

Carson City Public Works

Mandatory Sewer Extension Program for Phases 9, 10 and 12

OWNER:

Carson City Public Works

ENGINEER:



5510 LONGLEY LANE
RENO, NEVADA 89511
(775) 851-4788



08/11/2022

Prepared by Keith Karpstein, P.E.

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TECHNICAL MEMORANDUM #1

CARSON CITY PUBLIC WORKS

SE MANDATORY SEWER EXTENSION PROJECT

Prepared For: Carson City Public Works
Prepared By: Savannah Hughes, EI
Reviewed By: Keith Karpstein, PE
Date: August 2, 2022
Subject: Preliminary Alternatives Analysis

1.0 BACKGROUND

Nitrate contamination in groundwater underlying areas of southeast Carson City has long been established. In the early 1990s, a study was commissioned reviewing water supply well sample results and potential nitrate sources; ultimately the widespread use of septic systems in the southeast area of Carson City was determined to be the cause. In 1994, sanitary sewer collection system piping began to be installed into the area of concern. Installation of piping continued over the next 15 years; to date the project is approximately 75% complete. Three project phases encompassing up to approximately 140 current and future connections remain to be completed in the subject area.

Widespread literature and region-specific studies correlate the density of septic tanks to the presence of nitrate concentrations. “Fate and Transport of Septic Tank Derived Nitrogen in an Alluvial Aquifer, Carson Valley, Nevada” was a study conducted in partnership with the United States Geological Survey, Desert Research Institute, and the University of Nevada, Reno, Hydrological Science Program. This study concluded that the elevated nitrate concentrations are “most likely the result of septic tank use” [Jacobson, J., et. al.]. This conclusion was based partly on data showing the nitrate levels decreasing over time after the removal of the septic tanks. These reduced levels were shown to decrease at a faster rate particularly when the aquifer continued to be pumped. High density septic tank areas are defined within the study as more than 0.6 septic tanks per acre. Low septic tank densities are defined as less than 0.3 septic tanks per acre. The areas classified as “high septic tank density” have two to three times greater nitrate concentrations.

The existing properties located within this area, referenced as phases 9, 10, and 12 of the *Southeast Carson Sewer Extension Plan*, are currently served by individual septic systems. These systems are contributing to the continuing rise in nitrate levels that are negatively impacting groundwater resources. **Figure 1** shows the location of the phases within Carson City, as well as the location of each active well.

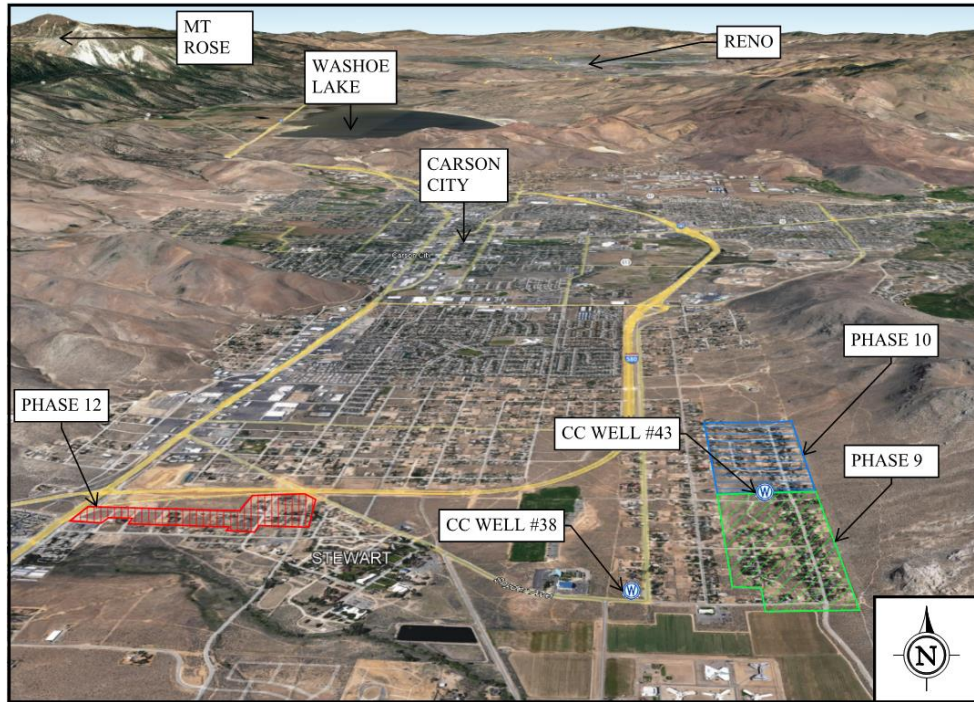


Figure 1: Vicinity map of Carson City and phase locations

Table 1 summarizes the attributes of phases 9, 10, and 12 in relation to septic tank densities.

Table 1: Septic tank densities by phase

	Area (acres)	Septic Tanks (units)	Density (tanks per acre)
Phase 9	60	58	0.96
Phase 10	98	54	0.55
Phase 12	38	20	0.52

A study specific to the Carson Valley supports the causal relationship between the use of septic tanks and high nitrate levels (Shiple and Rosen, 2005). This is of great interest to the Carson City Public Works Department due to the negative impacts of nitrate.

Nitrate is a chemical compound with one nitrate ion and three oxygen atoms. Many nitrate salts are soluble in water and are therefore a highly discussed constituent in both drinking water and wastewater. The maximum contaminant level (MCL) for nitrates is 10 mg/L, as a measurement of nitrogen. Some health complications that may arise due to high nitrate exposure include methemoglobinemia, otherwise known as blue baby syndrome, thyroid disease, and birth defects [NDEP].

Exceeding the nitrate MCL is a Tier 1 violation under 40 CFR 141.202(b). In addition to staying below the MCL of 10 mg/L, the utility has additional requirements if nitrate levels exceed specific levels below the MCL. If levels exceed 5 mg/L sampling frequency is increased to three times per week. If levels exceed 8 mg/L, the water will be pumped to waste until levels drop below 8 mg/L. These requirements make operation of the wells difficult, costly, and time intensive. This also greatly impacts the reliability of the water source.

Figure 2 and Figure 3 illustrate the rising nitrate levels over time, for wells 38 and 43, respectively.

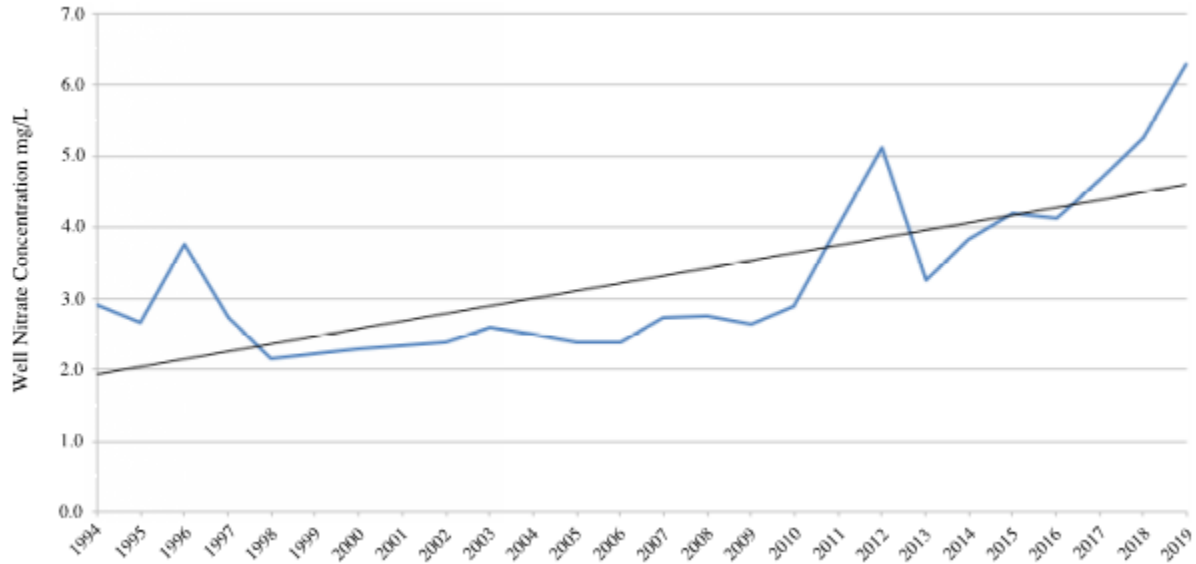


Figure 2: Well 38 nitrate concentrations from 1994-2019, during the summer months (July to October).

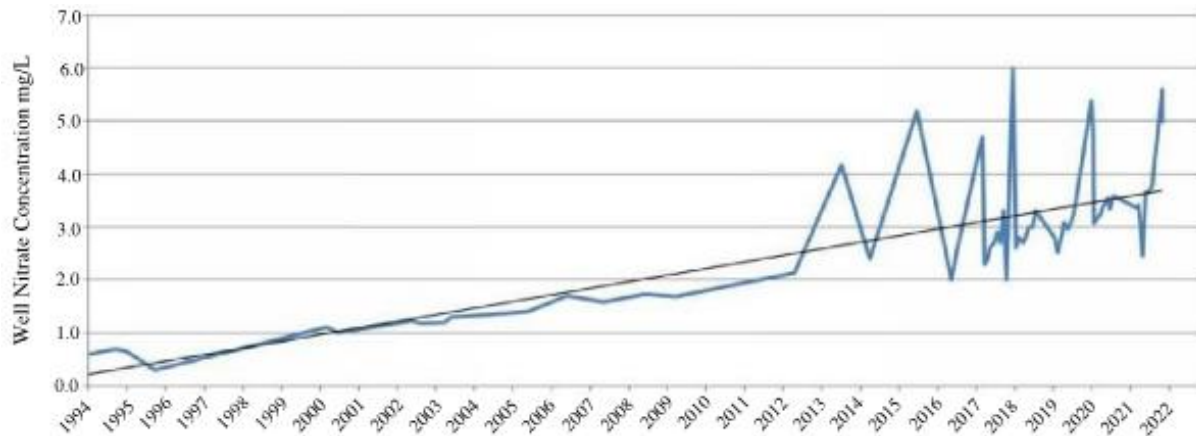


Figure 3: Well 43 nitrate concentrations from 1994 to 2022, taken on March 30th of each year, provided by Carson City Public Works.

1.1 PURPOSE

Several alternatives are being explored with the intent of reducing nitrogen concentrations at wells 38 and 43. These alternatives can be generally grouped into the following:

- **Alternative 1:** Extending the existing sewage collection system with the use of gravity sewer mains, force mains, municipal and residential lift stations;
- **Alternative 2:** Extending the existing sewage collection system with limited residential lift stations and septic tank denitrification systems installed at residencies not feasible to connect to the gravity sewer system without the installation of a municipal lift station;
- **Alternative 3:** Denitrification systems installed in all residential septic systems;
- **Alternative 4:** Nitrate treatment installed at wells no. 38 and 43. This alternative is not fully investigated within the scope of the technical memorandum but is mentioned to provide a more holistic explanation of the project options.

This technical memorandum explores several iterations of these alternatives to develop the best solution for Carson City Public Works and residents. **Appendix A** includes all the plan and profile drawings for the alternatives. **Appendix B** includes the corresponding cost estimates for all the alternatives and sub-alternatives.

2.0 PHASES 9 AND 10 ALTERNATIVES

For the preliminary evaluation of this project, three main alternatives have been established for Phase 9 and 10. Phases 9 and 10 are being evaluated jointly due to their close geographic proximity, and therefore the interconnected nature of the proposed improvements.

2.1 ALTERNATIVE 1

Alternative 1 includes collection system extension with gravity sewer, force mains, and residential and municipal lift stations. Residential lift stations are generally referring to prefabricated grinder pump stations that service an individual residence. These are proposed when the sewer laterals are unable to gravity flow into the sewer main. Municipal lift stations would be part of the overall collection system, connecting to a gravity sewer main and a force main. Any house connecting to the collections system will have their septic tank abandoned. It is assumed the individual homeowners will bear the cost of septic tank abandonment, lateral extensions, and prefabricate grinder pump stations, if required.

Alternative 1 consists of several sub-alternatives to provide multiple considerations to avoid the installation of a municipal lift station. Because of the complexities of Alternative 1 and these sub-alternatives, they have been further categorized by geographical Zones, as shown in **Figure 4**. These Zones have been established, corresponding to the houses serviced by each municipal lift station and direction of flow. The total number of lots in Phases 9 and 10 accumulate to be 114. A summary of each Zone is provided.

- Zone A – No municipal lift station and 1 residential lift stations; 47 lots.
- Zone B – Bennett lift station and 4 residential lift stations; 39 lots.
- Zone C – Heidi lift station and no residential lift stations; 24 lots.
- Zone D – No municipal lift station and 4 residential lift stations; 4 lots.

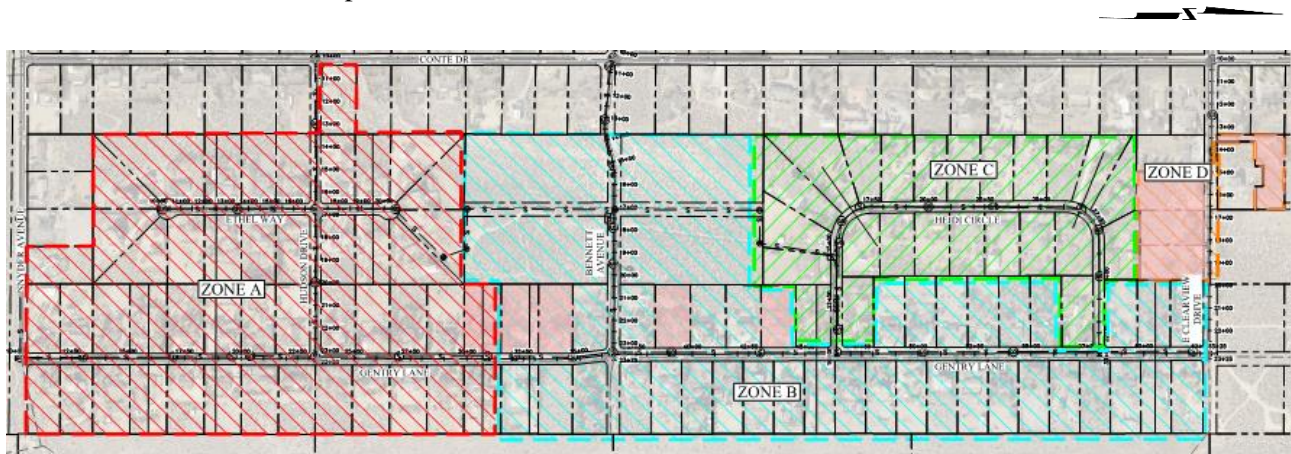


Figure 4: Phases 9 & 10, Alternative 1 Zones

2.1.1 Zone A

Zone A has one feasible alternative within Alternative 1. Zone A will consist of gravity sewer mains and one private residential lift station is anticipated. Gravity sewer within Zone A conveys collected sewage from Gentry Lane to Snyder Avenue and Hudson Drive. The flow from Hudson Drive collects from Ethel

and conveys the sewage to the existing system on Conte Drive. See sheets P1, P4 and P6 for the plan and profile design of Zone A.

Zone A is estimated to cost \$3,772,239 and will be installed independently of the preferred sub-alternatives for each Zone within Alternative 1. All costs for each zone are developed based on high, volatile prices seen in 2021 and 2022 and include a 30% contingency along with a 15% design and construction management add on. See Sheet 1 in Appendix B for a detailed cost breakdown of Alternative 1 in Zone A.

2.1.2 Zone B (Bennett Lift Station)

Zone B includes three sub-alternatives. The three different sub-alternatives and their respective costs are provided in **Table 2**.

Table 2: Zone B, Alternative 1 Capital Costs

Zone B Alternatives	Total Capital Cost
B 1.1	\$3,573,717
B 1.2	\$3,493,719
B 1.3	\$3,151,094

Alternative B 1.1: Gravity sewer mains will convey wastewater from Gentry Lane and down Bennett Avenue. A lift station on Bennett will be installed to then convey the wastewater to an existing manhole on Conte Drive. Four residential lift stations will be required. See sheet P5 in Appendix A for plan and profile design and Sheet 2 in Appendix B for a detailed cost estimate.

Alternative B 1.2: Gravity sewer mains will convey wastewater from Gentry Lane and down Bennett Avenue. In place of the Bennett Lift Station, gravity mains will be installed within existing easements as well as acquiring a new property easement parcel to the south (APN 010-261-08). This will convey sewage to Ethel Way solely via gravity. Four residential lift stations will be required. Gravel surfacing is proposed along the easements to provide maintenance as needed. See sheet BC 1.2 within Appendix A and Sheet 3 in Appendix B for a detailed cost estimate.

Alternative B 1.3: To avoid installing the Bennett lift station, the gravity sewer main along Gentry Lane can be deepened to approximately 25 feet, allowing wastewater to be conveyed to the Zone A gravity sewer main. This alternative will eliminate the need to provide any immediate gravity mains or a lift station along Bennett Avenue. However, if the empty lots along Bennett Avenue were to be developed, a future main and lift station would still be necessary. This Alternative would not work in conjunction with Zone C Alternative 1.2, unless the gravity main were to be extended all the way to Ethel Way. See sheet P1 within Appendix A and Sheet 4 in Appendix B for a detailed cost estimate.

2.1.3 Zone C (Heidi Lift Station)

Zone C includes two sub-alternatives. **Table 3** summarizes the capital costs for each sub-alternative for Zone C Alternative 1.

Table 3: Zone C, Alternative 1 Capital Costs

Zone C Alternatives	Total Capital Cost
C 1.1	\$1,922,055
C 1.2	\$2,112,949

Alternative C 1.1: Install gravity sewer, the Heidi Lift Station, and accompanying force main to convey sewage to Gentry Lane. See sheet P7 within Appendix A and Sheet 5 in Appendix B for a detailed cost estimate.

Alternative C 1.2: To avoid installing the Heidi Lift Station, a new property easement parcel (APN 010-333-08) would need to be acquired to then install a gravity sewer main from Heidi to transport sewage south to Bennett Avenue. Gravel surfacing is proposed along the easements to provide maintenance as needed. The alternative is the most compatible when working in conjunction with Zone B, Alternative 1.1 and 1.2 and does not work with Zone B, 1.3. See sheet BC 1.2 within Appendix A and Sheet 6 in Appendix B for a detailed cost estimate.

2.1.4 Zone D (Clearview)

Zone D includes three sub-alternatives. **Table 5** summarizes the cost of each sub-alternative for Zone D Alternative 1.

Table 4: Zone D, Alternative 1 Capital Costs

Zone D Alternatives	Total Capital Cost
D 1.1	\$145,464
D 1.2	\$488,636
D 1.3	\$702,562

Alternative D 1.1: Involves the installation of a manifold sanitary sewer force main and residential lift stations for four parcels. The manifold force main would connect to the Zone B infrastructure at a manhole at the Gentry Lane and E Clearview Drive intersection. The manifold system will be routed to the existing system on Conte Drive or routed to Gentry Lane and Zone B infrastructure. The estimate shown examines the route to Conte Drive. All residential lift stations would be provided by owners. See sheet P3 within Appendix A and Sheet 7 in Appendix B for a detailed cost estimate.

Alternative D 1.2: Install shallow gravity sewer main with four residential lift stations provided by owners. The main would convey sewage to Gentry Lane. See Sheet D 1.2 within Appendix A and Sheet 8 in Appendix B for a detailed cost estimate.

Alternative D 1.3: To avoid the installation of residential lift stations, the gravity sewer main will be deeper than it otherwise would be in Alternative 1.2, allowing all laterals to connect to the sewer main and flow via gravity, roughly 22' at its deepest point. While this does result in the elimination of residential lift station expenses, it increases the cost of construction due to the deeper trench excavation and the need for 60" manholes. See Sheet D 1.3 within Appendix A and Sheet 9 in Appendix B for a detailed cost estimate.

2.2 ALTERNATIVE 2

Alternative 2 involves the installation of denitrification units at the residential septic tanks, as a means of avoiding the use of municipal lift stations. This alternative assumes that easements cannot be acquired, and the Heidi and Bennett Lift Stations would be needed. All parcels within Zones B, C, and D would require denitrification units, Zone A does not require the use of denitrification as it can utilize gravity sewer mains without the need for a municipal lift station. Carson City would be responsible for the installation of the denitrification units, whereas operation and maintenance would be the financial responsibility of the either the homeowner or an outside agency called the Responsible Management Entity (RME). This approach is discussed further in Section 5.0 and operation and maintenance in Section 7.0.

Table 5: Alternative 2 – Capital Costs

Alternative 2	Capital Cost
Zone A	\$3,772,239
Zone B	\$2,947,850
Zone C	\$1,861,800
Zone D	\$310,300

*These costs are capital only and do not consider the present worth of service and RME

2.2.1 Zone A

Zone A will not require any denitrification as all lots can collectively work without the need of a municipal lift station. See **Section 2.1.1 Zone A** for a description of the proposed gravity system. See Sheet 1 of Appendix B for a detailed cost estimate.

2.2.2 Zone B

Alternative 2 for Zone B will opt out of the installation of the Bennett lift station, instead proposing that all residencies within Zone B will have denitrification units installed. Zone B also dictates Alternative 2 for Zone C as Zone C would require flow into Zone B. Therefore, choosing this alternative for Zone B includes all lots for Zone B and C combined (39 lots in Zone B and 24 lots in Zone C). See Sheet 10 of Appendix B for a detailed cost estimate.

2.2.3 Zone C

Zone C consists of 24 lots around Heidi Circle. These lots would require flow to Gentry Lane located within Zone B under Alternative C 1.1. If Zone B Alternative 2 is chosen, then no other option is possible except the denitrification of the 24 lots within Zone C. However, if one of the sub-alternatives proposed in Alternative 1 for Zone B is installed, Zone C denitrification can still be used independently of Zone B. See Sheet 11 of Appendix B for a detailed cost estimate.

2.2.4 Zone D

Zone D consists of 4 lots on Clearview Drive. Denitrification of these lots can work independently of any other option for the other zones. See Sheet 12 of Appendix B for a detailed cost estimate.

2.3 ALTERNATIVE 3

Alternative 3 is the least complex alternative that is being explored. Rather than extending the collection system to connect to the houses in Phases 9 & 10, each septic tank will be retrofitted to have a denitrification system installed. No collection system infrastructure would be considered. This alternative would require the installation of 113 denitrification units as one lot is currently vacant. This alternative has an associated capital cost of \$8,765,975. This number does not consider the present worth of service and RME. Operation and maintenance responsibilities and challenges are further discussed in Section 5.0. See sheet 13 in Appendix B for a detailed cost estimate.

3.0 PHASE 12

Phase 12 consists of 15 lots and exists independently of Phases 9 & 10. Phase 12 considers three design approaches, consistent with the three alternatives that are considered for Phases 9 & 10. Because Phase 12 is independent of Phases 9 & 10, those cost of the chosen alternatives for each Phase group will be additive. Phase 12 does not include Zones as applied in Phase 9 and 10 as there are no municipal lift stations included in the alternative options. **Table 6** summarizes the costs for each alternative for Phase 12. **Appendix A** includes all of the plan and profile drawings for the alternatives.

Table 6: Phase 12 Alternatives Capital Costs

Alternatives	Total Capital Cost
1	\$1,368,749
2	\$1,517,284
3	\$1,163,625

3.1 ALTERNATIVE 1

Alternative 1 for Phase 12 includes the use of gravity sewer main, residential lift stations, and a manifold force main. The gravity sewer main will flow the length of Arthur Drive, conveying sewage to an existing manhole at Center Drive. A manifold force main will be serviced by a residential lift station at each of the parcels requiring one along Silver Sage Drive (4 parcels total), north of Arthur Drive. Installation of residential lift stations will be the responsibility of the homeowners. See Sheets P17 and P18 for the plan and profile views and sheet 14 in Appendix B for a detailed cost estimate.

3.2 ALTERNATIVE 2

Alternative 2 proposes a gravity sewer main along Arthur Drive. However, rather than installing a manifold force main and residential lift stations along Silver Sage Drive, the parcels that would otherwise require them would opt for individual denitrification systems at each of the septic tanks (4 parcels total). See sheet 15 in Appendix B for a detailed cost estimate.

3.3 ALTERNATIVE 3

Alternative 3 proposes the installation of denitrification systems at each of the septic tanks within Phase 9. A total of 15 lots and denitrification units. This alternative does not involve any infrastructure associated with the public collection system. See sheet 16 in Appendix B for a detailed cost estimate.

4.0 ALTERNATIVE 4 -WELL DENITRIFICATION

Rather than installing infrastructure to prevent the contamination of groundwater with nitrates from the septic tanks, Alternative 4 explores the option of removing nitrates at the wells. This alternative would need to be installed at each well that has high nitrate levels.

The Environmental Protection Agency (EPA) has approved three methods for nitrate removal. These options include ion exchange, reverse osmosis, and electro dialysis.

Ion exchange is the most common option for treating larger amounts of water. Ion exchange produces deionized water that is highly pure and void of most minerals. A resin acts to facilitate the ion exchange mechanism, which requires routine recharging. This can only be done at special facilities. Failing to regenerate or replace the resin will lead to an increase in nitrate concentrations within the potable water so maintaining the resins is incredibly important.

University of California Davis provides “Technical Report 6: Drinking Water Treatment for Nitrate”. **Table 7** of this Report provides estimated costs for ion exchange treatment.

Table 7: Selected Published Costs* of Ion Exchange Systems for Nitrate Removal [UC Davis]

System Flow**	< 0.5 MGD	0.5 – 5 MGD	5 + MGD
Annualized Capital Cost (\$/1000 Gal)	0.37 – 1.21 [1]	0.28 – 0.94 [2,3]	0.28 – 0.61 [3,4,5]
O&M Cost (\$/1000 gal)	0.60 - 4.65 [1]	0.46 – 1.25 [2,3]	0.37 – 0.87 [3,4,5]
Total Annualized Cost (\$/1000 gal)	0.97 – 5.71 [1]	0.74 – 2.19 [2,3]	0.65 – 1.44 [3,4,5]

*Costs have been adjusted to 2010 dollars with 7% interest over 20 years.

**When available, costs are based on actual system flow rather than design capacity.

[1] Minnesota Department of Agriculture (N.D), not adjusted to 2010 dollars, 20 year amortization without interest. [2] Guter (1995). [3] Conlon et al. (1995). [4] Meyer et al. (2010). [5] Drewry (2010).

Within the UC Davis Report, several case studies are provided. Case #1 has similar flow and nitrate levels as the Carson City wells.

Table 8 provides a summary of the treatment system attributes to illustrate what a system for Carson City would resemble. The capital costs given in the study were given in 2007 dollars and converted to 2022 dollars using the Engineering News-Record historical Construction Cost Index (ENR-CCI) inflation factors. The annual operation and maintenance values were converted utilizing the U.S. Bureau of Labor Statistics Consumer Price Index factors to provide a better assessment of labor cost changes associated with labor maintenance. These costs are estimated for a single well and would be applicable to both Well 38 and Well 43.

Table 8: Case #1 Ion Exchange Treatment Characteristics [UC Davis]

Characteristic	Value	
Flow	400 GPM	
Nitrate Concentration (as N)	7 – 12 mg/L	
Treatment System Footprint	30’ x 35’	
Gallons Treated Before Regeneration is Needed	220,000 – 300,000	
Brine Disposal Option	Wastewater	
Capital Cost	\$350,000	(2007 Dollars)
	\$576,000	(2022 Dollars)
Annual Operation and Maintenance	\$66,500	(2007 Dollars)
	\$92,000	(2022 Dollars)

An important consideration with these treatment options is the disposal of brine. The waste product of ion exchange is a highly concentrated brine, consisting of all the ions removed during the treatment process.

The utility will need a method of disposing this brine. Oceans are the optimal disposal option, however, due to the inland nature of Carson City, this is not practical. The disposal option in the Case referred to previously disposed of the brine via the sewage system, one of the least expensive options. An assessment of the impact this would have on sewage treatment would need to be done prior to considering this as a viable option for Carson City. Other disposal options include deep well injection, trucking off-site, drying beds, and advanced treatment.

5.0 SEPTIC TANK DENITRIFICATION SYSTEM

Onsite wastewater treatment and disposal systems have been a well-known practice for several years. In 1980 the U.S Environmental Protection Agency issued the *Design Manual: Onsite Wastewater Treatment and Disposal Systems*. **Table 9** is modified from Table 1 of the *Design Manual* and provides the percent of total nitrogen removal from various on-site nitrogen removal processes. While multiple processes are included for reference, only some of them are practical options for the needs of Carson City. **Figure 5** provides a process flow schematic of a residential nitrate removal system, provided by Lombardo Associates.

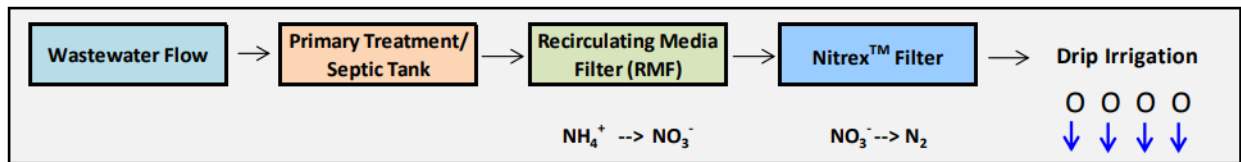


Figure 5: Residential Nitrate removal flow diagram from Lombardo Associates.

Table 9: Nitrogen removal processes and removal percentages [EPA, 1980].

Process	Percent Total Nitrogen Removal
Recirculating Sand Filters	40-50
Recirculating Sand Filters (w/ recycle to septic tank or anaerobic upflow filter)	70-80
Septic Tank Fixed Film System (w/ recycle to septic tank or anaerobic upflow filter) ^a	65-75
Sequencing batch reactor	50-80
Source Separation and removal	60-80
Source separation treatment applied to both systems, recombined	40-60
Intermittent Sand Filter, Anaerobic Upflow Filter	55-75

^a Commercially available systems

^b Source separation options are only available for new homes due to the cost prohibiting nature of retrofitting them for installation.

Several manufacturers are available for septic tank denitrification systems. When these systems are installed, it is typical for the manufacturer to also act as a Responsible Management Entity for the units due to the fallibility of homeowners maintaining these systems themselves. These are typically achieved through Public Private Partnerships and involve utility payments by the serviced parcels.

6.0 CAPITAL COSTS

Capital costs for each alternative include mobilization, demobilization, temporary erosion control, temporary traffic control where applicable and a 15% design and construction management cost. A 30% contingency is included to account for volatility in the supply chain in recent years, preliminary nature of the cost estimate, and unknown construction date. A complete breakdown of each alternative and sub-alternative is provided in Appendix B of this memorandum.

Table 10: Phases 9 & 10, Alternative 1 Capital Costs

ALTERNATIVE 1 – LIFT STATIONS OR GRAVITY MAINS								
ZONE A		ZONE B		ZONE C		ZONE D		Total Range
Sub-Alt	Cost	Sub-Alt	Cost	Sub-Alt	Cost	Sub-Alt	Cost	
A1.1	\$3,772,238	B1.1	\$3,573,717	C1.1	\$1,922,055	D1.1	\$145,464	8.9-10.1 million
		B1.2	\$3,493,719	C1.2	\$2,112,949	D1.2	\$488,636	
		B1.3	\$3,151,094			D1.3	\$702,562	

Table 11: Phases 9 & 10, Alternative 2 Capital Costs

ALTERNATIVE 2 – GRAVITY MAIN IN ZONE A AND DENITRIFICATION IN ZONES B, C, D				
ZONE A	ZONE B	ZONE C	ZONE D	TOTAL
\$3,695,479	\$2,947,850	\$1,861,800	\$310,300	\$8,815,429

Table 12: Phases 9 & 10, Alternative 3 Capital Costs

ALTERNATIVE 3 – ALL ZONES USE DENITRIFICATION
\$8,765,975

Table 13: Phase 12 Alternatives

PHASE 12 ALTERNATIVES	COST
ALTERNATIVE 1 – Gravity Main On Arthur And SSFM Manifold On Silver Age	\$1,368,749
ALTERNATIVE 2 – Denitrification On Silver Sage Lots, Gravity Main On Arthur	\$1,517,284
ALTERNATIVE 3 - Denitrification For All Lots	\$1,163,625

7.0 OPERATION AND MAINTENANCE

The different alternatives will vary in terms of operational and maintenance requirements. Municipal lift stations require significantly more maintenance and operator hours than a gravity sewer system does. The power required also adds to annual operating costs.

Gravity sewer mains and manholes typically require routine inspection via closed-caption television video (CCTV).

In a scenario where septic tank denitrification is used, the maintenance could be the responsibility of the homeowner, however as mentioned previously, it is recommended that an RME take control of denitrification maintenance. Assuming RME cost is approximately \$100,000 in labor and testing per year and a total of 128 denitrification systems between Phases 9, 10 and 12, the monthly payment per household would be approximately \$65. Providing maintenance over a 20-year period would cost \$2,000,000 without interest or 2.7 million with the notion of a flat forward rate of inflation at 3%.

The residential lift stations installation costs are expected to be the responsibility of the homeowners, therefore all maintenance associated with them will be the homeowner's responsibility as well.

8.0 CONCLUSION

The recommended solution for Carson City Public Works is to expand the sewer collection system to include Phases 9, 10, and 12. When comparing the first three alternatives with Alternative 4, the most important distinction is that the sewer collection alternatives provide a method of preventing the contamination at the source, rather than removing it at a later point. This approach also provides protection to the critical aquifer to the city. The primary benefit to this regarding efficacy, is that it is a solution that will prevent contamination of all groundwater and would be effective even if new wells are drilled in the future. In terms of principal alone, it is preferable to prevent contamination; therefore, Alternative 4 is the least favorable option.

The recommended solution for Phases 9 and 10 is a combination of the sub-alternatives within Alternative 1, with the exact alignments and sewer main depths to be determined in the design phase. As previous studies have shown, nitrate levels do drop consistently with the removal of septic tank systems. The denitrification units that are proposed in Alternatives 2 and 3 result in a few key issues. Primarily, the denitrification units present a notable constructability, maintenance, and reliability issue. Several site constraints will exist, solely due to the unique nature of the 128 occupied residential parcels. If the denitrification units are not installed or are unable to be installed, this will greatly decrease the effectiveness of the nitrate prevention efforts. Lastly, it has been shown that denitrification units have not generally been well maintained by homeowners. If these systems are left unmaintained then they offer no advantage over a typical septic system. Without the ability to enforce maintenance, homeowner-maintained denitrification units are not considered to be a reliable solution to the nitrate levels. Because of the lack of responsibility homeowners have shown in maintaining these systems, it is industry practice for these denitrification units to be maintained by an outside entity. This option will result in increased coordination expenses for Carson City. For these reasons, it is preferred that Phases 9 and 10 opt for sewer expansion via a combination of gravity sewer mains and municipal lift stations.

The recommended solution for Phase 12 is Alternative 1. This alternative includes gravity main and a manifold sanitary sewer force main, connected to residential lift stations where needed.

The best way to achieve effective nitrate prevention would be for Carson City Public Works to provide funding for the residential lift stations and sewer connections. This would eliminate the risk of homeowners opting out of connecting to the newly extended system. However, if Carson City does not provide this funding, Alternative 1 - for all phases - is still the most favorable option because it provides a mechanism for the proper disposal of sewage.

9.0 REFERENCES

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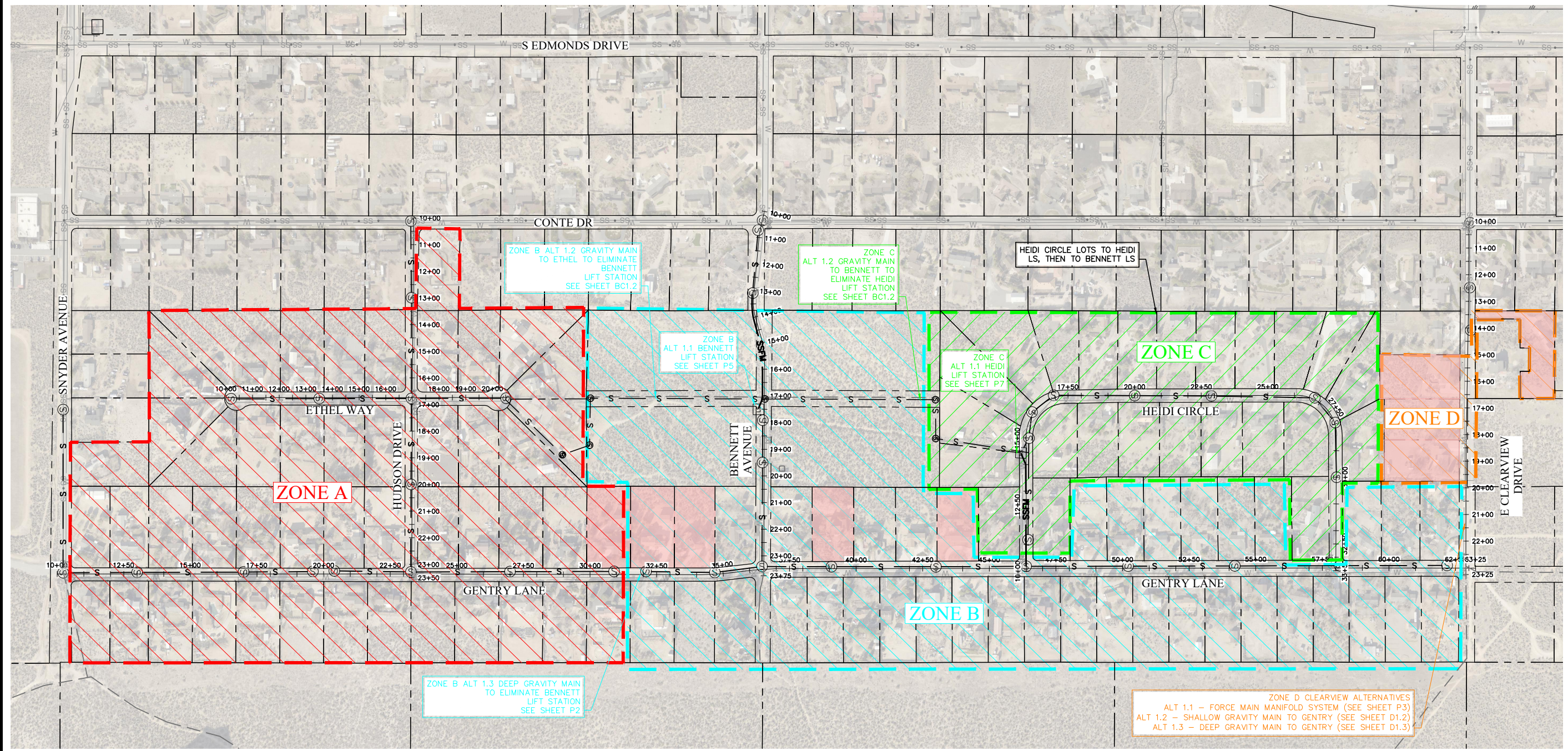
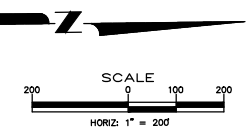
APPENDIX A

PRILIMINARY PLAN SET

DESIGNED BY: KK
 DRAWN BY: ED
 CHECKED BY: CL
 DWG NO.:
 SCALE (HORIZ): AS SHOWN
 SCALE (VERT): AS SHOWN
 PLOT DATE: 8/11/22

CARSON CITY PUBLIC WORKS DEPARTMENT
 3505 BUTTI WAY
 CARSON CITY, NEVADA 89701
 PH: 887-2355 FAX: 887-2112

FARR WEST ENGINEERING
 5510 LONGLEY LANE
 RENO, NEVADA 89511
 PHONE: (775) 851-4788
 billing@farrwestengineering.com-USA



- LOTS REQUIRING INDIVIDUAL LIFT STATIONS - 9 TOTAL
- ZONE A, 47 LOTS TOTAL, NO MUNICIPAL LIFT STATION REQUIRED.
- ZONE B - BENNETT LIFT STATION, 63 LOTS BEING SERVED WITH MUNICIPAL LIFT STATION WHICH INCLUDE 24 LOTS FROM HEIDI CIRCLE.
- ZONE C - HEIDI LIFT STATION, 24 LOTS BEING SERVED WITH MUNICIPAL LIFT STATION.
- ZONE D, 4 LOTS, NO MUNICIPAL LIFT STATIONS PROPOSED.

PHASES 9 AND 10

ZONE D CLEARVIEW ALTERNATIVES
 ALT 1.1 - FORCE MAIN MANIFOLD SYSTEM (SEE SHEET P3)
 ALT 1.2 - SHALLOW GRAVITY MAIN TO GENTRY (SEE SHEET D1.2)
 ALT 1.3 - DEEP GRAVITY MAIN TO GENTRY (SEE SHEET D1.3)



REV.	DATE	DESCRIPTION	BY APP'D

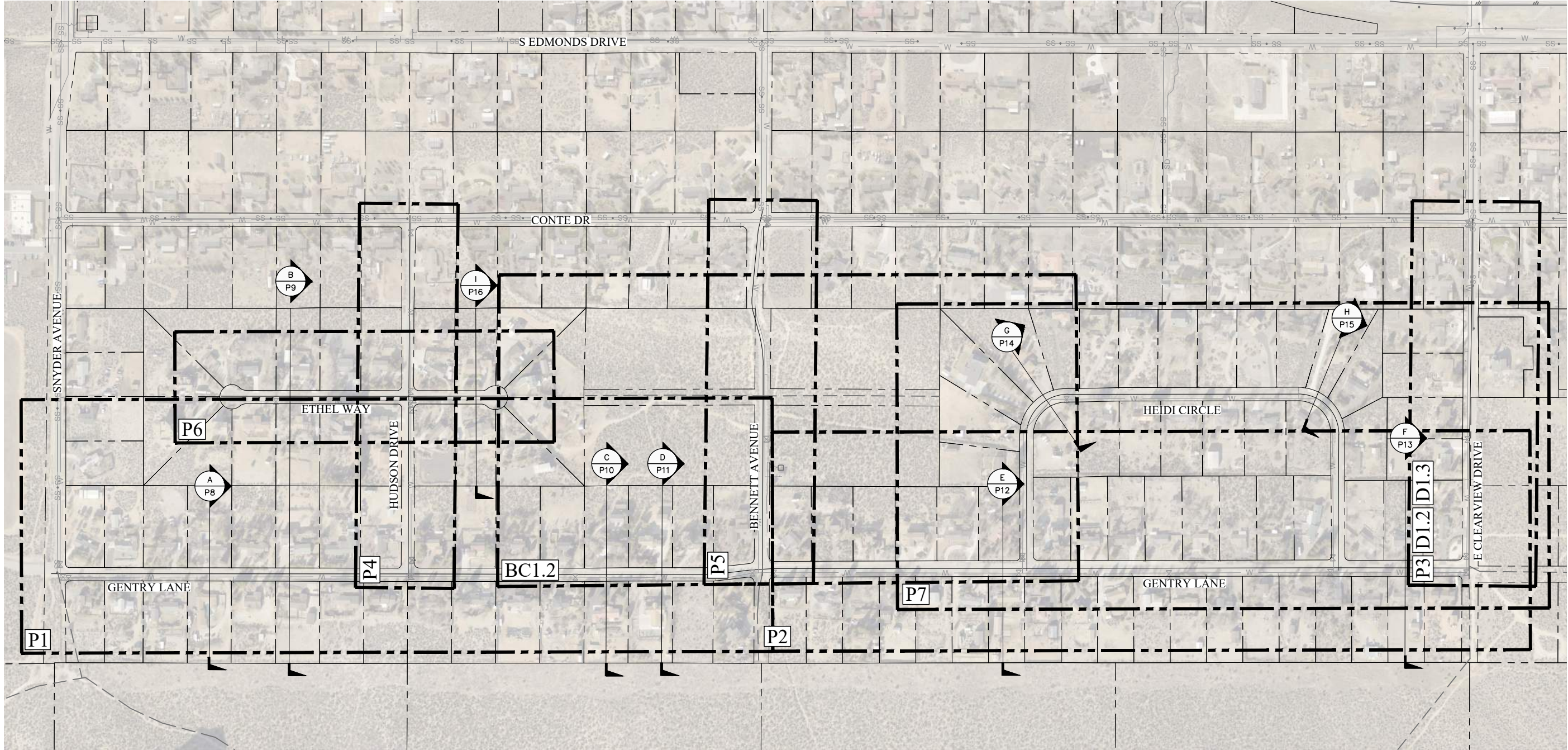
CARSON CITY - MANDATORY SEWER EXTENSION PROJECT
PHASE 9 AND 10 OVERALL MAP

SHEET
C1
 OF
24

PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

P:\Client Projects\Carson City of 115\1933 Carson City - St. Mandatory Sewer Extension Project - Phase 9, 10, and 12\5.0 Drawings\5.2 DWG\5.2.9 SHEET FILES\1933_C1-C2-OVERALL MAP.dwg, edited: 8/11/22

P:\Client Projects\Carson City of 115\1192 Carson City - SE Mandatory Sewer Extension Project - Phase 9, 10, and 12\5.0 Drawings\2 DWG\1192_C1-C2-OVERALL MAP.dwg, edwin, 6/23/22



PHASES 9 AND 10



DESIGNED BY: KK
 DRAWN BY: ED
 CHECKED BY: CL
 DWG NO.:
 SCALE (HORIZ): AS SHOWN
 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

CARSON CITY PUBLIC WORKS DEPARTMENT
 3505 BUTTI WAY
 CARSON CITY, NEVADA 89701
 PH: 887-2355 FAX: 887-2112

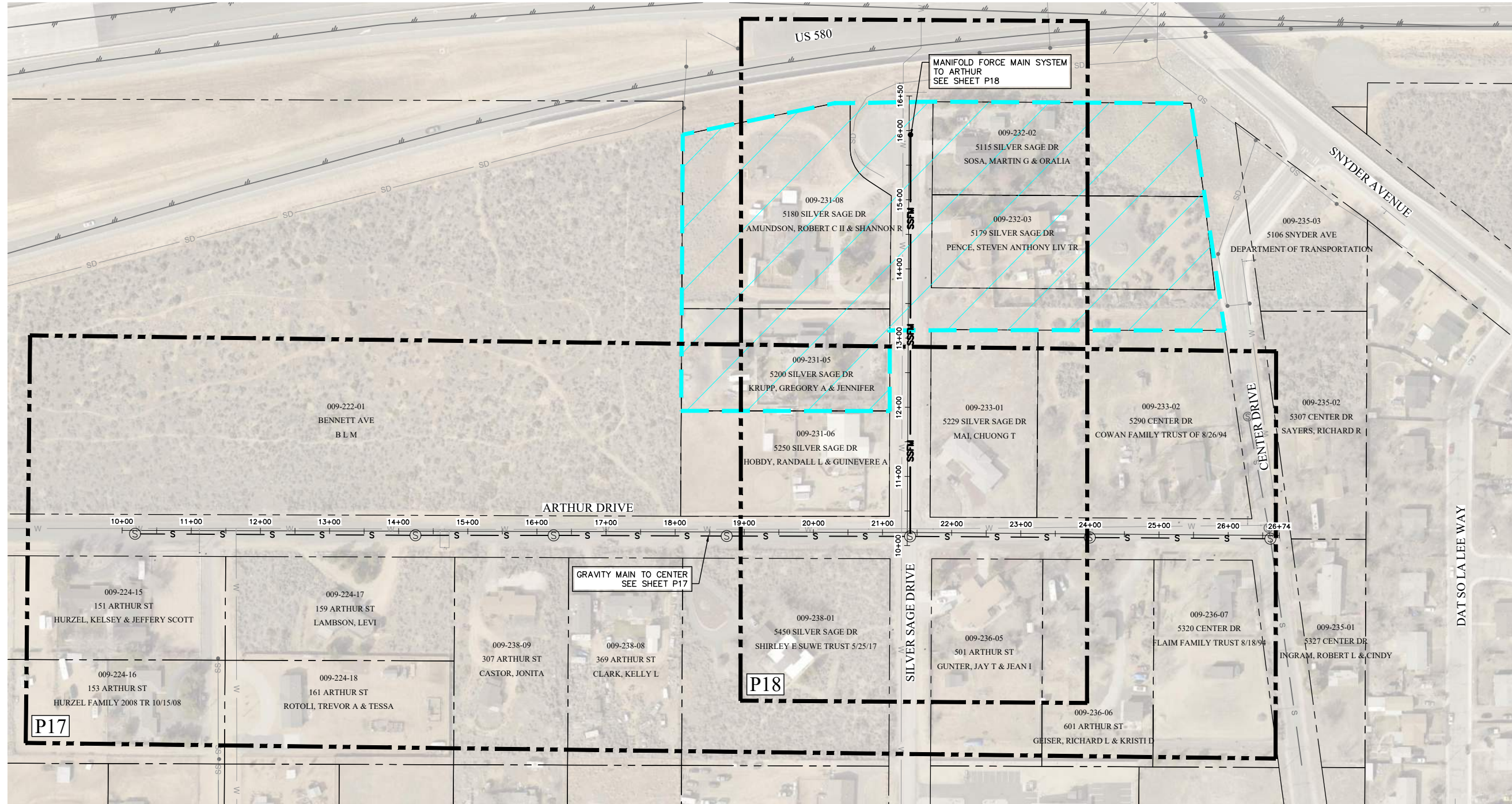
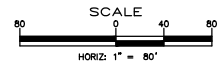
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REV.	DATE	DESCRIPTION	BY	APP'D

CARSON CITY - MANDATORY SEWER EXTENSION PROJECT
PHASE 9 AND 10
SHEET INDEX

SHEET
C2
 OF
24

PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)



PHASE 12

LOTS BEING SERVED WITH MANIFOLD FORCE MAIN SYSTEM (4 LOTS TOTAL, NO RESIDENTIAL LIFT STATIONS REQUIRED)

DESIGNED BY: KK
 DRAWN BY: ED
 CHECKED BY: CL
 DWG NO.:
 SCALE (HORIZ): AS SHOWN
 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT
PHASE 12
OVERALL MAP AND SHEET INDEX



SHEET
C3
 OF
24

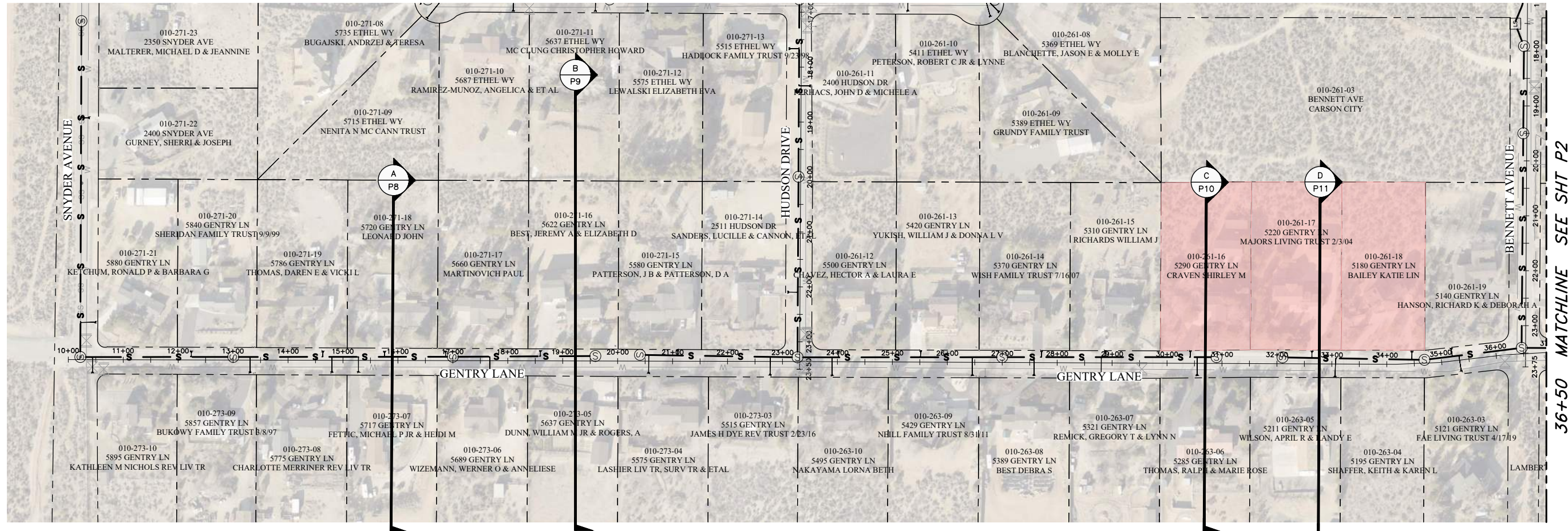
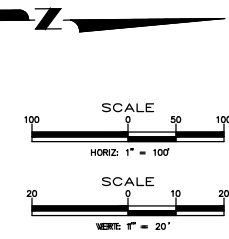
PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

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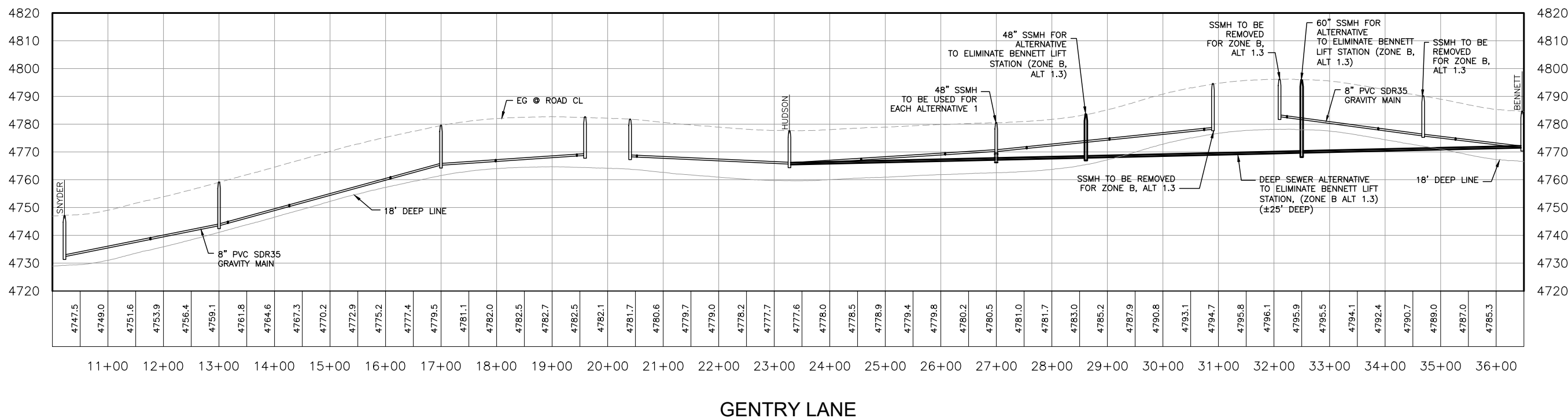
GENERAL NOTES:

1. EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
2. ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.

LEGEND:



36+50 MATCHLINE SEE SHT P2



GENTRY LANE

DESIGNED BY: KK
DRAWN BY: ED
CHECKED BY: CL
DWG NO.:
SCALE (HORIZ): AS SHOWN
SCALE (VERT): AS SHOWN
PLOT DATE: 6/23/22

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REV.	DATE	DESCRIPTION	BY	APP'D

CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 GENTRY LANE PLAN AND PROFILE STA 10+00 to STA 36+50

SHEET
P1
OF
24

PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

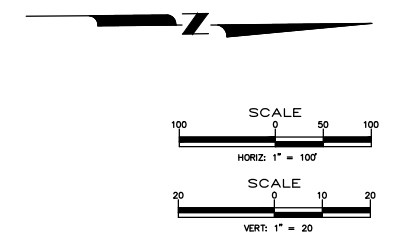
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GENERAL NOTES:

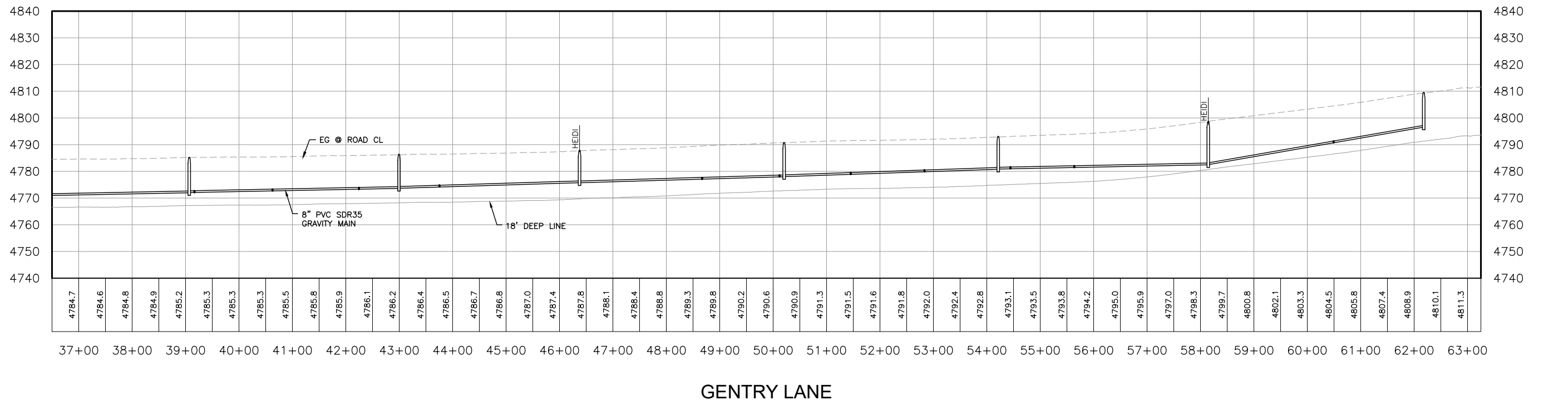
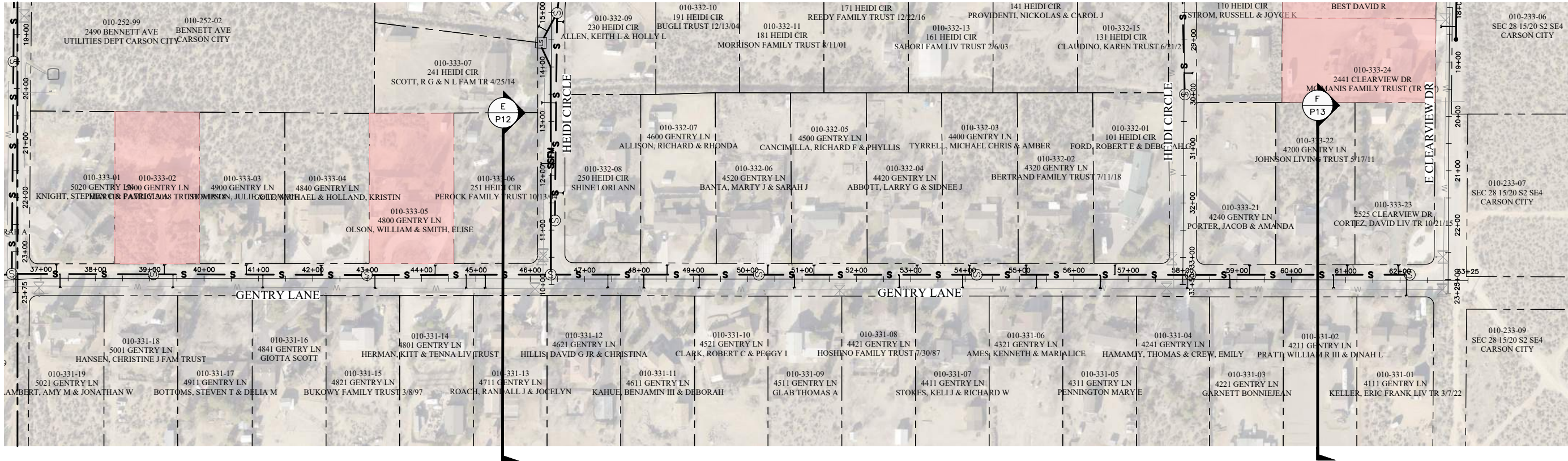
- EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
- ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.

LEGEND:

 LOTS REQUIRING INDIVIDUAL LIFT STATIONS



36+50 MATCHLINE SEE SHT P1



DESIGNED BY: KK
DRAWN BY: ED
CHECKED BY: CL
DWG NO.:
SCALE (HORIZ): AS SHOWN
SCALE (VERT): AS SHOWN
PLOT DATE: 6/23/22

CARSON CITY PUBLIC WORKS DEPARTMENT
3505 BUTTI WAY
CARSON CITY, NEVADA 89701
PH: 887-2355 FAX: 887-2112

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REV.	DATE	DESCRIPTION	BY	APP'D

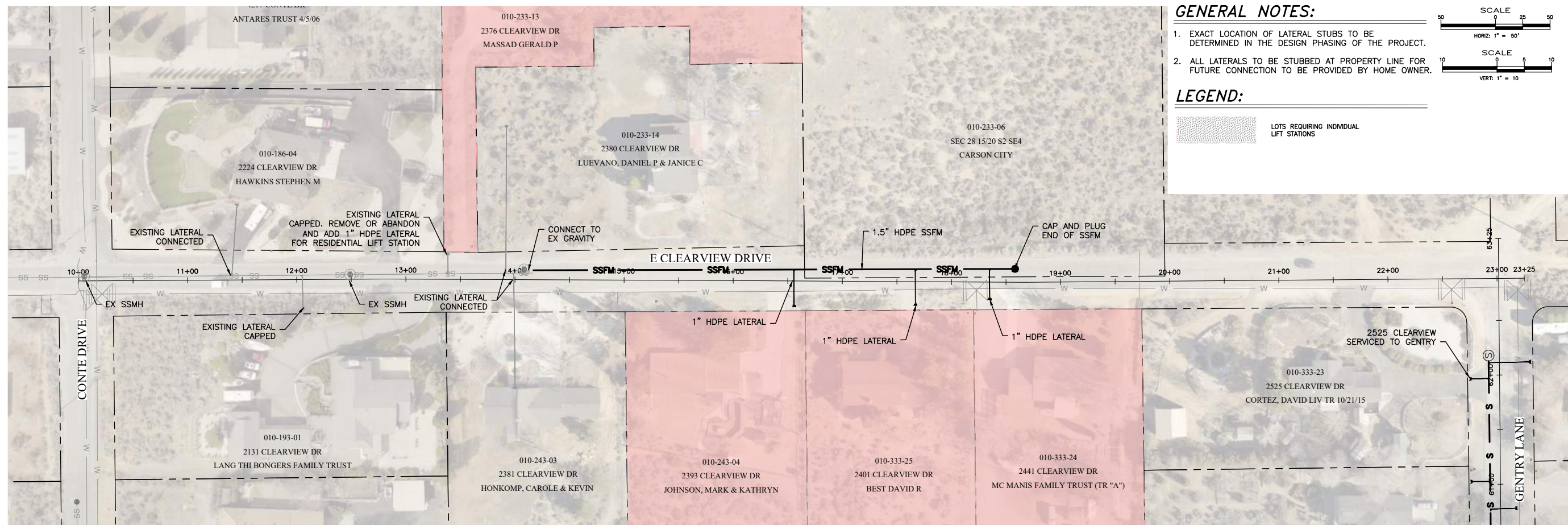
CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10
GENTRY LANE PLAN AND PROFILE
STA 36+50 to STA 63+00

SHEET **P2** OF **24**

PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

P:\Client Projects\Carson City of 115\1918 Carson City - SE Mandatory Sewer Extension Project - Phase 9, 10, and 12\5.0 Drawings\22 DWG\22.9 SHEET FILES\2193_P1-P7-PLAN AND PROFILE.dwg, edwin, 6/23/22

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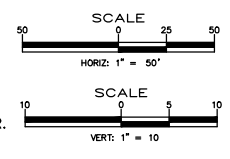


GENERAL NOTES:

1. EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
2. ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.

LEGEND:

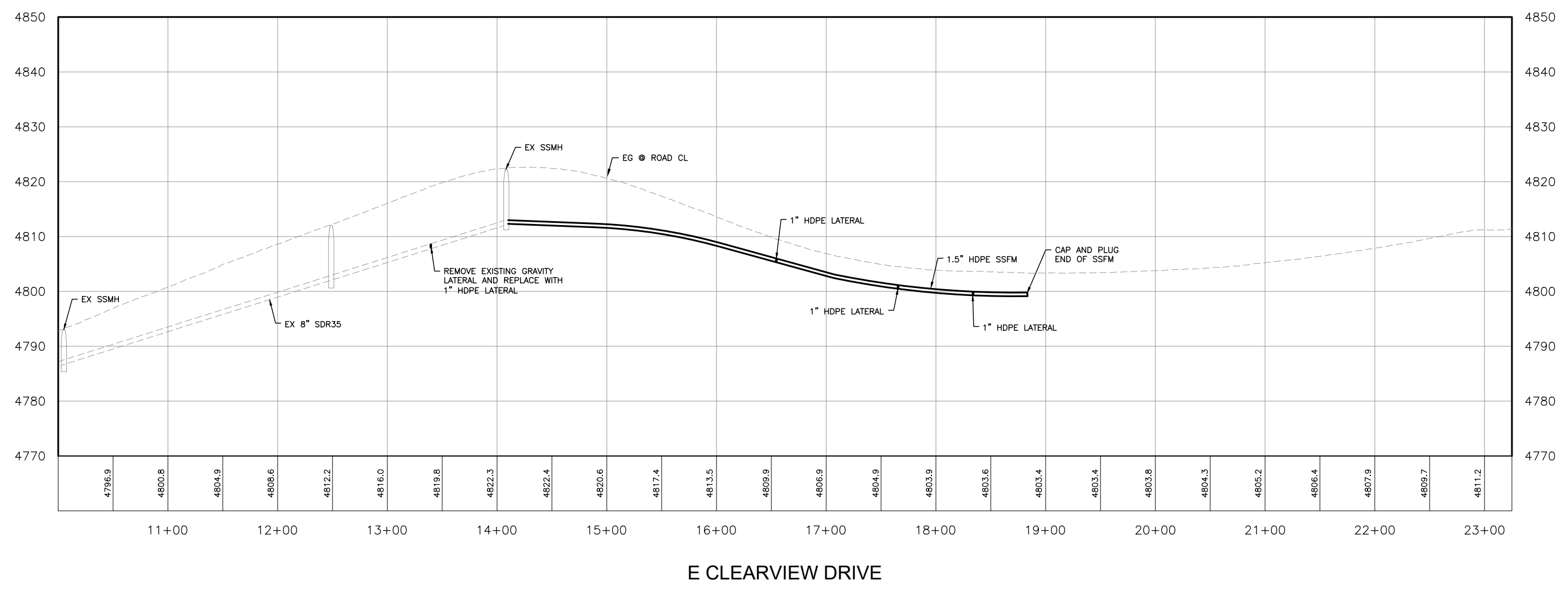
LOTS REQUIRING INDIVIDUAL LIFT STATIONS



DESIGNED BY: KKK
 DRAWN BY: ED
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REV.	DATE	DESCRIPTION	BY	APP'D

CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 E CLEARVIEW DRIVE PLAN AND PROFILE STA 10+00 to STA 23+00

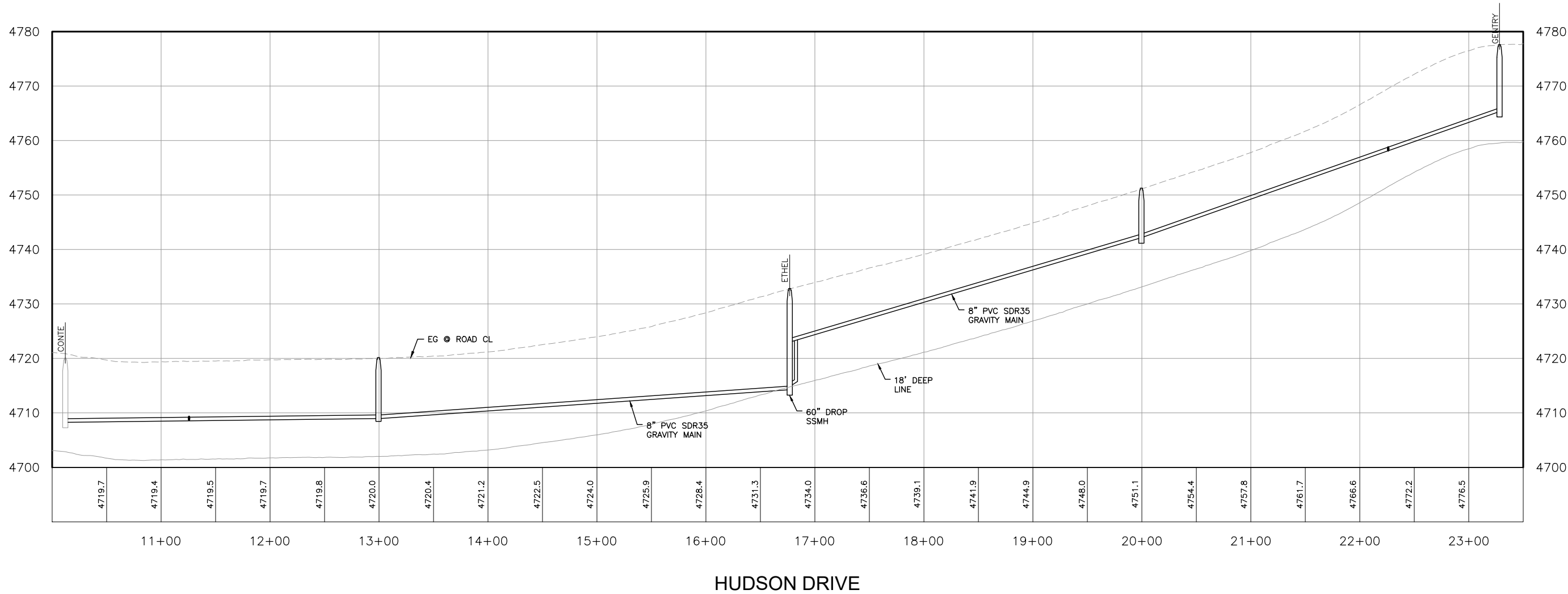
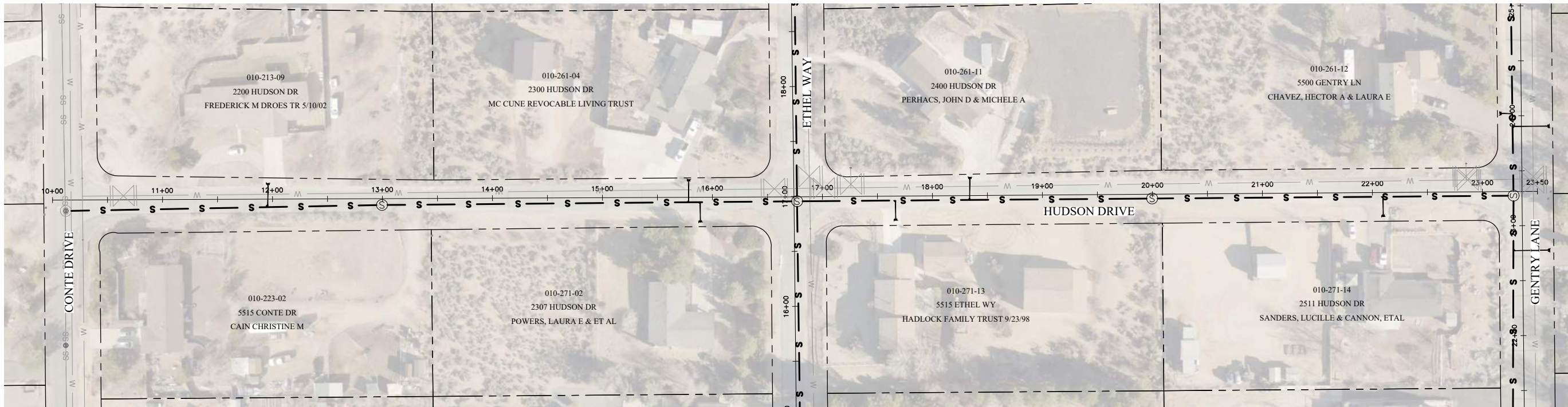
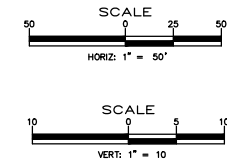
PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

GENERAL NOTES:

1. EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
2. ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.

LEGEND:

 LOTS REQUIRING INDIVIDUAL LIFT STATIONS



DESIGNED BY: KKK
 DRAWN BY: ED
 CHECKED BY: CL
 DWG NO.:
 SCALE (HORIZ): AS SHOWN
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REV.	DATE	DESCRIPTION	BY	APP'D

CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 HUDSON DRIVE PLAN AND PROFILE STA 10+00 to STA 23+50

SHEET **P4** OF **24**

PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

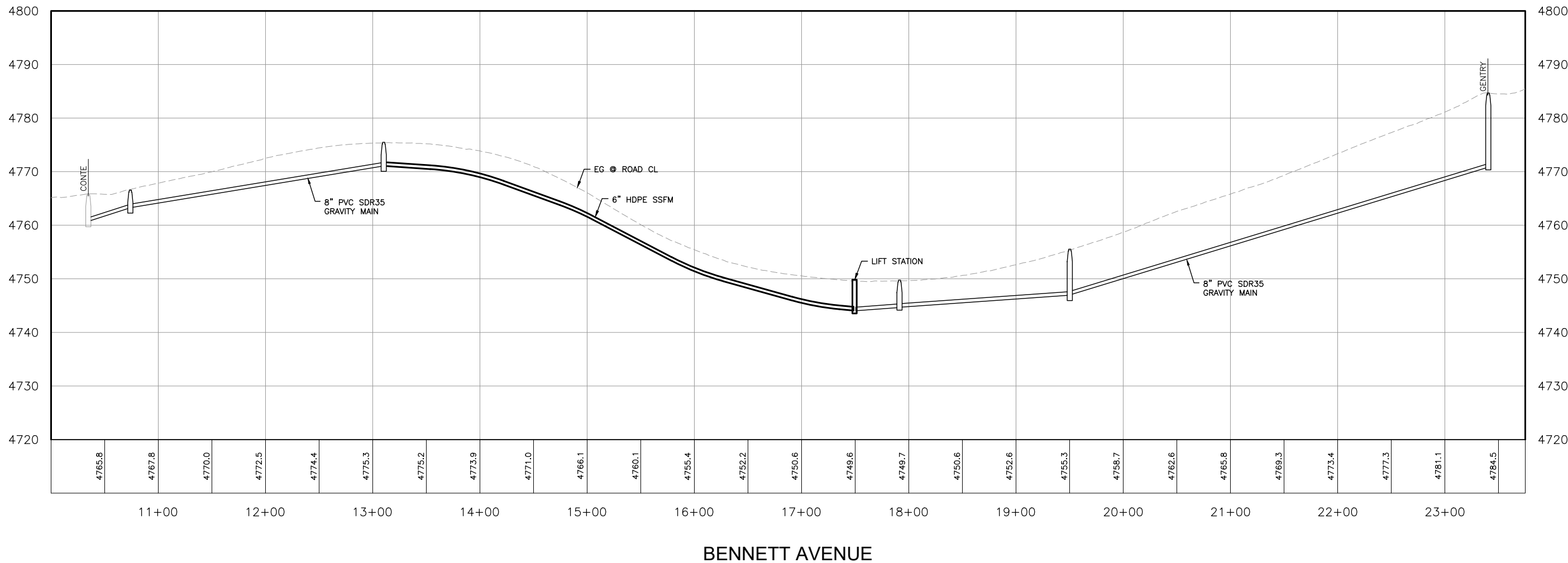
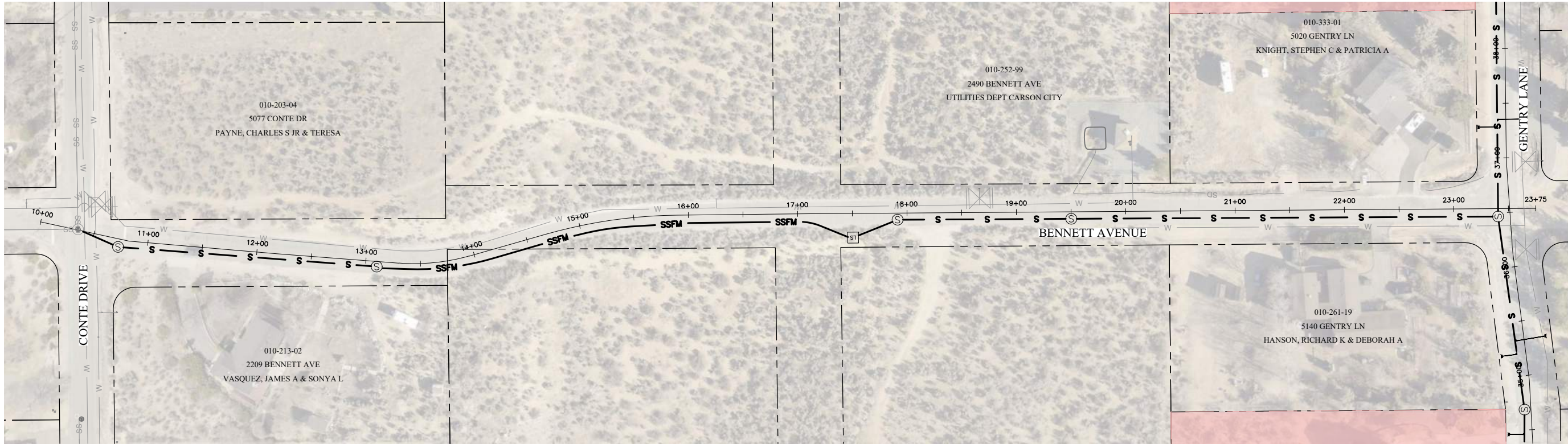
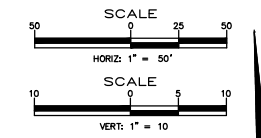
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GENERAL NOTES:

- EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
- ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.

LEGEND:

 LOTS REQUIRING INDIVIDUAL LIFT STATIONS



DESIGNED BY: KKK
 DRAWN BY: ED
 CHECKED BY: CL
 DWG NO.:
 SCALE (HORIZ): AS SHOWN
 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

CARSON CITY PUBLIC WORKS DEPARTMENT
 3505 BUTTI WAY
 CARSON CITY, NEVADA 89701
 PH: 887-2355 FAX: 887-2112

FARR WEST ENGINEERING
 5510 LONGLEY LANE
 RENO, NEVADA 89511
 PHONE: (775) 851-4788
 billing@farrwestengineering.com-USA

REV.	DATE	DESCRIPTION	BY	APP'D

CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 BENNETT AVENUE PLAN AND PROFILE STA 10+00 to STA 23+75

SHEET **P5** OF **24**

PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

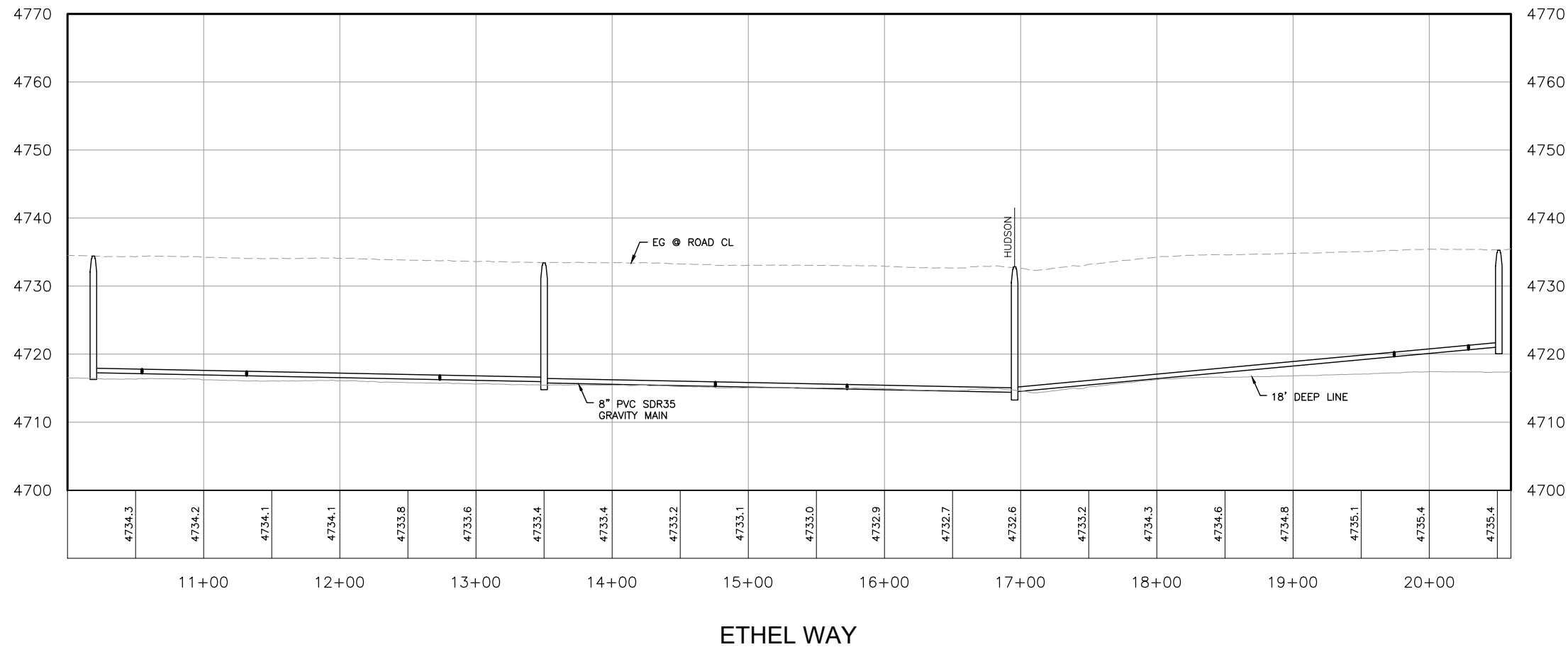
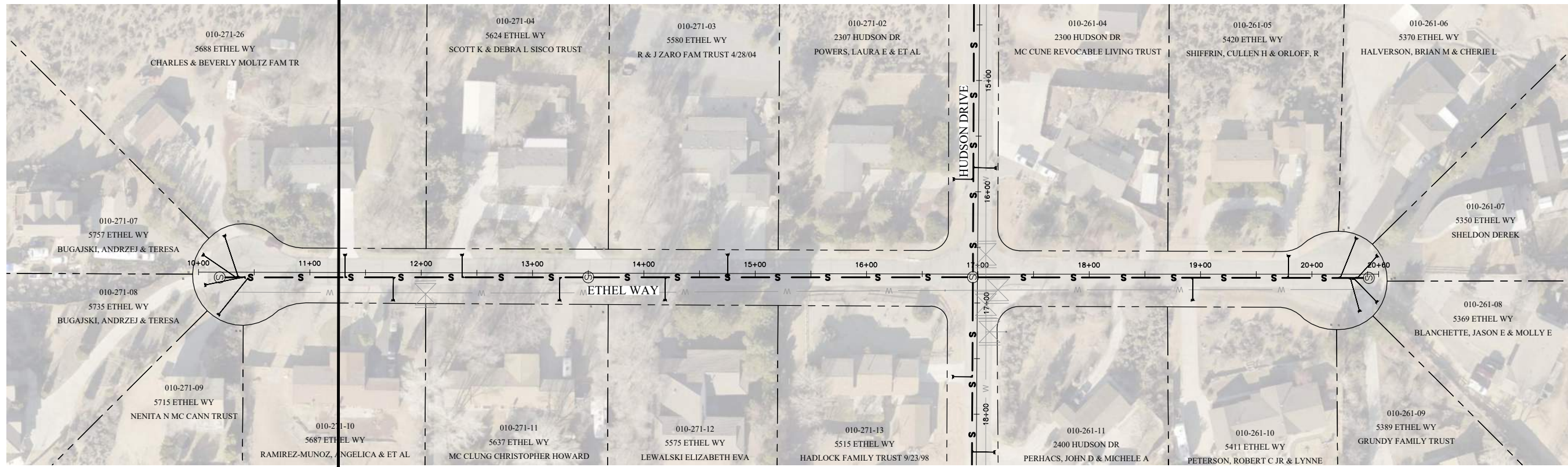
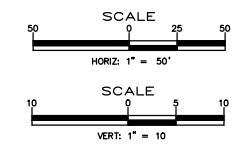
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GENERAL NOTES:

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2. ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.

LEGEND:

 LOTS REQUIRING INDIVIDUAL LIFT STATIONS



DESIGNED BY: KKK
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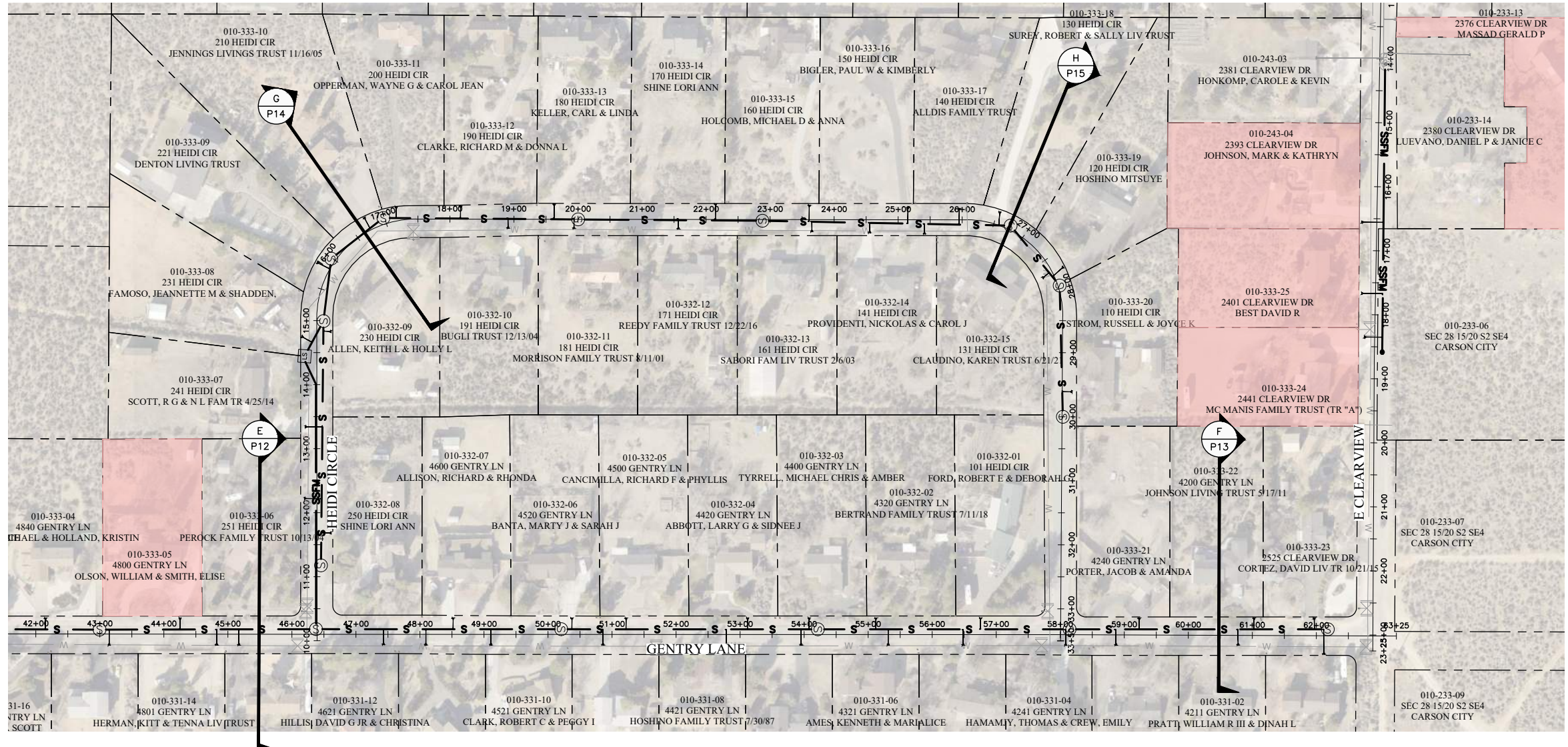
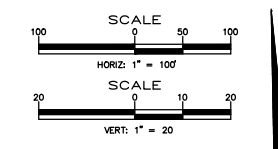
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ETHEL WAY
PLAN AND PROFILE
STA 10+00 to STA 20+60

SHEET
P6
 OF
24

PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

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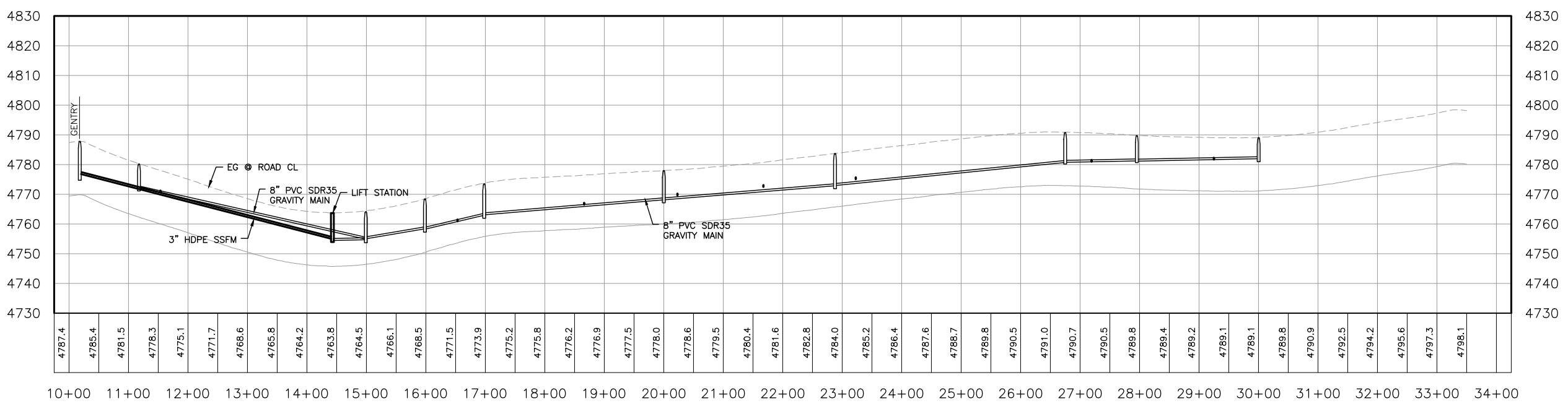
LEGEND:

[Symbol] LOTS REQUIRING INDIVIDUAL LIFT STATIONS

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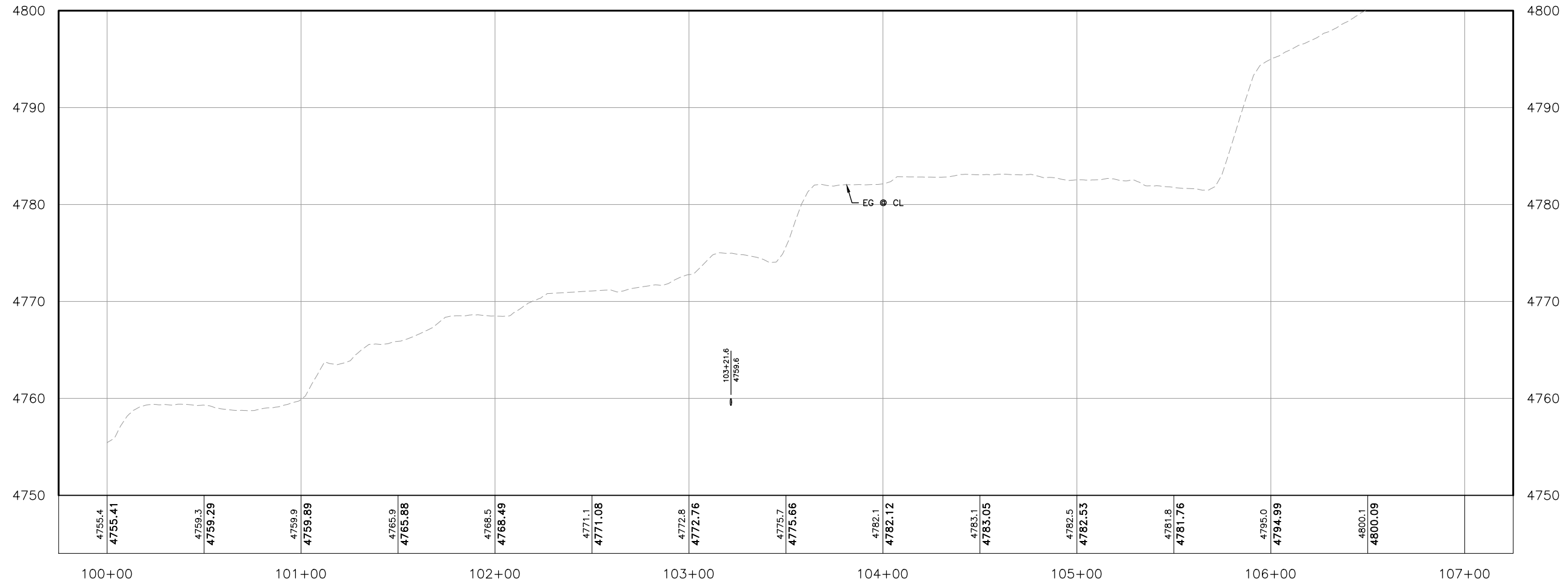
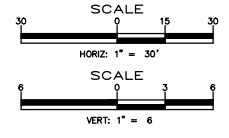


HEIDI CIRCLE

CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 HEIDI CIRCLE PLAN AND PROFILE STA 10+00 to STA 33+50

PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

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CROSS SECTION A

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 DRAWN BY: ED
 CHECKED BY: CL
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 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

CARSON CITY PUBLIC WORKS DEPARTMENT
 3505 BUTTI WAY
 CARSON CITY, NEVADA 89701
 PH: 887-2355 FAX: 887-2112

FARR WEST ENGINEERING
 5510 LONGLEY LANE
 RENO, NEVADA 89511
 PHONE: (775) 851-4788
 billing@farrwestengineering.com-USA

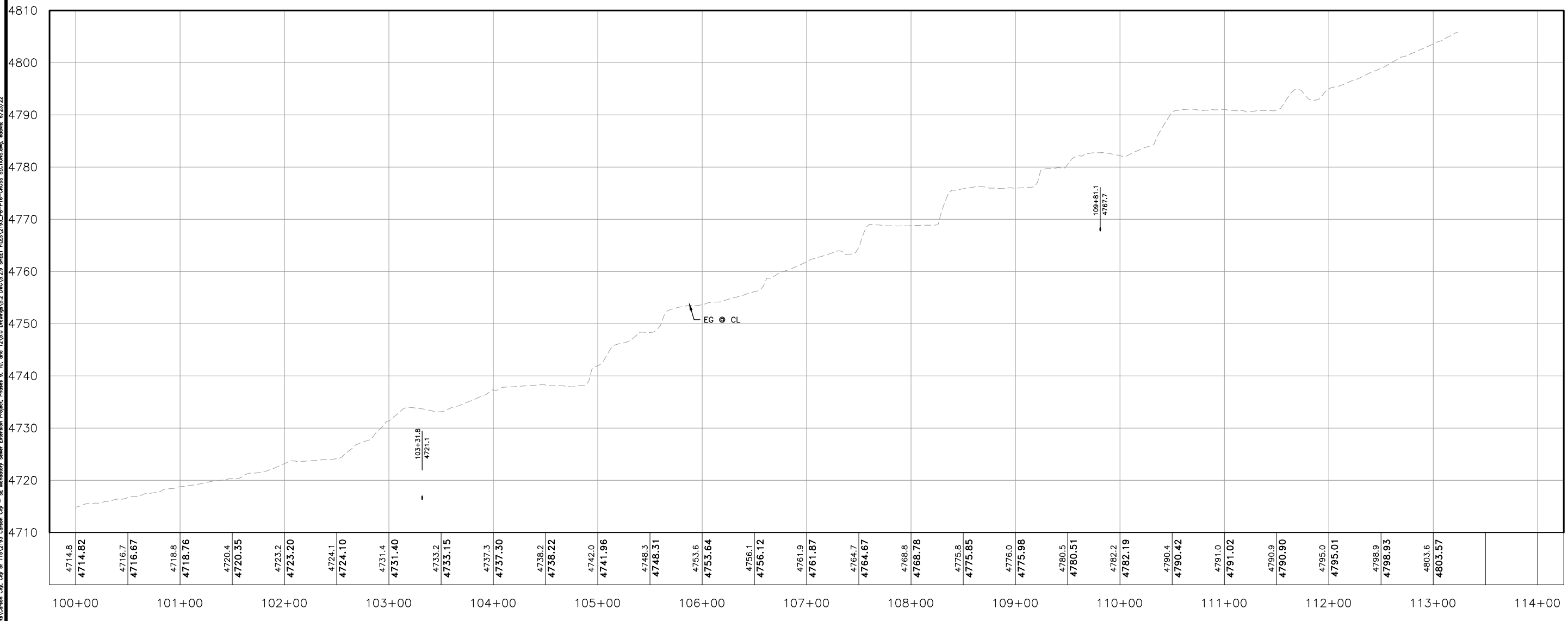
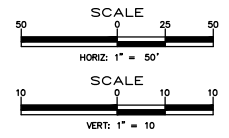
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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 GENTRY LANE CROSS SECTION

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PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

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DESIGNED BY: KKK
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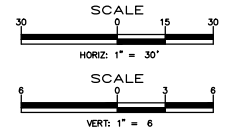
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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10
ETHEL WAY AND GENTRY LANE CROSS SECTION

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PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

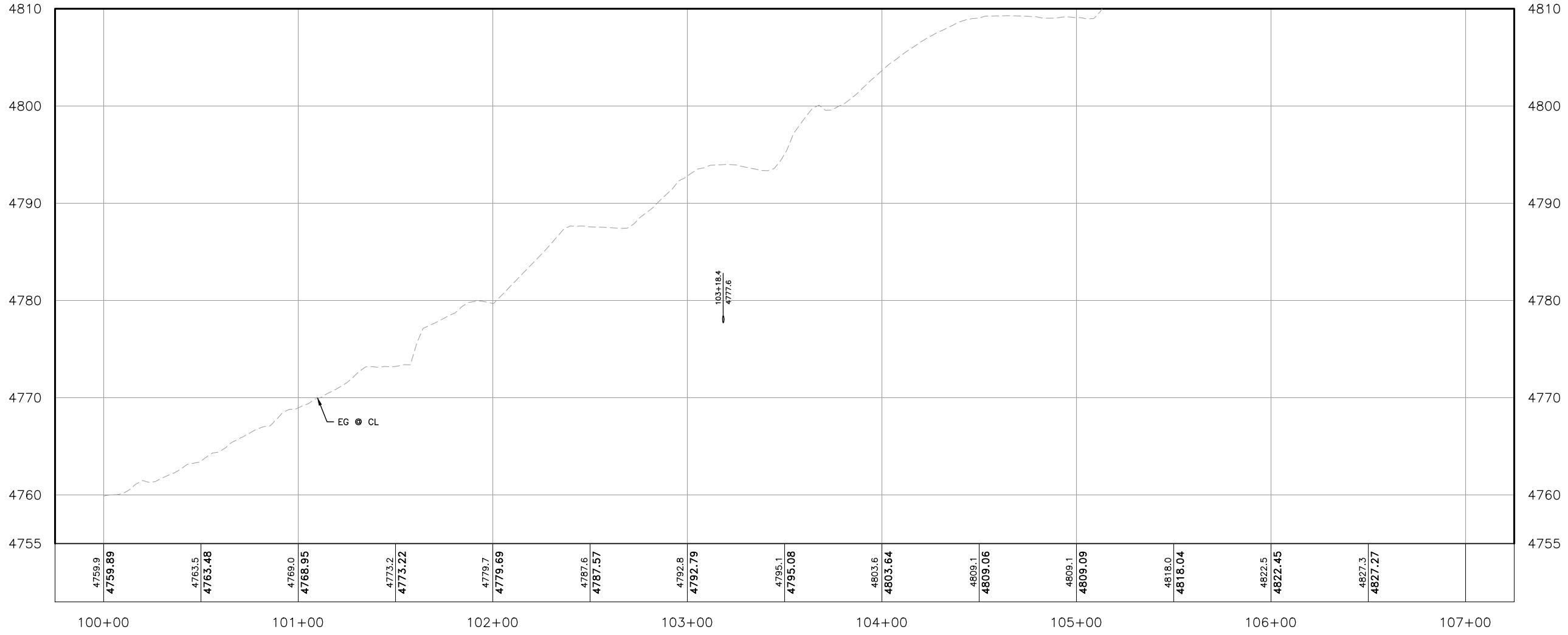
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 DRAWN BY: ED
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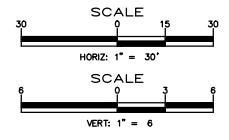
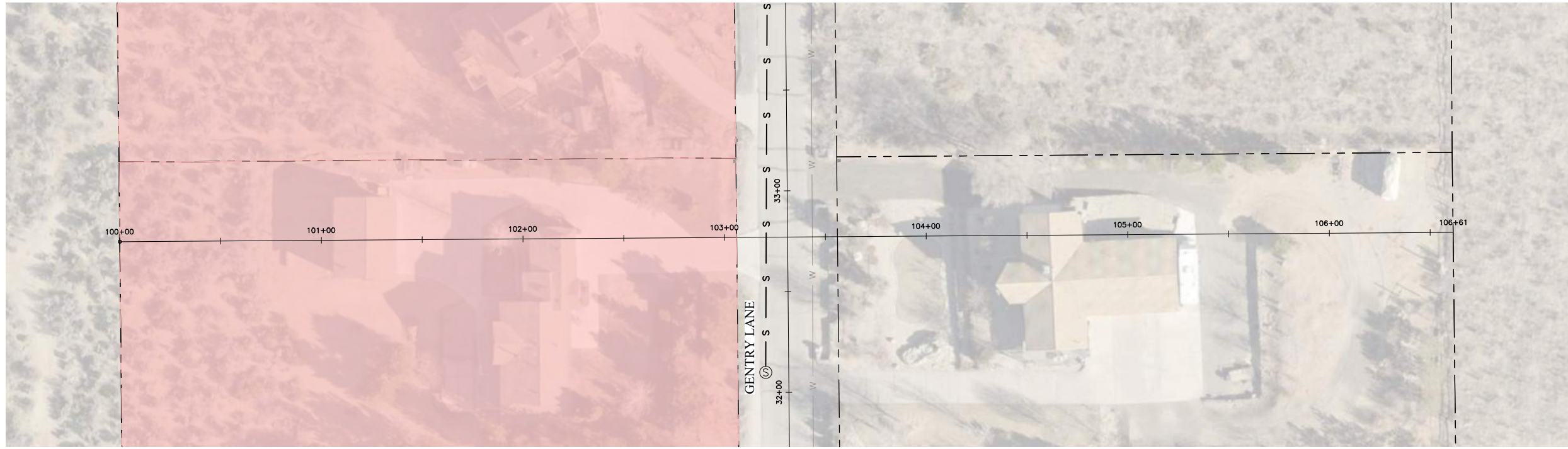
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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 GENTRY LANE CROSS SECTION

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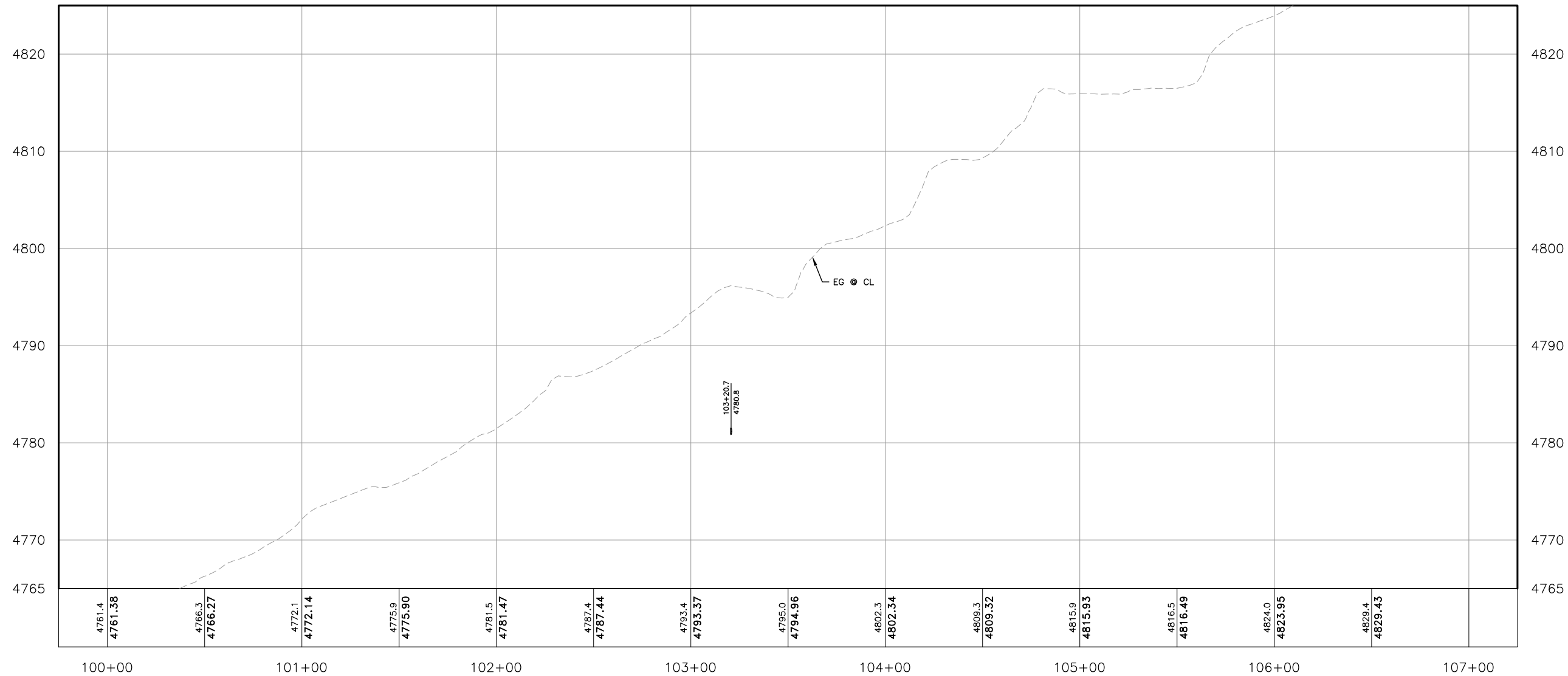
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DESIGNED BY: KKK
 DRAWN BY: ED
 CHECKED BY: CL
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 SCALE (HORIZ): AS SHOWN
 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

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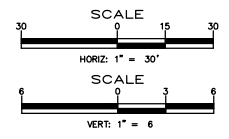
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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 GENTRY LANE CROSS SECTION

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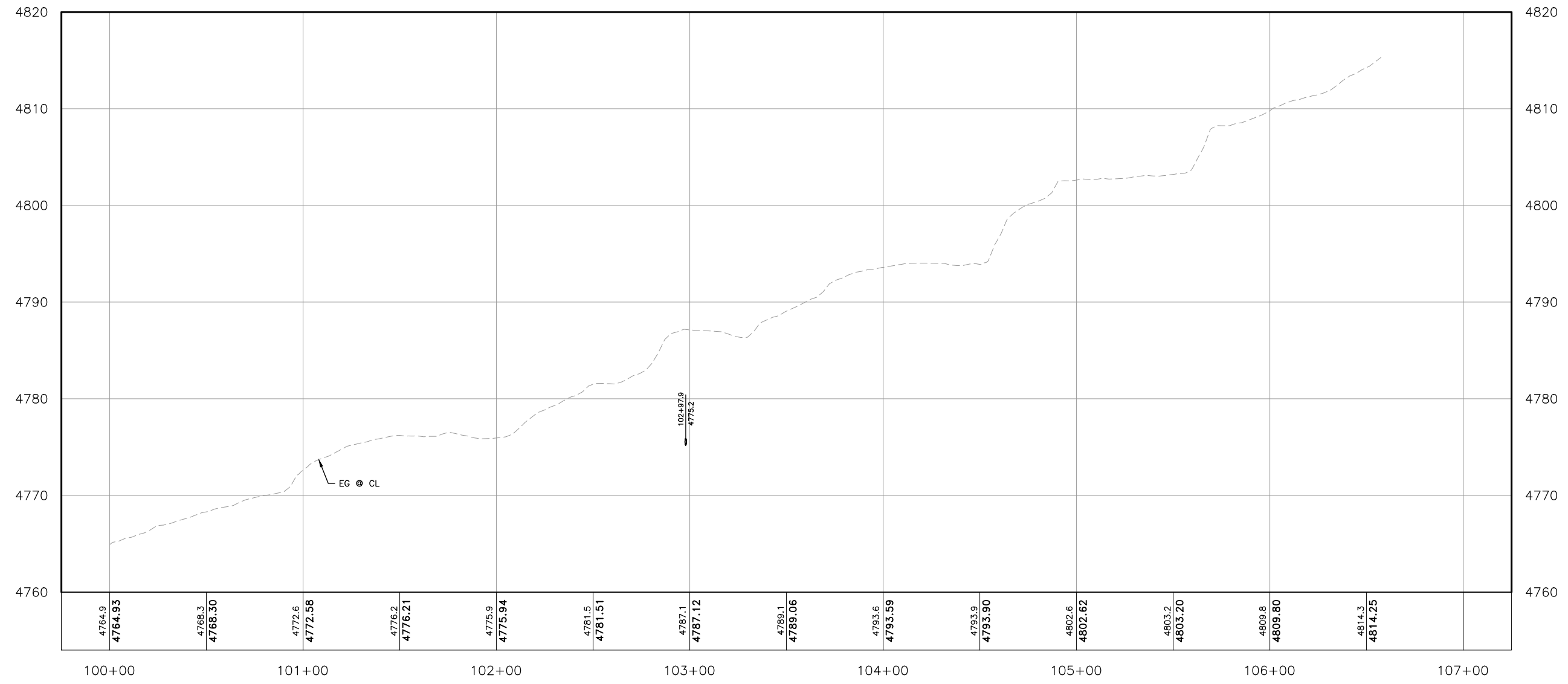
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CARSON CITY PUBLIC WORKS DEPARTMENT
 3505 BUTTI WAY
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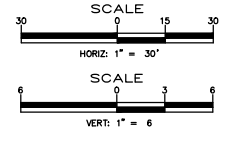
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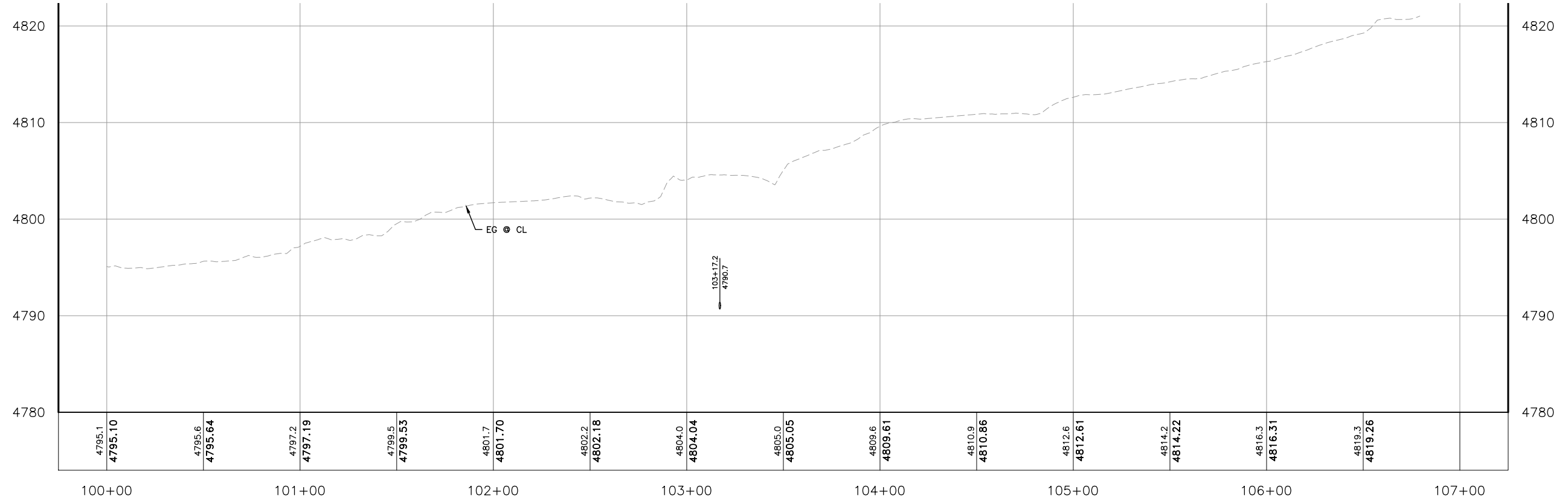
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DESIGNED BY: KKK
 DRAWN BY: ED
 CHECKED BY: CL
 DWG NO.:
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 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

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 RENO, NEVADA 89511
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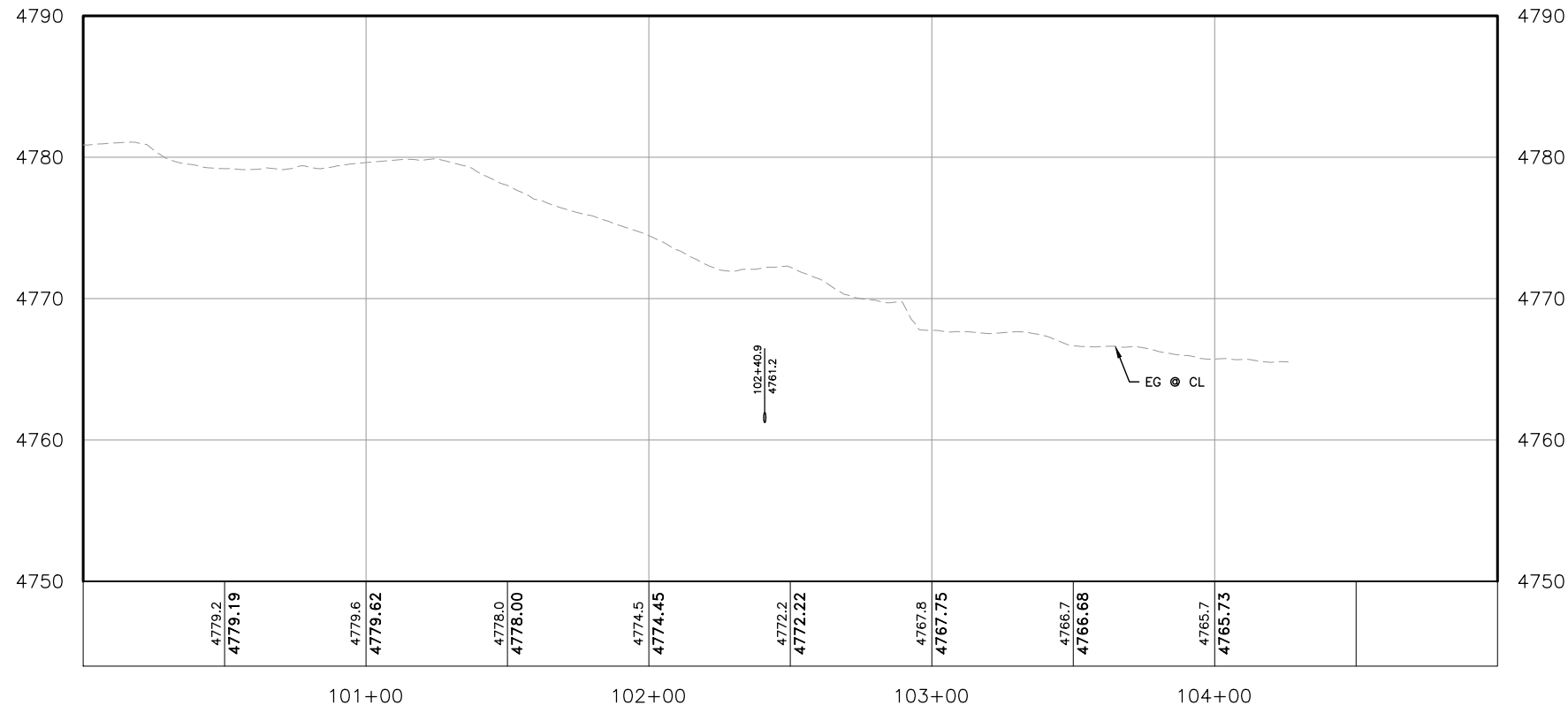
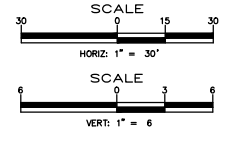
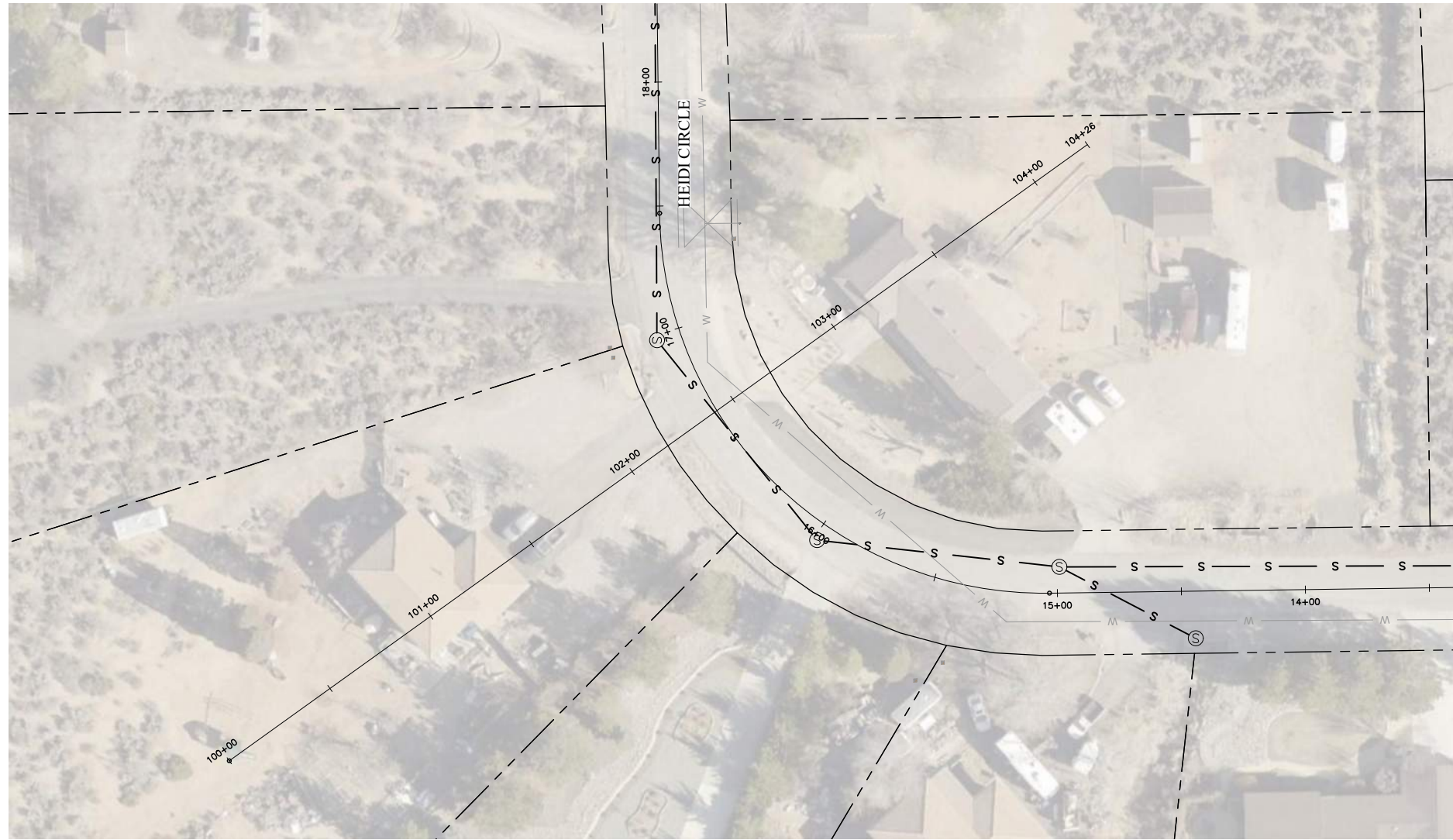
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**CARSON CITY - MANDATORY SEWER
 EXTENSION PROJECT
 PHASE 9 AND 10
 GENTRY LANE
 CROSS SECTION**

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PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

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CROSS SECTION G

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 5510 LONGLEY LANE
 RENO, NEVADA 89511
 PHONE: (775) 851-4788
 billing@farrwestengineering.com-USA

CARSON CITY PUBLIC WORKS DEPARTMENT
 3505 BUTTI WAY
 CARSON CITY, NEVADA 89701
 PH: 887-2355 FAX: 887-2112

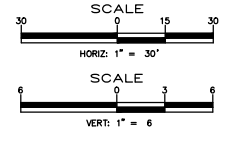
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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 HEIDI CIRCLE CROSS SECTION

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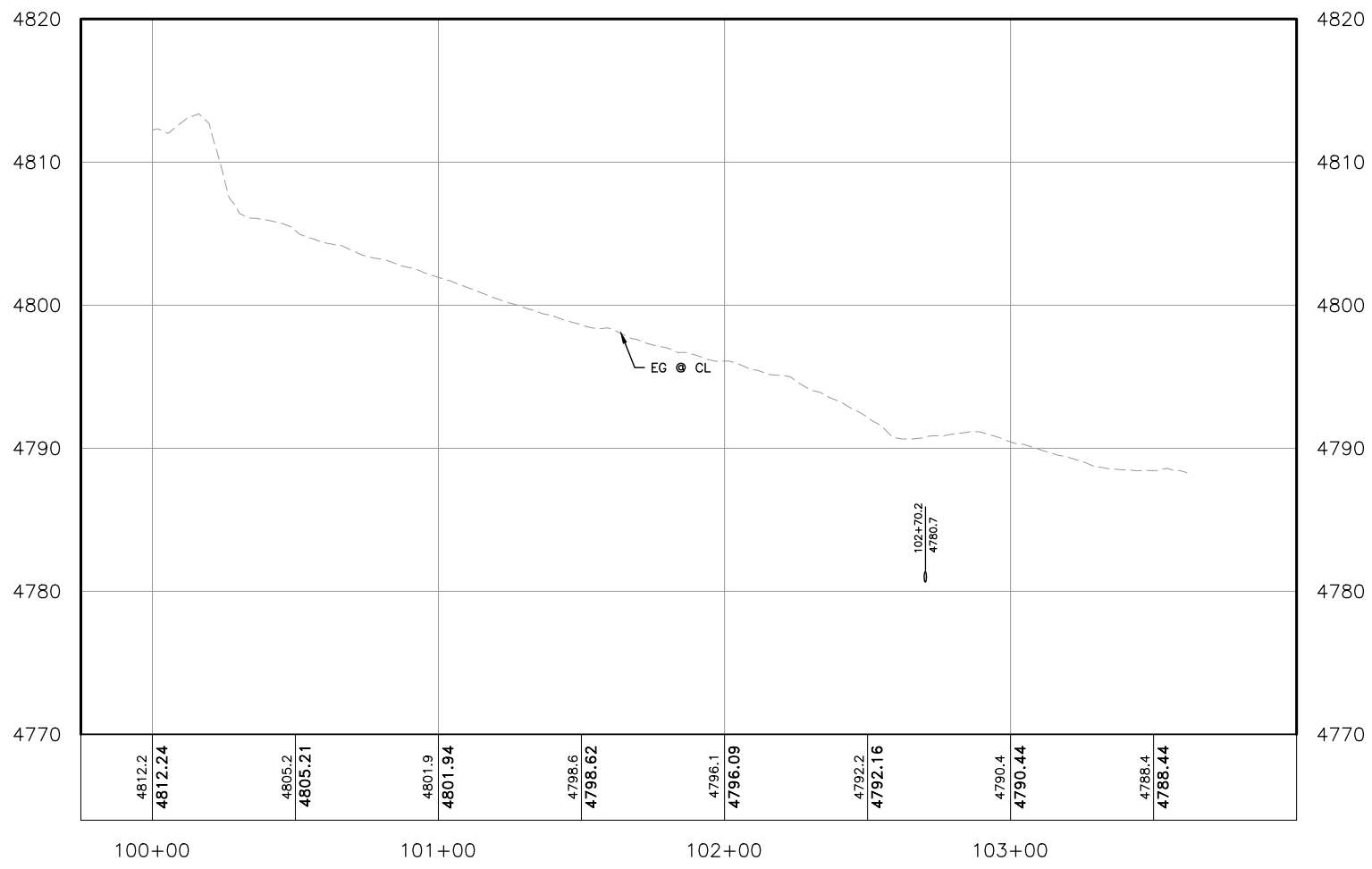
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SCALE (VERT): AS SHOWN
PLOT DATE: 6/23/22

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RENO, NEVADA 89511
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billing@farrwestengineering.com-USA



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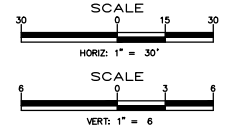
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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 HEIDI CIRCLE CROSS SECTION

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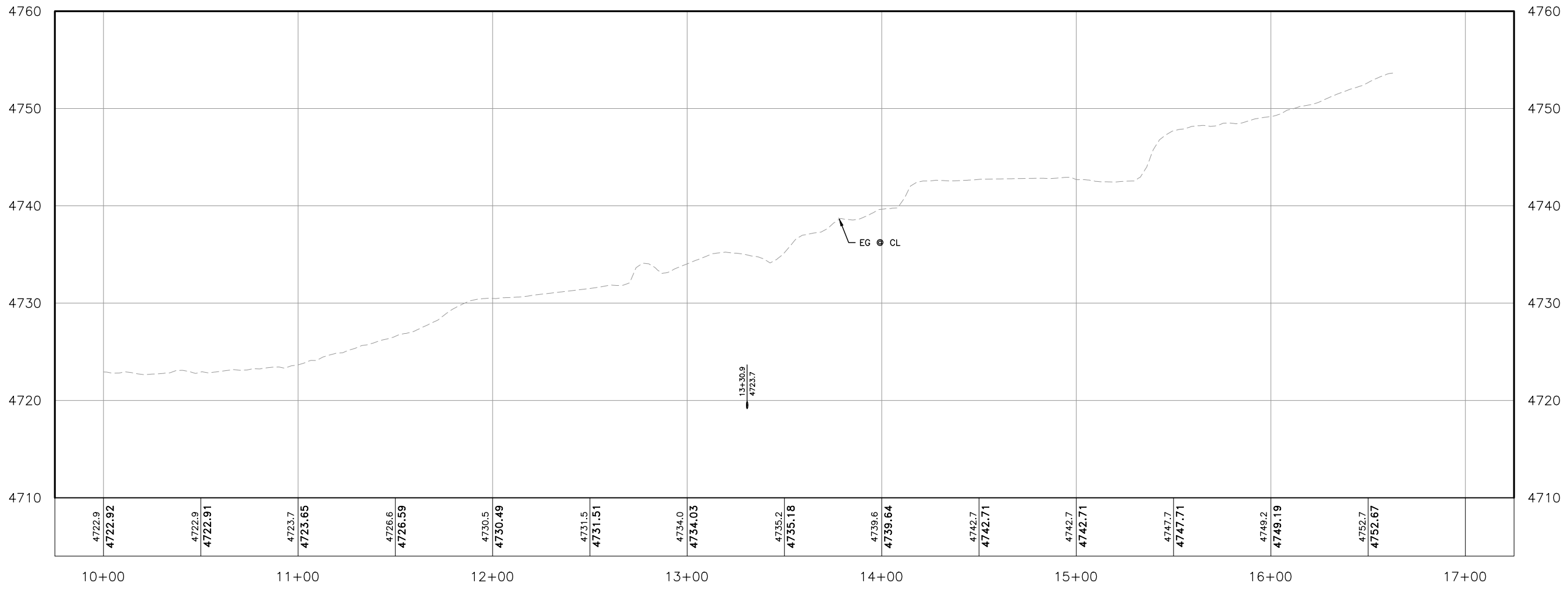
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DESIGNED BY: KKK
 DRAWN BY: ED
 CHECKED BY: CL
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 SCALE (HORIZ): AS SHOWN
 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

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 3505 BUTTI WAY
 CARSON CITY, NEVADA 89701
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CROSS SECTION I

REV.	DATE	DESCRIPTION	BY	APP'D

CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10
ETHEL WAY
CROSS SECTION

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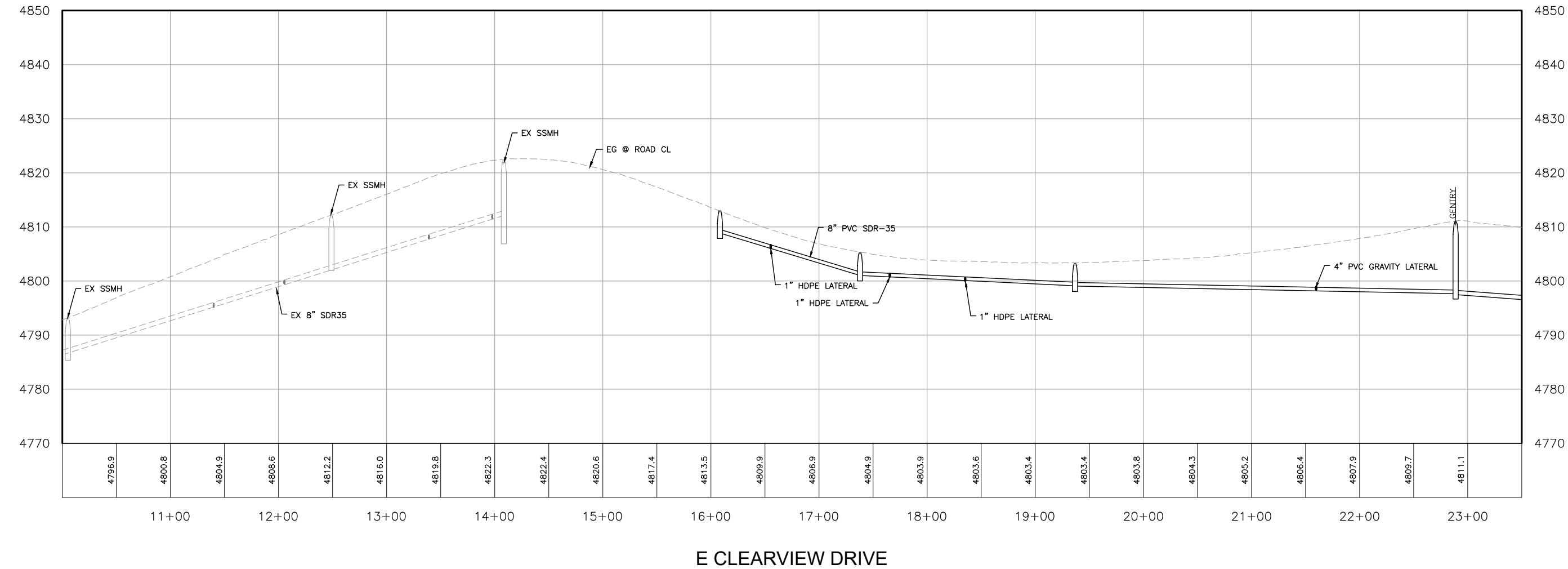
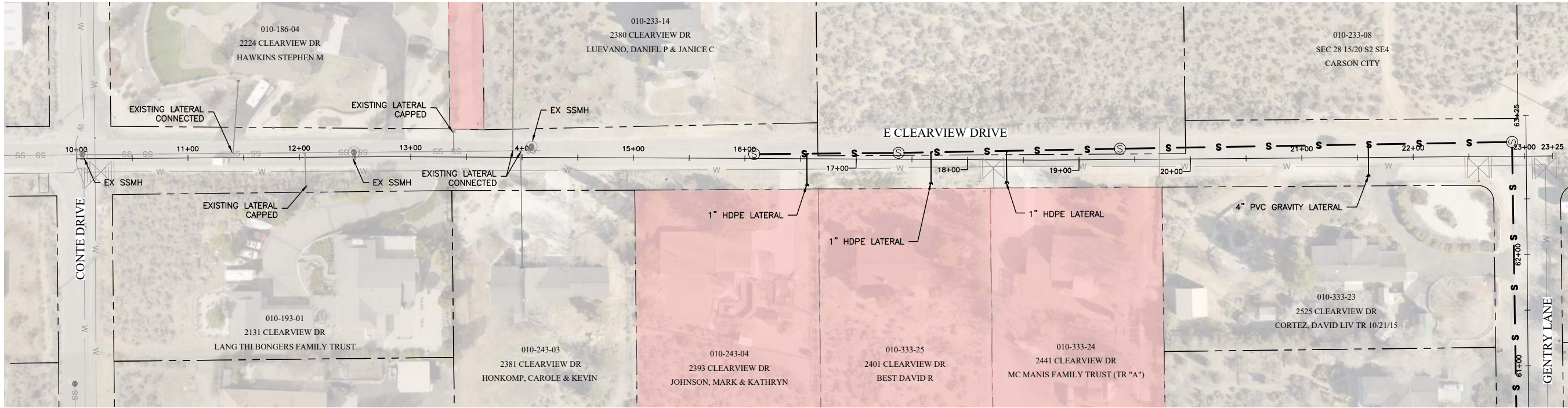
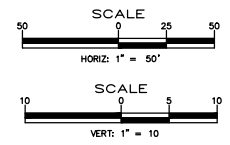
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GENERAL NOTES:

1. EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
2. ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.

LEGEND:

LOTS REQUIRING INDIVIDUAL LIFT STATIONS



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 DRAWN BY: ED
 CHECKED BY: CL
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 SCALE (HORIZ): AS SHOWN
 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

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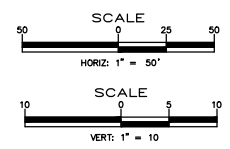
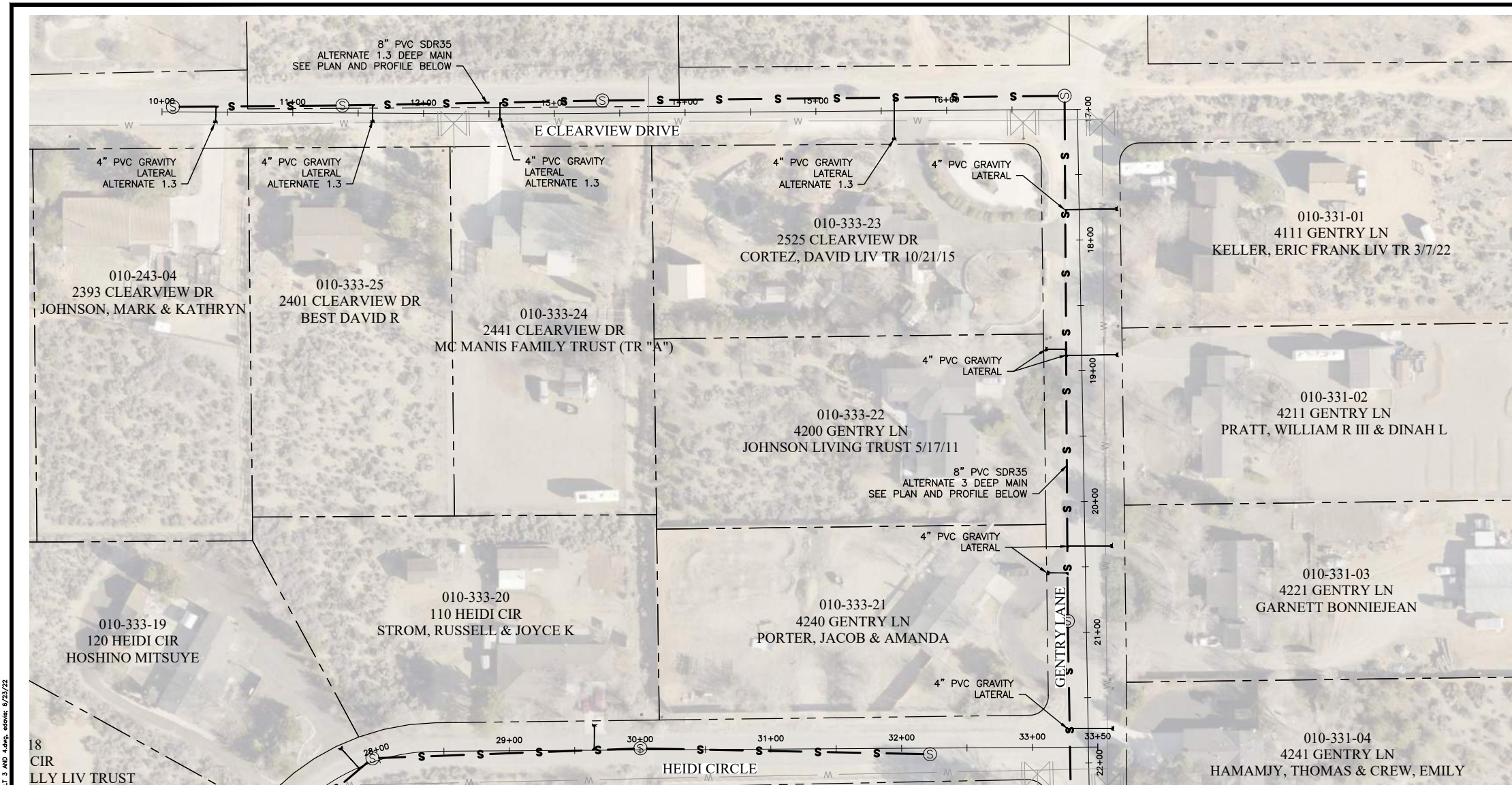
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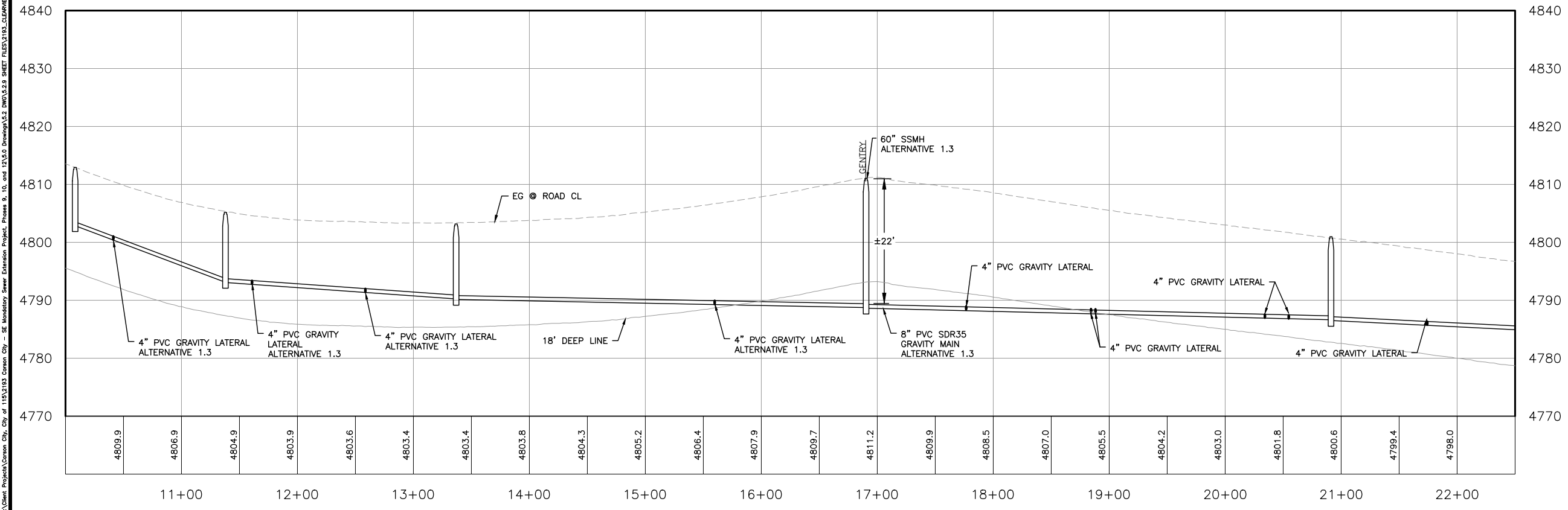
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GENERAL NOTES:

1. EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
2. ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.



DESIGNED BY: KK
 DRAWN BY: ED
 CHECKED BY: CL
 DWG NO.:
 SCALE (HORIZ): AS SHOWN
 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

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 3505 BUTTI WAY
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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 9 AND 10 E CLEARVIEW DRIVE PLAN AND PROFILE ZONE D ALTERNATIVES 1.3

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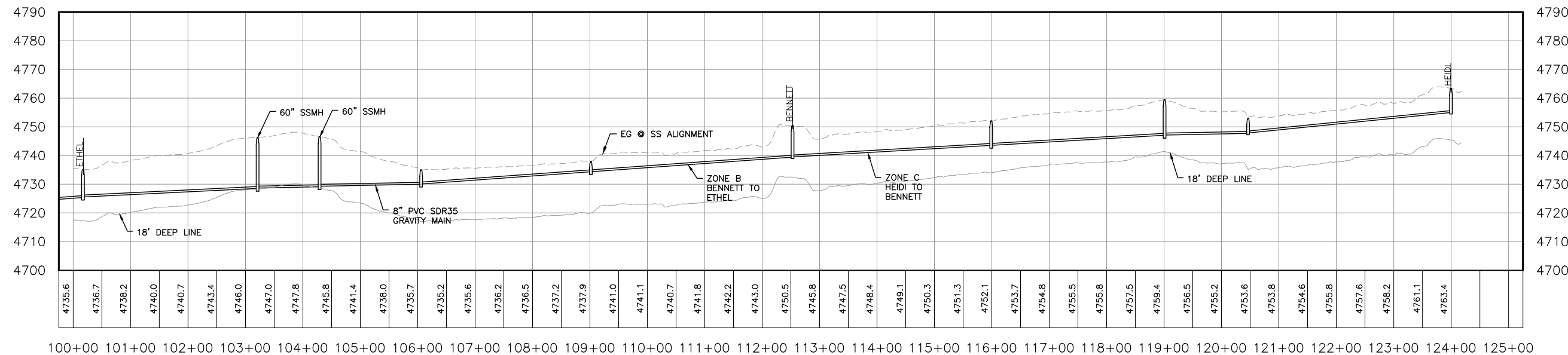
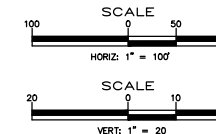
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GENERAL NOTES:

1. EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
2. ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.

LEGEND:



HEIDI CIRCLE TO ETHEL WAY

DESIGNED BY: KCK
 DRAWN BY: ED
 CHECKED BY: CL
 DWG NO.:
 SCALE (HORIZ): AS SHOWN
 SCALE (VERT): AS SHOWN
 PLOT DATE: 6/23/22

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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT
PHASE 9 AND 10
BENNETT AND HEIDI LIFT STATIONS
ZONES B & C ALTERNATIVES 1.2

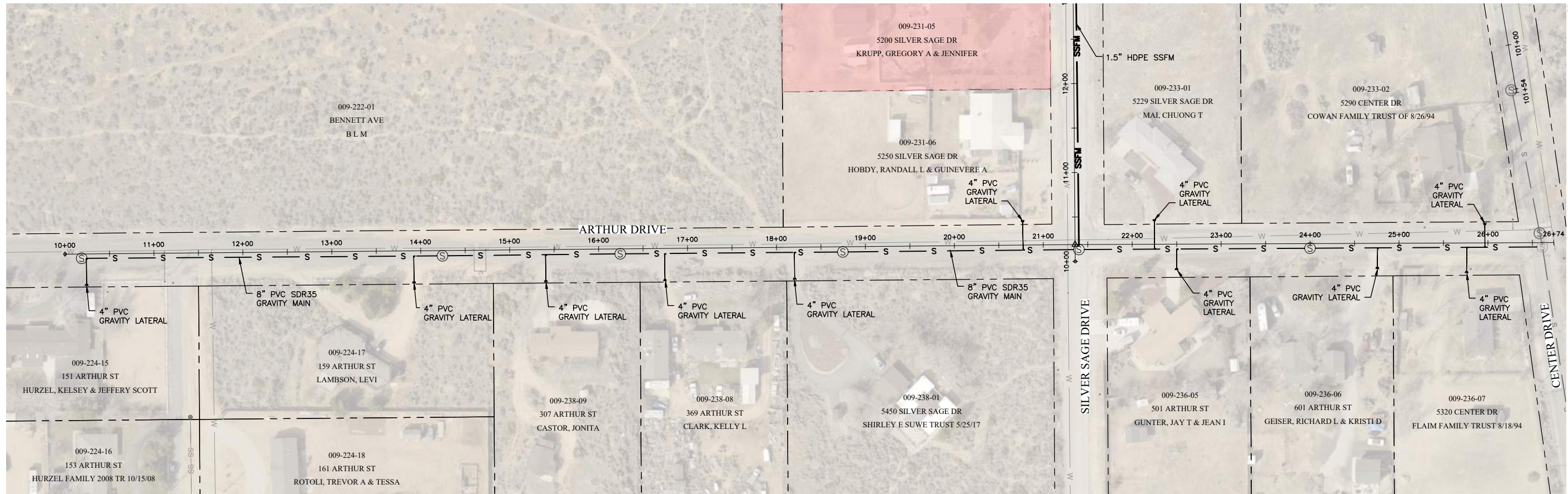
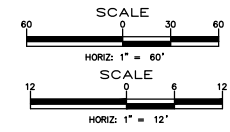
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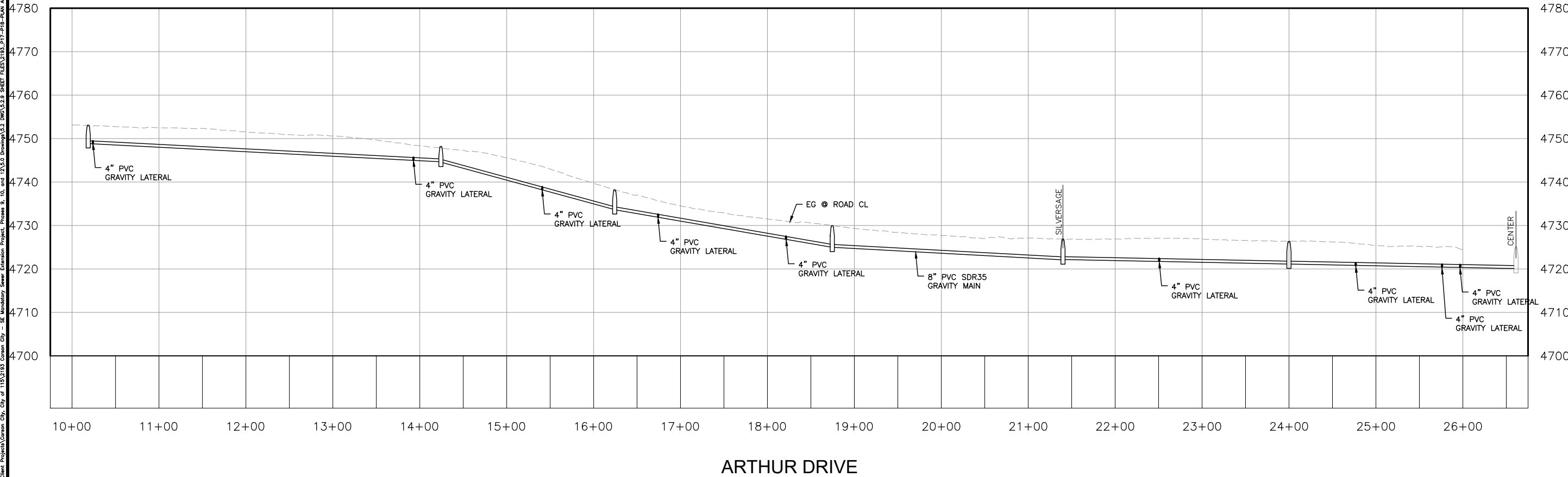
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GENERAL NOTES:

1. EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
2. ALL LATERALS TO BE STUBBED AT PROPERTY LINE FOR FUTURE CONNECTION TO BE PROVIDED BY HOME OWNER.



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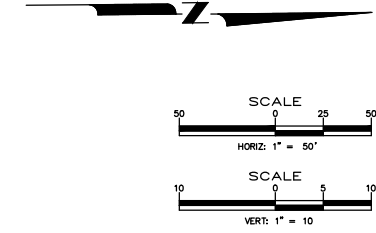
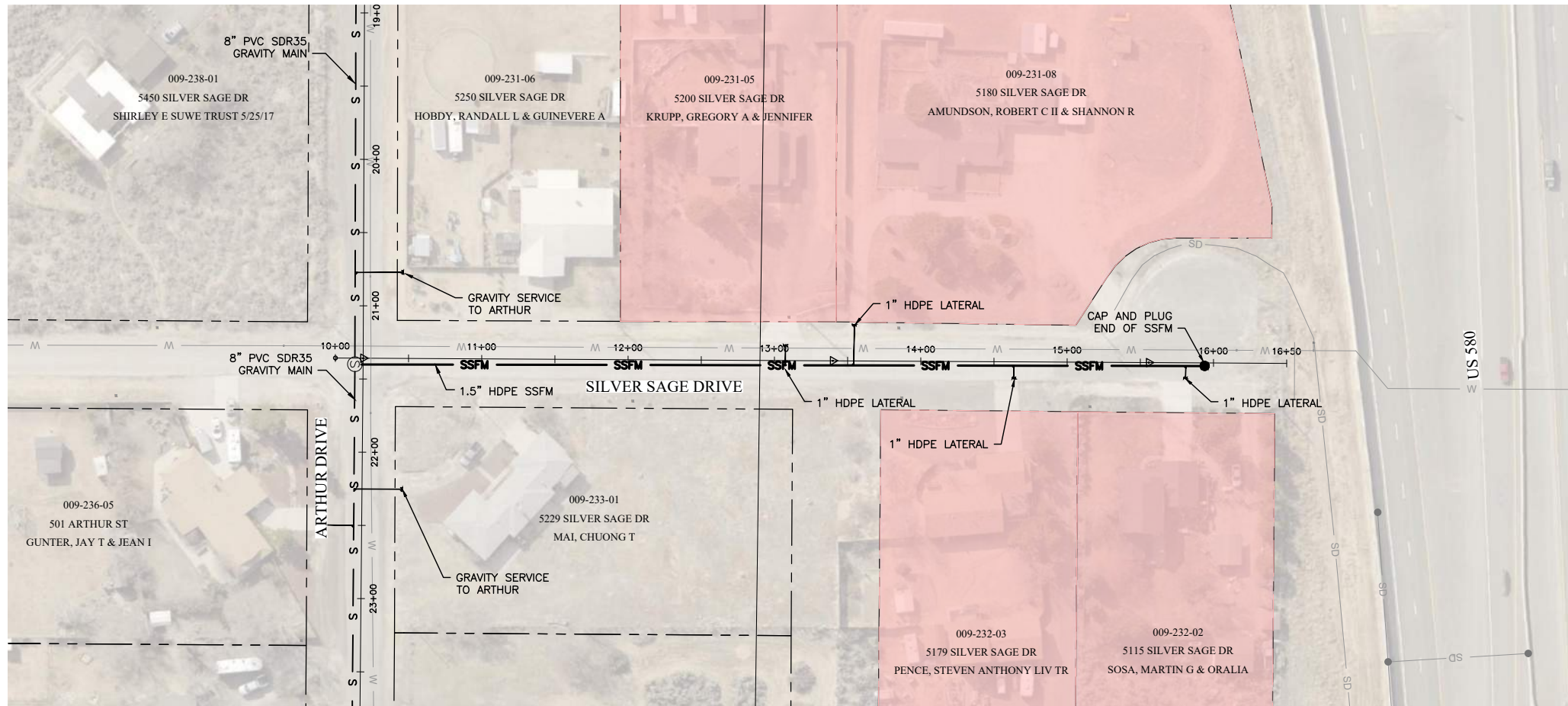
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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT PHASE 12 ARTHUR DRIVE PLAN AND PROFILE STA 10+00 to STA 26+75

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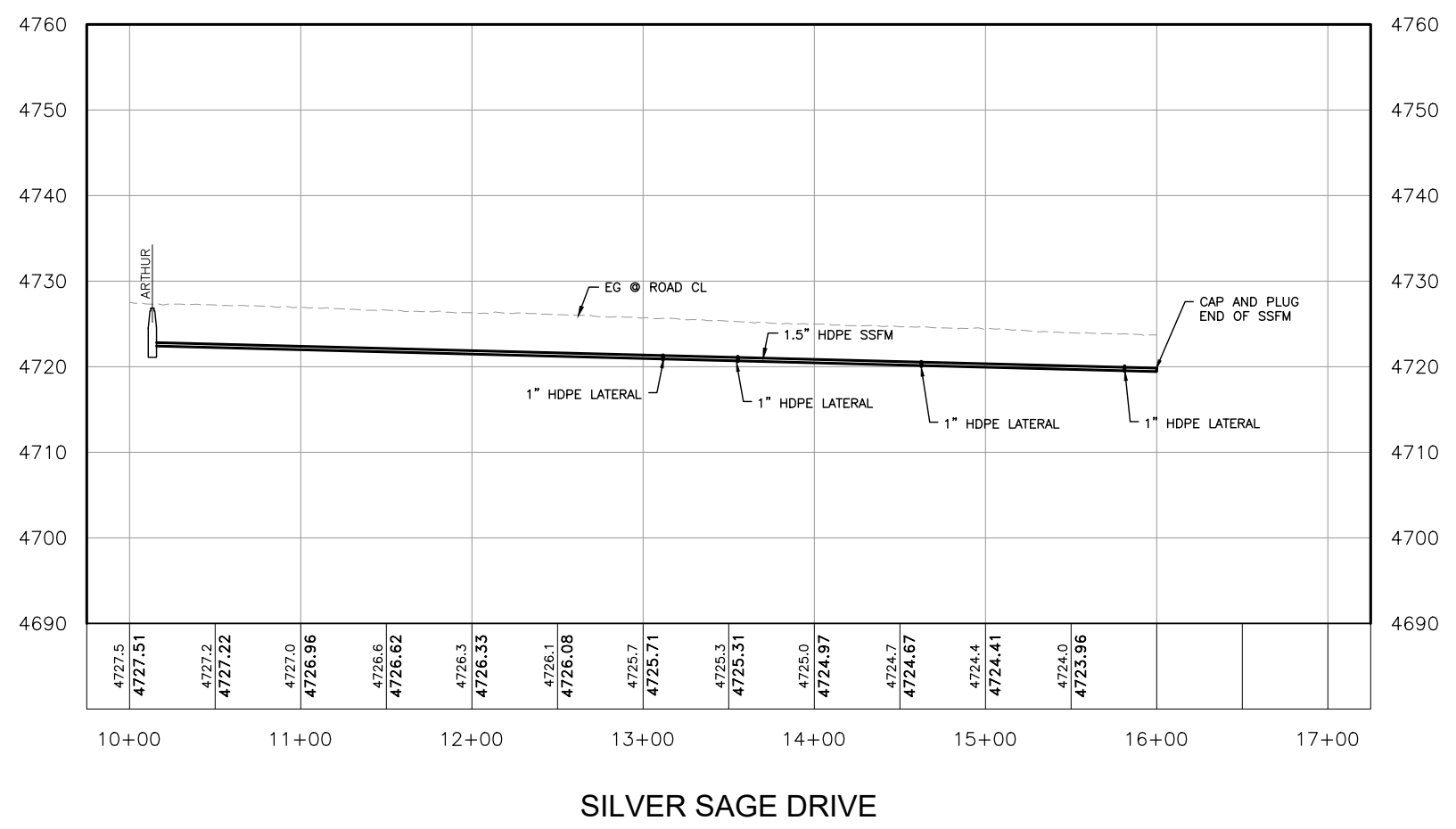
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GENERAL NOTES:

1. EXACT LOCATION OF LATERAL STUBS TO BE DETERMINED IN THE DESIGN PHASING OF THE PROJECT.
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 PH: 887-2355 FAX: 887-2112

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 RENO, NEVADA 89511
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CARSON CITY - MANDATORY SEWER EXTENSION PROJECT
PHASE 12
SILVER SAGE DRIVE
PLAN AND PROFILE
STA 10+00 to STA 16+50

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PRELIMINARY ENGINEERING (NOT FOR CONSTRUCTION)

APPENDIX B

PRELIMINARY COST ESTIMATES

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone A Alternative 1.1
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

ZONE A - ALTERNATIVE 1.1

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 118,252.00	\$ 118,252.00
2	Temporary Traffic Control (2.5%)	1	LS	\$ 59,126.00	\$ 59,126.00
3	Temporary Erosion Control (2.5%)	1	LS	\$ 59,126.00	\$ 59,126.00
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	4,621	LF	\$ 275.00	\$ 1,270,775.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	350	LF	\$ 412.50	\$ 144,375.00
6	48" Manhole	14	EA	\$ 12,000.00	\$ 168,000.00
7	60" Manhole	0	EA	\$ 16,000.00	\$ -
8	Pavement Restoration	4,971	LF	\$ 90.00	\$ 447,390.00
9	1.5" HDPE DR 11 Sanitary Sewer Force Main	0	LF	\$ 75.00	\$ -
10	1" HDPE Residential Force Main Lateral Stub	4	EA	\$ 3,000.00	\$ 12,000.00
11	4" PVC Residential Gravity Lateral Stub	43	EA	\$ 7,500.00	\$ 322,500.00
12	Municipal Lift Station	0	EA	\$ 250,000.00	\$ -
13	12' Wide Access Road w/ 6" Gravel	0	SF	\$ 1.50	\$ -
14	Property Easements	0	SF	\$ 5.00	\$ -

Construction Subtotal: \$ 2,601,544.00
30% Contingency: \$780,463.20
Design and CM: \$390,231.60
Base Bid Total: \$ 3,772,238.80

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone B Alternative 1.1
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
Project No. 2193
Date: 08/02/22
QC Check by: Keith Karpstein
Date: 08/02/22

ZONE B - ALTERNATIVE 1.1

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 112,028.75	\$ 112,028.75
2	Temporary Traffic Control (2.5%)	1	LS	\$ 56,014.38	\$ 56,014.38
3	Temporary Erosion Control (2.5%)	1	LS	\$ 56,014.38	\$ 56,014.38
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	3,864	LF	\$ 275.00	\$ 1,062,600.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	0	LF	\$ 412.50	\$ -
6	48" Manhole	14	EA	\$ 12,000.00	\$ 168,000.00
7	60" Manhole	0	EA	\$ 16,000.00	\$ -
8	Pavement Restoration	4,325	LF	\$ 90.00	\$ 389,250.00
9	6" HDPE DR 11 Sanitary Sewer Force Main	461	LF	\$ 225.00	\$ 103,725.00
10	1" HDPE Residential Force Main Lateral Stub	4	EA	\$ 3,000.00	\$ 12,000.00
11	4" PVC Residential Gravity Lateral Stub	34	EA	\$ 7,500.00	\$ 255,000.00
12	Municipal Lift Station	1	EA	\$ 250,000.00	\$ 250,000.00
13	12' Wide Access Road w/ 6" Gravel	0	SF	\$ 1.50	\$ -
14	Property Easements	0	SF	\$ 5.00	\$ -

Construction Subtotal: \$ 2,464,632.50
30% Contingency: \$739,389.75
Design and CM: \$ 369,694.88
Base Bid Total: \$ 3,573,717.13

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone B Alternative 1.2
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

ZONE B - ALTERNATIVE 1.2

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 109,520.98	\$ 109,520.98
2	Temporary Traffic Control (2.5%)	1	LS	\$ 54,760.49	\$ 54,760.49
3	Temporary Erosion Control (2.5%)	1	LS	\$ 54,760.49	\$ 54,760.49
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	4,743	LF	\$ 275.00	\$ 1,304,325.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	105	LF	\$ 412.50	\$ 43,312.50
6	48" Manhole	14	EA	\$ 12,000.00	\$ 168,000.00
7	60" Manhole	2	EA	\$ 16,000.00	\$ 32,000.00
8	Pavement Restoration	3,619	LF	\$ 90.00	\$ 325,710.00
9	6" HDPE DR 11 Sanitary Sewer Force Main	0	LF	\$ 225.00	\$ -
10	1" HDPE Residential Force Main Lateral Stub	4	EA	\$ 3,000.00	\$ 12,000.00
11	4" PVC Residential Gravity Lateral Stub	34	EA	\$ 7,500.00	\$ 255,000.00
12	Municipal Lift Station	0	EA	\$ 250,000.00	\$ -
13	12' Wide Access Road w/ 6" Gravel	14,748	SF	\$ 1.50	\$ 22,122.00
14	Property Easements	5590	SF	\$ 5.00	\$ 27,950.00

Construction Subtotal: \$ 2,409,461.45
30% Contingency: \$722,838.44
Design and CM: \$361,419.22
Base Bid Total: \$ 3,493,719.10

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone B Alternative 1.3
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
Project No. 2193
Date: 08/02/22
QC Check by: Keith Karpstein
Date: 08/02/22

ZONE B - ALTERNATIVE 1.3

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 98,780.38	\$ 98,780.38
2	Temporary Traffic Control (2.5%)	1	LS	\$ 49,390.19	\$ 49,390.19
3	Temporary Erosion Control (2.5%)	1	LS	\$ 49,390.19	\$ 49,390.19
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	3,273	LF	\$ 275.00	\$ 900,075.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	585	LF	\$ 412.50	\$ 241,312.50
6	48" Manhole	10	EA	\$ 12,000.00	\$ 120,000.00
7	60" Manhole	1	EA	\$ 16,000.00	\$ 16,000.00
8	Pavement Restoration	3,858	LF	\$ 90.00	\$ 347,220.00
9	6" HDPE DR 11 Sanitary Sewer Force Main	0	LF	\$ 225.00	\$ -
10	1" HDPE Residential Force Main Lateral Stub	2	EA	\$ 3,000.00	\$ 6,000.00
11	4" PVC Residential Gravity Lateral Stub	46	EA	\$ 7,500.00	\$ 345,000.00
12	Municipal Lift Station	0	EA	\$ 250,000.00	\$ -
13	12' Wide Access Road w/ 6" Gravel	0	SF	\$ 1.50	\$ -
14	Property Easements	0	SF	\$ 5.00	\$ -

Construction Subtotal: \$ 2,173,168.25
30% Contingency: \$651,950.48
Design and CM: \$325,975.24
Base Bid Total: \$ 3,151,093.96

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone C Alternative 1.1
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

ZONE C - ALTERNATIVE 1.1

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 60,252.50	\$ 60,252.50
2	Temporary Traffic Control (2.5%)	1	LS	\$ 30,126.25	\$ 30,126.25
3	Temporary Erosion Control (2.5%)	1	LS	\$ 30,126.25	\$ 30,126.25
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	1,925	LF	\$ 275.00	\$ 529,375.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	0	LF	\$ 412.50	\$ -
6	48" Manhole	9	EA	\$ 12,000.00	\$ 108,000.00
7	60" Manhole	0	EA	\$ 16,000.00	\$ -
8	Pavement Restoration	2,085	LF	\$ 90.00	\$ 187,650.00
9	3" HDPE DR 11 Sanitary Sewer Force Main	435	LF	\$ 115.00	\$ 50,025.00
10	1" HDPE Residential Force Main Lateral Stub	0	EA	\$ 3,000.00	\$ -
11	4" PVC Residential Gravity Lateral Stub	24	EA	\$ 7,500.00	\$ 180,000.00
12	*Municipal Lift Station	1	EA	\$ 150,000.00	\$ 150,000.00
13	12' Wide Access Road w/ 6" Gravel	0	SF	\$ 1.50	\$ -
14	Property Easements	0	SF	\$ 5.00	\$ -

*Lift Station priced differently than others as it will take in less flow and be smaller in size.

Construction Subtotal: \$ 1,325,555.00
30% Contingency: \$397,666.50
Design and CM: \$198,833.25
Base Bid Total: \$ 1,922,054.75

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone C Alternative 1.2
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
Project No. 2193
Date: 08/02/22
QC Check by: Keith Karpstein
Date: 08/02/22

ZONE C - ALTERNATIVE 1.2

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 66,236.65	\$ 66,236.65
2	Temporary Traffic Control (2.5%)	1	LS	\$ 33,118.33	\$ 33,118.33
3	Temporary Erosion Control (2.5%)	1	LS	\$ 33,118.33	\$ 33,118.33
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	2,990	LF	\$ 275.00	\$ 822,250.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	0	LF	\$ 412.50	\$ -
6	48" Manhole	11	EA	\$ 12,000.00	\$ 132,000.00
7	60" Manhole	0	EA	\$ 16,000.00	\$ -
8	Pavement Restoration	1,854	LF	\$ 90.00	\$ 166,860.00
9	1.5" HDPE DR 11 Sanitary Sewer Force Main	0	LF	\$ 75.00	\$ -
10	1" HDPE Residential Force Main Lateral Stub	0	EA	\$ 3,000.00	\$ -
11	4" PVC Residential Gravity Lateral Stub	24	EA	\$ 7,500.00	\$ 180,000.00
12	Municipal Lift Station	0	EA	\$ 150,000.00	\$ -
13	12' Wide Access Road w/ 6" Gravel	13,632	SF	\$ 1.50	\$ 20,448.00
14	Property Easements	635	SF	\$ 5.00	\$ 3,175.00

Construction Subtotal: \$ 1,457,206.30
30% Contingency: \$437,161.89
Design and CM: \$218,580.95
Base Bid Total: \$ 2,112,949.14

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone D Alternative 1.1
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
Project No. 2193
Date: 08/02/22
QC Check by: Keith Karpstein
Date: 08/02/22

ZONE D - ALTERNATIVE 1.1

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 4,560.00	\$ 4,560.00
2	Temporary Traffic Control (2.5%)	1	LS	\$ 2,280.00	\$ 2,280.00
3	Temporary Erosion Control (2.5%)	1	LS	\$ 2,280.00	\$ 2,280.00
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	0	LF	\$ 275.00	\$ -
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	0	LF	\$ 412.50	\$ -
6	48" Manhole	0	EA	\$ 12,000.00	\$ -
7	60" Manhole	0	EA	\$ 16,000.00	\$ -
8	Pavement Restoration	480	LF	\$ 90.00	\$ 43,200.00
9	1.5" HDPE DR 11 Sanitary Sewer Force Main	480	LF	\$ 75.00	\$ 36,000.00
10	1" HDPE Residential Force Main Lateral Stub	4	EA	\$ 3,000.00	\$ 12,000.00
11	4" PVC Residential Gravity Lateral Stub	0	EA	\$ 7,500.00	\$ -
12	Municipal Lift Station	0	EA	\$ 150,000.00	\$ -
13	12' Wide Access Road w/ 6" Gravel	0	SF	\$ 1.50	\$ -
14	Property Easements	0	SF	\$ 5.00	\$ -

Construction Subtotal: \$ 100,320.00
30% Contingency: \$30,096.00
Design and CM \$15,048.00
Base Bid Total: \$ 145,464.00

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone D Alternative 1.2
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

ZONE D - ALTERNATIVE 1.2

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 15,317.75	\$ 15,317.75
2	Temporary Traffic Control (2.5%)	1	LS	\$ 7,658.88	\$ 7,658.88
3	Temporary Erosion Control (2.5%)	1	LS	\$ 7,658.88	\$ 7,658.88
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	677	LF	\$ 275.00	\$ 186,175.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	0	LF	\$ 412.50	\$ -
6	48" Manhole	3	EA	\$ 12,000.00	\$ 36,000.00
7	60" Manhole	0	EA	\$ 16,000.00	\$ -
8	Pavement Restoration	752	LF	\$ 90.00	\$ 67,680.00
9	1.5" HDPE DR 11 Sanitary Sewer Force Main	0	LF	\$ 75.00	\$ -
10	1" HDPE Residential Force Main Lateral Stub	3	EA	\$ 3,000.00	\$ 9,000.00
11	4" PVC Residential Gravity Lateral Stub	1	EA	\$ 7,500.00	\$ 7,500.00
12	Municipal Lift Station	0	EA	\$ 150,000.00	\$ -
13	12' Wide Access Road w/ 6" Gravel	0	SF	\$ 1.50	\$ -
14	Property Easements	0	SF	\$ 5.00	\$ -

Construction Subtotal: \$ 336,990.50
30% Contingency: \$101,097.15
Design and CM: \$50,548.58
Base Bid Total: \$ 488,636.23

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone D Alternative 1.3
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

ZONE D - ALTERNATIVE 1.3

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 22,023.88	\$ 22,023.88
2	Temporary Traffic Control (2.5%)	1	LS	\$ 11,011.94	\$ 11,011.94
3	Temporary Erosion Control (2.5%)	1	LS	\$ 11,011.94	\$ 11,011.94
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	576	LF	\$ 275.00	\$ 158,400.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	295	LF	\$ 412.50	\$ 121,687.50
6	48" Manhole	3	EA	\$ 12,000.00	\$ 36,000.00
7	60" Manhole	1	EA	\$ 16,000.00	\$ 16,000.00
8	Pavement Restoration	871	LF	\$ 90.00	\$ 78,390.00
9	1.5" HDPE DR 11 Sanitary Sewer Force Main	0	LF	\$ 75.00	\$ -
10	1" HDPE Residential Force Main Lateral Stub	0	EA	\$ 3,000.00	\$ -
11	4" PVC Residential Gravity Lateral Stub	4	EA	\$ 7,500.00	\$ 30,000.00
12	Municipal Lift Station	0	EA	\$ 150,000.00	\$ -
13	12' Wide Access Road w/ 6" Gravel	0	SF	\$ 1.50	\$ -
14	Property Easements	0	SF	\$ 5.00	\$ -

Construction Subtotal: \$ 484,525.25
30% Contingency: \$145,357.58
Design and CM: \$72,678.79
Base Bid Total: \$ 702,561.61

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone B Alternative 2
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

ZONE B ALTERNATIVE 2

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 95,000.00	\$ 95,000.00
2	Temporary Erosion Control (1%)	1	LS	\$ 19,000.00	\$ 19,000.00
3	Temporary Traffic Control (1%)	1	LS	\$ 19,000.00	\$ 19,000.00
4	Zone B Denitrification Units	38	LF	\$ 50,000.00	\$ 1,900,000.00

Construction Subtotal: \$2,033,000.00
30% Contingency: \$609,900.00
Design and CM: \$304,950.00
Base Bid Total: \$2,947,850.00

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone C Alternative 2
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

ZONE C - ALTERNATIVE 2

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 60,000.00	\$ 60,000.00
2	Temporary Erosion Control (1%)	1	LS	\$ 12,000.00	\$ 12,000.00
3	Temporary Traffic Control (1%)	1	LS	\$ 12,000.00	\$ 12,000.00
4	Zone C Denitrification Units	24	EA	\$ 50,000.00	\$ 1,200,000.00

Construction Subtotal: \$1,284,000.00
30% Contingency: \$385,200.00
Design and CM: \$192,600.00
Base Bid Total: \$1,861,800.00

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Zone D Alternative 2
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

ZONE D - ALTERNATIVE 2

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 10,000.00	\$ 10,000.00
2	Temporary Erosion Control (1%)	1	LS	\$ 2,000.00	\$ 2,000.00
3	Temporary Traffic Control (1%)	1	LS	\$ 2,000.00	\$ 2,000.00
4	Zone D Denitrification Units	4	EA	\$ 50,000.00	\$ 200,000.00

Construction Subtotal: \$214,000.00
30% Contingency: \$64,200.00
Design and CM: \$32,100.00
Base Bid Total: \$310,300.00

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 9 & 10 Alternative 3
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

PHASE 9 AND 10 - ALTERNATIVE 3

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 282,500.00	\$ 282,500.00
2	Temporary Traffic Control (Zone A) (1%)	1	LS	\$ 56,500.00	\$ 56,500.00
3	Temporary Erosion Control (1%)	1	LS	\$ 56,500.00	\$ 56,500.00
4	Zone A Denitrification Units	47	LS	\$ 50,000.00	\$ 2,350,000.00
5	Zone B Denitrification Units	38	LF	\$ 50,000.00	\$ 1,900,000.00
6	Zone C Denitrification Units	24	EA	\$ 50,000.00	\$ 1,200,000.00
7	Zone D Denitrification Units	4	EA	\$ 50,000.00	\$ 200,000.00

Construction Subtotal: \$6,045,500.00
30% Contingency: \$1,813,650.00
Design and CM: \$906,825.00
Base Bid Total: \$8,765,975.00

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 12 Alternative 1
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

PHASE 12 ALTERNATIVE 1

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 42,907.50	\$ 42,907.50
2	Temporary Traffic Control (2.5%)	1	LS	\$ 21,453.75	\$ 21,453.75
3	Temporary Erosion Control (2.5%)	1	LS	\$ 21,453.75	\$ 21,453.75
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	1,635	LF	\$ 275.00	\$ 449,625.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	0	LF	\$ 412.50	\$ -
6	48" Manhole	6	EA	\$ 12,000.00	\$ 72,000.00
7	60" Manhole	0	EA	\$ 16,000.00	\$ -
8	Pavement Restoration	2,210	LF	\$ 90.00	\$ 198,900.00
9	1.5" HDPE DR 11 Sanitary Sewer Force Main	575	LF	\$ 75.00	\$ 43,125.00
10	1" HDPE Residential Force Main Lateral Stub	4	EA	\$ 3,000.00	\$ 12,000.00
11	4" PVC Residential Gravity Lateral Stub	11	EA	\$ 7,500.00	\$ 82,500.00
12	Municipal Lift Station	0	EA	\$ 150,000.00	\$ -
13	12' Wide Access Road w/ 6" Gravel	0	SF	\$ 1.50	\$ -
14	Property Easements	0	SF	\$ 5.00	\$ -

Construction Subtotal: \$ 943,965.00
30% Contingency: \$283,189.50
Design and CM: \$141,594.75
Base Bid Total: \$ 1,368,749.25

City of Carson City
Southeast Mandatory Sewer Extension Project - Phases 12 Alternative 2
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 08/02/22
 QC Check by: Keith Karpstein
 Date: 08/02/22

PHASE 12 - ALTERNATIVE 2

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 47,563.75	\$ 47,563.75
2	Temporary Traffic Control (2.5%)	1	LS	\$ 23,781.88	\$ 23,781.88
3	Temporary Erosion Control (2.5%)	1	LS	\$ 23,781.88	\$ 23,781.88
4	8" PVC SDR 35 Gravity Sewer Main <18' Deep	1,635	LF	\$ 275.00	\$ 449,625.00
5	8" PVC SDR 35 Gravity Sewer Main >18' Deep	0	LF	\$ 412.50	\$ -
6	48" Manhole	6	EA	\$ 12,000.00	\$ 72,000.00
7	60" Manhole	0	EA	\$ 16,000.00	\$ -
8	Pavement Restoration	1,635	LF	\$ 90.00	\$ 147,150.00
9	1.5" HDPE DR 11 Sanitary Sewer Force Main	0	LF	\$ 75.00	\$ -
10	1" HDPE Residential Force Main Lateral Stub	0	EA	\$ 3,000.00	\$ -
11	4" PVC Residential Gravity Lateral Stub	11	EA	\$ 7,500.00	\$ 82,500.00
12	Denitrification Units	4	EA	\$ 50,000.00	\$ 200,000.00

Construction Subtotal: \$1,046,402.50
30% Contingency: \$313,920.75
Design and CM: \$156,960.38
Base Bid Total: \$1,517,283.63

City of Carson City
Southeast Mandatory Sewer Extension Project - Phase 12 Alternative 3
Engineer's Opinion of Probable Construction Costs (Preliminary Submittal)

Estimate by: Eric Davis
 Project No. 2193
 Date: 8/2/2022
 QC Check by: Keith Karpstein
 Date: 8/2/2022

PHASE 12 - ALTERNATIVE 3

Bid Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization and Demobilization (NTE 5%)	1	LS	\$ 37,500.00	\$ 37,500.00
2	Temporary Erosion Control (1%)	1	LS	\$ 7,500.00	\$ 7,500.00
3	Temporary Traffic Control (1%)	1	LS	\$ 7,500.00	\$ 7,500.00
4	Septic Denitrification System	15	EA	\$ 50,000.00	\$ 750,000.00

Construction Subtotal: \$802,500.00
30% Contingency: \$240,750.00
Design and CM: \$120,375.00
Base Bid Total: \$1,163,625.00