APPENDIX E

NOISE

- **US 550 Noise Analysis**
- **Form 1209: Noise Wall at Old Homestead Mobile Home Park**

US 550 NOISE ANALYSIS

(CR220 TO COLORADO STATE LINE)

APRIL 2005

APPENDIX E

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NOISE OVERVIEW

A noise analysis was completed for US 550 from approximately one-half mile south of the junction of County Road (CR) 220 to the New Mexico state line. This report was prepared in conjunction with the on going NEPA process to improve US 550 from a two-lane to four-lane facility. These planned improvements constitute a Type 1 project.

Existing noise levels were analyzed and future noise levels modeled to quantify possible noise impacts as a result of widening US 550. The results aid in determination of project compliance with state and Federal standards for noise.

The Colorado Department of Transportation (CDOT), in conjunction with the Federal Highway Administration (FHWA) are developing a study of the potential environmental, social and economic impacts of reconstructing US Highway 550 (US 550) as a four-lane highway. The proposed action would improve the existing deficient highway design conditions and would provide increased capacity to accommodate projected future traffic volumes.

The project is located in La Plata County, Colorado. The 15.5 mile project corridor extends from the New Mexico state line to approximately one-half mile south of the junction of County Road (CR) 220. The project study area generally extends 300 feet east and west of the existing highway centerline.

METHODOLOGY

Traffic Noise Analysis Procedures

The noise analysis was performed in-accordance with the standards outlined in title 23, Code of Federal Regulation Article 772 (23 CFR 772), Department of Transportation, Federal Highway Administration (FHWA) and Colorado Department of Transportation (CDOT) Noise Analysis and Abatement Guidelines (December 1, 2002) in addressing noise generated impacts.

Traffic noise is most commonly measured in A-weighted decibels (dBA). An A-weighted decibel corresponds to the way the human ear perceives the magnitude of sounds at different frequencies. Also, since traffic noise is generated by passing vehicles and traffic volumes constantly fluctuate, a unit of measurement called the A equivalent level or L(eq) has been developed to characterize traffic noise impacts. The L(eq) is a summation of the individual sound energies from passing vehicles over a given period of time, usually an hour, and is expressed as A-weighted decibels.

Noise Abatement Guidelines

Operational Noise:

The Noise Abatement Criteria that apply are activity category B (residences, schools, churches, parks), activity category C (for the purposes of this study, mostly commercial areas), and activity category D (undeveloped lands). Noise abatement guidelines state that abatement strategies

must be considered when the L(eq) noise levels reach 66 dBA for an NAC B property, or 71 dBA for an NAC C property.

These guidelines also state that noise abatement should be considered when the noise levels "substantially exceed the existing noise levels". This criterion is defined as increases in the L(eq) of 10.0 dBA or more above existing noise levels.

Table 1

CDOT Noise Abatement Criteria - *A-Weighted Sound Level-decibels (dBA)*

Activity Category	Leq(h)		Description of Activity Category
A	56 (exterior)		Lands 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	66 (exterior)		Picnic area, recreational areas, playgrounds, active sport areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	71 (exterior)		Developed lands, properties, or activities not included in Categories A or B above.
D	None		Undeveloped lands.
E	51 (interior)		Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Consistent with federal guidance, CDOT also requires that noise abatement meet tests of feasibility and reasonableness, including both achieving a substantial noise reduction (at least 5dBA) and achieving a reasonable noise reduction per dollar spent. The reasonableness/ cost-effectiveness criteria are specifically defined as a cost per decibel of noise reduction per receiver (<$3,000 – Extremely Reasonable, $3,000-$3,750 – Reasonable, $3,750-$4,000 – Marginally Reasonable, >$4,000 – Unreasonable).

MODELING APPROACH

In order to model the roadway, the project was divided into individual sections and then into smaller segments based on the limitations of the noise modeling software. The roadway was broken into four sections, beginning at New Mexico state line (station 100+00) and ending approximately one-half mile south of the junction of County Road (CR) 220 and US 550 (station 913+06). The characteristics of the environment provided for natural locations of section breaks along US 550, as follows:

Section	Alternative Description	Alternative Name	Stationing by Section
- Section 1	(MP 0 to MP 3.1)	“State Line North”	sta. 100+00 to sta. 250+00
- Section 2	(MP 3.1 to MP 6.6)	“Bondad Hill”	sta. 250+00 to sta. 450+00
- Section 3	(MP 6.6 to MP 10.5)	“Sunnyside”	sta. 450+00 to sta. 640+00
- Section 4	(MP 10.5 to MP 15.5)	“Florida Mesa”	sta. 640+00 to sta. 913+06

US 550 Alternatives

The following is a more detailed description about the alternative alignments. Alternatives 1,2, and 3 differs only between MP 3.1 and 6.6 the remainder of the alignments are the same.

Alternative 1 generally follows the existing alignment for the 15.5 mile project corridor. Alternative 1 is generally described as follows:

- MP 0.0 to MP 3.1 (formerly "Section 1"): A two lane safety improvement was completed in this section in 2001. As part of that project, sufficient ROW was acquired to complete the four-lane improvement. Rough grading for the four-lane is complete and no work will be performed outside of existing ROW except for new driveway connections. The proposed alignment generally follows the existing median centerline. This is a 70 MPH design with a 46-foot depressed grass median.
- MP 3.1 to MP 6.6 (formerly "Section 2"): The proposed alignment generally follows the existing highway alignment with slight shifts to the east and west to flatten horizontal curves and reduce impacts to existing development. The grade at Bondad Hill is reduced from 6.5% to 6%. This is a 45 MPH design with a 14-foot median that utilizes a Type 7 median barrier. This section includes intersections with County Roads 213 and 318. Alternative 1 proposes to realign these intersections to improve geometrics and safety.
- MP 6.6 to MP 10.5 (formerly "Section 3"): The proposed alignment generally follows the existing highway alignment with moderate shifts to the east and slight shifts to the west to reduce impacts to existing development and to flatten horizontal curves. This section includes intersections with County Roads 215, 218 and 217. Alternative 1 proposes to realign the CR 215 intersection to improve geometrics and provide one-half mile spacing from the CR 218 intersection. This is a 70 MPH design with a 46-foot depressed grass median.
- MP 10.5 to MP 15.5 (formerly "Section 4"): The proposed alignment generally follows the existing highway with an easterly shift to hold the existing western ROW line. Easterly and westerly shifts are also proposed to flatten horizontal curves. This section includes intersections with CR 214, 219 (2 locations) and 302. The CR 219 intersections will be consolidated into a single access point located between the two existing intersections. This is a 70 MPH design with a 46-foot depressed grass median.

Alternative 2 follows the same alignment as Alternative 1 except between MP 3.1 to MP 6.6 where the alignment shifts slightly to the east to flatten horizontal curves at Bondad Hill and the grade is reduced from 6.5% to 5% (former alternative 2B). This is a 60 MPH design with a 14-foot median that utilizes a Type 7 median barrier.

Alternative 3 follows the same alignment as Alternative 1 except between MP 3.1 to MP 6.6 where the alignment shifts east of Bondad Hill (former alternative 2D) to minimize horizontal curves, reduce archaeological resource impacts, and reduce cost due to elimination of large retaining walls. This is a 70 MPH design with a 46-foot depressed grass median.

County roads, 220, 302, 214, 215, 213, and 318 were included in the modeling process to determine their noise impact.

Traffic Noise Modeling Procedures

For each section of the corridor, noise levels were modeled using the Colorado Department of Transportation's Noise Prediction Software entitled "The Technology Group Highway Noise Analysis Software Library". The CDOT software is based on FHWA's noise prediction model STAMINA 2.0/OPTIMA, and employs the 1994 Colorado emission factors.

Noise Model Validation

Noise measurements were taken at two locations in each section for a total of eight measurements along US 550 in December of 2003. Short-term noise level measurements were taken every minute for a 15-minute duration at the locations. Other data collected concurrently in the field included; receptor locations, traffic volumes, vehicle types, topography type, receptor location and vehicle operating speeds. Locations of any existing walls or other noise attenuation features were also noted for use in coding and validating the noise models.

The validation model was coded using the field data as input. The modeled receptor locations were placed primarily in residential areas where residents may be exposed to high noise levels, such as backyards, front porches, and patios, and were set at a height of 5 feet above ground. The results of the validation model were compared to the noise levels measured in the field. The average difference between the field-measured noise levels and the validated model results was +/-2.0 dBA, and considered acceptable (+/- 3.0 bBA). This is detailed in Table 2. The validated noise model was then used as the basis for the development of the Existing and Preferred Alternative noise models.

Table 2

US 550 Field Measurements & Model Validation Results

Calibration Receiver Site	Speed	Physical Location	Field Measurement (Leq)	Modeled (Leq)	Modeled minus Field	Cars (vph)	Medium Trucks (vph)	Heavy Trucks (vph)
CR8	60	Section 4	66.3	66.7	0.4	496	20	16
CR7	60	Section 4	62.3	60.3	-2.0	488	16	28
CR6	60	Section 3	59.3	57.3	-2.0	372	24	12
CR5	60	Section 3	58.9	60.4	1.5	432	20	12
CR4	60	Section 2	60.8	59.5	-1.3	264	24	20
CR3	60	Section 2	57.8	59.6	1.8	360	28	24
CR2	60	Section 1	64.2	62.5	-1.7	360	40	32
CR1	60	Section 1	58.0	58.6	0.6	360	56	20

ENVIRONMENTAL IMPACTS

Existing Conditions

The existing conditions model analysis was completed using traffic volumes that represent level of service (LOS) "C" traffic operating conditions, at the posted speed limit.

ALTERNATIVE CONDITIONS

The noise models, between the New Mexico state line and the intersection of County Road 220 and US 550, reflect LOS C operations for future traffic volumes with the proposed four-lane highway improvements operating at the proposed posted speed limits.

The following tables demonstrate the location of the breaks for the models between sections. Each model was run with the existing alignment and the proposed alignment to determine the change between existing and proposed conditions.

Section 4	
Model 1	Station 913+06 – Station 810+00
Model 2	Station 810+00 – Station 725+00
Model 3	Station 725+00 – Station 639+00

Section 2	
Model 7	Station 450+00 – Station 410+00
Model 8	Station 410+00 – Station 345+00
Model 9	Station 345+00 – Station 260+00
Model 10	Station 330+00 – Station 425+00

Section 3	
Model 4	Station 639+00 – Station 572+00
Model 5	Station 572+000 – Station 525+00
Model 6	Station 525+00 – Station 450+00

Section 1	
Model 11	Station 2660+00 – Station 170+00
Model 12	Station 170+000 – Station 100+00

The Alternative model results were compared to the existing conditions model data to determine where noise abatement should be considered. These results are included in Table 3 and Table 3a. Note that the alignment for Alternative 1, 2, and 3 is identical except for a portion in Section 2 (highlighted in Table 3a). Therefore Alternative 1 & 2 have similar results, and only in a small section is Alternative 3 different. Receivers that were only used for determination of noise contours are not included. Some receivers (homes) will be relocated as part of the preferred alternatives and are indicated by and asterisk(*) and were not considered for noise mitigation.

A total of seven receptor locations meet or exceed the NAC B noise threshold limits under Alternatives 1 and 2, but none exceeded the 10 dBA increase criteria. Of the seven locations, one receptor that exceeded the NAC B noise threshold limit, located in a yard in Mobile Home Park, was evaluated for a noise barrier. The remaining receptors that exceeded the NAC B noise threshold limit were not evaluated for noise barriers due to the distances between houses and the need for driveway access. In cases such as this when houses are located at great distances part and there is a need for breaks in the noise barrier, noise mitigation is not effective and not

considered feasible or reasonable. Figures 1 through 23 depict the areas where the future approach threshold contours (66 and 71 dBA) are expected. Note that the 71 dBA contour is shown only in sections with commercial uses. The noise model output is in Attachment 2.

Table 3
2025 Alternative 1 & 2 Noise Level Comparisons

Receptor	Land-Use Category	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 1 & 2 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
P3	B	66	1 house	53.2	55.9	No	No
P4	B	66	1 house	62.2*	**72.4***	**N/A**	**N/A**
P5	B	66	1 house	55.7	58.0	No	No
P7	B	66	1 house	52.6	57.3	No	No
R10	B	66	1 house, 5 outbuildings	53.1	57.8	No	No
R11	B	66	1 house, 4 outbuildings	55.8	61.2	No	No
R12	B	66	1 house	61.9	62.8	No	No
R13	B	66	1 house	60.3	61.6	No	No
R15	B	66	1 house	55.0	57.4	No	No
R16	B	66	1 house	54.9	57.7	No	No
R17	B	66	1 house	57.1	60.1	No	No
R18	B	66	1 house	56.6	59.9	No	No
R19	B	66	1 house	55.3	58.8	No	No
R20	B	66	2 houses	57.6	62.0	No	No
R22	B	66	2 houses	55.1	59.2	No	No
R24	C	71	2 businesses, 4 buildings	61.4	66.2	No	No
R25	B	66	1 house, 3 outbuildings	57.8	60.5	No	No
R26	B	66	1 house, 2 outbuildings	53.4	55.8	No	No
R27	B	66	1 house	**69.4**	**66.8**	**Yes**	No
R28	B	66	1 house, 1 outbuilding	**68.4**	65.6	No	No
R29	B	66	1 house, 1 outbuilding	**67.2**	65.5	No	No
R30	B	66	1 house, 2 outbuildings, 1 business	61.7	62.5	No	No
R31	B	66	1 house-ground level	64.0	63.9	No	No
R32	B	66	1 house, 1 outbuilding	**67.7***	**82.0***	**N/A**	**N/A**
R33	B	66	1 house, 3 outbuilding	58.9	**66.1**	**Yes**	No
R34	B	66	1 house	59.8	**67.6**	**Yes**	No
R35	B	66	1 house	**67.1**	65.6	No	No
R36	B	66	2 houses, 2 outbuildings	55.8	61.4	No	No
R38	B	66	3 houses, 1 outbuilding	52.7	55.4	No	No

Receptor	Land-Use Category	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 1 & 2 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
R41	B	66	2 houses, 1 outbuilding	51.5	54.3	No	No
R43	B	66	1 house, 3 outbuildings	59.9	61.2	No	No
R44	B	66	1 house, 1 outbuilding	60.5	61.6	No	No
R45	B	66	2 house, 2 outbuildings	62.8	63.2	No	No
R47	B	66	1 house, 4 outbuildings	**66.2**	**76.0***	**N/A**	**N/A**
R48	B	66	2 houses	58.3	58.8	No	No
R50	B	66	1 house, 2 outbuildings	57.9	59.1	No	No
R51	B	66	1 house	57.2	58.5	No	No
R53	B	66	2 houses	50.9	53.2	No	No
R54	B	66	1 house	57.0	58.5	No	No
R55	B	66	2 houses	54.7	56.6	No	No
R57	B	66	1 house	56.4	58.0	No	No
R58	B	66	1 house, 2 outbuildings	65.0	**75.4***	**N/A**	**N/A**
R59	B	66	1 house, 3 outbuildings	56.3	58.0	No	No
R64	B	66	1 house, 1 outbuilding	62.3	62.4	No	No
R66	B	66	2 houses, 3 outbuildings	59.6	60.5	No	No
R68	B	66	4 houses, 1 outbuilding	56.4	58.1	No	No
R72	B	66	2 houses, 4 outbuildings	63.1	64.3	No	No
R73	B	66	2 houses, 2 outbuildings	60.2	60.8	No	No
R76	B	66	2 houses, 1 outbuilding	51.8	56.2	No	No
R78	B	66	2 houses, 2 outbuildings	57.3	59.1	No	No
R79	B	66	1 house	63.8	**69.1***	**N/A**	**N/A**
R80	B	66	1 house	63.7	**68.6***	**N/A**	**N/A**
R81	B	66	1 house	59.4	63.4	No	No
R82	B	66	1 house	53.6	58.3	No	No
R83	B	66	1 house	54.4	60.1	No	No
R84	B	66	1 house, 1 outbuilding	59.2	59.5	No	No
P83	B	66	Sunnyside Elementary School	60.3	63.2	No	No
P84	B	66	Baptist Church	57.1	62.0	No	No
R85	B	66	1 house	58.0	62.9	No	No
R87	B	66	3 houses, 1 outbuilding	50.8	55.0	No	No
P89	B	66	10 mobile homes, Mobile Home Park	59.8	63.1	No	No
P90	B	66	6 mobile homes, Mobile Home	56.5	59.7	No	No

Receptor	Land-Use Category	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 1 & 2 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
			Park				
P91	B	66	13 mobile homes, Mobile Home Park	**66.8**	**67.7**	**Yes**	No
P93	B	66	13 mobile homes, Mobile Home Park	58.1	60.6	No	No
P94	B	66	12 mobile homes, Mobile Home Park	57.6	59.6	No	No
P95	B	66	7 mobile homes, Mobile Home Park	64.6	64.0	No	No
R89	B	66	Apartment Building (adjacent to Mobile Home Park)	65.8	65.4	No	No
R90	B	66	1 house	55.4	60.9	No	No
R91	B	66	1 house	63.2	**77.1***	**N/A**	**N/A**
R92	B	66	1 house	**67.8**	**77.9***	**N/A**	**N/A**
R93	B	66	1 house, 1 outbuilding	**70.0**	**73.6***	**N/A**	**N/A**
R94	B	66	1 house, 3 outbuildings	62.8	**77.0***	**N/A**	**N/A**
R95	B	66	1 house	62.4	**76.0***	**N/A**	**N/A**
R96	B	66	1 house	54.0	56.5	No	No
R97	B	66	1 house, 2 outbuildings	60.7	62.1	No	No
R98	B	66	1 house	51.9	54.6	No	No
R99	B	66	1 house, 1 outbuilding	50.2	52.9	No	No
R100	B	66	1 house	56.7	59.0*	N/A	N/A
R101	B	66	1 mobile home, 1 out building	58.1	64.3	No	No
R102	B	66	1 house, 1 outbuilding	51.0	55.5	No	No
R103	B	66	1 house, 1 outbuilding	54.2	58.9	No	No
R104	B	66	1 mobile home, 1 outbuilding	53.8	58.5	No	No
R105	B	66	1 mobile home	53.7	58.3	No	No
R106	B	66	1 mobile home	52.0	56.3	No	No
R107	B	66	1 mobile home	59.1	65.4	No	No
R108	B	66	1 mobile home	53.1	57.7	No	No
R109	B	66	1 house, 1 outbuilding	51.5	54.3	No	No
R110	B	66	1 house, 1 outbuilding	59.2	**65.5***	**N/A**	**N/A**
R111	B	66	3 houses, 3 outbuildings	59.8	**66.5**	**Yes**	No
R114	B	66	1 mobile home	54.3	58.9	No	No
R115	B	66	1 house, 2 outbuildings	55.9	61.0	No	No
R116	B	66	1 house (boarded up)	61.0	**67.4***	**N/A**	**N/A**

Receptor	Land-Use Category	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 1 & 2 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
R117b	B	66	1 house	62.5	**68.9***	**N/A**	**N/A**
R118b	B	66	1 house, 1 outbuilding	55.4	59.6	No	No
R119b	B	66	1 house	61.8	**67.6**	**Yes**	No
R121b	B	66	2 houses	59.4	62.5	No	No
R123b	B	66	2 houses	60.0	62.4	No	No
R124b	B	66	2 houses	60.6	**66.1**	**Yes**	No
R125b	B	66	1 house	63.1	65.0	No	No
R127b	B	66	1 house	64.8	**73.2***	**N/A**	**N/A**
R129b	B	66	3 houses	57.0	59.7	No	No
R131b	B	66	1 house	60.8	62.9*	N/A	N/A
R132b	B	66	1 house	**68.6**	**68.4***	**N/A**	**N/A**
R133b	B	66	2 houses	55.2	57.9	No	No
R135b	B	66	1 house	56.5	59.5	No	No
R136b	B	66	1 house	61.9	65.0	No	No
R137b	B	66	1 house	61.2	64.8	No	No
R138b	B	66	1 house	58.8	62.4	No	No
R139b	B	71	1 house	59.3	62.9	No	No
R140b	C	71	10 RVs (RV Park)	61.9	65.5	No	No
R141b	C	71	7 RVs (RV Park)	64.9	68.7	No	No
S107b	C	71	10 RVs (RV Park)	57.6	61.1	No	No
S106b	C	71	18 RVs (RV Park)	62.4	66.1	No	No
R142b	B	66	1 house	59.7	63.4	No	No
R144b	B	66	2 houses	55.1	63.0	No	No
R145b	B	66	1 house	50.8	53.9	No	No
R146b	B	66	1 house	54.2	56.7	No	No
R148b	B	66	1 house	58.7	60.5	No	No
R149b	B	66	1 house	63.8	**73.0***	**N/A**	**N/A**
R150b	B	66	1 house	59.8	65.3*	N/A	N/A
R151b	B	66	1 house	60.9	**66.9***	**N/A**	**N/A**
R152b	B	66	1 house	60.4	**66.2***	**N/A**	**N/A**
R153b	B	66	1 house	58.8	60.8	No	No
R154b	B	66	1 house	57.7	62.2	No	No
R155b	B	66	1 house	63.6	65.1	No	No

Receptor	Land-Use Category	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 1 & 2 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
R157b	B	66	1 house	59.3	64.4*	N/A	N/A
R160b	B	66	3 houses, several outbuildings	63.3	56.0	No	No
R162	B	66	2 house	59.9	65.0	No	No
R164	B	66	2 houses	55.9	60.3	No	No
R166	B	66	2 houses	56.7	61.1	No	No
R167	B	66	1 house, several outbuildings	48.9	52.2	No	No
R168	B	66	1 house, several outbuildings	48.7	52.1	No	No
R169	B	66	1 house	59.1	61.6	No	No
R170	B	66	2 houses	58.3	62.7	No	No
R175	B	66	4 houses, outbuildings	59.8	64.8	No	No
R176	B	66	3 houses, outbuildings	59.7	63.3	No	No
Total Exceeding						7	0

Receivers (homes) marked with a asterisk (*) will be relocated and are not considered for noise impact.

Receivers (homes) that are bold exceeded the NAC noise threshold.

Table 3a
2025 Alternative 3 Noise Level Comparisons

Receptor	Land-Use Category	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 3 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
P3	B	66	1 house	53.2	55.9	No	No
P4	B	66	1 house	62.2	**72.4***	**N/A**	**N/A**
P5	B	66	1 house	55.7	58.0	No	No
P7	B	66	1 house	52.6	57.3	No	No
R10	B	66	1 house, 5 outbuildings	53.1	57.8	No	No
R11	B	66	1 house, 4 outbuildings	55.8	61.2	No	No
R12	B	66	1 house	61.9	62.8	No	No
R13	B	66	1 house	60.3	61.6	No	No
R15	B	66	1 house	55.0	57.4	No	No
R16	B	66	1 house	54.9	57.7	No	No
R17	B	66	1 house	57.1	60.1	No	No

Recept or	Land Use Categor	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 3 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
R18	B	66	1 house	56.6	59.9	No	No
R19	B	66	1 house	55.3	58.8	No	No
R20	B	66	2 houses	57.6	62.0	No	No
R22	B	66	2 houses	55.1	59.2	No	No
R24	C	71	2 businesses, 4 buildings	61.4	66.2	No	No
R25	B	66	1 house, 3 outbuildings	57.8	60.5	No	No
R26	B	66	1 house, 2 outbuildings	53.4	55.8	No	No
R27	B	66	1 house	**69.4**	**66.8**	**Yes**	No
R28	B	66	1 house, 1 outbuilding	**68.4**	65.6	No	No
R29	B	66	1 house, 1 outbuilding	**67.2**	65.5	No	No
R30	B	66	1 house, 2 outbuildings, 1 business	61.7	62.5	No	No
R31	B	66	1 house-ground level	64.0	63.9	No	No
R32	B	66	1 house, 1 outbuilding	**67.7**	**82.0***	**N/A**	**N/A**
R33	B	66	1 house, 3 outbuilding	58.9	**66.1**	**Yes**	No
R34	B	66	1 house	59.8	**67.6**	**Yes**	No
R35	B	66	1 house	**67.1**	65.6	No	No
R36	B	66	2 houses, 2 outbuildings	55.8	61.4	No	No
R38	B	66	3 houses, 1 outbuilding	52.7	55.4	No	No
R41	B	66	2 houses, 1 outbuilding	51.5	54.3	No	No
R43	B	66	1 house, 3 outbuildings	59.9	61.2	No	No
R44	B	66	1 house, 1 outbuilding	60.5	61.6	No	No
R45	B	66	2 house, 2 outbuildings	62.8	63.2	No	No
R47	B	66	1 house, 4 outbuildings	**66.2**	**76.0***	**N/A**	**N/A**
R48	B	66	2 houses	58.3	58.8	No	No
R50	B	66	1 house, 2 outbuildings	57.9	59.1	No	No
R51	B	66	1 house	57.2	58.5	No	No
R53	B	66	2 houses	50.9	53.2	No	No
R54	B	66	1 house	57.0	58.5	No	No
R55	B	66	2 houses	54.7	56.6	No	No
R57	B	66	1 house	56.4	58.0	No	No
R58	B	66	1 house, 2 outbuildings	65.0	**75.4***	**N/A**	**N/A**
R59	B	66	1 house, 3 outbuildings	56.3	58.0	No	No
R64	B	66	1 house, 1 outbuilding	62.3	62.4	No	No
R66	B	66	2 houses, 3 outbuildings	59.6	60.5	No	No

Receptor	Land Use Category	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 3 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
R68	B	66	4 houses, 1 outbuilding	56.4	58.1	No	No
R72	B	66	2 houses, 4 outbuildings	63.1	64.3	No	No
R73	B	66	2 houses, 2 outbuildings	60.2	60.8	No	No
R76	B	66	2 houses, 1 outbuilding	51.8	56.2	No	No
R78	B	66	2 houses, 2 outbuildings	57.3	59.1	No	No
R79	B	66	1 house	63.8	**69.1***	**N/A**	**N/A**
R80	B	66	1 house	63.7	**68.6***	**N/A**	**N/A**
R81	B	66	1 house	59.4	63.4	No	No
R82	B	66	1 house	53.6	58.3	No	No
R83	B	66	1 house	54.4	60.1	No	No
R84	B	66	1 house, 1 outbuilding	59.2	59.5	No	No
P83	B	66	Sunnyside Elementary School	60.3	63.2	No	No
P84	B	66	Baptist Church	57.1	62.0	No	No
R85	B	66	1 house	58.0	62.9	No	No
R87	B	66	3 houses, 1 outbuilding	50.8	55.0	No	No
P89	B	66	10 mobile homes, Mobile Home Park	59.8	63.1	No	No
P90	B	66	6 mobile homes, Mobile Home Park	56.5	59.7	No	No
P91	B	66	13 mobile homes, Mobile Home Park	**66.8**	**67.7**	**Yes**	No
P93	B	66	13 mobile homes, Mobile Home Park	58.1	60.6	No	No
P94	B	66	12 mobile homes, Mobile Home Park	57.6	59.6	No	No
P95	B	66	7 mobile homes, Mobile Home Park	64.6	64.0	No	No
R89	B	66	Apartment Building (adjacent to Mobile Home Park)	65.8	65.4	No	No
R90	B	66	1 house	55.4	60.9	No	No
R91	B	66	1 house	63.2	**77.1***	**N/A**	**N/A**
R92	B	66	1 house	**67.8**	**77.9***	**N/A**	**N/A**
R93	B	66	1 house, 1 outbuilding	**70.0**	**73.6***	**N/A**	**N/A**
R94	B	66	1 house, 3 outbuildings	62.8	**77.0***	**N/A**	**N/A**
R95	B	66	1 house	62.4	**76.0***	**N/A**	**N/A**
R96	B	66	1 house	54.0	56.5	No	No
R97	B	66	1 house, 2 outbuildings	60.7	62.1	No	No
R98	B	66	1 house	51.9	54.6	No	No
R99	B	66	1 house, 1 outbuilding	50.2	52.9	No	No

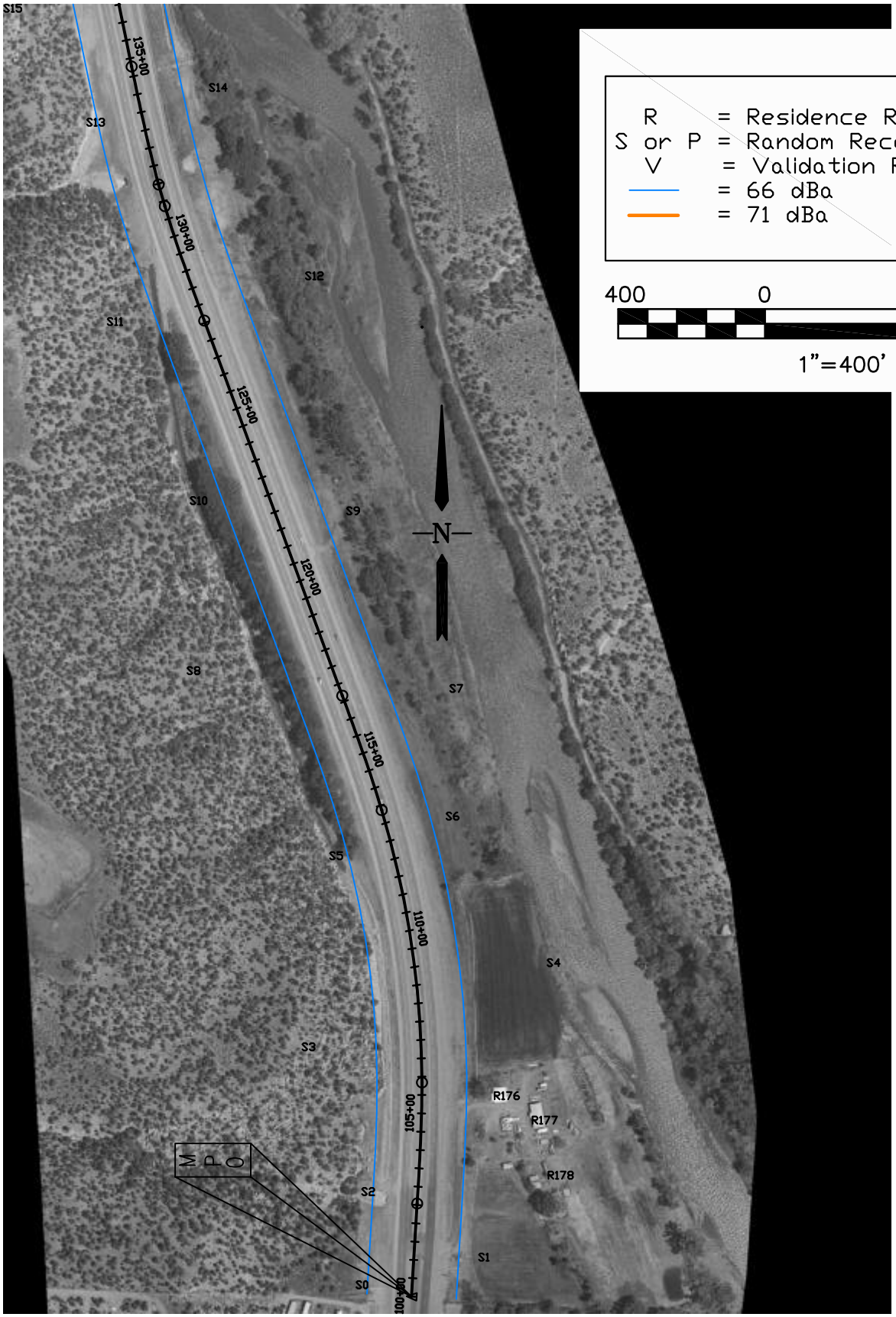
Receptor	Land Use Category	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 3 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
R100	B	66	1 house	56.7	59.0*	N/A	N/A
R101	B	66	1 mobile home, 1 out building	58.1	64.3	No	No
R102	B	66	1 house, 1 outbuilding	51.0	55.5	No	No
R103	B	66	1 house, 1 outbuilding	54.2	58.9	No	No
R104	B	66	1 mobile home, 1 outbuilding	53.8	58.5	No	No
R105	B	66	1 mobile home	53.7	58.3	No	No
R106	B	66	1 mobile home	52.0	56.3	No	No
R107	B	66	1 mobile home	59.1	65.4	No	No
R108	B	66	1 mobile home	53.1	57.7	No	No
R109	B	66	1 house, 1 outbuilding	51.5	54.3	No	No
R110	B	66	1 house, 1 outbuilding	59.2	**65.5***	**N/A**	**N/A**
R111	B	66	3 houses, 3 outbuildings	59.8	**66.5**	**Yes**	No
R114	B	66	1 mobile home	54.3	58.9	No	No
R115	B	66	1 house, 2 outbuildings	55.9	61.0	No	No
R116	B	66	1 house (boarded up)	61.0	**67.4***	**N/A**	**N/A**
R117d	B	66	1 house	62.5	**72.7***	**N/A**	**N/A**
R118d	B	66	1 house, 1 outbuilding	55.4	60.2	No	No
R119d	B	66	1 house	61.8	**68.9**	**Yes**	No
R121d	B	66	2 houses	59.4	61.9	No	No
R123d	B	66	2 houses	60.0	63.3	No	No
R124d	B	66	2 houses	60.6	63.7	No	No
R125d	B	66	1 house	63.1	**69.6**	**Yes**	No
R127d	B	66	1 house	64.8	**67.0***	**N/A**	**N/A**
R129d	B	66	3 houses	57.0	60.3	No	No
R131d	B	66	1 house	60.8	61.7*	N/A	N/A
R132d	B	66	1 house	**68.6**	64.4*	N/A	N/A
R133d	B	66	2 houses	55.2	54.8	No	No
R135d	B	66	1 house	56.5	55.1	No	No
R136d	B	66	1 house	61.9	56.5	No	No
R137d	B	66	1 house	61.2	55.8	No	No
R138d	B	66	1 house	58.8	54.4	No	No
R139d	B	71	1 house	59.3	54.3	No	No
R140d	C	71	10 RVs (RV Park)	61.9	54.6	No	No

Receptor	Land Use Category	CDOT NAC (dBA)	Represents	Existing Conditions Leq	2025 Alternative 3 Leq	Approach or Exceed NAC Limits?	10 dBA increase over Existing
R141d	C	71	7 RVs (RV Park)	64.9	54.3	No	No
S107d	C	71	10 RVs (RV Park)	57.6	52.7	No	No
S106d	C	71	18 RVs (RV Park)	62.4	53.1	No	No
R142d	B	66	1 house	59.7	55.0	No	No
R144d	B	66	2 houses	55.1	54.8	No	No
R145d	B	66	1 house	50.8	52.1	No	No
R146d	B	66	1 house	54.2	55.3	No	No
R148d	B	66	1 house	58.7	59.4	No	No
R149d	B	66	1 house	63.8	**75.0***	**N/A**	**N/A**
R150d	B	66	1 house	59.8	**68.5***	**N/A**	**N/A**
R151d	B	66	1 house	60.9	**70.8***	**N/A**	**N/A**
R152d	B	66	1 house	60.4	**68.3***	**N/A**	**N/A**
R153d	B	66	1 house	58.8	61.2	No	No
R154d	B	66	1 house	57.7	61.8	No	No
R155d	B	66	1 house	63.6	65.1	No	No
R157d	B	66	1 house	59.3	64.4*	N/A	N/A
R160d	B	66	3 houses, several outbuildings	63.3	56.1	No	No
R162	B	66	2 house	59.9	65.0	No	No
R164	B	66	2 houses	55.9	60.3	No	No
R166	B	66	2 houses	56.7	61.1	No	No
R167	B	66	1 house, several outbuildings	48.9	52.2	No	No
R168	B	66	1 house, several outbuildings	48.7	52.1	No	No
R169	B	66	1 house	59.1	61.6	No	No
R170	B	66	2 houses	58.3	62.7	No	No
R175	B	66	4 houses, outbuildings	59.8	64.8	No	No
R176	B	66	3 houses, outbuildings	59.7	63.3	No	No
Total Exceeding						7	0

Receivers (homes) marked with a asterisk (*) will be relocated and are not considered for noise impact.

Receivers (homes) that are bold exceeded the NAC noise threshold.

A total of seven receptor locations meet or exceed the NAC B noise threshold limits under Alternative 3.

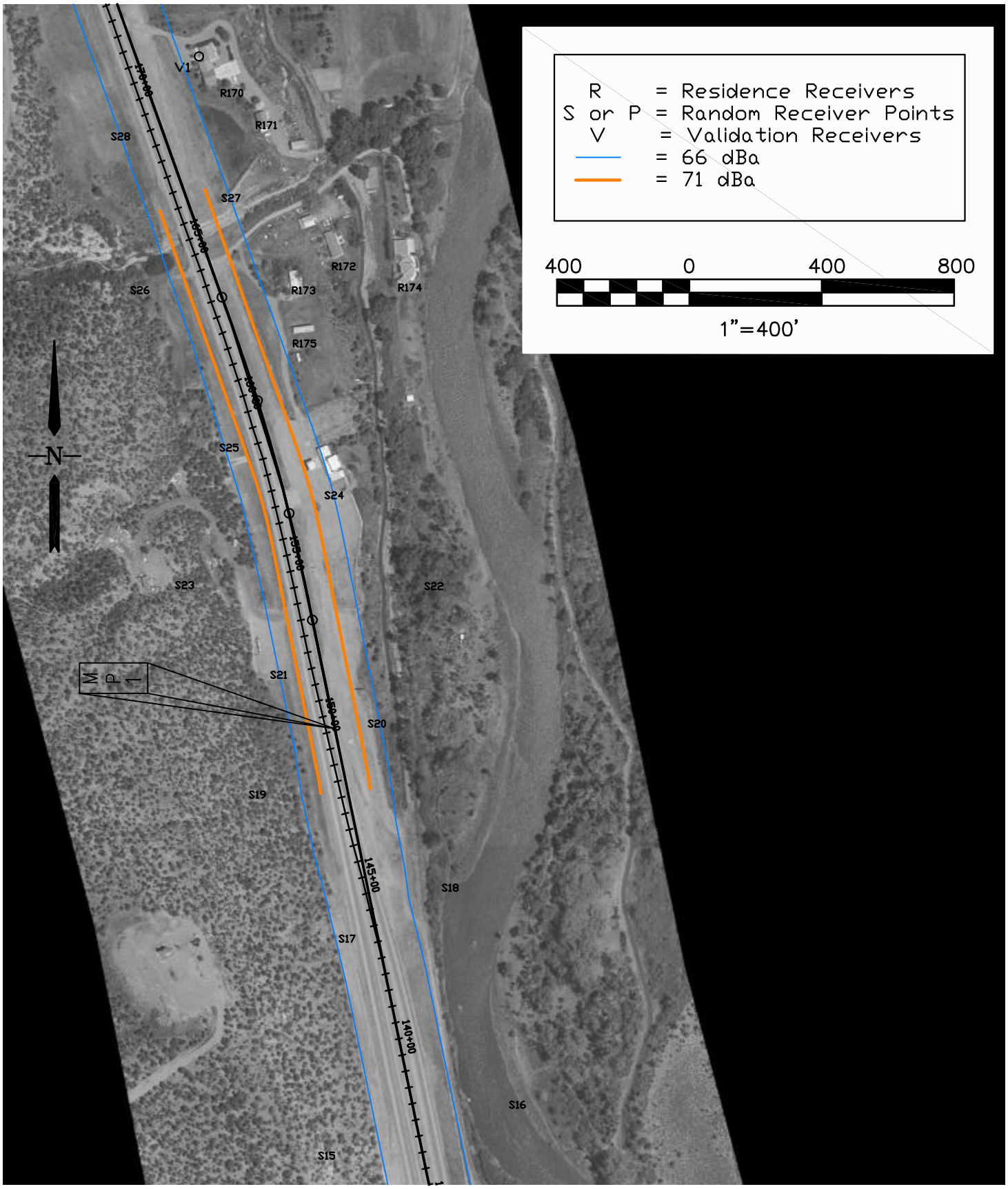


NOISE LEVELS

US 550

URS

FIGURE 1

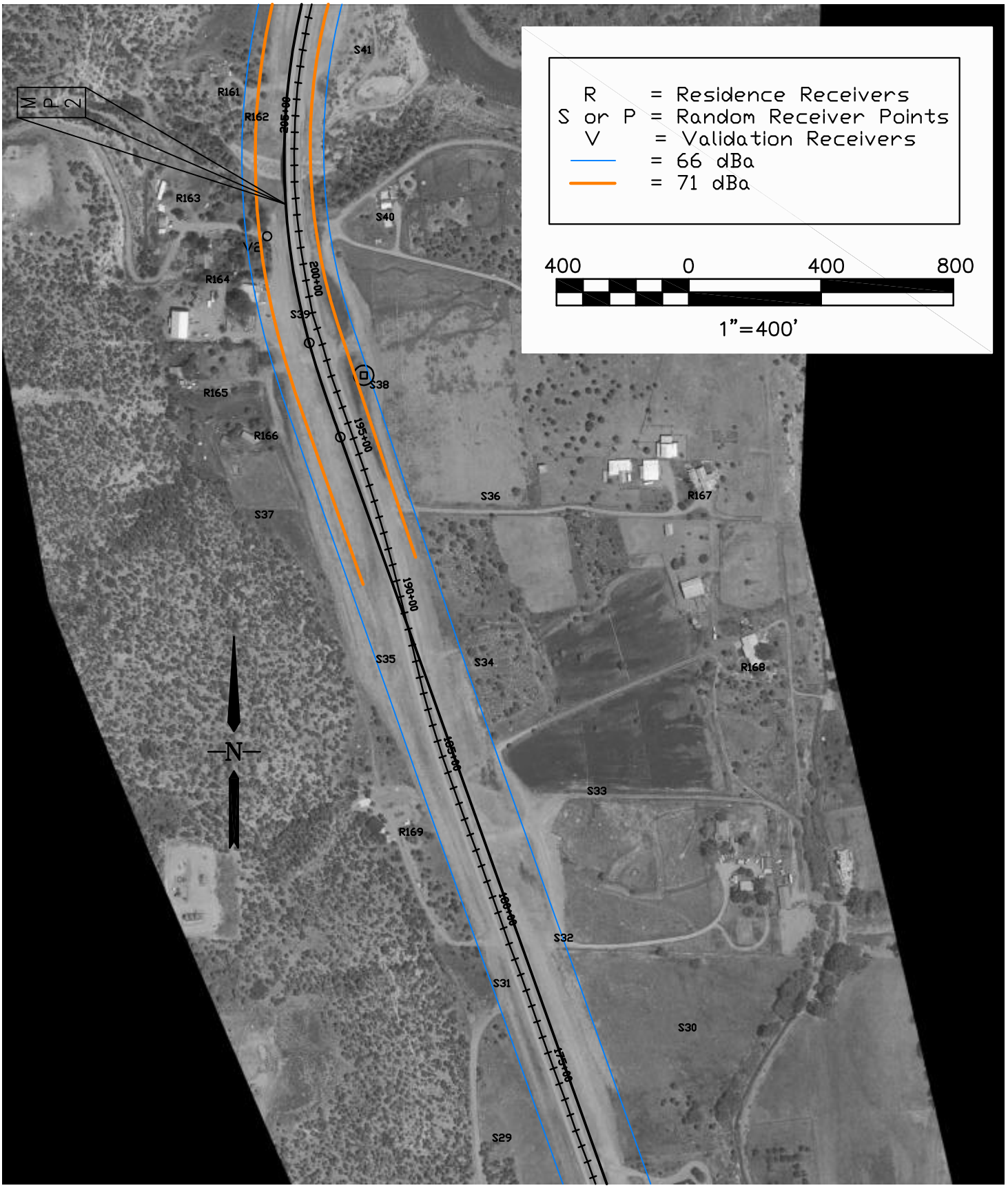


NOISE LEVELS

US 550

URS

FIGURE 2

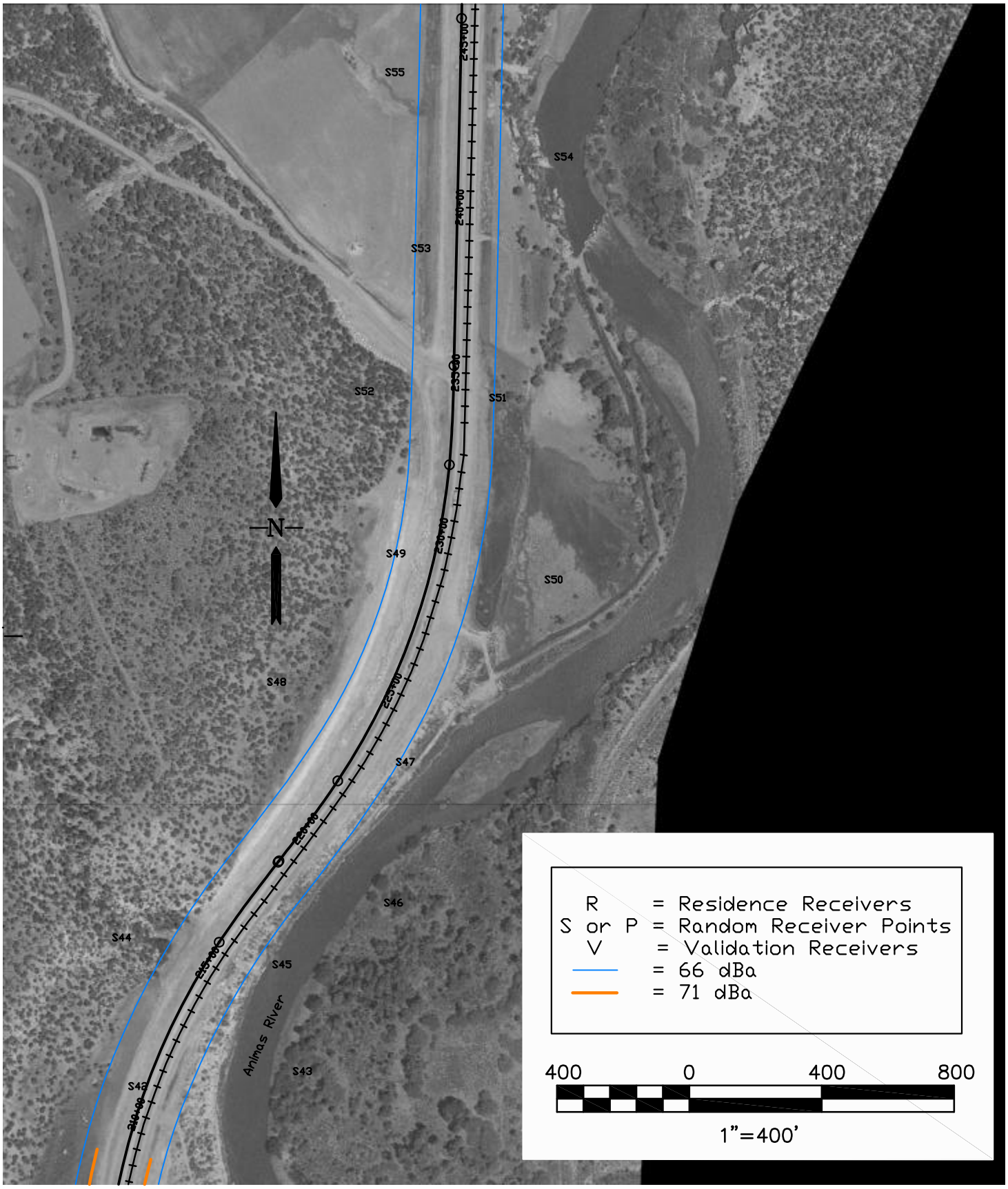


NOISE LEVELS

US 550

URS

FIGURE 3

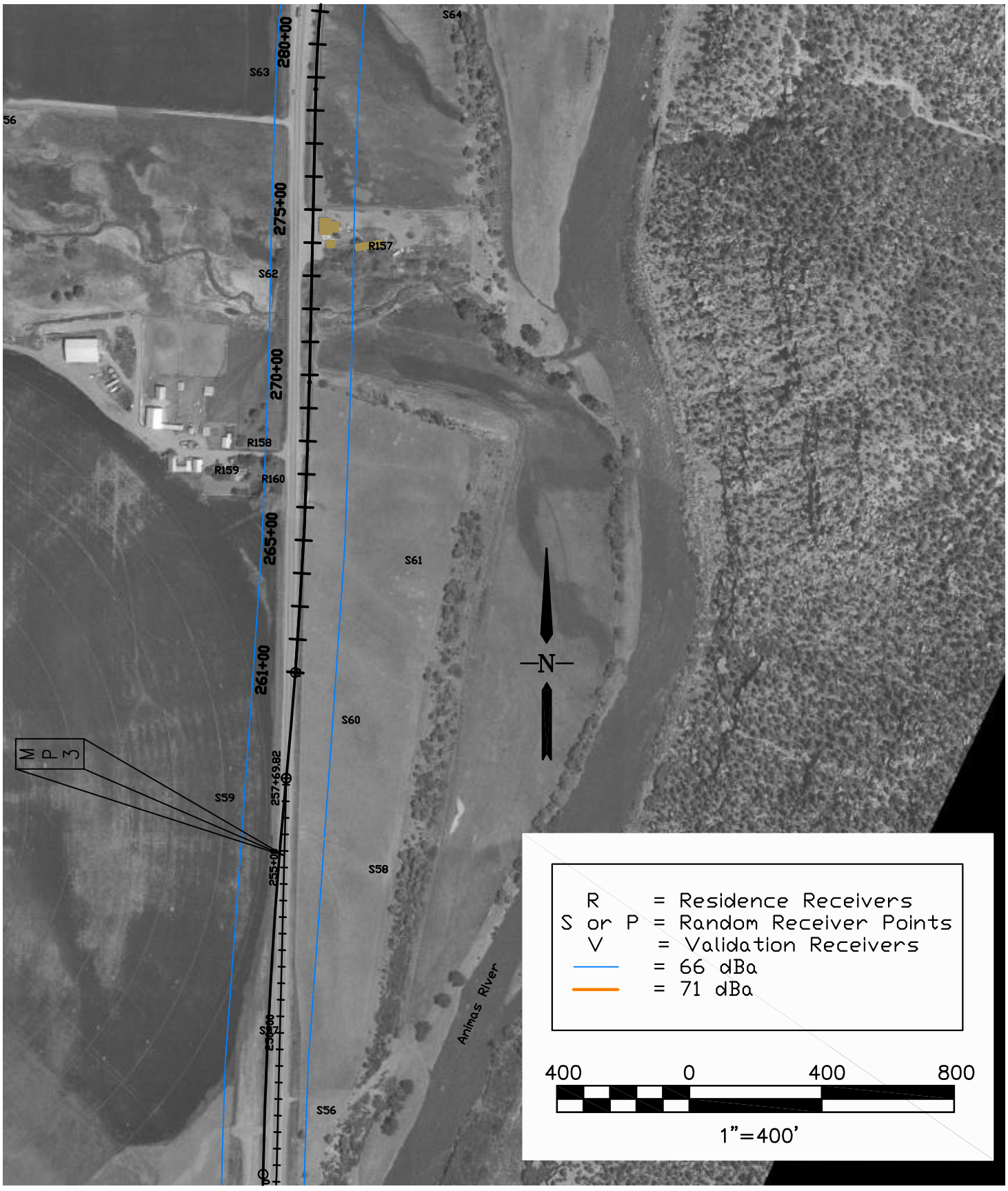


NOISE LEVELS

US 550

URS

FIGURE 4

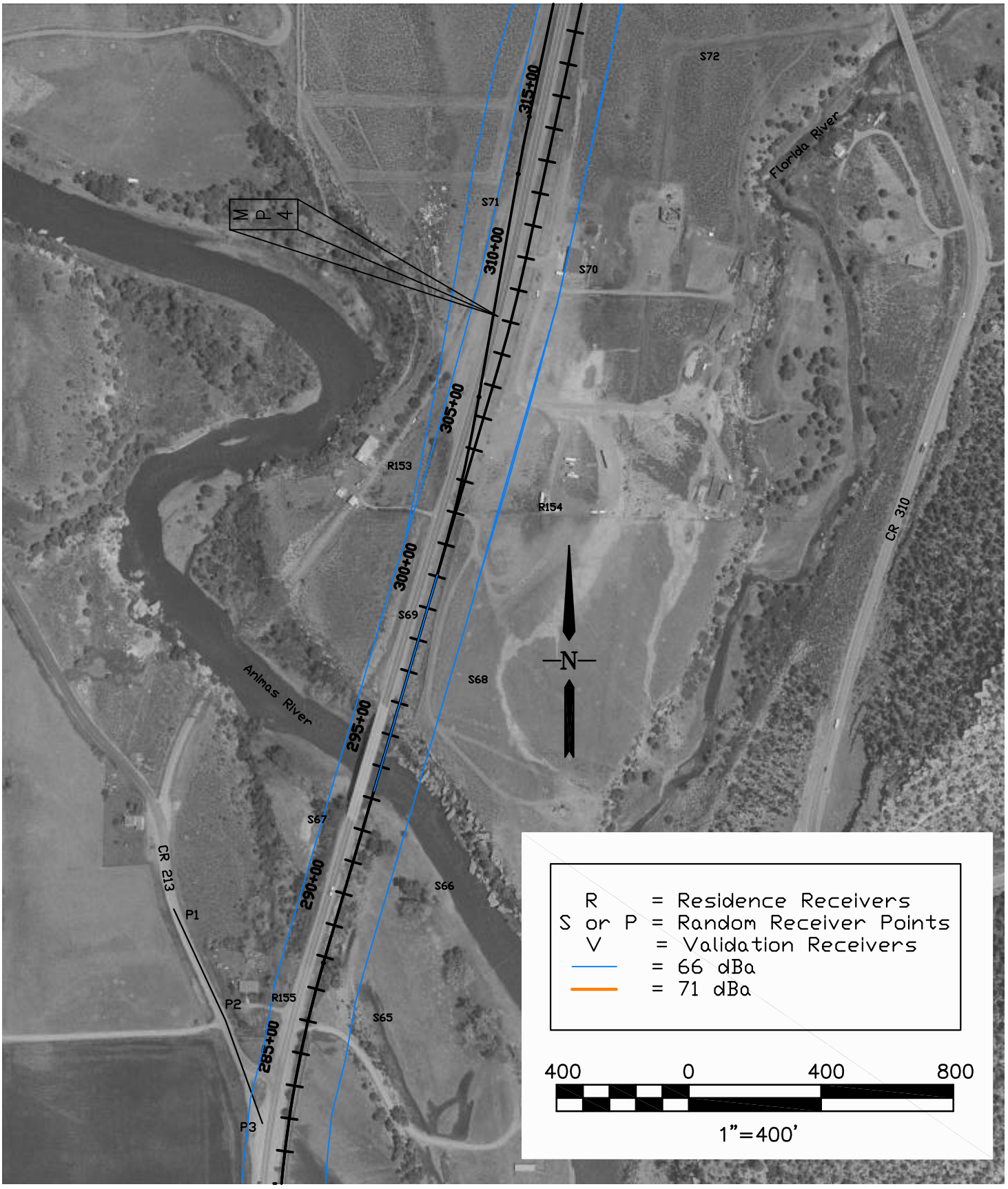


NOISE LEVELS

US 550

URS

FIGURE 5

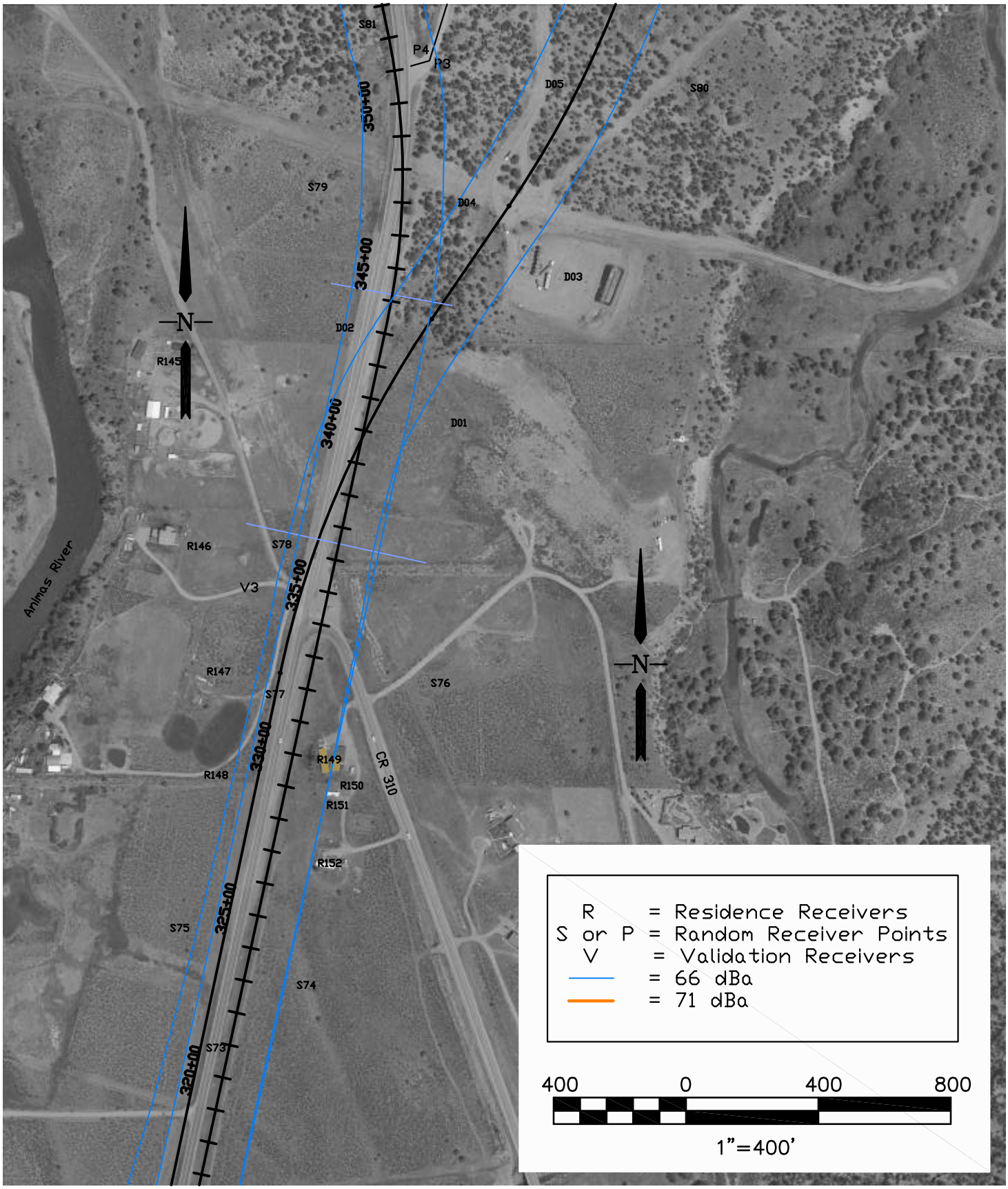


NOISE LEVELS

US 550

URS

FIGURE 6

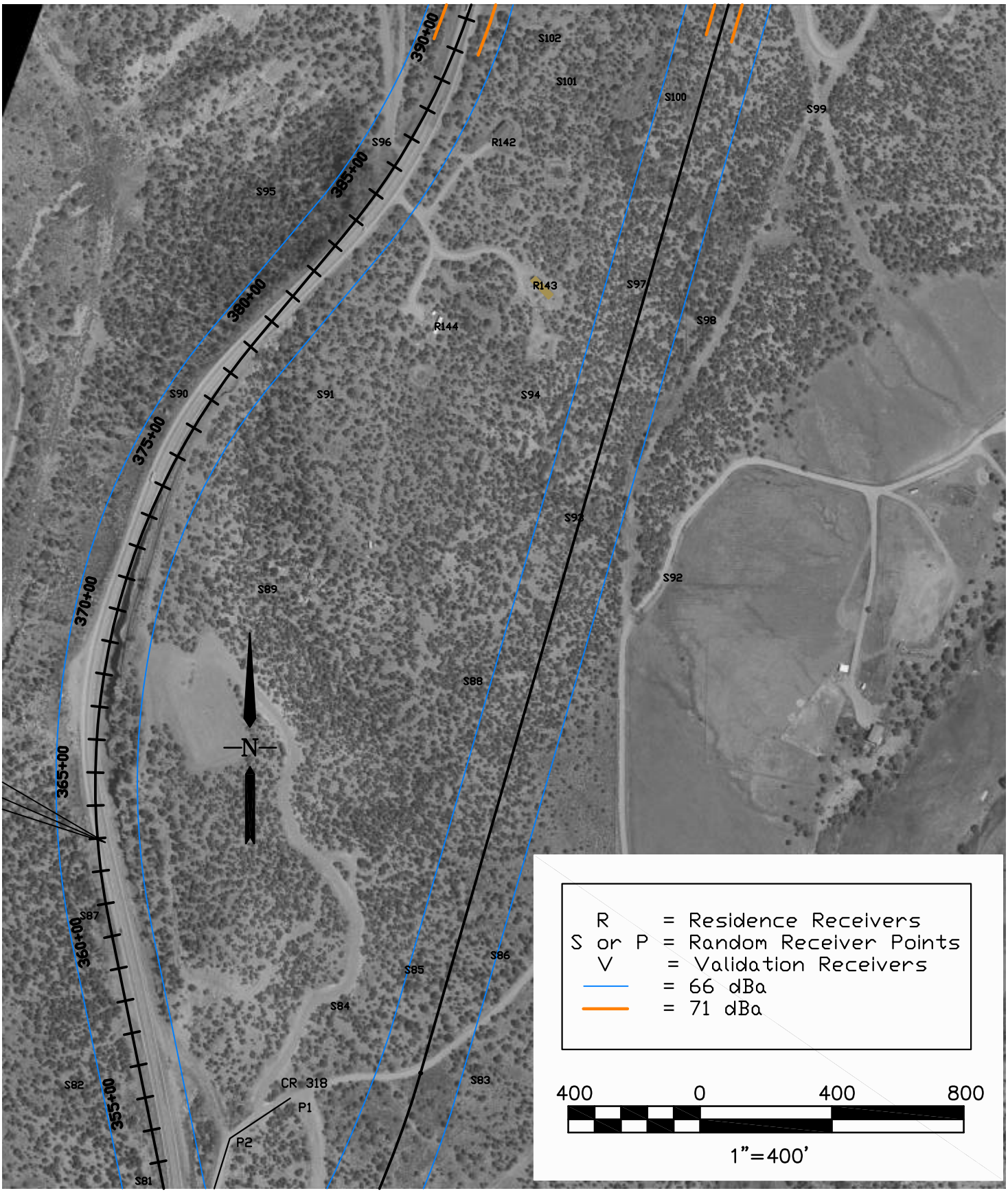


NOISE LEVELS

US 550

URS

FIGURE 7

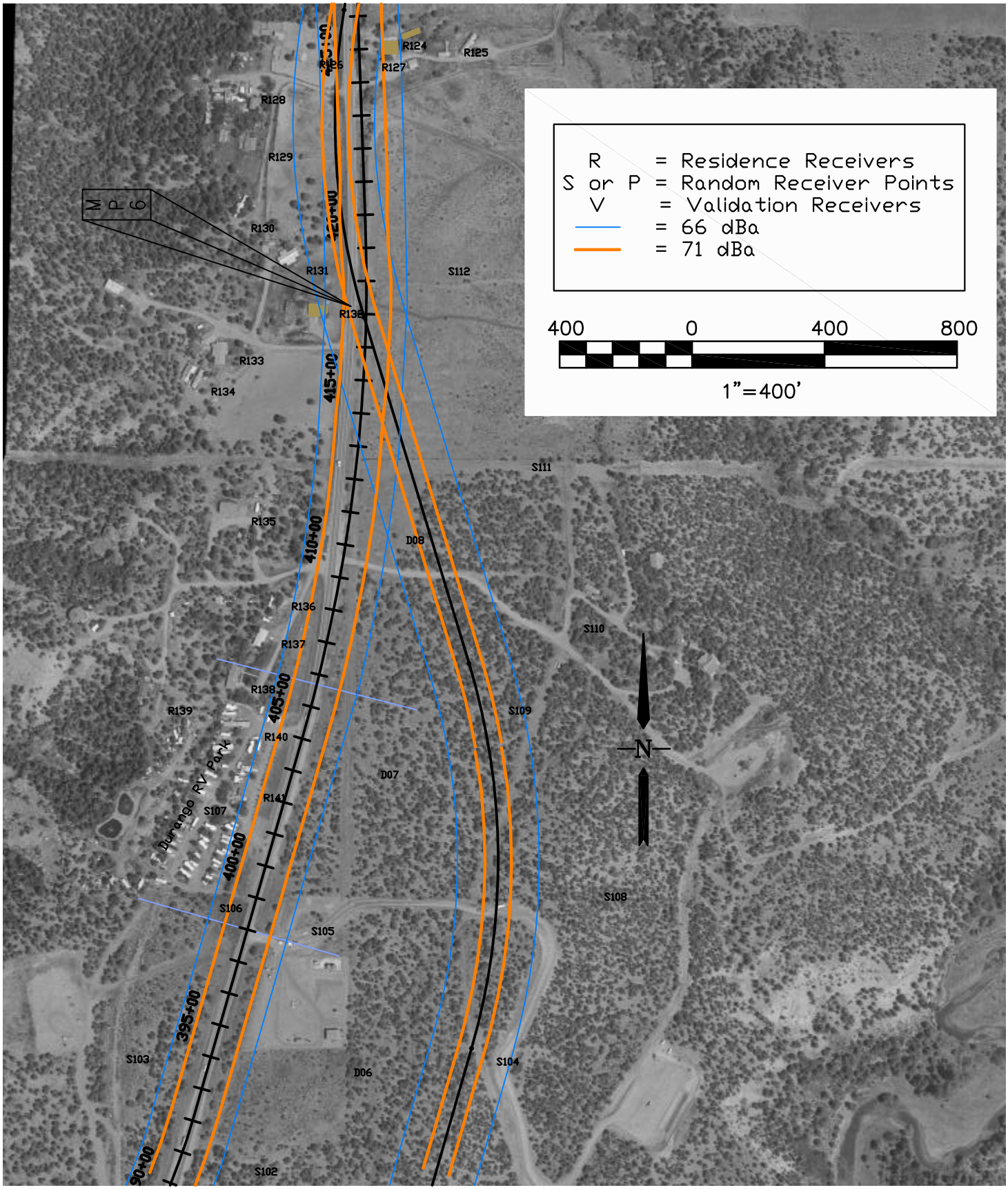


NOISE LEVELS

US 550

URS

FIGURE 8



NOISE LEVELS

US 550

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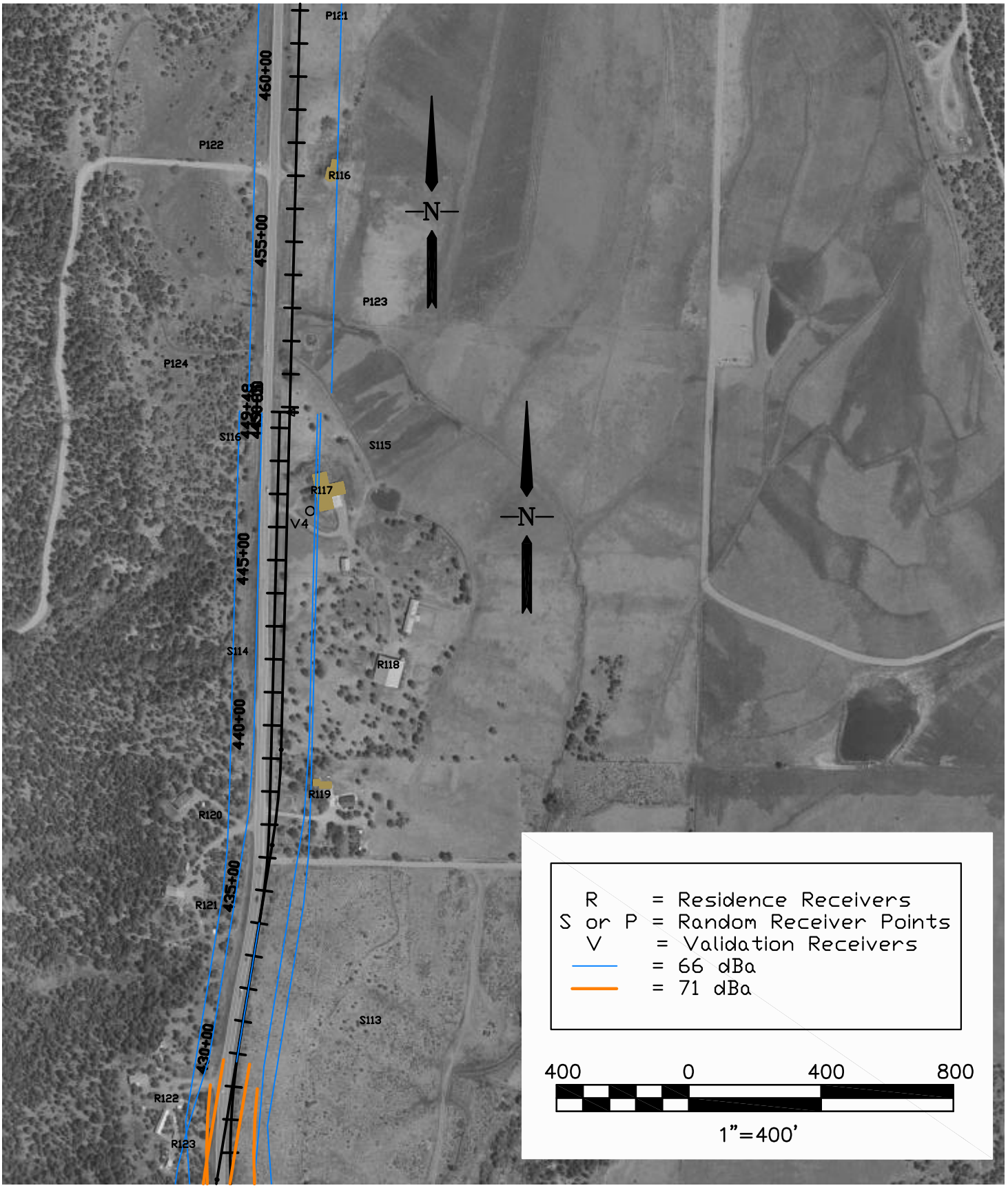
FIGURE 9

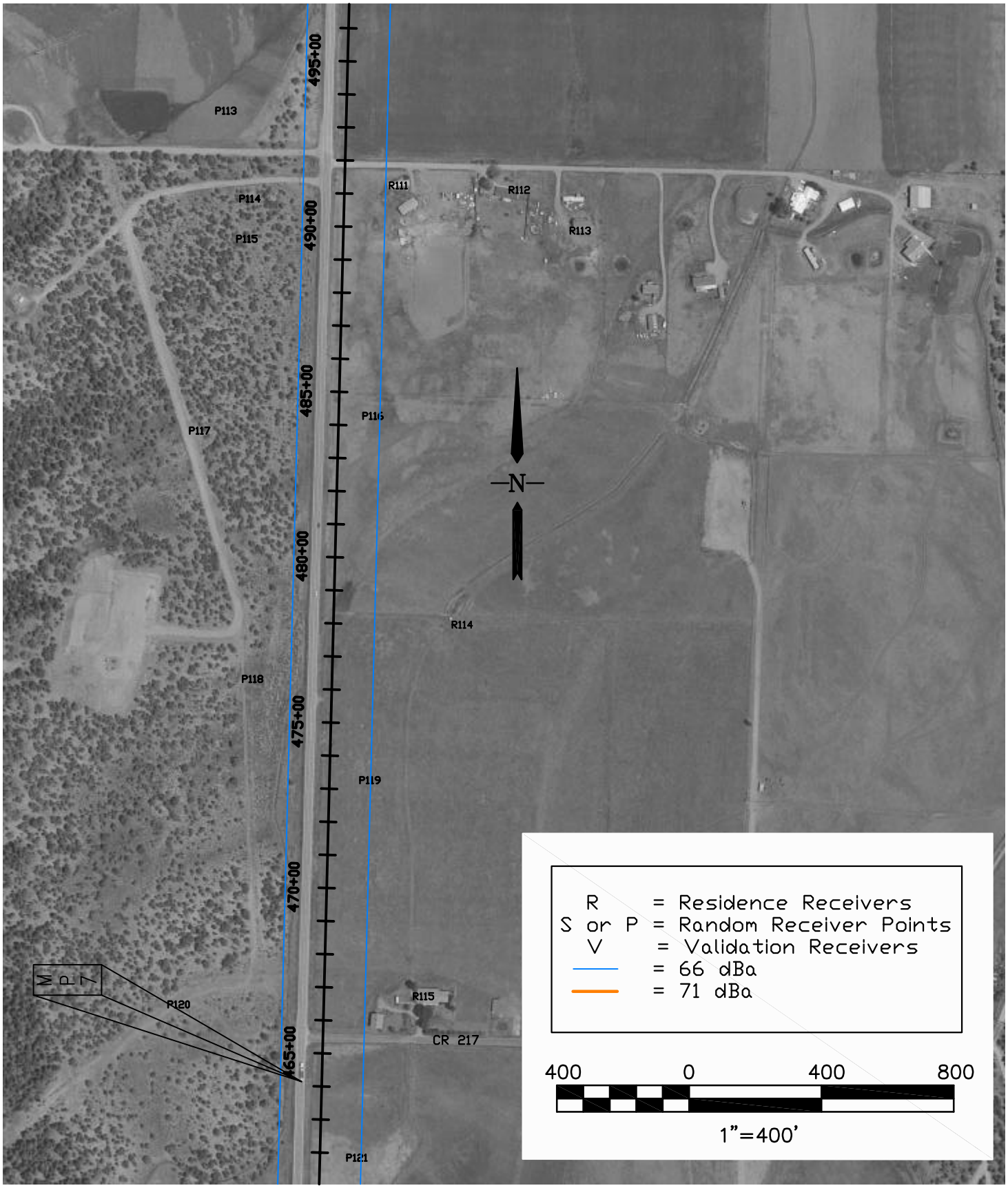


NOISE LEVELS

US 550

URS

FIGURE 10

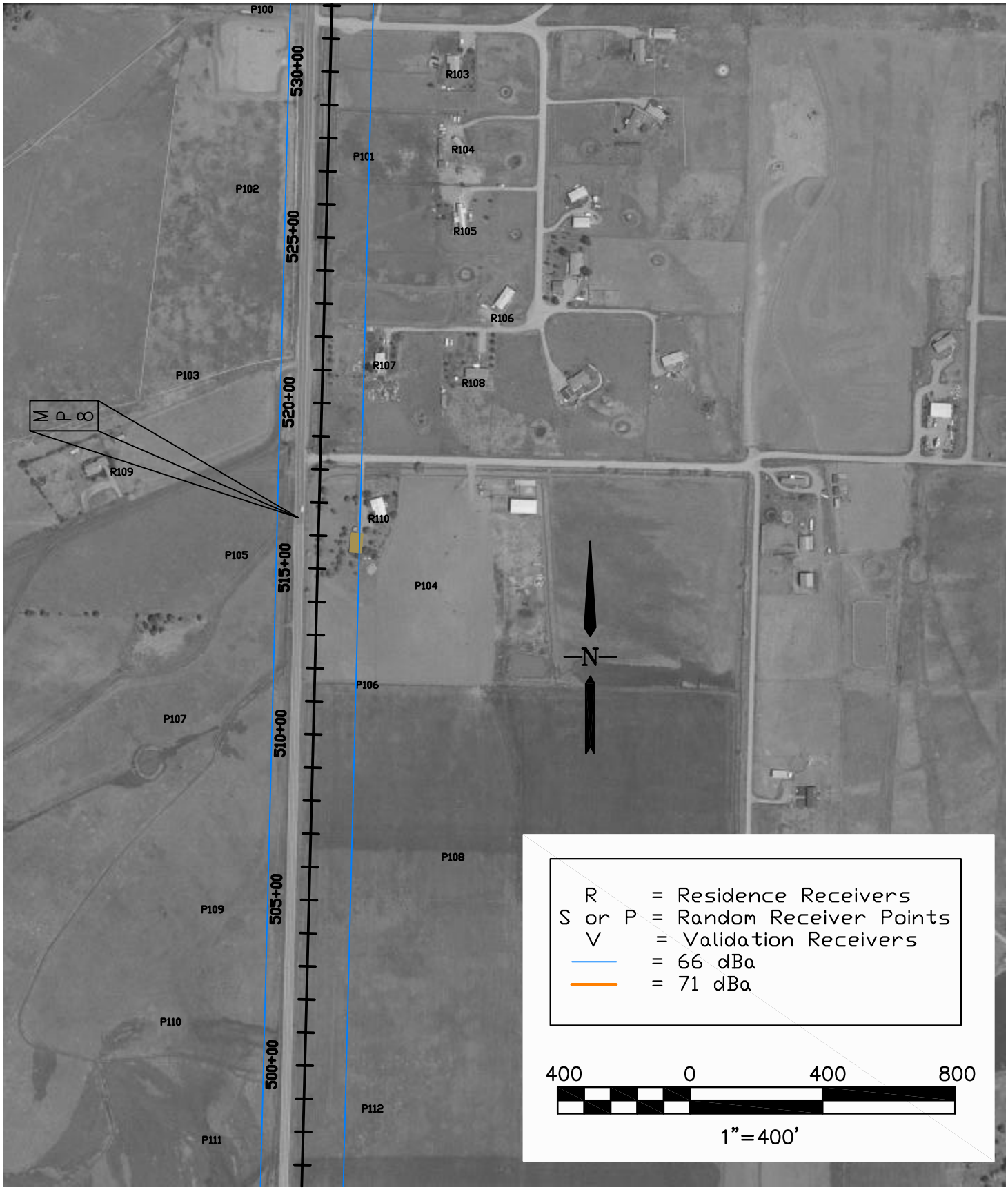


NOISE LEVELS

US 550

URS

FIGURE 11

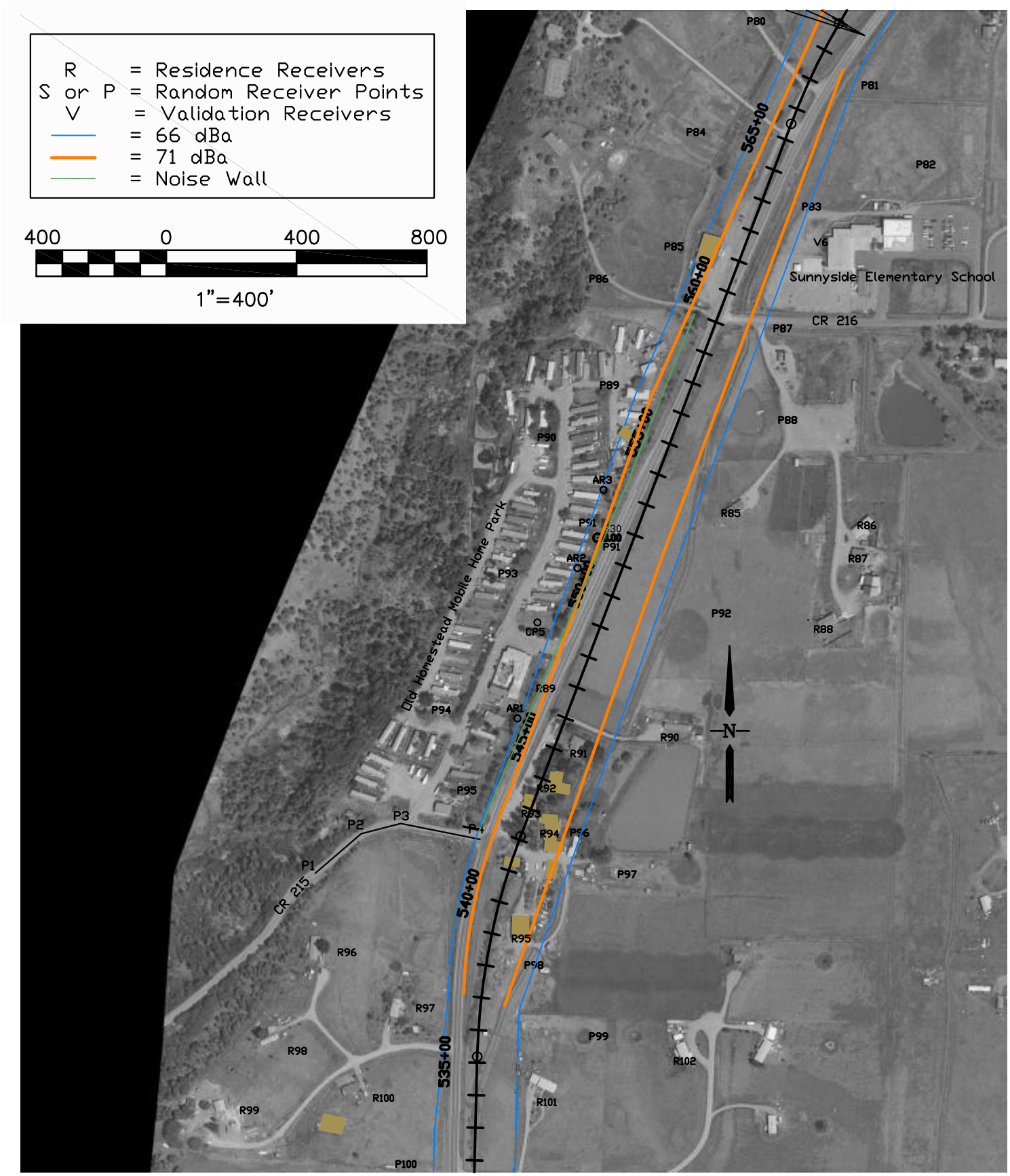


NOISE LEVELS

US 550

URS

FIGURE 12

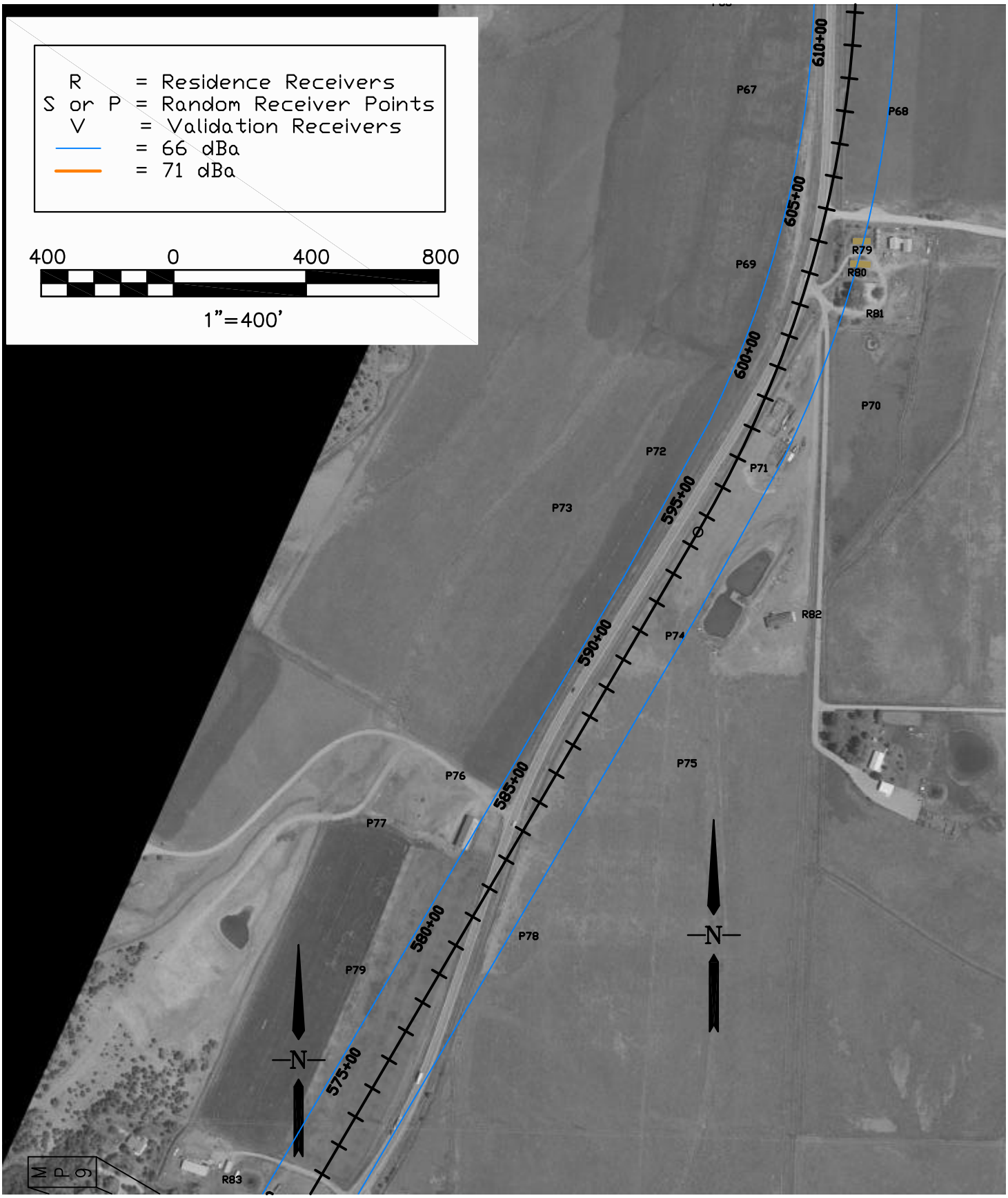


NOISE LEVELS

US 550

URS

FIGURE 13

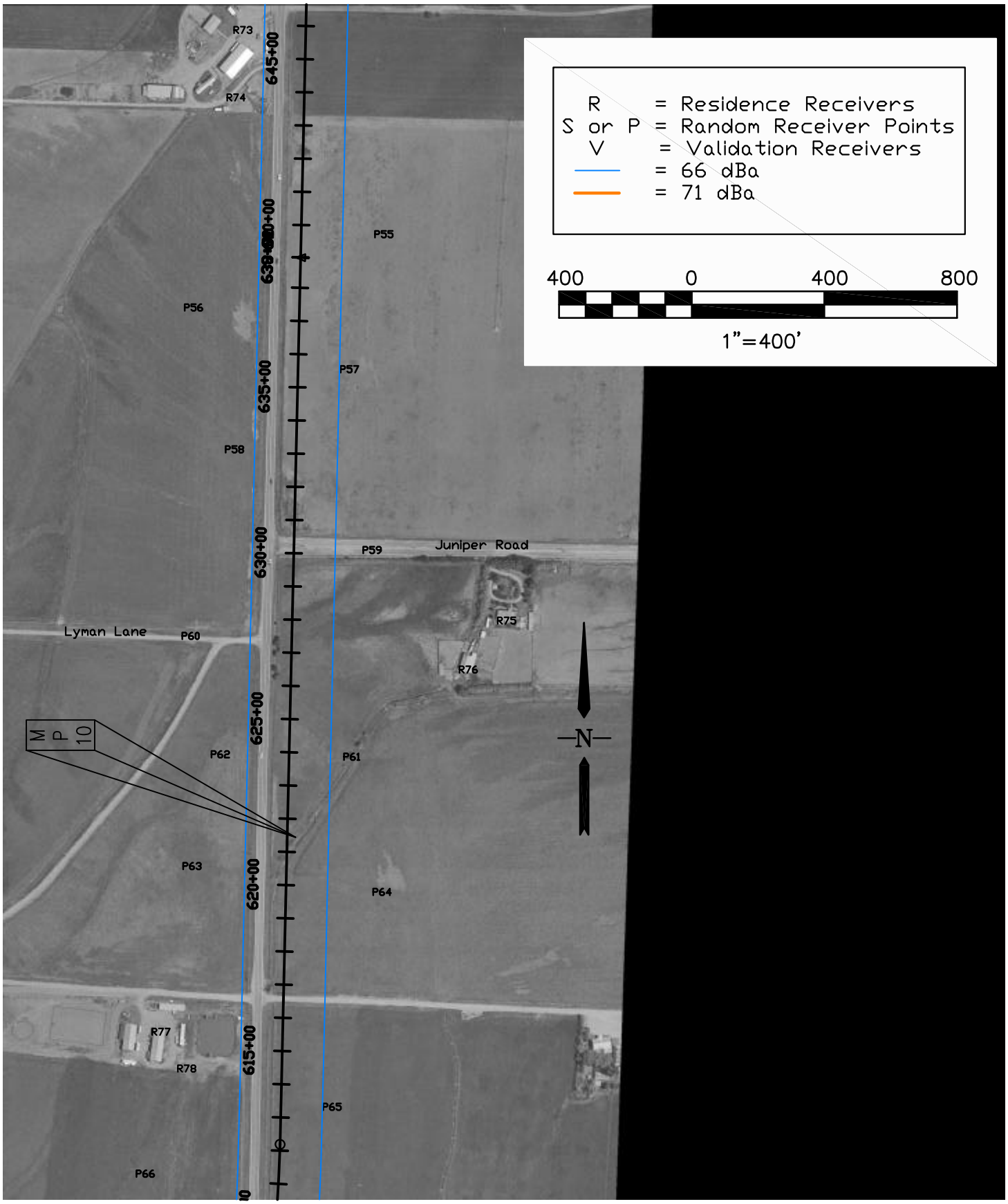


NOISE LEVELS

US 550

URS

FIGURE 14

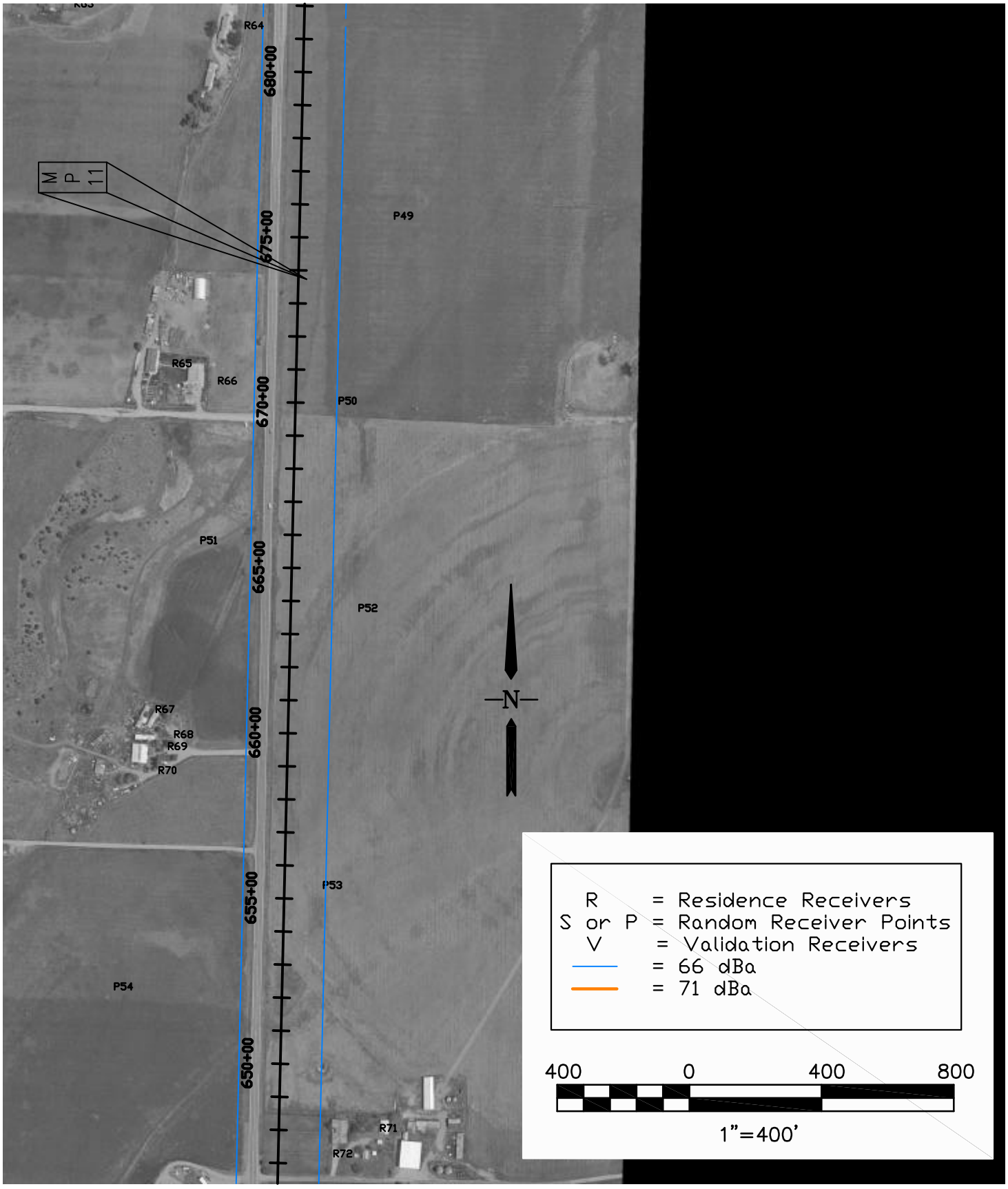


NOISE LEVELS

US 550

URS

FIGURE 15



NOISE LEVELS

US 550

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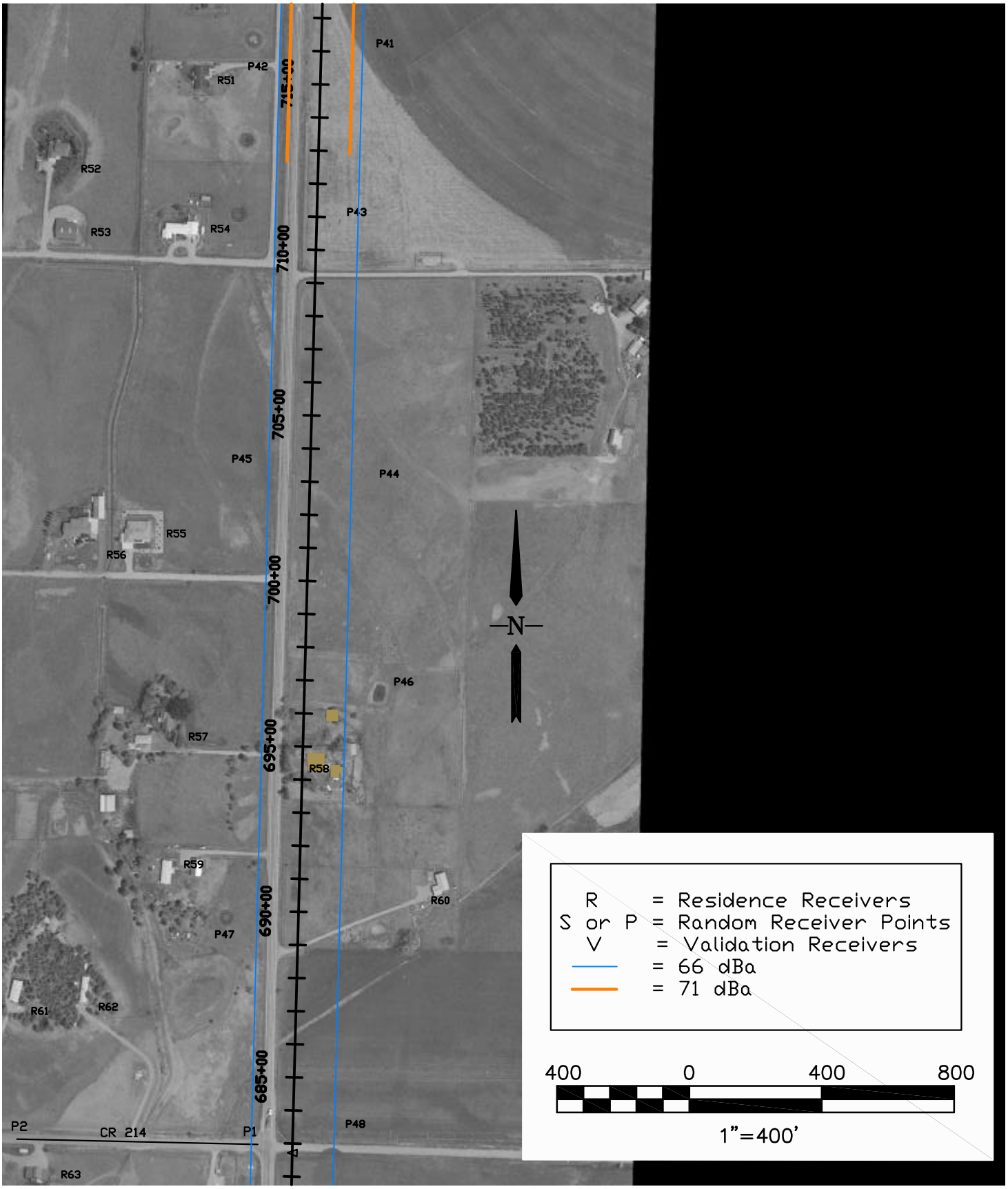
FIGURE 16



NOISE LEVELS

US 550

URS

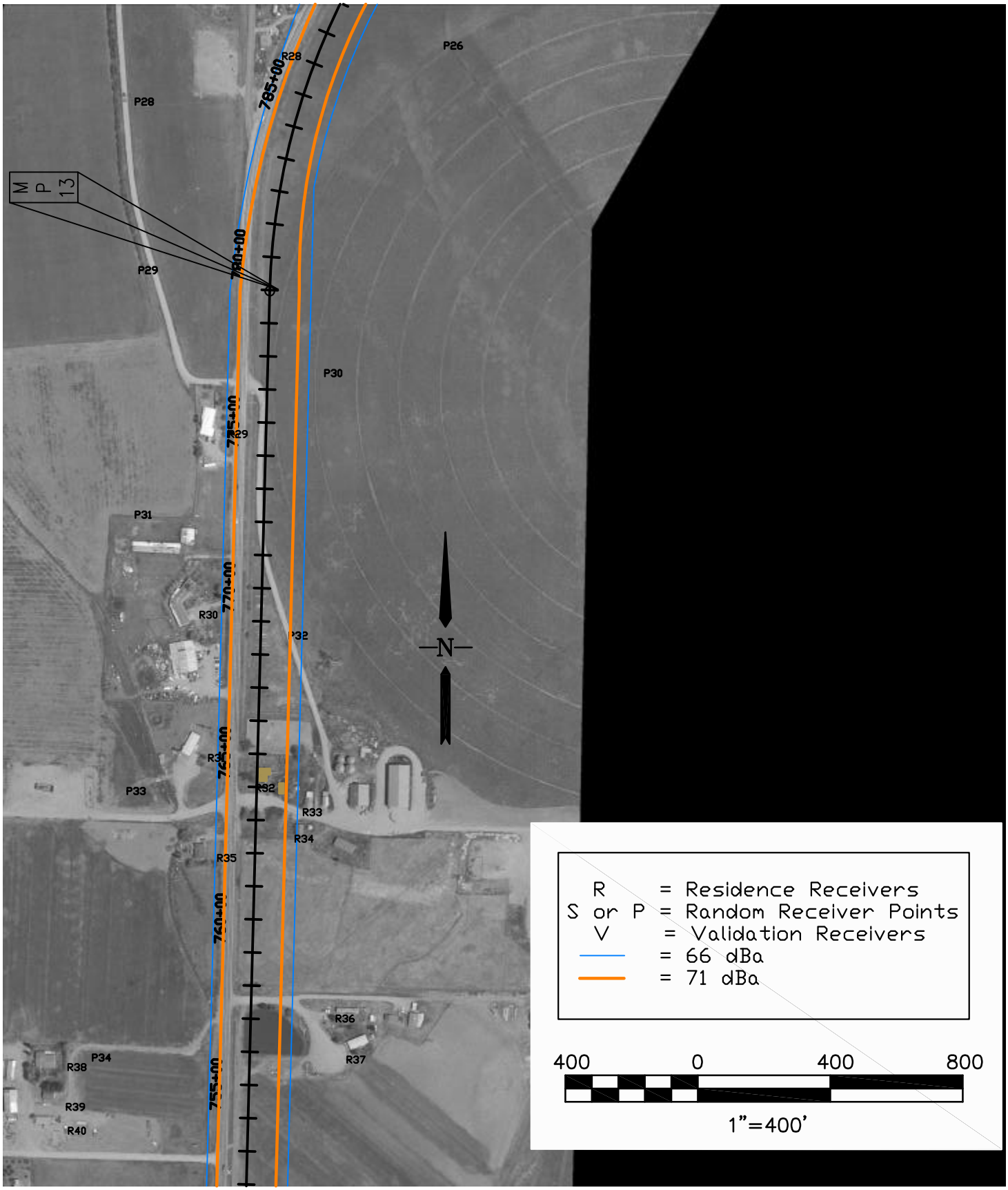
FIGURE 17

NOISE LEVELS

US 550

URS

FIGURE 18



NOISE LEVELS

US 550

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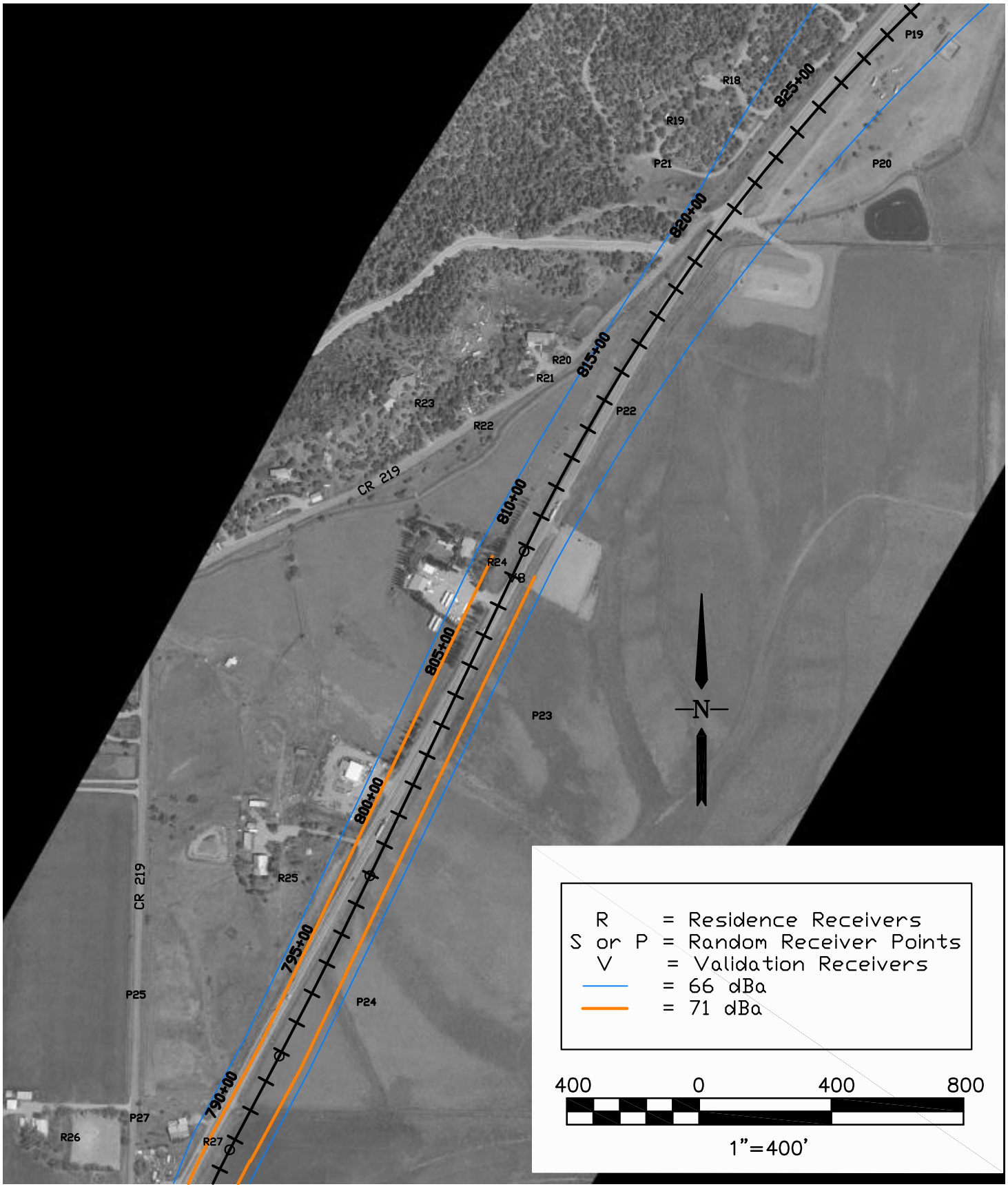
FIGURE 19



NOISE LEVELS

US 550

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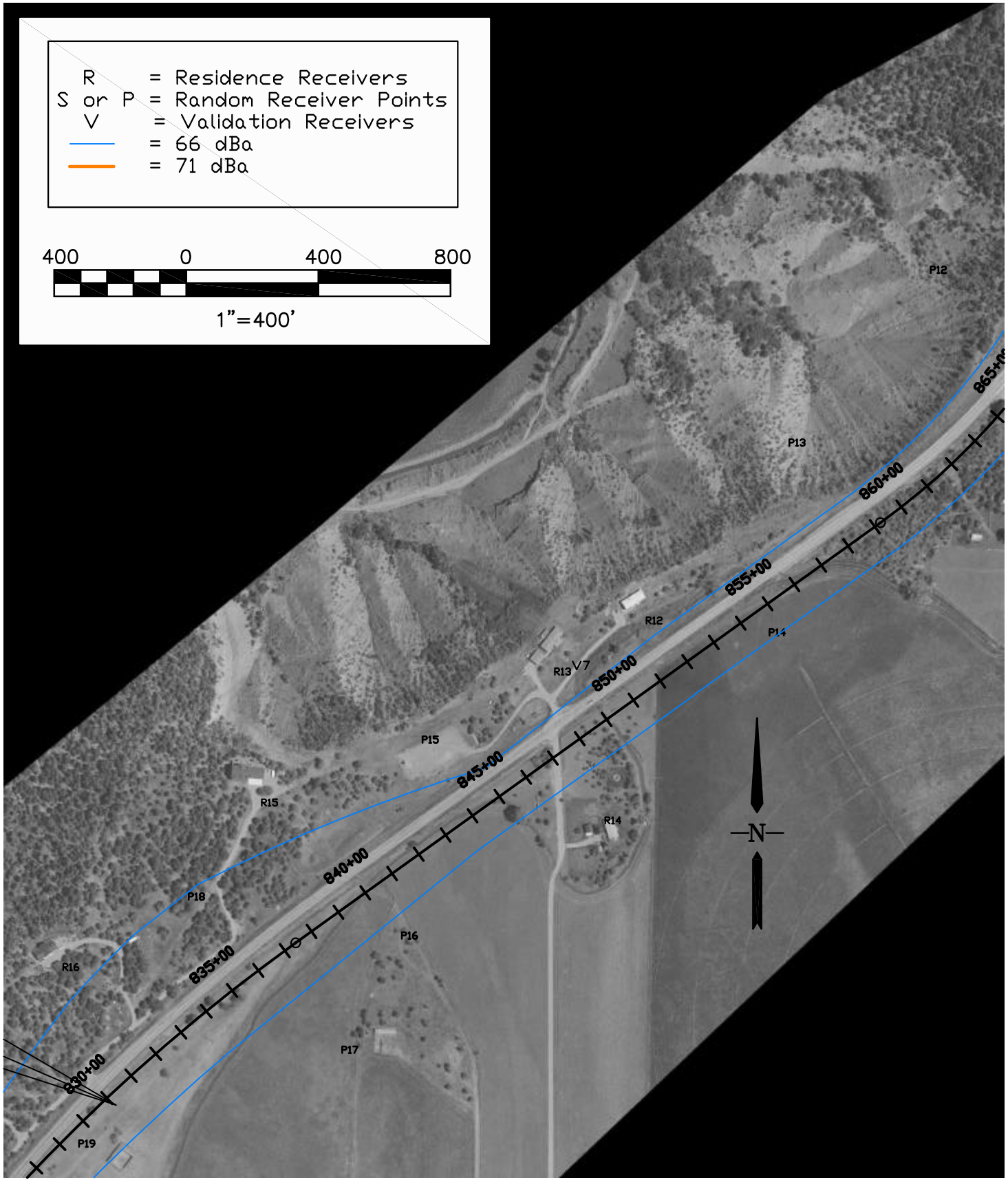
FIGURE 20



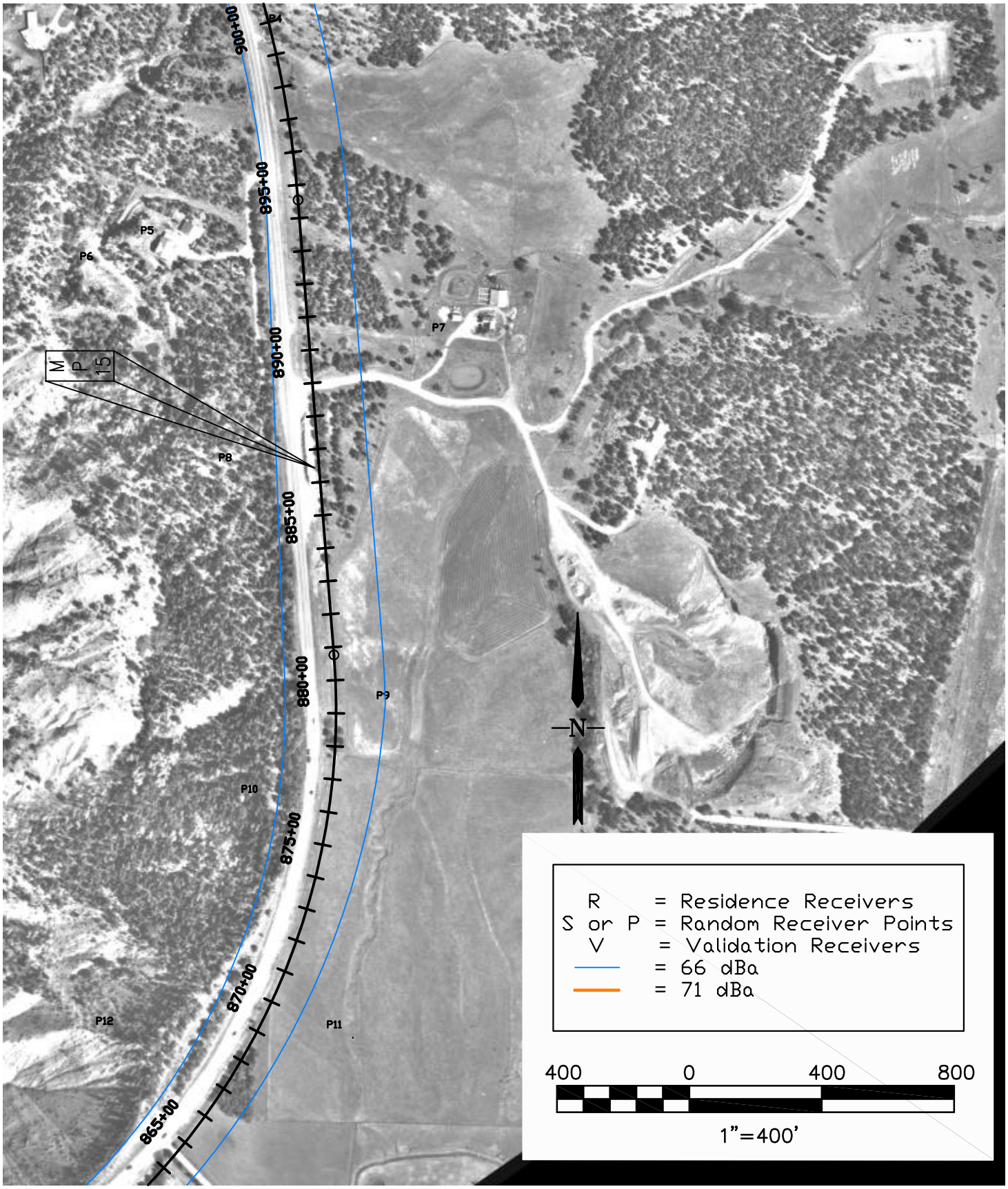
NOISE LEVELS

US 550

URS

FIGURE 21

\OUT OF STATE\DURANGO\US550\NOISE\Figures.dwg

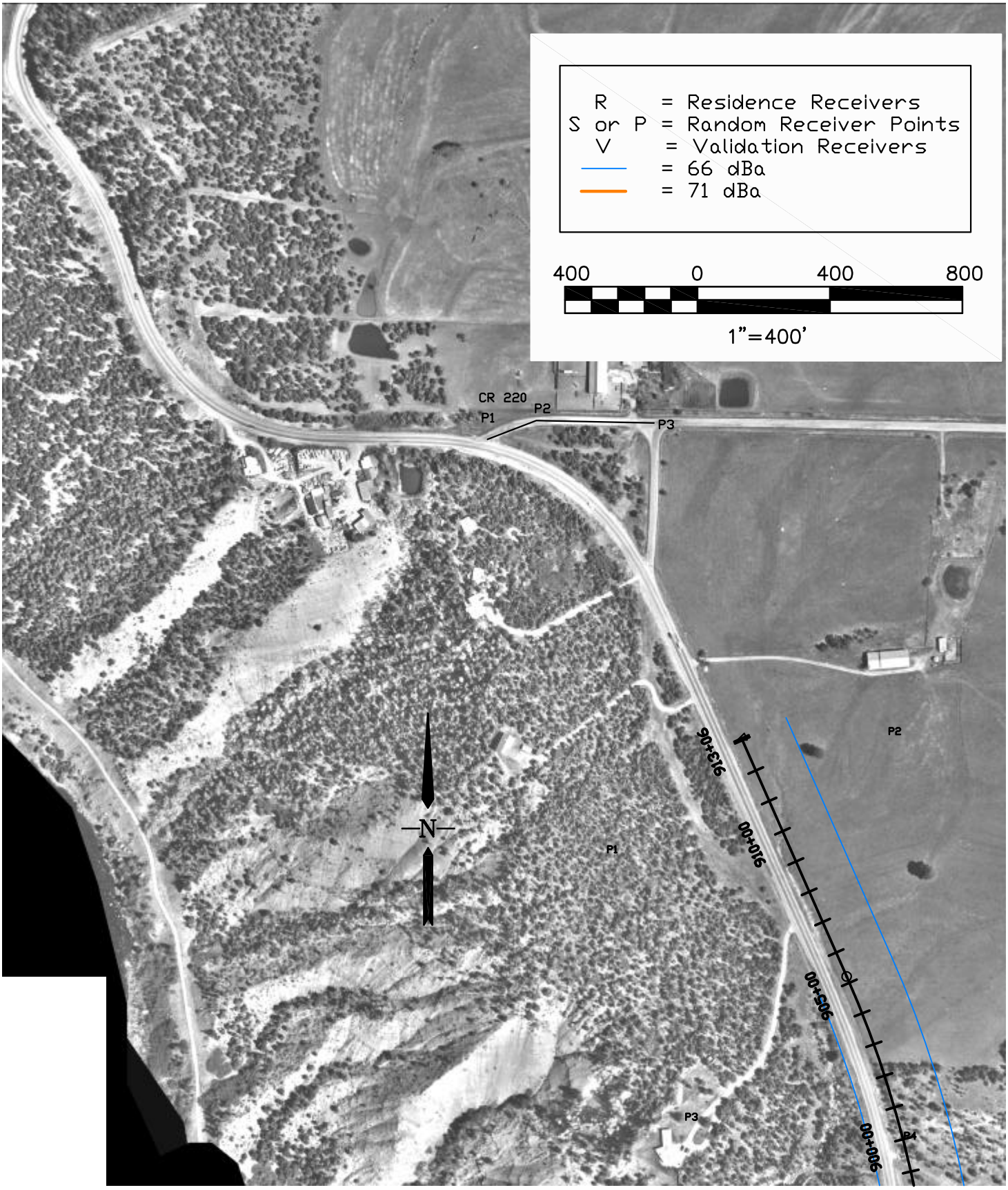


NOISE LEVELS

US 550

URS

FIGURE 22

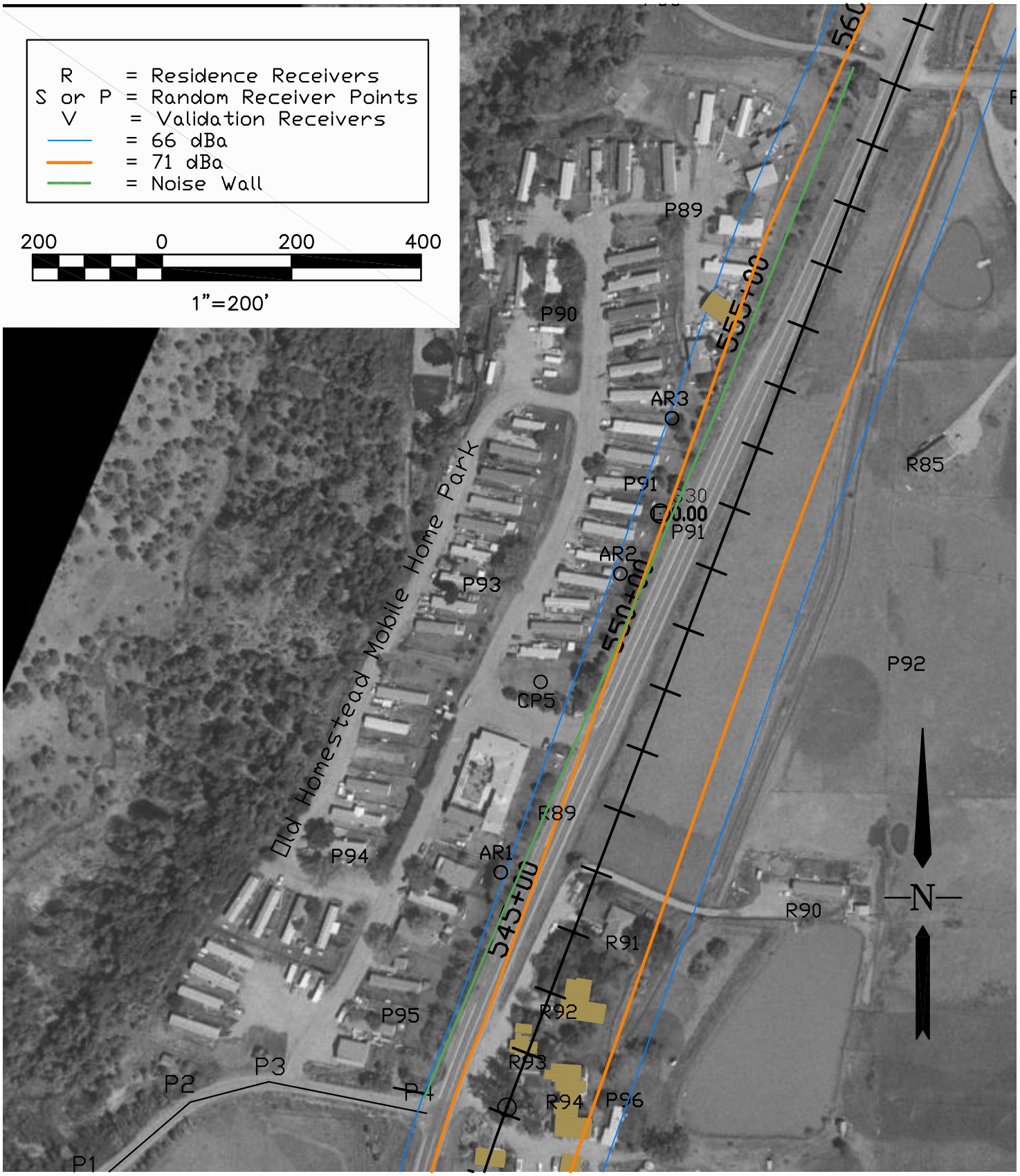


NOISE LEVELS

US 550

URS

FIGURE 23



NOISE LEVELS

US 550

URS

FIGURE 24

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MITIGATION

Operational Noise

Along US 550 from station 540+00 to 560+00 in Section 3 a number of mobile homes exist on the west side of the highway. These mobile homes are in close proximity to US 550, but will be set far enough back from the proposed alignment of US 550 to remain in place. For noise mitigation to be considered, a cost-effective continuous wall would have to be built the entire length of the Mobile Home Park. This often cannot be accomplished for housing areas due to wall openings required for driveways and the great distances between the homes.

Those receptors that met the "approach" NAC noise abatement criteria are listed in Table 4. If noise mitigation was determined to not be feasible and/or reasonable, the reasons are noted in the table. The noise analysis and abatement guideline worksheets (CDOT form 1209) were used to investigate the feasibility and reasonableness for each impacted location. Mitigation measures, to be considered feasible must achieve a 5-dBA or greater noise reduction for the front row receptors without engineering difficulties such as breaks or gaps in the barrier.

Table 4

Noise Mitigation Location Summary

Alternative	Receptor	Represents	Notes
1,2,3	R27	1 house	Isolated- found Unreasonable
1,2,3	R33	1 house, 3 outbuildings	Isolated - found Unreasonable
1,2,3	R34	1 house	Isolated - found Unreasonable
1,2,3	P91	13 mobile homes, Mobile Home Park	Modeled – See Table 5
1,2,3	R111	3 houses- 1 mobile, 2 houses, outbuildings	Isolated - found Unreasonable
1,2	R119b	1 house	Isolated - found Unreasonable
3	R119d	1 house	Isolated - found Unreasonable
1,2	R124b	2 houses	Isolated - found Unreasonable
3	R125d	1 house	Isolated - found Unreasonable

Isolated homes- Five receptors representing eight homes exceeded the NAC B noise threshold limit but were not considered for noise barriers due to the distances between houses and the need for driveway access. In cases such as this, when houses are located at great distances apart and there is a need for breaks in the noise barrier for driveways, noise mitigation is not effective and not considered feasible or reasonable.

Mobile Home Park - During the evaluation process only receptor P91 exceed the NAC B noise threshold limits however, in order to effectively manage noise mitigation a wall was evaluated the entire length of the Mobile Home Park (near Station 400+00). The wall modeled was 8 feet high and 1800 feet long, the analysis assumed a wall cost of $30 per square foot, resulting in a

wall costing $432,000.00. The CDOT Form 1209 has been included in Attachment 1. The location of the analyzed barrier is shown in figure F-24 of Appendix E.

An assessment of cost per impacted receiver per decibel was calculated to determine the reasonableness of building the noise barrier with no driveway openings. The driveway opening will be relocated to the roadway south of the site. The analysis determined that an average 8-dBA reduction would result in a cost of $855 per decibel per impacted receiver for this location. This is well below the current CDOT allowable minimum of $3000 per impacted receiver per decibel, and considered to be extremely reasonable. The following table summarizes the specific cost per benefit (cost reasonableness value).

Table 5

Wall Analysis Summary

Rec.	Description	No Wall	With 8 ft Wall	Noise Reduction	Total bBA reduction
P89	10 mobile homes, Mobile Home Park	63.1	55.3	7.85	78
P90	6 mobile homes, Mobile Home Park	59.7	53.5	6.2	37.2
P91	13 mobile homes, Mobile Home Park	67.7	51.7	16.0	208
P93	13 mobile homes, Mobile Home Park	60.6	55.2	5.4	70.2
P94	12 mobile homes, Mobile Home Park	59.6	54.9	4.7	56.4
P95	7 mobile homes, Mobile Home Park	64.0	57.5	6.5	45.5
R89	Apartment Building	65.4	55.5	9.9	9.9
Totals	**62 structures**			**56.5**	**505.2**

A wall length of 1,800 feet long, 8 feet high is considered reasonable for noise mitigation at the Mobile Home Park and noise mitigation is recommended.

The affected owners should be contacted to confirm their desire for noise mitigation during the design phase of this project.

Construction Noise

Construction will generate noise from diesel-powered earth moving equipment such as dump trucks and bulldozers, back-up alarms on certain equipment, compressors, and pile drivers. Construction noises at off-site receptor locations will usually be dependent on the loudest one or two pieces of equipment operating at the moment. Noise levels from diesel-powered equipment range from 80 to 95 dBA at a distance of 50 feet. Impact equipment such as rock drills and pile drivers can create generate louder noise levels.

Construction noise impacts, while temporary, can be mitigated, where feasible, by limiting work to day light hours, requiring the contractor to use well maintained equipment (especially with respect to mufflers), and through the use of mitigation measures such as temporary noise barriers where applicable.

Attachment 1- Form 1209

Attachment 1- Form 1209

FEASIBILITY	Yes	No	Not Applicable	Notes
Can a continuous noise barrier or berm be constructed?	x			
Can a 5 dBA noise reduction be achieved by constructing a noise barrier or berm?	x			
Can a 5 dBA noise reduction be achieved by insulation of the receiver?			x	
Are there any "fatal flaw" safety or maintenance issues involving the proposed noise barrier or berm?				Don't know at this point

REASONABLENESS	Yes	No	Not Applicable	Notes
Build Level dBA - without walls, majority of front row receivers [TYPE I PROJECTS ONLY]				
> 70 dBA				Very Reasonable
66-70 dBA	x			Reasonable
63-65.9 dBA				Marginally Reasonable
< 63 dBA				Unreasonable
Build Level Greater Than Existing				
> 10 dBA				Very Reasonable
5-10 dBA				Reasonable
3-4.9 dBA				Marginally Reasonable
< 3 dBA	x			Unreasonable
Cost Per Impacted Receiver Per Decibel (all receiving 3 dBA or more reduction)				
< $2500	x			Very Reasonable
$2500-$2999				Reasonable
$3000-$3500				Marginally Reasonable
> $3500				Unreasonable
Impacted Person's Desires (want the mitigation)				
> 75%				Very Reasonable
60-75%			unknown	Reasonable
40-59.9%				Marginally Reasonable
< 40%				Unreasonable

REASONABLENESS	Yes	No	Not Applicable	Notes
Development Type (percent Category "B")				
> 70%	x			Very Reasonable
45-70%				Reasonable
25-44.9%				Marginally Reasonable
< 25%				Unreasonable
Development Existence (exposure to traffic noise for more than 15 years)				
> 75%			x	Very Reasonable
50-75%				Reasonable
30-49.9%				Marginally Reasonable
< 30%				Unreasonable

INSULATION CONSIDERATIONS	Yes	No	Not Applicable	Notes
Are normal noise abatement measures physically infeasible or economically unreasonable?		x		
Is private residential property affected by a 30 dBA or more noise level increase?		x		
Are private residences impacted by 75 dBA or more?		x		
Does this project have noise impacts to public or non-profit buildings?		x		
If yes, is it reasonable and feasible to provide insulation for these buildings?			x	

ADDITIONAL CONSIDERATIONS
Barrier feasible and reasonable at 8 feet high and approximately 1800 feet long.

DECISION
Mitigation is recommended.