CARNUEL
SANITARY SEWER

DESIGN ANALYSIS REPORT

WATER AUTHORITY

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August 2019
Rev. November 2019
Smith Project No.: 119115

CARNUEL SANITARY SEWER

DESIGN ANALYSIS REPORT

WATER AUTHORITY

GRANT/FUNDING INFORMATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal as a professional engineer licensed to practice in the state of New Mexico, is affixed below.

JARED J. LUJAN
NEW MEXICO
20435
PROFESSIONAL ENGINEER

Engineer
Signature

12/5/19

Jared Lujan, PE

Smith Engineering Company

Solutions for Today... Vision for Tomorrow

November 8, 2019

Jane Rael, Project Manager
Water Resources, Planning & Engineering Division
Water Authority
1 Civic Plaza NW
Albuquerque, New Mexico, 87102

Re: Carnuel Sanitary Sewer Design Analysis Report

Water Authority Task No.: 119115

Dear Mrs. Rael:

Smith Engineering (Smith) is pleased to submit the enclosed Carnuel Sanitary Sewer Analysis Report. The report summarizes collection efforts completed for this study, evaluate three design alternatives with a design layout, life cycle cost, engineer's opinion of probable construction cost, and provides a recommended design alternative. This final report incorporates the comments and discussions from the review meeting. We appreciate the opportunity to complete this study for the Water Authority.

Sincerely,
Smith Engineering Company

Jared Lujan, P.E.
Project Manager

XXX/jf

Enclosure: Carnuel Sanitary Sewer Design Analysis Report

cc: Frank Roth, Water Authority
Isai Garcia, EI, Smith Engineering
Josh Flores, EI, Smith Engineering

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INTRODUCTION

The Albuquerque Bernalillo County Water Utility Authority (Water Authority) hired Smith Engineering (Smith) to prepare a Design Analysis Report (DAR) to convey sewage from residents within the study area to the Water Authority's gravity system. The initial basis of our analysis concentrated on alternative C1, Gravity Sewer System, of study area C identified in the existing Preliminary Engineering Report (PER) prepared by Bohannon Houston (Hill, 2010). Preliminary findings of the gravity sewer system indicated issues with constructability and high capital costs. Therefore, other alternatives were added to the evaluation with the intention of identifying a more feasible solution. The three alternatives evaluated are:

- Gravity Sewer System
- Low Pressure Sewer System with a Grinder Pump per Service
- Gravity/Low Pressure Sewer System Hybrid.

The study area C, as identified in the PER, is located between Interstate-40 (I-40) and New Mexico State Road 333 (NM 333). This area does not have any sanitary sewer infrastructure and residents utilize privately owned individual septic tanks. The purpose of this report is to provide a recommendation of a constructible and cost-effective solution to convey residential sewage to the Water Authority's gravity system and provide a budgetary project cost for the recommended solution. The Water Authority intends to use federal and state funding to assist with the construction of the project. The scope of this analysis consists of:

- Identify Population to be Served
- Provide Conceptual Layouts of the Different Alternatives
- Identify Residents with Grinder Pumps
- Perform Design Analysis of Alternatives
- Perform Conceptual Easement Investigation
- Conduct a Life Cycle Cost Analysis of Alternatives
- Perform Conceptual Permit Investigation

The life cycle cost analysis was conducted for an estimated life expectancy of 30 years assuming a 3% annual interest rate.

Figure 1 – Project Area C

PROJECT PLANNING

LOCATION

The community of Carnuel is in central New Mexico along I-40 in Bernalillo County, east of Albuquerque. According to the 2010 census, Carnuel has a population of 2,230 people. The study area C has an estimated population of 572 people. The elevation of Carnuel is 5,860 feet and is located at the mouth of the Tijeras Canyon. This area is distinguished by the rugged geography of the Manzano and Sandia Mountains. The area ranges in soil type from mostly sandy loam to rock outcrops.

Figure 2 – Carnuel Vicinity Map

SERVED POPULATION

Smith estimates there are 143 single family households within the project area. The average single-family household is 4 individuals per 2010 United States Census. The project will thus supply municipal sanitary sewer to approximately 572 people. The topography, easement gathering, and population location will dictate the majority of the proposed design layouts.

DESIGN ASSUMPTIONS AND CRITERIA

Smith used the same estimation procedure used in the PER (Hill, 2010) to determine the average, peak, and design flows for present and projected populations served. The estimated flow per household was determined using the ***OCTOBER 2008 REVISION CITY OF ALBUQUERQUE DEVELOPMENT PROCESS MANUAL, CHAPTER 24***, Sanitary Sewer Design Criteria. Estimated flows are based on population values. Population was based on the present (2010 U.S. Census) and projected populations estimated in the PER (Hill 2010). Four persons per dwelling unit criteria was used to obtain similar present and population projections. The following table shows present and projected population and flows for the study area C identified in the PER (Hill, 2010).

Table 1 – Area C Present and Projected Population and Flows

Population Present (2060)	Average Flow, gpd Present (2060)	Peak Flow, gpd Present (2060)	Design Flow, gpd Present (2060)
572 (1194)	63,690 (131,340)	217,047 (412,589)	260,456 (495,106)

ALTERNATIVES CONSIDERED

Smith evaluated three alternatives for Study Area C located between NM 333 to I-40. Conceptual layouts of each alternative were created utilizing data from the Mid Regional Council of Governments (MRCOG) consisting of 10-foot LIDAR ground contours from 2014 and aerial survey and imagery from 2018. Smith also conducted site visits to provide insight on the area topography as well as existing utilities, road dimensions, and investigate the possible location of septic tanks. Smith also identified possible residents that may require grinder pumps based on the available data and conceptual layouts created for the two alternatives with a gravity sewer aspect.

ALTERNATIVE 1: GRAVITY SEWER SYSTEM

The Gravity Sewer System alternative was designed to connect the most residents via gravity sewer without the aid of grinder pumps. The proposed layout consists of 20 lateral lines that flow South towards I-40 connecting to a collector line that flows west parallel to I-40. A lift station is proposed at the end of the collector line with 650 feet forcemain connecting to the existing 8” Tijeras forcemain along NM 333. The lateral lines were placed within existing easements identified from the Bernalillo County G.I.S. Planning Parcel and Imagery. Additional research is needed of the existing easements where proposed lateral lines are located to identify the actual easement designation. Most of the existing easements identified followed public access roads and in some cases these access roads have existing water utilities. The laterals that were not placed in existing easements were placed in areas that accommodate the existing topography and allow for the greatest potential for service connections to be installed without grinder pumps. The collector line running parallel with I-40 was placed in the New Mexico Department of Transportation right of way which will require a utility permit to install and maintain the line. The proposed sewer line crosses the Tijeras arroyo multiple times requiring CWA Section 401/404 Permit from the Army Corps of Engineers. For this alternative there is 9 residents that would possibly be excluded from the system due to the location of the property. If residents want to connect to the new sewer system additional infrastructure will need to be installed pending an availability statement from the Water Authority, the new infrastructure may be the responsibility of the resident.

Smith performed a hydraulic analysis of the proposed gravity system layout to verify pipe capacity and adequate flow velocities are met. The proposed gravity system layout was exported from AutoCAD C3D into the companion application “Storm and Sanitary Sewer Analysis”. Calculated design flows (Present and Projected) were assigned to individual manholes throughout the collection system to estimate a tributary flow rate for each segment of sewer collection line. A Manning n coefficient of 0.013 was assumed for all pipe and head losses at manholes was calculated based on degrees of bend. A steady state flow analysis was performed, and the following results were obtained:

- An 8” diameter pipe is a sufficient size for all lateral and collector lines to convey design flows at the proposed pipe slopes.
- The average max flow velocity throughout the system is 2.67 ft/s assuming an 8” diameter pipe.
- Pipes have adequate slopes with no pipe having a slope less than 0.5%.

After completion of the analysis, the conceptual design was finalized making sure to follow the City of Albuquerque Development Process Manual.

CONSTRUCTABILITY

Construction for this alternative would be very machine and labor driven. Topography of the study area required some of the proposed infrastructure to be designed at a depth of up to 25 feet while the rock outcrops are estimated to start anywhere from at the surface to 8 feet deep. Most of the trenching and excavation to construct this alternative will have some amount of rock excavation increasing construction costs drastically.

Figure 3 – Coyote Spring Bridge Above Large Rock Outcrop

The construction of the collector line along I-40 presents additional challenges outside of rock excavation. The proposed alignment is next to the right of way / private property line and is on a relatively steep slope toward the interstate or is on a narrow flat swath with steep slopes toward the interstate. Construction would be very difficult within this alignment because of the limited access and space. Coyote Spring Bridge is an obstacle located near the middle of Study Area C that crosses over I-40 that would require additional effort to construct a sewer line under. Smith evaluated Horizontal Directional Drilling for sewer line installation along I-40 as an alternative construction method with potential cost savings. This alternative construction method does not provide any cost savings due to difficulties to drill through inconsistent rock deposits and maintaining a consistent slope less than 2% during drilling as proposed. Traffic control and coordination with the NMDOT would be very thorough and highly involved throughout the task. Additionally, there are areas in which the layout of the gravity sewer crosses the Tijeras arroyo, requiring a CWA Section 401/404 Permit from the Army Corps of Engineers. This permit refers to ephemeral channels that may be altered due to urban development.

LAND REQUIREMENTS

The necessary land needed to construct this alternative would have to be within a public utility easement or NMDOT utility permit. Approximately 7,539 linear feet of gravity sewer will require NMDOT utility permit to be obtained. Approximately 12,135 linear feet of gravity sewer is currently being proposed to be placed in land where no existing public utility easement exist. Approximately 3,474 linear feet is currently being proposed to be installed in areas where there is a possible existing public utility easement. The attached layout in Appendix A includes a legend to clarify and distinguish the different easement information Smith obtained. Further easement investigation will be required for the direct placement of system lines.

ADVANTAGES/DISADVANTAGES

This alternative has the following advantages:

- Large volumes of flow can be handled to accommodate future growth or unexpected volumes.
- Minimal operation and maintenance cost would be needed for the gravity system since the system uses the minimum velocity necessary to allow solids to flow without settling.
- Installation of manholes allows for routine inspections or cleanout points if necessary.

This alternative has the following disadvantages:

- Very high upfront capital costs associated with installing gravity sewer.
- Topography of area has sudden elevation changes, which dictates the grade and depth of the system.
- Deep sewer excavation in certain areas will be necessary to maintain minimum cover and grade.
- The majority of the system will require mid to deep rock excavation. This will be a slow process of removing non-suitable material and importing suitable material for backfill and compaction.
- Future operation and maintenance access will be difficult along I-40 and the Tijeras arroyo.
- Obtain NMDOT Utility Permit and CWA Section 401/404 Permit from the Army Corps of Engineers.

ALTERNATIVE 2: LOW PRESSURE SEWER SYSTEM ALTERNATIVE

The Low-Pressure Sewer System alternative was designed with a grinder pump at each service. The proposed layout consists of multiple low pressure forcemains that convey low-pressure flow across the east bound lanes of NM 333 and connect to the existing 8” Tijeras forcemain. Each service connection includes a sump, a Simplex grinder pump for approximately one to two residents, check valve, and gate valve. Single cleanouts and double cleanouts are proposed every 400 feet of the pressure system for maintenance. This alternative would serve 139 single-family households out of the 143 single-family households in Study Area C. The other 4 single-family households are excluded from the system due to the location of the property. If residents want to connect to the new sewer system additional infrastructure will need to be installed pending an availability statement from the Water Authority, the new infrastructure may be the responsibility of the resident.

CONSTRUCTABILITY

Construction of the Low-Pressure Sewer System alternative would be the most feasible of the alternatives Smith evaluated due to the minimal amount of excavation required to install the proposed forcemain lines. It is anticipated that the collection forcemains will range from 2” to 6” HDPE SDR 11 pipe with a typical bury depth of three feet. With the proposed line size having small footprint and with excavation depth being much less than a conventional gravity sewer system, trenching, rock excavation (if needed), and import of suitable material for backfill will be more cost efficient.

LAND REQUIREMENTS

The layout of the system will consist of 16 pressurized lateral lines. 14 of these lines run through possible existing public utility easements and two of them will run through private property where a public utility easement will need to be obtained. NMDOT Utility Permits will also need to be obtain when connecting to the existing Tijeras forcemain. Further easement investigation will be required if this alternative is selected to verify the existing easement designations.

ADVANTAGES/DISADVANTAGES

This alternative has the following advantages:

- Low initial front-end cost.
- Typical 3-foot bury. This is important because of the amount rock present throughout the area, and appropriate backfill material.
- Minimal surface restoration costs.
- Fewer easement acquisitions

This alternative has the following disadvantages:

- Higher cost for residents.
- Odor control can be a problem if system is inadequately vented.
- Possible air release valves to be maintained.

ALTERNATIVE 3: GRAVITY/LOW PRESSURE SEWER SYSTEM ALTERNATIVE

The third alternative evaluated by Smith is a combination of a Gravity and Low-Pressure Sewer system. This system utilizes a layout that groups residential homes connecting to a shared gravity sewer system that transport the sewer to a shared lift station. Sanitary waste is then pumped to the existing 8" Tijeras forcemain along NM 333. The number of homes grouped together is based on the amount of flow that each lift station can handle. The lift stations considered are the following:

- Duplex Lift Station – Lift station consist of two grinder pumps for approximately 3 to 6 residences.
- Quadplex Lift Station – Lift station consist of four grinder pumps for approximately 7 to 12 residences.

The location of the lift station for each residential area was determined at the lowest point in the assortment of homes that would also be realistic to be placed within a probable public utility easement zone to be obtained.

For this alternative an estimated 12 residences will need grinder pumps due to topographic surface in the area. 111 residences will be able to connect via gravity to its shared gravity sewer system and 7 residences will be excluded from the system due to the location of the property. If residents want to connect to the new sewer system additional infrastructure will need to be installed pending an availability statement from the Water Authority, the new infrastructure may be the responsibility of the resident.

CONSTRUCTABILITY

The constructability of the Gravity/Low Pressure Sewer System Hybrid will be compromised of installing a gravity sewer line through probable existing easements and private easements that are acquired. Lift stations at the lowest point of each lateral line will need to be installed. In parallel, the low-pressure line will be installed next to the gravity line to transport waste to the existing 8" Tijeras forcemain. The obstacle that this alternative will face is that it will encounter deep rock excavation through the installment phase of gravity sewer line. Suitable material will also have to be imported for backfilling purposes for the rock excavation phase of the project. The installment of low-pressure lines does reduce the excavation and suitable material cost, the construction of 18 lift stations will be a large project cost.

LAND REQUIREMENTS

2,890 linear feet of public utility easements will need to be obtained for placement of gravity and low-pressure pipe. Approximately 9,000 feet of sewer infrastructure in being proposed to be installed in probable existing public utility easement, further investigation will need to be conducted to verify the designation of existing easements. There are currently 18 proposed lift station that will pump sewer to the existing Tijeras forcemain, easements will need to be acquired to install new lift stations. The attached layout in Appendix C includes a legend to clarify and distinguish the different easement information Smith obtained.

ADVANTAGES/DISADVANTAGES

This alternative has the following advantages:

- Gravity connections for most of the residents.
- A more affordable connecting expense for residences.
- Little to no operation expense for residences.
- Less NMDOT Utility Permits Required.

This alternative has the following disadvantages:

- Water Authority to maintain lift stations.
- Possible rock excavation in certain areas.
- Low resident accountability.
- Odor control can be a problem if system is inadequately vented.
- Possible air release valves to be maintained.
- Full-time service employee needed to maintain system (annual income included in life cycle cost)

SELECTION OF ALTERNATIVE

The following factors were used in the Engineer’s selection of the recommended alternative.

- Easements Required
- Permits Required
- Operation and Maintenance Cost
- Life Cycle Cost
- Construction Cost
- Impact to Residents
- Constructability

With each alternative there is a different number of easements that will need to be acquired. Smith performed a conceptual easement investigation to find out if there were any existing easements in the area. The conceptual layouts include the existing possible utility easement found in the area. As such, easements required was selected as a factor when recommending the best alternative.

Permits for the selected alternative will need to be in place before construction begins. It is understood that some of these permits from certain agencies are harder to obtain. For this project NMDOT permits would be required for all alternatives and permits with Army Corp of Engineers may be required for the gravity sewer alternative.

Operation and Maintenance Costs changes for each alternative. The life cycle cost performed for the different alternatives takes into consideration the cost associated with operation and maintenance of the new infrastructure.

Over time, the operation and maintenance of lift stations adds up to substantial amount of investment. Considering a present worth cost analysis of the life cycle costs can put this factor into perspective. Construction cost are equally important, if the amount of money spent on a particular project is significantly more than other similar projects serving similar number of residents, then the project may not move forward quickly and may decrease the likelihood of obtaining federal or state funds.

Each alternative will have a different impact to the residents living in the area. Some impacts associated with the different alternatives include easement acquisition, grinder pumps, service connection costs, operation and maintenance costs among others. Therefore, impact to residents was selected as a factor to be considered when recommending the best alternative.

The final factor is constructability. Smith will consider how difficult each alternative is to construct. The greater the difficulty of a project, the greater the construction cost of the project.

LIFE CYCLE COST ANALYSIS

The life cycle cost analysis was completed using the anticipated project cost for each alternative and the annual operation and maintenance cost identified for each alternative. The annual operation and maintenance costs as well as future replacements costs were converted using a Uniform Series Present Worth and Single Payment Present Worth calculation, respectively with an inflation adjusted rate of 3% for 30 years. Salvage value was not considered in this life cycle cost analysis. The total capital cost for each alternative reflects the cost associated with obtaining easements where there is no apparent easement in place. The total capital, O&M, and life cycle cost associated with alternative #2 Low Pressure include both public and private cost. Life cycle cost for the Hybrid alternative includes cost associated with employing a full-time maintenance employee and additional fees that residents living in this area will be charged by the Water Authority for additional services to maintain the sewer system.

Table 2 – Life Cycle Cost for Alternatives

Alternative	Engineering Cost	Capital Construction Cost	Easement Cost	Total O&M Cost (Over Life Expectancy)	Life Cycle Cost
#1 Gravity	$969,670.00*	$9,666,700.00	$30,120.00	$102,369.19	$10,765,859.19
#2 Low Pressure	$61,987.60**	$2,148,876.00	$4,940.00	$833,642.07	$3,049,445.67
#3 Hybrid	$609,087.20*	$6,090,872.00	$8,340.00	$2,053,814.42	$8,762,113.62

**Engineering Cost estimated to be 10% of the Capital Construction Cost.*
***Engineering Cost estimated to be 10% of the Water Authority Total Capital Construction Cost*

DECISION MATRIX

To select an alternative, Smith elected to use a matrix scoring system that assigned each criteria a number from one to three with three being assigned to the top alternative. The alternative with the most points is the selected alternative. The following table shows the scores for each alternative.

Table 3 – Decision Matrix

	Easements Required	Permits Required	Operation and Maintenance Cost	Life Cycle Cost	Construction Cost	Impact to Residents	Constructability	Total
Gravity Sewer Alternative	1	1	3	1	1	3	1	11
Low Pressure Sewer Alternative	3	3	1	3	3	1	3	17
Hybrid Sewer Alternative	2	2	2	2	2	2	2	14

EASEMENTS REQUIRED – The alternative with the lowest potential required easements was given the highest score possible. Further research will need to take place once an alternative is selected to verify exactly what type of easements exist and how many new easements will need to be acquired.

PERMITS REQUIRED – The alternative with the least known required permits was scored the highest.

OPERATION AND MAINTENANCE COST – The alternative with the least O&M cost was scored the highest.

LIFE CYCLE COST – The alternative with the lowest life cycle cost was scored the highest.

CONSTRUCTION COST – The alternative with the lowest construction cost was scored the highest.

IMPACT TO RESIDENTS – The alternative with the least impact to residents was score the highest.

CONSTRUCTABILITY – The alternative with the least impact to the site and simpler construction methods was scored the highest.

CONCLUSION AND RECOMMENDATIONS

Smith recommends the Low Pressure Sewer System (Alternative 2) for Carnuel study area C. This recommendation is based on evaluating the other alternatives and considering the topography, subsurface conditions (rock), and number of residents to be served in the area. This system requires minimal excavation (4 feet depth at max) to install a small diameter HDPE force main. The following table show the life cycle cost breakdown for the Water Utility Authority and residents living in the area.

Table 4 – Low Pressure Sewer Alternative

Low Pressure Alternative	Water Utility Authority	Private Households (139)	Per Private Household
Present Worth Capital Cost (Applicable Engineering + Easement Cost)	$686,803.60	$1,529,000.00	$11,000.00
Present Worth Total O&M Cost (30 yr Life)	$35,167.11	$798,474.96	$5,744.42
Present Worth Life Cycle Cost	$717,030.71	$2,327,474.96	$16,744.42

The Low-Pressure Sewer alternative has the lowest life cycle cost with residents paying most of the expense. Each resident would be required to purchase and install individual grinder lift stations, upgrade their existing electrical panels, and install the required length of forcemain to the property line. Total O&M cost for this alternative may be reduced depending on how well each resident maintains and follows normal operations recommended by the manufacture. It is estimated that each resident will have a yearly $75.00 operation cost and a pump replacement cost of $2,500 every 10 years. The pump replacement cost, as stated above, depends on how well each resident follows standard operation procedures provided by the manufacturer.

Table 4 row 5 "Per Private Household", breaks down the cost even further to show how much each resident would need to pay under this alternative, note that total O&M cost is over a 30 yr life span of the equipment. Currently, residents are using septic tanks for their sewer. If this alternative is chosen residents will not need to connect to the new sewer system if their septic tank is functioning, but before selling the property or if any major change happens to the property the resident will need to verity that their septic tank is up to code and working properly. If existing septic is not up to code residents will need to acquire the proper permits and upgrades or connect to the new sewer system. Installing new septic tanks or upgrading to new advance septic treatment can range from $4,000-$8,000 and $6,000-$15,000, respectively. Since most of the Carnuel area sits on bedrock advance septic treatment will most likely be required. The life cycle cost of the low-pressure alternative is just over the capital cost of installing an advance treatment septic and this cost can be decrease if each resident follows standard operation procedures. All in all, the low-pressure sewer system is the best alternative for both the Water Authority and the individual residents living in the Carnuel area.

REFERENCES

UNPUBLISHED MATERIAL:

Bohannan Huston Incorporated. “Carnuel Mutual Domestic Water and Wastewater Consumers Association Wastewater System Improvements.” Preliminary Engineering Report, 2010.

Mayhew, Chuck. "An Evaluation of O&M Expenses Environment One Pressure Sewers." Environment One Corporation, 2016.

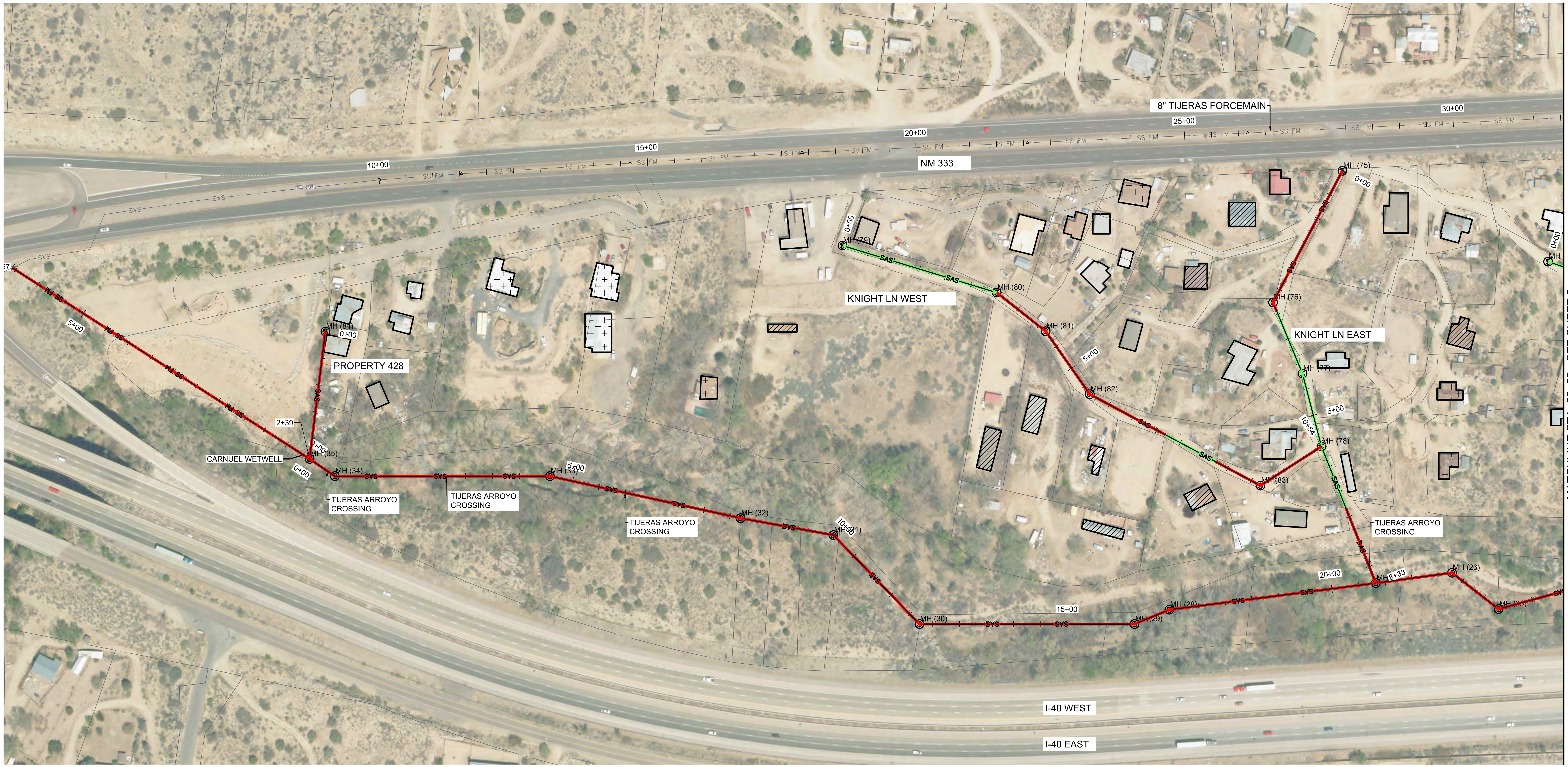
WEBSITES:

eLaws.us. Albuquerque, New Mexico Development Process Manual. August 2019. **http://albuquerque-nm.elaws.us/code/deprma_appsid555628_ch24**

Bernalillo County. Planning and Development Services. October 2019. **https://www.bernco.gov/planning/gis-maps.aspx**

Bernalillo County Code of Ordinances. Division 10. – Wastewater Systems. October 2014. **https://library.municode.com/nm/bernalillo_county/codes/code_of_ordinances?nodeId=BECOCO_CH42HESA_ARTIVENHECO_DIV10WASY**

APPENDIX A: GRAVITY SEWER ALTERNATIVE DESIGN LAYOUT



LEGEND

POSSIBLE EXISTING EASEMENT	(green line)
EASEMENT TO BE OBTAINED	(red line)
NMDOT UTILITY EASEMENT TO BE OBTAINED	(yellow line)
GRINDER PUMP SERVICE	(hatched)
PROPERTY CAN NOT BE SERVICED	(crosses)

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0 100' 200'

PRELIMINARY NOT FOR CONSTRUCTION

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CARNUEL
BERNALILLO COUNTY, NEW MEXICO

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

GRAVITY SEWER ALTERNATIVE
STA: 10+00 TO STA:32+05

SMITH ENGINEERING

JOB NO: 119115

DATE: AUGUST, 2019

SHEET NO: 1 OF 4

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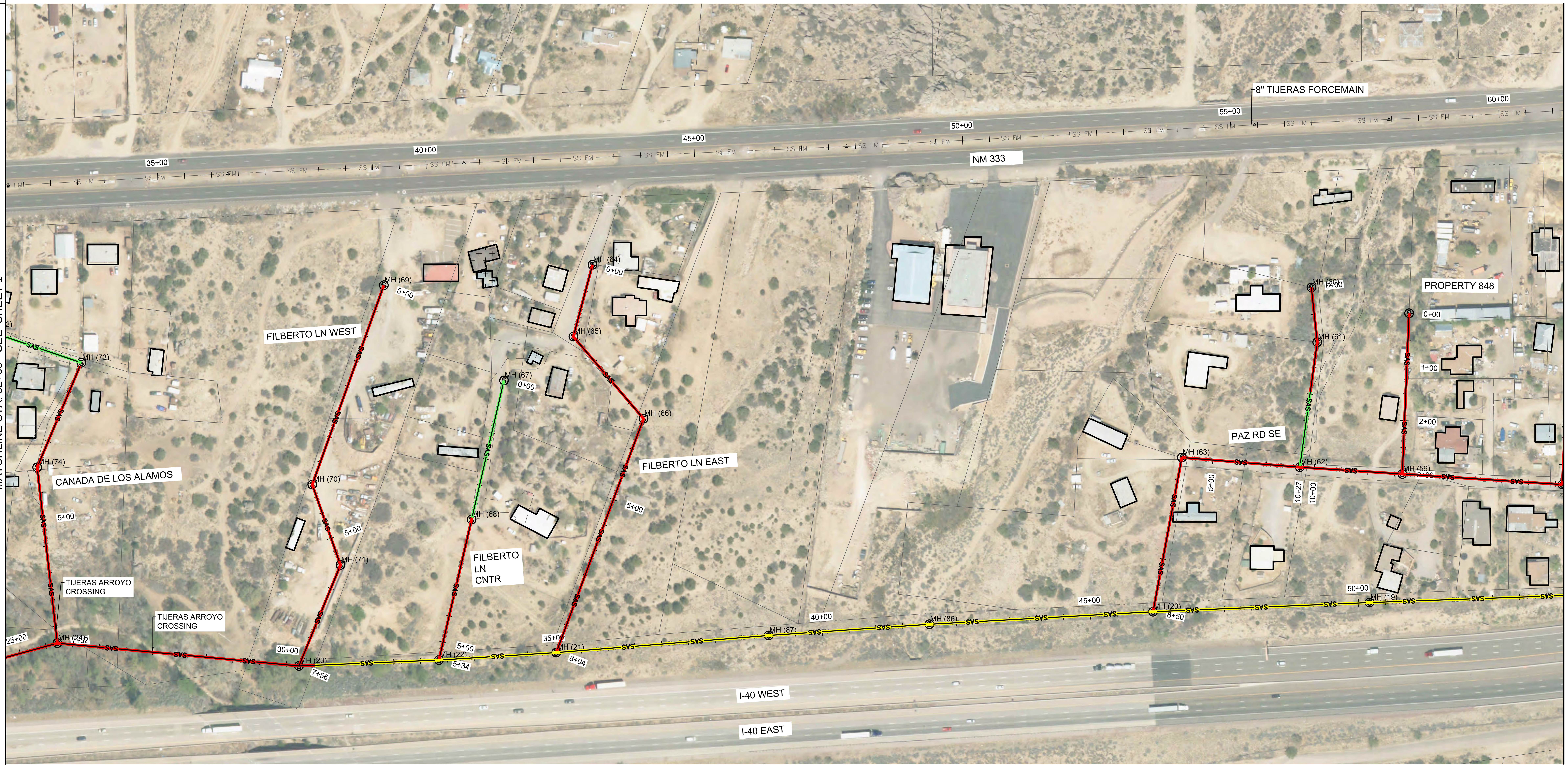

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EASEMENT TO BE OBTAINED	(red line)
NMDOT UTILITY EASEMENT TO BE OBTAINED	(yellow line)
GRINDER PUMP SERVICE	
PROPERTY CAN NOT BE SERVICED	

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CARNUEL
BERNALILLO COUNTY, NEW MEXICO

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

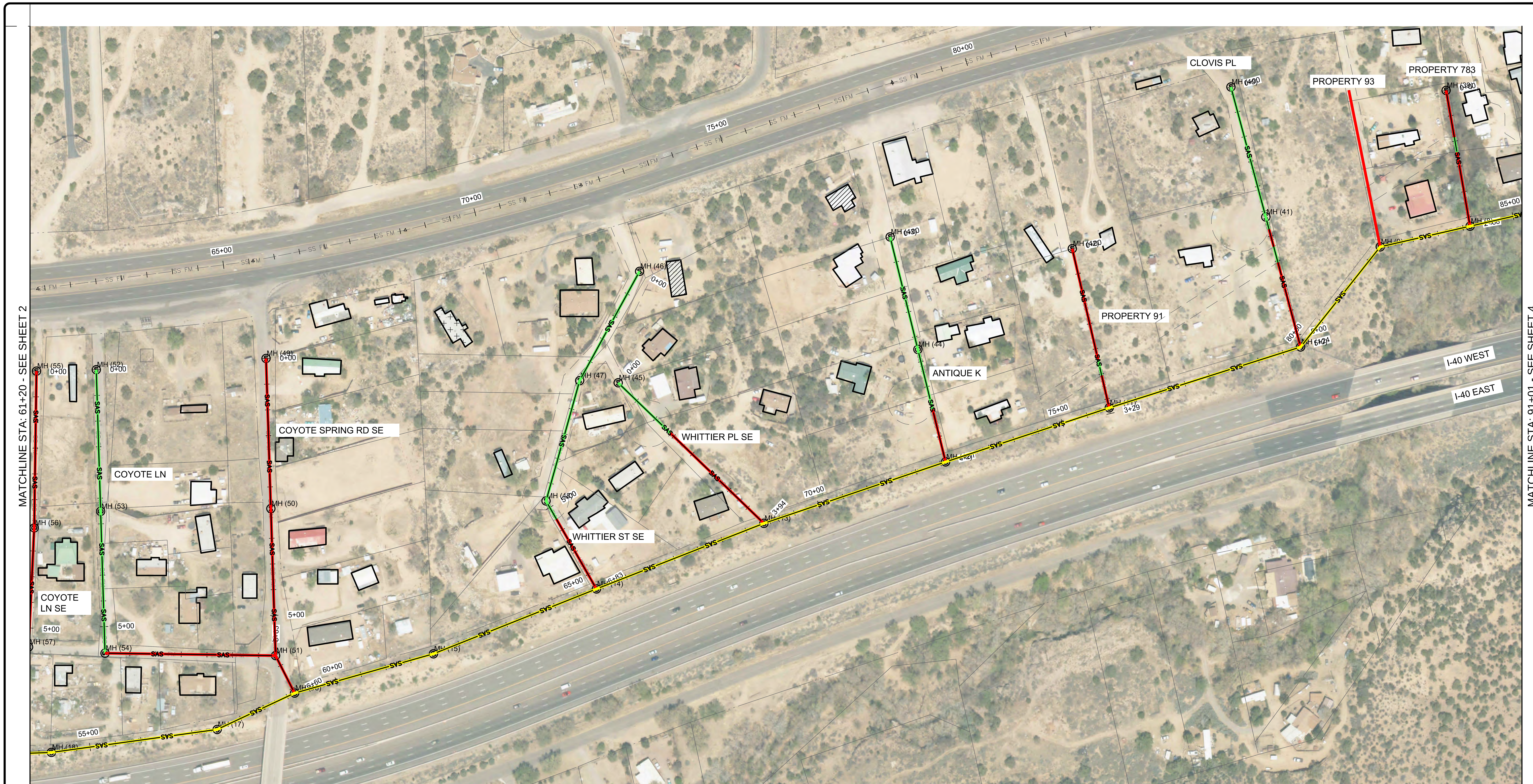
GRAVITY SEWER ALTERNATIVE
STA: 32+05 TO STA: 61+20

SMITH ENGINEERING

JOB NO:
119115

DATE:
AUGUST, 2019

SHEET NO:
2 OF 4



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NMDOT UTILITY EASEMENT TO BE OBTAINED	(yellow line)
GRINDER PUMP SERVICE	
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CARNUEL
BERNALILLO COUNTY, NEW MEXICO

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

GRAVITY SEWER ALTERNATIVE
STA: 61+20 TO STA: 91+01

SMITH ENGINEERING

JOB NO: 119115

DATE: AUGUST, 2019

SHEET NO: 3 OF 4

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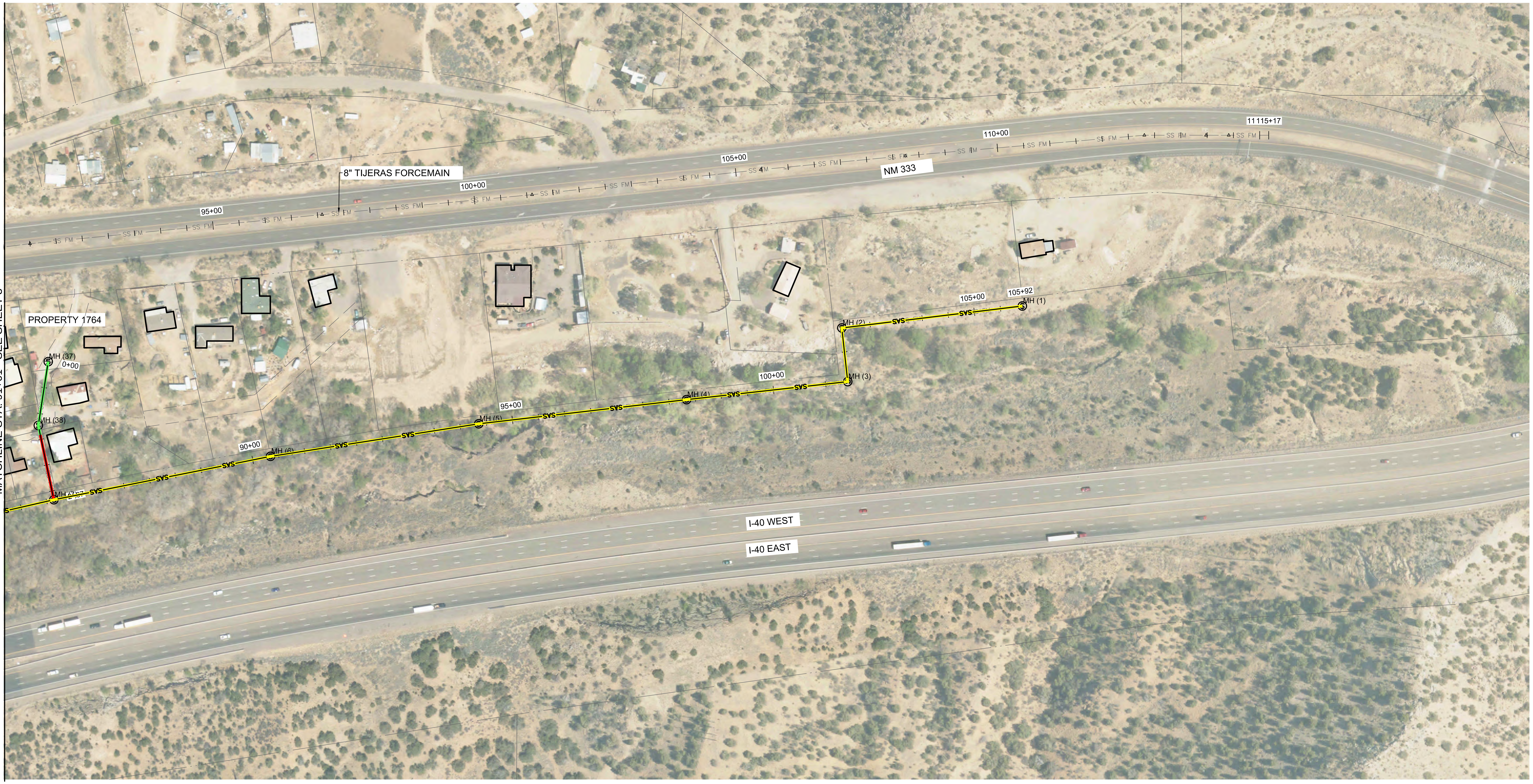

LEGEND

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EASEMENT TO BE OBTAINED	(red line)
NMDOT UTILITY EASEMENT TO BE OBTAINED	(yellow line)
GRINDER PUMP SERVICE	(hatched box)
PROPERTY CAN NOT BE SERVICED	(box with crosses)

N

0 100' 200'

PRELIMINARY NOT FOR CONSTRUCTION

CARNUEL
BERNALILLO COUNTY, NEW MEXICO

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CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

GRAVITY SEWER ALTERNATIVE
STA: 91+01

SMITH ENGINEERING

JOB NO: 119115

DATE: AUGUST, 2019

SHEET NO: 4 OF 4

APPENDIX B: LOW PRESSURE SEWER ALTERNATIVE DESIGN LAYOUT

MATCHLINE STA: 36+46 SEE SHEET 2

PRELIMINARY NOT FOR CONSTRUCTION

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WASTEWATER SYSTEM IMPROVEMENTS

LOW PRESSURE ALTERNATIVE
STA: 10+00 TO STA: 36+46

Solutions for Today...
Vision for Tomorrow

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JOB NO: 119115

DATE: AUGUST, 2019

SHEET NO: 1 OF 4

LEGEND

POSSIBLE EXISTING EASEMENT

EASEMENT TO BE OBTAINED

PROPERTY CAN NOT BE SERVICED

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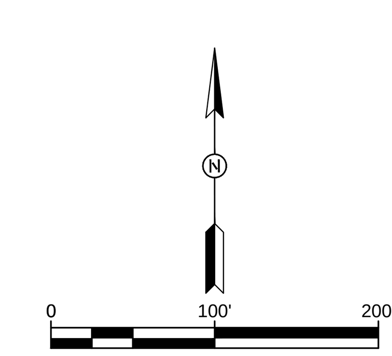

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POSSIBLE EXISTING EASEMENT	(green line)
EASEMENT TO BE OBTAINED	(red line)
PROPERTY CAN NOT BE SERVICED	

PRELIMINARY NOT FOR CONSTRUCTION

CARNUEL
BERNALILLO COUNTY, NEW MEXICO

NO.	REVISION DESCRIPTION	DATE	BY
5			
4			
3			
2			
1			

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

LOW PRESSURE ALTERNATIVE
STA: 36+46 TO STA: 65+35

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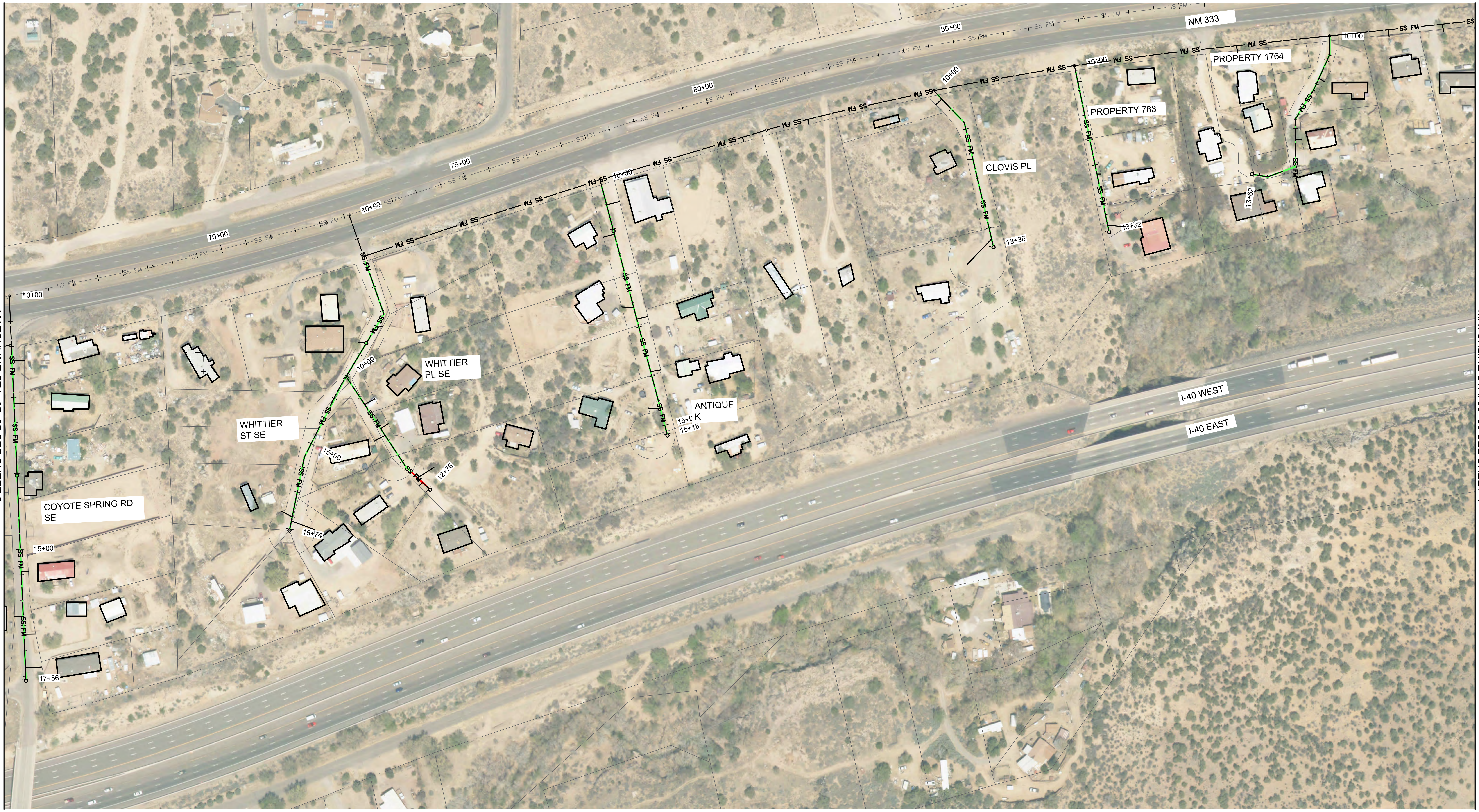
SMITH ENGINEERING

JOB NO: 119115

DATE: AUGUST, 2019

SHEET NO: 2 OF 4



MATCHLINE STA: 65+35 SEE SHEET 2

MATCHLINE STA: 95+36 SEE SHEET 4

LEGEND

POSSIBLE EXISTING EASEMENT

EASEMENT TO BE OBTAINED

PROPERTY CAN NOT BE SERVICED

0 100' 200'

PRELIMINARY NOT FOR CONSTRUCTION

NO.	REVISION DESCRIPTION	DATE	BY
1			
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5			

CARNUEL
BERNALILLO COUNTY, NEW MEXICO

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

LOW PRESSURE ALTERNATIVE
STA: 65+35 TO STA: 95+36

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JOB NO: 119115

DATE: AUGUST, 2019

SHEET NO: 3 OF 4

LEGEND

POSSIBLE EXISTING EASEMENT

EASEMENT TO BE OBTAINED

PROPERTY CAN NOT BE SERVICED

0 100' 200'

PRELIMINARY NOT FOR CONSTRUCTION

NO.	REVISION DESCRIPTION	DATE	BY
1			
2			
3			
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CARNUEL
BERNALILLO COUNTY, NEW MEXICO

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

LOW PRESSURE ALTERNATIVE
STA: 95+36 TO STA: 111+17

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DATE: AUGUST, 2019

SHEET NO: 4 OF 4

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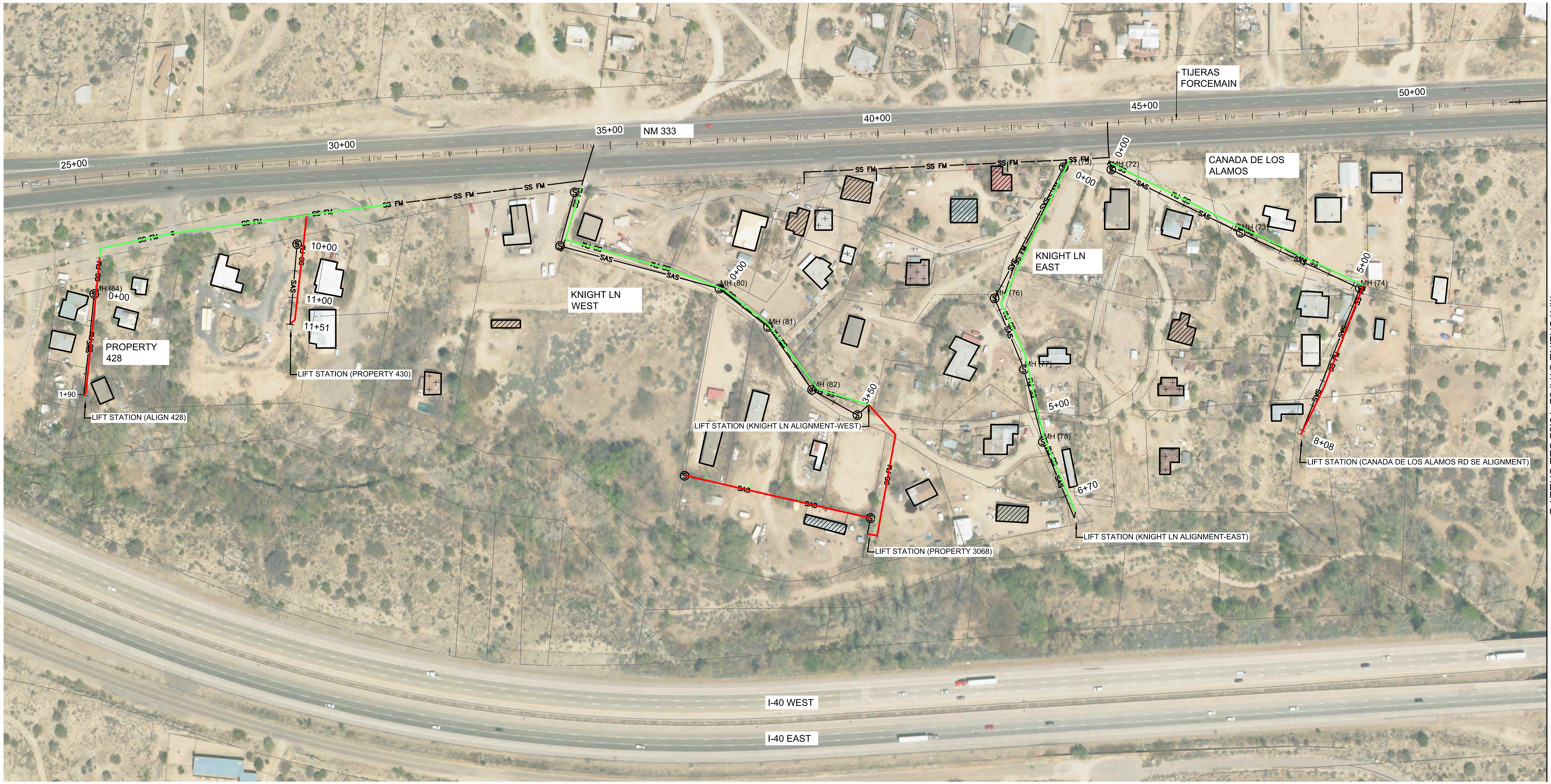
APPENDIX C: GRAVITY/LOW PRESSURE SEWER ALTERNATIVE DESIGN LAYOUT



MATCHLINE STA: 52+70.52 SEE SHEET 2

LIFT STATION	NUMBER OF RESIDENCE HOMES SERVED
PROPERTY 428	5
PROPERTY 430	3
KNIGHT LANE (WEST)	3
KNIGHT LN (WEST 1)	2
PROPERTY 3068	4
KNIGHT LANE (EAST)	4
CANADA DE LOS ALAMOS RD	9

LEGEND

POSSIBLE EXISTING EASEMENT

EASEMENT TO BE OBTAINED

GRINDER PUMP SERVICE

PROPERTY CAN NOT BE SERVICED

0 100' 200'

PRELIMINARY NOT FOR CONSTRUCTION

NO.	REVISION DESCRIPTION	DATE	BY
1			
2			
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5			

CARNUEL
BERNALILLO COUNTY, NEW MEXICO

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

GRAVITY/LOW PRESSURE ALTERNATIVE
STA: 23+86.14 TO STA: 52+70

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SHEET NO: 1 OF 4

LIFT STATION	NUMBER OF RESIDENCE HOMES SERVED
FILBERTO LN (WEST)	3
FILBERTO LN (EAST)	7
PAZ RD (SE)	7
COYOTE LN (SE)	11
COYOTE LN	7

LEGEND

POSSIBLE EXISTING EASEMENT

EASEMENT TO BE OBTAINED

GRINDER PUMP SERVICE

PROPERTY CAN NOT BE SERVICED

PRELIMINARY NOT FOR CONSTRUCTION

NO.	REVISION DESCRIPTION	DATE	BY
1			
2			
3			
4			
5			

CARNUEL
BERNALILLO COUNTY, NEW MEXICO

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

GRAVITY/LOW PRESSURE ALTERNATIVE
STA: 52+70 TO STA: 81+57

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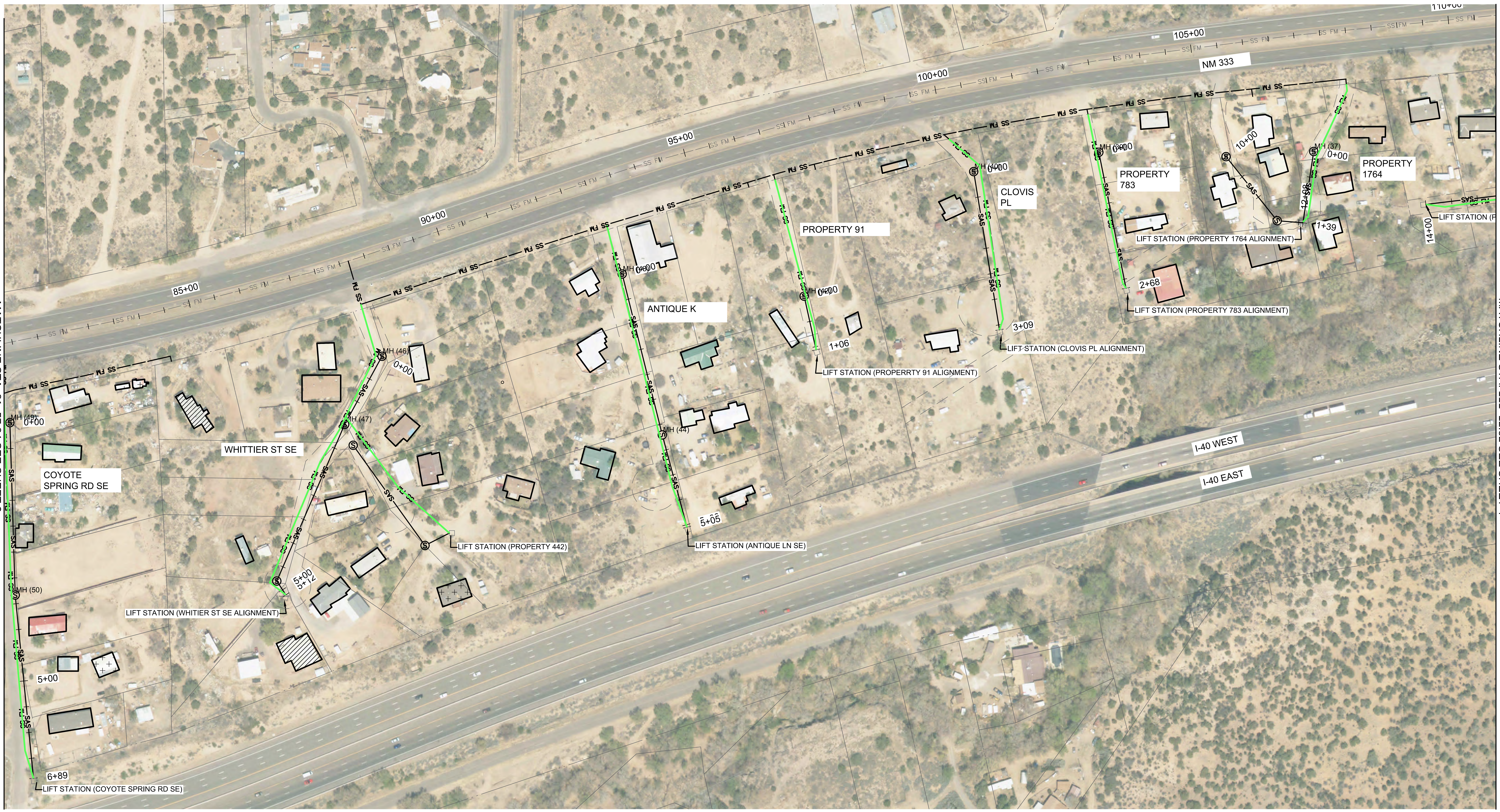
JOB NO: 119115
DATE: AUGUST, 2019
SHEET NO: 2 OF 4



LIFT STATION	NUMBER OF RESIDENCE HOMES SERVED
COYOTE SPRING RD (SE)	7
WHITIER ST (SE)	7
PROPERTY 442	3
ANTIQUE LN (SE)	7
PROPERTY 91	2
CLOVIS PL (SE)	3

LIFT STATION	NUMBER OF RESIDENCE HOMES SERVED
PROPERTY 783	3
PROPERTY 1764	7
PROPERTY 271	4

LEGEND

POSSIBLE EXISTING EASEMENT

EASEMENT TO BE OBTAINED

GRINDER PUMP SERVICE

PROPERTY CAN NOT BE SERVICED

0 100' 200'

PRELIMINARY NOT FOR CONSTRUCTION

CARNUEL
BERNALILLO COUNTY, NEW MEXICO

NO.	REVISION DESCRIPTION	DATE	BY
1			
2			
3			
4			
5			

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

GRAVITY/LOW PRESSURE ALTERNATIVE
STA: 81+57 TO STA: 111+82

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DATE: AUGUST, 2019

SHEET NO: 3 OF 4

MATCHLINE STA: 111+12.82 SEE SHEET 3

LEGEND

POSSIBLE EXISTING EASEMENT

EASEMENT TO BE OBTAINED

GRINDER PUMP SERVICE

PROPERTY CAN NOT BE SERVICED

N

0 100' 200'

PRELIMINARY NOT FOR CONSTRUCTION

CARNUEL
BERNALILLO COUNTY, NEW MEXICO

NO	REVISION DESCRIPTION	DATE	BY
1			
2			
3			
4			
5			

CARNUEL
WASTEWATER SYSTEM IMPROVEMENTS

GRAVITY/LOW PRESSURE ALTERNATIVE
STA: 111+12 TO STA: 130+92

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DATE: AUGUST, 2019

SHEET NO: 4 OF 4

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