NOISE REVIEW

KOLB ROAD

SABINO CANYON RD TO SUNRISE DR

TUCSON, ARIZONA

Prepared for:

PIMA COUNTY

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Pima County Project # 4KSCSD

Psomas Project # 7PIM160201

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1.0 Summary

This noise impact report is evaluating the projected noise impacts from the proposed widening and improvement project for Kolb Road between Sabino Canyon Road to Sunrise Drive in Tucson, Arizona.

The noise study found that there are no locations along the project that exceed the noise limit criteria. Hence, no additional noise mitigation is required.

2.0 Proposed Road Improvement

This project consists of widening approximately 2.1 miles of Kolb Road from two to three lanes (one travel lane per direction and a two-way left turn lane) between the intersections at Sabino Canyon Road and Sunrise Drive. The project will also include construction pedestrian facilities, improved drainage facilities, and the addition of paved shoulders. The overall study area is shown in Figure 1.

3.0 Noise Regulation

Potential negative impact from traffic noise is assessed on the basis of predicted noise levels approaching or exceeding Noise Abatement Criteria (NAC). The project has federal funding and uses the Arizona Department of Transportation (ADOT) Noise Abatement Requirements (NAR) to address noise impacts from road projects.

The ADOT 2017 NAR is the guideline used to assess the potential negative impacts from the highway traffic noise levels. The ADOT 2017 NAR is based on the noise levels approaching the FHWA Noise Abatement Criteria (NAC) impacted noise levels for different land use categories. ADOT defines “approaching” as within 1 dBA of the FHWA NAC for Categories A, B, C, D and E. There are no noise impact thresholds for Categories F or G. Table 1 shows the FHWA NAC for all land use categories.

ADOT 2017 NAR defines a traffic noise impact as:

- 66 dBA or greater for residential impacts and 71 dBA or greater for commercial properties; or,
- When the predicted level increase by 15 dBA or mores over existing noise levels.

Table 1: FHWA Noise Abatement Criteria

TABLE I FHWA NOISE ABATEMENT CRITERIA [1]		
Activity Category	dBA, LAeq1h [2]	Activity Description
A	57 (exterior)	Land on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B	67 (exterior)	Residential
C	67 (exterior)	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio structures, recording studios, schools, and television studios
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in categories A–D or F
F		Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G		Undeveloped lands that are not permitted
1 Sources: Federal Highway Administration (2011); 23 Code of Federal Regulations § 772 2 The 1-hour equivalent loudness in A-weighted decibels, which is the logarithmic average of noise over a 1 hour period		

ADOT 2017 NAR provides criteria for when the use of noise walls for noise abatement mitigation is reasonable and feasible. Where a sound wall is considered all of the following criteria must be met in order to recommend the barrier:

- Generally, it will not be reasonable to provide abatement for isolated developed properties.
- Mitigation is for only the first floor of multi-story residences.
- Barriers must be less than 24 feet tall.
- To be considered acoustically feasible, a noise abatement measure must achieve at least a 5 dBA reduction at 50% of impacted receptors.
- Noise barriers should be designed to reduce projected unmitigated noise levels by at least 7 dBA for benefited receptors closest to the transportation facility. To be considered reasonable, at least half of the benefited receptors in the first row shall achieve this level of noise reduction.
- The maximum reasonable cost of abatement is $49,000 per benefited receptor with barrier costs calculated at $35 per square foot, $85 per square foot if constructed on a structure.
- Non-residential land uses (such as a school) are considered to be more than one noise sensitive receiver. The area of the land is divided by 7,500 ft^2 (the area of a typical lot in Arizona) and multiplied by the land use density factor, to determine the number of noise sensitive receivers.

4.0 Noise Model Approach and Assumptions

For this study, the methods for determining the future noise levels and identifying possible mitigation measures to address future noise levels involved the following series of steps:

- Assess the existing and planned land uses (residential, commercial, industrial, etc.) and determination of sensitive noise receivers within the project corridor.
- Assess the existing conditions (including: traffic volumes; vehicle types; vehicle speeds; roadway layout; area topography; existing walls, and; locations of residences relative to the roadway).
- Predict the existing and future build scenario for a reasonable worse case noise condition using the Federal Highway Administration (FHWA) Traffic Noise Model version 2.5 (TNM 2.5).
- Verify the noise model by measuring the existing noise levels at representative noise sensitive receivers.
- Compare the modeled results with the NAR established by ADOT. Based on the results of the noise monitoring and modeling, potential noise mitigation was examined. This task included noise barrier modeling for noise mitigation as warranted by the results of the noise analysis. Reasonable and feasible mitigation, based on current ADOT Procedures, is then recommended.

4.1 Overview

An assessment of existing and planned land uses (residential, commercial, industrial, etc.) and determination of sensitive noise receivers was undertaken within the project corridor. Aerial photographs and field reconnaissance were used to determine the approximate locations and land use activities of potential sensitive receivers near the roadway. Field measurements were used to determine the existing noise levels throughout the Study Area, as described in Section 5.0, *Noise Model Verification*. Noise levels were measured at three sensitive receiver locations within the project area. The noise measurement locations are representative locations selected to determine the noise impacts along the project.

The TNM 2.5 model was used to predict the noise levels that would occur with the proposed improvements to Kolb Road receiver locations. Roadway geometry and topography, traffic volumes, existing barriers, land features, and the representative sites were entered into TNM 2.5 to replicate the conditions under which the noise level measurements were taken. Modeled noise levels were calculated and compared with the noise levels measured at sensitive receiver locations. This process examines the accuracy of the traffic noise model in performing noise level calculations for this project. Discrepancies in the model's calculations were addressed prior to using it for predicting future noise levels. Traffic volumes and speeds used in the modeling for this project represent "worst case" peak-hour traffic conditions.

Two conditions were modeled using TNM 2.5. Traffic volumes and mix used in the model were based on a traffic counts done by Psomas. Future predictions were based on the Pima Association of Governments (PAG) regional travel demand model and the Psomas Traffic Study. The model estimated the peak-hour traffic noise levels for:

- Existing traffic conditions – the model included the current street configuration and 2016 traffic volumes.
- Future build condition – the model included proposed road improvements and future projected 2040 traffic volumes.

Noise levels for the 2040 traffic and improved roadway conditions were compared with the appropriate noise abatement criterion to determine whether traffic noise mitigation should be considered. The most common form of mitigation are barriers along the roadway.

4.2 TNM 2.5 Modeling

The TNM 2.5 model translated the roads in the Study Area into a series of endpoints on a three-dimensional X, Y, and Z coordinate system. This computer model was developed to comply with FHWA noise regulations and is considered the current standard for roadway noise analyses.

The TNM model requires input data regarding the geometry of roadways in the Study Area, vehicle mix, traffic volumes, and vehicle speeds. The following data were used in the models:

- Vehicle Speeds – the modeled traffic speed was 5 mph higher than the posted speed
    - Kolb Road, north of Sabino Canyon Rd - 35 mph posted
    - Kolb Road, south of Sabino Canyon Rd - 40 mph posted
    - Sunrise Dr – 45 mph posted
    - Territory Dr – 35 mph posted
    - Snyder Rd, west of Kolb – 25 mph posted
    - Snyder Rd, east of Kolb – 35 mph posted
    - Sabino Canyon Rd – 40 mph posted
- Traffic Volumes were provided by Psomas, shown in Table 2.
- Vehicle Mix was provided by Psomas.
    - 80% automobiles
    - 19% light trucks (pick-up trucks)
    - 0.5% medium trucks
    - 0.5% motorcycles
- Elevations – topographic information was used for the roads and receivers. Topographic information was provided by Psomas.
- Ground – “Hard soil” (the ground type was selected in TNM to represent current conditions and to provide predictions that are close to the measurement results)
- Receiver heights – 5 feet above the ground

The proposed roadway and the surrounding arterial streets were defined by a series of roadway segment endpoints. Existing barriers, including residential privacy walls, were included in the model. Receivers were identified as single points and assigned an elevation of 5 feet above the ground to simulate the average height of human hearing. The sound levels were modeled using the A-weighted decibel (dBA), which is the measurement of sound that most closely approximates the sensitivity of the human ear. The noise level results are presented in LAeq1h, the equivalent average sound level measured for 1 hour, approximating the sensitivity of the human ear.

Table 2: Peak Hour Traffic Volumes AM (PM)

Road		Existing Volumes (2016)	Future Volumes (2040)
Kolb Road - Northbound	North of Sunrise	385 (299)	434(337)
Kolb Road - Southbound		419(313)	472(352)
Kolb Road - Northbound	Between Territory and Sunrise	582(459)	656(517)
Kolb Road - Southbound		461(616)	475(711)
Kolb Road - Northbound	Between Snyder and Territory	533(441)	601(497)
Kolb Road - Southbound		425(605)	494(656)
Kolb Road - Northbound	Between Sabino Canyon and Snyder	457(495)	515(558)
Kolb Road - Southbound		532(536)	717(676)
Kolb Road - Northbound	South of Sabino Canyon	984(1031)	1109(1162)
Kolb Road - Southbound		1384(1010)	1560(1138)
Sunrise – West of Kolb Road		1649(1423)	1859(1603)
Sunrise – East of Kolb Road		1010(798)	1138(899)
Territory – West of Kolb Road		180(249)	230(404)
Snyder – East of Kolb Road		31(31)	34(43)
Snyder – West of Kolb Road		330(313)	372(353)
Sabino Canyon – East of Kolb Road		1271(957)	1433(1078)

The vehicles were classified as automobiles (four wheels), medium trucks (2-axle long, buses, 2-axle 6 tire), and heavy trucks (3 to 6-axle vehicles). Each of these vehicle types generates noise from a different height above the roadway, called the source height.

TNM 2.5 uses the above-described information to calculate the noise contribution from each roadway segment to each receiver and then determine the cumulative effect of all roadway noise sources for each receiver. Validation studies conducted at the Volpe National Transportation Systems Center, a facility of the United States Department of Transportation Research and Innovative Technology Administration, show that the TNM 2.5 model typically predicts noise levels within an acceptable range of accuracy.

4.3 Analysis Limitations

This noise analysis is based on design and traffic information available at the time of the analysis.

While the TNM 2.5 model has been calibrated and tested against actual noise measurements for several years, it should be noted that it is still a noise prediction model. The results of this analysis assume the predicting capabilities of TNM are sufficient. Assumptions have been made to simplify the calculations for TNM.

- The receiver (representing human hearing) is 5 feet above ground.
- The angle of view from the receiver to the road is 180 degrees.
- The terrain between the roadway and the receiver is flat.
- The ground type is consistent throughout the project area.

The noise levels used in the predictions are measured as peak hour A-weighted Leq (LAeq1h), described in Appendix C. The A-weighted average that represents the steady level over 1 hour that would produce the same energy as the actual signal. The actual instantaneous noise levels fluctuate above and below the measured Leq during the measurement period (e.g., a police siren, a particularly noisy truck, or unusually high traffic volumes). Therefore, the use of LAeq1h for predicting noise levels and conducting the noise evaluation does not consider the noise levels as they may occur in their full range. The fluctuation of instantaneous noise levels will result in sounds that temporarily exceed (and be below) the Leq noise levels as they have been presented in the noise evaluation.

5.0 Noise Model Verification

Noise measurements are conducted to verify and calibrate the noise model. Noise measurement locations are selected in each representative area with varying traffic conditions, topography, distance from the noise source and obstructions (FHWA "Measurements of Highway Related Noise"). There is no clearly defined number or location of required noise measurements; however, each distinct part of a project should be verified with at least one noise level measurement.

Table 3 shows the measured and predicted noise levels at the six locations. Noise measurements were made on Thursday, June 22, 2017 and Tuesday, June 27, 2017 between 7:00 AM and 9:30 AM. The purpose of the noise level measurements was to document the existing noise level environment in the project area and capture the contribution of traffic noise from Kolb Road.

The equipment used for the noise level measurements were Larson Davis (LD) Models 820 precision integrating sound level meters (SLMs). The SLMs were calibrated in the field before use with an LD Model CAL-200 acoustical calibrator. The SLMs used for noise level measurements comply with the American National Standards Institute (ANSI) S1.4-1971 for a Type 1 SLM. The methodology used for the noise level measurements complied with procedures specified in Section 4 of the FHWA document FHWA-PD-96-046/DOT-VNTC-FHWA-96-5, Measurement of Highway-Related Noise (FHWA, 1996).

Noise measurements were made at Locations A, B, C, D, E and F, as shown in Figures 2 and 3. Noise measurement forms are located at the back of this report. The measured and predicted noise levels at these locations is shown in Table 3.

Table 3: June 22 and 27, 2017 Noise Measurements and Predictions Adjacent to Kolb Rd

Site ID	Location Description	Measured Noise Level (Leq)	Predicted Noise Level
A	7050 E Sunrise Rd	66	66
B	5281 N Rocky Ridge Pl	55	55
C	7255 E Snyder Rd	68	69
D	4700 N Kolb Rd	69	68
E	7161 E Painted Quail Circle	63*	63
F	7271 E Gambel Circle	66	65

*estimated traffic noise level – cicadas increased the overall measured level at this location

The predicted noise levels are within 1 dBA of the measured noise level. This verifies the accuracy of the noise model. These levels are measured at locations between the residence and the roadway on the outside of any barrier, which accounts for the increased levels over the table below.

6.0 Noise Model Predictions Results

Noise levels were evaluated at 12 locations in the project area. Existing barriers were factored into the model, with prediction sites located on the residence side of any existing barrier.

Table 4: Predicted Noise Levels from Kolb Road

Receiver ID	Receiver Location	Predicted Before Project (2016) Hourly Leq (dBA) AM / PM	Future (2040) Hourly Leq (dBA) AM / PM	Noise Limit (dBA)
1	7050 E Sunrise Rd	62 / 62	62 / 62	66
2	5348 N Gate Ridge Rd	53 / 53	53 / 54	66
3	5281 N Rocky Ridge Pl	50 / 50	51 / 51	66
4	5100 N Kolb Rd	61 / 60	61 / 61	66
5	5041 N Kolb Rd	63 / 63	63 / 64	66
6	7255 E Snyder Rd	51 / 51	51 / 51	66
7	4700 N Kolb Rd	50 / 50	51 / 51	66
8	Quail Canyon Two	46 / 46	47 / 47	66
9	7171 E Quail Run Dr	59 / 59	60 / 60	66
10	7161 E Painted Quail Circle	59 / 59	60 / 60	66
11	7223 E Inca Dove Dr	62 / 63	63 / 63	66
12	7271 E Gambel Circle	52 / 52	53 / 53	66
13	7261 E Cripple Creek Dr	55 / 55	56 / 56	66
14	7282 E Clayridge Rd	54 / 54	55 / 55	66
15	4200 N Ventana Dr	60 / 60	60 / 60	66

As shown in Table 4, the predicted future noise levels are below the noise limits at all locations along the project.

7.0 Construction Noise

Short-term noise impacts may be experienced during the construction of any part of the proposed improvements within the project Study Area. Properties in the vicinity of the project area would be exposed to noise from construction activities.

Construction noise differs from traffic noise in several ways:

- Construction noise lasts only for the duration of the construction contract, with most construction activities in noise-sensitive areas being conducted during hours that are least disturbing to adjacent and nearby residents.
- Construction activities generally are of a short-term nature, and depend on the nature of construction operations.
- Construction noise also is intermittent and depends on the type of operation, location, and function of the equipment, and the equipment usage cycle. Traffic noise, on the other hand, is present in a more continuous fashion after construction activities are completed.

Adjacent properties in the project area would be exposed to noise from construction activity.

Table 6 shows the noise levels produced by various types of construction equipment. The types of construction equipment used for this project will typically generate noise levels of 80 to 90 dBA at a distance of 15 meters (50 feet) while the equipment is operating. Construction equipment operations can vary from intermittent to fairly continuous, with multiple pieces of equipment operating concurrently.

Table 6: Typical Construction Equipment Noise Levels

Type of Equipment	Noise Level in dBA at 50 Feet
Bulldozer	80
Front Loader	72 – 84
Jack Hammer or Rock Drill	81 – 98
Crane with Headache Ball	75 – 87
Backhoe	72 – 93
Scraper and Grader	80 – 93
Electrical Generator	71 – 82
Concrete Pump	81 – 83
Concrete Vibrator	76
Concrete and Dump Trucks	83 – 90
Air Compressor	74 – 87
Pile Drivers (Peaks)	95 – 106
Pneumatic Tools	81 – 98
Roller (Compactor)	73 – 75
Saws	73 – 82
Source: U.S. EPA Noise from Construction Equipment and Operations	

Locations within about 500 meters (1,650 feet) of a construction site are expected to experience occasional episodes of noise levels greater than 60 dBA. Areas within about 150 meters (500 feet)

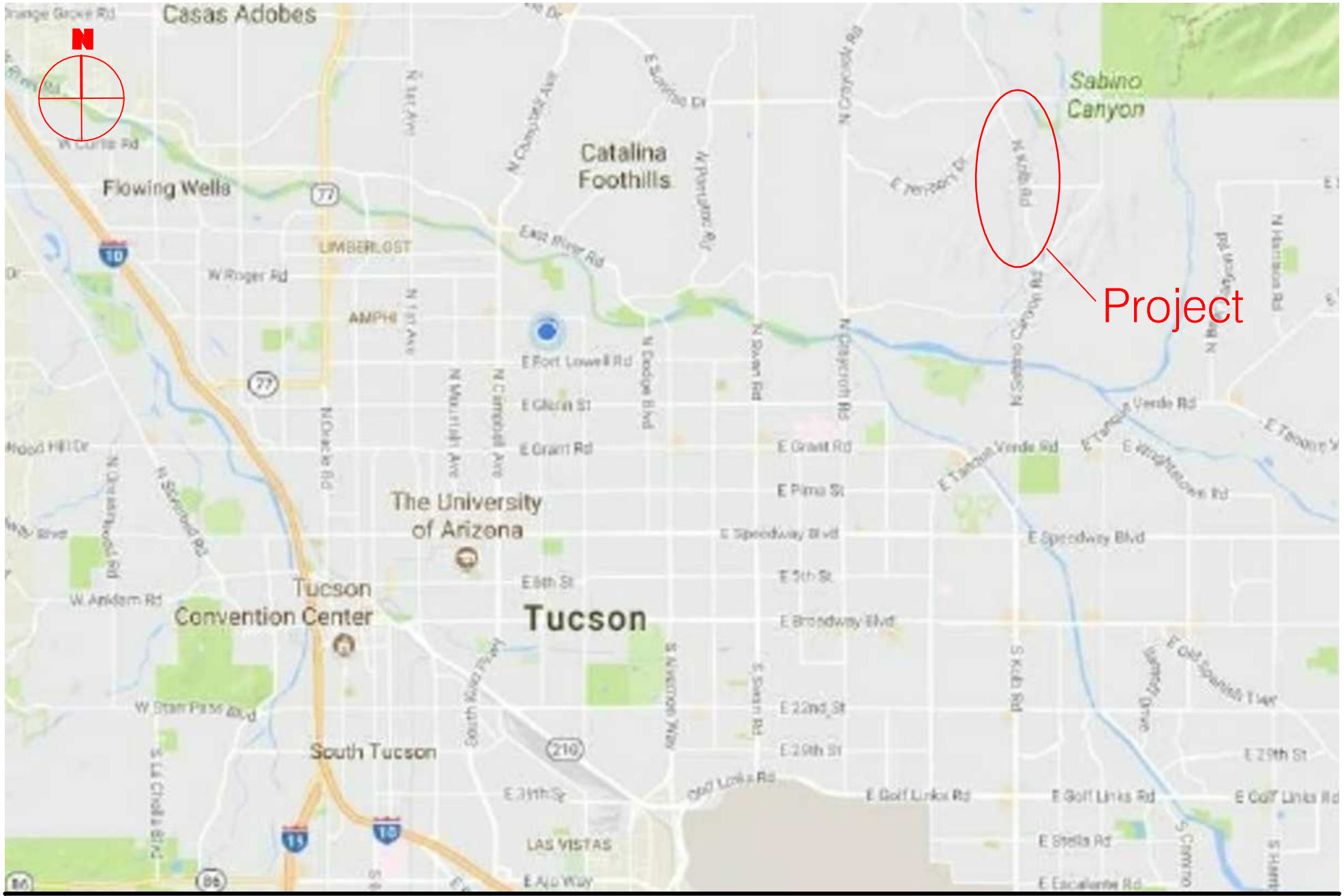
of a construction site will experience episodes with noise levels greater than 70 dBA. Such episodes of high noise levels will not be continuous throughout the day and will generally be restricted to daytime hours.

The following noise mitigation measures are recommended to reduce impacts from construction noise; however, not all measures may be feasible for the project:

- Re-route truck traffic away from residential streets, if possible. Select streets with fewest homes, if no alternatives are available.
- Locate equipment on the construction lot as far away from noise sensitive receivers as possible.
- Combine noisy operations to occur in the same time period. The total noise will not increase significantly and the duration of the noise impact will be less.
- Avoid nighttime activities. Sensitivity to noise increases during the nighttime hours at residential receivers.
- Use specially quieted equipment when possible, such as quieted and enclosed air compressors, residential or critical grade mufflers on all engines.
- Stationary equipment will be located as far away from sensitive receptors as possible. Loud, disrupting construction activities in noise sensitive areas will be conducted during hours that are least disturbing to adjacent and nearby residents.

APPENDIX A

Figures



NE Project: 16061 | *July 15, 2017* | *Bill Holliday, PE*

Figure No. 1

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Kolb Road, Sabino Canyon Rd to Sunrise Dr
Tucson, Arizona

DESCRIPTION: Vicnity Map

SCALE: N/A

Key

A Measurement Locations

1 Prediction Locations

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Figure No. 2

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Kolb Road, Sabino Canyon Rd to Sunrise Dr
Tucson, Arizona

DESCRIPTION: North Project

SCALE: N/A

Key

A Measurement Locations

1 Prediction Locations

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Figure No. 3

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Kolb Road, Sabino Canyon Rd to Sunrise Dr
Tucson, Arizona

DESCRIPTION: South Project

SCALE: N/A

APPENDIX B

Noise Measurement Field Forms

Sound Solutions
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Date _06/22/2017_ Project Number _____16061_____ Project Name __Kolb Rd. – Sabino to Sunrise ___

Project Location ___ Tucson, ARIZONA _____ Measurement Location Number_____A_____

Measurement Location Description____East side Kolb Rd_- Pinnacle Canyon Condos_____

Measurement Location (address)_____ 7050 E Sunrise rd_____ Time _7:05 AM Duration___30 min___

Day of the Week ___Thursday_____ Wind Speed ___2 mph_ Wind Direction __from_E_ Clouds _____clear_____

Temperature_85 F__ Humidity ___40___ Weather Condition_____clear_and hot_____

Average Noise Level _____66_____ Max Noise Level ____77_____ Min Noise Level _____50_____

Measurement Data						Traffic Count Data									
Sample	Time		Sound Level (dBA)			Auto		Med Truck		Heavy Truck		Bus		Motorcycle	
	Start	Duration	Leq	Lmin	Lmax	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
1	7 :05	10	65	50	77	31	31								
2	7 :15	10	67	55	74	27	22								
3	7 :25	10	67	57	72	36	35								

Sample	Background Noise	Unusual Noise Event
1.	traffic on Kolb – Distant leafblower	
2.	traffic on Kolb– truck idles across the street	
3.	traffic on Kolb	

Observations

Reciever is a an apartment complex just south of sunrise rd. The buildings have two stories, the elevation change means that some of these are below and some are above the road grade. The parking lot has a 3ft wall on the west side facing traffic

Photos

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Date _06/22/2017_ Project Number _____16061_____ Project Name __Kolb Rd. – Sabino to Sunrise ___

Project Location ___ Tucson, ARIZONA _____ Measurement Location Number_____**B**_____

Measurement Location Description____East side Kolb Rd _____

Measurement Location (address)_____ 5281 N Rocky Ridge Pl_____ Time _7:50 AM Duration___30 min___

Day of the Week ___Thursday_____ Wind Speed ___5 mph_ Wind Direction __from_E_ Clouds _____clear_____

Temperature_87 F__ Humidity ___20___ Weather Condition_____clear_and hot_____

Average Noise Level _____55_____ Max Noise Level ____66_____ Min Noise Level _____39_____

Measurement Data						Traffic Count Data									
Sample	Time		Sound Level (dBA)			Auto		Med Truck		Heavy Truck		Bus		Motorcycle	
	Start	Duration	Leq	Lmin	Lmax	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
1	7 :50	10	56	41	66	29	29		2		1				
2	8 :00	10	55	40	62	33	30		2						
3	8 :10	10	55	39	62	27	26	1							

Sample	Background Noise	Unusual Noise Event
1.	traffic on Kolb – Cicadas buzz	Medium Truck – 65 dBA Bird – 60 dBA
2.	traffic on Kolb– Cicadas buzz	
3.	traffic on Kolb– Cicadas buzz	

Observations

Reciever is a single family residence that is even with the roadway. Seperated by a wash. Residence has a 6ft wall that transitions to 5 ft

Photos

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Date _06/22/2017_ Project Number _____16061_____ Project Name __Kolb Rd. – Sabino to Sunrise ___

Project Location ___ Tucson, ARIZONA _____ Measurement Location Number_____C_____

Measurement Location Description____East side Kolb Rd north of snyder – Villas at Sabino Canyon_____

Measurement Location (address)_____ 7255 E Snyder Rd_____ Time _8:30 AM Duration___30 min___

Day of the Week ___Tuesday_____ Wind Speed ___2 mph_ Wind Direction __from SE_ Clouds _____clear_____

Temperature_91 F__ Humidity ___41___ Weather Condition_____clear_and hot_____

Average Noise Level _____68_____ Max Noise Level ____90_____ Min Noise Level _____42_____

Measurement Data						Traffic Count Data									
Sample	Time		Sound Level (dBA)			Auto		Med Truck		Heavy Truck		Bus		Motorcycle	
	Start	Duration	Leq	Lmin	Lmax	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
1	8 :30	10	67	34	77	33	35			1					1
2	8 :40	10	68	46	85	49	31	1							
3	8 :50	10	69	42	90	34	34	1							

Sample	Background Noise	Unusual Noise Event
1.	traffic on Kolb	
2.	traffic on Kolb	Person walks on gravel - 68 dBA
3.	traffic on Kolb	Heavy Truck – 87 dBA Siren – 90 dBA

Observations

Reciever is a large 2 story apartment complex that is sunken below road grade. 2nd floor recievers are 2 to 3 feet below roadway and have direct line of sight. Measurements were made on the slope just east of the road-grade.

Photos

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Date _06/27/2017_ Project Number _____16061_____ Project Name __Kolb Rd. – Sabino to Sunrise ___

Project Location ___ Tucson, ARIZONA _____ Measurement Location Number_____D_____

Measurement Location Description____East side Kolb Rd south of snyder – Arboretum Apartments_____

Measurement Location (address)_____ 4700 N Kolb Rd_____ Time _8:30 AM Duration___30 min___

Day of the Week ___Tuesday_____ Wind Speed ___5 mph_ Wind Direction __from SE_ Clouds _____clear_____

Temperature_90 F__ Humidity ___41___ Weather Condition_____clear_and hot_____

Average Noise Level _____69_____ Max Noise Level ____83_____ Min Noise Level _____49_____

Measurement Data						Traffic Count Data									
Sample	Time		Sound Level (dBA)			Auto		Med Truck		Heavy Truck		Bus		Motorcycle	
	Start	Duration	Leq	Lmin	Lmax	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
1	8 :30	10	70	56	83	25	46								1
2	8 :40	10	69	55	82	18	35								
3	8 :50	10	69	49	72	40	29								

Sample	Background Noise	Unusual Noise Event
1.	traffic on Kolb	
2.	traffic on Kolb	Leaf Blower – 64 dBA
3.	traffic on Kolb	Medium Truck – 87 dBA

Observations

Reciever is a large 2 story apartment complex that is sunken one story below road grade. 2nd floor recievers have direct line of sight to roadway. A 2 to 3 foot wall at the edge of the ROW does not block the line of sight. Measurements were made on the road-grade just in front of the wall.

Photos

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Date _06/27/2017_ Project Number _____16061_____ Project Name __Kolb Rd. – Sabino to Sunrise ___

Project Location ___ Tucson, ARIZONA _____ Measurement Location Number_____E_____

Measurement Location Description____West side Kolb Rd _____

Measurement Location (address)_____ 7161 E Painted Quail Circle_____ Time _7:50 AM Duration___30 min___

Day of the Week ___Tuesday_____ Wind Speed ___3 mph_ Wind Direction __from SE_ Clouds _____clear_____

Temperature_80 F__ Humidity ___41___ Weather Condition_____clear_and hot_____

Average Noise Level _____68_____ Max Noise Level ____72_____ Min Noise Level _____55_____

Measurement Data						Traffic Count Data									
Sample	Time		Sound Level (dBA)			Auto		Med Truck		Heavy Truck		Bus		Motorcycle	
	Start	Duration	Leq	Lmin	Lmax	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
1	7:50	10	68	56	71	33	31			1					
2	8 :00	10	68	59	72	37	41								
3	8 :10	10	68	55	72	40	29								

Sample	Background Noise	Unusual Noise Event
1.	traffic on Kolb – cicadas buzz	Cicadas – 66 dBA Traffic – 63 dBA
2.	traffic on Kolb – cicadas buzz	Cicadas – 67 dBA Traffic – 63 dBA
3.	traffic on Kolb – cicadas buzz	Dog Bark – 61 dBA Cicadas – 67 dBA Traffic – 63 dBA

Observations

Measurement location is even with roadway. Residence has elevated foundation and 4 foot wall. The residence is seperated from the road by a minor wash.

Photos

Sound Solutions
Acoustical Consulting

Tucson, AZ 520-979-2213
Phoenix, AZ 480-332-9325
San Diego, CA 619-449-4843
Las Vegas, NV 702-989-2406
Mexico 011-521-631-181-2931

info@noiseengineers.com
www.noiseengineers.com

Date _06/27/2017_ Project Number _____16061_____ Project Name __Kolb Rd. – Sabino to Sunrise ___

Project Location ___ Tucson, ARIZONA _____ Measurement Location Number_____F_____

Measurement Location Description____East side Kolb Rd – southern most measurement site _____

Measurement Location (address)_____ 7271 E Gambel Circle _____ Time _7:00 AM Duration___30 min___

Day of the Week ___Tuesday_____ Wind Speed ___3 mph_ Wind Direction __from SE_ Clouds _____clear_____

Temperature_80 F__ Humidity ___40___ Weather Condition_____clear_and hot_____

Average Noise Level _____66_____ Max Noise Level ____75_____ Min Noise Level _____44_____

Measurement Data						Traffic Count Data									
Sample	Time		Sound Level (dBA)			Auto		Med Truck		Heavy Truck		Bus		Motorcycle	
	Start	Duration	Leq	Lmin	Lmax	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
1	7:00	10	66	55	75	35	25								
2	7 10	10	66	44	74	38	29	1		1					1
3	7:20	10	67	46	74	40	53				1				

Sample	Background Noise	Unusual Noise Event
1.	traffic on Kolb – cicdas buzz	
2.	traffic on Kolb – cicdas buzz	Heavy Truck – 74 dBA
3.	traffic on Kolb – cicdas buzz	

Observations

Measurement location elevated above road with clear line of sight. Residence has no wall and is elevated approx. 8 feet above roadway

Photos

APPENDIX C

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as "unwanted" sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 μPa, which is approximately the lowest sound pressure that can be detected by the human ear.

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, background noise, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines) at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the human auditory system does. Thus the A-weighted sound level (read as "dBA") becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown in Table 7.

Equivalent Sound Level

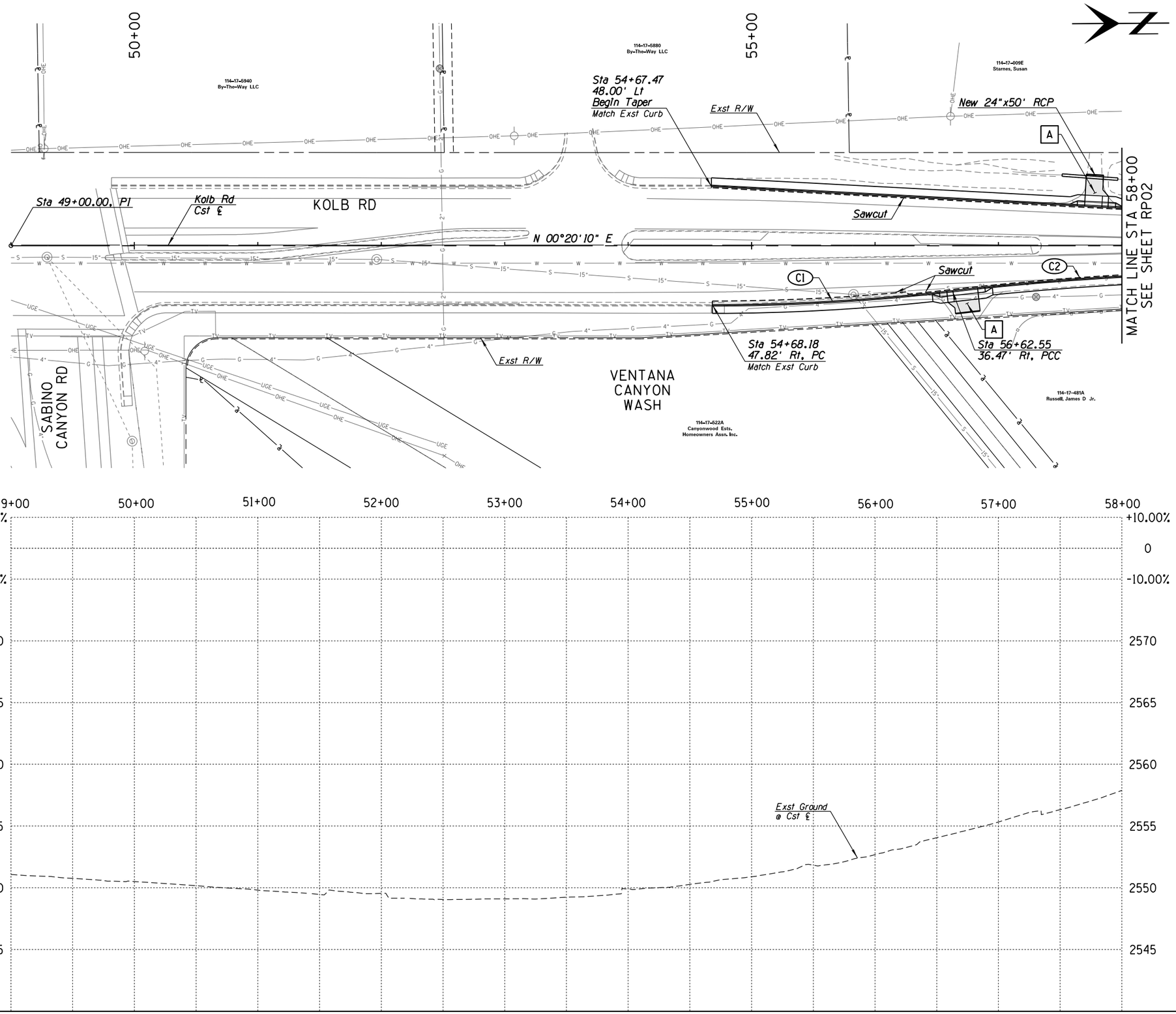
The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise.

Table 7: Common Sound Levels in dBA

Common Outdoor Sounds	Sound Pressure Level (dBA)	Common Indoor Sounds	Subjective Evaluation
Auto horn at 10’ Jackhammer at 50’	**100**	Printing plant	Deafening
Gas lawn mower at 4’ Pneumatic drill at 50’	**90**	Auditorium during applause Food blender at 3’	Very Loud
Concrete mixer at 50’ Jet flyover at 5000’	**80**	Telephone ringing at 8’ Vacuum cleaner at 5’	
Large dog barking at 50’ Large transformer at 50’	**70**	Electric shaver at 1’	Loud
Automobile at 55 mph at 150’ Urban residential	**60**	Normal conversation at 3’	
Small town residence	**50**	Office noise Dishwasher in adjacent room	Moderate
	40	Soft stereo music in residence Library	
Rustling leaves	**30**	Average bedroom at night Soft whisper at 3’	Faint
Quiet rural nighttime	**20**	Broadcast and recording studio	
	10	Human breathing	Very Faint
	0	Threshold of hearing (audibility)	
Source: Noise Expert measurements and reference library			

APPENDIX D

Plan and Profile Drawings



A Estimated driveway geometry.
Exact limits to be refined later.

Curve Table				
Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C1	1684.33	194.81	06°37'37"	97.52
C2	2283.84	194.91	04°53'23"	97.52

0 40' 80'

Call at least two full working days before you begin excavation
ARIZONA 811
Blue Stake, Inc.
Dial 8-1-1 or 1-800-STAKE-IT (782-5348)
In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP01 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

PIMA COUNTY DEPARTMENT OF TRANSPORTATION

ROADWAY PLAN AND PROFILE
FOR
KOLB ROAD
SABINO CANYON ROAD TO SUNRISE DRIVE
STA 49+00 TO STA 58+00

No.	Revision Description	Engineer	Date

		Date
Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

Initial Design
Phase Plans
Design Review

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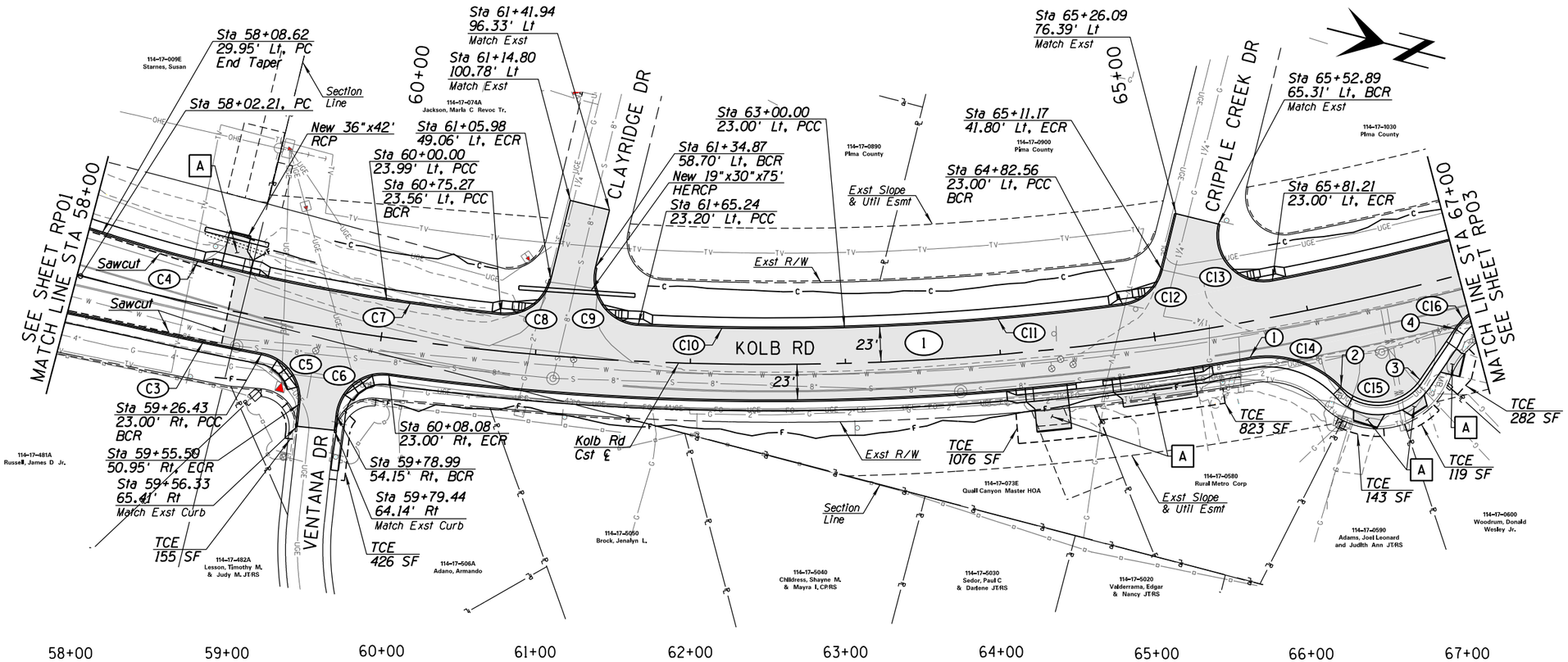

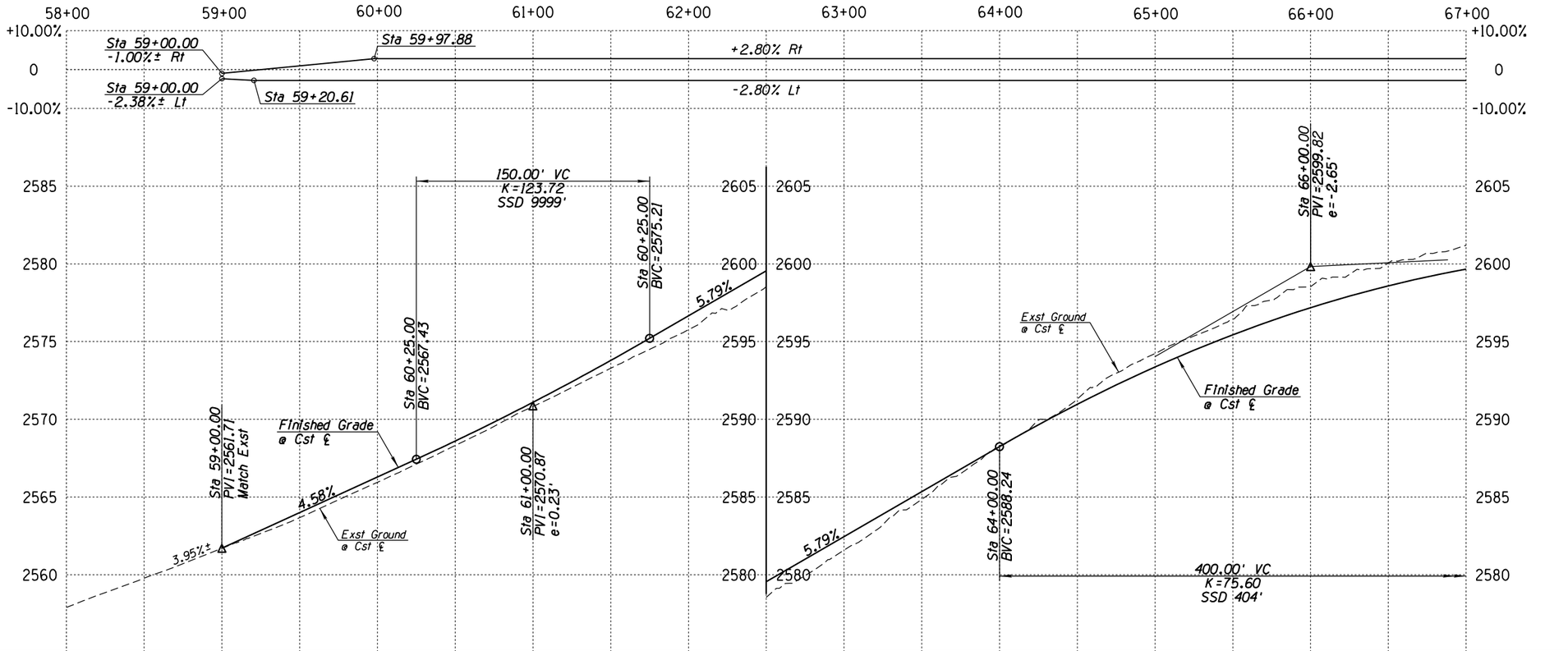

CURVE DATA

(1)

R = 1750.00'
L = 1060.99'
Δ = 34°44'15"
T = 547.37'
D = 03°16'27"

(1) Sta 65+58.16, 23.00' Rt, PC

(2) Sta 66+11.01, 52.67' Rt, PCC

(3) Sta 66+60.10, 59.46' Rt, PT

(4) Sta 66+89.13, 32.78' Rt, PC

[A] DW Geometry TBD

Curve Table

Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C3	1773.00	71.17	02°17'60"	35.59
C4	1185.05	188.63	09°07'12"	94.51
C5	30.00	44.83	85°36'40"	27.79
C6	30.00	48.02	91°42'56"	30.91
C7	1661.88	74.25	02°33'35"	37.13
C8	30.00	43.03	82°10'26"	26.16
C9	30.00	52.82	100°53'12"	36.32
C10	1661.88	132.98	04°35'05"	66.53
C11	1727.00	180.16	05°58'38"	90.16
C12	30.00	35.89	68°32'55"	20.44
C13	30.00	60.05	114°40'52"	46.80
C14	65.78	64.11	55°50'33"	34.86
C15	33.00	58.45	101°29'16"	40.38
C16	40.00	28.29	40°31'19"	14.77

0 40' 80'

Call at least two full working days before you begin excavation. ARIZONA 811 Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP02 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

Designed	M. ASHBY	5/17
Drawn	M. ASHBY	5/17
Checked	K. THORNTON	5/17
Proj. Engr.	K. THORNTON	5/17

No.	Revision Description	Engineer	Date

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Phase Plans
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ROADWAY PLAN AND PROFILE
FOR
KOLB ROAD
SABINO CANYON ROAD TO SUNRISE DRIVE
STA 58+00 TO STA 67+00

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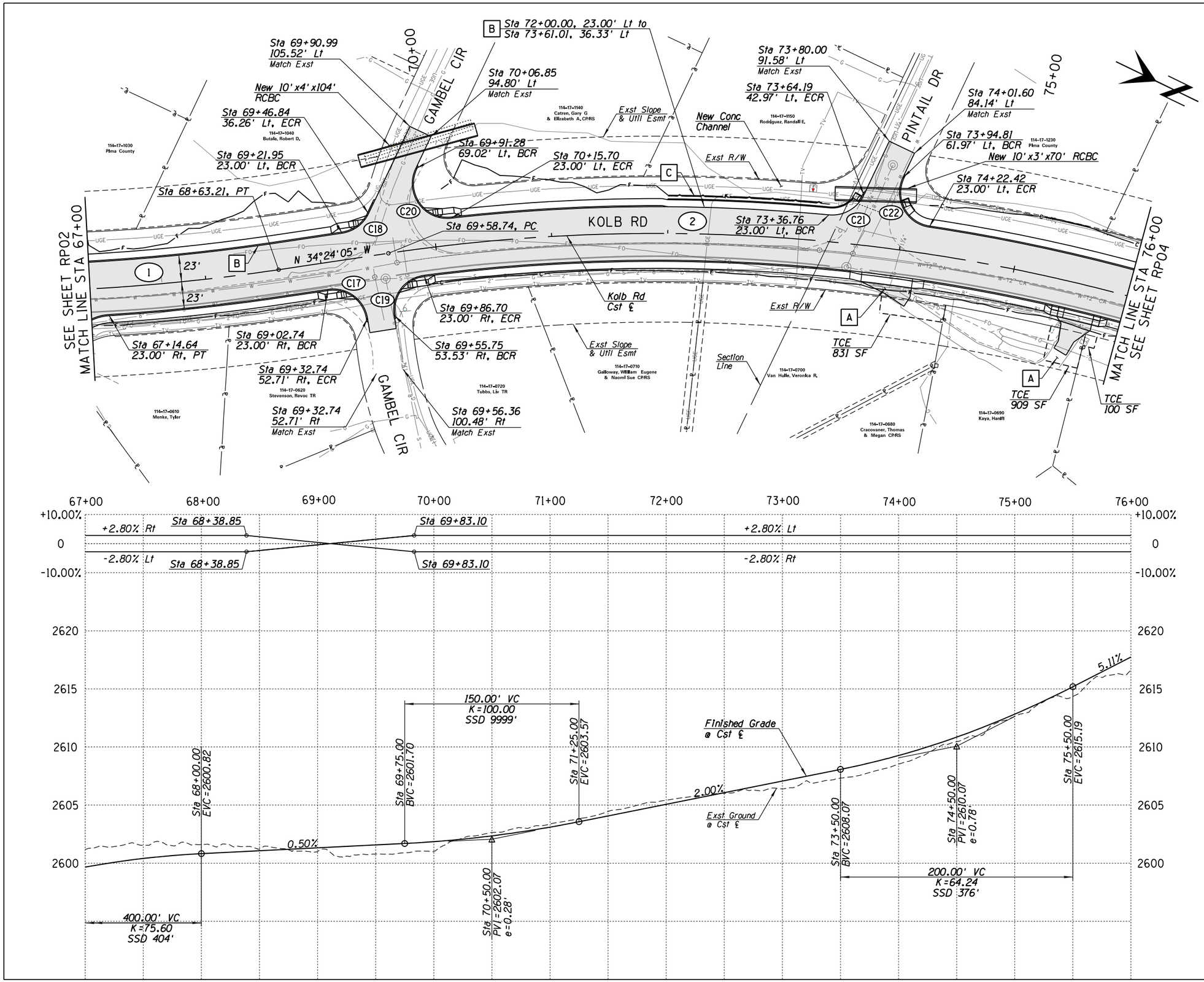

CURVE DATA

(1)	(2)
R= 1750.00'	R= 1560.00'
L= 1060.99'	L= 895.43'
Δ= 34°44'15"	Δ= 32°53'14"
T= 547.37'	T= 460.42'
D= 03°16'27"	D= 03°40'22"

A Estimated driveway geometry. Exact limits to be refined later.

B Conc Half-Barrier (H=42") with Integral 6' Sidewalk

C New CIP retaining wall Sta 72+00.00, 32.26' Lt to Sta 73+36.76, 32.26' Lt

Curve Table

Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C17	30.00	46.84	89°26'56"	29.71
C18	30.00	29.37	56°05'21"	15.98
C19	30.00	47.95	91°34'41"	30.84
C20	30.00	63.78	121°49'08"	53.92
C21	30.00	36.64	69°58'10"	20.99
C22	30.00	55.96	106°53'04"	40.46

0 40' 80'

Call at least two full working days before you begin excavation. ARIZONA 811 Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP03 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

		Date
Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

No.	Revision Description	Engineer	Date

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SABINO CANYON ROAD TO SUNRISE DRIVE
STA 67+00 TO STA 76+00

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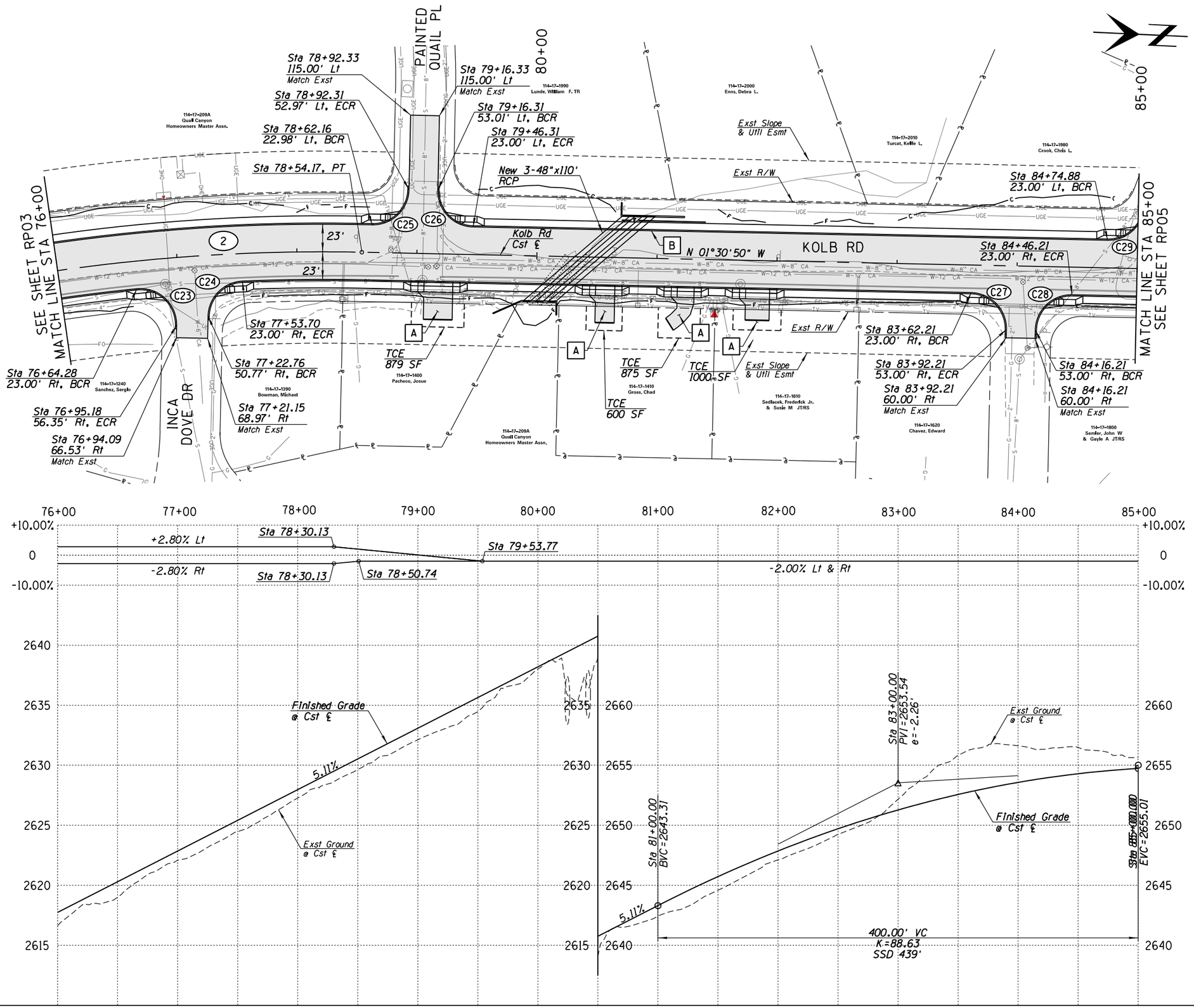

CURVE DATA

(2)

R = 1560.00'
L = 895.43'
Δ = 32°53'14"
T = 460.42'
D = 03°40'22"

A Estimated driveway geometry. Exact limits to be refined later.

B New guardrail

Curve Table				
Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C23	30.00	50.78	96°58'46"	33.90
C24	30.00	45.19	86°18'18"	28.13
C25	30.00	47.27	90°16'38"	30.15
C26	30.00	47.13	90°00'43"	30.01
C27	30.00	47.12	90°00'00"	30.00
C28	30.00	47.12	90°00'00"	30.00
C29	30.00	38.15	72°51'34"	22.14

0 40' 80'

Call at least two full working days before you begin excavation. ARIZONA 811 Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP04 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

		Date
Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

No.	Revision Description	Engineer	Date

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SABINO CANYON ROAD TO SUNRISE DRIVE
STA 76+00 TO STA 85+00

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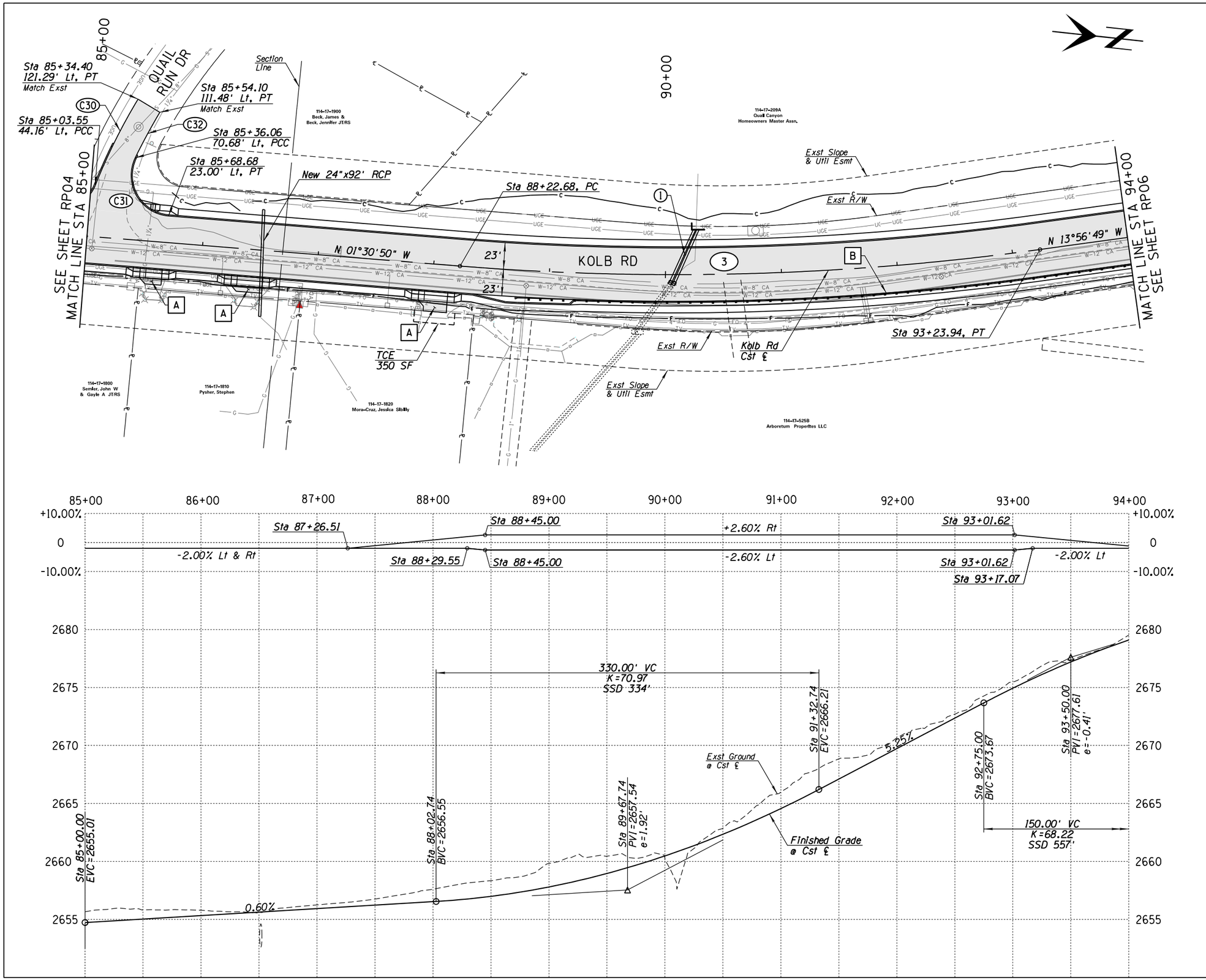

CURVE DATA

(3)

R= 2310.00'
L= 501.26'
Δ= 12°25'59"
T= 251.62'
D= 02°28'49"

A Estimated driveway geometry. Exact limits to be refined later.

B New guardrail

(1) Pipe extension 2-24" CMP and new headwall

Curve Table				
Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C30	511.00	83.16	09°19'29"	41.67
C31	35.00	67.95	111°14'08"	51.15
C32	489.00	44.63	05°13'46"	22.33

0 40' 80'

Call at least two full working days before you begin excavation. ARIZONA 811 Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP05 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

No.	Revision Description	Engineer	Date

		Date
Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

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STA 85+00 TO STA 94+00

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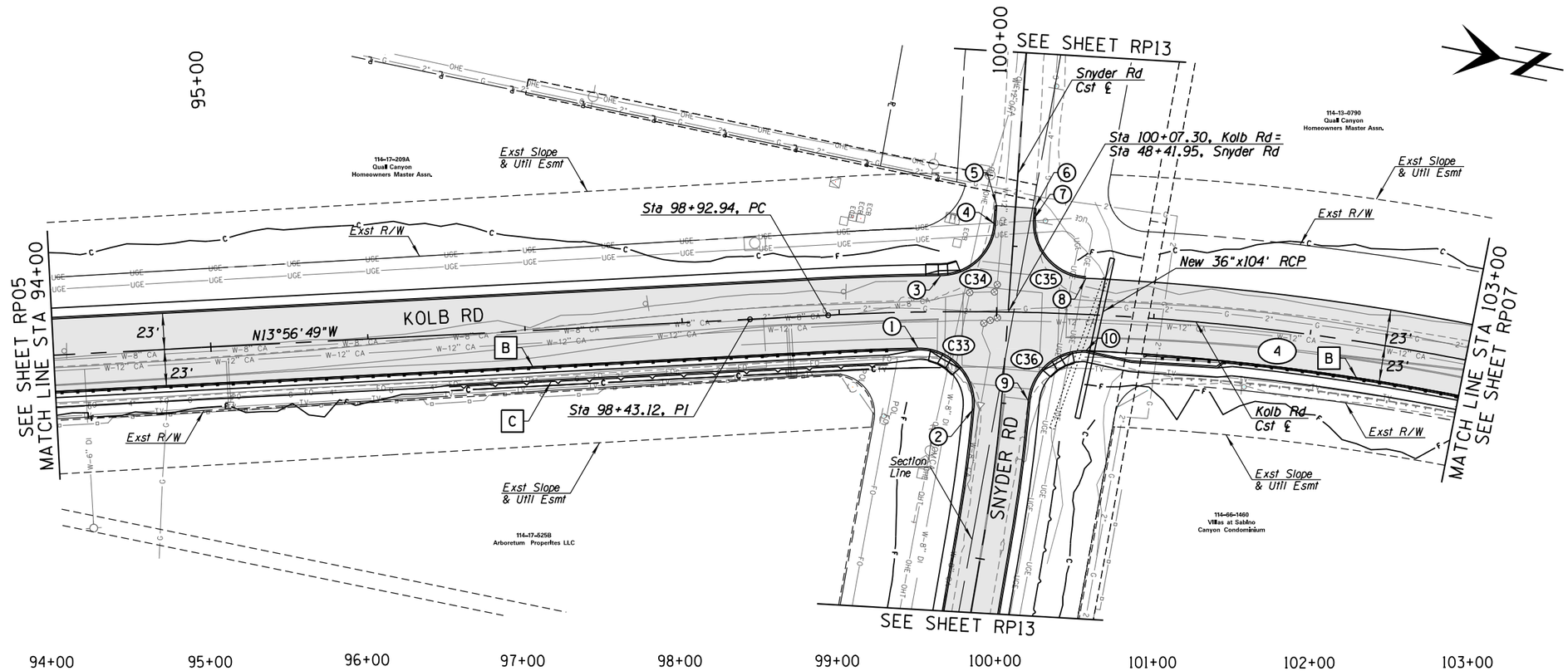

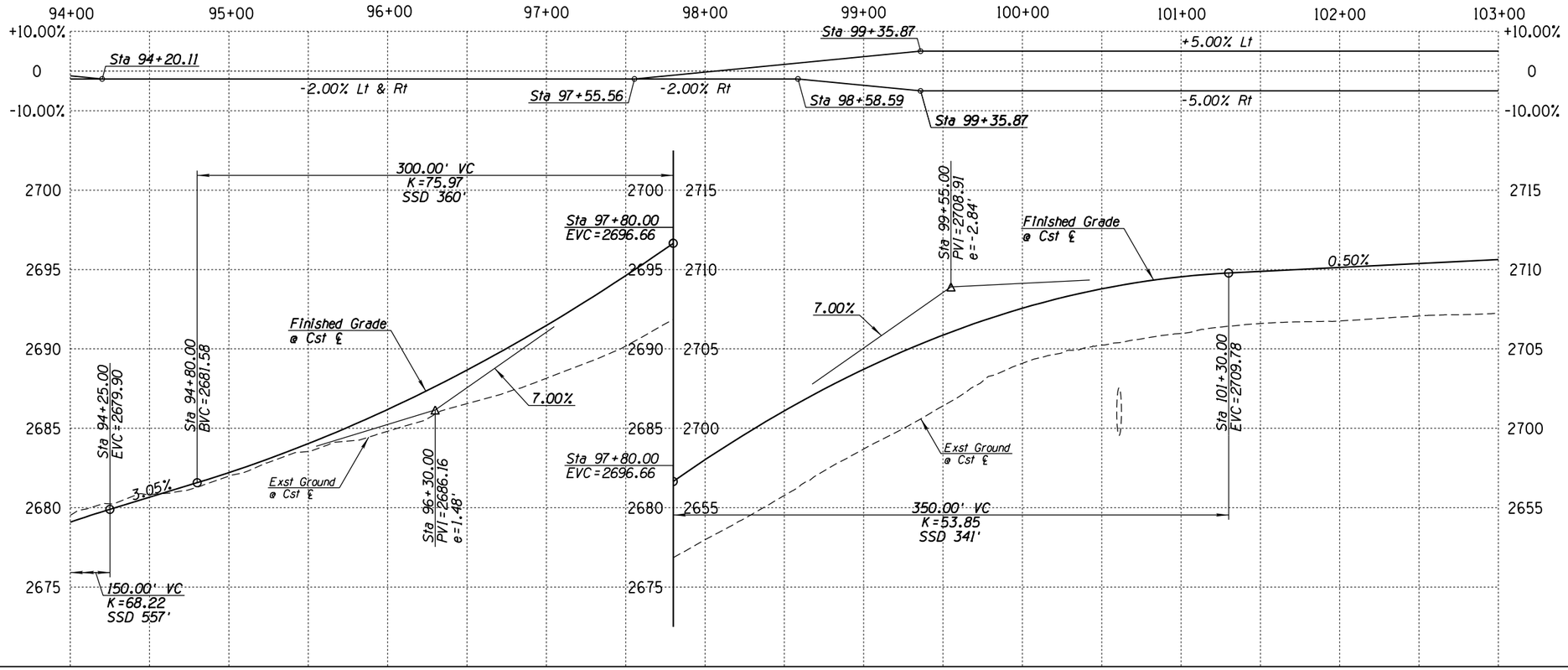

CURVE DATA

(4)

R = 1660.00'
L = 574.70'
Δ = 19°50'09"
T = 290.25'
D = 03°27'06"

1. Sta 99+49.74, 23.00' Rt, BCR
2. Sta 99+85.86, 61.53' Rt, ECR
3. Sta 99+64.83, 23.00' Lt, BCR
4. Sta 99+98.59, 55.57' Lt, ECR
5. Sta 99+99.27, 67.52' Lt
   Match Exst
6. Sta 100+22.31, 66.27' Lt
7. Match Exst
8. Sta 100+22.00, 59.23' Lt, BCR
9. Sta 100+55.79, 23.00' Lt, ECR
10. Sta 100+21.63, 56.24' Rt, BCR
11. Sta 100+57.83, 23.00' Rt, ECR

B New guardrail

C New CIP retaining wall
Sta 96+50.00, 33.00' Rt to
Sta 99+30.00, 33.00' Rt

Curve Table

Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C33	35.00	58.90	96°25'00"	39.16
C34	35.00	52.19	85°25'48"	32.31
C35	35.00	55.85	91°25'49"	35.88
C36	35.00	53.60	87°44'40"	33.65

0 40' 80'

Call at least two full working days before you begin excavation.
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In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP06 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

No.	Revision Description	Engineer	Date

		Date
Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

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SABINO CANYON ROAD TO SUNRISE DRIVE
STA 94+00 TO STA 103+00

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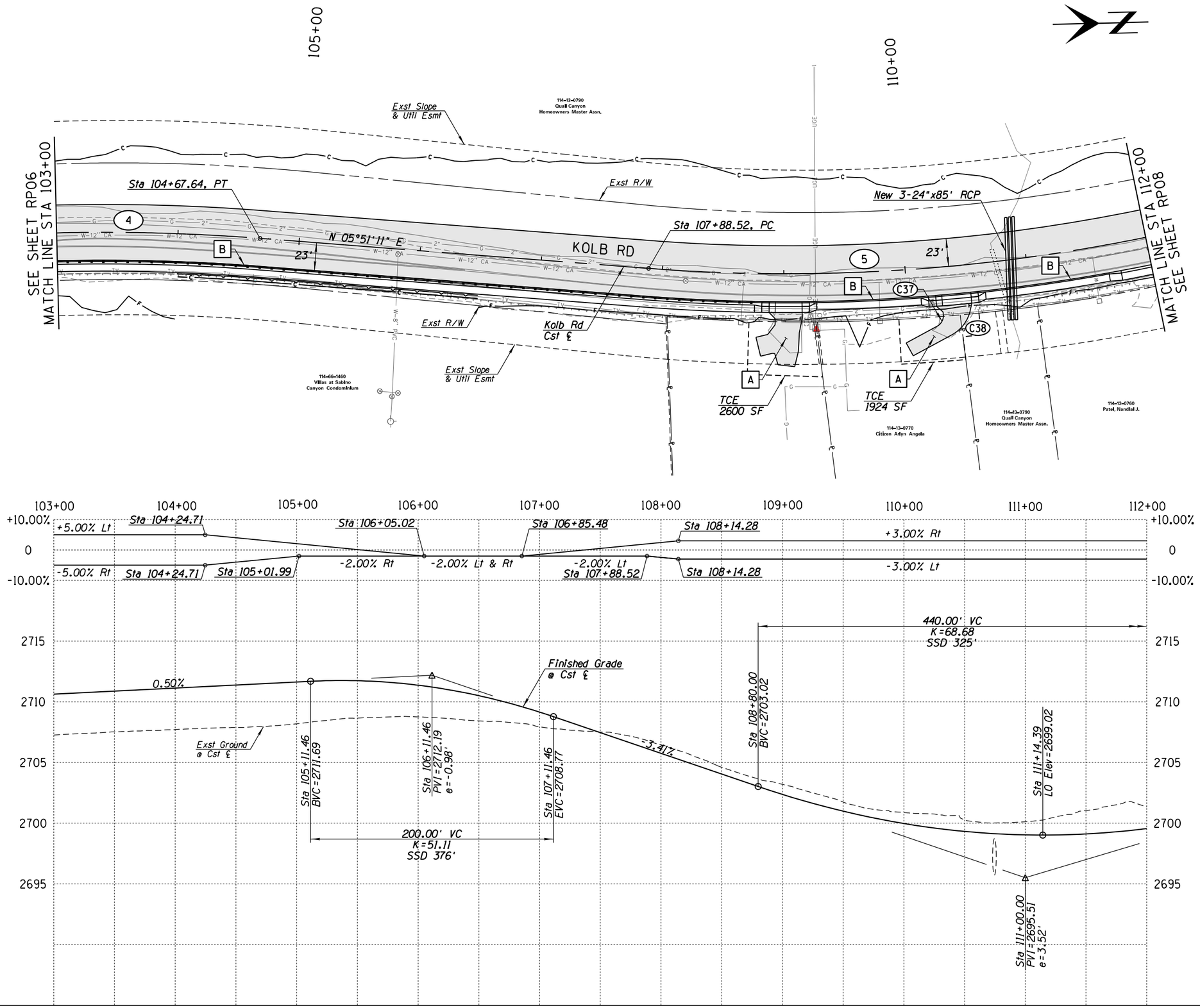

CURVE DATA

(4)	(5)
R= 1660.00'	R= 1473.00'
L= 574.70'	L= 561.15'
Δ= 19°50'09"	Δ= 21°49'38"
T= 290.25'	T= 284.02'
D= 03°27'06"	D= 03°53'23"

A Estimated driveway geometry. Exact limits to be refined later.

B New guardrail

Curve Table				
Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C37	10.00	11.66	66°49'01"	6.60
C38	30.00	25.98	49°36'53"	13.87

0 40' 80'

Call at least two full working days before you begin excavation. ARIZONA 811 Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP07 OF RP13

PAGE OF

PIMA COUNTY DEPARTMENT OF TRANSPORTATION

ROADWAY PLAN AND PROFILE
FOR
KOLB ROAD
SABINO CANYON ROAD TO SUNRISE DRIVE
STA 103+00 TO STA 112+00

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Initial Design
Phase Plans
Design Review

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PRISCILLA S. CORNELIO, P.E., DIRECTOR

		Date
Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

No.	Revision Description	Engineer	Date

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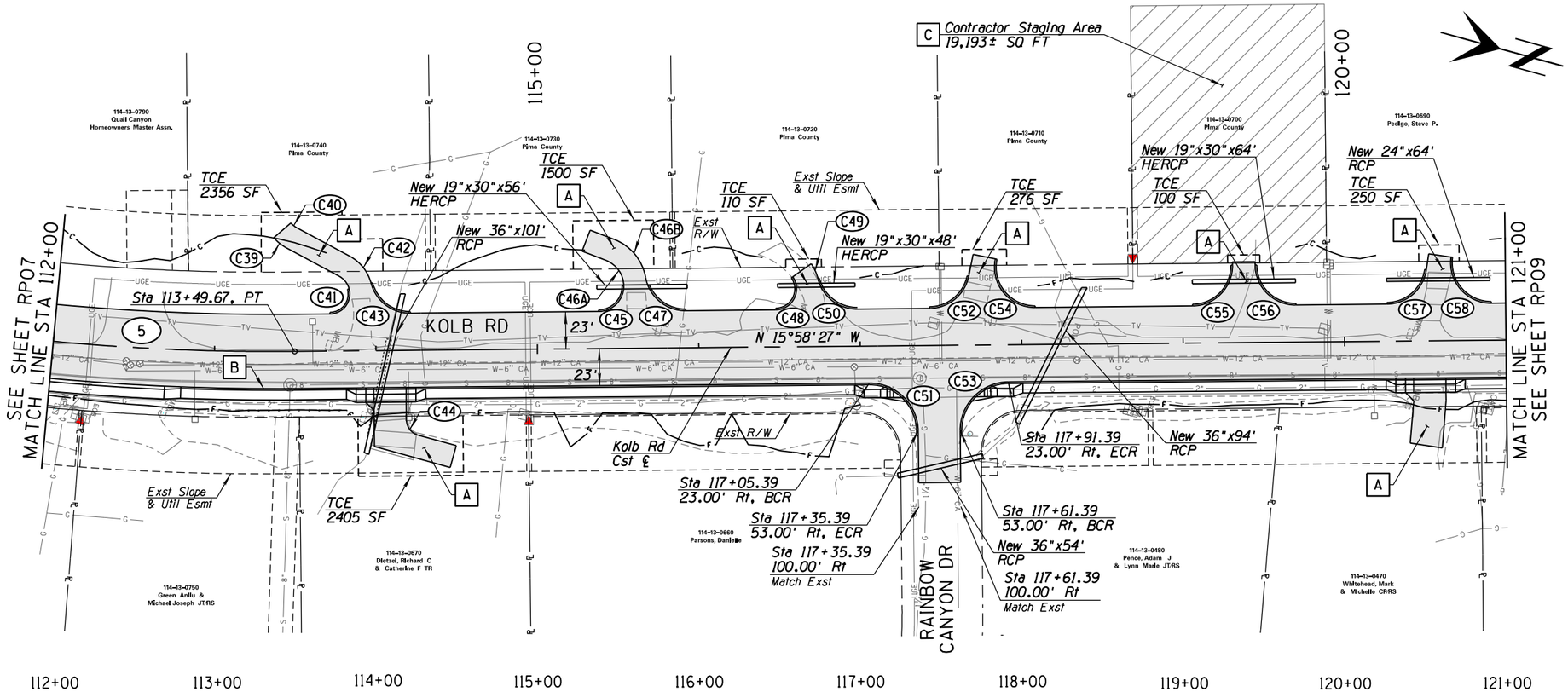

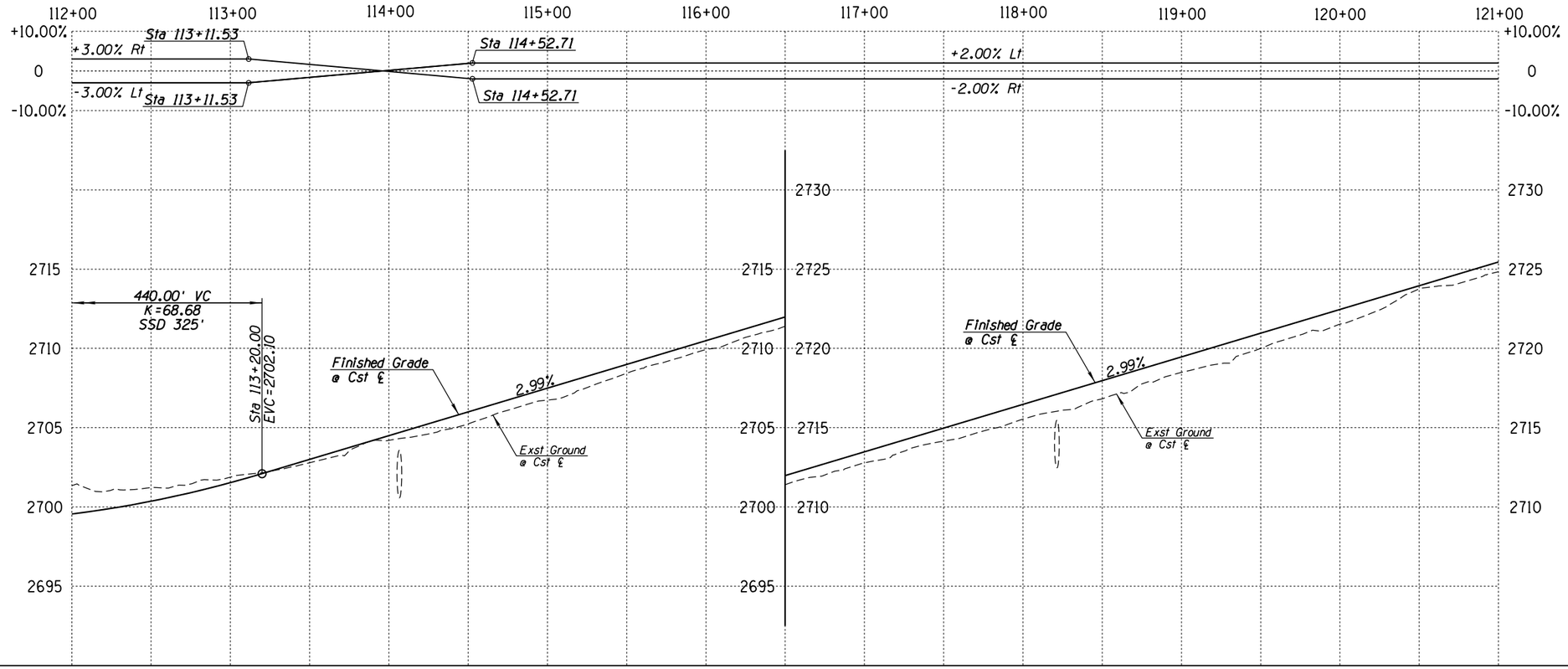

CURVE DATA

(5)

R= 1473.00'
L= 561.15'
Δ= 21°49'38"
T= 284.02'
D= 03°53'23"

A Estimated driveway geometry. Exact limits to be refined later.

B New guardrail

C The Contractor shall stay within the boundary of parcel 114-13-0700 for all staging activities.

Curve Table

Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C39	27.00	9.94	21°06'09"	5.03
C40	13.00	4.79	21°06'13"	2.42
C41	12.40	32.71	151°08'19"	48.20
C42	26.40	21.64	46°57'05"	11.47
C43	25.00	33.08	75°48'46"	19.47
C44	10.00	12.92	74°01'33"	7.54
C45	15.70	24.60	89°48'18"	15.64
C46A	17.00	20.30	68°24'49"	11.56
C46B	31.00	31.74	58°39'33"	17.42
C47	25.00	35.10	80°26'27"	21.14
C48	13.00	28.26	124°32'02"	24.73
C49	27.00	9.99	21°11'39"	5.05
C50	25.00	33.45	76°39'37"	19.77
C51	30.00	47.12	89°59'57"	30.00
C52	25.00	33.98	77°53'08"	20.20
C53	30.00	47.12	90°00'03"	30.00
C54	25.00	44.56	102°06'52"	30.94
C55	25.00	39.27	89°59'60"	25.00
C56	25.00	39.27	90°00'00"	25.00
C57	25.00	35.44	81°13'57"	21.44
C58	25.00	43.10	98°46'03"	29.15

0 40' 80'

Call at least two full working days before you begin excavation. ARIZONA 811 Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP08 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

No.	Revision Description	Engineer	Date

		Date
Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

Initial Design
Phase Plans
Design Review

NOT FOR CONSTRUCTION OR RECORDING

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333 E. Wetmore Road, Suite 450
Tucson, AZ 85705
(520) 292-2300 (520) 292-1290 fax
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PIMA COUNTY DEPARTMENT OF TRANSPORTATION

ROADWAY PLAN AND PROFILE
FOR
KOLB ROAD
SABINO CANYON ROAD TO SUNRISE DRIVE
STA 112+00 TO STA 121+00

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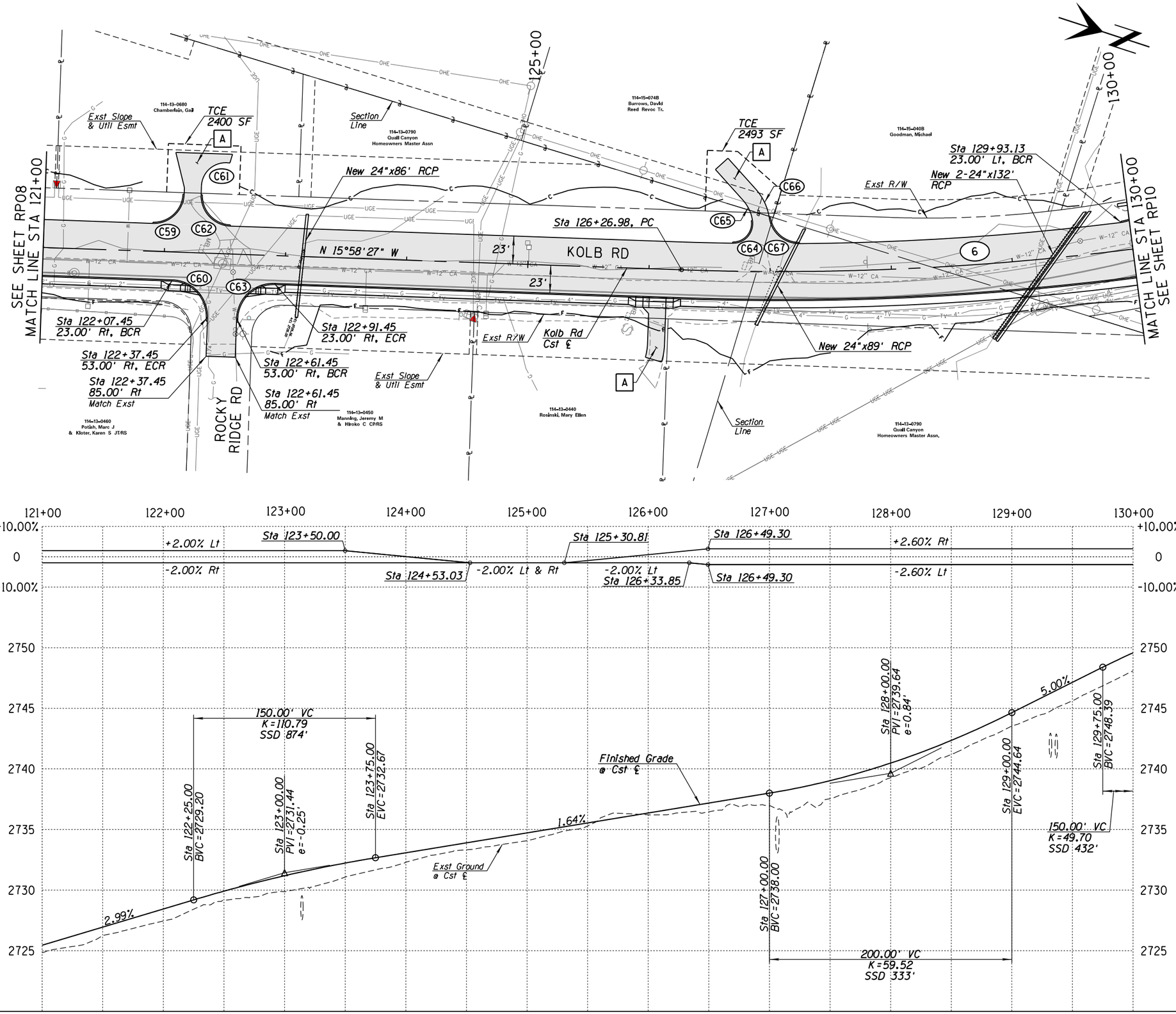

CURVE DATA

(6)

R= 2300.00'
L= 506.86'
Δ= 12°37'36"
T= 254.46'
D= 02°29'28"

[A] Estimated driveway geometry. Exact limits to be refined later.

Curve Table				
Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C59	25.00	39.27	89°59'60"	25.00
C60	30.00	47.13	90°00'12"	30.00
C61	20.00	34.17	97°53'48"	22.97
C62	25.00	39.27	90°00'00"	25.00
C63	30.00	47.12	89°59'48"	30.00
C64	16.34	28.44	99°41'27"	19.37
C65	32.22	18.65	33°10'33"	9.60
C66	46.22	26.76	33°10'33"	13.77
C67	25.00	35.65	81°41'51"	21.62

0 40' 80'

Call at least two full working days before you begin excavation. ARIZONA 811 Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP09 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

		Date
Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

No.	Revision Description	Engineer	Date

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ROADWAY PLAN AND PROFILE
FOR
KOLB ROAD
SABINO CANYON ROAD TO SUNRISE DRIVE
STA 121+00 TO STA 130+00

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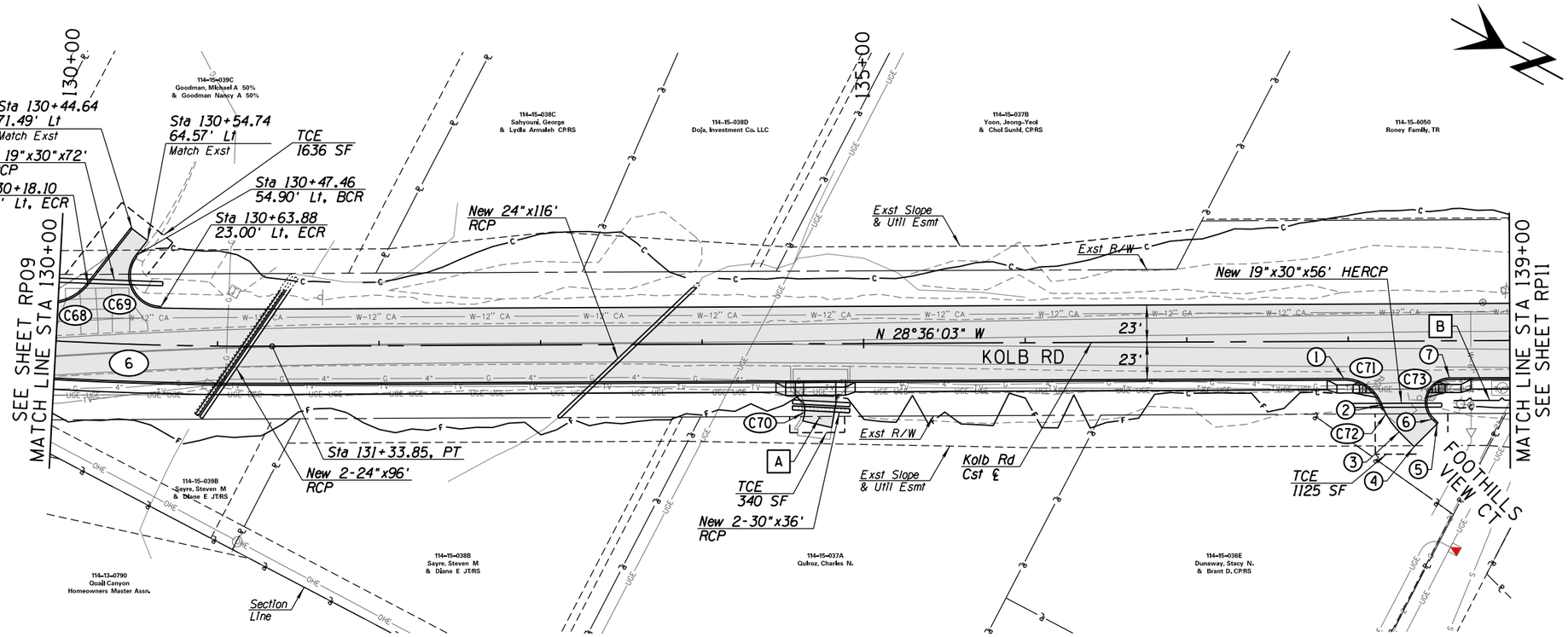

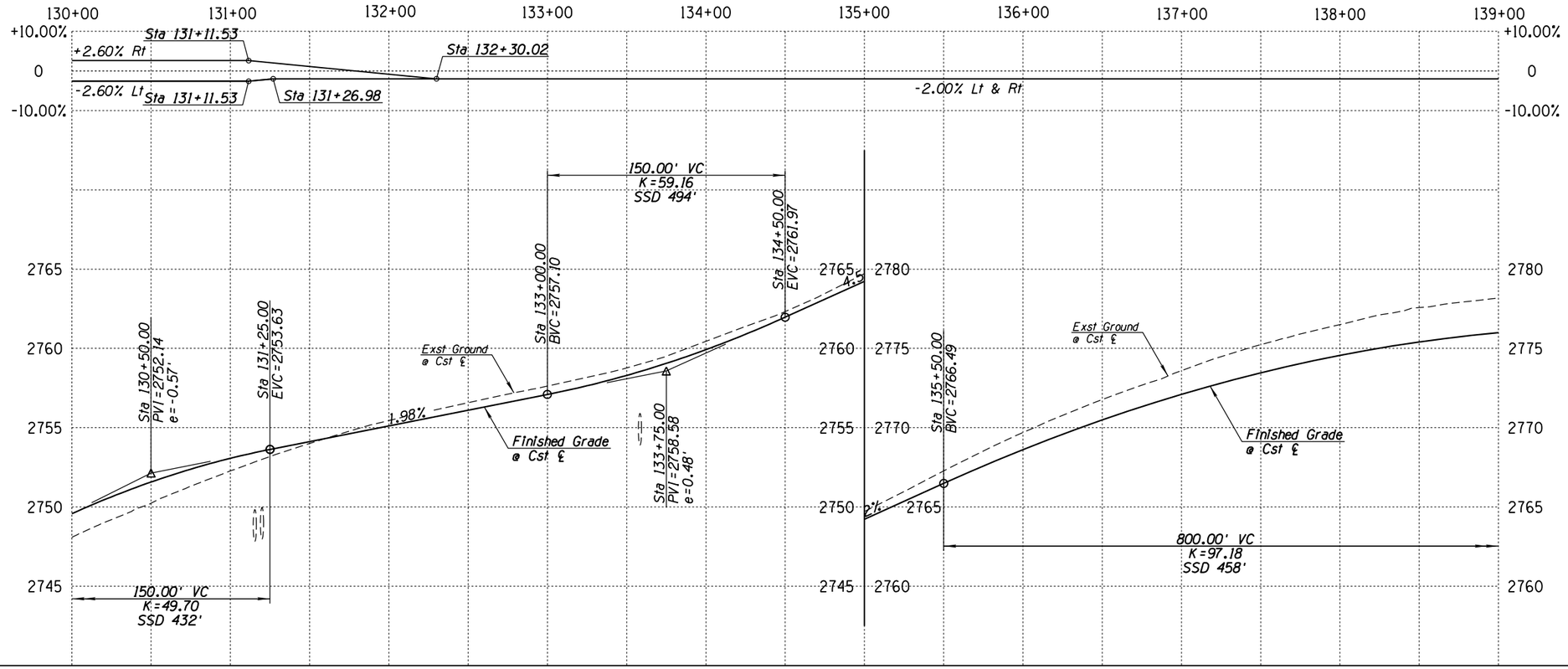

CURVE DATA

(6)

R= 2300.00'
L= 506.86'
Δ= 12°37'36"
T= 254.46'
D= 02°29'28"

A Estimated driveway geometry. Exact limits to be refined later.

B New soil nail retaining wall
Sta 138+65.00, 37.00' Rt to
Sta 139+00.00, 37.00' Rt

1. Sta 137+97.20, 23.00' Rt, PC
2. Sta 138+20.66, 39.36' Rt, PCC
3. Sta 138+31.29, 56.17' Rt, PT
4. Sta 138+40.40, 65.46' Rt Match Exst
5. Sta 138+54.68, 51.45' Rt Match Exst
6. Sta 138+51.79, 48.50' Rt, PC
7. Sta 138+62.50, 23.00' Rt, PT

Curve Table

Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C68	30.00	28.81	55°01'40"	15.63
C69	20.00	44.24	126°44'05"	39.88
C70	14.27	11.01	44°11'60"	5.79
C71	25.00	30.45	69°47'21"	17.44
C72	47.36	20.03	24°14'05"	10.17
C73	15.00	35.20	134°26'44"	35.72

0 40' 80'

Call at least two full working days before you begin excavation. ARIZONA 811 Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP10 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

		Date
Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

No.	Revision Description	Engineer	Date

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Phase Plans
Design Review

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PIMA COUNTY DEPARTMENT OF TRANSPORTATION

ROADWAY PLAN AND PROFILE
FOR
KOLB ROAD
SABINO CANYON ROAD TO SUNRISE DRIVE
STA 130+00 TO STA 139+00

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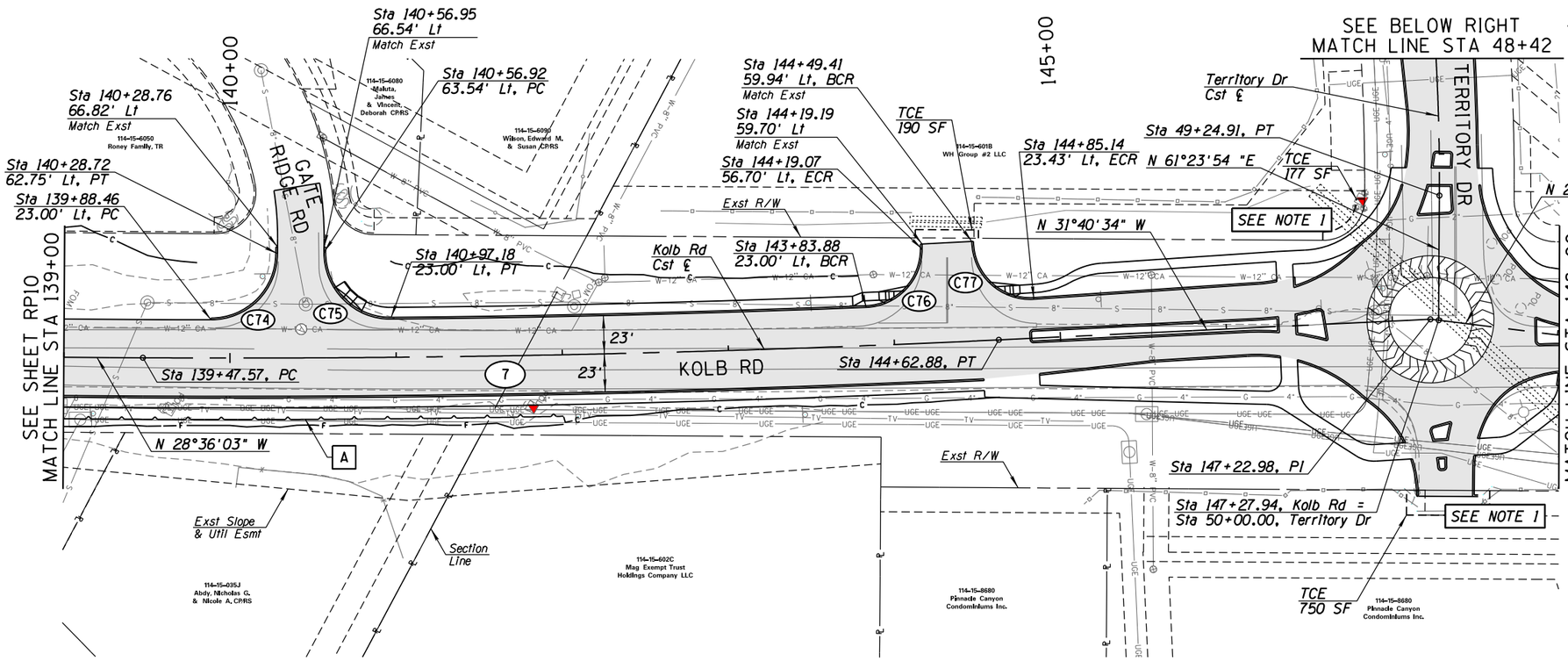
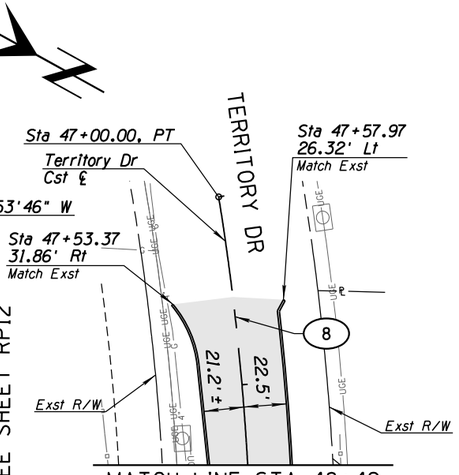




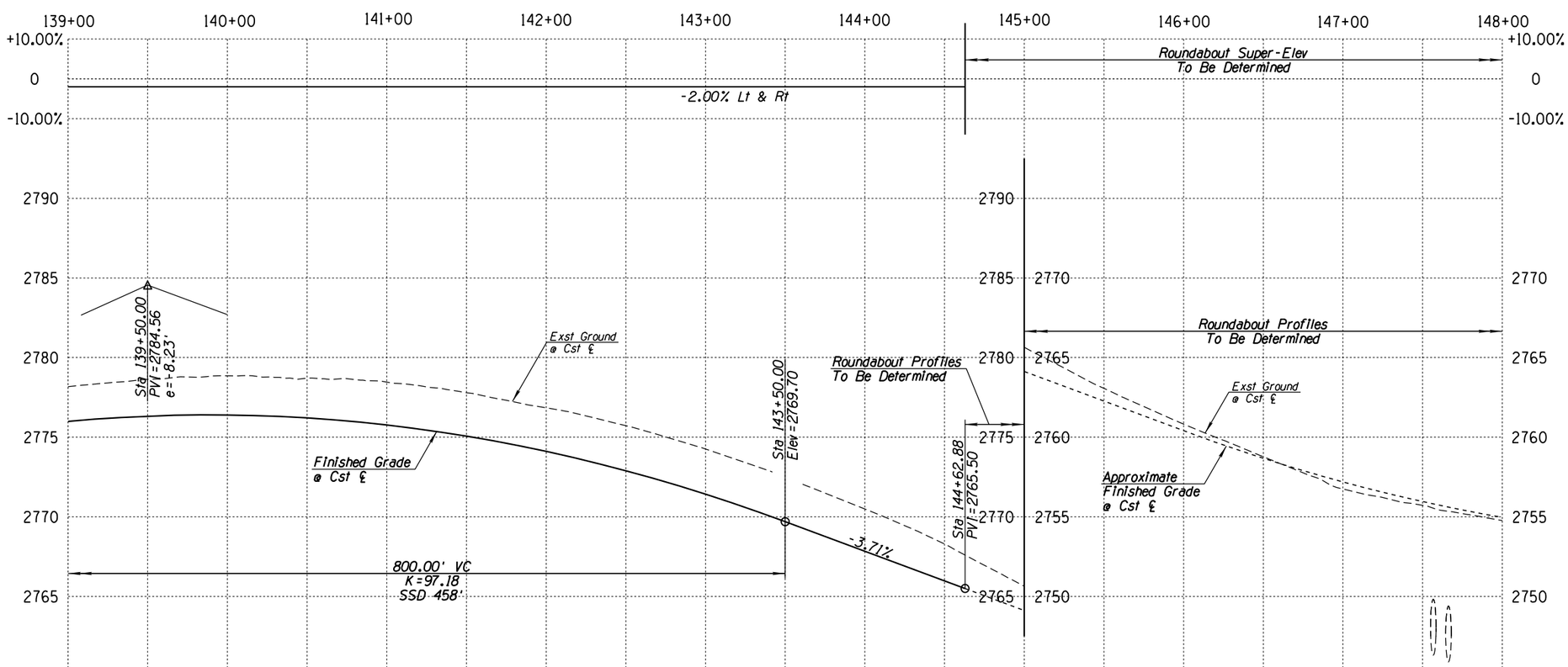
CURVE DATA

7	8
R = 9600.00'	R = 1350.00'
L = 515.31'	L = 224.91'
Δ = 03°04'32"	Δ = 09°32'44"
T = 257.72'	T = 112.72'
D = 00°35'49"	D = 04°14'39"

A New soil nail retaining wall
Sta 139+00.00, 37.00' Rt to
Sta 142+00.00, 37.00' Rt

NOTES:

1. Precise roundabout geometry to be refined later. Current dimensions and parameters are the following:
   - Inscribed Circle Diameter = 122.5'
   - Central Island Diameter = 50.5'
   - Circulatory Roadway Width = 23.0'
   - Truck Apron Width = 13.0'
   - Design Vehicle = WB-62
   - Average Entry Width = 15.9'
   - Average Exit Width = 14.9'



Curve Table				
Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C74	40.00	62.66	89°45'21"	39.83
C75	40.00	63.46	90°53'34"	40.63
C76	35.00	53.74	87°58'47"	33.79
C77	35.00	57.18	93°35'55"	37.27

0 40' 80'

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In Maricopa County (602) 263-1100

Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP11 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

No.	Revision Description	Engineer	Date

		Date
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Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

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PIMA COUNTY DEPARTMENT OF TRANSPORTATION

ROADWAY PLAN AND PROFILE
FOR
KOLB ROAD
SABINO CANYON ROAD TO SUNRISE DRIVE
STA 139+00 TO STA 148+00

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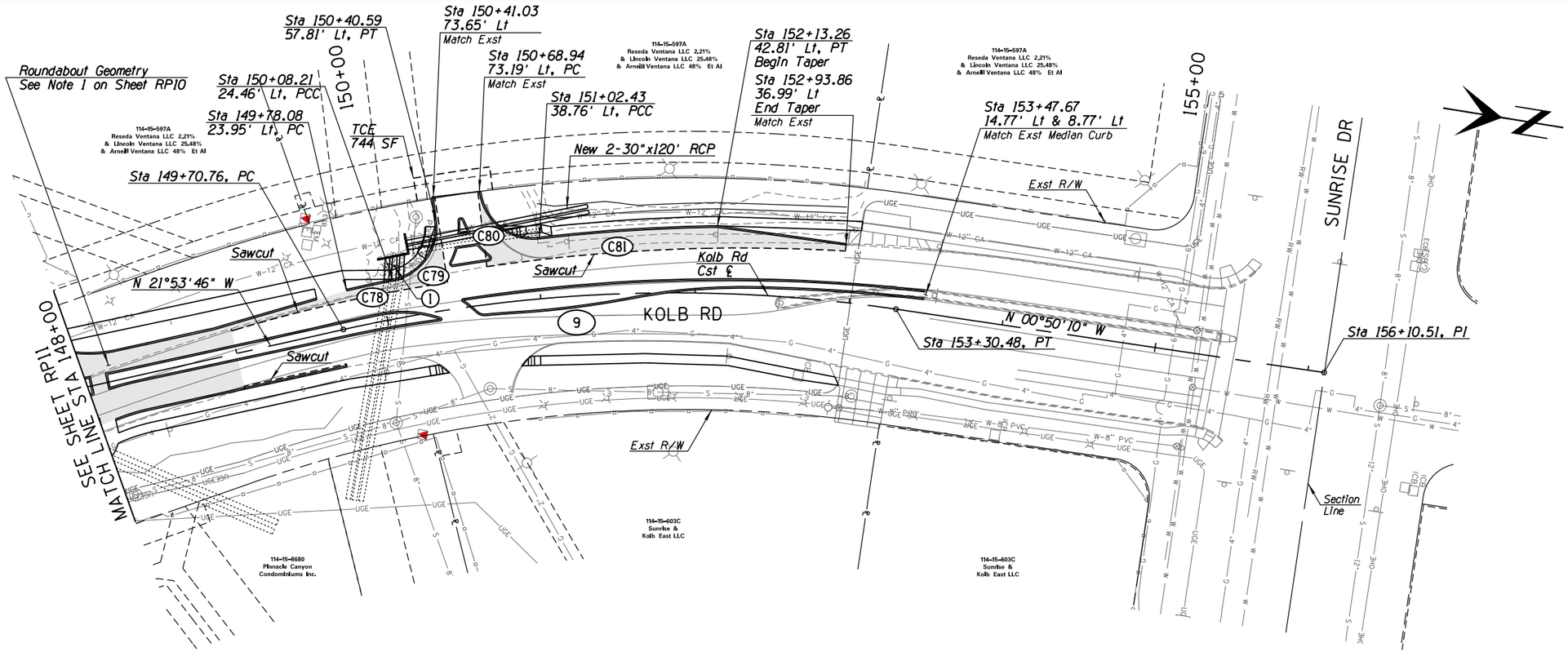

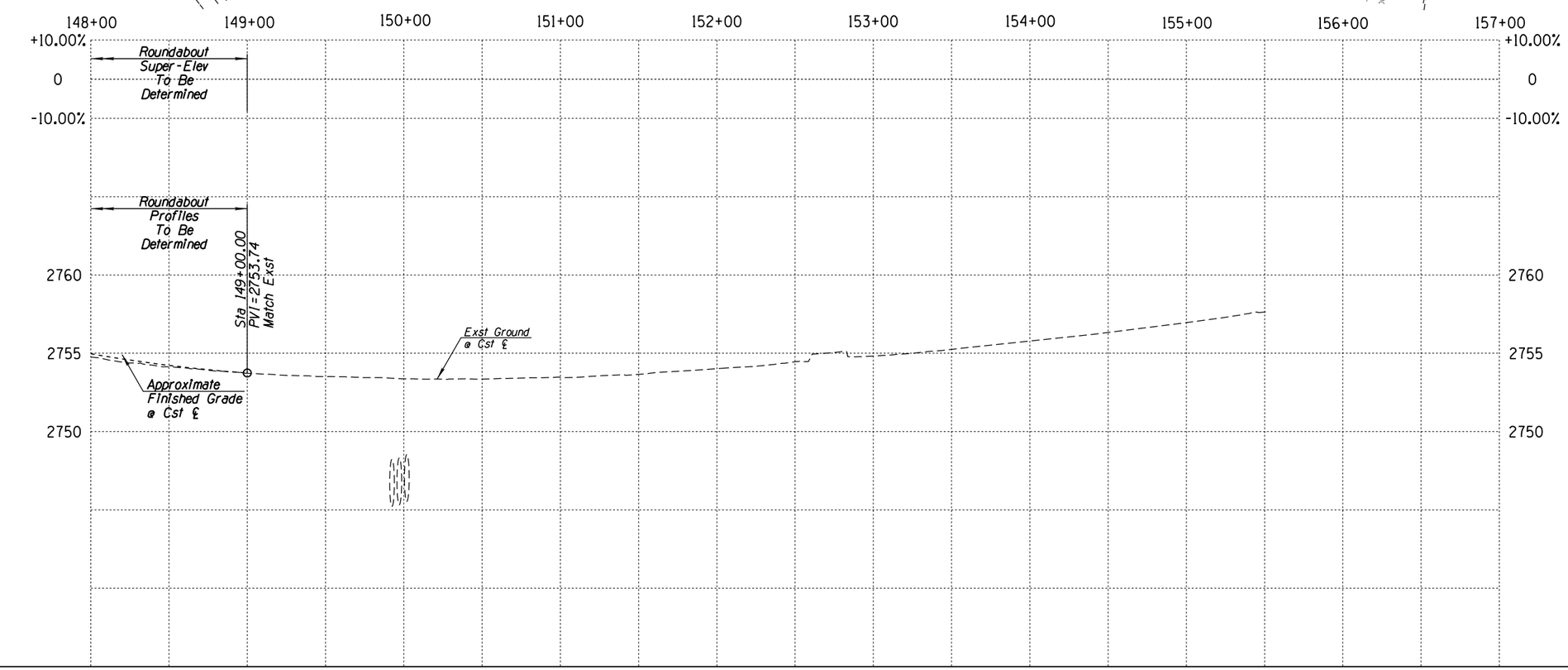

CURVE DATA

9

R= 978.66'
L= 359.72'
Δ= 21°03'35"
T= 181.91'
D= 05°51'16"

1 Pipe extension 3-36"x20' CMP and new headwall

Curve Table				
Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C78	1132.63	30.88	01°33'43"	15.44
C79	35.00	52.13	85°20'35"	32.26
C80	35.00	54.82	89°44'51"	34.85
C81	1144.63	115.51	05°46'55"	57.80

0 40' 80'

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Scales: Horiz. 1"=40' Vert. 1"=4'

SHEET RP12 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

PIMA COUNTY DEPARTMENT OF TRANSPORTATION

No.	Revision Description	Engineer	Date

Designed	M ASHBY	5/17
Drawn	M ASHBY	5/17
Checked	K THORNTON	5/17
Proj. Engr.	K THORNTON	5/17

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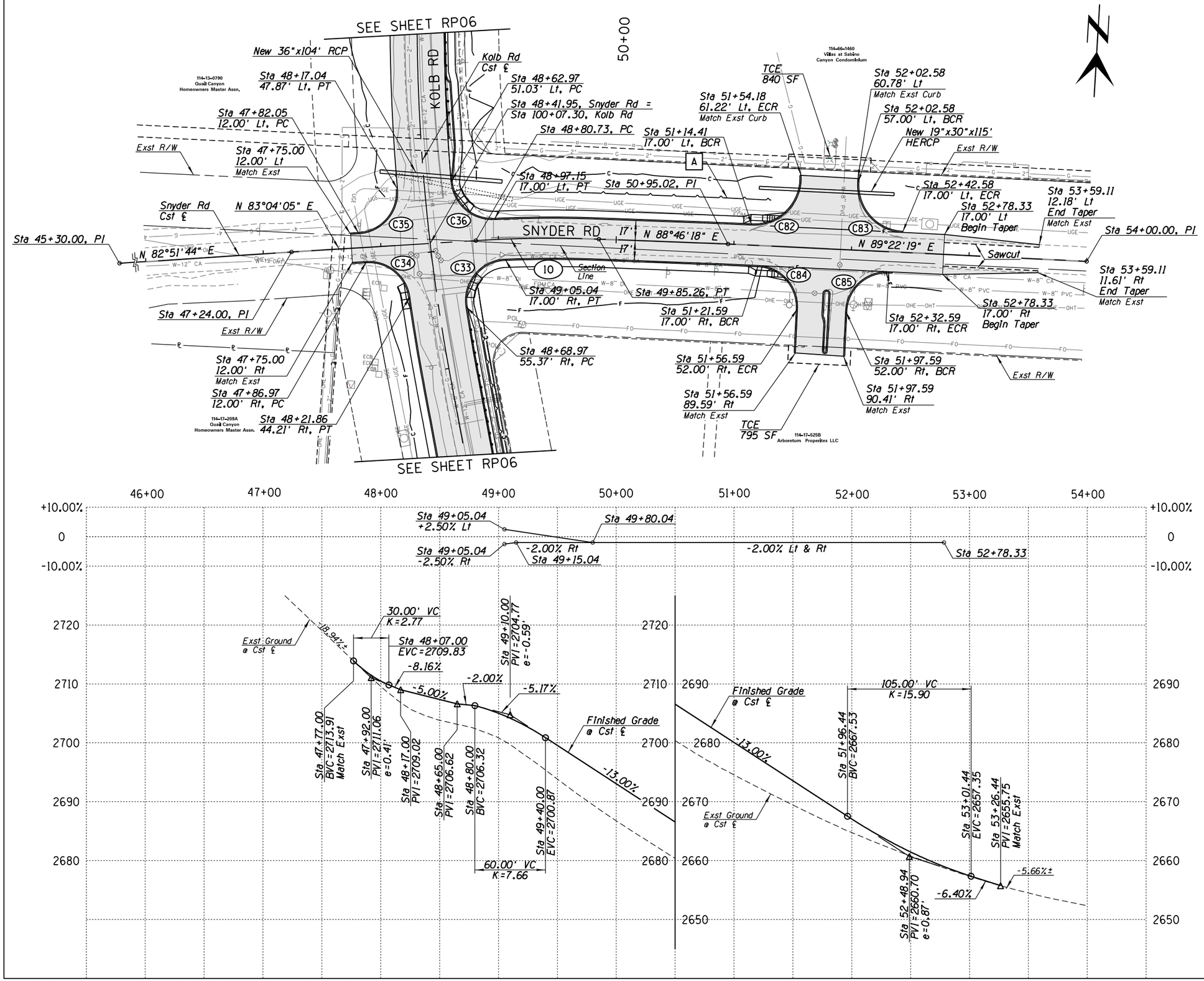
ROADWAY PLAN AND PROFILE
FOR
KOLB ROAD
SABINO CANYON ROAD TO SUNRISE DRIVE
STA 148+00 TO STA 157+00



CURVE DATA

(10)

R = 1050.00'
L = 104.52'
Δ = 05°42'13"
T = 52.30'
D = 05°27'24"

[A] New CIP retaining wall
Sta 49+20.00, 39.00' Lt to
Sta 51+30.00, 39.00' Lt

Curve Table				
Curve No	Radius (ft)	Length (ft)	Delta	Tangent (ft)
C33	35.00	58.90	96°25'00"	39.16
C34	35.00	52.19	85°25'48"	32.31
C35	35.00	55.85	91°25'49"	35.88
C36	35.00	53.60	87°44'40"	33.65
C82	40.00	67.06	96°03'05"	44.46
C83	40.00	62.83	90°00'00"	40.00
C84	35.00	54.98	89°59'51"	35.00
C85	35.00	54.98	90°00'09"	35.00

0 40' 80'

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Scales: Horiz. 1"=40' Vert. 1"=8'

SHEET RP13 OF RP13

PAGE OF

PRISCILLA S. CORNELIO, P.E., DIRECTOR

Designed	M. ASHBY	5/17
Drawn	M. ASHBY	5/17
Checked	K. THORNTON	5/17
Proj. Engr.	K. THORNTON	5/17

No.	Revision Description	Engineer	Date

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ROADWAY PLAN AND PROFILE
FOR
KOLB ROAD
SABINO CANYON ROAD TO SUNRISE DRIVE
STA 46+00 TO STA 54+00

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