faceplate with new 35A/3P breaker only MCC bucket and faceplate. Install new 3/4"-3#8, 1#10G branch circuit to location of new electric unit heater EUH-1 (replacement for demolished gas unit heater). Reuse existing conduit if in acceptable condition.

Level 2 EV Chargers and Supporting Infrastructure

- General: Installation of (2) level 2 EVSEs. Requires electrical upgrades in Shop/Maintenance Building, including:
 - Replacement of existing 30kW transformer feeding panel “LP-9000” with a new 45kW transformer and 100A feeder.
- 30 Day Metering: Required for 100A Panel “LP-9000” and 200A Panel “DP-9000” in Shop/Maintenance Building. Refer to drawings PDF sheet E-100 for panel locations.
- Electrical Demo:
 - Demolish existing “T-9000” transformer feeding panel “LP-9000”. Retain existing conduit and wire (per as-builts, 1 ½”-3#2,1#8G primary and 2 ½”-4#3/0,1#6G secondary) for re-use. See one-line on Sheet E-11 for more details.
 - Demolish existing panel “LP-9000”. Retain existing branch circuit conduit and wire for re-use.
- Electrical New Work:
 - Install (2) 60A 208V dual port pedestal type EVSE’s. Zefnet-60-CPD or approved equivalent
 - Install new 150A MCB 42 pole panelboard “LP-9000”. Refer drawing sheet E-9000 for panel location. Panel Shall contain:
 - (27) 20A/1P
 - (1) 20A/3P
 - (1) 30A/2P
 - (1) 30A/3P
 - (1) 40A/2P
 - (2) 60A/2P (EVSE)
 - Locate circuit breakers as needed to ensure the new EV load is balanced.
 - Install 1” – 4#6, 1#10G from panel “LP-9000” to location of EVSE’s as shown on plan sheet E-102. Provide pull-box / junction box to split the (2) 208V circuits to each EVSE.

PV Array Electrical Infrastructure (Costs are included in Renewables report)

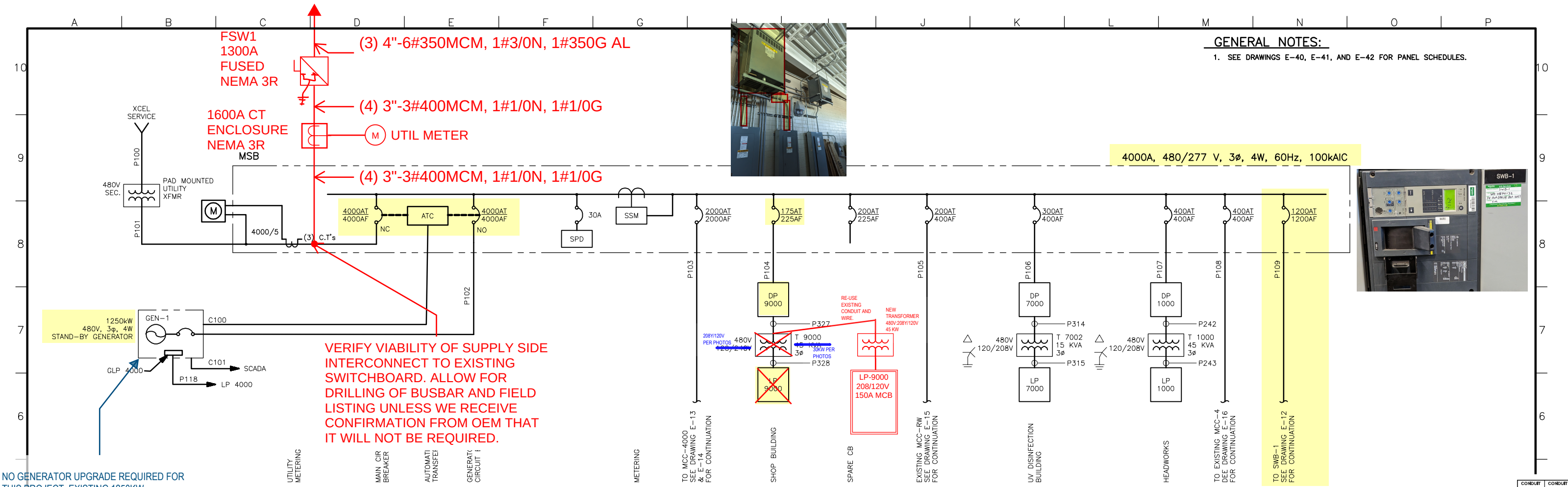
- General: 1300A PV interconnect for ground mount solar:
 - See one-line sheet E-11 and site plan E-100 for more details.



- Evaluation: evaluate MSB (4000A paralleling SWBD) to determine if supply side interconnect is possible.
- Electrical Demo: None required.
- Electrical New Work:
 - Supply & install new 1600A AMP CT enclosure and utility meter base.
 - Perform supply side interconnect to MSB, install (4) sets of 3#400, 1#1/0N, 1#1/0G between MSB and new CT enclosure, mounted adjacent. See sheet E-4008 for location.
 - Install 1300AF/3P NEMA 3R fused switch and service conductors from CT enclosure.
 - Install (3) 4"-6#350MCM, 1#3/0N, 1#350G AL to Array. Total feeder length 180' in new trench. Concrete encasement not required.

Electrical Exclusions

- Applicable sales, use and B&O tax
- Performance and Payment Bonds
- Utility company charges.
- Refurbishing existing lighting (cleaning, re-lamping, re-trimming, repair, restoration).
- Roof and building envelope penetrations, waterproofing.
- Moving, placing and (re)-calibrating owner equipment.
- Mechanical and plumbing control devices, including wiring, conduit, and components.
- Correcting existing code violations
- Hidden conditions.
- Removing, re-installing and replacing ceiling tiles.
- Opening and repairing walls and ceilings for electrical work.
- Patching and painting.
- Access panels.
- Temporary power and lighting
- Handling hazardous material including but not limited to asbestos, lead and PCB's.
- Overtime and shift premiums.
- Work stoppages, hindrances, multiple trim passes and out-of-sequence installation.
- Electrical engineering, calculations, drawings, peer review services.
- Structural and Seismic Engineering
- Material cost escalation.
- Plywood and specialty backing.
- Low voltage systems (telecom, CCTV, access control, audio visual, etc.).
- Any work not specifically included in this proposal.
- No thermostat relocations are included



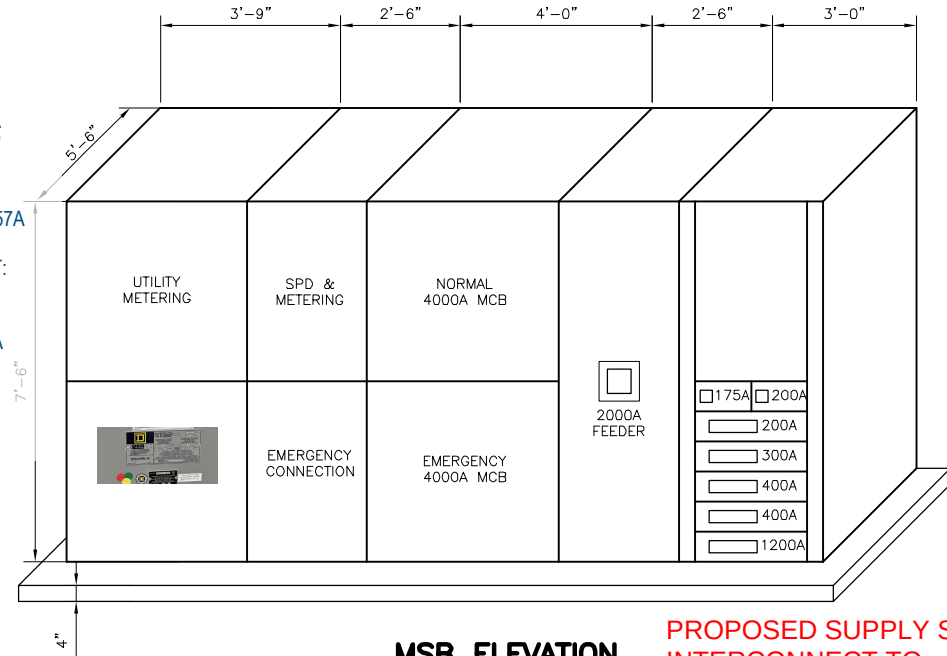
NO GENERATOR UPGRADE REQUIRED FOR THIS PROJECT. EXISTING 1250KW GENERATOR IS SUFFICIENT.

NEW EQUIPMENT ELECTRICAL DEMAND LOAD: 103.65A

EXISTING LOAD FROM UTILITY DATA: 1157A
- MAX DEMAND HEATING SEASON = 618KW
- CONVERTED TO AMPS AT 480V WITH .8 POWER FACTOR = 924.93A
- WITH 125% NEC REQUIRED FACTOR = 1157A

TOTAL LOAD AT THE END OF THE PROJECT: 1260.65A

EXISTING GENERATOR CAPACITY: 1879.45A
- 1250KW / .8PF = 1562.5 KVA @ 480V = 1879.45A



MSB ELEVATION
SCALE: NTS

PROPOSED SUPPLY SIDE INTERCONNECT TO HORIZONTAL BUS IN THIS SECTION



CONDUIT TAG	CONDUIT SIZE	CONDUIT FILL	FROM	TO	COMMENTS (DUCTBANK ID)
P100	6"		PRIMARY XCEL	XCEL PAD MNTD XFMR	MEDIUM VOLTAGE CABLE BY XCEL (D1)
P101	4"	10 SETS 4#500 KCMIL, #3/0 GND	XCEL PAD MNTD XFMR	MSB	NORMAL MAIN CIRCUIT BREAKER (D2)
P102	4"	10 SETS 4#500 KCMIL, #3/0 GND	GEN-1	MSB	EMERGENCY MAIN CIRCUIT BREAKER (D3)
P103	4"	6 SETS 4#500 KCMIL, #250 KCMIL GND	MSB	MCC-4000	VIA CABLE TRAY BELOW
P104	2 1/2"	4#4/0, #6 GND	MSB	DP-9000	(D7, D8, D12, D15)
P105	4"	4#500 KCMIL, #6 GND	MSB	EXISTING MCC-RW	(D7, D8, D21)
P106	4"	4#500 KCMIL, #4 GND	MSB	DP-7000	(D4, D5)
P107	4"	4#500 KCMIL, #3 GND	MSB	DP-1000	(D7, D8, D9, D10)
P108	4"	4#500 KCMIL, #3 GND	MSB	EXISTING MCC-4	(D7, D8, D12, D24)
P109	4"	4 SETS 4#350 KCMIL, #3/0 GND	MSB	SWB-1	(D7, D8, D12, D13)
P110	1 1/2"	4#2, #8 GND	SWB-1	EXISTING ADMIN OFFICE	
P111	4"	4#3/0, #6 GND	SWB-1	EXISTING BLWRP#2	
P112	3"	3#500 KCMIL, #3 GND	SWB-1	EXISTING B 8604 VFD	
P113	3"	3#500 KCMIL, #3 GND	SWB-1	EXISTING PP	LOCATED OUTDOORS
P114	3"	3#500 KCMIL, #3 GND	SWB-1	EXISTING B 8602 RVSS	
P115	3"	3#350 KCMIL, #4 GND	SWB-1	RVSS 8603	B 8603
P116	4"	4#500 KCMIL, #3 GND	SWB-1	EXISTING MCC-5F	
P117	4"	4#500 KCMIL, #3 GND	SWB-1	EXISTING MCC-3	
P118	2"	4#2, #8 GND	LP 4000	GLP 4000	(D3)
P119	1"	3#6, #10GND	BLWRP#2	EXISTING XFMR	
P120	3/4"	3#12, #12GND	MCC 4000	EF-4901	VIA DISCONNECT

CONDUIT TAG	CONDUIT SIZE
P300	3/4"
P301	3/4"
P302	3/4"
P303	3/4"
P304	3/4"
P305	3/4"
P306	1"
P307	2"
P308	1"
P309	1"
P310	1"
P311	1"
P312	1"
P313	1"
P314	3/4"
P315	1"
P316	3/4"
P317	3/4"
P318	3/4"
P319	3/4"
P320	3/4"
P321	3/4"
P322	3/4"
P323	3/4"
P324	3/4"
P325	3/4"
P326	3/4"
P327	1 1/2"
P328	2 1/2"
P329	NOT USED
P330	3/4"
P331	3/4"
P332	1-1/2"
P333	1-1/2"
P334	1-1/2"
P335	1-1/2"
P336	NOT USED
P337	NOT USED
P338	NOT USED
P339	NOT USED
P340	3/4"
C100	2"
C101	2"
C102	1"
C103	1"
C104	1"
C105	NOT USED

Dewberry
Dewberry Engineers Inc.
990 S. BROADWAY, SUITE 400
Denver, Colorado 80209
(303) 825-1802

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2"-SCALE ACCORDINGLY)
DRAWING ESL9665-11
DRAWN JMB
DESIGNED BHH
CHECKED BHH

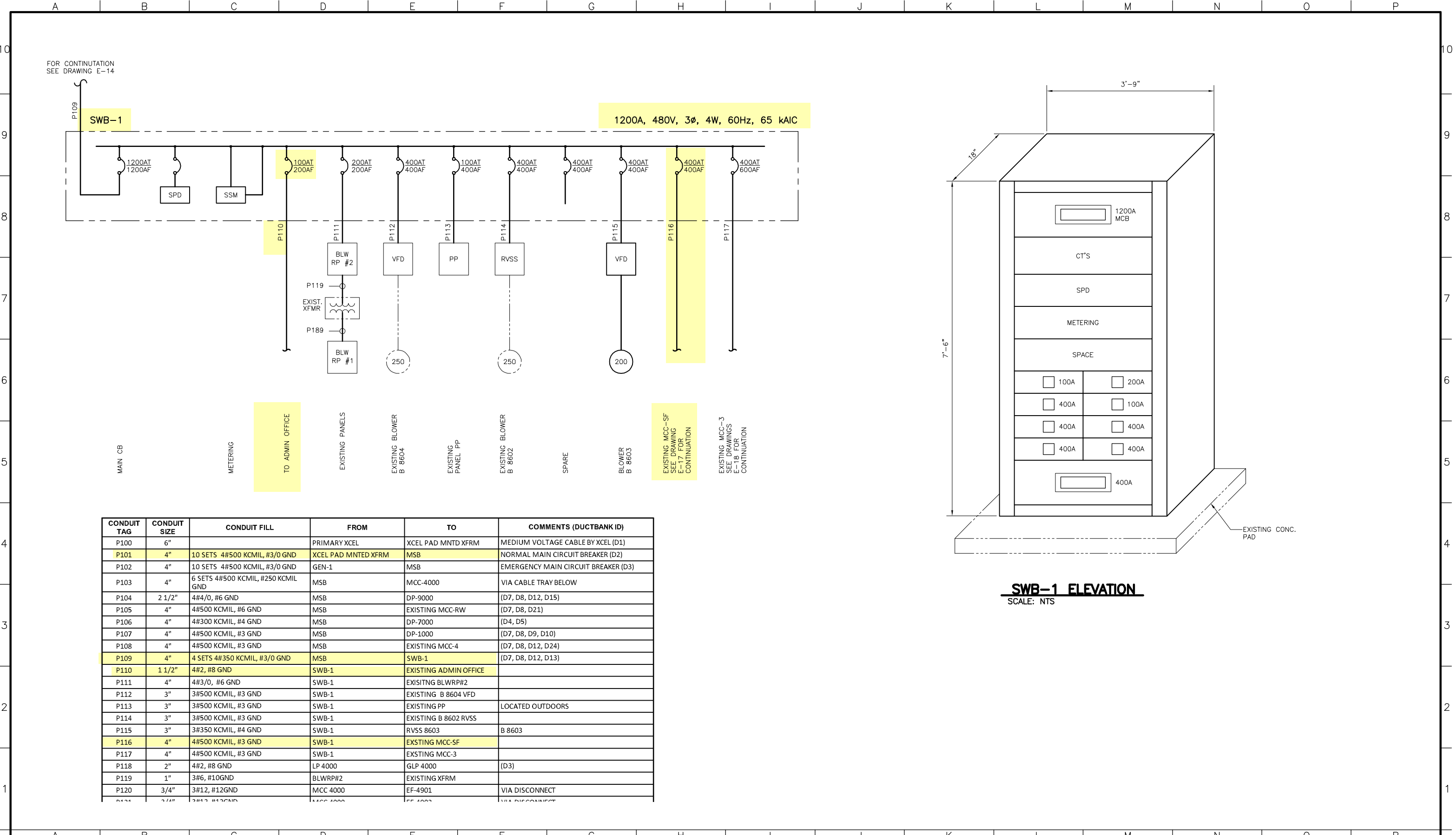
APPROVED:
PRINCIPAL
DATE:

REVISIONS
REV. DESCRIPTION BY DATE APP.
- RECORD DRAWINGS PSF 02/21/18 AEB

CITY OF LOUISVILLE
LOUISVILLE, COLORADO
WASTEWATER TREATMENT PLANT

ELECTRICAL
MAIN DISTRIBUTION
ONE-LINE DIAGRAM

DATE: 10/02/14
PROJECT NUMBER: 50059665
REVISION NO. -
DRAWING NUMBER E-11
SHEET NUMBER



FOR CONTINUATION
SEE DWG E-10

EXISTING MCC-SF

480V, 3 ϕ , 4W, 600A

GENERAL NOTES:

1. REMOVE ALL EXISTING EXPOSED CONDUIT AND WIRING TO EXISTING EQUIPMENT TO BE DEMOLISHED.
2. REUSED BUCKETS SHALL BE RELABELLED ACCORDINGLY.

KEY NOTES:

- 1 THE CONTRACTOR SHALL FURNISH AND INSTALL A 480V, 3 PHASE, 20A CIRCUIT BREAKER FOR NEW OUTDOOR INFRARED HEATER. UPDATE THE PANEL SCHEDULE ACCORDINGLY. FURNISH AND INSTALL 3#12, #12GND, 3/4" FROM EXISTING 480V PANEL TO HEATER.
- 2 CONTRACTOR SHALL REMOVE WIRING AND CONDUIT FROM EXISTING CONVEYOR MOTOR TO BE DEMOLISHED BACK TO MCC. STARTER SHALL BE TESTED AND REUSED TO FEED NEW CONVEYOR MOTOR.

EXISTING MCC-SF ONE-LINE DIAGRAM -DEMOLITION

SCALE: NTS

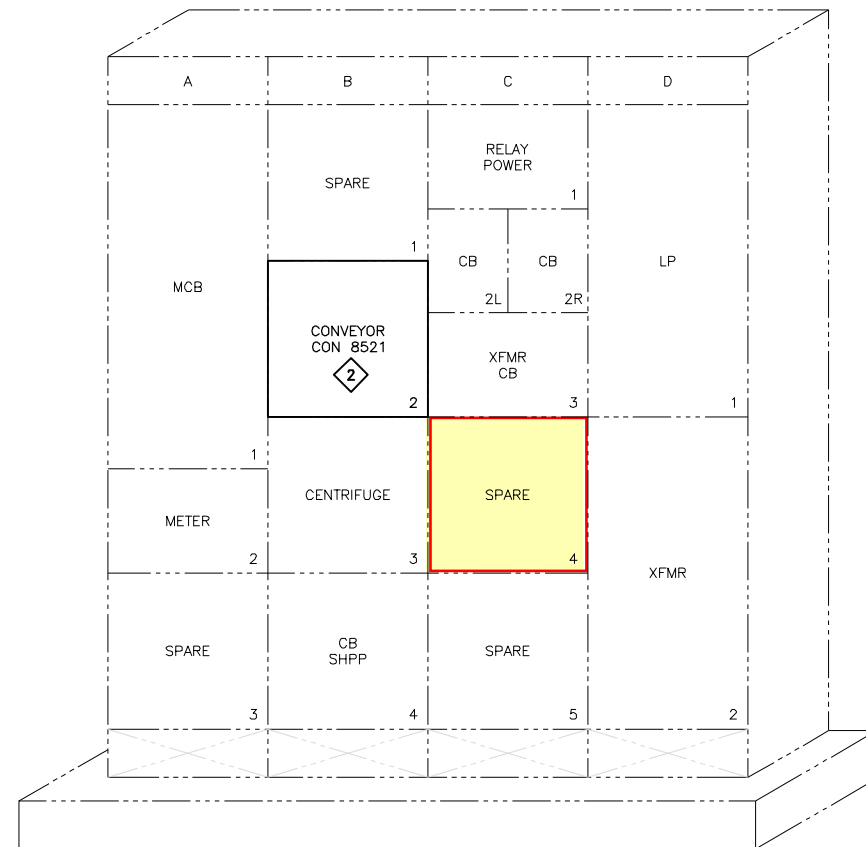
FOR CONTINUATION
SEE DWG E-12

MODIFIED MCC-SF

480V, 3 ϕ , 4W, 600A

EXISTING MCC-SF ONE-LINE DIAGRAM -MODIFIED

SCALE: NTS



EXISTING MCC-SF-MODIFIED

SCALE: NTS



Dewberry[®]

Dewberry Engineers Inc.

990 S. BROADWAY, SUITE 400
Denver, Colorado 80209
(303) 825-1802

LINE IS 2 INCHES
AT FULL SIZE
(IF NOT 2"=SCALE ACCORDINGLY)

DRAWING EDT9665-17
DRAWN JMB
DESIGNED BHH
CHECKED BHH

APPROVED:

PRINCIPAL

DATE:

REVISIONS

REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

CITY OF LOUISVILLE
LOUISVILLE, COLORADO

WASTEWATER TREATMENT PLANT

ELECTRICAL

EXISTING MCC-SF ONE-LINE DIAGRAMS
DEMOLITION AND MODIFIED

DATE: 02/03/15
PROJECT NUMBER: 50059665
REVISION NO. -
DRAWING NUMBER E-17
SHEET NUMBER

PANEL NAME: DP-7000				480/277		VOLTS		SCCR: 65K		SURFACE MOUNTED							
BUS RATING (A): 400				3 :PHASE		4 :WIRE		MAIN OCP: 300A		MSB :FED FROM							
Description	Phase KVA			Brkr Size	Circuit No	Circuit No	Brkr Size	Phase KVA			Description						
	A	B	C					A	B	C							
ON SITE REUSE, P-7111	7.50			40	1	2	20	0.89			LIGHTING						
		7.50			3	4	20		0.87		LIGHTING						
			7.50		5	6	20			0.62	LIGHTING						
ON SITE REUSE, P-7112	7.50			40	7	8	30	4.72			TRANSFORMER - T 7000, 15KVA						
		7.50			9	10		3.74									
			7.50		11	12			1.52								
FILTER SUPPLY PUMP, P-7101	7.00			30	13	14	20	0.30			OVERHEAD DOOR, OHD-7000						
		7.00			15	16		0.30									
			7.00		17	18			0.30								
FILTER SUPPLY PUMP, P-7102	7.00			30	19	20	60	13.20			UV SYSTEM TRANSFORMER (T7001)						
		7.00			21	22		13.20									
			7.00		23	24			13.20								
JIB CRANE, BC-7000	1.00			20	25	26	20	0.00			SPARE						
		1.00			27	28	20		0.00		SPARE						
			1.00		29	30	20			0.00	SPARE						
HV-7901	9.30			50	31	32	20	0.00			SPARE						
		9.30			33	34			0.00								
			9.30		35	36				0.00							
SPARE	0.00			20	37	38	20	0.00			SPARE						
		0.00			39	40			0.00								
			0.00		41	42				0.00							
ESTIMATED DEMAND																	
				TOTAL CONNECTED KVA				FACTOR				KVA					
TOTAL				58.414		57.405		54.941		170.76				0.75		128.07	

- NOTES:
- ALL CONDUITS SHALL CONTAIN AN EQUIPMENT GROUNDING CONDUCTOR PER THE NATIONAL ELECTRICAL CODE.
 - SEE SPECIFICATION SECTION 16470 FOR PANELBOARD DETAILS.

DP-7000

PANEL NAME: LP-7000				120/208		VOLTS		SCCR: 10KA				SURFACE MOUNTED	
BUS RATING (A): 100				3 :PHASE		4 :WIRE		MAIN OCP: 100A				T-7000 :FED FROM	
Description	Phase KVA			Brkr Size	Circuit No	Circuit No	Brkr Size	Phase KVA			Description		
	A	B	C					A	B	C			
SAMPLER	0.80			20	1	2	20	0.72			RECEPTACLES		
ETP-7702		0.30		20	3	4	20		0.54		RECEPTACLES		
LIT-7101, LIT-7102			0.30	20	5	6	20			0.72	RECEPTACLES		
FIT-7150	0.20			20	7	8	20	0.40			P-7120		
SPARE		0.00		20	9	10	20		0.30		LIT-7111, LIT-7112		
SPARE			0.00	20	11	12	20			0.50	FLT-7130		
DMSS-1	2.60			40	13	14	20	0.00			SPARE		
		2.60			15	16	20		0.00		SPARE		
SPARE			0.00	20	17	18	20			0.00	SPARE		
ESTIMATED DEMAND													
TOTAL			A	B	C	TOTAL CONNECTED KVA			FACTOR		KVA		
			4.72	3.74	1.52	9.98			0.75		7.49		

- NOTES:
- ALL WIRING SHALL BE 2#12,#12GND, 3/4" C UNLESS OTHERWISE NOTED
 - ALL CONDUITS SHALL CONTAIN AN EQUIPMENT GROUNDING CONDUCTOR PER THE NATIONAL ELECTRICAL CODE.
 - SEE SPECIFICATION SECTION 16470 FOR PANELBOARD DETAILS.

LP-7000

PANEL NAME: DP-9000				480/277		VOLTS		SCCR:				FLUSH MOUNTED					
BUS RATING (A): 225				3 :PHASE		4 :WIRE		MAIN OCP: 175				MSB :FED FROM					
Description	Phase KVA			Brkr Size	Circuit No	Circuit No	Brkr Size	Phase KVA			Description						
	A	B	C					A	B	C							
OVERHEAD DOOR OHD 9001	1.90			20	1	2	100	12.74			TRANSFORMER T-9000						
OVERHEAD DOOR OHD 9002		1.90		20	3	4			12.39								
OVERHEAD DOOR OHD 9003			1.90	20	5	6				12.08							
SPARE	0.00			20	7	8	20	1.67			UNIT HEATER, UH-9001						
SPARE		0.00		20	9	10			1.67								
SPARE			0.00	20	11	12				1.67							
UH-9008	4.00			20	13	14	20	1.67			UNIT HEATER, UH-9002						
UH-9007		2.00		20	15	16			1.67								
UH-9003			2.00	20	17	18				1.67							
UNIT HEATER, UH-9006	1.67			20	19	20	20	1.67			UNIT HEATER, UH-9004						
		1.67			21	22			1.67								
			1.67		23	24				1.67							
BRIDGE CRANE, BC-9000	1.30			40	25	26	20	1.67			UNIT HEATER, UH-9005						
		1.30			27	28			1.67								
			1.30		29	30				1.67							
ESTIMATED DEMAND																	
TOTAL												TOTAL CONNECTED KVA		FACTOR		KVA	
28.286 25.94 25.627												79.85		0.75		59.89	

- NOTES:
- ALL CONDUITS SHALL CONTAIN AN EQUIPMENT GROUNDING CONDUCTOR PER THE NATIONAL ELECTRICAL CODE.
 - SEE SPECIFICATION SECTION 16470 FOR PANELBOARD DETAILS.

DP-9000

PANEL NAME: LP-9000				480/240		VOLTS		SCCR: PHOTOS		SURFACE MOUNTED					
BUS RATING (A): 225				3 :PHASE		3 :WIRE		MAIN OCP: 200A				T-9000 :FED FROM			
Description	Phase KVA			Brkr Size	Circuit No	Circuit No	Brkr Size	Phase KVA			Description				
	A	B	C					A	B	C					
RECEPTACLES	0.72			20	1	2	20	1.11			SHOP LIGHTING				
RECEPTACLES		0.72		20	3	4	20		1.11		SHOP LIGHTING				
RECEPTACLES			0.72	20	5	6	20			0.41	TOOLS, WELDING, STORAGE LTNG				
RECEPTACLES	0.72			20	7	8	20	0.35			TOOLS LIGHTING				
RECEPTACLES		0.72		20	9	10	20				EF-9001				
RECEPTACLES			0.54	20	11	12	20			0.57	OUTDOOR LIGHTING				
RECEPTACLES	0.54			20	13	14	30	2.00			WATER HEATER, WH 9700 (NOTE 4)				
RECEPTACLES		0.54		20	15	16			2.00						
RECEPTACLES			0.54	20	17	18				2.00					
RETRACTABLE RECEPT	0.50			20	19	20	20	0.00			SPARE				
RETRACTABLE RECEPT		0.50		20	21	22			0.00						
RETRACTABLE RECEPT			0.50	20	23	24				0.00					
240V WELDING RECEPTACLE (NOTE 5)	2.40			30	25	26		2.00			AIR COMPRESSOR (NOTE 4)				
		2.40		30	27	28	30		2.00						
240V WELDING RECEPTACLE (NOTE 5)	2.40		2.40	30	29	30			2.00						
240V WELDING RECEPTACLE (NOTE 5)	2.40			30	31	32	20	0.00			SPARE				
		2.40		30	33	34			0.00						
		2.40		30	35	36		60/2		0.00					
SPARE	0.00			20	37	38	60/2	0.00			NEW EV CHARGER				
SPARE		0.00		20	39	40			0.00		NEW EV CHARGER				
SPARE			0.00	20	41	42				0.00					
ESTIMATED DEMAND															
		A	B	C	TOTAL CONNECTED KVA				FACTOR		KVA				
TOTAL		12.736	12.39	12.077	37.20				0.85		31.62				

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10															10
9															9
8															8
7															7
6															6
5															5
4															4
3															3
2															2
1															1

CONDUIT TAG	CONDUIT SIZE	CONDUIT FILL	FROM	TO	COMMENTS (DUCTBANK ID)
P100	6"		PRIMARY XCEL	XCEL PAD MNTD XFRM	MEDIUM VOLTAGE CABLE BY XCEL (D1)
P101	4"	10 SETS 4#500 KCMIL, #3/0 GND	XCEL PAD MINTED XFRM	MSB	NORMAL MAIN CIRCUIT BREAKER (D2)
P102	4"	10 SETS 4#500 KCMIL, #3/0 GND	GEN-1	MSB	EMERGENCY MAIN CIRCUIT BREAKER (D3)
P103	4"	6 SETS 4#500 KCMIL, #250 KCMIL GND	MSB	MCC-4000	VIA CABLE TRAY BELOW
P104	2 1/2"	4#4/0, #6 GND	MSB	DP-9000	(D7, D8, D12, D15)
P105	4"	4#500 KCMIL, #6 GND	MSB	EXISTING MCC-RW	(D7, D8, D21)
P106	4"	4#300 KCMIL, #4 GND	MSB	DP-7000	(D4, D5)
P107	4"	4#500 KCMIL, #3 GND	MSB	DP-1000	(D7, D8, D9, D10)
P108	4"	4#500 KCMIL, #3 GND	MSB	EXISTING MCC-4	(D7, D8, D12, D24)
P109	4"	4 SETS 4#350 KCMIL, #3/0 GND	MSB	SWB-1	(D7, D8, D12, D13)
P110	1 1/2"	4#2, #8 GND	SWB-1	EXISTING ADMIN OFFICE	
P111	4"	4#3/0, #6 GND	SWB-1	EXISITNG BLWRP#2	
P112	3"	3#500 KCMIL, #3 GND	SWB-1	EXISTING B 8604 VFD	
P113	3"	3#500 KCMIL, #3 GND	SWB-1	EXISTING PP	LOCATED OUTDOORS
P114	3"	3#500 KCMIL, #3 GND	SWB-1	EXISTING B 8602 RVSS	
P115	3"	3#350 KCMIL, #4 GND	SWB-1	RVSS 8603	B 8603
P116	4"	4#500 KCMIL, #3 GND	SWB-1	EXSTING MCC-SF	
P117	4"	4#500 KCMIL, #3 GND	SWB-1	EXSTING MCC-3	
P118	2"	4#2, #8 GND	LP 4000	GLP 4000	(D3)
P119	1"	3#6, #10GND	BLWRP#2	EXISTING XFRM	
P120	3/4"	3#12, #12GND	MCC 4000	EF-4901	VIA DISCONNECT
P121	3/4"	3#12, #12GND	MCC 4000	EF-4902	VIA DISCONNECT
P122	3/4"	3#6, #8 GND	MCC 4000	VFD-4201	
P123	3/4"	3#6, #8 GND	MCC 4000	VFD-4202	
P124	3/4"	3#6, #8 GND	MCC 4000	VFD-4203	
P125	3/4"	3#6, #8 GND	MCC 4000	VFD-4204	
P126	3/4"	3#12, #12 GND	MCC 4000	VFD-4301	
P127	3/4"	3#12, #12 GND	MCC 4000	VFD-4302	
P128	3/4"	3#12, #12 GND	MCC 4000	VFD-4303	
P129	3/4"	3#12, #12 GND	MCC 4000	VFD-4304	
P130	3/4"	3#12, #12 GND	MCC 4000	VFD-4401	
P131	3/4"	3#12, #12 GND	MCC 4000	VFD-4402	
P132	3/4"	3#12, #12 GND	MCC 4000	VFD-4403	
P133	3/4"	3#12, #12 GND	MCC 4000	VFD-4404	
P134	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3111	TO MIXER VIA DISCONNECT
P135	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3112	TO MIXER VIA DISCONNECT
P136	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3113	TO MIXER VIA DISCONNECT
P137	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3114	TO MIXER VIA DISCONNECT
P138	NOT USED	NOT USED	NOT USED	NOT USED	
P139	NOT USED	NOT USED	NOT USED	NOT USED	
P140	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3117	TO MIXER VIA DISCONNECT
P141	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3211	TO MIXER VIA DISCONNECT
P142	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3212	TO MIXER VIA DISCONNECT
P143	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3213	TO MIXER VIA DISCONNECT
P144	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3214	TO MIXER VIA DISCONNECT
P145	NOT USED	NOT USED	NOT USED	NOT USED	
P146	NOT USED	NOT USED	NOT USED	NOT USED	
P147	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3217	TO MIXER VIA DISCONNECT
P148	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3311	TO MIXER VIA DISCONNECT
P149	1"	3#10, 3#14, #10 GND	MCC 4000	MXR/CS-3312	TO MIXER VIA DISCONNECT

CONDUIT TAG	CONDUIT SIZE	CONDUIT FILL	FROM	TO	COMMENTS (DUCTBANK ID)
P150	1"	3#10, 3#14, #10 GND	MCC-4000	MXR/CS-3313	TO MIXER VIA DISCONNECT
P151	1"	3#10, 3#14, #10 GND	MCC-4000	MXR/CS-3314	TO MIXER VIA DISCONNECT
P152	NOT USED	NOT USED	NOT USED	NOT USED	
P153	NOT USED	NOT USED	NOT USED	NOT USED	
P154	1"	3#10, 3#14, #10 GND	MCC-4000	MXR/CS-3317	TO MIXER VIA DISCONNECT
P155	4"	3#350, #4 GND	MCC-4000	B-4101	VIA VFD, VFD CABLE IN CABLE TRAY
P156	4"	3#350, #4 GND	MCC-4000	B-4102	VIA VFD, VFD CABLE IN CABLE TRAY
P157	4"	3#350, #4 GND	MCC-4000	B-4103	VIA VFD, VFD CABLE IN CABLE TRAY
P158	3/4"	3#12, #12 GND	MCC-4000	P-4501	VIA VFD, VFD CABLE IN CABLE TRAY
P159	3/4"	3#12, #12 GND	MCC-4000	P-4502	VIA VFD, VFD CABLE IN CABLE TRAY
P160	3/4"	3#10, #10 GND	MCC-4000	LCP-4501	VENDOR CABLE TO LCP FROM PUMPS IN CONDUIT
P161	3/4"	3#12, #12 GND	MCC-4000	UH-4901	VIA DISCONNECT
P162	3/4"	3#12, #12 GND	MCC-4000	UH-4902	VIA DISCONNECT
P163	3/4"	3#12, #12 GND	MCC-4000	UH-4903	VIA DISCONNECT
P164	3/4"	3#12, #12 GND	MCC-4000	UH-4904	VIA DISCONNECT
P165	3/4"	3#12, #12 GND	MCC-4000	UH-4905	VIA DISCONNECT
P166	3/4"	3#12, #12 GND	MCC-4000	UH-4906	VIA DISCONNECT
P167	2"	3#3, #8 GND	MCC-4000	DH-4901	VIA DISCONNECT
P168	2"	3#3, #8 GND	MCC-4000	DH-4902	VIA DISCONNECT
P169	3/4"	3#10, 3#14, #10 GND	MCC-4000	COL-5101/CS-5101	VIA JB 5101 (D4), 3#14 FOR CS-5101
P170	3/4"	3#10, 3#14, #10 GND	MCC-4000	COL-5201/CS-5201	VIA JB 5201 (D4), 3#14 FOR CS-5201
P171	3/4"	3#10, 3#14, #10 GND	MCC-4000	COL-5301/CS-5301	VIA JB 5301 (D4, D6), 3#14 FOR CS-5301
P172	3/4"	3#10 #10 GND	MCC-4000	RTU-4901	VIA DISCONNECT
P173	3/4"	3#10 #10 GND	MCC-4000	ERU-4901	VIA DISCONNECT
P174	3/4"	3#10 #10 GND	MCC-4000	ERU-4902	VIA DISCONNECT
P175	1 1/2"	3#2, #8 GND	MCC-4000	DP-4000	
P176	1 1/2"	3#4, #8 GND	DP-4000	T 4000	
P177	2 1/2"	4#4/0, #6 GND	T 4000	LP-4000	
P178	NOT USED	NOT USED	NOT USED	NOT USED	
P179	NOT USED	NOT USED	NOT USED	NOT USED	
P180	3/4"	3#12, #12 GND	EXISTING MCC-RW	CV-7501	
P181	3/4"	3#12, #12 GND	EXISTING MCC-4	GDR-8510	VIA DISCONNECT
P182	3/4"	3#10, #10 GND	EXISTING MCC-4	P-8401	VIA VFD AND DISCONNECT
P183	3/4"	3#10, #10 GND	EXISTING MCC-4	P-8402	VIA VFD AND DISCONNECT
P184	3/4"	3#12, #12 GND	EXISTING MCC-4	P-8001	VIA VFD AND DISCONNECT
P185	3/4"	3#12, #12 GND	EXISTING MCC-4	P-8002	VIA VFD AND DISCONNECT
P186	3/4"	3#12, #12 GND	EXISTING MCC-4	P-8301	VIA VFD AND DISCONNECT
P187	1"	3#12, #12 GND	EXISTING MCC 4	TV-8101	
P188	1"	3#12, #12 GND	EXISTING MCC 4	TV-8201	
P189	1 1/2"	4#2, 6 GND	EXISTING XMFR	BLWRP#1	
P190	3/4"	3#12, #12GND	EXISTING MCC-SF	CON 8502	VIA DISCONNECT
P191	3/4"	3#12, #12GND	EXISTING MCC-3	EX. IRRIGATION PMP	TEMPORARY
P192	3/4"	3#12, #12GND	EXISTING MCC-3	EX. IRRIGATION PMP	TEMPORARY
P193	NOT USED	NOT USED	NOT USED	NOT USED	
P194	NOT USED	NOT USED	NOT USED	NOT USED	
P195	NOT USED	NOT USED	NOT USED	NOT USED	
P196	NOT USED	NOT USED	NOT USED	NOT USED	
P197	NOT USED	NOT USED	NOT USED	NOT USED	
P198	NOT USED	NOT USED	NOT USED	NOT USED	
P199	NOT USED	NOT USED	NOT USED	NOT USED	



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DRAWING_EDT9665-45

DRAWN_JMB

DESIGNED_BHH

CHECKED_BHH

APPROVED:

PRINCIPAL

DATE:

REVISIONS

REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

CITY OF LOUISVILLE
LOUISVILLE, COLORADO

WASTEWATER TREATMENT PLANT

ELECTRICAL

CONDUIT AND CABLE SCHEDULES
SHEET 1

DATE: 02/05/15

PROJECT NUMBER: 50059665

REVISION NO. -

DRAWING NUMBER E-45

SHEET NUMBER

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10															10
9															9
8															8
7															7
6															6
5															5
4															4
3															3
2															2
1															1

CONDUIT TAG	CONDUIT SIZE	CONDUIT FILL	FROM	TO	COMMENTS (DUCTBANK ID)
P200	3/4"	3#12, #12GND	DP-1000	P 1221	VIA VFD , VFD CABLE
P201	3/4"	3#12, #12GND	DP-1000	P 1222	VIA VFD , VFD CABLE
P202	3/4"	3#12, #12GND	DP-1000	LCP 1002	
P203	3/4"	3#12, #12GND	LCP 1002	SCR 1002	
P204	3/4"	2#14, #14GND	LCP 1002	SV 1002A	
P205	3/4"	2#14, #14GND	LCP 1002	SV 1002B	
P206	3/4"	2#14, #14GND	LCP 1002	ES 1002	
P207	3/4"	#16 TSP	LCP 1002	LIT 102	
P208	3/4"	3#12, #12GND	DP-1000	LCP 1003	
P209	3/4"	3#12, #12GND	LCP 1003	SCR 1003	
P210	3/4"	4#14, #14GND	LCP 1003	SV 1003A	
P211	3/4"	4#14, #14GND	LCP 1003	SV 1003B	
P212	3/4"	2#14, #14GND	LCP 1003	ES 1003	
P213	3/4"	#16 TSP	LCP 1003	LIT 1003	
P214	3/4"	3#12, #12GND	DP-1000	LCP 1242	
P215	3/4"	3#12, #12GND	DP-1000	MME 1242	
P216	3/4"	3#12, #12GND	DP-1000	UH 1901	VIA DISCONNECT
P217	3/4"	3#12, #12GND	DP-1000	UH 1902	VIA DISCONNECT
P218	3/4"	3#12, #12GND	DP-1000	OH 1003	
P219	1"	6#12, #12GND	DP-1000	JB	
P220	3/4"	3#12, #12GND	JB	OH 1001	
P221	3/4"	3#12, #12GND	JB	OH 1002	
P222	1"	3#8, #10GND	DP-1000	LCP 3000	
P223	1"	3#12, #12GND, 4#14, #14GND	LCP 3000	PJB 3001	
P224	1"	VENDOR CABLE	PJB 3001	P 3001	
P225	1"	3#12, #12GND, 4#14, #14GND	LCP 3000	PJB 3002	
P226	1"	VENDOR CABLE	PJB 3002	P 3002	
P227	1"	3#12, #12GND, 4#14, #14GND	LCP 3000	PJB 3003	
P228	1"	VENDOR CABLE	PJB 3003	P 3003	
P229	1"	3#12, #12GND, 4#14, #14GND	LCP 3000	PJB 3004	
P230	1"	VENDOR CABLE	PJB 3004	P 3004	
P231	1"	3#12, #12GND, 4#14, #14GND	LCP 3000	PJB 3005	
P232	1"	VENDOR CABLE	PJB 3005	P 3005	
P233	1"	4#14, #14GND	LCP 3000	CJB 3001	
P234	3/4"	8#14, #14GND	LCP 3000	CJB 3000	
P235	3/4"	2#14, #14GND	CJB 3001	LSLL 3013	
P236	3/4"	2#14, #14GND	CJB 3001	LSHH 3012	
P237	3/4"	2#14, #14GND	CJB 3000	LSLL 3023	
P238	3/4"	2#14, #14GND	CJB 3000	LSHH 3022	
P239	3/4"	NOT USED	NOT USED	NOT USED	
P240	3/4"	NOT USED	NOT USED	NOT USED	
P241	3/4"	NOT USED	NOT USED	NOT USED	
P242	1"	3#8, #8GND	DP-1000	T 1000	
P243	1 1/2"	4#2, #8GND	T 1000	LP 1000	
P244	1"	3#4, #8GND	DP-1000	DH 1901	
P245	1"	3#4, #8GND	DP-1000	DH 1902	
P246	1"	3#10, #10GND	DP-1000	LCP 9700	
P247	3/4"	6#12, #12, GND	LCP 9700	PJB 9700	
P248	1"	3#12, #12GND, 4#14, #14GND	PJB 9700	P 9702	
P249	1"	3#12, #12GND, 4#14, #14GND	PJB 9700	P 9703	

CONDUIT TAG	CONDUIT SIZE	CONDUIT FILL	FROM	TO	COMMENTS (DUCTBANK ID)
P250	1 1/2"	8#14, #14GND	LCP 9700	CJB 9700	
P251	NOT USED	NOT USED	NOT USED	NOT USED	
P252	3/4"	2#14, #14 GND	CJB 9700	LSL 9711	
P253	3/4"	2#14, #14 GND	CJB 9700	LSH 9711	
P254	3/4"	2#14, #14 GND	CJB 9700	LSHH 9711	
P255	1"	3#12, #12 GND	DP-1000	MME 1101	
P256	1"	3#10, #10 GND	DP-1000	LCP 1701	
P257	1"	3#12, #12 GND	LCP 1701	P 1701	
P258	1"	2#14, #14 GND	LCP 1701	LSL 1231	
P259	1"	2#14, #14 GND	LCP 1701	LSH 1231	
P260	1"	2#14, #14 GND	LCP 1701	LSHH 1231	
P261	3/4"	2#14, #14GND	LSLL-9711	CJB 9700	
P262	CABLE TRAY	3#6, 12#14, #8 GND	VFD-4201	P/SWU/SV/CS-4201	CABLE IN CABLE TRAY
P263	CABLE TRAY	3#6, 12#14, #8 GND	VFD-4202	P/SWU/SV/CS-4202	CABLE IN CABLE TRAY
P264	CABLE TRAY	3#6, 12#14, #8 GND	VFD-4203	P/SWU/SV/CS-4203	CABLE IN CABLE TRAY
P265	CABLE TRAY	3#6, 12#14, #8 GND	VFD-4204	P/SWU/SV/CS-4204	CABLE IN CABLE TRAY
P266	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4301	P/SWU/SV/CS-4301	CABLE IN CABLE TRAY
P267	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4302	P/SWU/SV/CS-4302	CABLE IN CABLE TRAY
P268	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4303	P/SWU/SV/CS-4303	CABLE IN CABLE TRAY
P269	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4304	P/SWU/SV/CS-4304	CABLE IN CABLE TRAY
P270	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4401	P/SWU/SV/CS-4401	CABLE IN CABLE TRAY
P271	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4402	P/SWU/SV/CS-4402	CABLE IN CABLE TRAY
P272	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4403	P/SWU/SV/CS-4403	CABLE IN CABLE TRAY
P273	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4404	P/SWU/SV/CS-4404	CABLE IN CABLE TRAY
P274	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4501	P/SWU/SV/CS-4501	CABLE IN CABLE TRAY
P275	CABLE TRAY	3#12, 12#14, #12 GND	VFD-4502	P/SWU/SV/CS-4502	CABLE IN CABLE TRAY
P276	NOT USED	NOT USED	NOT USED	NOT USED	
P277	NOT USED	NOT USED	NOT USED	NOT USED	
P278	NOT USED	NOT USED	NOT USED	NOT USED	
P279	NOT USED	NOT USED	NOT USED	NOT USED	
P280	NOT USED	NOT USED	NOT USED	NOT USED	
P281	NOT USED	NOT USED	NOT USED	NOT USED	
P282	NOT USED	NOT USED	NOT USED	NOT USED	
P283	NOT USED	NOT USED	NOT USED	NOT USED	
P284	NOT USED	NOT USED	NOT USED	NOT USED	
P285	NOT USED	NOT USED	NOT USED	NOT USED	
P286	NOT USED	NOT USED	NOT USED	NOT USED	
P287	NOT USED	NOT USED	NOT USED	NOT USED	
P288	NOT USED	NOT USED	NOT USED	NOT USED	
P289	NOT USED	NOT USED	NOT USED	NOT USED	
P290	NOT USED	NOT USED	NOT USED	NOT USED	
P291	NOT USED	NOT USED	NOT USED	NOT USED	
P292	NOT USED	NOT USED	NOT USED	NOT USED	
P293	NOT USED	NOT USED	NOT USED	NOT USED	
P294	NOT USED	NOT USED	NOT USED	NOT USED	
P295	NOT USED	NOT USED	NOT USED	NOT USED	
P296	NOT USED	NOT USED	NOT USED	NOT USED	
P297	NOT USED	NOT USED	NOT USED	NOT USED	
P298	NOT USED	NOT USED	NOT USED	NOT USED	
P299	NOT USED	NOT USED	NOTE USED	NOT USED	



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DRAWING EDT9665-46

DRAWN JMB

DESIGNED BHH

CHECKED BHH

APPROVED:

PRINCIPAL

DATE:

REVISIONS

REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

CITY OF LOUISVILLE
LOUISVILLE, COLORADO

WASTEWATER TREATMENT PLANT

ELECTRICAL

CONDUIT AND CABLE SCHEDULES
SHEET 2

DATE: 02/05/15

PROJECT NUMBER: 50059665

REVISION NO. -

DRAWING NUMBER E-46

SHEET NUMBER

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10															10
9															9
8															8
7															7
6															6
5															5
4															4
3															3
2															2
1															1

CONDUIT TAG	CONDUIT SIZE	CONDUIT FILL	FROM	TO	COMMENTS (DUCTBANK ID)
P300	3/4"	3#10, #10GND	DP-7000	VFD-7111	
P301	3/4"	3#10, #10 GND	DP-7000	VFD-7112	
P302	3/4"	3#10, #10 GND	DP-7000	VFD-7101	
P303	3/4"	3#10, #10 GND	DP-7000	VFD-7102	
P304	3/4"	3#12, #12 GND	DP-7000	OHD-7000	
P305	3/4"	3#12, #12 GND	DP-7000	BC-7000	
P306	1"	3#6, #10GND	DP-7000	T 7001	
P307	2"	4#1/0, #6GND	T 7001	PDDC 7000	
P308	1"	VENDOR CABLE	PDDC 7000	MME 7011	
P309	1"	VENDOR CABLE	PDDC 7000	MME 7012	
P310	1"	VENDOR CABLE	PDDC 7000	MME 7013	
P311	1"	VENDOR CABLE	PDDC 7000	MME 7021	
P312	1"	VENDOR CABLE	PDDC 7000	MME 7022	
P313	1"	VENDOR CABLE	PDDC 7000	MME 7023	
P314	3/4"	3#10, #10GND	DP-7000	T 7002	
P315	1"	4#6, #8GND	T 7002	LP 7000	
P316	3/4"	3#8, #10GND	DP-7000	HV 7901	VIA DISCONNECT
P317	3/4"	3#12, #12 GND	DP-9000	OHD-9001	
P318	3/4"	3#12, #12 GND	DP-9000	OHD-9002	
P319	3/4"	3#12, #12 GND	DP-9000	OHD-9003	
P320	3/4"	3#12, #12 GND	DP-9000	BC-9000	
P321	3/4"	3#12, #12 GND	DP-9000	UH-9001	VIA DISCONNECT
P322	3/4"	3#12, #12 GND	DP-9000	UH-9002	VIA DISCONNECT
P323	3/4"	2#12, #12 GND	DP-9000	UH-9003	VIA DISCONNECT
P324	3/4"	3#12, #12 GND	DP-9000	UH-9004	VIA DISCONNECT
P325	3/4"	3#12, #12 GND	DP-9000	UH-9005	VIA DISCONNECT
P326	3/4"	3#12, #12 GND	DP-9000	UH-9006	VIA DISCONNECT
P327	1 1/2"	3#2, #8 GND	DP-9000	T-9000	
P328	2 1/2"	4#3/0, #6 GND	T-9000	LP 9000	
P329	NOT USED	NOT USED	NOT USED	NOT USED	
P330	3/4"	2#12, #12GND	DP-9000	UH-9007	VIA DISCONNECT
P331	3/4"	2#12, #12GND	DP-9000	UH-9008	VIA DISCONNECT
P332	1-1/2"	3#6, 12#14, #6GND	VFD-7111	P/SWU/CS/SV-7111	
P333	1-1/2"	3#6, 12#14, #6GND	VFD-7112	P/SWU/CS/SV-7112	
P334	1-1/2"	3#8, 12#14, #8GND	VFD-7101	P/SWU/CS/SV-7101	
P335	1-1/2"	3#8, 12#14, #8GND	VFD-7102	P/SWU/CS/SV-7102	
P336	NOT USED	NOT USED	NOT USED	NOT USED	
P337	NOT USED	NOT USED	NOT USED	NOT USED	
P338	NOT USED	NOT USED	NOT USED	NOT USED	
P339	NOT USED	NOT USED	NOT USED	NOT USED	
P340	3/4"	3#8, #10GND	LP-9000	WASHER/DRYER	LOCATED IN SHOP RESTROOM
C100	2"	4#14, #14NGD	GEN-1	ATC (MSB)	
C101	2"	16#14,1#12GND	GEN-1	ACC 4000	
C102	1"	6#14, #14GND	MCC-4000	COL 5101	
C103	1"	6#14, #14GND	MCC-4000	COL 5201	
C104	1"	6#14, #14GND	MCC-4000	COL 5301	
C105	NOT USED	NOT USED	NOT USED	NOT USED	

CONDUIT TAG	CONDUIT SIZE	CONDUIT FILL	FROM	TO	COMMENTS (DUCTBANK ID)
C120	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C121	3/4"	4#14, #14 GND	ACC-7500	JBC	
C122	3/4"	2#14, #14 GND	JBC	SV-7250	
C123	3/4"	2#14, #14 GND	JBC	SV-7251	
C124	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C125	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C130	3/4"	ENET	ACC-8000	VFD 8301	
C131	3/4"	NOT USED	NOT USED	NOT USED	NOT USED
C132	3/4"	ENET	ACC-8000	VFD 8401	
C133	3/4"	ENET	ACC-8000	VFD 8402	
C134	3/4"	ENET	ACC-8000	VFD 8002	
C135	3/4"	ENET	ACC-8000	VFD 8001	
C136	3/4"	4#14, #14 GND	ACC-8000	MCC-4	
C137	3/4"	4#14, #14 GND	VFD-8001	SWU/SV-8001	
C138	3/4"	4#14, #14 GND	VFD-8002	SWU/SV-8002	
C139	3/4"	4#14, #14 GND	VFD-8401	SWU/SV-8401	
C140	3/4"	4#14, #14 GND	VFD-8402	SWU/SV-8402	
C141	3/4"	4#14, #14 GND	VFD-8301	SWU/SV-8301	
C142	1"	ENET	ACC-8000	LCP 8510	
C143	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C144	3/4"	ENET	ACC-4000	LCP-4100	
C145	NOT USED	NOT USED	NOT USED	NOT USED	
C146	NOT USED	NOT USED	NOT USED	NOT USED	
C147	NOT USED	NOT USED	NOT USED	NOT USED	
C148	NOT USED	NOT USED	NOT USED	NOT USED	
C149	3/4"	ENET	ACC 4000	FSP 4000	
C150	3/4"	ENET	LCP-4100	LCP-4101	
C151	3/4"	ENET	LCP-4100	LCP-4102	
C152	3/4"	ENET	LCP-4100	LCP-4103	
C153	3/4"	ENET	ACC 4000	VFD 4201	
C154	3/4"	ENET	ACC 4000	VFD 4202	
C155	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C156	3/4"	ENET	ACC 4000	VFD 4203	
C157	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C158	3/4"	ENET	ACC 4000	VFD 4204	
C159	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C160	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C161	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C162	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C163	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C164	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C165	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C166	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C167	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C168	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C169	3/4"	ENET	ACC 4000	VFD 4301	
C170	3/4"	ENET	ACC 4000	VFD 4302	
C171	3/4"	ENET	ACC 4000	VFD 4303	
C172	3/4"	ENET	ACC 4000	VFD 4304	
C173	3/4"	ENET	ACC 4000	VFD 4401	



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DRAWING EDT9665-47

DRAWN JMB

DESIGNED BHH

CHECKED BHH

APPROVED:

PRINCIPAL

DATE:

REVISIONS

REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

CITY OF LOUISVILLE
LOUISVILLE, COLORADO

WASTEWATER TREATMENT PLANT

ELECTRICAL

CONDUIT AND CABLE SCHEDULES
SHEET 3

DATE: 02/05/15

PROJECT NUMBER: 50059665

REVISION NO. -

DRAWING NUMBER **E-47**

SHEET NUMBER

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
10															10
9															9
8															8
7															7
6															6
5															5
4															4
3															3
2															2
1															1

CONDUIT TAG	CONDUIT SIZE	CONDUIT FILL	FROM	TO	COMMENTS (DUCTBANK ID)
C174	3/4"	ENET	ACC 4000	VFD 4402	
C175	3/4"	ENET	ACC 4000	VFD 4403	
C176	3/4"	ENET	ACC 4000	VFD 4404	
C177	3/4"	2#14, #14 GND	ACC 4000	SV 4541	
C178	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C179	1"	10#14, 1#14 GND	ACC 4000	LCP 4700	CONTACTS FOR SUMP PUMP SYSTEM
C180	1"	11#14, #14 GND	VFD 4501	SWU/LCS/SV 4501	7#14 FOR LCS, 2#14 FOR SV, 2#14 FOR SWU
C181	1"	11#14, #14 GND	VFD 4502	SWU/LCS/SV 4502	7#14 FOR LCS, 2#14 FOR SV, 2#14 FOR SWU
C182	3/4"	ENET	ACC 4000	VFD 4501	
C183	3/4"	ENET	ACC 4000	VFD 4502	
C184	3/4"	ENET	ACC 8600	LCP/VFD 8602	
C185	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C200	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C201	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C202	3/4"	ENET	ACC-1000	LCP 1002	
C203	3/4"	ENET	ACC-1000	LCP 1003	
C204	3/4"	ENET	ACC-1000	LCP 1242	
C205	3/4"	ENET	ACC-1000	LCP 3000	
C206	3/4"	NOT USED	NOT USED	NOT USED	
C207	3/4"	10#14, 1#14G	ACC-1000	LCP 9700	
C208	3/4"	ENET	ACC-1000	MME 1101	
C209	3/4"	6#14, 1#14 GND	ACC-1000	LCP 1701	FOR RUN, COMMON ALARM AND LSH CONTACTS
C210	3/4"	4#14, #14 GND	LCP-1242	SWU/SV 1221	2#14 FOR SV, 2#14 FOR SWU
C211	3/4"	4#14, #14 GND	LCP-1242	SWU/SV 1222	2#14 FOR SV, 2#14 FOR SWU
C212	3/4"	#16 TSP	ACC-1000	SMP 1301	
C213	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C214	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C300	3/4"	ENET	ACC-7000	VFD 7111	
C301	3/4"	ENET	ACC-7000	VFD 7112	
C302	3/4"	ENET	ACC-7000	VFD 7101	
C303	3/4"	ENET	ACC-7000	VFD 7102	
C304	3/4"	ENET	ACC-7000	PDDC 7000	
C305	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C306	3/4"	#16 TSP	ACC-7000	SMP 7301	
C307	1"	11#14, #14 GND	VFD 7101	SWU/LCS/SV 7111	7#14 FOR LCS, 2#14 FOR SV, 2#14 FOR SWU
C308	1"	11#14, #14 GND	VFD 7102	SWU/LCS/SV 7112	7#14 FOR LCS, 2#14 FOR SV, 2#14 FOR SWU
C309	1"	11#14, #14 GND	VFD 7111	SWU/LCS/SV 7103	7#14 FOR LCS, 2#14 FOR SV, 2#14 FOR SWU
C310	1"	11#14, #14 GND	VFD 7112	SWU/LCS/SV 7104	7#14 FOR LCS, 2#14 FOR SV, 2#14 FOR SWU
C311	3/4"	#16 TSP	MCC-4000	MXR-3111	FOR MOISTURE AND TEMP SENSORS
C312	3/4"	#16 TSP	MCC-4000	MXR-3112	FOR MOISTURE AND TEMP SENSORS
C313	3/4"	#16 TSP	MCC-4000	MXR-3113	FOR MOISTURE AND TEMP SENSORS
C314	3/4"	#16 TSP	MCC-4000	MXR-3114	FOR MOISTURE AND TEMP SENSORS
C315	3/4"	#16 TSP	MCC-4000	MXR-3115	FOR MOISTURE AND TEMP SENSORS
C316	3/4"	#16 TSP	MCC-4000	MXR-3116	FOR MOISTURE AND TEMP SENSORS
C317	3/4"	#16 TSP	MCC-4000	MXR-3117	FOR MOISTURE AND TEMP SENSORS
C318	3/4"	#16 TSP	MCC-4000	MXR-3211	FOR MOISTURE AND TEMP SENSORS
C319	3/4"	#16 TSP	MCC-4000	MXR-3212	FOR MOISTURE AND TEMP SENSORS
C320	3/4"	#16 TSP	MCC-4000	MXR-3213	FOR MOISTURE AND TEMP SENSORS
C321	3/4"	#16 TSP	MCC-4000	MXR-3214	FOR MOISTURE AND TEMP SENSORS
C322	3/4"	#16 TSP	MCC-4000	MXR-3215	FOR MOISTURE AND TEMP SENSORS

CONDUIT TAG	CONDUIT SIZE	CONDUIT FILL	FROM	TO	COMMENTS (DUCTBANK ID)
C323	3/4"	#16 TSP	MCC-4000	MXR-3216	FOR MOISTURE AND TEMP SENSORS
C324	3/4"	#16 TSP	MCC-4000	MXR-3217	FOR MOISTURE AND TEMP SENSORS
C325	3/4"	#16 TSP	MCC-4000	MXR-3311	FOR MOISTURE AND TEMP SENSORS
C326	3/4"	#16 TSP	MCC-4000	MXR-3312	FOR MOISTURE AND TEMP SENSORS
C327	3/4"	#16 TSP	MCC-4000	MXR-3313	FOR MOISTURE AND TEMP SENSORS
C328	3/4"	#16 TSP	MCC-4000	MXR-3314	FOR MOISTURE AND TEMP SENSORS
C329	3/4"	#16 TSP	MCC-4000	MXR-3315	FOR MOISTURE AND TEMP SENSORS
C330	3/4"	#16 TSP	MCC-4000	MXR-3316	FOR MOISTURE AND TEMP SENSORS
C331	3/4"	#16 TSP	MCC-4000	MXR-3317	FOR MOISTURE AND TEMP SENSORS
C332	3/4"	2#14, 1#14G	VFD 4201	P-4201	MOTOR THERMISTOR LEADS VIA JB
C333	3/4"	2#14, 1#14G	VFD 4202	P-4202	MOTOR THERMISTOR LEADS VIA JB
C334	3/4"	2#14, 1#14G	VFD 4203	P-4203	MOTOR THERMISTOR LEADS VIA JB
C335	3/4"	2#14, 1#14G	VFD 4204	P-4204	MOTOR THERMISTOR LEADS VIA JB
C336	3/4"	2#14, 1#14G	VFD 4301	P-4301	MOTOR THERMISTOR LEADS VIA JB
C337	3/4"	2#14, 1#14G	VFD 4302	P-4302	MOTOR THERMISTOR LEADS VIA JB
C338	3/4"	2#14, 1#14G	VFD 4303	P-4303	MOTOR THERMISTOR LEADS VIA JB
C339	3/4"	2#14, 1#14G	VFD 4304	P-4304	MOTOR THERMISTOR LEADS VIA JB
C340	3/4"	2#14, 1#14G	VFD 4401	P-4401	MOTOR THERMISTOR LEADS VIA JB
C341	3/4"	2#14, 1#14G	VFD 4402	P-4402	MOTOR THERMISTOR LEADS VIA JB
C342	3/4"	2#14, 1#14G	VFD 4403	P-4403	MOTOR THERMISTOR LEADS VIA JB
C343	3/4"	2#14, 1#14G	VFD 4404	P-4404	MOTOR THERMISTOR LEADS VIA JB
C344	3/4"	2#14, 1#14G	VFD 4501	P-4501	MOTOR THERMISTOR LEADS VIA JB
C345	3/4"	2#14, 1#14G	VFD 4502	P-4502	MOTOR THERMISTOR LEADS VIA JB
C346	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C347	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C348	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C349	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C350	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C351	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C352	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C353	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C354	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C355	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C356	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C357	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C358	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C359	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C360	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C361	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C362	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C363	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C364	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C365	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C366	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C367	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C368	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C369	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C370	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C371	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED
C372	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED



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DRAWING EDT9665-48

DRAWN BHH

DESIGNED BHH

CHECKED BHH

APPROVED:

PRINCIPAL

DATE:

REVISIONS

REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

CITY OF LOUISVILLE
LOUISVILLE, COLORADO

WASTEWATER TREATMENT PLANT

ELECTRICAL

CONDUIT AND CABLE SCHEDULES
SHEET 4

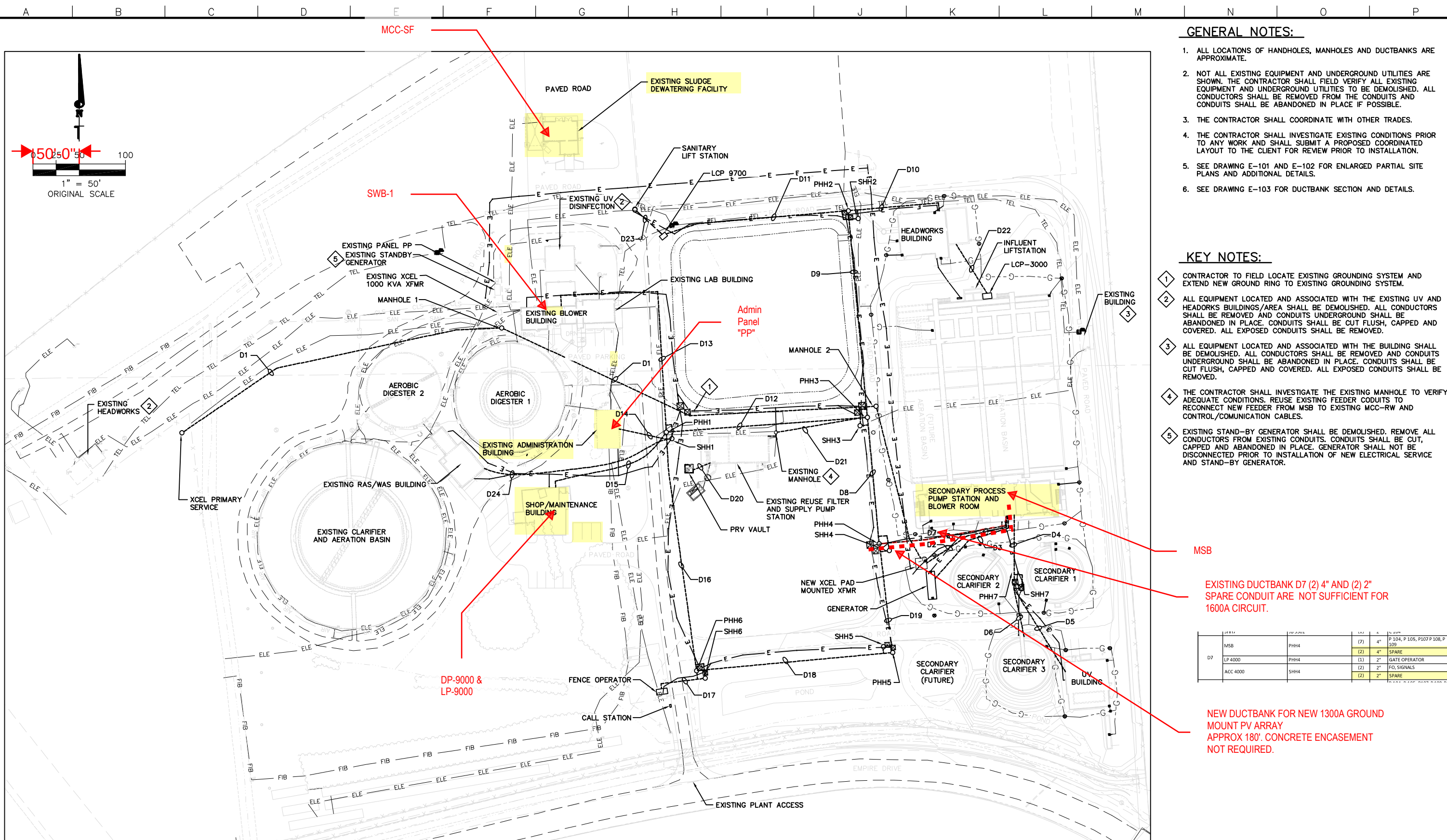
DATE: 03/03/15

PROJECT NUMBER: 50059665

REVISION NO. -

DRAWING NUMBER **E-48**

SHEET NUMBER



GENERAL NOTES:

- 1. ALL LOCATIONS OF HANDHOLES, MANHOLES AND DUCTBANKS ARE APPROXIMATE.
- 2. NOT ALL EXISTING EQUIPMENT AND UNDERGROUND UTILITIES ARE SHOWN. THE CONTRACTOR SHALL FIELD VERIFY ALL EXISTING EQUIPMENT AND UNDERGROUND UTILITIES TO BE DEMOLISHED. ALL CONDUITORS SHALL BE REMOVED FROM THE CONDUITS AND CONDUITS SHALL BE ABANDONED IN PLACE IF POSSIBLE.
- 3. THE CONTRACTOR SHALL COORDINATE WITH OTHER TRADES.
- 4. THE CONTRACTOR SHALL INVESTIGATE EXISTING CONDITIONS PRIOR TO ANY WORK AND SHALL SUBMIT A PROPOSED COORDINATED LAYOUT TO THE CLIENT FOR REVIEW PRIOR TO INSTALLATION.
- 5. SEE DRAWING E-101 AND E-102 FOR ENLARGED PARTIAL SITE PLANS AND ADDITIONAL DETAILS.
- 6. SEE DRAWING E-103 FOR DUCTBANK SECTION AND DETAILS.

KEY NOTES:

- 1. CONTRACTOR TO FIELD LOCATE EXISTING GROUNDING SYSTEM AND EXTEND NEW GROUND RING TO EXISTING GROUNDING SYSTEM.
- 2. ALL EQUIPMENT LOCATED AND ASSOCIATED WITH THE EXISTING UV AND HEADWORKS BUILDINGS/AREA SHALL BE DEMOLISHED. ALL CONDUITORS SHALL BE REMOVED AND CONDUITS UNDERGROUND SHALL BE ABANDONED IN PLACE. CONDUITS SHALL BE CUT FLUSH, CAPPED AND COVERED. ALL EXPOSED CONDUITS SHALL BE REMOVED.
- 3. ALL EQUIPMENT LOCATED AND ASSOCIATED WITH THE BUILDING SHALL BE DEMOLISHED. ALL CONDUITORS SHALL BE REMOVED AND CONDUITS UNDERGROUND SHALL BE ABANDONED IN PLACE. CONDUITS SHALL BE CUT FLUSH, CAPPED AND COVERED. ALL EXPOSED CONDUITS SHALL BE REMOVED.
- 4. THE CONTRACTOR SHALL INVESTIGATE THE EXISTING MANHOLE TO VERIFY ADEQUATE CONDITIONS. REUSE EXISTING FEEDER CONDUITS TO RECONNECT NEW FEEDER FROM MSB TO EXISTING MCC-RW AND CONTROL/COMMUNICATION CABLES.
- 5. EXISTING STAND-BY GENERATOR SHALL BE DEMOLISHED. REMOVE ALL CONDUITORS FROM EXISTING CONDUITS. CONDUITS SHALL BE CUT, CAPPED AND ABANDONED IN PLACE. GENERATOR SHALL NOT BE DISCONNECTED PRIOR TO INSTALLATION OF NEW ELECTRICAL SERVICE AND STAND-BY GENERATOR.

ITEM	DESCRIPTION	QTY	UNIT	NOTES
D7	MSB	(7)	4"	P 104, P 105, P 107 P 108, P 109
	LP 4000	(2)	4"	SPARE
	ACC 4000	(1)	2"	GATE OPERATOR
		(2)	2"	FD, SIGNALS
		(2)	2"	SPARE

NEW DUCTBANK FOR NEW 1300A GROUND MOUNT PV ARRAY APPROX 180'. CONCRETE ENCASEMENT NOT REQUIRED.

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DRAWING ECPL9665-100
DRAWN JMB
DESIGNED BHH
CHECKED BHH

APPROVED:

PRINCIPAL

DATE:

REVISIONS				
REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

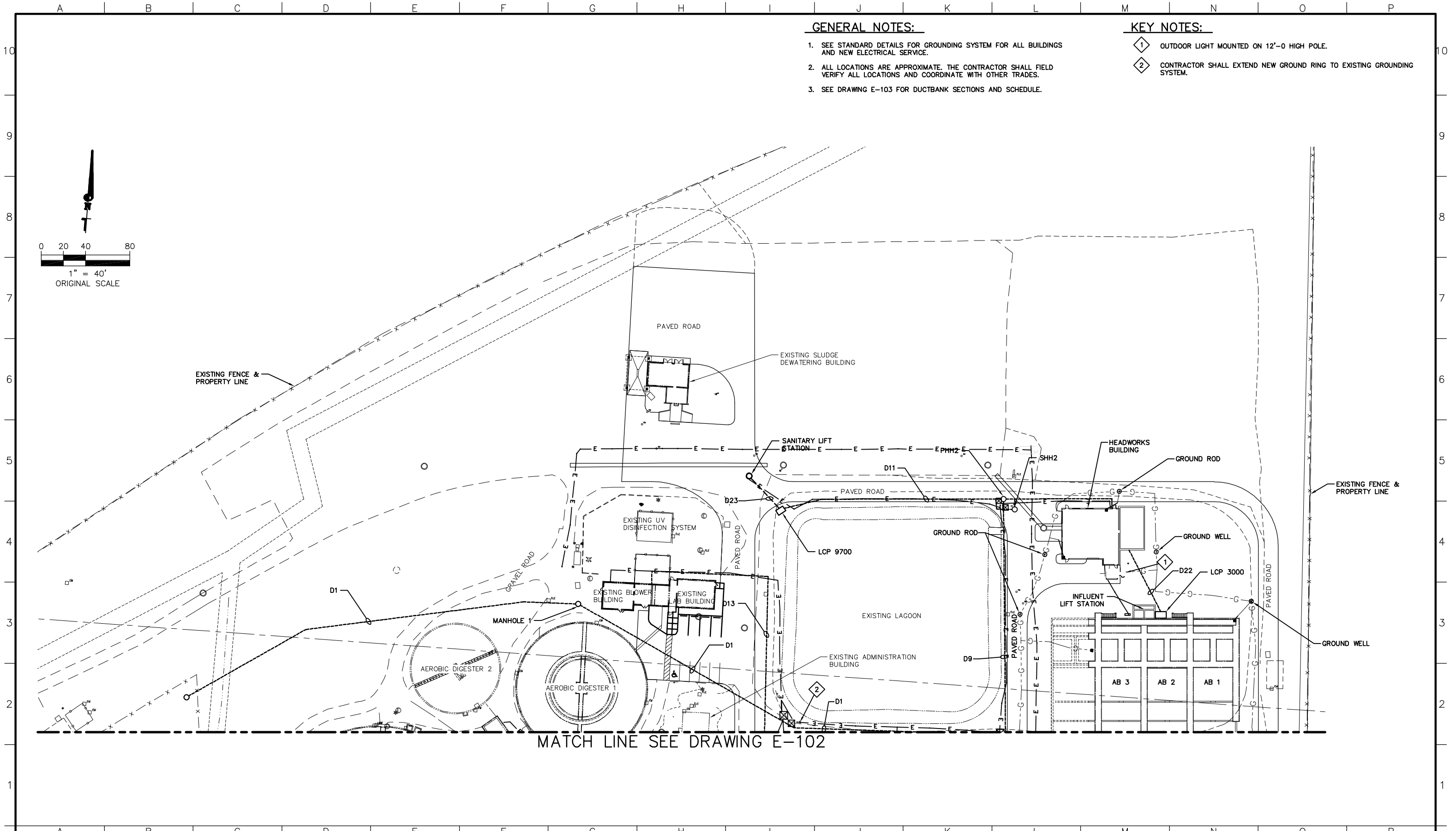
CITY OF LOUISVILLE
LOUISVILLE, COLORADO

WASTEWATER TREATMENT PLANT

ELECTRICAL

ELECTRICAL SITE PLAN

DATE: 06/05/14
PROJECT NUMBER: 50059665
REVISION NO. -
DRAWING NUMBER
E-100
SHEET NUMBER



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DRAWING ECPL9665-101
DRAWN JMB
DESIGNED BHH
CHECKED BHH

APPROVED:

PRINCIPAL

DATE:

REVISIONS

REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

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LOUISVILLE, COLORADO

WASTEWATER TREATMENT PLANT

ELECTRICAL

ENLARGED ELECTRICAL SITE
PLAN 1

DATE: 06/06/14

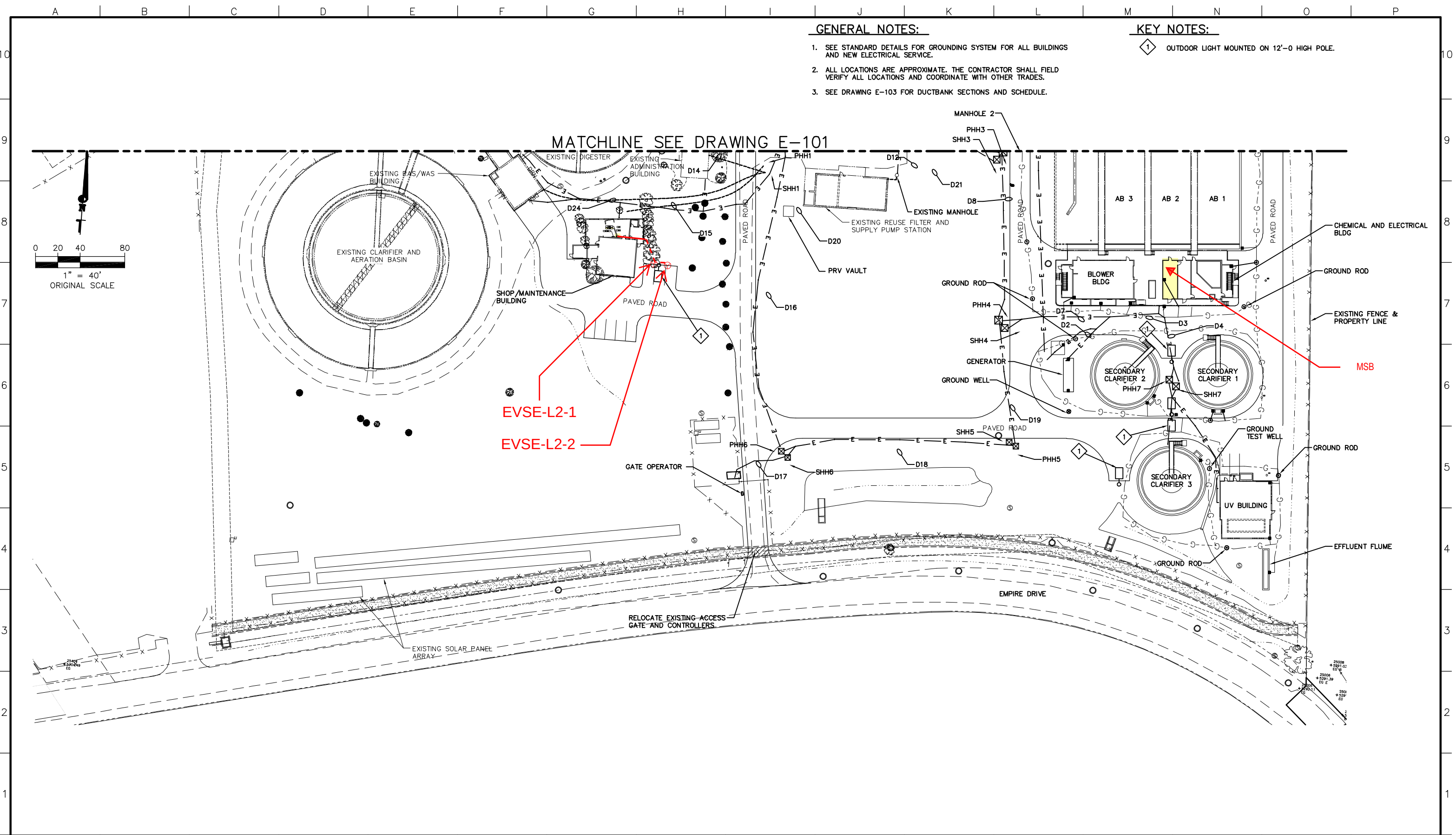
PROJECT
NUMBER: 50059665

REVISION NO. -

DRAWING NUMBER

E-101

SHEET NUMBER



GENERAL NOTES:

1. SEE STANDARD DETAILS FOR GROUNDING SYSTEM FOR ALL BUILDINGS AND NEW ELECTRICAL SERVICE.
2. ALL LOCATIONS ARE APPROXIMATE. THE CONTRACTOR SHALL FIELD VERIFY ALL LOCATIONS AND COORDINATE WITH OTHER TRADES.
3. SEE DRAWING E-103 FOR DUCTBANK SECTIONS AND SCHEDULE.

KEY NOTES:

- 1 OUTDOOR LIGHT MOUNTED ON 12'-0" HIGH POLE.

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LINE IS 2 INCHES
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(IF NOT 2"=SCALE ACCORDINGLY)
DRAWING ECPL9665-102
DRAWN JMB
DESIGNED BHH
CHECKED BHH

APPROVED:

PRINCIPAL

DATE:

REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

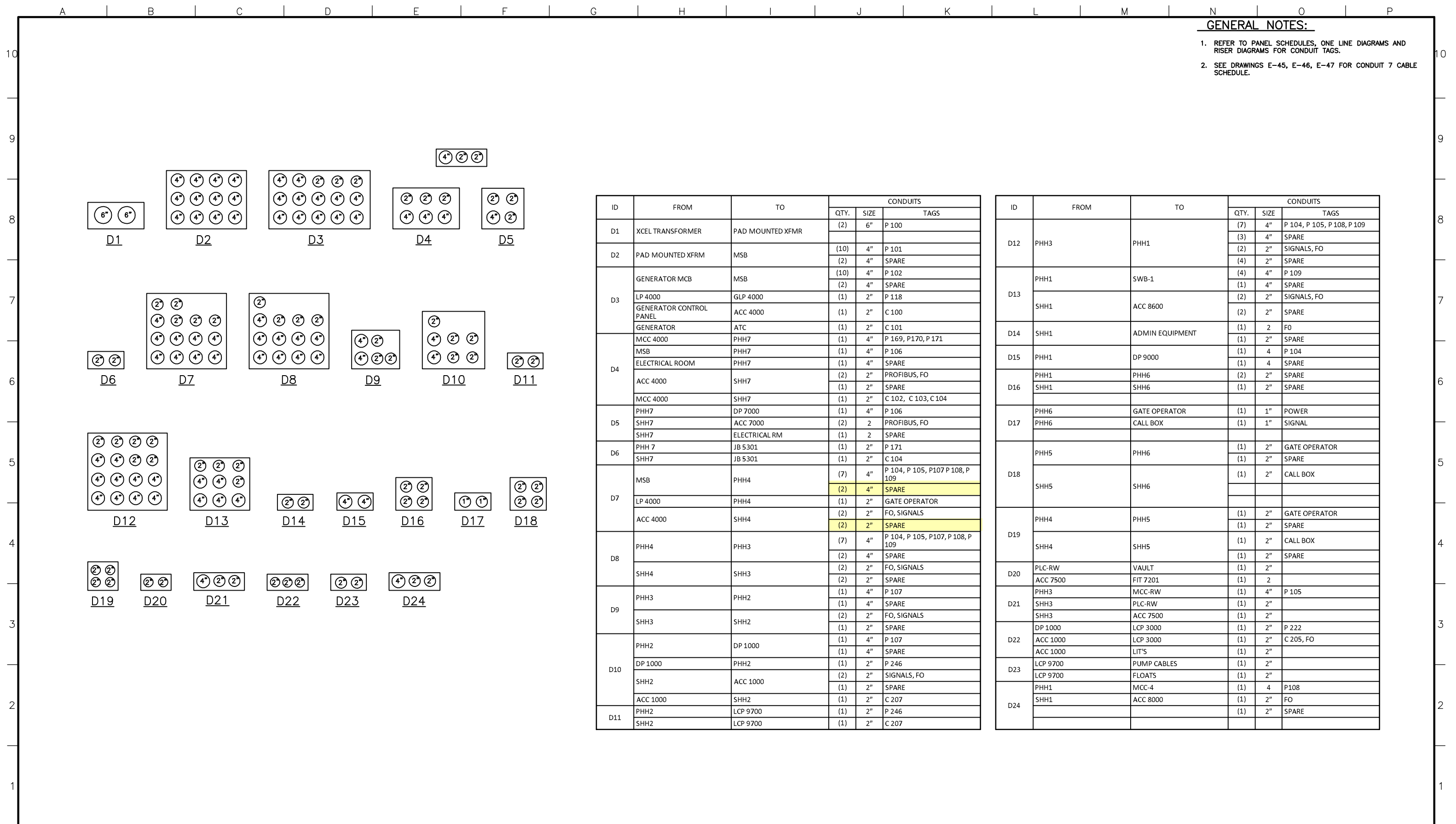
CITY OF LOUISVILLE
LOUISVILLE, COLORADO

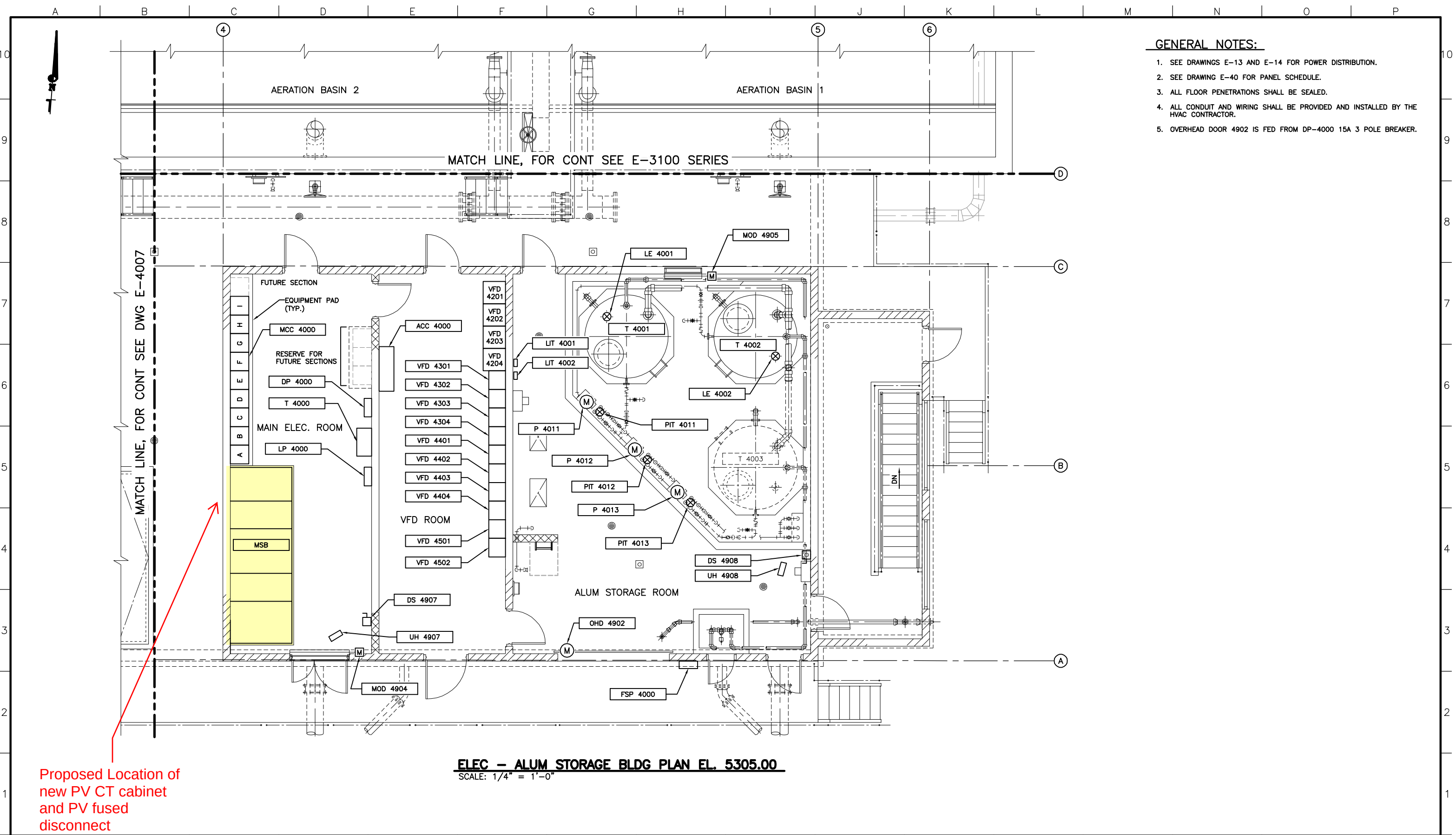
WASTEWATER TREATMENT PLANT

ELECTRICAL

ENLARGED ELECTRICAL SITE
PLAN 2

DATE: 06/06/14
PROJECT NUMBER: 50059665
REVISION NO. -
DRAWING NUMBER
E-102
SHEET NUMBER





GENERAL NOTES:

1. SEE DRAWINGS E-13 AND E-14 FOR POWER DISTRIBUTION.
2. SEE DRAWING E-40 FOR PANEL SCHEDULE.
3. ALL FLOOR PENETRATIONS SHALL BE SEALED.
4. ALL CONDUIT AND WIRING SHALL BE PROVIDED AND INSTALLED BY THE HVAC CONTRACTOR.
5. OVERHEAD DOOR 4902 IS FED FROM DP-4000 15A 3 POLE BREAKER.

Proposed Location of
new PV CT cabinet
and PV fused
disconnect

ELEC - ALUM STORAGE BLDG PLAN EL. 5305.00
SCALE: 1/4" = 1'-0"

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LINE IS 2 INCHES AT FULL SIZE (IF NOT 2"=SCALE ACCORDINGLY)	
DRAWING	EPL9665-4008
DRAWN	JMB
DESIGNED	BHH
CHECKED	BHH

APPROVED:
PRINCIPAL
DATE:

REVISIONS				
REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

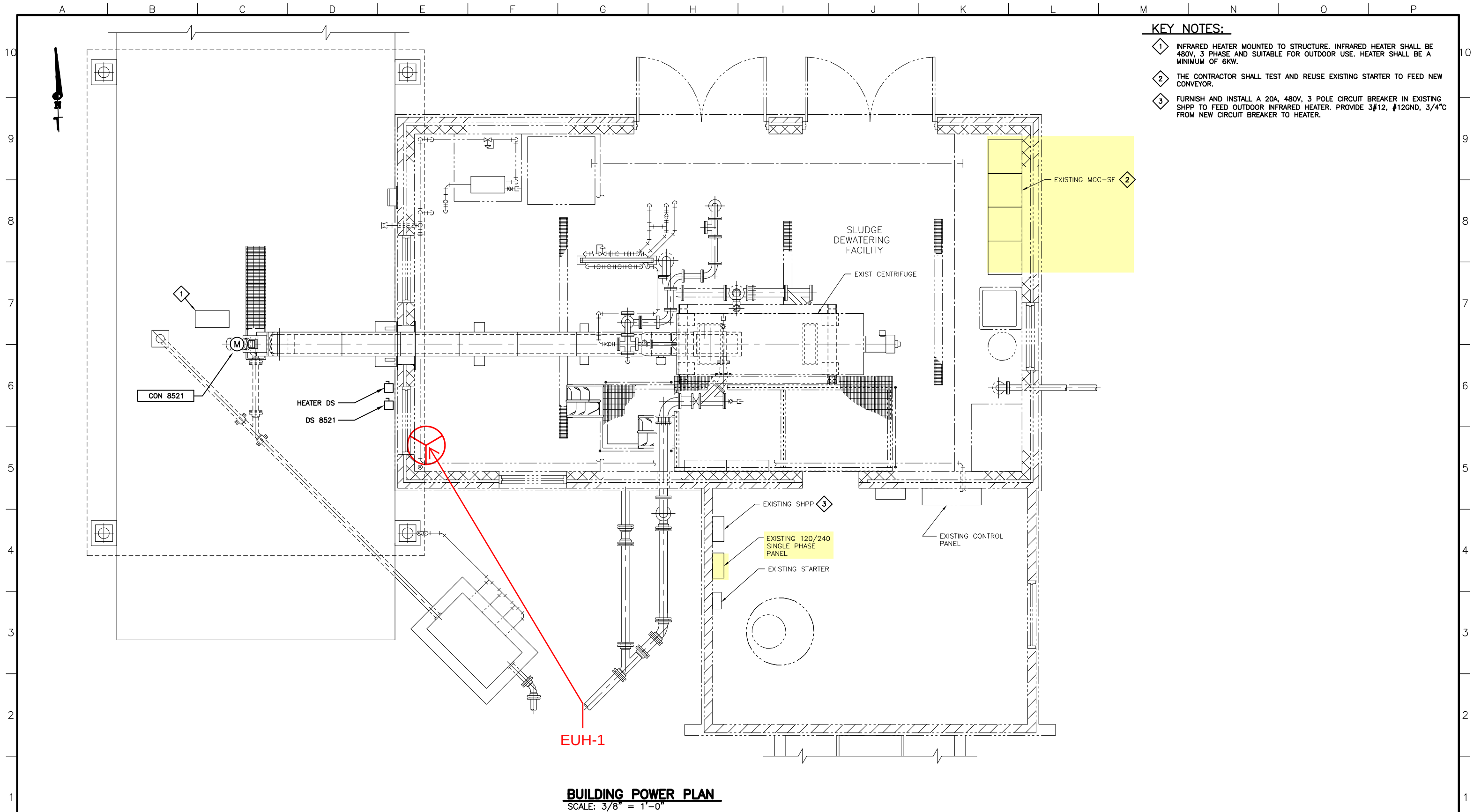
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LOUISVILLE, COLORADO

WASTEWATER TREATMENT PLANT

ELECTRICAL

SECONDARY PROCESS PUMP
STATION UPPER LEVEL
EQUIPMENT POWER PLAN

DATE:	06/05/14
PROJECT NUMBER:	50059665
REVISION NO.	-
DRAWING NUMBER	E-4008
SHEET NUMBER	



KEY NOTES:

- 1 INFRARED HEATER MOUNTED TO STRUCTURE. INFRARED HEATER SHALL BE 480V, 3 PHASE AND SUITABLE FOR OUTDOOR USE. HEATER SHALL BE A MINIMUM OF 6KW.
- 2 THE CONTRACTOR SHALL TEST AND REUSE EXISTING STARTER TO FEED NEW CONVEYOR.
- 3 FURNISH AND INSTALL A 20A, 480V, 3 POLE CIRCUIT BREAKER IN EXISTING SHPP TO FEED OUTDOOR INFRARED HEATER. PROVIDE 3#12, #12GND, 3/4" FROM NEW CIRCUIT BREAKER TO HEATER.



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LINE IS 2 INCHES
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DRAWING EPL9665-8500
DRAWN JMB
DESIGNED BHH
CHECKED BHH

APPROVED:

PRINCIPAL

DATE:

REVISIONS

REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB

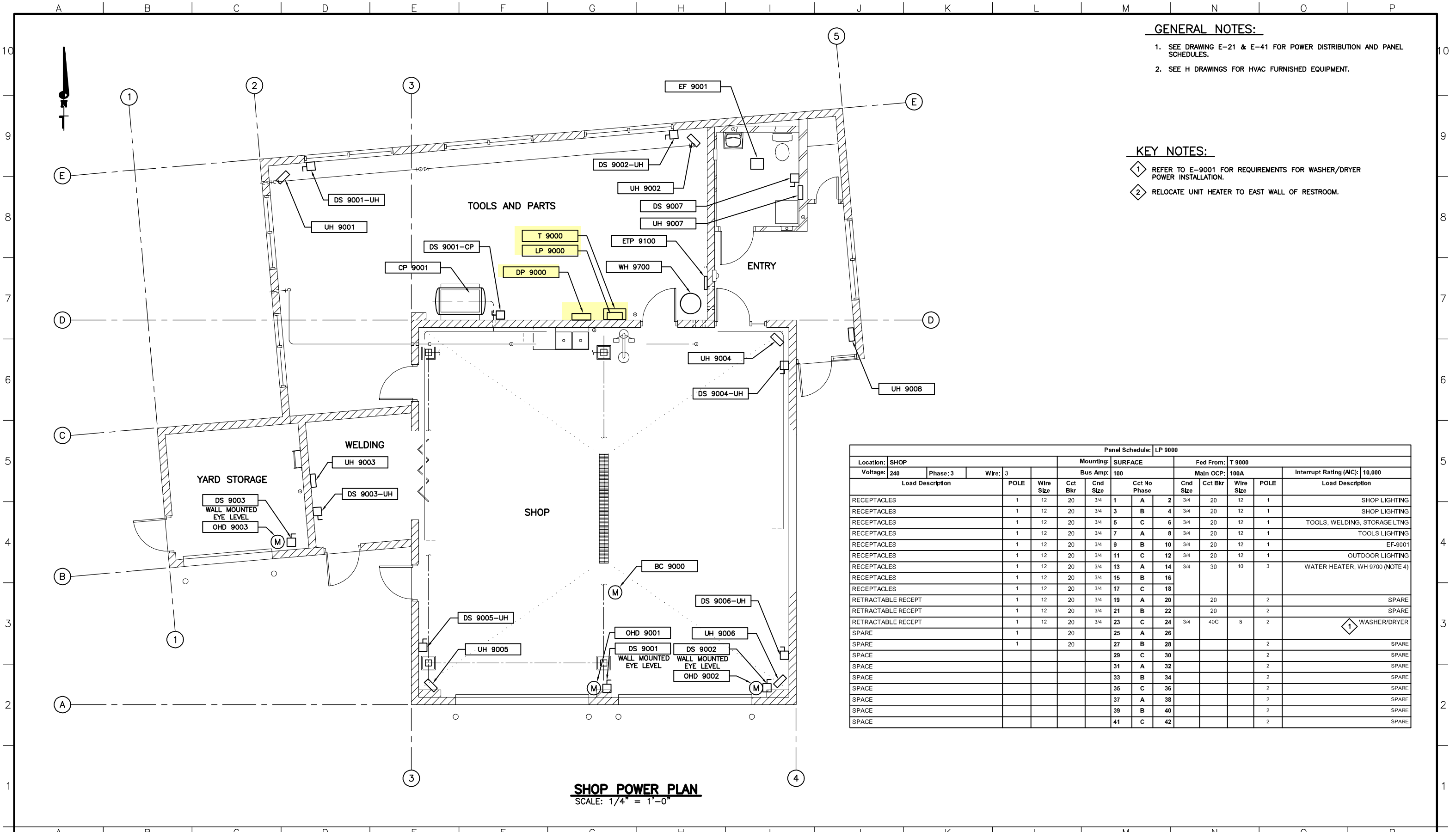
CITY OF LOUISVILLE
LOUISVILLE, COLORADO

WASTEWATER TREATMENT PLANT

ELECTRICAL

EXISTING SLUDGE DEWATERING
FACILITY EQUIPMENT POWER PLAN

DATE: 06/05/14
PROJECT NUMBER: 50059665
REVISION NO. -
DRAWING NUMBER
E-8500
SHEET NUMBER



GENERAL NOTES:

- SEE DRAWING E-21 & E-41 FOR POWER DISTRIBUTION AND PANEL SCHEDULES.
- SEE H DRAWINGS FOR HVAC FURNISHED EQUIPMENT.

KEY NOTES:

- REFER TO E-9001 FOR REQUIREMENTS FOR WASHER/DRYER POWER INSTALLATION.
- RELOCATE UNIT HEATER TO EAST WALL OF RESTROOM.

Panel Schedule: LP 9000															
Location:	SHOP				Mounting: SURFACE				Fed From: T 9000						
Voltage:	240	Phase: 3	Wire: 3		Bus Amp:		100				Main OCP: 100A		Interrupt Rating (AIC): 10,000		
Load Description				POLE	Wire Size	Cct Bkr	Cnd Size	Cct No Phase		Cnd Size	Cct Bkr	Wire Size	POLE	Load Description	
RECEPTACLES				1	12	20	3/4	1	A	2	3/4	20	12	1	SHOP LIGHTING
RECEPTACLES				1	12	20	3/4	3	B	4	3/4	20	12	1	SHOP LIGHTING
RECEPTACLES				1	12	20	3/4	5	C	6	3/4	20	12	1	TOOLS, WELDING, STORAGE LTNG
RECEPTACLES				1	12	20	3/4	7	A	8	3/4	20	12	1	TOOLS LIGHTING
RECEPTACLES				1	12	20	3/4	9	B	10	3/4	20	12	1	EF-9001
RECEPTACLES				1	12	20	3/4	11	C	12	3/4	20	12	1	OUTDOOR LIGHTING
RECEPTACLES				1	12	20	3/4	13	A	14	3/4	30	10	3	WATER HEATER, WH 9700 (NOTE 4)
RECEPTACLES				1	12	20	3/4	15	B	16					
RECEPTACLES				1	12	20	3/4	17	C	18					
RETRACTABLE RECEPT				1	12	20	3/4	19	A	20		20		2	SPARE
RETRACTABLE RECEPT				1	12	20	3/4	21	B	22		20		2	SPARE
RETRACTABLE RECEPT				1	12	20	3/4	23	C	24	3/4	40G	8	2	1 WASHER/DRYER
SPARE				1		20		25	A	26					
SPARE				1		20		27	B	28			2	SPARE	
SPACE								29	C	30			2	SPARE	
SPACE								31	A	32			2	SPARE	
SPACE								33	B	34			2	SPARE	
SPACE								35	C	36			2	SPARE	
SPACE								37	A	38			2	SPARE	
SPACE								39	B	40			2	SPARE	
SPACE								41	C	42			2	SPARE	

SHOP POWER PLAN
SCALE: 1/4" = 1'-0"

REVISIONS				
REV.	DESCRIPTION	BY	DATE	APP.
-	RECORD DRAWINGS	PSF	02/21/18	AEB



Appendix

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City of Louisville

Wastewater Treatment Plant

Electric Vehicle Charging Narrative

Electric Vehicle Charging Narrative

Electric Vehicle Charging Narrative

Fleet & Electric Vehicle Charging

As part of the decarbonization study, the fleet vehicles were analyzed for replacement with electric vehicle (EV) equivalents. In addition, building electrical capacities were reviewed to determine if they have enough capacity to charge the fleet vehicles and if any electrical upgrades may be needed to the buildings.

EV Fleet Conversion

Based on current technology, transitioning from internal combustion engine (ICE) vehicles to EVs can substantially lower overall carbon emissions. A caveat to consider in assessing the environmental impact of EVs is the variation of electricity generation sources in each area. The state of Colorado relies mainly on coal and natural gas. However, the share of these fuel sources as a percentage of total generation is decreasing. Alternative energy sources such as wind and solar are increasing rapidly. By using additional onsite renewable energy sources and phasing in vehicle replacement it will be possible for Louisville's fleet to be entirely carbon free.

In the current vehicle market mainly light duty vehicles are being produced. The battery technology is still being developed for heavy-duty vehicles. The market is rapidly changing so over the course of the next 5 years, new innovation should allow heavy duty vehicles to be carbon free through either advanced battery technology or other yet to be determined technology.

EVs typically have a higher initial capital cost to purchase or lease when compared to ICE vehicles, EVs can cost less in the long-term due to lower fuel costs, different maintenance requirements, and longer vehicle lives. Therefore, it is important to consider the entire lifespan of a vehicle when investing in fleet vehicles. There are also limiting factors of EVs to consider, such as range and power needs of certain fleet vehicles, as well as the near-constant changes in the electric vehicle and infrastructure technology.

Charging Infrastructure

When planning for EV charging infrastructure, it is recommended to proactively plan for the number of charging stations needed by installing more electrical equipment (e.g. transformers and conduits) than is needed for the initial purchase of EVs. It is more cost effective to install excess electrical equipment during the initial installation than having to add electrical wires each time additional stations are required. This electrical equipment installation does not include purchasing all the charging stations that can fit with that equipment, but instead having the electrical capacity to purchase charging stations to meet future capacity needs without additional construction. The city has already thought about this and this report is the result of that forward thinking.

While there are three levels of EV charging infrastructure currently available, Level 2 charging is currently the most prevalent among them and requires electrical infrastructure upgrades to extend 240 volt AC service to locations where the EVs would charge. It charges at over twice the rate of level 1, adding 12 to 80 miles of range per hour charging. Level 3 charges are also becoming more common and can add from 80 to 500 miles of range per hour. Level 3 charging typically requires a 480 volt AC service. The level 2 and 3 chargers with the increased rate of charging can justify the costs to serve the needs of fleet management in a timely manner. Costs per unit can vary within these ranges depending on the installation and labor costs, warranties for equipment, and operation and maintenance costs for the equipment. Level 2 chargers provide good value for infrastructure investment when factoring in cost and time required to charge when compared to Level 3 chargers. Level 3 chargers can make sense when high use vehicles need quick recharging, though these chargers will cost more to install and incur a higher charging cost than level 2 chargers.

Electric Vehicle Charging Narrative

For the public chargers the City may want to consider charging a some type of fee for usage. Many charging stations charge a usage fee at some dollar per kWh of charging. This can help offset the peak demand that may be incurred by the city. Another option is to charge an idle fee. This type of fee encourages people not to leave their vehicle plugged in for long period of times once the vehicle has reached full charge.

Another consideration for charging infrastructure is the daily charging schedule. Most of the buildings reviewed for this study are on a secondary general rate schedule. This rate schedule does not have time of use rates for electrical consumption or peak demand. This means depending on when and how many vehicles charge relative to the buildings peak demand, it may increase the demand charges the city pays. Xcel Energy does offer a EV charging rate plan that incentivize the intentional reduction of electricity use during peak energy demand periods, such as during hot summer days. This rate plane does require a separate service for just the charging stations. Planning for fleet recharging during off-peak periods can add up to thousands of dollars in savings.

Battery capacity

Battery technology is changing rapidly, resulting in increased charge capacity and lower operating cost per mile. Many manufactures now offer eight year/100,000 mile warranties on their EV batteries (generally covering defects and workmanship), and some offers an eight year/100,000 mile warranty on battery capacity. Auto manufacturer warranties and charge capacity have generally reduced consumer concern about battery life and range. As a result, the analysis of total ownership cost does not account for the cost of EV battery replacement, assuming that municipal vehicles will be retired at the warranty expiration.

Wastewater Treatment Plant Site

The WWTP has four vehicles. One is considered a medium-duty vehicle and the other three are light duty vehicles. These vehicles are primarily used at the wastewater treatment plant. The heavy-duty vehicle is used for plowing operations in the winter. See the table below.

Site	Make	Model	Quantity
Wastewater Treatment	Ford	Escape	1
	Ford	F-150	1
	Ford	F-250	1

We recommend installing 2 chargers and upgrading the electrical infrastructure to support them. Currently there is no direct replacement for the heavy-duty truck (used to plow the parking lot). It is anticipated those types of vehicles will be available in the next 10 years. The table below shows the number of recommended chargers.

Existing Public charging stations	Existing Public Charger Level	Quantity of New Level 2 Public Charger	Quantity of New Level 3 Public Charger	Quantity of New Level 2 Fleet Charger	Quantity of New Level 3 fleet Charger
0	N/A	0	0	2	0

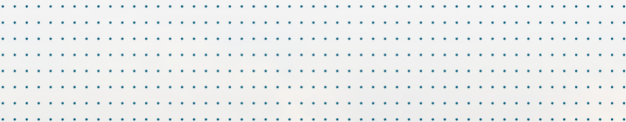
At this site the number of fleet chargers selected to be installed here were based on the number of vehicles stored onsite. This is separate from the placeholder EV chargers currently in design for the Solid Handling Project.

The quantity of public chargers selected for this site was zero because there is limited public visitation at the site.



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City of Louisville Decarbonization Study

Louisville Wastewater Treatment
Plant

RENEWABLES SUPPORTING ANALYSIS

LOUISVILLE, CO

AUGUST 18, 2023

Together Building a Thriving Planet



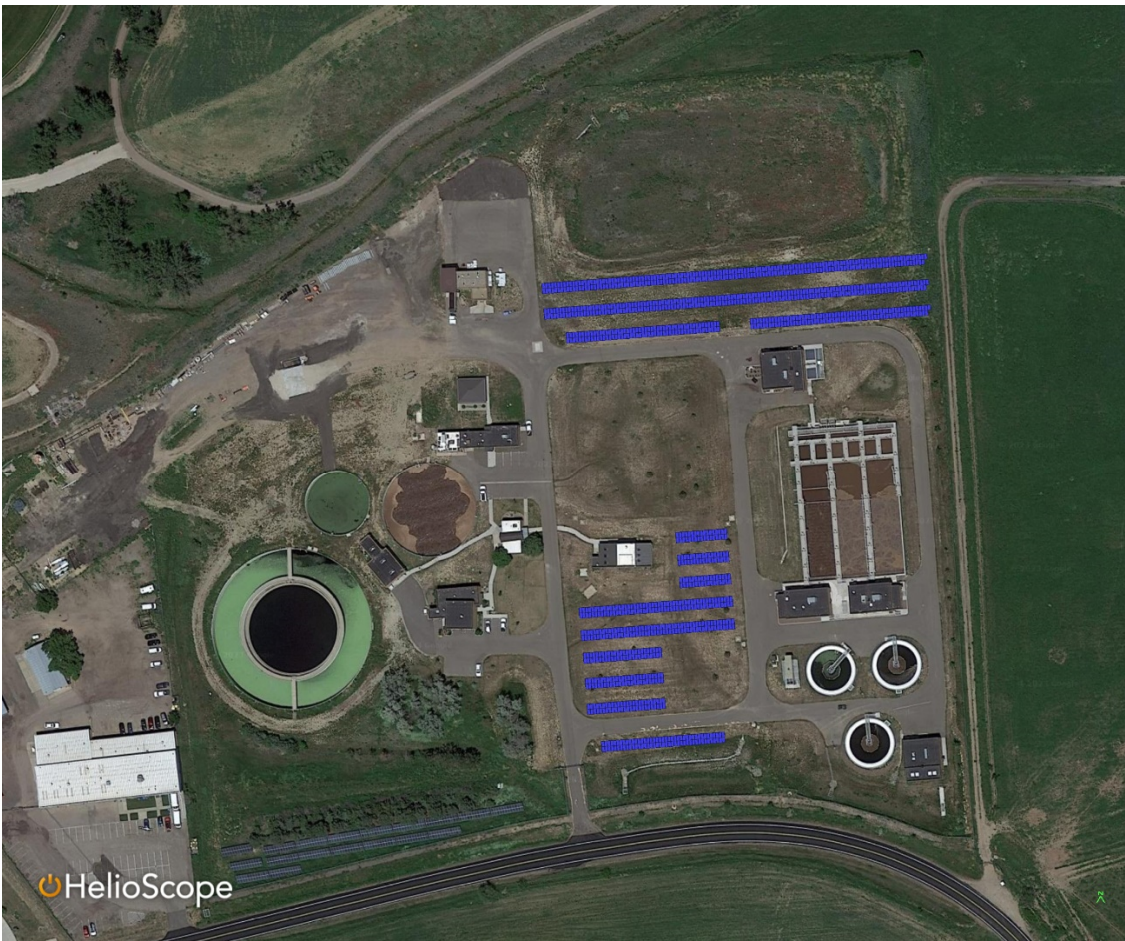
Louisville Wastewater Treatment Plant

The Louisville Wastewater Treatment Plant is a great candidate for a fixed-tilt ground mount solar PV system. On the Northeastern corner of the facility there is room for a 394.7kWdc array. In the Southern Central portion of the parcel, there is a potential array location suited for a 293.8kWdc array. Total DC production for the site would be 688.5kWdc.

1. Proposed Solar PV System Overview

Below is a high-level summary of the proposed system specifications. Please note, specific equipment manufacturers and models may change depending on availability and market conditions at the time of construction.

SITE NAME	SITE ADDRESS	SIZE (KW-DC)	SIZE (KW-AC)	SYSTEM TYPE	YEAR 1 PRODUCTION (kWh)
Wastewater Treatment Plant	1601 Empire Rd, Louisville, CO 80027	688.5	550	Fixed-tilt ground mount	1,140,272



Louisville Wastewater Treatment Plant

LOUISVILLE WASTE WATER TREATMENT PLANT EQUIPMENT AND QUANTITY SUMMARY

QUANTITY	EQUIPMENT DESCRIPTION
1275	JA Solar, JAM72D30-540 (540W) – Bifacial Mono PERC Half Cell Double Glass Modules
5	CPS SCA50KTL-DO/US-480 - Inverters
5	CPS SCA26KTL-DO/US-480 - Inverters
1	30° Fixed-Tilt Ground Mount Racking System
1	AlsoEnergy Data Acquisition System (DAS) Package – PLCS600
1	Electrical Balance of Systems Package

AlsoEnergy Data Acquisition System (DAS) includes the equipment/functionality listed below.

- NEMA 4 Enclosure and Data Logger
- Cellular modem
- CT Based Revenue Grade Meter
- Inverter Direct Monitoring
- 5-year service plan
- A Meteorological Station consisting of the following:
 - Cell Temp Sensor
 - Pyranometer
- Publicly accessible web-based dashboard functionality

The Electrical Balance of Systems Package includes all components to create an electrically complete ground mounted solar PV installation. This includes grounding materials, wiring, conduit, MCT, panelboards/combiners, switchgear, fuses, and disconnects. For the purposes of this decarbonization study, this scope may be split between the electrical and solar PV pricing. More details provided in Section 4.

2. Production Modeling

Array layouts and system production are modeled in Helioscope, an industry-standard design and energy modeling software package with 3-dimensional modeling capabilities. Through Helioscope, we can incorporate site-specific characteristics of buildings and shade producing obstructions to determine their impacts upon system layout and production. McKinstry further applies our knowledge of codes and regulations, industry best practices, and professional judgment to ensure that designs are code-compliant and strike a balance across customer preferences, production, constructability, and price concerns.

Helioscope provides robust PV system output modeling capabilities. We use these in conjunction with Typical Meteorological Year (TMY) weather datasets, real-world equipment specifications, proprietary 3rd-party-engineered dust and snow soiling models, and professional judgment to determine a system's annual kWh production. For City of Louisville, we are using the TMY, DENVER INTL AP, NSRDB (tmy3,l) weather data set and soiling conditions from the DNV-GL NOAA Lafayette station. Full Helioscope report below.

Louisville Wastewater Treatment Plant



Annual Production Report produced by Mountain Bryan H

Cohort 2 - WWTP Northeastern & South Central Arrays City of Louisville, 951 Spruce St, Louisville, CO 80027

Report

Project Name	City of Louisville
Project Address	951 Spruce St, Louisville, CO 80027
Prepared By	Mountain Bryan H bryanh@mckinstry.com



System Metrics

Design	Cohort 2 - WWTP Northeastern & South Central Arrays
Module DC Nameplate	688.5 kW
Inverter AC Nameplate	550.0 kW Load Ratio: 1.25
Annual Production	1,140 GWh
Performance Ratio	83.0%
kWh/kWp	1,656.2
Weather Dataset	TMY, DENVER INTL AP, NSRDB (tmy3, I)
Simulator Version	bea0c32975-f7c166ba04e5790ed422-e085315a86

Project Location

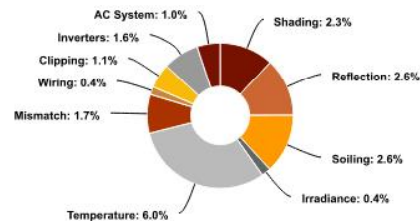


Monthly Production



Month	GHI (kWh/m ²)	POA (kWh/m ²)	Shaded (kWh/m ²)	Nameplate (kWh)	Grid (kWh)
January	77.6	134.6	129.9	83,954.7	78,859.0
February	88.7	131.1	128.2	82,903.0	77,158.1
March	144.4	183.3	180.2	116,512.0	103,956.2
April	143.6	157.6	154.1	100,305.9	89,220.8
May	196.1	197.0	192.5	127,978.5	112,164.2
June	218.0	209.6	205.1	139,280.8	118,288.6
July	208.2	204.4	199.9	134,256.9	114,729.1
August	185.7	198.0	193.9	130,371.9	110,892.8
September	155.3	186.2	182.8	122,913.9	105,252.4
October	114.2	160.2	157.5	106,193.7	93,840.4
November	73.9	118.9	115.2	75,133.3	70,151.9
December	64.4	115.4	110.1	70,358.1	65,759.5

Sources of System Loss



Louisville Wastewater Treatment Plant



Annual Production Report produced by Mountain Bryan H

⚡ Annual Production			
	Description	Output	% Delta
Irradiance (kWh/m ²)	Annual Global Horizontal Irradiance	1,670.2	
	POA Irradiance	1,996.3	19.5%
	Shaded Irradiance	1,949.5	-2.3%
	Irradiance after Reflection	1,899.7	-2.6%
	Irradiance after Soiling	1,850.5	-2.6%
	Total Collector Irradiance	1,850.5	0.0%
Energy (kWh)	Nameplate	1,290,162.9	
	Output at Irradiance Levels	1,285,011.4	-0.4%
	Output at Cell Temperature Derate	1,207,370.7	-6.0%
	Output After Mismatch	1,186,911.6	-1.7%
	Optimal DC Output	1,182,745.6	-0.4%
	Constrained DC Output	1,170,084.9	-1.1%
	Inverter Output	1,151,790.8	-1.6%
	Energy to Grid	1,140,272.9	-1.0%
Temperature Metrics			
	Avg. Operating Ambient Temp		15.0 °C
	Avg. Operating Cell Temp		29.6 °C
Simulation Metrics			
	Operating Hours	4513	
	Solved Hours	4513	

📦 Components		
Component	Name	Count
Inverters	CPS SCA50KTL-DO/480 (Chint)	5 (250.0 kW)
Inverters	CPS SCA60KTL-DO/480 (Chint)	5 (300.0 kW)
Strings	10 AWG (Copper)	75 (11,246.5 ft)
Module	JA Solar, JAM72D30-540/MB (540W)	1,275 (688.5 kW)

☁ Condition Set												
Description	Ground 30 deg											
Weather Dataset	TMY, DENVER INTL AP, NSRDB (tmy3, I)											
Solar Angle Location	Project Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Diffusion Model											
Temperature Model Parameters	Rack Type				U _{const}				U _{wind}			
	Fixed Tilt				20				0			
	Flush Mount				15				0			
	East-West				29				0			
	Carport				29				0			
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	D
	5	5	5	4	2	0	1	1	1	1	4	6
Irradiation Variance	3.5%											
Cell Temperature Spread	3° C											
Module Binning Range	0% to 2.5%											
AC System Derate	1.00%											
Trackers	Maximum Angle						Backtracking					
	30°						Disabled					
Module Characterizations	Module				Uploaded By		Characterization					
	JAM72D30-540/MB (JA Solar)				HelioScope		Spec Sheet Characterization, PAN					
Component Characterizations	Device						Uploaded By		Characterization			
	CPS SCA50KTL-DO/480 (Chint)						HelioScope		Spec Sheet			
	CPS SCA60KTL-DO/480 (Chint)						HelioScope		Spec Sheet			

Louisville Wastewater Treatment Plant

3. Annual Utility Savings and Value of Solar Energy

To analyze utility bill savings, we utilize Energy Toolbase, an industry-standard bill modeling software package. Energy Toolbase estimates bill savings based upon a site's electric load characteristics, PV system production (imported from Helioscope or other sources), and local utility tariffs and net metering policies. Xcel Energy tariffs and Net Metering tariff adjustments used in this analysis are:

- Secondary General (SG)
- Net Metering Service (Schedule NM)

To properly calculate the annual utility savings associated with the solar PV, we need to analyze the building load after all electrification and carbon reduction measures are implemented. As noted in the Summary Report, there is one bundle of measures – Bundle 1. Baseline utility year is Dec 2019 and a modeled usage profile was created from the Waste Water Treatment Plant interval data for Dec 2021 through Nov 2022. This scenario provides a 37% consumption offset.

OPTION 1- GROUND MOUNT ONLY ESTIMATE

SCENARIO	ANNUAL SAVINGS	ENERGY SAVINGS	DEMAND SAVINGS
Bundle 1	\$69,037	\$64,543	\$4,494

Bundle 1 does not qualify for a rate switch to SPVTOU. To qualify for a rate switch to SPVTOU, the building must have a minimum 30% load factor for the trailing 12 months and a maximum service load rating of 500kW. This site's service load is over 500kW. The 500kW threshold was established under the old Solar*Rewards Community Program. We're awaiting confirmation from XCEL that the qualifying service load for the SPVTOU rate class will remain at 500kW and not be increased to 1000kW. For the purposes of this study, the Wastewater site was modeled without the potential to transition to the SPVTOU rate class. Anecdotally, if XCEL approves a 1000kW service load this site would qualify for the SPVTOU rate switch considering the 2019 average load factor was 60% and the projected increased load factor after electrification would be 61%.

4. System Price and Financial Results

There are two main avenues City of Louisville can choose to finance these projects – cash purchase or tax-exempt lease purchase (TELP). As a tax-exempt entity, City of Louisville is eligible for direct pay in Year 1 at Energy Investment Tax Credit (ITC) rates. These rates are 30% for cash purchase and 25.5% for TELP.

At this early feasibility study stage of a portfolio, we focus on simple payback to get a high-level look at the project economics. Our simple payback calculation is based on Year 1 solar production, Year 1 annual utility savings, and the Solar*Rewards C&I incentive program. Should any of these projects move into the next stage of development, McKinstry would develop more detailed proformas and cash flows to include items like solar degradation, Operations & Maintenance, discount rates, and more.

McKinstry aims to recommend solar systems that will pay back in the at least the system lifetime, 30 years for a ground mount system. This system would pay back well within the solar lifetime and at 15 years when looking at simple payback and using a TELP funding strategy.

Louisville Wastewater Treatment Plant

OPTION 1 - GROUND MOUNT ONLY

BUNDLE 1	SYSTEM PRICE	ANNUAL SAVINGS	UTILITY INCENTIVE	SIMPLE PAYBACK (YRS)
Cash Purchase or Tax-Exempt Lease Purchase (TELP)	\$2,125,000	\$69,037	\$37,315	20.2
TELP with IRA	\$1,583,125			15.07
Cash Purchase with IRA	\$1,487,500			14.16

Please note that there is not proposed service upgrade for this site. The full PV scope from the Point of Interconnection, to the Solar Disconnect, Solar Meter, AC Combiner, Inverters to Modules is included in the pricing below. Additionally, pricing below assumes Louisville moves forward with a system at the Howard Berry Water Treatment Plant (HBWTP) and the Sid Copeland Water Treatment Plant (SCWTP); there are cost efficiencies in material, installation, and construction management scopes using a portfolio approach.

Another metric that may be useful as the City of Louisville considers the best way to decarbonize is levelized cost of electricity (LCOE). This is defined as capital cost divided by the estimated system lifetime production with units of \$/kWh. It can help the City of Louisville compare the value of owning onsite solar versus subscribing to renewable utility programs like Renewable Connect and Windsourse. The table below shows LCOE with and without the Solar*Rewards C&I incentive.

OPTION 1 - GROUND MOUNT ONLY

BUNDLE 1	LCOE - NO UTILITY INCENTIVES (\$/KWH)	LCOE - W/ UTILITY INCENTIVES (\$/KWH)
Cash Purchase or Tax-Exempt Lease Purchase (TELP)	\$0.062	\$0.039
TELP with IRA	\$0.046	\$0.023
Cash Purchase with IRA	\$0.043	\$0.020

5. Future Considerations and Next Steps

Should Louisville decide to move forward with the Wastewater Treatment Plant PV ground mount system, next steps would involve a geotechnical study, utility locates, land survey, racking and electrical bid sets, an interconnection application to Xcel, a subcontractor RFP to get final pricing, and any other due diligence items necessary to de-risk the project and ready it for implementation.

Louisville Wastewater Treatment Plant

6. Assumptions, Inclusions, and Exclusions

- Codes and Utility Standards:
 - NEC 2020
 - IBC 2018
 - IFC 2018
 - Xcel Energy Blue Book (7/31/2022 Version)
 - Xcel Energy DG Tech Manual (10/28/2021 Version)
- Tax-exempt
- Prevailing wage
- The full PV scope from the Point of Interconnection, to the Solar Disconnect, Solar Meter, AC Combiner, Inverters to Modules
- Pricing assumes a portfolio approach; Louisville will move forward with a solar PV system at both the Howard Berry Water Treatment Plant and Sid Copeland Water Treatment Plant
- Pricing includes payment & performance bond
- Terms & Conditions listed in the Xcel Energy Interconnection Agreement
- Current labor rates
- Modeling:
 - TMY, DENVER INTL AP, NSRDB (tmy3,l) weather file
 - 1.5% production gain for ground mounts with bifacial modules
 - Soiling data from DNV-GL
- Design Loads
 - Wind speed:
 - Risk Category II: 145mph
 - Exposure: C
 - Ground snow load: 30 psf
 - Risk Category II: 1.0 importance factor
- No interconnection upgrade costs
- No grounding transformers
- Major equipment warranties
 - Modules – 12 year Product
 - Modules – 30 year Power Output
 - Inverters – 10 years
 - DAS – 5 years
 - AC Combiners – 5 years
- No extended warranties
- No ongoing DAS Costs
 - Any ongoing fees beyond year 5 are excluded (both Cell Service and Data Subscription Monitoring fees).
- No backup generation
- Favorable soil conditions. No hard drilling or special footers/foundations required.
- No hazardous soils or materials (asbestos, PFAS, etc.). Should monitoring, mitigation, abatement, and/or disposal be required, Louisville would be responsible for this additional scope.
- Xcel Energy Solar*Rewards C&I Incentives:
 - Bundle 1: Tier 3: 500kWac-1000kWac = \$0.035/kWh for 20 years

Louisville Wastewater Treatment Plant

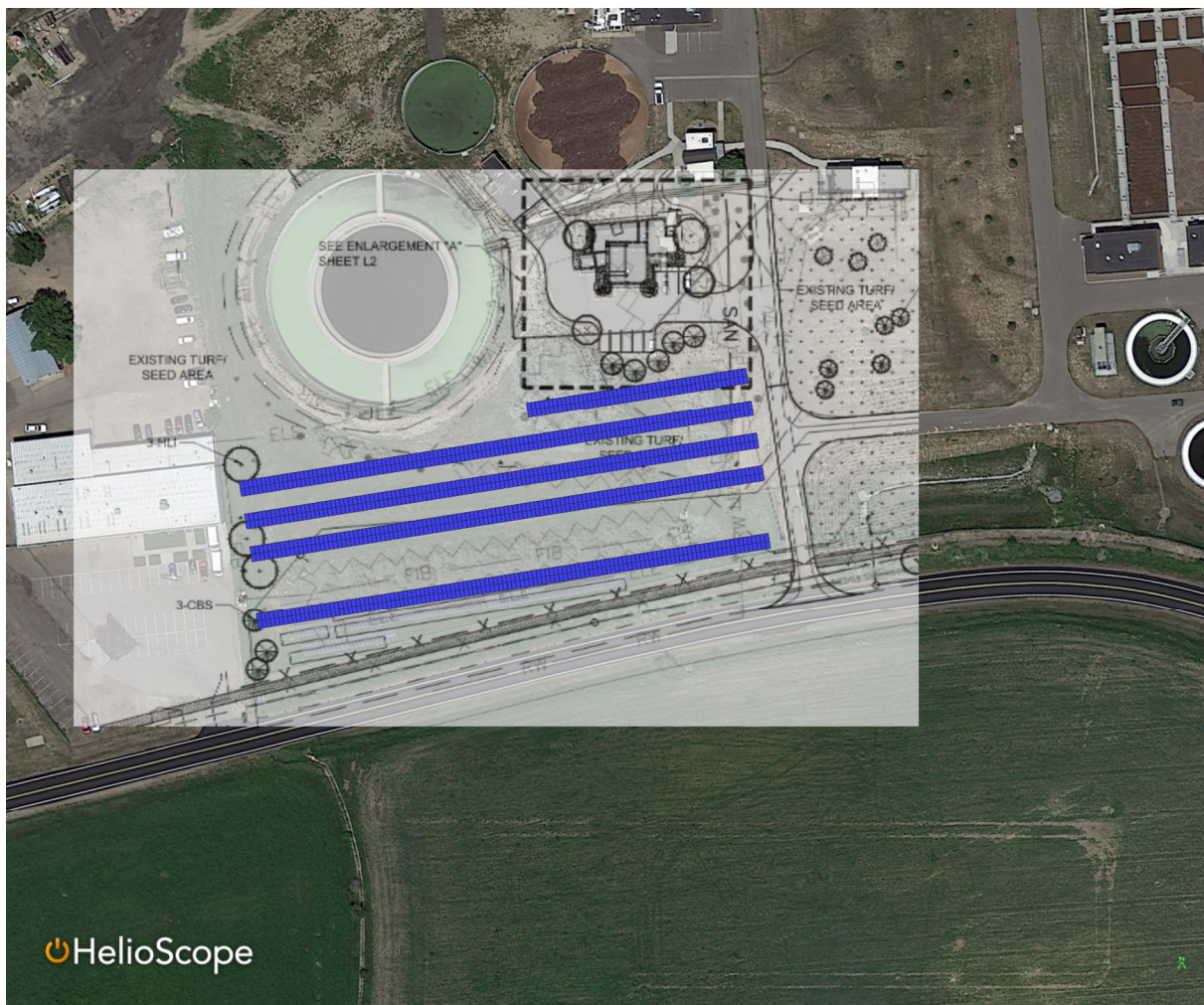
7. Future Expansion

The Wastewater site has a unique opportunity to expand the total array capacity on the site to the Solar*Rewards Community Program cap of 1MWac. To do so, the existing 100kW array on site would need to outlive its useful life and/or meet minimum standards for financial payback to justify its demolition.

The below image details a potential Max Fit option of 569.2kWdc / 1054 Solar Modules / 450kWac array. It would have the potential to expand this facility's % offset from 37% to 68%.

To prepare this area for a solar array, there would need to be grading performed to level the existing berm and care taken to not disturb the fiber line that appears to run within the berm. This area is ideal for a solar array as it is currently unused space that with no plans for expanding wastewater treatment infrastructure at this location. It has the potential to be a permanent solar array field depicted in all future master plans.

At a minimum, additional conduits could be laid to integrate this array to the existing electrical system. Timing of this array's installation would need to be balanced with aforementioned demo of the existing array pending Louisville financial analysis of the existing array. Currently we have not evaluated the cost impact of this expansion.





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WWTP Cost Estimates

Three sets of numbers are listed below:

1. Cost Delta of Decarbonization – These are the total construction costs minus the replacement costs that would've been spent to replace the existing units with like-for-like fossil fuel units. These numbers represent the true cost of this decarbonization effort.
2. Total Decarbonization Construction Costs – These are the total amounts of money that will need to be allocated for budgetary purposes. The delta between the above numbers and the below numbers represents the cost of decarbonization.
3. Baseline Costs - These are the costs that would be spent to replace the existing gas-based systems with like-for-like gas units.

All numbers are “all-in costs”, including all GC markups, permitting, etc. They are also Rough Order of Magnitude (ROM) numbers, with a +/-20% range. See the “Construction Pricing Context” section in the report body for more detail. All costs associated with the solar PV systems (including the electrical infrastructure to support these systems) are included in the Renewables costs as outlined in a separate section of the Appendix.

Cost Delta of Decarbonization

DECARBONIZATION DELTA COSTS: WWTP

	Total Cost
Full Electrification	\$ 187,000

Total Decarbonization Construction Costs

FULL ELECTRIFICATION: WWTP

Scope	Total Cost
HVAC Rooftop Units and Ductwork	\$ 45,000
HVAC Piping	\$ 105,000
Domestic Water Heating and Piping	\$ 58,000
Electrical	\$ 182,000
GC all-in Total (design, CM, bonds, etc.)	\$ 389,000

EV Charging L2	\$ 137,000
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Baseline Costs

GAS LIKE-FOR-LIKE REPLACEMENT COSTS: WWTP

	Total Cost
Waste Water Plant	\$ 202,000