ENGINEERING REPORT IN SUPPORT OF
APPLICATION FOR LICENSE AND PROGRAM TEST AUTHORITY
EMPLOYING MOMENT METHOD MODELING
KCRN 1120 KHZ 50 KW D DA
LIMON, COLORADO

JANUARY 2019

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SUMMARY

This engineering report is submitted on behalf of Catholic Radio Network, Inc., (hereinafter referred to as "CRN"), licensee of AM station KCRN, Limon, Colorado, in support of an application for license and authorization for program test authority to cover construction authorized in permit BMP-20170323AAO. The permit authorizes KCRN to increase day power to 50 kilowatts and change transmitter site location. KCRN is licensed to operate daytime hours only on 1120 kilohertz with power of 0.25 kilowatts employing a non-directional antenna.

In support thereof, contained in this report is a complete method of moments proof of performance for the KCRN directional antenna system with associated engineering exhibits and the Engineering section of FCC Form 302-AM.

METHODOLOGY

The antenna system has been adjusted to produce monitoring system parameters in compliance with the method of moments ("MoM") calculated values (as calculated using Expert Mininec Broadcast Professional Version 23 and the antenna monitoring system has been adjusted to produce monitoring system parameters which are within ± 5% in field ratio and ± 3° in phase of the modeled values as required by Section 73.151(c)(2)(ii) of the rules.

All test and impedance measurements, antenna adjustments and antenna modeling presented in this report were done by Kurt R. Gorman of Phasetek, Inc.

SAMPLE SYSTEM

Tower currents were sampled with new Delta TCT-1 toroidal transformers with a sensitivity of 0.5 volts per amp mounted in weatherproof enclosures located at the base of each tower. The toroid sampling units were calibrated by the manufacturer and certified as being within 2% amplitude and 2° phase accuracy. In addition, the units were measured with an Array Solutions VNA-2180 vector network analyzer and found to be within the manufacturer's specifications as shown in the following table.

TCT	SN	Amplitude 1120 Khz	Phase 1120 Khz
1	18412	1.000	0.0°
2	18413	1.000	0.1°

The toroidal sampling units are connected to the antenna monitor with equal lengths of Radio Frequency Systems LCF12-50J foam coaxial cable. The sample lines are equal in length, buried and exposed to similar environmental conditions. Manufacturer specifications were verified following installation. The antenna monitor is a new Gorman Redlich CMR, serial number 1060-B. The antenna monitor was calibrated with a "T" connector and two equal length cables. The results are within the manufacturer's rated maximum accuracy of ± 2% amplitude and ± 1° phase and are provided in the table below. The sample system as installed meets FCC type approval requirements.

INPUT	Amplitude 1120 Khz	Phase 1120 Khz
1	Reference	0.0°
2	0.999	-0.1°

Impedance measurements were made on the antenna sampling system using a Hewlett Packard 8753ES vector network analyzer with a Tunwall directional coupler. The measurements were made looking into the antenna monitor ends of the sample lines with the tower ends open-circuited, and also with them connected to the toroidal sampling transformers, and measured at a frequency of 1120 kilohertz. All connectors were installed on the sample lines and readings were normalized to include the test leads.

The table below shows the frequencies above and below the carrier frequency where resonance, defined as zero reactance corresponding with low resistance, was found. The electrical length at carrier frequency appearing in the table below was calculated by computing the ratio of the frequencies.

Tower	Resonance Below 1120 Khz	Resonance Above 1120 Khz	Calculated Electrical Length 1120 khz
1	1057 khz	3186 khz	95.4°
2	1054 khz	3178 khz	95.6°

Based upon the measurements shown above, the sample lines are within the required tolerance of one electrical degree.

To determine the characteristic impedance values of the sample lines, open-circuited measurements were made with frequencies offset to produce ± 45 degrees of electrical length from resonance. The characteristic impedance was calculated using the following formula, where R1 +j X1 and R2 +j X2 are the measured impedances at the +45 and -45 degree offset frequencies, respectively:

$$Z_O = ((R_1^2 + X_1^2)^{1/2} \times (R_2^2 + X_2^2)^{1/2})^{1/2}$$

Tower	+45 Degree Offset Frequency (KHz)	+45 Degree Measured Impedance (Ohms)	-45 Degree Offset Frequency (KHz)	-45 Degree Measured Impedance (Ohms)	Calculated Characteristic Impedance (Ohms)	1120 khz Impedance connected to TCT (Ohms)
1	1585.5	2.5 +j 49.9	528.5	0.6 –j 50.4	50.18	34.0 + j17.9
2	1581.3	2.5 +j 50.0	527.1	0.6 –j 50.4	50.23	33.9 + j16.1
			MAXIMUM IMPEDANCE DELTA		0.05	

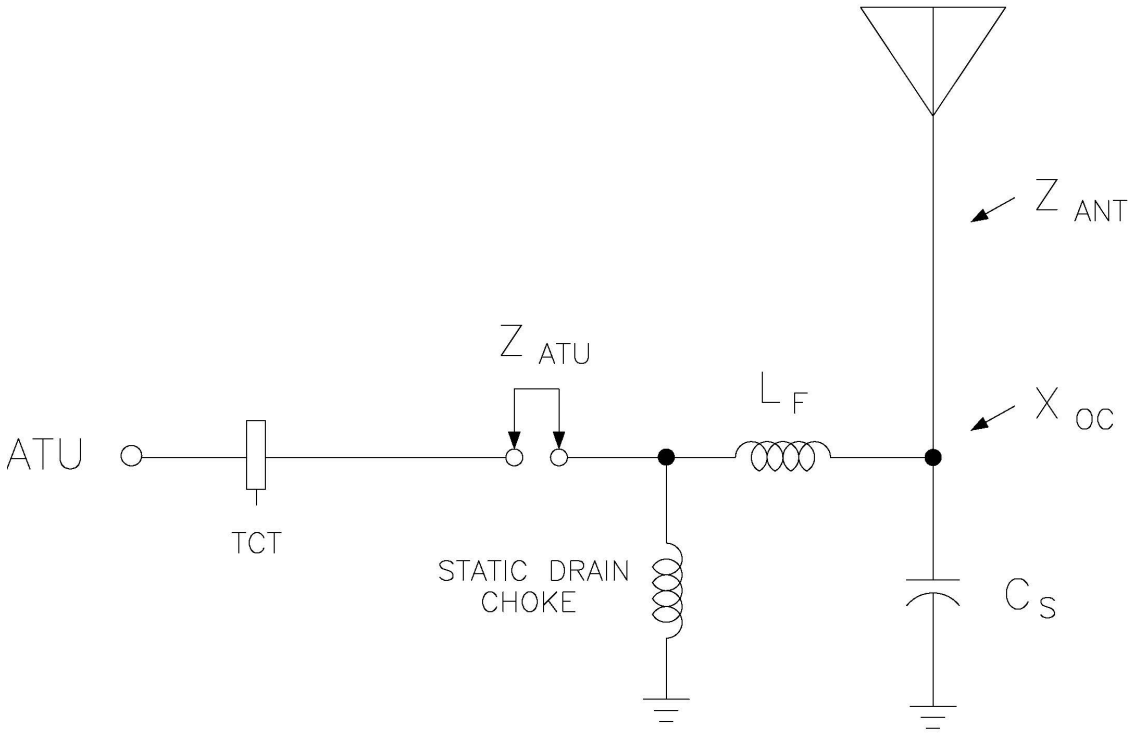
As shown above, the sample lines measured characteristic impedance meets the requirement that they be within 2 ohms.

TOWER BASE IMPEDANCE MEASUREMENTS

The impedance of each tower was measured at the output of the networks at the base of each tower. All impedance measurements were obtained with an Array Solutions Power Aim/120. Before use, tests of known impedances were made to verify accurate operation. Measurements were taken with the test leads shorted (for reference), and from the antenna tuning network (ATU) output to the tower with the tower base shorted. All measurements were taken for each tower at the ATU output with the other tower open-circuited. The following exhibits describe the measurement conditions and assumptions used in the MoM analysis.

EXHIBIT 1

KCRN TOWER IMPEDANCE MEASUREMENTS COMPARED TO METHOD OF MOMENTS MODEL



TOWER	Specified Cs (pf)	Measured L_F (µH)	Measured X_F (Ω)	Modeled Z_{ANT} (Ω)	Modeled Z_{ATU} (Ω)	Measured Z_{ATU} (Ω)
1	15	2.70	+j19.0	34.5 –j 1.5	34.4 +j 17.4	34.0 +j 17.9
2	15	2.42	+j17.0	34.5 –j 1.5	34.4 +j 15.4	33.9 +j 15.9

TOWER	Calculated X_{OC} (Ω)
1	-j 11,006.4
2	-j 11,006.5

EXHIBIT II

KCRN MOM MODEL PARAMETERS

Tower #	Wire #	# of Segments	Base Node
1	1	24	1
2	2	24	25

Tower #	Physical Height Degrees	Modeled Height Degrees	Modeled Radius Meters	% of Equivalent Radius
1	80.0	85.8	.2911	100.0
2	80.0	85.8	.2911	100.0

NOTES

1. BOTH TOWERS ARE UNIFORM CROSS SECTION, GUYED AND ARE BASE INSULATED. TOWERS HAVE A TRIANGULAR FACE WITH A WIDTH OF 24 INCHES.

2. BOTH TOWER BASE INSULATORS ARE AUSTIN A-4197L. BOTH BASE INSULATORS WERE MODELED WITH AN ASSUMED CAPACITANCE OF 15 PF. (-J 9473.5 OHMS AT 1120 KHZ)

3. BOTH TOWERS HAVE PHASETEK, INC. P600-161-2-16-18 STATIC DRAIN CHOKES. THESE MEASURE J 68000 OHMS AT1120 KHZ.

EXHIBIT III

KCRN DERIVED OPERATING PARAMETERS

KCRN Calculated Day Parameters

Tower	Theoretical Field/Phase	Base Network Input Currents	Normalized TCT Value Ratio/ Phase
1 (W)	1.000/0.0°	30.03/5.10°	1.000/0.0°
2 (E)	0.800/102.0°	25.86/103.57°	0.861/98.5°

METHOD OF MOMENTS DETAIL

One wire was used to represent each of the two towers. Towers were driven individually to verify the model compared to measured impedance data. Once the model was verified, the day directional antenna system was computed including the complex voltage values for sources located at ground level. These sources produce current moment sums for each tower that, when normalized, equate to the theoretical field parameters for each respective tower.

EXHIBIT IV

KCRN MOMENT MODELING

TOWER 1 (OTHER OPEN)

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GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire  caps Distance     Angle        Z            radius      segs
 1    none 0            0            0            .2911        12
           0            0            85.8
 2    none 90.          90.          0            .2911        12
           90.          90.          85.8

Number of wires          =  2
          current nodes  =  24

                         minimum                  maximum
Individual wires      wire    value             wire  value
segment length         1      7.15               1    7.15
radius                 1      .2911              1    .2911


ELECTRICAL DESCRIPTION
Frequencies (MHz)
     frequency                no. of  segment length (wavelengths)
 no. lowest       step         steps   minimum        maximum
 1   1.12         0             1      .0198611       .0198611

Sources
source node    sector  magnitude      phase          type
 1      1       1      1.             0              voltage

Lumped loads
             resistance    reactance     inductance  capacitance passive
load  node   (ohms)        (ohms)        (mH)        (uF)        circuit
 1     13    0             -11,006.5     0           0            0



IMPEDANCE
   normalization = 50.
freq     resist   react    imped    phase    VSWR    S11      S12
(MHz)    (ohms)   (ohms)   (ohms)   (deg)            dB       dB
source =  1; node 1, sector 1
1.12     34.46    -1.5167  34.493   357.5    1.4535  -14.664  -.15097
```

TOWER 2 (OTHER OPEN)

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.2911	12
		0	0	85.8		
2	none	90.	90.	0	.2911	12
		90.	90.	85.8		

Number of wires = 2
current nodes = 24

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	1	7.15	1	7.15
radius	1	.2911	1	.2911

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.12	0	1	.0198611	.0198611

Sources

source	node	sector	magnitude	phase	type
1	13	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	-11,006.4	0	0	0

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 13, sector 1							
1.12	34.46	-1.5171	34.493	357.5	1.4535	-14.664	-.15097

KCRN DAY MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = 1.12 MHz

tower	field ratio magnitude	phase (deg)
1	1.	0
2	.8	102.

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	1,465.25	23.8	30.0628	4.9
13	592.934	46.5	25.8126	103.5

Sum of square of source currents = 3,140.13
Total power = 50,000. watts

TOWER ADMITTANCE MATRIX

admittance	real (mhos)	imaginary (mhos)
Y(1, 1)	.0252521	-.0120577
Y(1, 2)	-.00816904	.0178883
Y(2, 1)	-.00816904	.0178883
Y(2, 2)	.0252519	-.0120581

TOWER IMPEDANCE MATRIX

impedance	real (ohms)	imaginary (ohms)
Z(1, 1)	34.5135	-1.51205
Z(1, 2)	17.917	-16.3827
Z(2, 1)	17.917	-16.3827
Z(2, 2)	34.5135	-1.5115

KCRN DAY SUMMARY

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.2911	12
		0	0	85.8		
2	none	90.	90.	0	.2911	12
		90.	90.	85.8		

Number of wires = 2
current nodes = 24

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	1	7.15	1	7.15
radius	1	.2911	1	.2911

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1.12	0	1	.0198611	.0198611

Sources

source	node	sector	magnitude	phase	type
1	1	1	2,072.18	23.8	voltage
2	13	1	838.535	46.5	voltage

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
1.12	46.102	15.815	48.74	18.9	1.4017	-15.533	-.1232
source = 2; node 13, sector 1							
1.12	12.508	-19.267	22.971	303.	4.625	-3.8163	-2.3307

CURRENT rms
Frequency = 1.12 MHz
Input power = 50,000. watts
Efficiency = 100. %
coordinates in degrees

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
GND	0	0	0	30.0628	4.9	29.9547	2.54695
2	0	0	7.15	30.206	2.9	30.1676	1.52316
3	0	0	14.3	29.7526	1.7	29.7396	.877505
4	0	0	21.45	28.7901	.7	28.7878	.365203
5	0	0	28.6	27.3388	359.9	27.3387	-.0410281
6	0	0	35.75	25.4192	359.2	25.4167	-.351359
7	0	0	42.9	23.0548	358.6	23.0477	-.570291
8	0	0	50.05	20.2721	358.	20.26	-.700418
9	0	0	57.2	17.098	357.5	17.0819	-.743643
10	0	0	64.35	13.5556	357.	13.5374	-.701378
11	0	0	71.5	9.65182	356.6	9.63475	-.573802
12	0	0	78.65	5.34462	356.2	5.33267	-.357112
END	0	0	85.8	0	0	0	0
GND	0	-90.	0	25.8127	103.5	-6.03598	25.0971
14	0	-90.	7.15	25.2427	103.	-5.66561	24.5987
15	0	-90.	14.3	24.4334	102.6	-5.33354	23.8441
16	0	-90.	21.45	23.3008	102.3	-4.96328	22.766
17	0	-90.	28.6	21.8464	102.	-4.54937	21.3675
18	0	-90.	35.75	20.0825	101.8	-4.09302	19.661
19	0	-90.	42.9	18.0269	101.5	-3.5982	17.6642
20	0	-90.	50.05	15.7005	101.3	-3.07021	15.3974
21	0	-90.	57.2	13.125	101.	-2.51474	12.8818
22	0	-90.	64.35	10.3188	100.8	-1.93703	10.1354
23	0	-90.	71.5	7.28888	100.6	-1.34019	7.16462
24	0	-90.	78.65	4.00505	100.4	-.720825	3.93964
END	0	-90.	85.8	0	0	0	0

EXHIBIT V

KCRN TOWER BASE CIRCUIT ANALYSIS MODEL

CIRCUIT ANALYSIS

Circuit Analysis was performed on each tower of the KCRN model. "Phasetek" nodal Circuit Analysis program was used to compute base model Input/Output voltages and currents. For the directional mode, the calculated Mininec Tower Base Drive Voltage was used to determine the Base Network Input Current. This point is the location of the Sampling TCT. "Z_1" represents the ATU Shunt impedance, "Z_2" represents the Tower Feed impedance, and "Z_3" represents the Tower Base Shunt impedance.

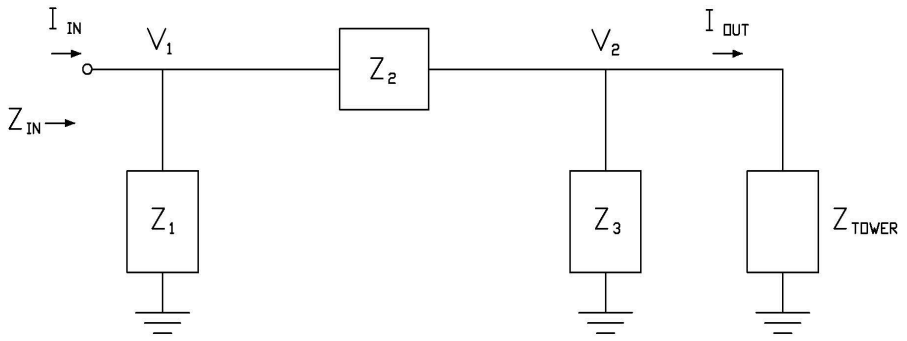


EXHIBIT VI

KCRN CIRCUIT ANALYSIS

BASE NETWORK COMPUTATION

KCRN TOWER 1 (OTHER OPEN)

FREQUENCY : 1120.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00, 68000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 19.00 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00, -9473.50 OHMS
TOWER IMPEDANCE (R,X) : 34.46, -1.52 OHMS

NODE	TO NODE	IMPEDANCE (OHMS) R	X
1	GROUND	0.00	68000.00
2	GROUND	34.45	-1.65
1	2	0.00	19.00

NODE	VOLTAGE MAGNITUDE	PHASE
1	100.00	0.00
2	89.41	-29.47

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS):	34.43	17.37	38.56	26.77
INPUT CURRENT (AMPS):	2.32	-1.17	2.59	-26.77
OUTPUT CURRENT (AMPS):	2.31	-1.17	2.59	-26.95

INPUT/OUTPUT CURRENT RATIO = 1.0004
INPUT/OUTPUT PHASE = 0.18 DEGREES

BASE NETWORK COMPUTATION

KCRN TOWER 1 DAY

FREQUENCY : 1120.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00, 68000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 19.00 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00, -9473.50 OHMS
TOWER IMPEDANCE (R,X) : 46.10, 15.82 OHMS

NODE	TO	NODE	IMPEDANCE (OHMS) R	X
1		GROUND	0.00	68000.00
2		GROUND	46.26	15.62
1		2	0.00	19.00

NODE	VOLTAGE MAGNITUDE	PHASE
1	1734.01	41.95
2	1465.25	23.80

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS):	46.21	34.63	57.75	36.85
INPUT CURRENT (AMPS):	29.91	2.67	30.03	5.10
OUTPUT CURRENT (AMPS):	29.95	2.55	30.06	4.86

INPUT/OUTPUT CURRENT RATIO = 0.9989
INPUT/OUTPUT PHASE = 0.24 DEGREES

BASE NETWORK COMPUTATION

KCRN TOWER 2(OTHER OPEN)

FREQUENCY : 1120.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00, 68000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 17.00 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00, -9473.50 OHMS
TOWER IMPEDANCE (R,X) : 34.46, -1.52 OHMS

NODE	TO	NODE	IMPEDANCE (OHMS) R	X
1		GROUND	0.00	68000.00
2		GROUND	34.45	-1.65
1		2	0.00	17.00

NODE	VOLTAGE MAGNITUDE	PHASE
1	100.00	0.00
2	91.44	-26.76

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS):	34.43	15.37	37.71	24.05
INPUT CURRENT (AMPS):	2.42	-1.08	2.65	-24.05
OUTPUT CURRENT (AMPS):	2.42	-1.09	2.65	-24.23

INPUT/OUTPUT CURRENT RATIO = 1.0004
INPUT/OUTPUT PHASE = 0.18 DEGREES

BASE NETWORK COMPUTATION

KCRN TOWER 2 DAY

FREQUENCY : 1120.00 kHz
ATU SHUNT IMPEDANCE (R,X) : 0.00, 68000.00 OHMS
TOWER FEED IMPEDANCE (R,X) : 0.00, 17.00 OHMS
TOWER SHUNT IMPEDANCE (R,X) : 0.00, -9473.50 OHMS
TOWER IMPEDANCE (R,X) : 12.51, -19.27 OHMS

NODE	TO	NODE	IMPEDANCE (OHMS) R	X
1		GROUND	0.00	68000.00
2		GROUND	12.46	-19.24
1		2	0.00	17.00

NODE	VOLTAGE MAGNITUDE	PHASE
1	327.39	93.37
2	592.93	46.50

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS):	12.46	-2.24	12.66	-10.20
INPUT CURRENT (AMPS):	-6.07	25.14	25.86	103.57
OUTPUT CURRENT (AMPS):	-6.03	25.10	25.81	103.51

INPUT/OUTPUT CURRENT RATIO = 1.0020
INPUT/OUTPUT PHASE = 0.07 DEGREES

FIELD STRENGTH MEASUREMENTS

Reference field strength measurements were made using a Potomac Instruments FIM-4100, serial number 249, last calibrated January 21, 2016. Measurements were taken at three locations along each pattern null radial determined from the KCRN standard daytime pattern and on the major lobe radial of the pattern. The measured field strengths, descriptions, and GPS coordinates for the reference measurement points are shown below. All locations indicated are listed using NAD 27 datum.

60° Radial Day

Point No.	Dist. Km.	Latitude	Longitude	Time Local	Field mV/m	Point Description
1	2.92	39° 17' 15.0"	104° 07' 53.7"	1349	114	County Road 113
2	7.02	39° 18' 21.3"	104° 05' 24.8"	1330	47.4	County Road 122
3	7.58	39° 18' 30.1"	104° 05' 04.6"	1323	37.1	County Road 125 west side

120° Radial Day

Point No.	Dist. Km.	Latitude	Longitude	Time Local	Field mV/m	Point Description
1	1.95	39° 15' 56.0"	104° 08' 28.7"	1257	132	County Road 113 opposite metal building on west side
2	3.79	39° 15' 26.4"	104° 07' 22.0"	1307	87.7	County Road 117 east side
3	3.94	39° 15' 23.4"	104° 07' 17.3"	1310	92.3	Drive 26710 County Road 117 north of dumpster

270° Radial Day

Point No.	Dist. Km.	Latitude	Longitude	Time Local	Field mV/m	Point Description
1	1.48	39° 16’ 27.6”	104° 10’ 41.6”	1206	2234	County Road 105
2	6.30	39° 16’ 27.8”	104° 14’ 03.4”	1220	414	County Road 93
3	7.85	39° 16’ 27.8”	104° 15’ 07.9”	1240	320	Highway 86 north side

All measurements were conducted on January 20, 2019 by Kurt R. Gorman.

TOWER ARRAY SURVEY

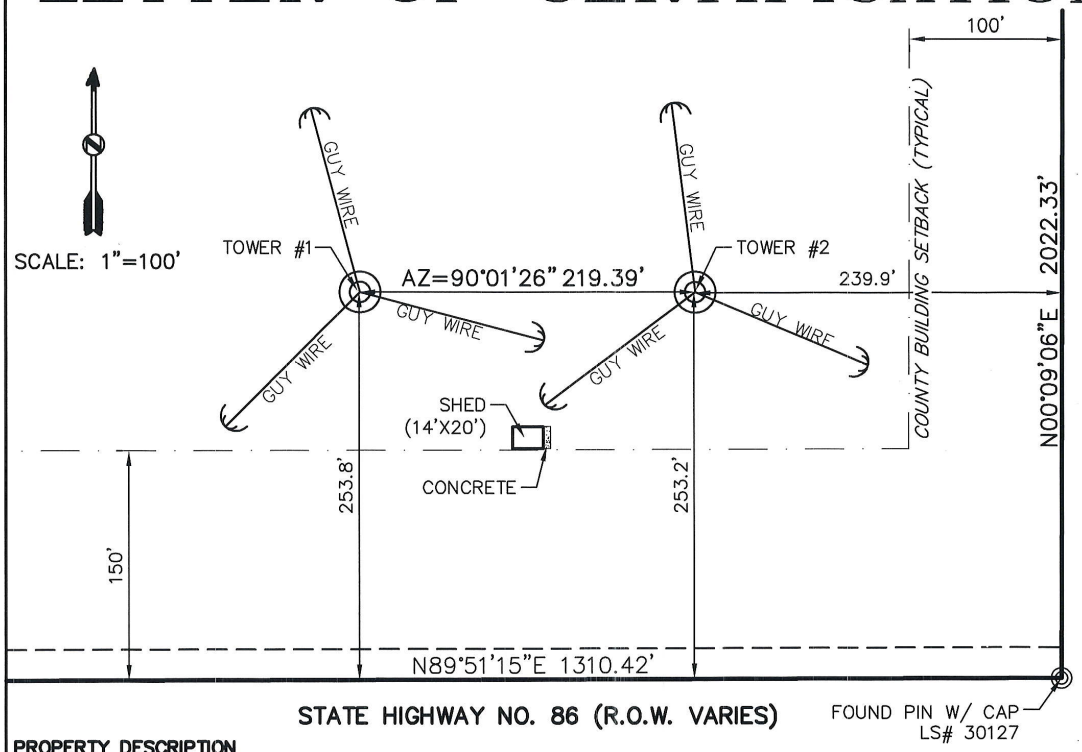
Shown below is a survey of the KCRN tower array conducted by a licensed professional land surveyor confirming the KCRN tower array has been built in compliance with FCC specifications.

High Prairie Survey Co.

Physical Address: 345 Comanche Street
Mail to: P.O. Box 384 • Kiowa, CO 80117

Ph. 303.621.8672 • Fax 303.621.7749
www.HighPrairieSurvey.com • info@highprairiesurvey.com

LETTER OF CERTIFICATION



PROPERTY DESCRIPTION

PARCEL D:

A PARCEL OF LAND LOCATED IN THE S 1/2 OF SECTION 12, TOWNSHIP 9 SOUTH, RANGE 61 WEST OF THE 6TH P.M., AND THE S 1/2 OF SECTION 7, TOWNSHIP 9, RANGE 60 WEST OF THE 6TH P.M., COUNTY OF ELBERT, STATE OF COLORADO, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS: COMMENCING AT THE SOUTHWEST CORNER OF SAID SECTION 12, AND CONSIDERING THE WEST LINE OF SAID SECTION 12 TO BEAR N00°48'54"W, WITH ALL BEARINGS CONTAINED HEREIN RELATIVE THERETO; THENCE N00°48'54"W ALONG THE WESTERLY LINE OF SAID SECTION 12 A DISTANCE OF 2072.33 FEET; THENCE N89°00'12" E A DISTANCE OF 3924.86 TO THE POINT OF BEGINNING; THENCE CONTINUING N89°00'12"E A DISTANCE OF 1310.42 FEET; THENCE S00°41'58"E A DISTANCE OF 2022.33 FEET TO A POINT ON THE NORTHERLY RIGHT OF WAY OF COLORADO STATE HIGHWAY NO. 86;
THENCE ALONG THE SAID RIGHT OF WAY THE FOLLOWING COURSE: S89°00'12"W A DISTANCE OF 1310.42 FEET;
THENCE N00°41'58"W A DISTANCE OF 2022.33 FEET TO THE POINT OF BEGINNING.

TOGETHER WITH AND SUBJECT TO:

A STRIP OF LAND, 30 FEET IN WIDTH, FOR ACCESS EASEMENT PURPOSES, LOCATED IN THE S 1/2 OF SECTION 7, TOWNSHIP 9 SOUTH, RANGE 60 WEST OF THE 6TH P.M., COUNTY OF ELBERT, STATE OF COLORADO, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS: COMMENCING AT THE SOUTHEAST CORNER OF SAID SECTION 7, AND CONSIDERING THE EAST LINE OF SAID SECTION 7 TO BEAR N00°41'28"W, WITH ALL BEARINGS CONTAINED HEREIN RELATIVE THERETO; THENCE N00°41'28"W ALONG THE EASTERLY LINE OF SAID SECTION 7 A DISTANCE OF 2053.29 FEET; THENCE S89°00'12"W A DISTANCE OF 5241.45 FEET; THENCE S00°41'58" E A DISTANCE OF 1992.33 FEET TO THE POINT OF BEGINNING; THENCE N89°00'12"E A DISTANCE OF 15.00 FEET; THENCE S00°41'58" E A DISTANCE OF 30.04 FEET TO A POINT ON THE NORTHERLY RIGHT OF WAY OF COLORADO STATE HIGHWAY NO. 86; THENCE ALONG THE SAID RIGHT OF WAY THE FOLLOWING COURSE: S89°00'12"W A DISTANCE OF 30.00 FEET; THENCE N00°41'58"W A DISTANCE OF 30.00 FEET; THENCE N89°00'12"E A DISTANCE OF 15.00 FEET TO THE POINT OF BEGINNING, COUNTY OF ELBERT, STATE OF COLORADO.

Date: 01/16/2019	BDS
Client: 76TH & N STARK INVESTORS	
SHEET 1 OF 2	**Job #**16300-LOC

High Prairie Survey Co.

Physical Address: 345 Comanche Street
Mail to: P.O. Box 384 • Kiowa, CO 80117

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LETTER OF CERTIFICATION

I CERTIFY THAT ON JANUARY 15, 2019 THAT I PERFORMED A SURVEY OF THE RADIO TOWERS AND DETERMINED THAT THE HORIZONTAL DISTANCE BETWEEN THE CENTER OF THE TOWERS IS 219.38 FEET AND THE AZIMUTH BETWEEN THE CENTER OF THE TWO TOWERS IS 90°01'26" AND BASED UPON TRUE NORTH.

THIS LETTER OF CERTIFICATION WAS PREPARED BY KEITH WESTFALL, COLORADO PLS# 30127 FOR AND ON BEHALF OF HIGH PRAIRIE SURVEY COMPANY, 345 COMANCHE STREET, P.O. BOX 384, KIOWA, COLORADO 80117.

Reference:	Revision Date:	
	Date: 01/16/2019	BDS
	Client: 76TH & N STARK INVESTORS	
	SHEET 2 OF 2	Job #16300-LOC

DECLARATION

The foregoing was prepared by or under the immediate supervision of Charles A. Hecht of Charles A. Hecht & Associates, Inc., Freehold, New Jersey, whose qualifications are a matter of record with the Federal Communications Commission. All statements herein are true and correct of his knowledge except such statements made on information and belief, and as to those statements, he believes them to be true and correct under the penalty of perjury.

Respectfully submitted,

/s/

Charles A. Hecht
Charles A. Hecht & Associates, Inc.
19 Mackenzie Court
Freehold, New Jersey 07728
(732) 577-0711
January 25, 2019