STAFF REPORT

DATE: October 26, 2010

TO: City Council

FROM: Robert A. Clarke, Interim Public Works Director
Dianna Jensen, Principal Civil Engineer, Water Division

SUBJECT: Authorization to Sole Source Work to Wireless Guys, Inc. to Install Access Points and Backhaul of Supervisory Control and Data Acquisition (SCADA) System, CIP No. 8183

Recommendation
Approve the attached resolution authorizing the City Manager to execute the contract with Wireless Guys, Inc., Vacaville, CA, for proposed services for installment of radio equipment for the SCADA upgrade project (CIP No. 8183) in the amount of $67,556.

Fiscal Impact
Adequate funds to upgrade the SCADA system are included in the CIP funding for this fiscal year. The estimated cost for the necessary work is $18,600 for labor and $48,956 for parts, for the total of $67,556.

Council Goal(s)
- Sustain existing infrastructure, identifying areas where improvements are necessary.
- Capitalize on and/or share existing resources.

Background and Analysis
The Water Division initiated a pilot project to replace the aging SCADA system in fiscal year 2008/2009. (The Supervisory Control and Data Acquisition system, or "SCADA," provides real-time data about the city's public works infrastructure at a central location. This infrastructure includes wells, storage tanks, sewer lift stations, and storm drainage lift stations.) The pilot project included installing the new radio equipment (subscriber modules) at a well site, a storm drainage lift station, a sewer lift station, receiving antennas (access points) on the elevated storage tank, and a receiving antenna at Public Works. This pilot system has been in operation since August 2009. After working with the pilot system for over six months, we began implementing full build-out of the SCADA replacement.

Full build-out includes installing subscriber modules at the remaining wells, storage tanks, sewer lift and storm drain lift stations; installation of a full array of access points on the Police Department (PD) Tower; and communication links between the PD Tower, Public Works (PW) Tower, and the elevated storage tank (called "backhaul" connections). We have in-house staff capable of installing the subscriber modules at the individual field sites and this process has been underway since May 2010. The next major step is the installation of access points on the PD

Tower and the backhaul connections. These components of the build-out require the assistance of professional services due to the complication of installing equipment on the PD and PW Towers.

In order to ensure that the equipment placed on the PD Tower did not interfere with other existing radio equipment, we commissioned a radio interference study. We also commissioned a Windload Study to ensure that the PD Tower could support the full array of access points we are planning to install. These studies are attached for your reference.

Collaboration of Departments and Utilizing City Staff

This project has been an opportunity to work collaboratively with other departments to ensure the best outcome. While this is a Public Works maintained system, members of working group have included staff from our IS department as this is a major communications project and their expertise has been instrumental in moving forward. The work on the PD Tower has included discussions with PD staff to make sure they are aware of the proposed installation of equipment.

City staff has been involved in the design review of this new SCADA system and was part of the training that occurred during the pilot project. Because of this our electricians are able to take on the installation of the subscriber modules at all sites except the storage tanks. We have estimated that we are going to be able to install the equipment for about ½ the cost of a contractor, at a savings of $312,000. Using city staff to perform the work is anticipated to take up to two years, about 6 months longer than a contractor, but is worth the savings.

Need to Sole Source

As we were researching how to advance this project once the initial pilot project was complete, we had a difficult time finding a company that could perform the specific work that was required. Wireless Guys is knowledgeable about the radios and has experience with installing equipment on towers, and we decided to hire them to perform the windload study and the radio interference study. If either of these studies had shown that using the PD Tower was not feasible, no further work would have been required. Most of the cost of this proposed work is in purchasing the equipment and the labor cost would have been much higher if we had to get another company up to speed. Wireless Guys, due to their previous work, has been in communication with our design engineer throughout this process and will be working closely with them to complete this portion of the project.

Attachments

1. Resolution
2. Windload Study
3. Radio Interference Study
4. Scope of Work and Project Estimate from Wireless Guys

RESOLUTION NO. 10-XXX, SERIES 2010

**RESOLUTION APPROVING SOLE SOURCE SCADA WORK
TO WIRELESS GUYS**

WHEREAS, the City of Davis Public Works Department is ready to move forward with full implementation of the SCADA replacement project; and

WHEREAS, the contractor, Wireless Guys, has been involved with the project on a limited capacity this past year; and

WHEREAS, sole sourcing the remaining portion of this work to Wireless Guys will save the City money because they are already familiar with the equipment we are using.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Davis that the Public Works Department is authorized to sole source to Wireless Guys to install access points and backhaul of SCADA system.

PASSED AND ADOPTED by the City Council of the City of Davis this 26th day of October, 2010 by the following vote:

AYES:

NOES:

Don Saylor
Mayor

ATTEST:

Zoe Mirabile, CMC
City Clerk

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beyond design.

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May 7, 2010

Steven Williams
WirelessGuys
207 W. Los Angeles Ave. Suite 300
Moorpark, CA 93021

RE: City of Davis
Police Station Radio Tower

Dear Steve,

I have analyzed the referenced tower to accommodate the new equipment being added to the tower. The equipment consists of 6-access points @ 120' above grade, 1-BH @ 120' above grade, and CMM at grade. The results of the calculations allow the equipment to be added without overstressing the structure of the tower. Actually, the tower is about 50% stressed.

The year the tower was installed, the anchor bolt code requirement was conservative. However, recent codes have become much more conservative. Due to the minimal mass being added to the structure, about 5% of the total mass, the original code year will govern the analysis. The anchor bolt capacity far exceeds the tension loads calculated by the Risa Tower program.

Thank you for the opportunity to provide service for your company. If you have any further questions, please feel free to call our office.

Sincerely,

Carl Ballantyne, P. E.

Document prepared for:

CITY OF DAVIS

Job: 7249-09-3

CO-LOCATION INTERFERENCE ANALYSIS REPORT

REV 1.1

For

City of Davis
23 Russell Blvd
Davis CA 95616

Date: September 29th 2010
Prepared by: WirelessGuys, Inc.

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CONTACTS

The WirelessGuys technical personnel responsible for this document's content are:

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Vlad Skrbic	Sr. Systems Engineer	(805) 530 3536 x118	vskrbic@wirelessguys.com

City of Davis representatives involved in this project are:

Name	Role	Phone	Email
Grant Olson	Primary Contact	(530) 757-5686	GOlson@CityofDavis.org

1.0 Executive Summary

This report presents a radio frequency interference (RFI) analysis which was performed on the Police Tower, located at **38°32'59.9"N, 121°43'7.6"W - 2600 5th St, Davis, CA 95618**.

The RFI analysis consists of transmitter noise, receiver desensitization, intermodulation, harmonic and transmitter spurious output interference. The report consists of Sections that provide details of the communications site, antenna systems, operational frequencies and each interference analysis mode.

A summary of the interference analysis results is depicted in the following Table.

Interference Analysis Mode	Type Mix	Status	Summary	Worst-Case Margin (dB)
Transmitter Noise	N/A	Passed	No Interference was predicted	44.1
Receiver Desensitization	N/A	Passed	No Interference was predicted	77.4
Transmitter Intermodulation	1 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	2 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	3 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	4 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	5 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	6 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	7 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	1 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	2 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	3 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	4 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	5 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	6 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	7 Tx	Passed	No Interference was predicted	N/A
Transmitter Harmonics	N/A	Passed	No Interference was predicted	N/A
Transmitter Spurious Output	N/A	Passed	No Interference was predicted	N/A
Interference Level Summing - C/(I+N)	N/A	Passed	No Interference was predicted	N/A
Wideband IM Spectral Analysis	N/A	N/A	No Analysis performed	N/A

The analysis was performed with the setup options depicted in the Table below.

Analysis	Description
Receiver Performance	Receiver sensitivity threshold plus 6/12 dB margin
Receiver Bandwidth	Receiver Dependent
Antenna Patterns Considered	No (Worst Case)
Measured Antenna Isolation Data	No
Filters/Multicouplers Considered	Yes
Number of Simultaneous Transmitters Mixed	7
Highest Intermodulation Order Tested	7
Condense Intermodulation Hit Quantity	No
TX IM Bandwidth Multiplication	No
Tx/Rx Systems Excluded	None
Site File Name	Davis PD Tower.dta
Report File Name	7249-09 City of Davis Interference Report.doc
ComSitePro Software Version	8.1.0

2.0 Site Description

The site parameters are:

Site Name: Davis PD Tower
Owner: City of Davis
Site Description: Police Department, behind parking lot
Address: 2600 5th St, Davis, CA 95618
Latitude: 38°32'59.9"N
Longitude: 121°43'7.6"W
Elevation: 40 Feet AMSL
Notes: N/A

2.1 Communications Systems

System	Provider
1	Police Tower 140’
2	Police Tower 120’
3	Police Tower 110’
4	Police Tower 90’
5	Police Tower 80’
6	Police Tower 50’

3.0 Transmitter Frequencies

Freq #	Ant #	Provider	Channel Label	ID	Frequency	Power (Watts)	BW (KHz)
1	1	Police Tower 140'	1	A	853.63750	35	16
2	1	Police Tower 140'	2	B	853.07500	35	16
3	1	Police Tower 140'	3	C	852.66250	35	16
4	1	Police Tower 140'	4	D	852.27500	35	16
5	1	Police Tower 140'	5	E	858.23750	35	16
6	2	Police Tower 120'	6	F	906.00000	.25	8000
7	2	Police Tower 120'	7	G	909.00000	.25	8000
8	2	Police Tower 120'	8	H	912.00000	.25	8000
9	2	Police Tower 120'	9	I	915.00000	.25	8000
10	2	Police Tower 120'	10	J	918.00000	.25	8000
11	2	Police Tower 120'	11	K	922.00000	.25	8000
12	3	Police Tower 110'	12	L	2437.0000	.25	20000
13	4	Police Tower 90'	13	M	154.37000	50	16
14	4	Police Tower 90'	14	N	154.92000	50	16
15	5	Police Tower 80'	15	O	5785.0000	.25	20000
16	6	Police Tower 50'	16	P	855.37500	35	16
17	6	Police Tower 50'	17	Q	855.97500	35	16
18	6	Police Tower 50'	18	R	856.57500	35	16

4.0 Receiver Frequencies

Freq #	Ant #	Provider	Channel Label	ID	Frequency	Sen (dBm)	BW (KHz)
1	1	Police Tower 140'	1	A	808.63750	-116	25
2	1	Police Tower 140'	2	B	808.07500	-116	25
3	1	Police Tower 140'	3	C	807.66250	-116	25
4	1	Police Tower 140'	4	D	807.27500	-116	25
5	1	Police Tower 140'	5	E	813.23750	-116	25
6	2	Police Tower 120'	6	F	906.00000	-96	12.5
7	2	Police Tower 120'	7	G	909.00000	-96	12.5
8	2	Police Tower 120'	8	H	912.00000	-96	12.5
9	2	Police Tower 120'	9	I	915.00000	-96	12.5
10	2	Police Tower 120'	10	J	918.00000	-96	12.5
11	2	Police Tower 120'	11	K	922.00000	-96	12.5
12	3	Police Tower 110'	12	L	2437.0000	-95	25
13	4	Police Tower 90'	13	M	155.97000	-116	25
14	4	Police Tower 90'	14	N	156.52000	-116	25
15	5	Police Tower 80'	15	O	5785.0000	-95	25
16	6	Police Tower 50'	16	P	806.37500	-119	25
17	6	Police Tower 50'	17	Q	806.97500	-119	25
18	6	Police Tower 50'	18	R	807.57500	-119	25

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5.0 Transmitter Noise Analysis

Transmitter noise interference occurs because a transmitter radiates energy on its operating frequency as well as frequencies above and below the assigned frequency. The energy that is radiated above and below the assigned frequency is known as sideband noise energy and extends for several megahertz on either side of the operating frequency. This undesired noise energy can fall within the passband of a nearby receiver even if the receiver's operating frequency is several megahertz away. The transmitter noise appears as "on-channel" noise interference and cannot be filtered out at the receiver. It is on the receiver's operating frequency and competes with the desired signal, which in effect, degrades the operational performance.

The analysis predicts each transmitter's noise signal level present at the input of each receiver. It takes into account the transmitter's noise characteristics, frequency separation, power output, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in both systems. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required, if any, to prevent receiver performance degradation caused by transmitter noise interference. The Table below depicts the results of this analysis. For each receiver, the transmitter that has the worst-case impact is displayed. The Signal Margin represents the margin in dB, before the receiver's performance is degraded. A negative number indicates that the performance is degraded and the value indicates how much additional isolation is required to prevent receiver performance degradation.

Receiver Provider	Receive Sensitivity (dBm)	Receive Frequency (MHz)	Transmitter Provider	Transmit Power (Watts)	Transmit Frequency (MHz)	Attn Required (dB)	Attn Provided (dB)	Signal Margin (dB)
Motorola	-116	807-813	Motorola	100	852-858	50	91.8	41.8
Motorola	-96	902-928	Motorola	0.25	902-928	50	76.4	26.4
Cisco	-95	2400-2500	Cisco	0.25	2400-2500	50	82.1	32.1
TBD	-116	155-157	TBD	100	154-155	50	95.2	45.2
TBD	-116	155-157	TBD	50	154-155	50	91.7	41.7
Cisco	-95	5725-5875	Motorola	0.25	5725-5875	50	102.4	52.4
Motorola	-116	806-808	Motorola	35	855-857	50	88.5	38.5

No transmitter noise interference problems were predicted.

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6.0 Receiver Desensitization Analysis

Receiver desensitization interference occurs when an undesired signal from a nearby "off-frequency" transmitter is sufficiently close to a receiver's operating frequency. The signal may get through the RF selectivity of the receiver. If this undesired signal is of sufficient amplitude, the receiver's critical voltage and current levels are altered and the performance of the receiver is degraded at its operating frequency. The gain of the receiver is reduced, thereby reducing the performance of the receiver.

A transmitter can be operating several megahertz away from the receiver frequency and/or its antenna can be located several thousand feet from the receiver's antenna and still cause interference.

The analysis predicts each transmitter's signal level present at the input of each receiver. It takes into account the transmitter's power output, frequency separation, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in both systems. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required, if any, to prevent receiver performance degradation caused by receiver desensitization interference. The Table below depicts the results of this analysis. For each receiver, the transmitter that has the worst-case impact is displayed. The Signal Margin represents the margin in dB, before the receiver's performance is degraded. A negative number indicates that the performance is degraded and the value indicates how much additional isolation is required to prevent receiver performance degradation.

Receiver Provider	Receive Sensitivity (dBm)	Receive Frequency (MHz)	Transmitter Provider	Transmit Frequency (MHz)	Attn Required (dB)	Attn Provided (dB)	Signal Margin (dB)
Motorola	-116	807-813	Motorola	852-858	12.1	91.8	79.7
Motorola	-96	902-928	Motorola	902-928	12.1	76.4	64.3
Cisco	-95	2400-2500	Cisco	2400-2500	12.1	82.1	70
TBD	-116	155-157	TBD	154-155	12.1	95.2	83.4
TBD	-116	155-157	TBD	154-155	12.1	91.7	79.6
Cisco	-95	5725-5875	Cisco	5725-5875	12.1	102.4	90.4
Motorola	-116	806-808	Motorola	855-857	12.1	88.5	76.4

No receiver desensitization interference problems were predicted.

7.0 Intermodulation Interference Analysis

There are three basic categories of Intermodulation (IM) interference. They are receiver produced, transmitter produced, and "other" radiated IM. Transmitter produced IM is the result of one or more transmitters impressing a signal in the non-linear final output stage circuitry of another transmitter, usually via antenna coupling. The IM product frequency is then re-radiated from the transmitter's antenna. Receiver produced IM is the result of two or more transmitter signals mixing in a receiver RF amplifier or mixer stage when operating in a non-linear range.

"Other" radiated IM is the result of transmitter signals mixing in other non-linear junctions. These junctions are usually metallic, such as rusty bolts on a tower, dissimilar metallic junctions, or other non-linear metallic junctions in the area. IM products can also be caused by non-linearity in the transmission system such as antenna, transmission line, or connectors.

Communication sites with co-located transmitters, usually have RF coupling between each transmitter and antenna system. This results in the signals of each transmitter entering the nonlinear final output (PA) circuitry of the other transmitters. When intermodulation (IM) products are created in the output circuitry and they fall within the passband of the final amplifier, the IM products are re-radiated and may interfere with receivers at the same site or at other nearby sites. Additionally, these strong transmitter signals may directly enter a receiver and drive the RF amplifier into a nonlinear operation, or if not filtered effectively by the receiver input circuitry, these signals could mix in the nonlinear circuitry of the receiver front-end or mixer, creating IM products directly in the receiver.

The frequencies of IM products are derived from mathematical formulae. IM products are classified by their "order" (2nd, 3rd, 4th, ...Nth). Some of the more common forms of mixing are illustrated in the following examples. Note that The "A", "B", and "C" designations are the mixing frequencies. The numerical number assigned to the letter designation indicates the harmonic relationship of the frequency. Thus, 2A means the 2nd harmonic of frequency A.

Order	Mixing Formulae
First	A=B, A=C, etc.
Second	A ± B, A ± C, etc.
Third	A + B - C, A ± 2B, 2A ± B, etc.
Fourth	A ± 3B, 2A ± 2B, 3A ± B, etc.
Fifth	A ± 4B, 2A ± 3B, 3A ± 2B, 4A ± B, etc.
Sixth	A ± 3B ± 2C, 2A ± 2B ± 2C, 3A ± 2B ± C, etc.
Seventh	A ± 6B, 2A ± 5B, 3A ± 4B, 4A ± 3B, 5A ± 2B, etc.
Eighth	A ± 7B, 2A ± 6B, 3A ± 5B, 4A ± 4B, 5A ± 3B, 6A ± 2B, etc.
Ninth	A ± 8B, 2A ± 7B, 3A ± 6B, 4A ± 5B, 5A ± 4B, 6A ± 3B, etc.

The above IM product formulae are just a few of the many possible combinations. When there are four frequencies involved at one time, the mixing possibilities increase tremendously. Not all of the mixing possibilities are significant in creating interference signals. Some fall "out-of-band" of the receiver and the higher order IM products are usually weaker in signal strength.

7.1 Transmitter Generated Intermodulation Analysis

Intermodulation in transmitters occurs when a signal from another transmitter is impressed on the nonlinear final output stage circuitry, usually via antenna coupling. The power level of the IM product is determined by the power level of the incoming extraneous signal from another transmitter and by a conversion loss factor. The conversion loss factor takes into account the mixing efficiency of the transmitter's final output stage. Conversion loss differs with transmitter design, adjustment, frequency separation of the source signals, and with the order of the IM product.

The analysis calculates all possible IM product frequencies that could potentially interfere with receivers at the communications site based on each receiver's individual bandwidth. It then predicts each IM signal level present at the input of each affected receiver. For each IM frequency, the analysis considers all possible sources of IM generation in the transmitters. For example, if there are four transmitters involve, the analysis will calculate the IM signal level that would be generated in each transmitter. For this example, that would be four possible mixing conditions.

The analysis takes into account the transmitter's power output, modulation bandwidth, conversion losses, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for each IM interference signal that occurs.

No transmitter generated intermodulation interference problems were predicted.

7.2 Receiver Generated Intermodulation Analysis

Within a receiver, when two or more strong off-channel signals enter and mix in the receiver and one of the IM product frequencies created coincides with the receiver operating frequency, potential interference results. This internal IM mixing process takes place in the receiver's RF amplifier when it operates in a nonlinear range and/or in the first mixer, which, of course, has been designed to operate as a nonlinear device.

Receivers have a similar conversion loss type factor and receiver performance is commonly described in terms of conversion loss with respect to the 2A - B type products. Here, conversion loss is the ratio of a specified level of A and B to the level of the resulting IM product, when the product is viewed as an equivalent on-channel signal. Receiver conversion loss varies with input levels, AGC action, and product order.

The analysis calculates all possible IM product frequencies that could potentially interfere with receivers at the communications site based on each receiver's individual bandwidth. It then predicts each IM signal level present at the input of each affected receiver. For each IM frequency, the analysis considers that the IM signal is generated directly in the receiver.

The analysis takes into account the transmitter's power output, modulation bandwidth, conversion losses, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for each IM interference signal that occurs.

No receiver generated intermodulation interference problems were predicted.

8.0 Transmitter Harmonic Output Interference Analysis

Transmitter harmonic interference is due to non-linear characteristics in a transmitter. The harmonics are typically created due to frequency multiplers and the non-linear design of the final output stage of the transmitter. If the harmonic signal falls within the passband of a nearby receiver and the signal level is of sufficient amplitude, it can degrade the performance of the receiver.

The analysis takes into account the transmitter's harmonic characteristics, output level, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for any harmonics that fall within a receiver's passband. Receivers experiencing transmitter harmonic interference are depicted in the following Table.

Transmitter		Harmonic		Affected Receiver		Attn Needed
ID	Frequency (MHz)	Frequency (MHz)	Order	ID	Frequency (MHz)	
None						

No transmitter generated harmonic interference problems were predicted.

9.0 Transmitter Spurious Output Interference Analysis

Transmitter spurious output interference can be attributed to many different factors in a transmitter. The generation of spurious frequencies could be due to non-linear characteristics in a transmitter or possibly the physical placement of components and unwanted coupling. If a spurious signal falls within the passband of a nearby receiver and the signal level is of sufficient amplitude, it can degrade the performance of the receiver.

The analysis takes into account a transmitter's spurious output specification, output levels, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for any transmitter spurious signals that fall within a receiver's passband. Receivers experiencing transmitter spurious output interference are depicted in the following Table.

Transmitter		**Affected Receiver**		**Attn Needed**
ID	**Frequency (MHz)**	**ID**	**Frequency (MHz)**	
None				

No transmitter generated spurious interference problems were predicted.

10.0 Interference Power Level Summing Analysis

This section of the report provides a summary of all interference power levels associated with each individual receiver at the site. This includes the sum of IM, transmitter wideband noise and receiver desensitization power levels. The carrier-to-noise (C/I + N) ratio for each receiver is based on the aggregate of interference power levels.

A negative (C/I + N) ratio indicates that the performance of the receiver is degraded and the value indicates how much additional isolation is required to prevent receiver performance degradation.

The following Table presents this data.

Receiver		Interference Power Level (dBw)				
Receiver Provider	**Freq (MHz)**	**Tx Noise**	**Rx Desense**	**IM Power**	**Aggregate**	**(C/I+N)**
Motorola	813.2375	-181	-214	0	-197.5	37.5
Motorola	902-928	-177	-210	0	-193.5	36.7
Cisco	2400-2500	-213	-246	0	-229.5	43.6
TBD	154.3700	-161	-194	0	-177.5	33.7
TBD	154.9200	-169	-202	0	-185.5	35.2
Cisco	5725-5875	-231	-273	0	-251.5	55.3
Motorola	822.3750	-175	-208	0	-191.5	36.4

Dianna Jensen, Principal Engineer
City of Davis
23 Russell Blvd
Davis, CA 95616

September 28, 2010

WirelessGuys proposes to expand the City of Davis wireless SCADA system utilizing the Motorola Canopy 900 MHz product line.

The Police Department Tower ("PD"), Public Works Tower ("PW") and the Elevated Water Storage Tank ("EST") make up the backhaul infrastructure for the City of Davis wireless network. The PD and EST are the main wireless collection points for the remote SCADA equipment. The PW tower is the connection point to the City of Davis wired network. Connecting PD, PW and EST with point-to-point wireless connections will add network redundancy.

WirelessGuys, Inc. scope includes all labor and materials to install the radios, antennas, cable, grounding and mounting hardware on the towers at PD, PW and EST.

Prior to tower climbing, mounting and aligning the new components of the wireless network WirelessGuys will work with Control Point Engineering to stage, program, label, bench test and document the new radios. Each radio to be installed on the towers will need IP addresses and frequencies assigned to them. These frequencies will need to be carefully coordinated with the University of Davis published frequencies. Once the radios communicate on the bench they will be installed in the field. We should have Grant's team install one Canopy 900 MHz subscriber module at a RTU before the tower installation begins to verify connectivity.

The last day of construction is reserved for alignment and final punch list. During alignment both WirelessGuys and Control Point Engineering will need VPN access to the radios being installed. Control Point Engineering will be in the lead dictating signal levels and qualities to the WirelessGuys, Inc. alignment team on the towers. Once acceptable statistics have been verified by Control Point Engineering and WirelessGuys control of the wireless network will be returned to the City of Davis.

At the PD Tower WirelessGuys, Inc. will install the mounting hardware on three legs of the tower to provide 360 degrees of coverage. A total of six Motorola Canopy Access Points will be installed, aligned and declinated according to specifications provided by Control Point Engineering during the staging phase of the project. The mounts will be at 110 feet above ground level and on each leg of the tower. There will be two Access Point radios on each leg of the tower. WirelessGuys will also install two Canopy 5.4 GHz backhaul links with integrated antenna on the appropriate tower mount and align the antenna with a similar radio installed on the tower at PW and the catwalk railing on EST. Please note that 5.4 GHz may be interfered with by nearby radar systems. The

Canopy 5.4 GHz system will have DFS enabled that might affect the stability of the wireless network.

WirelessGuys will use outdoor rated UV protected/shielded CAT5e cable to the eight radios and will include two extra cable runs to the highest mounting point. These cables will be terminated with grounded RJ-45 connectors, tested and weatherproofed for future expansion. Proper mounting, spacing and grounding techniques will be used. The GPS synchronization antenna will be mounted on the roof of the vault and terminated at the CMM. A managed Ethernet switch will be installed to build redundancy into the system.

All cabling will terminate inside the City of Davis provided communication vault on the west wall. An appropriate sized 5/8" piece of plywood will provide the backplane to mount two 20 Amp duplex receptacles and one Motorola Cluster Management Module (CMM). Power will be provided by running ½" EMT to the nearest LP panel and running #12 AWG wire to a 20 Amp single pole breaker installed by WirelessGuys.

From the railing of the EST the existing Motorola Canopy Access Points will be connected to the PW Tower and PD Tower via two new Canopy integrated antenna backhaul links. The antenna and radio will be connected to the existing spare CAT5e cable and terminated and grounded appropriately to the CMM located in the remote terminal enclosure located at ground level. A managed Ethernet switch will be installed to build redundancy into the system. The antennas will be aligned towards the PW and PD in an azimuth provided by Control Point Engineering.

At the Public Works Tower WirelessGuys, Inc. will install two Canopy backhaul radios to the 60 foot tower with the existing Canopy SM (subscriber module). Outdoor rated UV protected/shielded CAT5e cable will be installed, grounded appropriately and terminated to a new managed Ethernet switch for redundancy. If a new roof penetration is required WirelessGuys, Inc. will work with City Staff to install to their specification.

Estimate

Date	Estimate #
9/23/2010	18082-10

207 W. Los Angeles Ave. Suite #300
Moorpark, CA 93021-1875
805-578-8590
www.WirelessGuys.com

Bill To	Ship To
City of Davis 23 Russell Blvd Davis CA 95616 United States	City of Davis 1717 5th Street Davis CA 95616 United States

Expires	Project	Terms	Ship Via	Payment
10/23/2010	7249-09-2 Tow...	Net 30	FedEx Ground®	

Qty	Description	Rate	Amount	Tax
1	-Project Manager -Two-man Tower Crew - -Planning -Mobilization -Tower Work -Alignment -Troubleshooting - - - - - - - - - - - Installation at PD, EST and PW. -	18,600.00	18,600.00	

Subtotal	18,600.00
Shipping Cost (FedEx Ground®)	0.00
Total	$18,600.00

9/23/2010

Material Estimate To Install Remaining (Three-Site) Tower Canopy Hardware

ITEM#	Description	Motorola Model No.	PD (Qty)	PW (Qty)	EST (Qty)	Total (Qty)	Cost /Each	Total Cost
	Motorola Canopy Equipment							
1	900 MHz integrated AP w/filter and AES encription.	9001APFDD	6	0	0	6	$ 2,245.00	$ 13,470.00
2	900 MHz SM integrated filtered with AES encription.	9001SMFDD	0	0	0	0	$ 759.00	$ -
3	Lightning arrestor for AP and SM units.	600SS	8	6	4	18	$ 35.00	$ 630.00
4	Lightning arrestor for CMM (10 plugs)	ALPU-CMM3	1	0	0	1	$ 650.00	$ 650.00
5	Cluster management module micro (CMM micro) w/GPS.	1070CKDB	1	0	0	1	$ 1,100.00	$ 1,100.00
6	CMM micro GPS coaxial antenna cable.	CXTA19E-50	50 ft.	0	0	1	$ 58.00	$ 58.00
7 a	Canopy 5.4 GHZ backhaul link. MOTOwi4 PP54500	WB2874AA	1	1	1	3	$ 9,500.00	$ 28,500.00
8	Network management software (Prizm 2.0) server license kit. Includes 10 EMS license packs and	N/A	1	0	0	1		$ -
9	10 BAM license paks.	N/A	1	0	0	1		$ -
10	Ethernet Switch and Power Supply	2989527	1	1	1	3	$ 499.00	$ 1,497.00
		2866446	1	1	1	3	$ 99.00	$ 297.00
	Tower Mounting Hardware							
11	Cluster mount for 900MHZ radio, half bracket assembly, one for each tower leg.	CCM900-H	3	0	0	3	$ 170.00	$ 510.00
12	Tower brackets for cluster mount.	CCM1-H	3	0	0	3	$ 50.00	$ 150.00
13	Stackable Snap-in hangers.	464871	5	1	2	5	$ 24.00	$ 120.00
14	Hanger kit inserts.	372585	5	1	2	5	$ 8.00	$ 40.00
15	Cable, Cat5e, 500ft pull box, outdoor, shielded (STP), burial, black jacket, drain wire, waterproof tape (dry),	CAT5E-STP-500FT	5	2	3	10	$ 100.00	$ 1,000.00
16	Misc RJ45, Ground Wire, UV straps, weather sealant	Misc	1	1	0	2	$ 50.00	$ 100.00
17	Grounding Kit	445755	2	1	1	3	$ 10.00	$ 30.00
18	Stand-off bracket	477944	2	2	2	6	$ 134.00	$ 804.00
								$ 48,956.00