Licensee Cell Site Name: Denver Fire Station #28
Licensee Cell Site #: DN03433C Lease ID 106225

LICENSE AGREEMENT

This **LICENSE AGREEMENT** ("Agreement") is made and effective as of January 1, 2023 (the "Effective Date") by and between the **CITY AND COUNTY OF DENVER**, a municipal corporation of the State of Colorado (hereinafter referred to as the "**City**") and **T-MOBILE WEST LLC**, a Delaware limited liability company authorized to do business in the State of Colorado with a principal place of business address of 12920 SE 38th Street, Bellevue, WA 98006 (the "**Licensee**"). The Parties are referred to herein, collectively, as the "Parties."

RECITALS

WHEREAS, the City owns and operates the real property located at 4306 S Wolff Street, Denver, Colorado 80212 and all appurtenances thereto (the "Subject Property");

WHEREAS, the City has right, title, and interest in and to the Subject Property together with the facilities, easements, rights, licenses, and privileges hereinafter granted, and has full power and authority to enter into an agreement in respect thereof;

WHEREAS, the Parties desire to enter into this Agreement regarding Licensee's use of certain designated areas at the Subject Property for Licensee's operation of a cellular site and tower at the Subject Property as described in **Exhibit A** attached hereto (the "Licensed Area");

NOW, THEREFORE, in consideration of the premises and the mutual covenants and obligations herein set forth, the Parties agree as follows:

DEFINITIONS

The capitalized terms used in this Agreement and any and all exhibits hereto, will have the meanings given such terms in the paragraph in which such terms are parenthetically defined. The meanings given to terms defined will be equally applicable to the singular and plural forms of such terms. In addition, the following capitalized terms shall have the following meanings:

A. "Agreement" shall have the meaning set forth in the preamble hereto.

B. "ADA" means Americans with Disabilities Act and any other federal or state laws requiring access for the disabled to public accommodations.

C. "Applicable Law" means all federal, state, and local laws applicable in the context of the specific matter addressed in this Agreement, including but not limited to: 1) the constitutions, laws, and rules and regulations of the United States of America and the State of Colorado; 2) the City Charter, the Denver Revised Municipal Code, and building, fire, electrical, plumbing and other applicable codes, as they may be amended from time to time; 3) rules and regulations, including any standards and specifications, promulgated or amended by the Denver Department of Safety and the Denver Fire Department; 4) any rules and regulations promulgated

or amended by other City departments and agencies applicable to this Agreement; 5) executive orders issued by the Mayor; 6) any court order, judgment, or decree or any appellate decision applicable to this Agreement; 7) any federal, state, or local administrative decision or order applicable to this Agreement; 8) any anti-discrimination laws;

D. "Cancellation" means the revocation of the License and the termination or cancellation of the Agreement, including mutual termination by the parties, in the manner specified in this Agreement.

E. "City Representative" means the Division of Real Estate's designee(s) who will oversee and direct all activities of Licensee under this Agreement. The City Representative(s) may be employees or contractors of the City, Denver's Facilities Management division, Denver's Technology Services, the Electronic Engineering Bureau of the Department of Safety, and/or Denver's Division of Real Estate. Contact information for the City Representative and the assigned responsibilities, if there is more than one City Representative, shall be provided to Licensee upon execution of this Agreement. The City may identify, change, add or delete City Representative(s) by written notice to Licensee.

F. "City System" means all existing and future communication and other electronic facilities, equipment and instrumentation and related infrastructure and utility connections located at the Subject Property including, but not limited to, public safety channels, radio system or other electronic means of sending, receiving, processing and recording information and data for public safety purposes.

G. "DRMC" means the Denver Revised Municipal Code as it may be amended from time to time.

H. "Effective Date" means the date this Agreement goes into effect, as specified in section 2.01.

I. **"**Emergency" means an occurrence or incident that presents an imminent threat of widespread or severe damage, injury, or loss of life or property resulting from any natural cause or cause of human origin, including but not limited to fire, explosion, flood, earthquake, wind, storm, structural failure, hazardous substance, environmental contamination, civil disturbance, vandalism, or breach of security.

J. "FCC" means the Federal Communications Commission.

K. "Director" means the director of the City's Division of Real Estate.

L. "License" means the license granted as specified in section 1.01(a) which is exclusive only to the extent specified in this Agreement and which is restricted and revocable as specified in this Agreement. No property or leasehold interest or right is granted by the License.

M. "Licensed Area" means the location at the Subject Property where Licensee is authorized to install and operate the Licensed System, as specified in section 1.01(a).

N. "Licensed System" means the radio frequency equipment and wireless communication facility, and related equipment, infrastructure and utility connections authorized by the City and installed and operated by Licensee within the Licensed Area of the Subject Property, as specified in section 1.01(a).

O. "Licensee" means the legal entity to which the License is granted under and in accordance with this Agreement, as identified in opening paragraph of this Agreement. To the extent that Licensee retains contractors, consultants, or subcontractors to perform any of Licensee's rights and obligations under the Agreement, Licensee shall also mean those contractors, consultants, and subcontractors.

P. "License Fee" means the compensation to be paid by Licensee to the City for the use of the Licensed Area and the operation of the Licensed System at the Subject Property as specified in section 3.01.

Q. "Minimum Technical Standards" mean those standards set forth in **Exhibit B** as these Minimum Technical Standards may be updated from time-to-time, as needed, to address the state-of-the-art.

R. "Party" means either the City or Licensee, as appropriate in the context, and Parties means both the City and Licensee.

S. "Permitted Use" means the uses (subject to restrictions) as specified in section 1.02, which Licensee may make of the Licensed Area in the installation and operation of the Licensed System.

T. "RF" (Radio Frequency) Interference means any emission, radiation or induction from or associated with the Licensed System that affects the functioning of or degrades, obstructs, or interrupts radio or other wireless communications being made by the City or other authorized parties to or from the Subject Property or the operation of any communication system located at the Subject Property.

U. "Point of Contact" means the Director of Real Estate at the City and County of Denver, or the Director's designated representative during regular business hours.

V. "Site Study" means a site and technical interference study, **Exhibit C**, field tests or other activities or investigations related to the resolution of RF Interference that may be associated with the Licensed System as specified in section 5.02

W. "Term" means the duration of the Agreement running from the Effective Date of the Agreement, as specified in section 2.01 including any Term Extensions as specified in section 2.02.

X. "Term Extension" means any extensions of the duration of the Agreement as specified in section 2.02.

SECTION 1
LICENSE; PERMITTED USE; and ACCESS

1.01 Grant of License.

(a) City hereby grants a License to Licensee for the use of certain designated areas at the Subject Property as depicted on **Exhibit A** (the "Licensed Area") for the installation and operation by Licensee, of the Licensed System, as the Licensed System is technically described, also in **Exhibit A**. The Licensed System shall be situated within the Licensed Area as depicted in **Exhibit A**. The Licensed Area shall not include any existing City System. Any proposed change to the Licensed Area depicted in **Exhibit A** shall require an amendment in writing to this Agreement.

1.02 Permitted Use/Restrictions.

(a) The Licensed Area at the Subject Property shall be used for the installation, maintenance, alteration, repair, replacement, operation, and removal of the Licensed System within the Licensed Area, in accordance with this Agreement ("Permitted Use"). The Licensed System shall be owned by Licensee. Except as expressly provided in this Agreement, the City may not disturb or modify the Licensed System without the prior written permission of Licensee.

(b) Licensee may access the Subject Property, use the Licensed Area, and install and operate the Licensed System only as set forth in this Agreement. The Permitted Use does not authorize any activity that would conflict or interfere with the public health, safety or welfare purpose or operation of the Subject Property or any City System. Such prohibited conflict or interference includes RF Interference as set forth in this Agreement and **Exhibit C** ("Site Study"). Licensee shall likewise take every reasonable measure to promptly and effectively avoid or remedy any emergency situation within its control that could adversely impact the Subject Property, the City System, the Licensed Area, or the Licensed System.

1.03 Access.

(a) Provided that Licensee gives at least twenty-four (24) hours prior notice to the Point of Contact, Licensee has the reasonable right of access, ingress to and egress from the Licensed Area during regular business hours for Licensee's employees, contractors and agents, including suppliers of materials and furnishers of service (collectively "Licensee's Personnel").

(b) In the event of an urgent situation where Licensee needs prompt access to the Licensed System during or outside of regular business hours, which shall be deemed to include any failure of Licensed System or any portion thereof, Licensee shall communicate with the

Point of Contact to arrange for access by Licensee's Personnel. The City's Point of Contact for emergencies shall be Mike Stutz, mike.stutz@denvergov.org, (720) 913-2404 (Office); (303) 944-4193 (Mobile).

(c) With respect to all access to the Subject Property, Licensee's Personnel must present legally sufficient identification, preferably in the form of a badge with picture ID issued by Licensee; will be subject to escort by the City's Designee and search and inspection of items brought onto the Subject Property; and will comply with all restrictions and security protocols set by the Director and the City Representative. All equipment, vehicles, machinery and other materials brought onto the Subject Property site must be necessary for the work authorized to be performed.

(d) Should Licensee require access into a secure area of the Subject Property which may require prior approval or escort, then the permission of the City Representative must be obtained and any security protocols must be strictly observed by Licensee.

(e) The exercise of access by Licensee or Licensee's personnel shall not conflict or interfere with the operations of the Subject Property or the City System and may not block access at or the use of the Subject Property nor be in violation of the ADA. In addition, the exercise of access shall not conflict or interfere with the City System unless prior written permission is obtained from the City Representative.

(f) Any particular access on the Subject Property may, at any time, temporarily or permanently, be closed, so long as an alternative means of access is made available to Licensee within a reasonable time. During the duration of any state of Emergency declared by the President of the United States, the Governor of the State of Colorado, or the Mayor of the City and County of Denver, access may be denied for security and public safety reasons. Licensee hereby releases and discharges the City from any and all claims, demands or causes of action which Licensee may now, or at any time hereafter, have against the City, arising or alleged to arise out of the closing of any point of access on the Subject Property site or the temporary unavailability of such access.

SECTION 2
TERM and TERM EXTENSION

2.01 Term.

Except as otherwise specified or agreed upon, the Term of this Agreement shall commence on the Effective Date. The Effective Date shall be the first day of the month immediately following the date upon which the City shall have delivered the fully executed Agreement to the Licensee. The City shall deliver the fully executed agreement to the Licensee no later than thirty (30) calendar days after all authorized representatives for the City shall have signed, dated, and executed the Agreement by affixing their respective signatures to the

Agreement. The Agreement shall expire 5 years after the Effective Date unless extended pursuant to Section 2.02.

2.02 Term Extension.

Licensee may exercise two (2), separate, independent options to renew the License for two additional five-year periods with a 3% increase over the most recent lease rate at the end of each Term. Licensee shall provide notice to the City of its intent to exercise any renewal option by no later than sixty (60) days before the end of a Term. All terms and conditions shall remain in effect in accordance with this Agreement during the renewal period, including the percentage fee increase under Section 3.01, unless otherwise modified by mutual written agreement. Modifications, if any, must be set forth in an amendment to this Agreement and processed for approval in the same manner as the Agreement.

SECTION 3
LICENSE FEE

3.01 License Fee.

(a) Licensee agrees to pay City a monthly License Fee of **TWO THOUSAND, FIVE HUNDRED DOLLARS AND ZERO CENTS** (**$2,500.00**), payable in equal monthly installments beginning on the Effective Date and continuing on the first day of each month thereafter for the Term of the Agreement and any Term renewal. The License Fee shall increase three percent (3%) each year, with the increased License Fee taking effect on the anniversary of the Effective Date of this Agreement each year. This License Fee is subject to modification should there be any modification to the Licensed System as described in **Exhibit A** by Licensee.

(b) The License Fee does not include the payment for electrical service for the Licensed System. Licensee shall bear the costs of all maintenance and repairs to the Licensed System, and Licensee shall pay for a separate electric meter for the operation of the Licensed System, as well as all monthly costs of utility and electricity associated with the use and operation of the Licensed System. Licensee shall make these payments directly to the utility provider, not to the City.

(c) Any License Fee paid to the City shall not be refundable in the event of Cancellation, as provided in this Agreement.

3.02 Maximum Contract Amount

(a) Notwithstanding any other provision of the Agreement and any renewal options exercised by the Licensee, the maximum payment obligation under this Agreement shall not exceed **ONE HUNDRED FIFTY-NINE THOUSAND TWO HUNDRED SEVENTY-FOUR DOLLARS AND 08 CENTS ($ 159,274.08)** (the "Maximum Contract Amount").

3.03 Place and Manner of Payments.

All sums payable to City, including the License Fee and other costs and expenses incurred by the City and reimbursable by Licensee under this Agreement, shall be made payable, without notice, to the "Manager of Finance for the City and County of Denver" and delivered to:

City and County of Denver
Division of Real Estate
201 West Colfax Avenue, Dept. 1010
Denver, Colorado 80202

All payments shall be made in legal tender of the United States. Any payment not made to City accrues interest at the lesser of (i) 18% per annum, or (ii) the maximum interest rate allowed under law, commencing on the fifth (5^{th}) calendar day after the date such amount is due and owing until paid to City. Licensee agrees to pay any charges, fees, or costs incurred by the City for collection of unpaid License Fees or other unpaid costs and expenses of Licensee specified in this Agreement, including reasonable attorney's fees.

SECTION 4
DESIGN, CONSTRUCTION, AND INSTALLATION

4.01 General.

(a) On or after the Effective Date of this Agreement, Licensee shall, at its sole cost and expense, properly maintain and preserve within the Licensed Area, the Licensed System in accordance with **Exhibit A** (unless changes are authorized under section 4.02)**,** and in accordance with the terms and conditions of this Agreement.

(b) The Licensed System shall in all respects be designed and maintained in accordance with Applicable Law, and pursuant to any required building permit and zoning permit to be obtained by Licensee from the City, and according to requirements or design guidelines of the Denver's Technology Services division, the Denver Department of Safety and the Denver Fire Department.

4.02 Plans and Specifications.

(a) Prior to any installation or any modification to the Licensed System, a copy of complete and accurate plans and specifications for the Licensed System must be submitted to the City Representative for review. These plans and specifications must include complete specifications of transmitter power, operating frequencies, filter passband and rejection

characteristics, antenna model numbers and radiation patterns (both horizontal and vertical plane patterns), antenna height and location, and placement of utilities servicing the Licensed System.

(b) Licensee shall cooperate with the City Representative in the review of the plans and specifications and shall make any reasonable modifications required by the City Representative. Upon completion of the review and any required modifications, the City Representative will approve the plans and specifications. Modification to the Licensed System may be denied in the City's sole and absolute discretion. An amendment to this Agreement, including a possible increase in license fee, may be required.

4.03 Maintenance, Preservation, and Modifications of Licensed Area and Licensed System

(a) Licensee is responsible for undertaking all measures necessary and appropriate under Applicable Law in the maintenance of the Licensed Area and operation of the Licensed System to protect the health and safety of the public, City employees, and Licensee's employees and contractors and to lawfully conduct the work associated with the use, maintenance, and preservation of the Licensed Area and the Licensed System. Licensee shall be responsible for securing and maintaining all required and valid permits, licenses and approvals for Licensee's maintenance and preservation of the Licensed Area and Licensed System.

(b) Licensee shall include in Licensee's contract(s) with its consultants, contractors, and sub-contractors, provisions whereby such consultants, contractors, and subcontractors shall defend and hold harmless the City from all costs, liens, damages and expenses related to the design, construction, installation, and modification work regarding the Licensed Area or Licensed System.

(c) Licensee shall be responsible for obtaining utility locates prior to starting any authorized digging on City property. If damage should occur to any existing underground utilities or other underground facilities on City property, whether or not a utility locate was obtained, Licensee shall immediately report the damage to the City Representative and shall take all actions and incur all costs and expenses necessary to repair the damage in a manner satisfactory to the City Representative.

(d) Upon completion of the installation of any modifications or alterations, Licensee shall timely furnish to the City Representative with documented evidence of payment, contractor's affidavits and full and final waivers of all liens for labor, services, or materials.

(e) Equipment shall be located in designated locations as depicted on **Exhibit A** within the Licensed Area. The temporary placement of any equipment or materials outside of the Licensed Area shall require the prior written approval of the City Representative. No equipment or materials shall be placed so as to block access at or use of the Subject Property or in violation of the ADA.

(f) Licensee is responsible for acquiring land lines required for the installation and operation of the Licensed System. The installation or modification of land lines at the Subject Property shall be subject to the prior written approval of the City Representative. Licensee shall be solely responsible for paying any fees, charges, surcharges, taxes, assessments, and similar costs and expenses associated with the land lines.

(g) The City is not responsible for the Licensed System or Licensee's other authorized installations or modifications. Licensee shall be responsible for securing the Licensed System and Licensee's other authorized installations or modifications and keeping them in good working order.

SECTION 5
USE AND OPERATION

5.01 Authorized Frequencies.

In the operation of the Licensed System, Licensee may only operate Licensee's System in the radio bands and frequencies (and no others) which Licensee or FirstNet are authorized by the FCC to use. Operation in any radio band licensed for use by a City System is prohibited. Addition or change in radio bands or frequencies is prohibited unless Licensee first provides prior written notice to the Director and first provides an intermodulation report to the Director.

5.02 RF (Radio Frequency) Interference.

(a) Licensee acknowledges that City's unimpeded use and operation of 303 W Colfax Avenue is critical to the health, safety and welfare of the City and County of Denver and its inhabitants. Licensee shall use its best efforts, at all times, to avoid any RF Interference or interference of any kind with the operation or use of any City System as set forth in this Agreement and **Exhibit C**. Licensee shall diligently work to prevent and, in the event of failure to do so, immediately correct radio frequency interference to the City System and any component elements, including the City's WiFi system, and to cooperate with, and comply with the directions from, the City Representative assigned to deal with RF Interference. To help achieve this goal, Licensee shall comply with the following:

(b) Licensee agrees to comply with all federal, state, local, or other government regulations applicable to Licensee and its activities operating or using the Licensed System, including, but not limited to, regulations and standards published by the FCC.

(c) Upon written request by the City Representative, Licensee agrees to conduct an Interference Study prior to commencing operations and/or during the entire Term or Term Extension of this Agreement, and to furnish the City Representative with the results of the Site Study and to include it as part of Licensee's System Plans and Specifications. If Licensee should fail within a period specified by the City Representative to undertake or complete an Interference Study, the City may arrange for such an Interference Study and Licensee shall reimburse the City for the cost and expense of conducting and preparing the Interference Study.

(d) Licensee agrees to comply with the current Minimum Technical Standards attached hereto as **Exhibit B**.

(e) In order to prevent RF Interference, Licensee shall maintain and repair, at no cost to the City, the Licensed System, in order to comply with FCC rules and the reasonable requirements of the City Representative. If this maintenance should necessitate changing out or replacing existing antennas, the requirements of section 5.04 shall be applicable.

(f) If authorized to make changes, Licensee shall notify the City Representative of the specific changes to associated RF equipment, transmit and receive frequencies, transmitter output power, antenna configurations, and effective radiated power before making the changes. An Interference Study shall be conducted by Licensee, if directed by the City Representative and at Licensee's sole cost and expense, prior to any proposed frequency changes. The requirements of section 5.04 shall be applicable to the changes addressed herein.

(g) To extent there are more than one licensee operating RF equipment at the Subject Property, all licensees are encouraged to resolve potential or real interference problems amongst themselves. Licensee agrees to cooperate fully with City and other licensees to diagnose and correct interference problems. Such cooperation may require Licensee to temporarily reduce or shut down transmit power to help diagnose problems.

(h) When the City Representative, based on inquiry and evaluation, becomes aware of a potential or existing RF Interference problem caused directly or indirectly, wholly or partially, by the Licensed System, the City may require Licensee to reimburse City for the cost of an Interference Study to include radio frequency measurements. The purpose of this Interference Study is to identify the problem and determine if the problem is caused directly or indirectly, wholly or partially, by the Licensed System. This Interference Study shall be conducted by a consulting engineer selected by the Director after consultation with Licensee and the City Representative. In the event there are additional licensees operating at the Subject Property, Licensee shall pay for a pro rata share of the costs of the Interference Study, unless Licensee or another party is determined to be solely responsible for the interference, in which case the responsible party shall pay all costs and expenses. Pro rata share shall be determined by

dividing the costs by the number of non-City licensees operating at the Subject Property.

(i) When necessary to correct RF Interference problems, as determined by the Chief in the Chief's reasonable discretion, Licensee agrees, at its sole cost and expense, to install cavity-type bandpass filters, notch filters, isolators, or other state-of-the-art equipment. These equipment items are in addition to the minimum equipment of the Minimum Technical Standards. The minimum equipment items shall be installed regardless.

(j) Licensee shall ensure that its frequencies used for the operation of the Licensed System do not interfere with any operation of the Subject Property, including without limitation interference with public safety or the City System. Licensee shall provide documentation of the frequencies that it is authorized to use and is using for the Licensed System. Licensee shall not occupy any frequencies that they are not using for the purposes of blocking other licensees from operating. Prior to modifying the Licensed System, Licensee shall be responsible for conducting an RF scan to verify there will be no RF Interference with other systems.

(k) If Licensee's equipment or operations cause RF Interference, as determined by the City in the City's reasonable discretion, including without limitation interference with the City System, and if the interference is not eliminated within ten (10) days after written notice from the Director, then City may, at Licensee's sole cost and expense, temporarily turn off the power to the Licensed System, except for intermittent testing. The City Representative shall contact Licensee at the time the Licensed System needs to be deactivated so Licensee can facilitate the effort to deactivate the Licensed System, isolate any interference, and turn the Licensed System back on with minimal interruption. Licensee, at its sole cost and expense and subject to the requirements of section 5.06, shall (i) have the right to make such repairs, maintenance, replacements or adjustments to the Licensed System as may be reasonably necessary to prevent such RF Interference, and (ii) have the right to conduct intermittent tests of the Licensed System at times mutually agreeable to the City Representative to determine if the Licensed System will continue to cause such RF Interference.

(l) The City requires that Licensee operate its Licensed System with no RF Interference to other licensees' systems. Any unresolved disputes regarding the cause or resolution of specific RF Interference problems or complaints must be evaluated by an independent third party selected by the Director who is competent to evaluate the potential causes of the interference and the measures required for its resolution. If it is determined that RF Interference to the equipment, frequencies or channels of Licensee or other licensees operating at the Subject Property is a result of the non-compliance of those facilities with the Minimum Technical Standards, it shall be the responsibility of Licensee or other licensees to resolve the interference in accordance with the Minimum Technical Standards. If the RF Interference continues when these facilities are brought into compliance with the Minimum Technical Standards, then it shall be Licensee's responsibility to take whatever measures are necessary to resolve the interference promptly and effectively or disengage the operation of the

Licensed System or equipment causing the RF Interference until the RF Interference is resolved to the satisfaction of the City Representative.

5.03 Operational Test Procedures.

The following test procedures shall be approved by City prior to or during, whichever is applicable, Licensee's operation of the Licensed System.

(a) Perform a desktop interference study to include all frequencies to be used by Licensee to ensure no RF Interference is likely from intermodulation products or out-of-band emissions.

(b) Verify the results of the Interference Study by conducting appropriate measurements of the installed systems.

(c) If problems are found, make recommendations for additional filtering, channel changes, greater antenna separation, or other fixes, as necessary.

5.04 Changes to Licensed System.

(a) Licensee shall provide prior written notice to the Director of any proposed change in radio cabinets, transmitter power, frequencies, filters, number of antennae, antenna locations, antenna height, antenna orientation, or related aspects of the Licensed System. Any proposed new, or proposed changes to, antennae, antenna mounts or mounting hardware, or structural changes to the Subject Property or tower, require that Professional Engineer stamped structural drawings be provided for review and approval. All reviews of proposed changes shall be subject to such process as prescribed by the Director and undertaken by the City Representative.

(b) Any proposed changes which are significant (as determined by the Director) will require a review of the current lease rate and may result in an additional License Fee being charged to Licensee and possible other changes to the terms and conditions of the Agreement. These changes, along with any addition, relocation or replacement of antennae or other equipment outside the Licensed Area, shall require an amendment to the Agreement which must be approved in the same manner as this Agreement. Changes or occupation or use of areas outside of the Licensed Area which are not authorized as provided herein will be considered to be in breach of this Agreement.

(c) All such changes shall be subject to the Minimum Technical Standards and the installation and operational conditions set forth in this Agreement. The approval form must be attached to the scope of work and stamped structural drawings sheets (not separate). All contractors, subcontractors and vendors must have a copy of the signed approval sheets to

present to the officer in charge of the Subject Property, before any work may begin.

5.05 Repairs and Maintenance; Removal.

(a) The maintenance, care, repair, alteration, enhancement or replacement of the Licensed System or infrastructure within the Licensed Area shall be made by Licensee at its sole cost and expense. Licensee covenants and agrees during the Term or Term Extension of this Agreement, after the installation of the Licensed System and occupancy of the Licensed Area, that Licensee:

(1) shall keep the Licensed System in good order and condition, and will make all necessary and appropriate repairs or changes thereof if approved as required in section 5.04 above;

(2) shall not permit rubbish, debris, waste materials or anything unsightly or detrimental to health, or likely to create a fire or explosion hazard, or conducive to deterioration, to remain in any part of the Licensed Area or the Subject Property or to be disposed of improperly;

(3) shall at all times maintain the Licensed System in accordance with Applicable Law, the Minimum Technical Standards, FCC requirements, and manufacturer's specifications;

(4) shall promptly repair any and all damage to, among other things, the structures, equipment and surrounding property at the Subject Property which result from Licensee's installation and operation of its Licensed; and

(5) shall store tools, test equipment and work materials only in areas at Subject Property approved by the City Representative.

(b) All portions of the Licensed System brought onto the Subject Property by Licensee will be and remain Licensee's personal property and, at Licensee's option, may be removed by Licensee at any time during or after the Term. City waives any and all lien rights it may have, statutory or otherwise, concerning the Licensed System or any portion thereof. Removal or other modifications are subject to Section 1.03 regarding access to the Licensed Area. The Licensed System shall be deemed personal property for purposes of this Agreement, regardless of whether any portion is deemed real or personal property under applicable law; City consents to Licensee's right to remove all or any portion of the Licensed System from time to time in Licensee's sole discretion subject to Section 1.03.

(c) If Licensee should be of the opinion that repair, alteration or replacement of the Subject Property is needed ("Alteration"), Licensee shall submit in writing a request to the Director explaining the perceived need for the Alteration. City will maintain and repair the Subject Property, and all areas of the Licensed Area where Licensee does not have exclusive control, in reasonably good condition, subject to reasonable wear and tear and damage from the elements. Any obligation of the City to perform the work shall be strictly contingent upon approvals, including contracts, required by Applicable Law and obtaining all funding needed for the Alteration. If Licensee proposes to make and pay for the Alterations, it should provide plans and a budget with the request submitted to the Director.

5.06 Right to Enter, Inspect and Make Repairs and Improvements.

(a) The City and its authorized officers, employees, agents, contractors, subcontractors and other representatives shall have the right (at such times as may be reasonable under the circumstances to avoid unreasonable interruption of Licensee's operations) to access the Licensed Area for the following purposes:

(1) to inspect such equipment at reasonable intervals during regular business hours (or at any time in case of Emergency or urgent need to protect the City System) to determine whether Licensee has complied and is complying with the terms and conditions of this Agreement;

(2) to perform maintenance and make repairs and replacements in cases where Licensee is obligated but has failed to do so, after the City has given Licensee reasonable notice so to do, in which event Licensee shall reimburse the City for the reasonable cost thereof within thirty (30) days of Licensee's receipt of City's invoice accompanied by reasonable substantiation of the costs incurred. The City shall have the right to seek recovery of the cost of the maintenance or repair by any judicial remedy available should Licensee fail to pay the cost of the repair. Under no circumstances will City attempt to repair or alter in any way Licensee's Licensed System, including its operational equipment such as base station radios, other electronic equipment, alarm systems, antennas, coaxial cable, DAS, UPS, etc.; however, this restriction shall not limit the City in performing inspections and repairs and protecting the City System and the Subject Property as provided in this Agreement.

(b) The City reserves the right at all times to take any action it deems necessary, in its sole discretion, to repair, maintain, alter, expand, or improve the City System and the Subject Property and the improvements thereon in connection with their use and operation. The City agrees to give reasonable advance notice of any such activities to Licensee and to reasonably cooperate with Licensee to carry out such activities with a minimum amount of interference to Licensee's use of the Licensed Area. Licensee agrees to cooperate with the City with respect to such repairs, maintenance, alterations, expansions, or improvements and to accommodate such work to the extent the City deems necessary and at Licensee's sole expense.

5.07 Utilities.

(a) Licensee shall pay for a separate electric meter for the operation of the Licensed System, as well as all monthly costs of utility and electricity associated with the use and operation of the Licensed System. Licensee shall make these payments directly to the utility provider, not to the City.

(b) Licensee shall be responsible for providing and properly maintaining and replacing, subject to the requirements of section 5.04 above and the installation requirements of section 4.03 above, an independent ventilation, heating, and air conditioning system for those portions of the Licensed System, if any, that are expressly required by the manufacturer of the System to maintain manufacturer's warranties based upon Licensee's installation of the Licensed System at the Subject Property.

5.08 Interruption of Utility Services.

(a) Licensee agrees that City shall not be liable for failure of any utility services to be supplied to the Licensed System, or for a failure of the electrical generator, or for any interruption of utility services to the Licensed System caused by third parties.

(b) The City reserves the right to temporarily interrupt utility services at such time as may be necessary by reason of accident, unavailability of employees, repairs, alterations or improvements or whenever by reason of *force majeure*, including any state of Emergency declared by the President of the United States, the Governor of the State of Colorado, or the Mayor of the City and County of Denver for which such interruption is reasonable for security and public safety reasons. The City shall not be liable for operational or business losses or for damages to persons or property due to such interruptions. Nor shall such interruptions in any way be construed as cause for abatement of the License Fee, unless caused by the demonstrated gross negligence or intentional misconduct of the City or its agents, contractors or employees.

(c) No backup power supplies shall be placed within the Licensed Area or elsewhere on the Subject Property without the prior, written approval of the City Representative and after obtaining any required permits, licenses or approvals for such backup power supplies.

SECTION 6
INSURANCE; INDEMNITY and DEFENSE; GOVERNMENTAL IMMUNITY; LIMITS ON LIABILITY; and TAXES, LICENSES, LIENS AND FEES

6.01 Insurance.

(a) **General Conditions**: Licensee agrees to secure, at or before the time of execution of this Agreement, the following insurance covering all operations, goods or services provided pursuant to this Agreement. Licensee shall keep the required insurance coverage in

effect at all times during the term of the Agreement, including any extension thereof, and during any warranty period. The required insurance shall be underwritten by an insurer eligible to do business in Colorado and rated by A.M. Best Company as "A-VII" or better. Each policy shall require notification to the City in the event any of the required policies be canceled before the expiration date thereof. Such written notice shall be sent to the parties identified in the Notices section of this Agreement. Said notice shall be sent thirty (30) days prior to such cancellation. If such written notice is unavailable from the insurer, Licensee shall provide written notice of cancellation, non-renewal of any required coverage that is not replaced to the parties identified in the Notices section by - mail, referencing the City's contract number. Licensee shall be responsible for the payment of any deductible or self-insured retention. The insurance coverages specified in this Agreement are the requirements, and these requirements do not lessen or limit the liability of the Licensee. The Licensee shall maintain, at its own expense, any additional kinds or amounts of insurance that it may deem necessary to cover its obligations and liabilities under this Agreement.

Proof of Insurance: Licensee may not commence services or work relating to this Agreement prior to placement of coverages required under this Agreement. Licensee certifies that the certificate of insurance attached as Exhibit D, preferably an ACORD form, complies with all insurance requirements of this Agreement. The City requests that the City's contract number be referenced on the certificate of insurance. The City's acceptance of a certificate of insurance or other proof of insurance that does not comply with all insurance requirements set forth in this Agreement shall not act as a waiver of Licensee's breach of this Agreement or of any of the City's rights or remedies under this Agreement. In the event of a claim giving rise to a coverage dispute, The City reserves the right to request a copy of the applicable Policy giving rise to such dispute.

(b) **Additional Insureds**: For Commercial General Liability, Auto Liability and Excess Liability/Umbrella (if required), Licensee's insurer(s) shall include the City and County of Denver, its elected and appointed officials, employees and volunteers as additional insured.

(c) **Waiver of Subrogation:** For all coverages required under this Agreement, Licensee's insurer shall waive subrogation rights against the City.

(d) **Subcontractors and Subconsultants:** Licensee shall confirm and document that all subcontractors and subconsultants (including independent contractors, suppliers or other entities providing goods or services required by this Agreement) procure and maintain coverage as approved by the Licensee and appropriate to their respective primary business risks considering the nature and scope of services provided.

(e) **Workers' Compensation and Employer's Liability Insurance:** Licensee shall maintain the coverage as required by statute for each work location and shall maintain Employer's Liability insurance with limits of $100,000 per occurrence for each bodily injury claim, $100,000 per occurrence for each bodily injury caused by disease claim, and $500,000 aggregate for all bodily injuries caused by disease claims.

(f) **Commercial General Liability:** Licensee shall maintain a Commercial General Liability insurance policy per ISO form CG 00 01 or equivalent with - limits of $1,000,000 for each bodily injury and property damage occurrence, $2,000,000 products and completed operations aggregate (if applicable), and $2,000,000 policy aggregate.

(g) **Automobile Liability:** Licensee shall maintain Automobile Liability with - limits of $1,000,000 per accident combined single limit applicable to all owned, hired and non-owned vehicles used at the Leased Premises.

(h) **Property Insurance**: Licensee shall provide 100% replacement cost for Licensee's tenant improvements and personal property. Business Interruption coverage shall be included with limits not less than the annual payments due to the City under this License Agreement. Licensee understands and acknowledges that the City does not provide any insurance coverage for any property of the Licensee, its agents, employees or assignees located in the Leased Premises and Licensee acknowledges and agrees that the Licensee, its agents, employees, and assignees have no claim against the City for any damage or loss of personal property and belongings of Licensee, its agents, employees or assignees in the Licensed Area.

(i) Failure to comply with the requirements of this section 6.01 shall be legal grounds under this Agreement for work by Licensee at the Subject Property to be ordered to cease or to be restricted, as deemed appropriate by the Director or the Denver Risk Management Office, until compliance is achieved and any unpaid claims are resolved to the reasonable satisfaction of the City Representative and the Denver Risk Management Office. These insurance obligations shall survive the expiration of the Agreement and Cancellation for three (3) years.

6.02 Indemnification & Defense.

(a) Licensee hereby agrees to defend, indemnify, and hold harmless City, its appointed and elected officials, agents and employees against all liabilities, claims, judgments, suits or demands for damages to persons or property arising out of, resulting from, or relating to regarding the use and occupancy of, and activities and operations on, the Subject Property site by Licensee (including its officers, employees, representatives, suppliers, contractors, subcontractors and agents) under this Agreement ("Claims"), unless such Claims have been specifically determined by the trier of fact to be the sole negligence or willful misconduct of City. This indemnity shall be interpreted in the broadest possible manner to indemnify City for any acts or omissions of Licensee (including its officers, employees, representatives, suppliers, contractors, subcontractors and agents) either passive or active, irrespective of fault, including City's concurrent negligence whether active or passive, except for the sole negligence or willful misconduct of City.

(b) Licensee's duty to defend and indemnify City shall arise at the time written notice of the Claim is first provided to City regardless of whether an action has been filed in court on the Claim. Licensee's duty to defend and indemnify the City shall arise even if City is the only

party sued and/or it is alleged that City's negligence or willful misconduct was the sole cause of the alleged damages.

(c) Licensee will defend any and all Claims which may be brought or threatened against City and will pay on behalf of City any expenses incurred by reason of such Claims including, but not limited to, court costs and attorney fees incurred in defending and investigating such Claims or seeking to enforce this indemnity obligation. Such payments on behalf of City shall be in addition to any other legal remedies available to City and shall not be considered City's exclusive remedy.

(d) Insurance coverage requirements specified in this Agreement shall in no way lessen or limit the liability of Licensee under the terms of this indemnification obligation. Licensee shall obtain, at its own expense, any additional insurance that it deems necessary for City's protection.

(e) This indemnification and defense obligation shall survive the expiration of this Agreement and Cancellation.

6.03 Colorado Governmental Immunity Act.

Licensee understands and agrees that City is relying upon, and has not waived, the monetary limitations and all other rights, immunities and protection provided by the Colorado Governmental Act, § 24-10-101 *et seq*., C.R.S., and any related statutory protections against liability.

6.04 Limitation on Liability.

Licensee agrees that no liability shall attach to the City for any damages or losses incurred or claimed by Licensee or any other person or party on account of the installation, construction or operation of the Licensed System by Licensee. Licensee agrees that it shall not in any way seek damages or make any claims against the City for any interference or delay caused by construction in adjacent areas, other businesses or operations, including without limitation damages or losses in the nature of delay damages, lost labor productivity, and impact damages.

6.05 Environmental Requirements.

(a) Licensee and its contractor(s) and subcontractor(s) shall obtain all federal, state, and local environmental permits necessary for the work to be performed and shall comply with all applicable federal, state, and local environmental permit requirements applicable to any work performed on the Subject Property. Licensee and its contractor(s) and subcontractor(s) shall comply with all applicable local, state, and federal environmental guidelines, rules, regulations,

statutes, laws, and orders applicable to the work (collectively, "Environmental Requirements"), including but not limited to Environmental Requirements regarding the storage, use, transportation, and disposal of Hazardous Materials and regarding releases or threatened releases of Hazardous Materials to the environment.

(b) The term "Hazardous Materials" shall mean asbestos, asbestos-contaminated soils, and asbestos-containing materials, special wastes, polychlorinated biphenyls (PCBs), any petroleum products, natural gas, radioactive source material, pesticides, any hazardous waste as defined at 42 U.S.C. § 6903(5) of the Solid Waste Disposal Act, any hazardous substance as defined at 42 U.S.C. § 9601(14) of the Comprehensive Environmental Response, Compensation and Liability Act, and chemical substance as defined at 15 U.S.C.§ 2602(2) of the Toxic Substances Control Act, and any guidelines issued and rules or regulations promulgated pursuant to such statutes, or any other applicable federal or state statute.

(c) No Hazardous Materials shall be brought onto, or stored on, the Subject Property site without the prior, written approval of the City Representative and, if required by the City Representative, the prior, written approval of the Denver Department of Environmental Health and/or the Colorado Department of Public Health and Environment.

(d) The obligations of Licensee set out in this section 6.05 shall survive the expiration of the Agreement and Cancellation.

6.06 Taxes, Licenses, Liens and Fees.

(a) Licensee agrees to promptly pay all taxes, excises, license fees and permit fees of whatever nature applicable to its operations hereunder and to take out and keep current all municipal, state or federal licenses required for the conduct of its business or operations under this Agreement and further agrees not to permit any of said taxes, excises, license fees or permit fees to become delinquent.

(b) Licensee also agrees not to permit any mechanic's or materialman's or any other lien to become attached or be foreclosed upon the Subject Property or the tower, or improvements thereto, or any part or parcel thereof, by reason of any work or labor performed or materials furnished by any mechanic or materialman for Licensee, as contractors or subcontractors.

(c) Licensee further agrees to promptly pay when due all bills, debts and obligations incurred by it in connection with its operations hereunder, and not to permit the same to become delinquent and to suffer no lien, mortgage, judgment or execution to be filed against the Subject Property, the City System, the Licensed System, or related improvements, which may in any way impair the rights of the City under this Agreement or to the City's property.

(d) The obligations of Licensee set out in this section 6.06 shall survive the expiration of the Agreement and Cancellation.

6.07 No Waiver.

No failure of either Party to insist upon the strict performance of a term, covenant or agreement contained in this Agreement shall be deemed or taken to be a waiver by such Party of any succeeding failure to perform or any breach or default.

SECTION 7
CITY RIGHTS

7.01 City's Rights.

(a) City shall retain all the rights to the use, occupancy and ownership of the Subject Property; and such use, occupancy and ownership by the City shall be the primary use of the Subject Property and shall not be interfered with by the exercise of the rights granted hereunder during the Term or Term Extension of the Agreement, except to the extent interference shall be a result of Licensee's reasonable uses and actions in the installation, inspection, maintenance, alteration, repair, replacement, operation and removal of the Licensed System as authorized under this Agreement; provided, however, that Licensee shall be liable to the City for any damage to improvements that may result from such installation, inspection, maintenance, alteration, repair, replacement, operation and removal.

(b) If the City desires Licensee to leave in place any modifications made by Licensee to the Tower and so states in a written notice to Licensee, then Licensee shall leave such modifications in place without compensation from or to the City. If Licensee is required to remove the modifications and does not restore damage resulting from said removal and thereby causing the City to have to undertake the restoration, then Licensee shall promptly reimburse the City for the work. The City specifically reserves for itself, other Licensees, licensees and assignees of City, all rights which do not materially and adversely interfere with Licensee's exercise of its License under this Agreement; provided, however, the City will not materially and adversely interfere with, and will not knowingly permit or allow other licensees to materially and adversely interfere with, the rights of Licensee under the terms of this Agreement except to the extent expressly provided in this Agreement.

(c) Upon expiration of the Agreement or Cancellation or on the date specified in any demand for possession by the City after any default by Licensee (after any applicable notice and cure periods), Licensee covenants and agrees to surrender possession of the Licensed Area and all other parts of the Subject Property site to the City in the same condition as when first occupied, ordinary wear and tear excepted but subject to the repair and restoration requirements provided in this Agreement.

(d) Licensee shall remove, at its sole cost, upon expiration of the Agreement or Cancellation, the Licensed System and all of Licensee's personal property within thirty (30) calendar days after expiration or Cancellation, as applicable. If such removal should damage the Subject Property, Licensee agrees, at its sole cost, to immediately repair such damage in a good and workmanlike manner and to put the property in the same condition as it would have been if the Licensed System had not been installed, reasonable wear and tear excepted but subject to the repair and restoration requirements provided in this Agreement. If Licensee fails to remove the Licensed System and Licensee's personal property within thirty (30) calendar days after the expiration of this Agreement or Cancellation, as applicable, the City, at its option, may remove, store and/or dispose of same and retain any proceeds therefrom, and further is entitled to recover any cost incurred by the City in removing same and in restoring the Subject Property.

(e) If Licensee holds over after the expiration of this Agreement or Cancellation, and so long as the Licensed System is still situated on the Subject Property site (even if it has been disconnected), Licensee shall pay to City a holdover fee equal to 250% of the then total License Fee prorated from the effective expiration or Cancellation date, whichever is applicable, to the date the Licensed System is properly and completely removed from the property. Nothing herein shall be construed to give Licensee the right to hold over at any time, and the City may exercise any and all remedies at law or in equity to recover possession of the Property, as well as any damages caused by Licensee.

SECTION 8
LOSS OF, AND LIABILITIES PERTAINING TO THE LICENSED SYSTEM

8.01 Damage or Destruction and Restoration.

In case of damage or loss of all or any portion of the Licensed System or the Tower, Licensee will give prompt notice thereof to the City; and, except as otherwise provided herein, Licensee shall promptly commence and complete with due diligence (subject to delays beyond its control), the restoration of the Licensed System as nearly as reasonably practicable to the value and condition thereof immediately prior to such damage or destruction. In the event of such damage or destruction, Licensee shall be entitled to use or receive reimbursement from the proceeds of all property insurance policy or policies held by Licensee for the Licensed System. The License Fee payable under section 3.01 shall continue to be due and owing.

8.02 Licensee's Election Not to Restore Damaged Licensed System.

In case of the damage or destruction of all or any part of the Licensed System, Licensee, within ninety (90) days thereafter, may elect not to restore or replace the Licensed System, and this Agreement shall be terminated. Licensee must notify the City within said 90 days of the damage or destruction to all or any part of the Licensed System of its intentions not to restore or replace the Licensed System and shall pay the City, in full, six (6) months of payments for the License Fee under section 3.01 from the date that the notice not to restore or replace is provided

to the City. Licensee shall promptly proceed to remove the Licensed System from the Licensed Area and to repair and restore the Subject Property in accordance with Section 4 and section 7.01 and as otherwise provided in this Agreement within thirty (30) days after Licensee elects not to restore or replace the Licensed System. The obligations of Licensee under this section 8.02 shall survive the expiration of this Agreement and Cancellation.

SECTION 9
DEFAULT; REMEDIES; and DISPUTES

9.01 Licensee Default.

Licensee shall be in substantial default under this Agreement if Licensee:

(a) Fails to timely pay to the City on the fifth (5^{th}) calendar day after the date License Fee or any other payments are due and owing under this Agreement; provided, however, default shall not occur until the tenth (10^{th}) calendar day after written notice is provided by the City to Licensee; or

(b) Becomes insolvent, or takes the benefit of any present or future insolvency or bankruptcy statute, or makes a general assignment for the benefit of creditors, or consents to the appointment of a receiver, trustee or liquidator of any or substantially all of its property; or

(c) Transfers its interest under this Agreement, unless such transfer is specifically authorized pursuant to section 10.01; or

(d) Fails to submit or fails to timely submit complete and accurate plans and specifications, bonds, proof of insurance and other submittals as required by the express terms of this Agreement, and such failure continues for a period of thirty (30) calendar days after Licensee has received written notice from the City of such failure; or

(e) Abandons, deserts or vacates the Licensed System or Licensed Area; or

(f) Suffers any materialmen's or mechanic's lien or attachment to be filed against the Licensed System, the City System, or the Subject Property because of any act or omission of Licensee, and such lien or attachment is not discharged or contested by Licensee in good faith by proper legal proceedings within thirty (30) calendar days after Licensee's receipt of written notice thereof from City; or

(g) Fails to keep, perform and observe any other promise, covenant or agreement set forth in this Agreement and such failure continues for a period of more than thirty (30) calendar days after delivery by City of a written notice of such breach or default, except where a shorter

period is specified herein, or where fulfillment of its obligation requires activity over a period of time and Licensee within thirty (30) days of Licensee notice Licensee commences in good faith to perform whatever may be required to correct its failure to perform and continues such performance without interruption except for causes beyond its control (which must be documented in a written notice to the City); or

(h) Gives its permission to any person to use for any illegal or unauthorized purpose any portion of the City's property made available to Licensee for its use under this Agreement; or

(i) Or any of its officers or employees are convicted, plead nolo contendere, enter into a formal agreement in which they admit guilt, enter a plea of guilty, or otherwise admit culpability to criminal offenses of bribery, kickbacks, collusive bidding, bid-rigging, antitrust, fraud, undue influence, theft, racketeering, extortion or any offense of a similar nature, in connection with the Licensee's business or operations in the State of Colorado.

9.02 Remedies.

If Licensee substantially defaults in any of the covenants, terms and conditions herein and such default is not cured within any applicable notice and cure periods, the City may exercise any one or more of the following remedies:

(a) The City may elect to allow this Agreement to continue in full force and effect and to enforce all of City's rights and remedies hereunder, including without limitation the right to collect compensation as it becomes due together with interest or recover any damages or losses resulting from the action or inaction of Licensee.

(b) The City may engage in Cancellation and repossess the Licensed Area, without liability for so doing and without having to comply with any eviction process under state law, upon giving thirty (30) calendar days written notice to Licensee of the intended Cancellation, at the end of which time all the rights hereunder of Licensee shall terminate, unless the default shall have been cured as prescribed in section 9.01 or elsewhere in this Agreement. Licensee shall be liable to the City for all amounts owing to the City or any other party with respect to Licensee's operations at the Subject Property or under this Agreement.

(c) The remedies provided in this Agreement shall be cumulative and shall in no way affect any other remedy available to the City under law or equity. The obligations of Licensee under this section 9.02 shall survive the expiration of the Agreement and Cancellation.

9.03 City Default.

City's failure to perform any term or condition under this Agreement within thirty (30) days after written notice from Licensee specifying the failure will be deemed a default by City and a breach of this Agreement. No such failure, however, will be deemed to exist if City has commenced to cure the default within such period and provided such efforts are prosecuted to completion with reasonable diligence. Delay in curing a default will be excused if due to causes beyond the reasonable control of City. If City remains in default beyond any applicable cure period, Licensee will have: (i) the right to cure City's default and to deduct the costs of such cure from any monies due to City from Licensee, and (ii) any and all other rights available to it under law and equity. The Parties agree to work diligently together and in good faith, using reasonable efforts to resolve any unforeseen issues and disputes and to expeditiously take such actions as are necessary and appropriate to perform the duties and obligations of this Agreement. Any dispute between the City and Licensee, including whether a default by Licensee is substantial or has been timely and effectively cured, shall be taken to administrative hearing, pursuant to the procedure established by Section 56-106, DRMC. For the purpose of that procedure, the City official rendering a final determination shall be the Executive Director of the Denver Department of Safety.

SECTION 10
MISCELLANEOUS PROVISIONS

10.01 Assignments.

(a) Licensee shall not assign or otherwise transfer its interest in this Agreement, in whole or in part, or otherwise transfer any rights or interest in or to the License granted under this Agreement, without the prior written consent of the Director, which consent can be given or denied in Director's sole discretion, and subject to approval, under section 10.16 below, of an amendment to this Agreement authorizing the assignment. The Director may require any proposed assignee to demonstrate that it is appropriately licensed and authorized to provide the same services as Licensee and has the ability to perform the terms and conditions of this Agreement including any financial obligations under this Agreement.

(b) Notwithstanding the foregoing, Licensee may assign this Agreement, and the License granted herein, in whole, to any business entity which is parent, subsidiary, affiliate of Licensee, or to any party that acquires all or substantially all of Licensee's radio spectrum assets in the Denver market area, by reason of a merger, acquisition or other business reorganization. The burden shall be on Licensee to demonstrate, to the satisfaction of the Director, that any proposed assignment qualifies under this sub-section 10.01(b).

(c) The License granted under this Agreement may not be sold under any circumstances. Any contract entered by Licensee to sell or convey the License granted herein shall not be binding on the City and shall be grounds for terminating the Agreement, at the discretion of the Director.

(d) Under no circumstances shall Licensee be authorized to allow any other licensee

or sub-licensee to co-locate or operate any system at the Subject Property.

10.02 Fair Dealing; Further Assurances.

(a) In all cases where the consent or approval of one Party is required before the other may act, or where the agreement or cooperation of the Parties is separately or mutually required as a legal or practical matter, then in that event the Parties agree that each will act in a fair and reasonable manner with a view to carrying out the intents and goals of this Agreement as the same are set forth herein, subject to the terms hereof.

(b) From time to time, upon the request of a Party, the other Party agrees to make, execute and deliver or cause to be made, executed and delivered to the requesting Party any and all further instruments, certificates and documents consistent with the provisions of this Agreement as may, in the reasonable opinion of the requesting Party, be necessary or desirable in order to effectuate, complete or perfect the rights of said Party under this Agreement, provided said requesting Party is currently in full compliance with the provisions of this Agreement and has tendered or offered to tender any reciprocal instruments, certificates and documents to which the other Party is entitled under the Agreement.

10.03 Bond Ordinance.

This Agreement and the rights granted or conveyed hereby are in all respects subject and subordinate to any and all City bond ordinances related to the Subject Property and to any other bond ordinances which should amend, supplement or replace such bond ordinances. The parties agree that the bond ordinances permit the terms of this Agreement as written and that Licensee shall comply with all IRS regulations and take no action that would jeopardize the tax exempt status of the bonds. This Agreement has been approved by the City's bond counsel, attached hereto as **Exhibit E**. This Agreement may not be executed and may not be amended in the future without prior written approval of the City's bond counsel.

10.04 Financial Interests.

Except for financial interests authorized by the City in accordance with the City Charter and ordinances, any financial interests created in, or used to secure financing and payment for the costs of, any work performed or improvements made under this Agreement by Licensee, including but not limited to any bonds, certificates of participation, purchase agreements, and Uniform Commercial Code filings, shall expressly exclude from such debt or financial security contained in such financial instrument(s) any title, rights and interests held by the City in the property subject to this Agreement. The terms and conditions of this Agreement must be expressly recognized in any such financial instrument(s) created or entered by or on behalf of Licensee, which must specifically acknowledge and affirm that any financial interests created by the financial instrument(s) are subordinate to this Agreement and may not encumber the City's title, rights and interests in the subject property or under this Agreement.

10.05 Appropriation.

Notwithstanding any provision of this Agreement to the contrary, the rights and obligations of the City under this Agreement are contingent upon all funds necessary for work or expenditures contemplated under this Agreement being budgeted, appropriated and otherwise made available by the City. The Parties acknowledge that this Agreement is not intended to create a multiple-fiscal year direct or indirect debt or financial obligation of the City, except to the extent that capital improvement funds that are lawfully appropriated can be lawfully carried over to subsequent years.

10.06 Contracting or Subcontracting.

Any work that is allowed to be contracted or subcontracted under this Agreement shall be subject, by the terms of the contract or subcontract, to every provision of this Agreement. Compliance with this provision shall be the responsibility of the Party who arranged the contract or authorized the subcontract. Except as otherwise expressly stated in this Agreement, no Party shall be liable or have a financial obligation to or for any contractor, subcontractor, supplier, or other person or entity with which the other Party contracts or has a contractual arrangement.

10.07 Third Parties.

This Agreement does not, and shall not be deemed or construed to, confer upon or grant to any third party or parties any right to claim damages or to bring any suit, action or other proceeding against either the City or Licensee because of any breach hereof or because of any of the terms, covenants, agreements and conditions herein.

10.08 Force Majeure.

Neither Party hereto shall be liable to the other for any failure, delay or interruption in the performance of any of the terms, covenants or conditions of this Agreement due to causes beyond the reasonable control of that Party, including without limitation strikes, boycotts, labor disputes, embargoes, shortages of materials, acts of God, acts of the public enemy, acts of superior governmental authority, severe weather conditions, fire, floods, riots, rebellion, sabotage or any other circumstance for which such Party is not responsible or which is not in its power to control, but in no event shall this section be construed so as to allow Licensee to reduce or abate its obligation to pay the License Fee prescribed in this Agreement.

10.09 No Discrimination in Employment (City Executive Order No. 8):

In connection with the performance of work under the Agreement, Licensee may not refuse to hire, discharge, promote, demote, or discriminate in matters of compensation against any person

otherwise qualified, solely because of race, color, religion, national origin, ethnicity, citizenship, immigration status, gender, age, sexual orientation, gender identity, gender expression, marital status, source of income, military status, protective hairstyle, or disability. Licensee shall insert the foregoing provision in all subcontracts.

10.10 Non-Discrimination and Equal Employment Opportunity

(a) In carrying out its obligations under the Agreement, Licensee and its officers, employees, members, and subcontractors hereby affirm current and ongoing compliance with 29 CFR Part 37, Title VII of the Civil Rights Act of 1964, The Americans With Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973, the Age Discrimination Act of 1975, Title IX of the Education Amendments of 1972, and all other nondiscrimination and equal employment opportunity statutes, laws, and regulations. Licensee agrees not discriminate against any employee or applicant for employment because of race, religion, national origin, ancestry, color, gender, gender identity, sexual orientation, age, disability, political affiliation or belief, or veteran status. Licensee will ensure that all qualified applicants are hired, and all employees are considered for promotion, demotion, transfer; recruitment or recruitment advertising, layoff, termination, rates of pay, other forms of compensation, selection for training (including apprenticeship), or any other employment-related opportunities, without regard to race, religion, national origin, ancestry, color, gender, gender identity, sexual orientation, age, disability, political affiliation or belief, or veteran status.

(b) Licensee agrees to post notices affirming compliance with all applicable federal and state non-discrimination laws in conspicuous places accessible to all employees and applicants for employment. Licensee will affirm that all qualified applicants will receive consideration for employment without regard to race, religion, national origin, ancestry, color, gender, gender identity, sexual orientation, age, disability, political affiliation or belief, or veteran status in all solicitations or advertisements for employees placed by or on behalf of Licensee.

(c) Licensee will incorporate the foregoing requirements of this Section in all of its subcontracts.

(d) Licensee agrees to collect and maintain data necessary to show compliance with the nondiscrimination provisions of this section.

10.11 Conflict of Interest.

The Parties agree that no official, officer or employee of the City shall have any personal or beneficial interest whatsoever in the services or property described herein, and Licensee further agrees not to hire or contract for services any official, officer or employee of the City or any other person which would be in violation of the Denver Revised Municipal Code Chapter 2, Article IV, Code of Ethics, or Denver City Charter provisions 1.2.9 and 1.2.12.

10.12 Applicable Law; Authority; Venue; Enforcement; and Claims.

(a) The Parties agree to comply with all Applicable Law in existence as of the Effective Date of this Agreement or as may be subsequently enacted or adopted and become applicable.

(b) This Agreement shall be construed and enforced in accordance with the laws of the United States, the State of Colorado, and the applicable provisions of the Charter and Revised Municipal Code of the City and County of Denver.

(c) Venue for any legal action relating to this Agreement shall lie in the District Court in and for the City and County of Denver.

(d) The Parties agree that this Agreement may be enforced in law or in equity for specific performance, injunctive, or other appropriate relief, including actual damages (notwithstanding Cancellation), as may be available according to the laws and statutes of the State of Colorado; provided, however, the Parties agree to and hereby release any claims for incidental, consequential, or punitive damages; provided, further, no provision of this Agreement may be enforced by the creation or recording of any type of lien against real property owned by the City, nor may any foreclosure process be utilized to recover any moneys owed by the City to Licensee. It is specifically understood that, by executing this Agreement, each Party commits itself to perform pursuant to these terms and conditions contained in this Agreement, and that any failure to comply which results in any recoverable damages shall not cause, by itself, the revocation or termination of any rights or obligations under this Agreement.

(e) Nothing in this section 10.12 shall be construed as a waiver, release, reduction or modification of any insurance, bond, indemnification or other liability obligations of Licensee or Licensee's design professional, contractor or sub-contractor expressly provided for in this Agreement.

(f) No official, officer, director, agent, or employee of either Party shall be charged personally or held contractually liable to the other Party or its officials, officers, directors, agents, or employees under any term or condition of this Agreement or for any breach, default, or violation under this Agreement.

(g) In the event that any claim, demand, suit, or action is made or brought in writing by any person or entity against one of the Parties related in any way to this Agreement, the Party in receipt of same shall promptly notify and provide a copy of said claim, demand, suit, or action to the other Party.

10.13 Use, Possession or Sale of Alcohol or Drugs; Smoking Policy.

(a) Licensee and its officers, agents, employees, and contractors shall cooperate and comply with the provisions of the City and County of Denver's policy or order or any successor policy or order concerning the use, possession or sale of alcohol or drugs on City property.

(b) Licensee and its officers, agents, employees, and contractors shall cooperate and comply with the provisions of the City's policy or order prohibiting smoking in buildings and certain facilities, and Licensee agrees it will take reasonable action to prohibit smoking by its employees in the public areas of the Subject Property.

10.14 Notices.

All legal and administrative notices hereunder shall be given in writing to the following by hand delivery, by a nationally recognized overnight courier, or by certified mail, postage prepaid, return receipt requested.

To the City:

City and County of Denver
Division of Real Estate
201 W Colfax Ave, Dept 1010
Denver, CO 80202
Attn: Director of Real Estate

City Attorney's Office
City and County of Denver
1437 Bannock Street, Room 353
Denver, CO 80202

To the Licensee:

T-Mobile West LLC
Attn: Property Management
12920 SE 38th Street
Bellevue, WA 98006
Cell Site Name: Denver Fire Station #28
Cell Site #: DN03433C

All proposed amendments to the Agreement, letter approvals for proposed actions by Licensee, proposed changes to the exhibits, and any document or affidavit seeking the signature of the Director or the Executive Director of Safety, shall be provided to both the Director and

the City Attorney's Office. Licensee and City shall designate local contact personnel for operational and otherwise day-to-day business communications which may be made by telephone or email. Any changes to this contact information shall be provided immediately once known.

10.15 Examination of Records and Audit

Any authorized agent of the City, including the City Auditor or his or her representative, has the right to access, and the right to examine, copy and retain copies, at City's election in paper or electronic form, any pertinent books, documents, papers and records related to Licensee's performance pursuant to this Agreement, and any other transactions related to this Agreement. Licensee shall cooperate with City representatives and City representatives shall be granted access to the foregoing documents and information during reasonable business hours and until the latter of three (3) years after the final payment under the Agreement or expiration of the applicable statute of limitations. When conducting an audit of this Agreement, the City Auditor shall be subject to government auditing standards issued by the United States Government Accountability Office by the Comptroller General of the United States, including with respect to disclosure of information acquired during the course of an audit. No examination of records and audits pursuant to this paragraph shall require Licensee to make disclosures in violation of state or federal privacy laws. Licensee shall at all times comply with D.R.M.C. 20-276.

10.16 Parties' Obligation Regarding Confidential Information.

The Parties agree that issues governing the use and disclosure of Confidential Information, as defined below, provided to or made available to the City by Licensee will be governed by the following provisions:

(a) As used herein, the term "Confidential Information" means all information, of any nature and in any form, regardless of when given, that (i) is disclosed or provided by or through Licensee to the City pursuant to performance of this Agreement; and (ii) has been clearly marked or indicated in writing as being confidential by Licensee; provided, that no part of this Agreement or the exhibits attached to this Agreement shall be deemed to contain Confidential Information. Information falling within this definition shall be treated by the City as confidential proprietary information of Licensee pursuant to the provisions of the Colorado Open Records Act and under any rule of court. Information not so marked or indicated will not be so considered.

(b) Except as expressly provided in this Agreement or as otherwise mandated by the Colorado Open Records Act or other applicable law, the City will not disclose Confidential Information to anyone other than individuals designated by the Director, including the City Representative, without the prior written consent of Licensee. The City will not use, or permit others to use, Confidential Information for any purpose other than actions incidental to the

performance and enforcement of this Agreement between the City and Licensee, including but not limited to auditing of records of Licensee by the City Auditor and/or other representatives of the City. The City will take all reasonable measures to avoid disclosure, dissemination or unauthorized use of Confidential Information, including, at a minimum, those measures that it takes to protect its own Confidential Information of a similar nature.

(c) The Parties recognize that the mere marking of a document as "Confidential" does not render it conclusively confidential under the Colorado Open Records Act. Consequently, in the event that the City is served with an Open Records Request or subpoena from any third party requesting all or part of any Confidential Information as defined herein, the City shall give timely notice to Licensee of such request or subpoena within the time parameters of the Colorado Open Records Act or of any applicable court rule. In that event, Licensee agrees upon receipt of actual notice from the City of such Open Records Request or subpoena to immediately undertake, at its own cost and expense, to defend such Confidential Information from disclosure pursuant to the Colorado Open Records Act or applicable court rule and shall defend, save and hold harmless and indemnify the City and its agents and employees with respect to such issues.

(d) Licensee shall not at any time or in any manner, either directly or indirectly, divulge, disclose or communicate to any person, firm or corporation in any manner whatsoever any information concerning any matters which are not subject to public disclosure, including without limitation the trade secrets of businesses or entities doing business with the City, security measures utilized by the City, and other privileged or confidential information.

10.17 Entire Agreement; Amendment.

The Parties acknowledge and agree that the provisions contained herein, including all exhibits attached hereto, constitute the entire agreement and that all representations made by any officer, agent or employee of the respective Parties unless included herein are null and void and of no effect. No alterations, amendments, changes or modifications, unless expressly reserved to the City herein, shall be valid unless executed by an instrument in writing by all the Parties with the same formality as this Agreement.

10.18 Severability.

If any term or provision of this Agreement is held by a court of law (following all legal rights of appeal or the expiration of time therefore) to be illegal or unenforceable or in conflict with any law of the State of Colorado or the City Charter or City ordinance, the validity of the remaining portions or provisions shall not be affected, and the rights and obligations of the Parties shall be construed and enforced as if the Agreement did not contain the particular term or provision held to be invalid; provided, however, if the invalidated term or provision was a critical or material consideration of either Party in entering this Agreement, the Parties shall work together, in good faith, to come up with an amendment to this Agreement that substantially

satisfies the previously intended consideration while being in compliance with Applicable Law and the judgment of the court. Judicial invalidation of the License Fee, in whole or part, shall result in a failure of consideration and termination of this Agreement.

10.19 Time of Essence.

The Parties agree that in the performance of the terms and requirements of this Agreement by Licensee and the City, time is of the essence.

10.20 Section Headings.

The section headings herein are for convenience in reference only and are not intended to define or limit the scope of any provision of this Agreement.

10.21 Approval and Execution of Agreement.

This Agreement is expressly subject to and shall not be or become effective or binding on the City until City Council approval, if required by Charter, is obtained and the Agreement is fully executed by all required City signatories and all required Licensee signatories.

10.22 Authority

Each Party represents and warrants that it has taken all actions that are necessary or that are required by its applicable law to legally authorize the undersigned signatories to execute this Agreement on behalf of the Party and to bind the Party to its terms. The person(s) executing this Agreement on behalf of each Party warrants that he/she/they have full authorization to execute this Agreement. The City shall have the right, in its discretion, to either temporarily suspend or permanently terminate the Agreement if there is any valid dispute as to the legal authority of Licensee or the person signing this Agreement on behalf of Licensee to enter into this Agreement.

10.23 Electronic Signatures and Electronic Records.

The Parties consent to the use of electronic signatures. The Agreement, and any other documents requiring a signature hereunder, may be signed electronically. The Parties agree not to deny the legal effect or enforceability of the Agreement solely because it is in electronic form or because an electronic record was used in its formation. The Parties agree not to object to the admissibility of the Agreement in the form of an electronic record, or a paper copy of an electronic document, or a paper copy of a document bearing an electronic signature, on the ground that it is an electronic record or electronic signature or that it is not in its original form or is not an original.

SIGNATURE PAGES AND EXHIBITS FOLLOW THIS PAGE

Contract Control Number: FINAN-202368064-00
Contractor Name: T-MOBILE WEST LLC

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals at Denver, Colorado as of:

SEAL

CITY AND COUNTY OF DENVER:

ATTEST:

By: _____

_____

APPROVED AS TO FORM:

Attorney for the City and County of Denver

By: _____

REGISTERED AND COUNTERSIGNED:

By: _____

By: _____

Contract Control Number: FINAN-202368064-00
Contractor Name: T-MOBILE WEST LLC

By: Please see attached signature page

Name: _____
(please print)

Title: _____
(please print)

ATTEST: [if required]

By: _____

Name: _____
(please print)

Title: _____
(please print)

Contract Control Number: FINAN-202368064-00
Contractor Name: T-MOBILE WEST LLC

By: DocuSigned by: Elise Pettyjohn AD5933E796A14D8...

Name: Elise Pettyjohn
(please print)

Title: Sr. Manager, Project Management Technical
(please print)

6/20/2023

ATTEST: [if required]

By: _____

Name: _____
(please print)

Title: _____
(please print)

EXHIBIT A

T-Mobile®

SITE ID: DN03433C

APPROVAL SIGNATURE BLOCK

THE FOLLOWING PARTIES HAVE REVIEWED THESE DOCUMENTS.

ALL DOCUMENTS ARE SUBJECT TO REVIEW BY THE LOCAL ZONING/BUILDING DEPARTMENTS AND MAY IMPOSE CHANGES OR MODIFICATIONS.

		☐ APPROVED ☐ REJECTED	
PROJECT MANAGER (PRINT)	PROJECT MANAGER		DATE
		☐ APPROVED ☐ REJECTED	
RF ENGINEER (PRINT)	RF ENGINEER		DATE
		☐ APPROVED ☐ REJECTED	
SITE ACQUISITION (PRINT)	SITE ACQUISITION		DATE
		☒ APPROVED ☐ REJECTED	
Tim Leuch	Tim Leuch		10/27/20
CONSTRUCTION MANAGER (PRINT)	CONSTRUCTION MANAGER		DATE
		☐ APPROVED ☐ REJECTED	
OPERATIONS (PRINT)	OPERATIONS		DATE

T-Mobile®

SITE ID: DN03433C

APPROVAL SIGNATURE BLOCK

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		☐ APPROVED ☐ REJECTED	
PROJECT MANAGER (PRINT)	PROJECT MANAGER		DATE
		☐ APPROVED ☐ REJECTED	
RF ENGINEER (PRINT)	RF ENGINEER		DATE
		☐ APPROVED ☐ REJECTED	
SITE ACQUISITION (PRINT)	SITE ACQUISITION		DATE
Tim Leuch	*Tim Leuch* See T3	☐ APPROVED ☒ REJECTED	10/27/20
CONSTRUCTION MANAGER (PRINT)	CONSTRUCTION MANAGER		DATE
		☐ APPROVED ☐ REJECTED	
OPERATIONS (PRINT)	OPERATIONS		DATE

T-Mobile®

SITE ID: DN03433C

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		☐ APPROVED ☐ REJECTED	
PROJECT MANAGER (PRINT)	PROJECT MANAGER		DATE
		☐ APPROVED ☐ REJECTED	
RF ENGINEER (PRINT)	RF ENGINEER		DATE
		☐ APPROVED ☐ REJECTED	
SITE ACQUISITION (PRINT)	SITE ACQUISITION		DATE
		☐ APPROVED ☒ REJECTED	
Tim Leuch	Tim Leuch See T3(2)		10/22/20
CONSTRUCTION MANAGER (PRINT)	CONSTRUCTION MANAGER		DATE
		☐ APPROVED ☐ REJECTED	
OPERATIONS (PRINT)	OPERATIONS		DATE

SITE ID: DN03433C

APPROVAL SIGNATURE BLOCK

THE FOLLOWING PARTIES HAVE REVIEWED THESE DOCUMENTS.

ALL DOCUMENTS ARE SUBJECT TO REVIEW BY THE LOCAL ZONING/BUILDING DEPARTMENTS AND MAY IMPOSE CHANGES OR MODIFICATIONS.

		☐ APPROVED ☐ REJECTED	
PROJECT MANAGER (PRINT)	PROJECT MANAGER		DATE
Ravi Namdev	Ravi Namdev	☒ APPROVED ☐ REJECTED	09/29/2020
RF ENGINEER (PRINT)	RF ENGINEER		DATE
		☐ APPROVED ☐ REJECTED	
SITE ACQUISITION (PRINT)	SITE ACQUISITION		DATE
Tim Leuch	Tim Leuch See T3(4), T4	☐ APPROVED ☒ REJECTED	9/30/20
CONSTRUCTION MANAGER (PRINT)	CONSTRUCTION MANAGER		DATE
Steve Ramsey	Steve Ramsey	☑ APPROVED ☐ REJECTED	10/2/20
OPERATIONS (PRINT)	OPERATIONS		DATE

T-Mobile

SITE ID: DENVER_FIRE_28
SITE ID NUMBER: DN03433C
SITE ADDRESS: 4306 S. WOLFF STREET
DENVER, COLORADO, 80236

SITE COORDINATES: 39.638125, -105.048767
SITE CONFIGURATION: ANCHOR PHASE 3 L600 5G POPS

SHEET INDEX

SITE INFORMATION

SITE INFORMATION

SITE NAME:	DENVER_FIRE_28
SITE ID:	DN03433C
SITE ADDRESS:	4306 S. WOLFF STREET DENVER, COLORADO, 80236
COUNTY:	CITY AND COUNTY OF DENVER
JURISDICTION:	CITY AND COUNTY OF DENVER
ASSESSOR'S PARCEL #	08072-10-001-000
LATITUDE:	39.638125
LONGITUDE:	-105.048767
STRUCTURE TYPE:	SELF SUPPORT TOWER
STRUCTURE HEIGHT:	130'-0"±
POWER PROVIDER:	XCEL ENERGY

PROJECT DESCRIPTION

MODIFICATION OF AN EXISTING "NON-INHABITABLE" T-MOBILE TELECOMMUNICATIONS SITE CONSISTING OF:

REMOVING
- (12) EXISTING ANTENNAS
- (15) RRU'S
- (6) EXISTING SYSTEM MODULES
- (2) EXISTING EQUIPMENT CABINETS

INSTALLING
- (9) NEW ANTENNAS
- (3) NEW RRU'S
- (2) NEW EQUIPMENT CABINETS
- (1) NEW SYSTEM MODULES

ON AN EXISTING SELF SUPPORT TOWER WITHIN THE EXISTING LEASE AREA.

INSTALLATION IS UNMANNED AND NOT FOR HUMAN HABITATION PUBLIC ACCESS IS RESTRICTED A.D.A. ACCESSIBILITY NOT REQUIRED.

PROJECT TEAM

PROPERTY OWNER:
RMTN PROPERTIES LLC.
385 BROADWAY ST.
BOULDER, CO 80305

APPLICANT
T-MOBILE
18400 E. 22ND AVE.
AURORA, CO 80216

SITE ACQUISITION CONSULTANT
INSITE INC.
1S660 MIDWEST RD. SUITE 140
OAKBROOK TERRACE, IL 60181
CHARLIE AUGELLO
PH: 720.236.9199
E-MAIL: AUGELLO@INSITE-INC.COM

A&E PROJECT MANAGER
INSITE INC.
1S660 MIDWEST RD. SUITE 140
OAKBROOK TERRACE, IL 60181
GARY WATTS
PH: 303.815.8296
E-MAIL: WATTS@INSITE-INC.COM

ENGINEER ON RECORD
TELEMTN ENGINEERING
104 BROADWAY, SUITE 600
DENVER, CO 80203
KHRIS SCOTT, PE
PH: 303.596.6804
EMAIL: KSCOTT@TELEMTN.COM

DRIVING DIRECTIONS

FROM T-MOBILE OFFICE 18400 E. 22ND AVE:

HEAD EAST ON E. 22ND. AVE. TOWARDS TOWER RD. FOR 197 FT. TURN LEFT AT THE FIRST CROSS ST. ONTO TOWER RD. IN .8 MI. UE THE EFT TWO LANES TO TURN LEFT TO MERGE ONTO I-70 W. IN .3 MI. MERGE ONTO I-70 W. IN 2 MI. USE THE RIGHT TWO LANES TO TAKE EXIT 282 TO MERGE ONTO I-225 S. TOWARDS COLORADO SPRINGS/ AURORA AND FOLLOW FOR 12.7 MI. USE THE MIDDLE LANE TO TAKE EXIT 1A FOR I-25 S. TOWARDS COLORADO SPRINGS, IN .4 MI. KEEP RIGHT TO CONTINUE ON EXIT 199, FOLLOW SIGNS FOR CO-88 W. AND MERGE ONTO CO-88W/E BELLEVIEW AVE. IN .5 MI. MERGE ONTO CO-88 W/E BELLEVIEW AVE. AND FOLLOW FOR 6.5 MI. TURN RIGHT ONTO CO-88 N/S FEDERAL BLVD. IN .5 MI. TURN LEFT ONTO W. UNION AVE. IN .2 MI. TURN RIGHT ONTO S. IRVING ST./ W. UNION AVE. AND FOLLOW FOR .4 MI. TURN LEFT ONTO W. QUINCY AVE. AND FOLLOW FOR 1 MI. TURN LEFT ONTO S. WOLFF ST. AND YOUR DESTINATION WILL BE ON THE IN 135 FT.

ESTIMATED DISTANCE: 25.4 MILES
ESTIMATED TIME: 40 MINUTES

APPLICABLE CODES

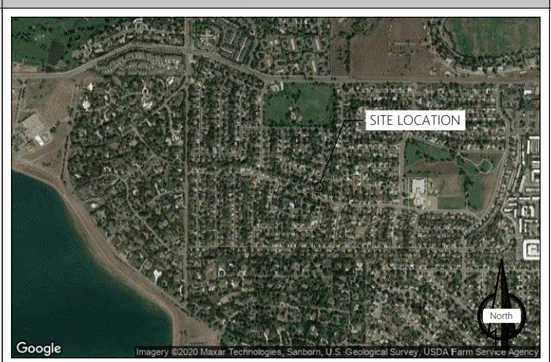
ALL CONSTRUCTION, ALTERATION, OR DEMOLITION SHALL BE PERFORMED AND MATERIALS INSTALLED IN ACCORDANCE WITH THE CURRENT EDITIONS OF THE FOLLOWING CODES AS ADOPTED BY THE LOCAL GOVERNING AUTHORITIES TO INCLUDE COMPLIANCE WITH THE LATEST FEDERAL STATE, AND LOCAL AMENDMENTS, REGULATIONS AND ORDINANCES.

GOVERNING CODES AS APPLICABLE:
2018 IBC, 2018 IFC, 2018 IEBC, 2018 IRC, 2018 IMC, 2018 IPC, 2018 IFGC, 2019 DBC, 2019 DFC, 2020 NEC

811 Know what's below. Call before you dig.

MANDATORY: CONTRACTOR TO CALL TO VERIFY UTILITIES, AT LEAST TWO WORKING DAYS PRIOR TO DIGGING.
BEFORE YOU DIG, CALL: 1-800-922-1987
HTTP://CALL811.COM/MAP-PAGE/COLORADO

VICINITY MAP



SITE PHOTO

REFERENCE DOCUMENTS

DOCUMENT NAME	DATE
DN03433C_ANCHOR_5_DRAFT_2020-08-06	8/6/20
STRUCTURAL ANALYSIS PASSING REPORT; BY TELEMNT	10/20/2020
MOUNT ANALYSIS PASSING WITH MODS REPORT; BY TELEMNT	10/16/20

PRESENTED BY:

T-Mobile

Insite inc.
Wireless Consulting Services
1S660 MIDWEST RD. SUITE 140 OAKBROOK TERRACE, IL 60181

TeleMtn ENGINEERING

SITE NAME:
DENVER_FIRE_28
SITE ADDRESS:
4306 S. WOLFF STREET
DENVER, COLORADO, 80236
SITE COUNTY:
CITY AND COUNTY OF DENVER

SITE ID:
DN03433C

REVISIONS

Rev:	Date:	Description:	By:
0	09.22.20	PRELIM	DE
1	10.21.20	100% CONSTRUCTION	DE
2	10.23.20	100% CONSTRUCTION	DE
3	10.27.20	100% CONSTRUCTION	DE
4			
5			
6			
7			

STAMPING SIGNATURE:

THIS WORK WAS PREPARED BY MYSELF OR UNDER MY SUPERVISION. CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION. ALL SCALES ARE SET FOR 11"x17".

SHEET TITLE:
COVER SHEET

SHEET NUMBER:
T1.0

DRAWN BY:	CHK BY:	APV BY:
DE	GD	GD

D:\Files\OneDrive\Insite, Inc\TMO DENVER - Documents\DN03433C\Anchor\A&E\CAD\DN03433C_A and E_CDs_ANCHOR.dwg PLOT DATE: 10/23/2020 BY:Dewayne Edwards

TELEMTN ENGINEERING, HAS NOT PERFORMED A STRUCTURAL ANALYSIS FOR THIS PROJECT. PRIOR TO THE INSTALLATION OF THE PROPOSED EQUIPMENT OR MODIFICATION OF THE EXISTING STRUCTURE, A STRUCTURAL ANALYSIS/DESIGN WILL BE PERFORMED BY THE OWNER'S AGENT (OTHERS, A LICENSED ENGINEER) TO CERTIFY THAT THE EXISTING/ PROPOSED COMMUNICATION STRUCTURE AND COMPONENTS ARE STRUCTURALLY ADEQUATE TO SUPPORT ALL EXISTING AND PROPOSED ANTENNAS, COAXIAL CABLES, AND OTHER APPURTENANCES. THE OWNER'S AGENT SHALL FURNISH A CERTIFICATION LETTER/ REPORT SEALED BY A REGISTERED PROFESSIONAL ENGINEER STATING THAT THIS STRUCTURAL ANALYSIS WAS PREPARED IN ACCORDANCE WITH ALL APPLICABLE CODES AND STANDARDS.THESE DRAWINGS ARE NOT AND SHOULD NOT BE CONSTRUED AS STRUCTURAL QUALIFICATION OF THE MAIN STRUCTURE OR COMPONENTS.

1 OVERALL SITE PLAN

0' 4' 8' 16'

SCALE: 1/128" = 1'-0" (11 X 17) - SCALE: 1/56" = 1'-0" (22 X 34)

PRESENTED BY:

T-Mobile

Insite inc.
Wireless Consulting Services
15660 MIDWEST RD. SUITE 140 OAKBROOK TERRACE, IL 60181

TeleMtn ENGINEERING

SITE NAME:

DENVER_FIRE_28

SITE ADDRESS:

4306 S. WOLFF STREET
DENVER, COLORADO, 80236

SITE COUNTY:

CITY AND COUNTY OF DENVER

SITE ID:

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STAMPING SIGNATURE:

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SHEET TITLE:

OVERALL SITE PLAN

SHEET NUMBER:

T2.0

DRAWN BY:	CHK BY:	APV BY:
DE	GD	GD

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1 T-MOBILE LEASE AREA PHOTO

2 ENLARGED SITE PLAN

0' 16' 32' 64'

SCALE: 1/32" = 1'-0" (11 X 17) - SCALE: 1/16" = 1'-0" (22 X 34)

PRESENTED BY:

T-Mobile

Insite inc.
Wireless Consulting Services
15660 MIDWEST RD. SUITE 140 OAKBROOK TERRACE, IL 60181

TeleMtn ENGINEERING

SITE NAME:

DENVER_FIRE_28

SITE ADDRESS:

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SHEET TITLE:

ENLARGED SITE PLAN

SHEET NUMBER:

T2.1

DRAWN BY:	CHK BY:	APV BY:
DE	GD	GD

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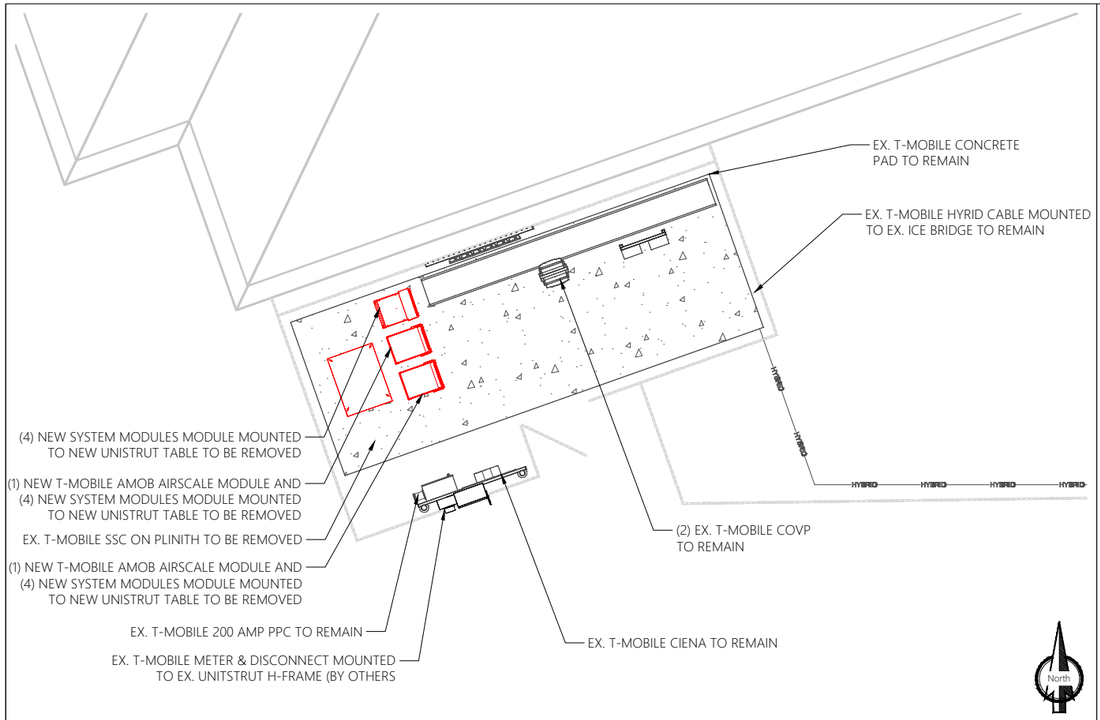
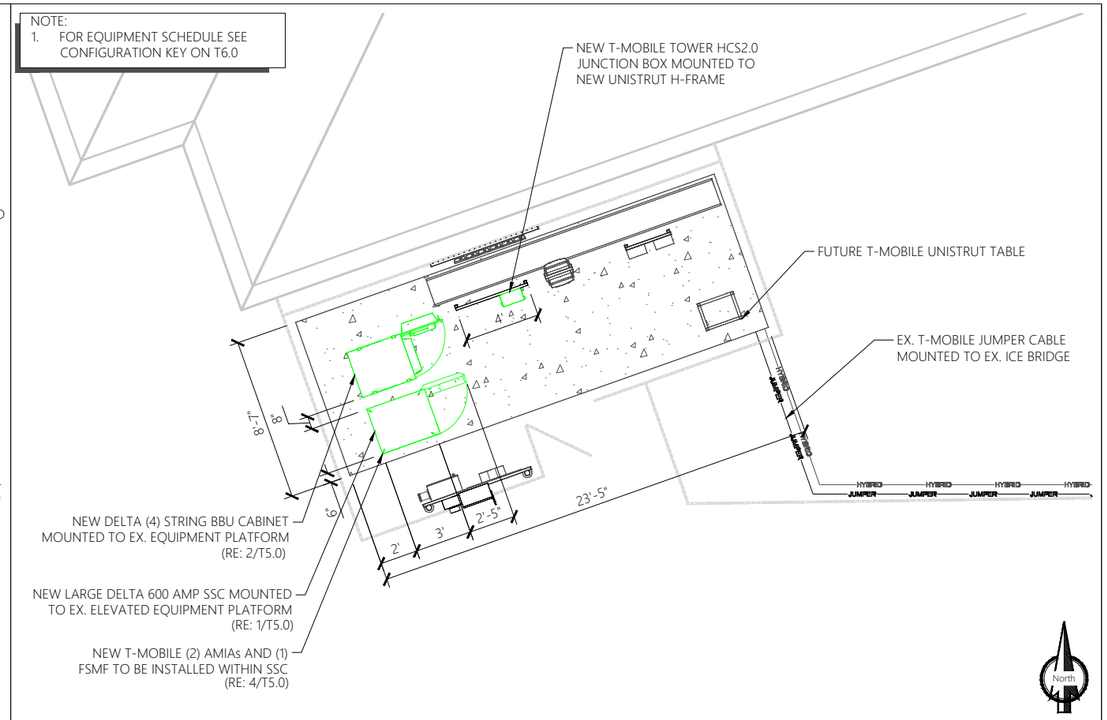


1 EX. EQUIPMENT LAYOUT

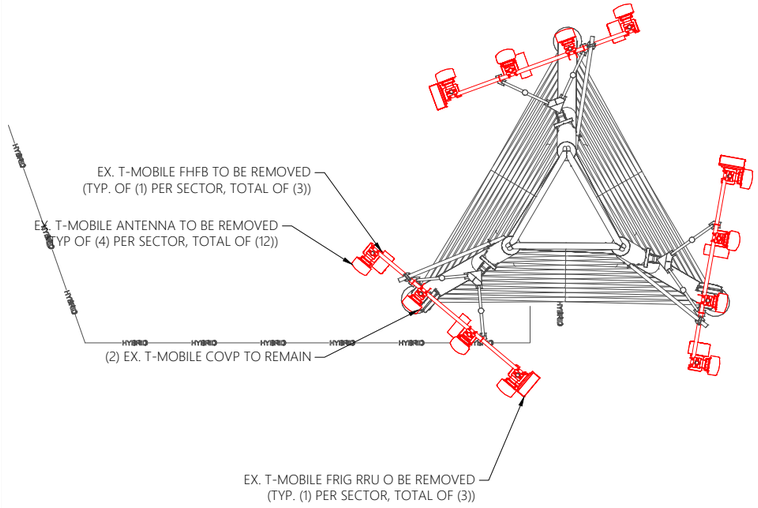
0' 2' 4' 8'
SCALE: 1/4" = 1'-0" (11 X 17) - SCALE: 1/2" = 1'-0" (22 X 34)

NOTE:
1. FOR EQUIPMENT SCHEDULE SEE CONFIGURATION KEY ON T6.0



2 NEW EQUIPMENT LAYOUT

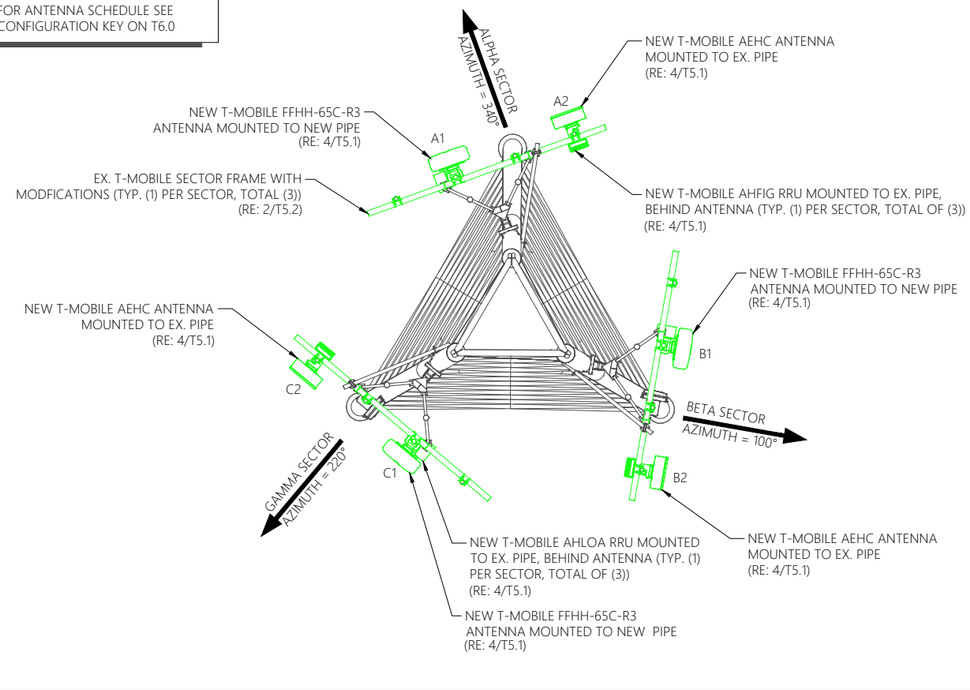
0' 2' 4' 8'
SCALE: 1/4" = 1'-0" (11 X 17) - SCALE: 1/2" = 1'-0" (22 X 34)



3 EX. ANTENNA LAYOUT

0' 4' 8' 16'
SCALE: 1/8" = 1'-0" (11 X 17) - SCALE: 1/4" = 1'-0" (22 X 34)

NOTE:
1. FOR ANTENNA SCHEDULE SEE CONFIGURATION KEY ON T6.0



4 NEW ANTENNA LAYOUT

0' 4' 8' 16'
SCALE: 1/8" = 1'-0" (11 X 17) - SCALE: 1/4" = 1'-0" (22 X 34)

PRESENTED BY:

T-Mobile

Insite inc.
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SHEET TITLE:

NEW & EX. EQUIPMENT & ANTENNA LAYOUTS

SHEET NUMBER:

T3.0

DRAWN BY:	CHK BY:	APV BY:
DE	GD	GD

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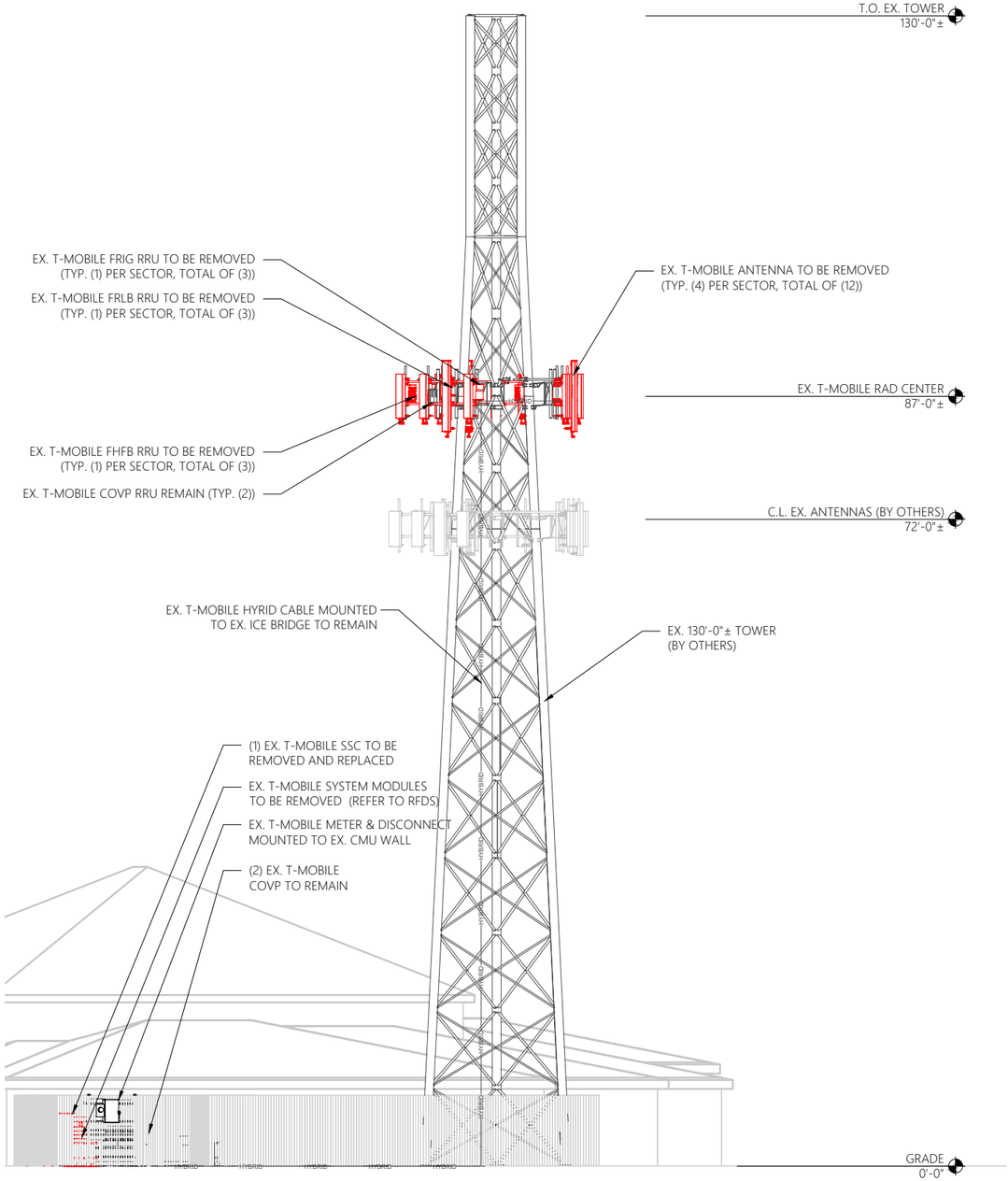
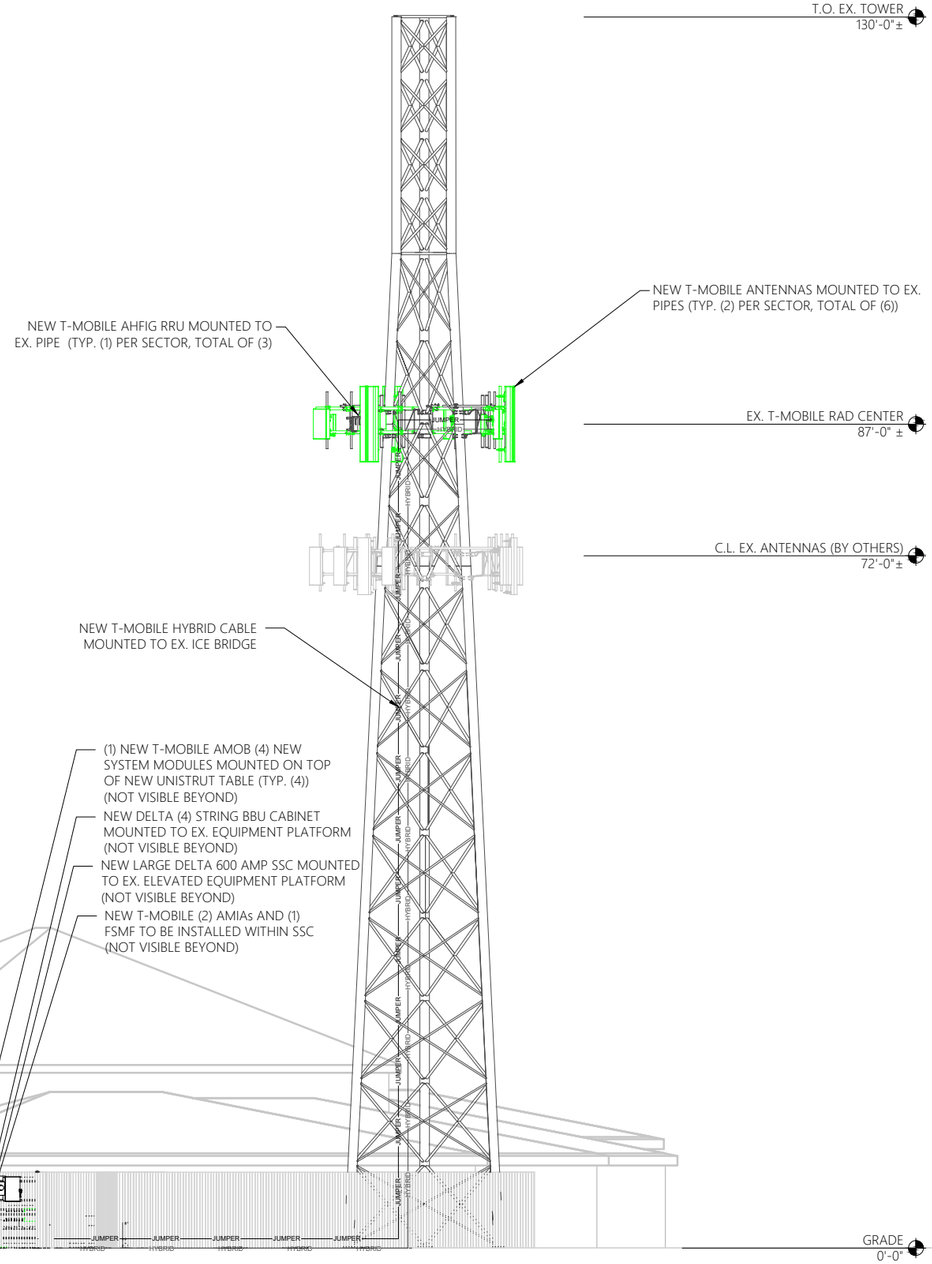


1 NEW NORTH ELEVATION

0' 8' 16' 32'

SCALE: 1/16" = 1'-0" (11 X 17) - SCALE: 1/8" = 1'-0" (22 X 34)



2 NEW NORTH ELEVATION

0' 8' 16' 32'

SCALE: 1/16" = 1'-0" (11 X 17) - SCALE: 1/8" = 1'-0" (22 X 34)

PRESENTED BY:

T-Mobile

Insite inc.
Wireless Consulting Services
15660 MIDWEST RD. SUITE 140 OAKBROOK TERRACE, IL 60181

TeleMtn ENGINEERING

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SITE COUNTY:

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EX. & NEW
ELEVATIONS

SHEET NUMBER:

T4.0

DRAWN BY:	CHK BY:	APV BY:
DE	GD	GD

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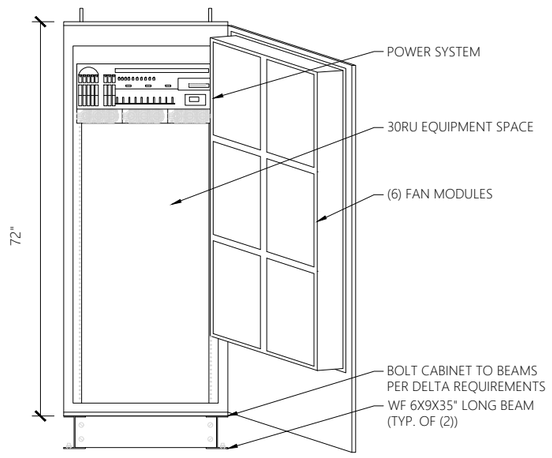
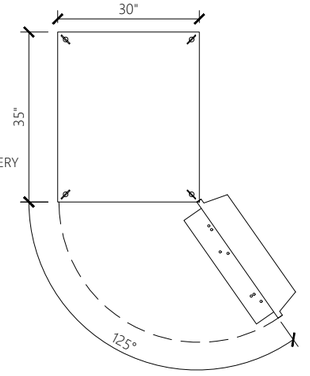
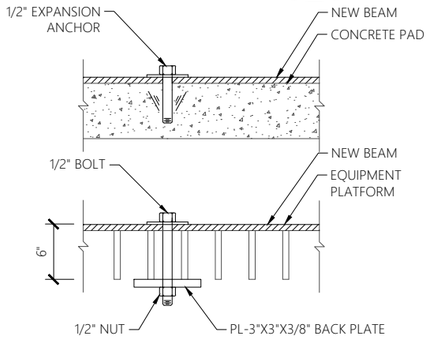
DELTA LARGE OUTDOOR ENCLOSURE: ESOA600-HCU01

INTERNAL RACK DIMENSION	TOTAL EQUIPMENT SPACE, 30RU: HORIZONTAL RACK: 19" X 27RU VERTICAL RACK: 19" X 3RU POWER SYSTEM SPACE: 23" X 12RU
DC OUTPUT CURRENT:	600A
DC OUTPUT VOLTAGE:	48 VDC
CLEARANCES:	36" ON ALL SIDES
ADDITIONAL SPECS:	3 RU FOR DC DISTRIBUTION, RECTIFIER = DPR3000, 2Px3 POSITIONS FOR BATTERY BREAKER,, 10 RU FOR EQUIPMENT 19" OR 23", (3) STRINGS FOR BATTERIES
NOKIA FMFA PLINTH:	2.7" H x 30" W x 36" D - 20.5 lbs
WEIGHT:	551 lbs (WITHOUT EQUIPEMENT OR BATTERIES)



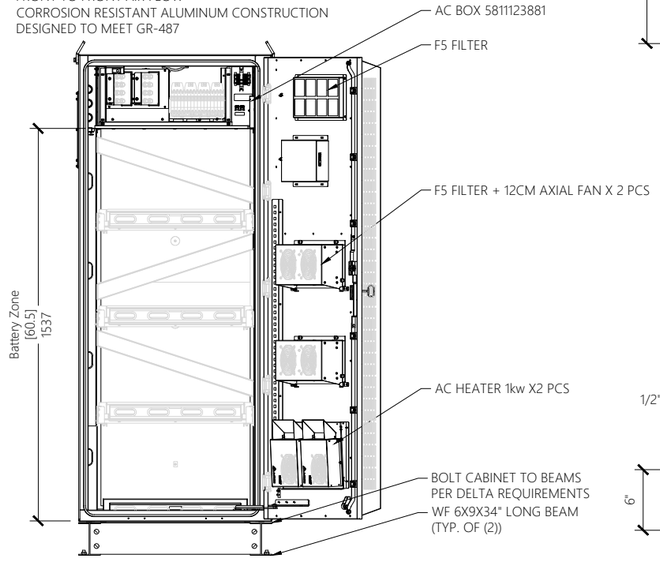


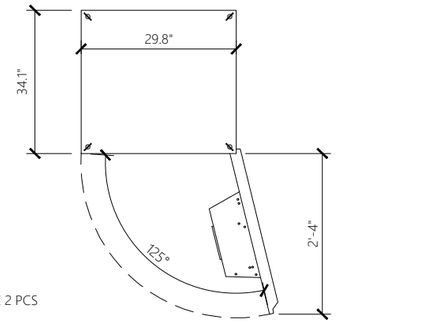


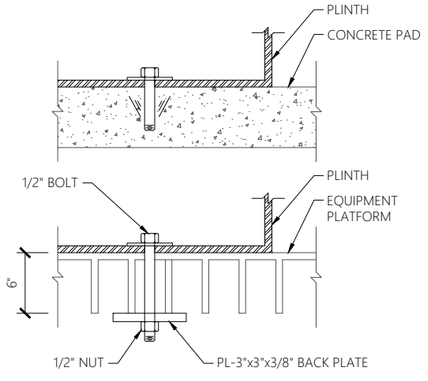
1 NEW DELTA ESOA600 HCU01 DETAIL — SCALE: NTS
SCALE: NTS

DELTA LARGE BATTERY 3 CABINET ENCLOSURE: ESOF015-ECV04

COMPACT DESIGN FOR BATTERY STRINGS:
- DIRECT AIR COOLING SOLUTION
- SUPPORTS FOUR STRINGS OF -48V VRLA BATTERIES UP TO 210AH
- 600A RATED BUS BAR WITH 200A BREAKER PER STRING
- BULK INPUT/OUTPUT WITH ABILITY TO DAISY CHAIN CABINETS
- FRONT TO FRONT AIR FLOW
- CORROSION RESISTANT ALUMINUM CONSTRUCTION
- DESIGNED TO MEET GR-487

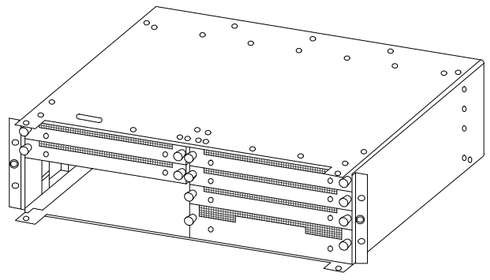


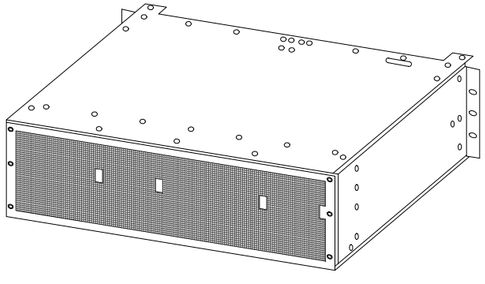




2 NEW DELTA ESOF015-ECV04 DETAIL — SCALE: NTS
SCALE: NTS

AMIA IS PRIMARY FOR INDOOR SITES (ENVIRONMENTALLY CONTROLLED) OR SITE SUPPORT CABINETS

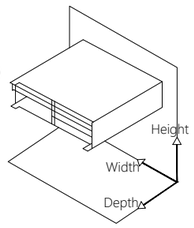


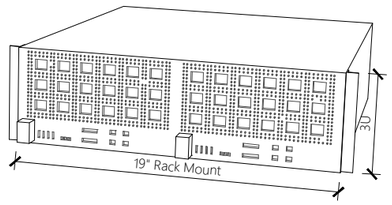


- ONE NOKIA AIRSCALE SUBRACK (AMIA), INCLUDING BACKPLANE FOR HIGH BANDWIDTH CONNECTIVITY BETWEEN PROCESSING PLUG-IN UNITS
- ONE OR TWO NOKIA AIRSCALE COMMON (ASIA) PLUG-IN UNITS FOR TRANSPORT INTERFACING AND FOR CENTRALIZED PROCESSING
- UP TO SIX NOKIA AIRSCALE CAPACITY (ABIA) PLUG-IN UNITS FOR BASEBAND PROCESSING AND FOR OPTICAL INTERFACES WITH RADIO UNITS

PROPERTY	VALUE
HEIGHT	128.5 mm (5.1 in)
DEPTH	400 mm (15.7 in)
WIDTH	447 mm (17.6 in)
WEIGHT	EMPTY: 5.1 kg (11.2 lb) WITH DUMMY PANELS: 6.8 kg (15 LB) WITH ALL UNITS: 23.9 kg (52.7 lb)

DIMENSIONS ORIENTATION





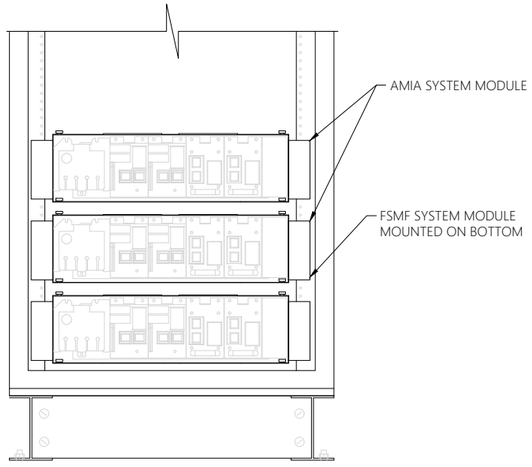
3 NEW NOKIA AMIA AIRSCALE DETAIL — SCALE: NTS
SCALE: NTS

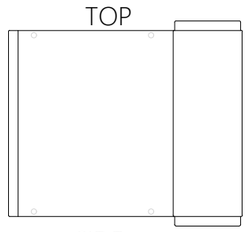
SYSTEM/RADIO MODULES MOUNTED IN SSC

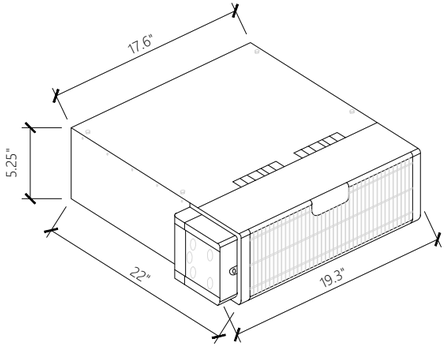
FSMF

CLEARANCES:	FRONT: 23.6" BACK: 8" TOP: 1.2" SIDES: 4"
WEIGHT:	44 lbs

ADDITIONAL NOTE: MODULE CAN BE INSTALLED VERTICALLY & HORIZONTALLY







4 SYSTEM RADIO MODULES MOUNTED IN SSC — SCALE: NTS
SCALE: NTS

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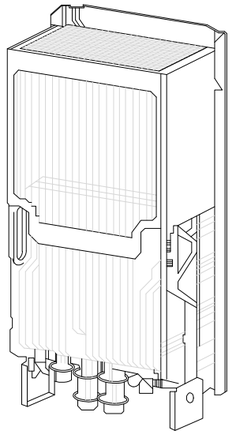
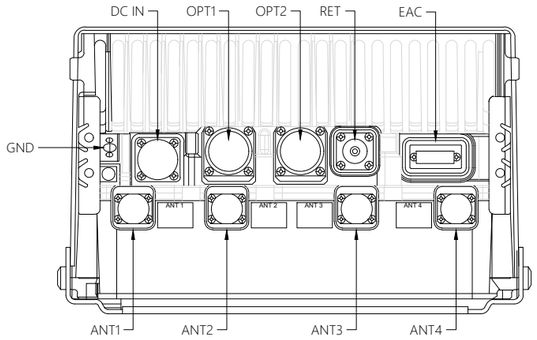


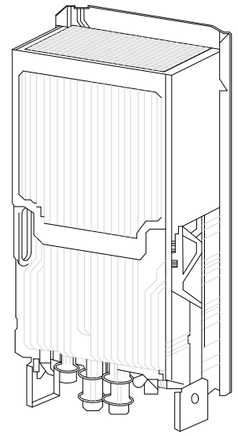


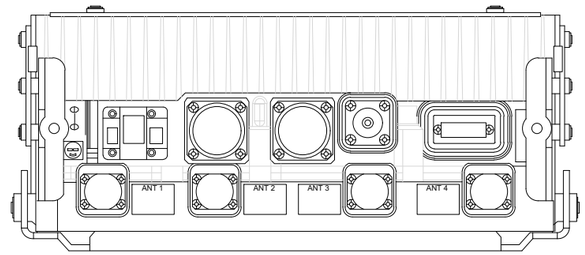
DIMENSION	VALUE
HEIGHT	22 INCHES (W/ BRACKET 26.6 INCHES)
WIDTH	12.1 INCHES (W/ BRACKET 12.9 INCHES)
DEPTH	7.4 INCHES (W/ BRACKET 8.1 INCHES)
WEIGHT	83.8 LBS

CHARACTERSTIC	AHLOA CAPABILITY
NOMINAL SUPPLY VOLTAGE	-48.0 VDC
NOMINAL INPUT VOLT RANGE	-40.5 TO -57.0 VDC
EXTENDED INPUT VOLT RAGE	-36.0 TO -40.5 VDC -57.0 TO -60.0 VDC
VOLTAGE	14.5 V
POWER SUPPLY	T.B.D.

1 NEW NOKIA AHLOA RRU DETAIL

SCALE: NTS
SCALE: NTS





DIMENSION	VALUE
HEIGHT	27.3 INCHES
WIDTH	12 INCHES
DEPTH	5.2 INCHES
WEIGHT	70.5 LBS.

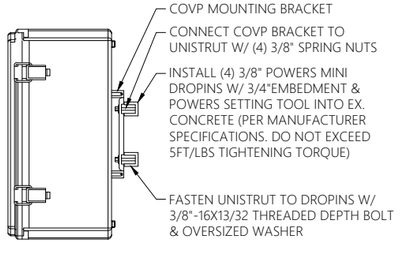
PRODUCT	AHFIG (AIRSCALE 4T4R DUAL MID-BAND RADIO)
TYPE	4T4R RRH (1 PER SECTOR), 2X9.8 CPRI FIBER
MAX OUTPUT POWER	4X40W AWS + 3X80W PCS (MAX 4 CARRIERS PER BAND)
SPECTRUM BAND	B25 + B66 (SRAN CAPABLE)
IBW (DL/UL)	B66: 80MHZ B25: 65 MHZ
FORM FACTOR (HXWXD) WEIGHT (LBS)	695 MM (27.3") X 308MM (12") X 131MM (5.2") 70.5 LBS (32 KG)

2 NEW NOKIA AHFIG RRU DETAIL

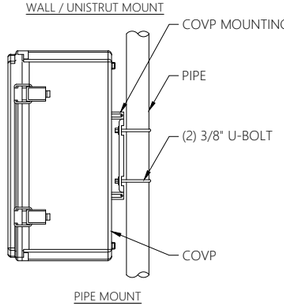
SCALE: NTS
SCALE: NTS

RAYCAP: BOTTOM COVP/FIBER JUNCTION BOX (RTMDC-5634-PF-48)

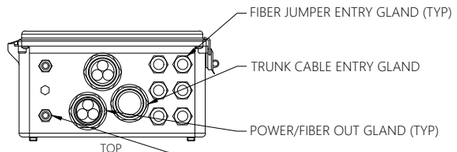
NOMINAL OPERATING VOLTAGE:	48 VDC
NOMINAL DISCHARGE CURRENT:	20 kA 8/20ms
MAXIMUM SURGE CURRENT:	60 kA 8/20ms
MAXIMUM CONTINUOUS OPERATING VOLTAGE:	75 VDC
VOLTAGE PROTECTION RATING:	400 V
TOTAL WEIGHT:	21.85 lbs



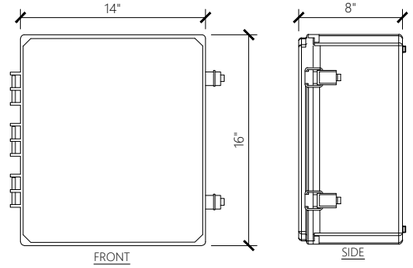
WALL / UNISTRUT MOUNT



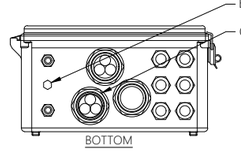
PIPE MOUNT



TOP



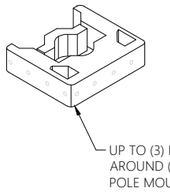
FRONT SIDE



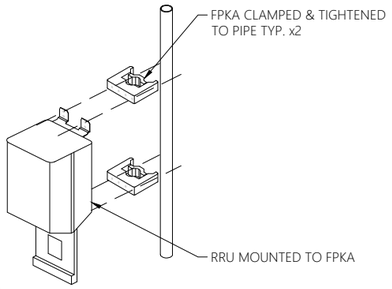
BOTTOM

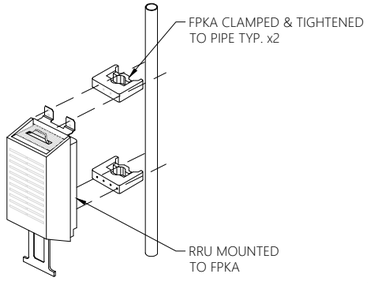
3 RAYCAP RTMDC 5634 PF 48 DETAIL

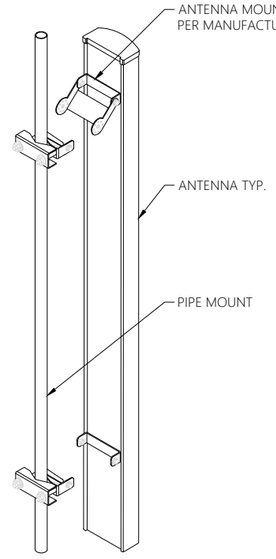
SCALE: NTS
SCALE: NTS



NOKIA FPKA BRACKET







NOTE:
REFER TO S-SHEETS FOR MOUNT DETAILS (IF APPLICABLE)

ANTENNA TO PIPE MOUNTED

4 RRU AND ANTENNA MOUNTING DETAIL

SCALE: NTS
SCALE: NTS

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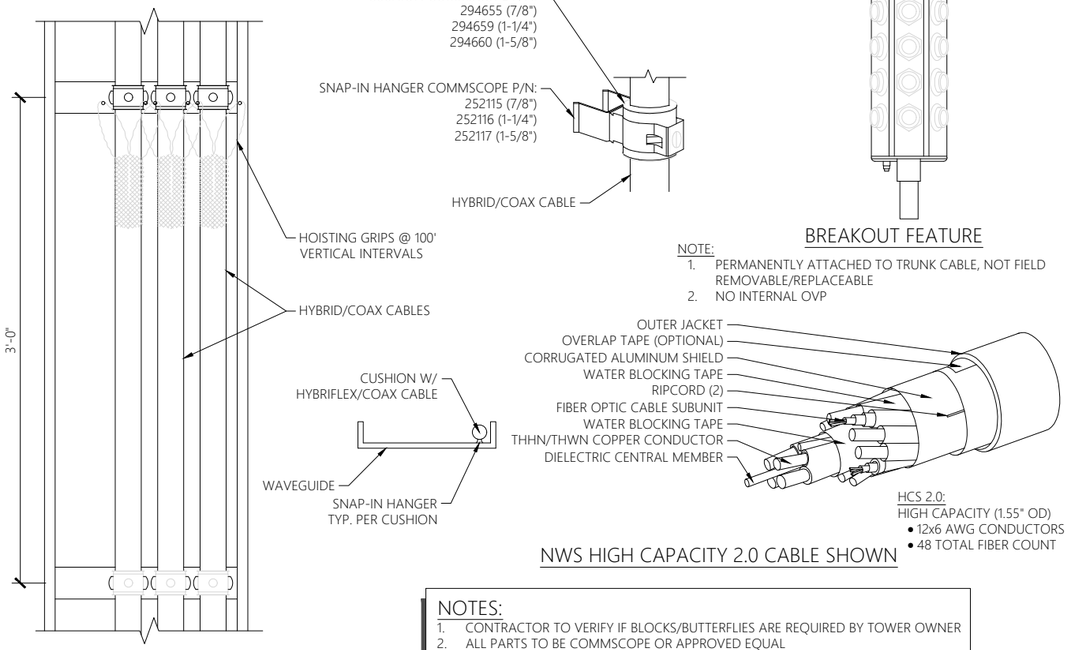
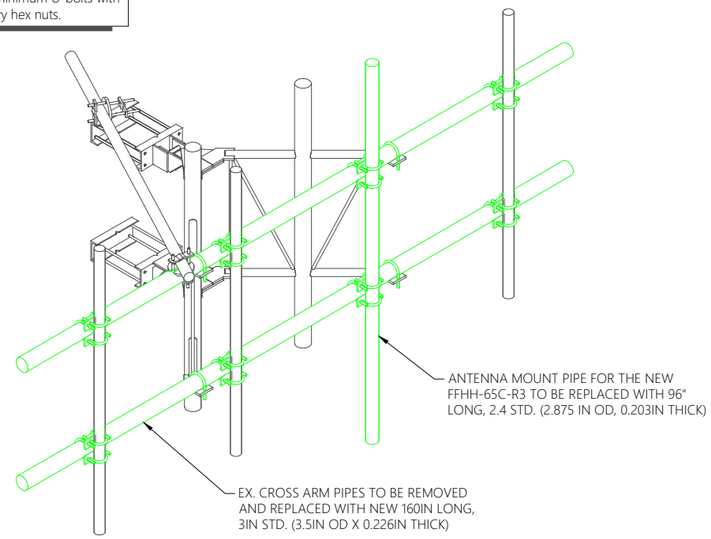


NOTES:
1. CONTRACTOR TO VERIFY IF BLOCKS/BUTTERFLIES ARE REQUIRED BY TOWER OWNER
2. ALL PARTS TO BE COMMSCOPE OR APPROVED EQUAL

1 HCS 2.0 HYBRID CABLE & MOUNTING DETAIL

SCALE: NTS
SCALE: NTS

NOTE:
The existing antenna pipes and cross over plate may be reused when adding the proposed antennas to the existing mount. However, all U-bolts that are loosened or removed may NOT be reused and shall be replaced with new 36ksi minimum U-bolts with matching flat washers, lock washers, and heavy hex nuts.



2 ANTENNA MOUNT MODIFICATIONS

SCALE: NTS
SCALE: NTS

3 NOT USED

SCALE: NTS
SCALE: NTS

4 NOT USED

SCALE: NTS
SCALE: NTS

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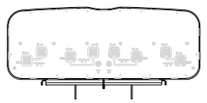

8-port sector antenna, 4x 617-806 and 4x 1695–2360 MHz, 65° HPBW,
3x RET, 600 MHz-Ready Antenna Technology

Electrical Specifications

Frequency Band, MHz	617-698	698–806	1695–1880	1850–1990	1920–2200	2300–2360
Gain, dBi	15.4	15.8	17.9	18.4	18.8	19.6
Beamwidth, Horizontal, degrees	66	61	64	65	64	56
Beamwidth, Vertical, degrees	10.2	9.2	5.7	5.3	4.9	4.4
Beam Tilt, degrees	2–13	2–13	2–12	2–12	2–12	2–12
USLS (First Lobe), dB	18	17	19	19	19	22
Front-to-Back Ratio at 180°, dB	33	31	38	41	40	38
Isolation, dB	28	28	28	28	28	28
Isolation, Intersystem, dB	28	28	28	28	28	28
VSWR | Return Loss, dB	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0	1.5 | 14.0
PIM, 3rd Order, 2 x 20 W, dBc	-150	-153	-153	-153	-153	-153
Input Power per Port at 50°C, maximum, watts	250	250	250	250	250	200
Polarization	±45°	±45°	±45°	±45°	±45°	±45°
Impedance	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm

Electrical Specifications, BASTA*

Frequency Band, MHz	617-698	698–806	1695–1880	1850–1990	1920–2200	2300–2360
Gain by all Beam Tilts, average, dBi	15.2	15.5	17.5	18.0	18.4	19.2
Gain by all Beam Tilts Tolerance, dB	±0.4	±0.4	±0.4	±0.5	±0.5	±0.6
Gain by Beam Tilt, average, dBi	2 ° | 15.0 8 ° | 15.3 13 ° | 15.1	2 ° | 15.3 8 ° | 15.6 13 ° | 15.3	2 ° | 17.3 7 ° | 17.6 12 ° | 17.5	2 ° | 17.8 7 ° | 18.1 12 ° | 17.9	2 ° | 18.1 7 ° | 18.5 12 ° | 18.4	2 ° | 18.7 7 ° | 19.3 12 ° | 19.2
Beamwidth, Horizontal Tolerance, degrees	±3	±5.1	±5.9	±5.6	±5.9	±7.2
Beamwidth, Vertical Tolerance, degrees	±0.6	±0.6	±0.4	±0.3	±0.4	±0.2
USLS, beampeak to 20° above beampeak, dB	17	14	15	15	16	17
Front-to-Back Total Power at 180° ± 30°, dB	23	21	30	31	31	30
CPR at Boresight, dB	21	20	18	18	19	19
CPR at Sector, dB	7	10	8	7	8	7

* CommScope® supports NGMN recommendations on Base Station Antenna Standards (BASTA). To learn more about the benefits of BASTA, download the whitepaper Time to Raise the Bar on BSAs.

Array Layout

COMMSCOPE

FFHH-65C-R3

Antenna Type	Sector
Band	Multiband
Performance Note	Outdoor usage
Total Input Power, maximum	900 W @ 50 °C

Mechanical Specifications

RF Connector Quantity, total	8
RF Connector Quantity, low band	4
RF Connector Quantity, high band	4
RF Connector Interface	4.3-10 Female
Color	Light gray
Grounding Type	RF connector inner conductor and body grounded to reflector and mounting bracket
Radiator Material	Aluminum | Low loss circuit board
Radome Material	Fiberglass, UV resistant
Reflector Material	Aluminum
RF Connector Location	Bottom
Wind Loading, frontal	1055.0 N @ 150 km/h 237.2 lbf @ 150 km/h
Wind Loading, lateral	355.0 N @ 150 km/h 79.8 lbf @ 150 km/h
Wind Loading, maximum	1433.0 N @ 150 km/h 322.2 lbf @ 150 km/h
Wind Speed, maximum	241 km/h | 150 mph

Dimensions

Length	2437.0 mm | 95.9 in
Width	640.0 mm | 25.2 in
Depth	235.0 mm | 9.3 in
Net Weight, without mounting kit	57.9 kg | 127.6 lb

Remote Electrical Tilt (RET) Information

Input Voltage	10–30 Vdc
Internal RET	High band (2) | Low band (1)
Power Consumption, idle state, maximum	1 W
Power Consumption, normal conditions, maximum 10 W	
Protocol	3GPP/AISG 2.0 (Single RET)
RET Interface	8-pin DIN Female | 8-pin DIN Male
RET Interface, quantity	1 female | 1 male

COMMSCOPE

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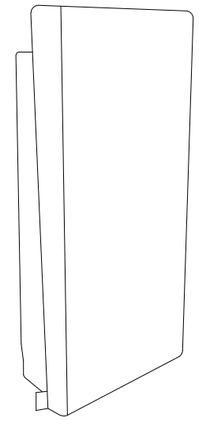
AEHC AirScale MAA 64T64R 192AE B41 320W

Preliminary technical data

Specificatin	Details
Standard	3GPP NR and LTE compliant, TDD, FCC compliant
Band/Frequency range	2496-2690 Mhz 3 GPP 841
Max. supported modulation	256 QAM
Number of TX/RX paths	64T/64R
MIMO streams	16
Instantaneous bandwidth IBW	194 Mhz
Occupied bandwidth OBW	190 Mhz
Total average EIRP	79 dBm
Max. output power per TRX	5 W / TRX (320 W total)
Dimensions	970 mm (H) x 540 mm (W) x 205 mm (D)
Volume	941
Weight	47 kg (without mounting brackets)
Supply voltage / Connector type	DC -36 V - 60 V / 2 pole connector
Power consumption	1280 W typical (75% DL duty cycle, 30% RF load) 1690 W max (75% DL duty cycle, 100% RF load)
Optical ports	4 x SFP28, 10/25GE eCPRI (Octis)
Other interfaces / Connector type	RF monitor port / SMA, Control AISG, External Alarms / MDR26, status LED
Operational temperature range	-40 °C +55 °C
Cooling	Nateral convection cooling
Installation optinos	Pole / Wall, ± 15° vertical
Ingress / Surge protection	IP65, Class II 20 kA
Supported RAT	5G, TD-LTE

AirScale High Power Wide Band MAA benefits

- 5G Adaptive Antenna System for optimized capacity and coverage
- Beamforming capable 64T64R with total 320W output power
- Full band operation for B41



AEHC 475124A

NOKIA

1 ANTENNA SPECIFICATION SHEETS

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ANTENNA NOTES:

1. ANTENNA CONTRACTOR SHALL INSURE THAT ALL ANTENNA MOUNTING PIPES ARE PLUMB.
2. FEEDLINE LENGTHS INDICATED ARE APPROXIMATE.
3. ANTENNA COAXIAL FEEDERS & ANTENNA JUMPERS SHALL BE COLOR CODED PER T-MOBILE REQUIREMENTS.
4. IN ADDITION TO THE COLOR CODE THE FOLLOWING ANTENNA SECTOR COLOR STRIPE SHALL BE ADDED TO EACH ANTENNA SECTOR FEEDLINE & JUMPER.
ALPHA - RED STRIPE
BETA - BLUE STRIPE
GAMMA - WHITE STRIPE
DELTA - GREEN STRIPE
EPSILON - GRAY STRIPE
ZETA - BROWN STRIPE
HYBRID - GRAY STRIPE
5. MULTI PORT ANTENNAS: TERMINATE UNUSED ANTENNA PORTS WITH CONNECTOR CAP &
WEATHERPROOF THOROUGHLY. JUMPERS FROM TMA'S MUST TERMINATE TO OPPOSITE POLARIZATIONS IN EACH SECTOR.
6. CONTRACTOR MUST FOLLOW ALL MANUFACTURERS' RECOMMENDATIONS REGARDING THE INSTALLATION OF FEEDLINES, CONNECTORS, AND ANTENNAS.
7. MINIMUM BEND RADIUS:
LDF4-50A (1/2" HARD LINE) = 5"
FSJ4-50B (1/2" SUPER FLEX) = 1 1/4"
AVA5-50A (7/8" HARD LINE) = 10"
AVA7-50A (1-5/8" HARD LINE) = 15"
LDF7-50A (1-5/8" HARD LINE) = 20"
8. CONTRACTOR SHALL RECORD THE SERIAL #, SECTOR, AND POSITION OF EACH ACTUATOR INSTALLED AT THE ANTENNAS AND PROVIDE THE INFORMATION TO T-MOBILE.
9. WEATHERPROOF ALL ANTENNA CONNECTORS WITH SELF AMALGAMATING TAPE.
10. ANTENNA CONTRACTOR SHALL PERFORM A "TAPE DROP" MEASUREMENT TO CONFIRM/ VALIDATE ANTENNA CENTERLINE (ACL) HEIGHT. CONTRACTOR SHALL SUBMIT A COMPLETED
HEIGHT VERIFICATION FORM TO THE CONSTRUCTION MANAGER.
11. ALL FIBER RUNS CONTAINED IN ONE COMMSCOPE HYBRID DC-FIBER CABLE (MODEL# HCS 2.0 TRUNK CABLE 12#6AWG24 SM FIBER PR) FROM LOWER COVP TO UPPER COVP, HYBRID CABLE SHALL BE COLOR CODED PER T-MOBILE REQUIREMENTS.

ANTENNA KEY

STATUS	ANTENNA NUMBER / SERVICED TECH	COLOR CODE (SEE SNOTE 3) SECTOR COLOR/#	ANTENNA VENDER	MODEL #	AZIMUTH	ELECT. DOWN TILT	MECH DOWNTILT	ANTENNA CENTERLINE	TECH.	COAXIAL FEEDER (QTY) SIZE	COAXIAL FEEDER COLOR CODE	HYBRID FEEDER QUANTITY	HYBRID FEEDER COLOR CODE
PROPOSED	A-1 LTE 600, N600, LTE 700, UMTS 2100, LTE 2100, LTE 1900, G1900	RED 4	COMMSCOPE	FFHH-65C-R3	340°	0	0°	87'-0" ±	L700, L600, N600, U2100, L1900, L2100, G1900	-	-	(4) NEW JUMPERS	-
		RED 3											
		RED 2											
		RED 1											
PROPOSED	A-2 LTE 2500, N2500	RED 1	NOKIA	AEHC	340°	0	0°	87'-0" ±	L2500, N2500	-	-	(1) NEW JUMPER	GREY 1
PROPOSED	B-1 LTE 600, N600, LTE 700, UMTS 2100, LTE 2100, LTE 1900, G1900	BLUE 4	COMMSCOPE	FFHH-65C-R3	100°	0	0°	87'-0" ±	L700, L600, N600, U2100, L1900, L2100, G1900	-	-	(4) NEW JUMPERS	-
		BLUE 3											
		BLUE 2											
		BLUE 1											
PROPOSED	B-2 LTE 2500, N2500	BLUE 1	NOKIA	AEHC	100°	0	0°	87'-0" ±	L2500, N2500	-	-	(1) NEW JUMPER	GREY 1
PROPOSED	C-1 LTE 600, N600, LTE 700, UMTS 2100, LTE 2100, LTE 1900, G1900	WHITE 4	COMMSCOPE	FFHH-65C-R3	220°	0	0°	87'-0" ±	L700, L600, N600, U2100, L1900, L2100, G1900	-	-	(4) NEW JUMPERS	-
		WHITE 3											
		WHITE 2											
		WHITE 1											
PROPOSED	C-2 LTE 2500, N2500	WHITE 1	NOKIA	AEHC	220°	0	0°	87'-0" ±	L2500, N2500	-	-	(1) NEW JUMPER	GREY 1

EQUIPMENT PAD / EQUIPMENT KEY

LOCATION	VENDOR	EQUIPMENT	MODEL NUMBER	TECH.	QTY.	STATUS
MULTI SECTOR	RAYCAP	COVP	RNSNDC-7771-PF-48	-	2	EXISTING
MULTI SECTOR	NOKIA	JUNCTION BOX	HCS 2.0 TOWER JUNCTION BOX	-	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ASIB	LTE 700, LTE 600, LTE 2100, LTE 1900	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ASIK	N2500	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ASIK	N600	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ASIB	LRE 2500	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	FSMF	G1900, U2100	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ABIA	LTE 2100, LTE 1900	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ABIA	LTE 1900	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ABIA	LTE 700, LTE 600	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ABIL	N2500	3	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ABIL	N600	1	PROPOSED
SSC	NOKIA	SYSTEM MODULE	ABIC	LTE 2500	3	PROPOSED
SSC	NOKIA	SYSTEM MODULE	AMIA	-	2	PROPOSED
SSC	-	VOLTAGE BOOSTER	VOLTAGE BOOSTER NEEDED IF HYBRID IS UNDER 250'	-	1	PROPOSED
CABINET	NOKIA	TRANSPORT SYSTEM	CSR IXRe	-	1	PROPOSED

ROOFTOP EQUIPMENT KEY

LOCATION	VENDOR	EQUIPMENT	MODEL NUMBER	TECHNOLOGY	QTY.	STATUS
MULTI SECTOR	NOKIA	PENDANT	HCS 2.0 PENDANT	-	1	PROPOSED
MULTI SECTOR	RAYCAP	COVP	RNSNDC-7771-PF-48	-	2	EXISTING
1 PER SECTOR	NOKIA	RRU	AHFIG	GSM 1900, L1900, U2100, L2100	3	PROPOSED
1 PER SECTOR	NOKIA	RRU	AHLOA	L600, L700, N600	3	PROPOSED

EQUIPMENT FEEDLINE KEY

LOCATION	VENDOR	EQUIPMENT	MODEL NUMBER	TECHNOLOGY	QTY.	STATUS
PER SECTOR	NSN	HYBRID CABLE	125' ± NSN HIGH CAP HCS	-	1	PROPOSED
PER SECTOR	NSN	JUMPER CABLE	125' ± HCS 2.O JUMPER CABLE - #6AWG 2PR	-	15	PROPOSED

1 EQUIPMENT KEY CONFIGURATION

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1 NSN CONFIGURATION DIAGRAM

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GENERAL CONSTRUCTION NOTES

1. THE FACILITY IS AN UNOCCUPIED WIRELESS FACILITY.
2. PLANS ARE NOT TO BE SCALED AND ARE INTENDED TO BE A DIAGRAMMATIC OUTLINE ONLY, UNLESS NOTED OTHERWISE. THE WORK SHALL INCLUDE FURNISHING MATERIALS, EQUIPMENT, APPURTENANCES AND LABOR NECESSARY TO COMPLETE ALL INSTALLATIONS AS INDICATED ON THE DRAWINGS.
3. PRIOR TO THE SUBMISSION OF BIDS, THE CONTRACTORS SHALL VISIT THE JOB SITE AND BE RESPONSIBLE FOR ALL CONTRACT DOCUMENTS, FIELD CONDITIONS AND DIMENSIONS, AND CONFIRMING THAT THE WORK MAY BE ACCOMPLISHED AS SHOWN PRIOR TO PROCEEDING WITH CONSTRUCTION. ANY DISCREPANCIES ARE TO BE BROUGHT TO THE ATTENTION OF THE IMPLEMENTATION ENGINEER AND ARCHITECT/ENGINEER PRIOR TO PROCEEDING WITH THE WORK.
4. THE CONTRACTOR SHALL RECEIVE, IN WRITING, AUTHORIZATION TO PROCEED BEFORE STARTING WORK ON ANY ITEM NOT CLEARLY DEFINED OR IDENTIFIED BY THE CONTRACT DOCUMENTS.
5. CONTRACTOR SHALL CONTACT LOCAL DIGGERS HOTLINE 48 HOURS PRIOR TO PROCEEDING WITH ANY EXCAVATION, SITE WORK OR CONSTRUCTION.
6. THE CONTRACTOR SHALL INSTALL ALL EQUIPMENT AND MATERIALS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS UNLESS SPECIFICALLY INDICATED OTHERWISE OR WHERE LOCAL CODES OR REGULATIONS TAKE PRECEDENCE.
7. ALL WORK PERFORMED AND MATERIALS INSTALLED SHALL BE IN STRICT ACCORDANCE WITH ALL APPLICABLE CODES, REGULATIONS AND ORDINANCES. CONTRACTOR SHALL GIVE ALL NOTICES AND COMPLY WITH ALL LAWS, ORDINANCES, RULES, REGULATIONS AND LAWFUL ORDERS OF ANY PUBLIC AUTHORITY REGARDING THE PERFORMANCE OF THE WORK. MECHANICAL AND ELECTRICAL SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH ALL APPLICABLE MUNICIPAL AND UTILITY COMPANY SPECIFICATIONS, AND LOCAL AND STATE JURISDICTIONAL CODES, ORDINANCES AND APPLICABLE REGULATIONS.
8. THE GENERAL CONTRACTOR SHALL SUPERVISE AND DIRECT THE WORK, USING THE BEST SKILLS AND ATTENTION. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES AND PROCEDURES AND FOR COORDINATING ALL PORTIONS OF THE WORK UNDER THE CONTRACT INCLUDING CONTACT AND COORDINATION WITH THE CONSTRUCTION FIELD ENGINEER AND WITH THE LANDLORD'S AUTHORIZED REPRESENTATIVE.
9. DETAILS ARE INTENDED TO SHOW END RESULT OF DESIGN. MINOR MODIFICATIONS MAY BE REQUIRED TO SUIT JOB DIMENSIONS OR CONDITIONS, AND SUCH MODIFICATIONS SHALL BE INCLUDED AS PART OF THE WORK.
10. REPRESENTATIONS OF TRUE NORTH, OTHER THAN THOSE FOUND ON THE PLOT OF SURVEY DRAWING, SHALL NOT BE USED TO IDENTIFY OR ESTABLISH THE BEARING OF TRUE NORTH AT THE SITE. THE CONTRACTOR SHALL RELY SOLELY ON THE PLOT OF SURVEY DRAWING AND ANY SURVEYOR'S MARKINGS AT THE SITE FOR THE ESTABLISHMENT OF TRUE NORTH, AND SHALL NOTIFY THE ARCHITECT/ENGINEER PRIOR TO PROCEEDING WITH THE WORK IF ANY DISCREPANCY IS FOUND BETWEEN THE VARIOUS ELEMENTS OF THE WORKING DRAWINGS AND THE TRUE NORTH ORIENTATION AS DEPICTED ON THE PLAT OF SURVEY. THE CONTRACTOR SHALL ASSUME SOLE LIABILITY FOR ANY FAILURE TO NOTIFY THE ARCHITECT/ENGINEER.

STRUCTURAL NOTES

GENERAL CONDITIONS

1. DESIGN AND CONSTRUCTION OF ALL WORK SHALL CONFORM TO THE APPROVED EDITION OF THE IBC EDITION AND ALL OTHER APPLICABLE STATE CODES, ORDINANCES, AND REGULATIONS. IN CASE OF CONFLICT BETWEEN THE CODES, STANDARDS, AND REGULATIONS. SPECIFICATIONS, GENERAL NOTES AND/OR MANUFACTURER'S REQUIREMENTS. USE THE MOST STRINGENT PROVISION.
2. IT IS THE EXPRESS INTENT OF THE PARTIES INVOLVED IN THIS PROJECT THAT THE CONTRACTOR OR SUBCONTRACTOR OR INDEPENDENT CONTRACTOR OR THEIR RESPECTIVE EMPLOYEES SHALL EXCULPATE THE ARCHITECT, THE ENGINEER, THE CONSTRUCTION MANAGER, THE OWNER, AND THEIR AGENTS, FROM ANY LIABILITY WHATSOEVER AND HOLD THEM HARMLESS AGAINST LOSS, DAMAGES, LIABILITY OR ANY EXPENSE ARISING IN ANY MATTER FROM THE WRONGFUL OR NEGLIGENT ACT, OR FAILURE TO CARRY OUT THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, OR THE CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES OR PROCEDURES OR FAILURE TO CONFORM TO THE STATE SCAFFOLDING ACT IN CONNECTION WITH THE WORK.
3. DO NOT SCALE DRAWINGS.
4. VERIFY ALL EQUIPMENT MOUNTING DIMENSIONS PER MANUFACTURER DRAWINGS.
5. SUBMIT ONE SEPIA AND TWO PRINTS OF ALL STRUCTURAL SHOP DRAWINGS. MARKED UP SEPIA SHALL BE RETURNED.

STRUCTURAL STEEL NOTES:

1. CHANNELS, ANGLES AND PLATES SHALL BE ASTM A36 MATERIAL, UNLESS NOTED OTHERWISE.
2. SQUARE AND RECTANGULAR TUBE STEEL HSS SECTIONS SHALL BE ASTM A500, GRADE B (Fy = 46 ksi) MATERIAL.
3. ROUND PIPE SECTIONS SHALL BE ASTM A53, GRADE B (Fy =35 ksi) MATERIAL.
4. DESIGN, FABRICATION, AND ERECTION SHALL BE IN ACCORDANCE WITH THE "AISC SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS" , WITH COMMENTARY AND THE "CODE OF STANDARD PRACTICE" .
5. ALL STEEL SHALL HAVE ONE COAT OF SHOP PRIMER. DO NOT PAINT AREAS WITHIN 3" OF BOLTS, WELDS OR HEADED STUDS.
6. BOLTS SHALL BE HIGH STRENGTH BOLTS, A325, CONFORMING TO ASTM SPECIFICATIONS. ALL CONNECTIONS SHALL HAVE A MINIMUM OF 2 BOLTS.
7. WELDING SHALL BE CONDUCTED BY CERTIFIED WELDERS AND SHALL CONFORM TO THE AWS CODES FOR ARC AND GAS WELDING IN BUILDING CONSTRUCTION.
8. WELDS SHALL BE MADE USING E70XX ELECTRODES AND SHALL BE 3/16" MINIMUM UNLESS OTHERWISE NOTED.
9. WELDING SHALL BE PERFORMED IN ACCORDANCE WITH A WELDED PROCEDURE SPECIFICATION (WPS) AS PER AWS D1.1 , D1.3 AND D1.4.
10. ONLY PRE-QUALIFIED WELDING PROCEDURES SHALL BE USED.
11. UNLESS SPECIFICALLY ADDRESSED IN THE SPECIFICATIONS OR THE DETAILS, ALL STEEL ITEMS PERMANENTLY EXPOSED TO EARTH OR WEATHER SHALL BE CORROSION-RESISTANT BY GALVANIZING OR BY THE USE OF STAINLESS STEEL.
12. ALL FIELD WELDS ON GALVANIZED MATERIAL SHALL BE BRUSH-COATED WITH A ZINC-RICH PAINT.

FRP NOTES:

1. ALL FRP MATERIAL SHALL BE EXTREN SERIES 500 OR EQUIVALENT, PRODUCED BY THE PULTRUSION METHOD.
2. ALL ADHESIVE RESIN SHALL BE PLEXUS METHACRYLATE OR AN EQUIVALENT ADHESIVE RESIN THAT IS COMPATIBLE WITH THE RESIN MATRIX USED IN THE STRUCTURAL SHAPES.
3. ALL FRP CONNECTIONS SHALL BE FULLY-BONDED AT EACH SIDE WITH A 1/4" PLATE AND A MINIMUM OF (2) 3/8" DIAMETER FLATHEAD FRP SCREWS PER MEMBER.
4. ISOPLAST NUTS AND BOLTS SHALL BE TIGHTENED TO A SNUG-TIGHT FIT PLUS AN ADDITIONAL 1/2 TURN, PRIOR TO BEING LOCKED WITH EPOXY.
5. ALL PANELS / SHEATHING SHALL BE FULLY BONDED WITH 3/8" FLATHEAD FRP SCREWS AT 12" O.C.
6. ALL FIELD CUT AND DRILLED EDGES, HOLES AND ABRASIONS SHALL BE SEALED WITH A CATALYZED EPOXY RESIN COMPATIBLE WITH THE MANUFACTURER'S ORIGINAL RESIN.

STANDARDS FOR ALL CONCRETE WORK

1. ALL CONCRETE WORK SHALL CONFORM WITH ACI. 318 OR LATEST. DETAIL REINFORCING IN CONFORMANCE WITH ACI. SP66 LATEST.
2. NO SPLICES OF REINFORCEMENT SHALL BE MADE EXCEPT AS DETAILED OR AUTHORIZED BY THE STRUCTURAL ENGINEER. LAP SPLICES WHERE PERMITTED SHALL BE A MINIMUM OF 30 BAR DIAMETERS.
3. PROVIDE ALL ACCESSORIES NECESSARY TO SUPPORT REINFORCING AT POSITIONS SHOW ON DRAWINGS.
4. WIRE FABRIC REINFORCEMENT MUST LAP ONE FULL MESH AT SIDE AND END LAPS SHALL BE TIED TOGETHER.
5. CURE AFTER FINISHING CONCRETE. KEEP MOIST FOR 7 DAYS AFTER POURING.
6. COMPACT STRUCTURAL FILL 95% PROCTOR DENSITY PRIOR TO PLACING CONCRETE UNDER SLABS.
7. 1/4" CHAMFER ON ALL CORNERS AND EDGES.
8. ALL CONCRETE SHALL BE PORTLAND, TYPE 1 CEMENT WITH A MINIMUM OF 28 DAY STRENGTH OF 3000 PSI., 4" SLUMP AND A MINIMUM AIR ENTRAPMENT OF 4%.
9. ALL REINFORCING STEEL SHALL BE GRADE 60. ALL REINFORCING MESH SHALL CONFORM TO ASTM A 185.

ELECTRICAL NOTES

1. SUBMITTAL OF BID INDICATES CONTRACTOR IS COGNIZANT OF ALL JOB SITE CONDITIONS AND WORK TO BE PREFORMED UNDER THIS CONTRACT. CONTRACTOR IS RESPONSIBLE FOR ALL FIELD VERIFICATION.
2. THESE PLANS ARE DIAGRAMMATIC ONLY, AND NOT TO BE SCALED.
3. ELECTRICAL CONTRACTOR SHALL PROVIDE ALL LABOR, MATERIALS, INSURANCE, EQUIPMENT, INSTALLATION, CONSTRUCTION TOOLS, TRANSPORTATION, ETC. FOR A COMPLETE AND PROPERLY OPERATIVE SYSTEM ENERGIZED THROUGHOUT AND AS INDICATED ON DRAWINGS, AS SPECIFIED HEREIN AND/OR AS OTHERWISE REQUIRED.
4. ALL MATERIALS AND EQUIPMENT SHALL BE NEW AND IN PERFECT CONDITION WHEN INSTALLED AND SHALL BE OF THE BEST GRADE OR GROUP OF EQUIPMENT. MATERIALS SHALL BE LISTED AND APPROVED BY UNDER-WRITER'S LABORATORY AND SHALL BEAR THE INSPECTION LABEL "J" WHERE SUBJECT TO SUCH APPROVAL MATERIALS SHALL MEET WITH APPROVAL OF THE DIVISION OF INDUSTRIAL SAFETY AND ALL GOVERNING BODIES HAVING JURISDICTION. MATERIALS SHALL BE MANUFACTURED IN ACCORDANCE WITH APPLICABLE STANDARDS ESTABLISHED BY ANSI, NEMA AND NBFU.
5. ALL CONDUIT INSTALLED SHALL BE SURFACE MOUNTED UNLESS OTHERWISE NOTED.
6. ELECTRICAL CONTRACTOR SHALL CARRY OUT HIS WORK WITH ACCORDANCE WITH ALL GOVERNING STATE, COUNTY, LOCAL CODES AND O.S.H.A.
7. ELECTRICAL CONTRACTOR SHALL SECURE ALL NECESSARY ELECTRICAL PERMITS, AND PAY ALL REQUIRED FEES.
8. COMPLETE JOB SHALL BE GUARANTEED FOR A PERIOD OF NO LESS THAN ONE YEAR AFTER THE DATE OF JOB COMPLETION. ANY WORK, MATERIAL, OR EQUIPMENT FOUND TO BE FAULTY DURING THAT PERIOD SHALL BE CORRECTED AT ONCE, UPON WRITTEN NOTIFICATION, AT THE EXPENSE OF THE ELECTRICAL CONTRACTOR.
9. ALL CONDUIT ONLY (C.O.) SHALL HAVE A PULL WIRE OR ROPE, AND TRUE TAPE.
10. PROVIDE THE OWNER WITH ONE SET OF COMPLETE DIMENSIONS AND CIRCUITS, WITHIN 10 WORKING DAYS OF PROJECT COMPLETION. ELECTRICAL "AS BUILT" DRAWINGS, SHOWING ACTUAL LOCATION OF CONDUITS.
11. ALL BROCHURES, OPERATING MANUALS, CATALOGS, SHOP DRAWINGS, ETC. SHALL BE TURNED OVER TO PROJECT MANAGER AT JOB COMPLETION.
12. USE T-TAP CONNECTIONS ON ALL MULTI-CIRCUITS WITH COMMON NEUTRAL CONDUCTOR FOR LIGHTING FIXTURE. ALL CONDUCTORS SHALL BE COPPER.
13. THE EXTERIOR GROUND RING SHALL BE TESTED PER CCI SPECIFICATIONS AND SHALL HAVE A RESISTANCE TO EARTH OF 5 OHMS OR LESS. IF NOT NOTIFY ENGINEER.
14. ALL CIRCUIT BREAKERS, FUSES AND ELECTRICAL EQUIPMENT SHALL HAVE AN INTERRUPTING RATING NOT LESS THAN THE MAXIMUM SHORT =CIRCUIT CURRENT TO WHICH THEY MAY BE SUBJECTED, AND A MINIMUM OF 10,000 A.I.C.
15. THE ENTIRE ELECTRICAL INSTALLATION SHALL BE GROUNDED AS REQUIRED BY ALL APPLICABLE CODES.
16. PATCH, REPAIR, AND PAINT ANY AREA THAT HAS BEEN DAMAGED IN THE COURSE OF THE ELECTRICAL WORK.
17. IN DRILLING HOLES INTO CONCRETE (WHETHER FOR FASTENING OR ANCHORING PURPOSES OR PENETRATIONS THROUGH THE FLOOR FOR CONDUIT RUNS, PIPE RUNS, ETC.) IT MUST BE CLEARLY UNDERSTOOD THAT TENDONS AND RE-BARS WILL NOT BE DRILLED INTO, CUT, OR DAMAGED UNDER ANY CIRCUMSTANCES.
18. LOCATION OF TENDONS AN RE-BARS ARE NOT DEFINITELY KNOWN AND THEREFORE MUST BE SEARCHED FOR BY APPROPRIATE METHODS AND EQUIPMENT VIA X-RAY, OR OTHER DEVICES THAT CAN ACCURATELY LOCATE THE REINFORCING STEEL TENDONS.
19. PENETRATIONS IN FIRE RATED WALLS SHALL BE FIRE STOPPED IN ACCORDANCE WITH APPLICABLE LOCAL BUILDING CODES. USING U.L. RATED MATERIALS.
20. ELECTRICAL CONTRACTOR IS TO COORDINATE WITH UTILITY COMPANY FOR CONNECTION OF TEMPORARY AND PERMANENT POWER TO THE SITE. THE TEMPORARY POWER AND ALL HOOK-UP COSTS SHALL BE PAID BY THE CONTRACTOR.
21. ELECTRICAL CONTRACTOR SHALL SUBMIT SHOP DRAWINGS AND/OR CATALOG CUT-SHEETS ON ALL NON-SPECIFIED ORIGINAL MATERIALS AND EQUIPMENT, TO PROJECT MANAGER PRIOR TO COMMENCEMENT OF THE WORK.
22. UPON COMPLETION OF WORK, CONDUCT CONTINUITY AND SHORT CIRCUIT, AS WELL AS, GROUNDING TEST, GROUNDING TEST SHALL BE PREFORMED BY INDEPENDENT TESTING AGENCY, WITH WRITTEN REPORT SUBMITTED TO THE PROJECT MANAGER FOR REVIEW AND APPROVAL.
23. CLEAN PREMISES DAILY OF ALL DEBRIS RESULTING FROM WORK AND LEAVE WORK PREMISES IN A COMPLETE AND UNDAMAGED CONDITION.
24. ALL EXTERIOR WALL PENETRATIONS SHALL BE SEALED WITH POLYSEAM SEALANT.
25. ALL #2 TINNED BARE COPPER DOWNLEADS TO BE PROTECTED BY 1/2" P.V.C. PIPE AND SECURED.
26. COMPRESSION FITTINGS TO BE USED ON ALL CONDUITS (NO SET SCREWS).
27. ALL #6 STRANDED COPPER WITH GREEN INSULATION TO BE ATTACHED WITH CRIMPED DOUBLE LUG, ATTACHED WITH NUTS, BOLTS AND STAR WASHERS TYPICAL AND NO-OX GREASE BETWEEN LUG AND BUS BAR.
28. ALL ABOVE GROUND CONDUIT SHALL BE RIGID GALVANIZED CONDUIT WITH WEATHERPROOF FITTINGS.

GROUNDING

1. ALL METALLIC PARTS OF ELECTRICAL EQUIPMENT WHICH DO NOT CARRY CURRENT SHALL BE GROUNDED IN ACCORDANCE WITH THE REQUIREMENTS OF THE BUILDING MANUFACTURER, T-MOBILE GROUNDING AND BONDING STANDARDS, AND THE NATIONAL ELECTRICAL CODE.
2. PROVIDE ELECTRICAL GROUNDING AND BONDING SYSTEM INDICATED WITH ASSEMBLY OF MATERIALS, INCLUDING GROUNDING ELECTRODES, BONDING JUMPERS AND ADDITIONAL ACCESSORIES AS REQUIRED FOR A COMPLETE INSTALLATION.
3. ALL GROUNDING CONDUCTORS SHALL PROVIDE A STRAIGHT DOWNWARD PATH TO GROUND WITH GRADUAL BEND AS REQUIRED. GROUNDING CONDUCTORS SHALL NOT BE LOOPED OR SHARPLY BENT. ROUTE GROUNDING CONNECTIONS AND CONDUCTORS TO GROUND IN THE SHORTEST AND STRAIGHTEST PATHS POSSIBLE TO MINIMIZE TRANSIENT VOLTAGE RISES. BUILDINGS AND/OR NEW TOWERS GREATER THAN 75 FEET IN HEIGHT AND WHERE THE MAIN
4. GROUNDING CONDUCTORS ARE REQUIRED TO BE ROUTED TO GRADE, THE CONTRACTOR SHALL ROUTE TWO GROUNDING CONDUCTORS FROM THE ROOFTOP, TOWERS, AND WATER TOWERS GROUND RING, TO THE EXISTING GROUNDING SYSTEM, THE GROUNDING CONDUCTORS SHALL NOT BE SMALLER THAN #2 AWG COPPER. ROOFTOP GROUND RING SHALL BE BONDED TO THE EXISTING GROUNDING SYSTEM, THE BUILDING STEEL COLUMNS, LIGHTNING PROTECTION SYSTEM, AND BUILDING MAIN WATER LINE (FERROUS OR NONFERROUS METAL PIPING ONLY).
5. TIGHTEN GROUNDING AND BONDING CONNECTORS, INCLUDING SCREWS AND BOLTS, IN ACCORDANCE WITH MANUFACTURER'S PUBLISHED TORQUE TIGHTENING VALUES FOR CONNECTORS AND BOLTS. WHERE MANUFACTURER'S TORQUING REQUIREMENTS ARE NOT AVAILABLE, TIGHTEN CONNECTIONS TO COMPLY WITH TIGHTENING TORQUE VALUES SPECIFIED IN UL TO ASSURE PERMANENT AND EFFECTIVE GROUNDING. CONTRACTOR SHALL VERIFY THE LOCATIONS OF GROUNDING TIE-IN-POINTS TO THE EXISTING
6. ALL UNDERGROUND GROUNDING CONNECTIONS SHALL BE MADE BY THE GROUNDING SYSTEM. EXOTHERMIC WELD PROCESS AND INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
7. ALL GROUNDING CONNECTIONS SHALL BE INSPECTED FOR TIGHTNESS. EXOTHERMIC WELDED CONNECTIONS SHALL BE APPROVED BY THE INSPECTOR HAVING JURISDICTION BEFORE BEING PERMANENTLY CONCEALED.
8. APPLY CORROSION-RESISTANCE FINISH TO FIELD CONNECTIONS AND PLACES WHERE FACTORY APPLIED PROTECTIVE COATINGS HAVE BEEN DESTROYED.
9. A SEPARATE, CONTINUOUS, INSULATED EQUIPMENT GROUNDING CONDUCTOR SHALL BE INSTALLED IN ALL FEEDER AND BRANCH CIRCUITS.
10. BOND ALL INSULATED GROUNDING BUSHINGS WITH A BARE 6 AWG GROUNDING CONDUCTOR TO A GROUND BUS.
11. DIRECT BURIED GROUNDING CONDUCTORS SHALL BE INSTALLED AT A NOMINAL DEPTH OF 36" MINIMUM BELOW GRADE, OR 6" BELOW THE FROST LINE, USE THE GREATER OF THE TWO DISTANCES.
12. ALL GROUNDING CONDUCTORS EMBEDDED IN OR PENETRATING CONCRETE SHALL BE INSTALLED IN SCHEDULE 40 PVC CONDUIT.
13. THE INSTALLATION OF CHEMICAL ELECTROLYTIC GROUNDING SYSTEM IN STRICT ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. REMOVE SEALING TAPE FROM LEACHING AND BREATHER HOLES. INSTALL PROTECTIVE BOX FLUSH WITH GRADE.
14. DRIVE GROUND RODS UNTIL TOPS ARE A MINIMUM DISTANCE OF 36" DEPTH OR 6" BELOW FROST LINE, USING THE GREATER OF THE TWO DISTANCES.
15. IF COAX ON THE ICE BRIDGE IS MORE THAN 6 FT. FROM THE GROUND BAR AT THE BASE OF THE TOWER, A SECOND GROUND BAR WILL BE NEEDED AT THE END OF THE ICE BRIDGE, TO GROUND THE COAX CABLE GROUNDING KITS AND IN-LINE ARRESTORS
16. CONTRACTOR SHALL REPAIR, AND/OR REPLACE, EXISTING GROUNDING SYSTEM COMPONENTS DAMAGED DURING CONSTRUCTION AT THE CONTRACTORS EXPENSE.

PRESENTED BY:

T-Mobile

Insite inc.
Wireless Consulting Services
15660 MIDWEST RD. SUITE 140 OAKBROOK TERRACE, IL 60181

TeleMtn ENGINEERING

SITE NAME:

DENVER_FIRE_28

SITE ADDRESS:

4306 S. WOLFF STREET
DENVER, COLORADO, 80236

SITE COUNTY:

CITY AND COUNTY OF DENVER

SITE ID:

DN03433C

REVISIONS

Rev:	Date:	Description:	By:
0	09.22.20	PRELIM	DE
1	10.21.20	100% CONSTRUCTION	DE
2	10.23.20	100% CONSTRUCTION	DE
3	10.27.20	100% CONSTRUCTION	DE
4			
5			
6			
7			

STAMPING SIGNATURE:

THIS WORK WAS PREPARED BY MYSELF OR UNDER MY SUPERVISION. CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION. ALL SCALES ARE SET FOR 11"x17"

SHEET TITLE:

GENERAL NOTES

SHEET NUMBER:

GN1.0

DRAWN BY:	CHK BY:	APV BY:
DE	GD	GD

Date: **August 27, 2019**

John Wabiszczewicz
T-Mobile
18400 E 22nd Avenue
Aurora, CO 80216

104 Broadway, Suite 600
Denver, CO 80203
P: 303-596-6804

Subject:	**Feasibility Structural Analysis Report**	
Carrier Designation:	**T-Mobile L600 Upgrade**	
	Carrier Site Number:	**DN03433C**
	Carrier Site Name:	**Denver Fire #28**
Site Data:	**4306 S. Wolff Street, Denver, Denver County, CO, 80236**	
	Latitude 39.638125° Longitude -105.04876666°	
Structure Information:	**Structure Height & Type:**	**130ft Self-Support**

Dear Mr. John Wabiszczewicz,

TeleMtn Engineering is pleased to submit this **"Feasibility Structural Analysis Report"** to determine the structural integrity of the structural integrity of the above-mentioned structure.

The purpose of the analysis is to determine whether the existing tower structure and foundation is capable of supporting additional loads. Based on this analysis, it has been determined that the structural capacity of the tower structure and foundation, under the following load case, to be:

Final Loading Configuration	**62.6% Sufficient Capacity**

This analysis was completed in accordance with the 2015 IBC, the TIA-222-G-4 standard, and the 2016 Denver Building and Fire Code Amendments. This analysis utilizes a nominal 3-second gust wind speed of 89mph (converted to an equivalent 115mph ultimate 3-second gust wind speed per Section 1609.3.1 for use with TIA-222-G). Applicable standard references and design criteria are listed in Section 2 - Analysis Criteria.

All new antennas and equipment shall be placed on the structure as shown in the drawings issued by this office.

We at TeleMtn Engineering appreciate the opportunity of providing our continuing professional services to you and T-Mobile. If you have any questions or need further assistance on this or any other projects, please give us a call.

Respectfully Submitted by:

Khristopher Scott, PE
Principal Engineer
303-596-6804
kscott@telemtn.com

TABLE OF CONTENTS

1) INTRODUCTION

At the request of T-Mobile, TeleMtn Engineering, LLC has analyzed the existing structure including all proposed and existing loads as listed in section 2 of this report. This analysis has been completed in accordance with all applicable codes and standards as required by the local jurisdiction. If any of the provided information or assumptions incorrectly represents this mount TeleMtn Engineering must be notified immediately to evaluate the significance of the discrepancy.

The existing structure is a 3 sided 130ft self-support tower designed by Cellxion on 11/30/2007. The tower was originally designed for a wind speed of 100mph (fastest mile) without ice a per TIA-222-F. The tower foundation are drilled piers. At this time, there are no known modifications previously installed.

2) ANALYSIS CRITERIA

Building Code: 2015 IBC
TIA-222 Revision: TIA-222-G
Risk Category: III
Nominal Wind Speed 89mph $V_{3\text{-sec}}$
Ultimate Wind Speed: 115mph V_{ult}
Exposure Category: C
Topographic Category & Crest Height: 1
Topographic Factor: 1.0
Ice Thickness: 0in
Wind Speed with Ice: 50mph
Seismic Ss: 0.188g
Service Wind Speed: 30mph

Notes:
1) Per TIA-222-G-4 section 2.6.4, ice loads may be ignored since the design ice thickness is less than or equal to 0.25in.
2) Per TIA-222-G-4 section 2.7.3, seismic effects may be ignored since S_S is less than 1.0g.

Table 1 - Final Proposed Equipment Configuration

Mount Level (ft)	Appurtenance Level (ft)	Number	Manufacturer	Model	Feedlines
130	130	1	Typ	Lightning Rod	-
125	125	1	Typ	4' Grid Dish w/ Pipe Mount	(1) 7/8"
115	115	2	Typ	Omni Antenna	(2) 7/8"
		2		Standoff Mounts	
100	100	1	Typ	Omni Antenna	(1) 7/8"
		1		Standoff Mounts	
87	87	6	Andrew	TMBXX-6516-A2M	(1) Hybrid
		3	Commscope	FFHH-65C-R3	
		3	Nokia	FRIG	
		3		FHFB	
		3		AHLOA	
		3	Raycap	RNSNDC-7771-PF-48	
		3	Typ	T-Frames	
72	72	9	Typ	4'x1' Antenna	(12) 1-5/8"
		3		8'x1' Antenna	
		3		Sector Frame	

3) ANALYSIS PROCEDURE

Table 2 - Documents Provided

Document	Source	Reference	Date
Site Photos	CNV	4306 South Wolff Street	05/15/2019
Preliminary Construction Drawings	Insite Inc.	DN03433C	08/06/2019
Previous Structural Analysis	Centerline Solutions	TMO-16-0071-19	05/19/2016

3.1) Analysis Method

Tower Numerics - tnxTower (version 8.0.4.0), a 3-D finite element general-purpose modeling, analysis, and design program specifically for telecommunication industry was used to create a three-dimensional model of the existing tower structure and calculate member stresses for various load cases. The 3-D model includes the tower, existing appurtenances, and all proposed loads. The analysis output is included in Appendices of this report.

3.2) Assumptions

1) Tower and structures have been designed, constructed, and maintained in accordance with the manufacturer's specifications and all applicable codes.
2) The configuration of antennas, transmission cables, mounts and other appurtenances are as specified in Tables 1 and 2 and the referenced drawings.
3) The base plate grout was not considered in this analysis.
4) All member connections are assumed to have been designed to meet or exceed the load carrying capacity of the connected member unless otherwise specified in this report.
5) TeleMtn Engineering, LLC shall be notified immediately of any discrepancies found in the data listed in this report.
6) Any appurtenances not shown in the load description table have not been considered in this analysis. TeleMtn Engineering should be notified immediately to determine the structural significant if any discrepancies are found.

This analysis may be affected if any assumptions are not valid or have been made in error. TeleMtn Engineering should be notified to determine the effect on the structural integrity of the antenna mounting system.

4) ANALYSIS RESULTS

Table 3 - Section Capacity (Summary)

Section No.	Elevation (ft)	Component Type	Size	Critical Element	P (K)	SF*P_allow (K)	% Capacity	Pass/Fail
T1	130 - 120	Leg	1 3/4	3	-1571.38	58740.50	2.7	Pass
T2	120 - 100	Leg	1 3/4	27	-13244.60	44889.40	29.5	Pass
T3	100 - 80	Leg	2 1/4	60	-31284.00	104909.00	29.8	Pass
T4	80 - 60	Leg	2 1/2	96	-60161.00	112394.00	53.5	Pass
T5	60 - 40	Leg	2 3/4	123	-89096.10	152917.00	58.3	Pass
T6	40 - 20	Leg	3	150	-115618.00	198961.00	58.1	Pass
T7	20 - 0	Leg	3 1/4	177	-140504.00	250286.00	56.1	Pass
T1	130 - 120	Diagonal	L2x2x3/16	12	-573.97	15245.30	3.8 8.5 (b)	Pass
T2	120 - 100	Diagonal	L2x2x3/16	33	-1539.71	14577.70	10.6 22.2 (b)	Pass
T3	100 - 80	Diagonal	L2x2x3/16	68	-3003.37	12156.40	24.7 44.0 (b)	Pass
T4	80 - 60	Diagonal	L2x2x3/16	101	-4037.92	8393.91	48.1 62.6 (b)	Pass
T5	60 - 40	Diagonal	L2 1/2x2 1/2x3/16	128	-4035.86	12286.00	32.8 44.3 (b)	Pass
T6	40 - 20	Diagonal	L2 1/2x2 1/2x1/4	155	-4198.63	12118.70	34.6	Pass
T7	20 - 0	Diagonal	L2 1/2x2 1/2x1/4	182	-4470.81	9405.72	47.5	Pass
T1	130 - 120	Top Girt	L2x2x3/16	6	-34.15	10134.40	0.3	Pass
T3	100 - 80	Top Girt	L2x2x3/16	63	-116.63	10134.40	1.2 1.7 (b)	Pass
							Summary	
						Leg (T5)	58.3	Pass
						Diagonal (T4)	62.6	Pass
						Top Girt (T3)	1.7	Pass
						Bolt Checks	62.6	Pass
						RATING =	**62.6**	**Pass**

Table 4 - Tower Component Stresses vs. Capacity

Notes	Component	Elevation (ft)	% Capacity	Pass / Fail
1	Anchor Rods	0	43.6%	Pass

Notes:
1) See additional documentation in "Appendix A - Analysis Output" for calculations supporting the percent capacity.

Table 5 - Tower Displacement and Deflection

Notes	Elevation (ft)	Appurtenance	Gov. Load Comb.	Deflection (in)	Tilt (deg)	Twist (deg)	Radius of Curvature (ft)
1	125.00	4' Grid	26	1.738	0.1105	0.0119	Inf

Notes:
1) The deflections are listed above for critical tower elevations using the serviceability wind speed listed.

Table 6 - Foundation Reactions

Reaction Typ	Original Design Reaction	Final Loading Reaction	Pass / Fail
Tower - Overturning (kip*ft)	2,994	1,591.420	Pass
Tower - Shear (kips)	26	23.891	
Leg - Download (kips)	482	143.417	
Leg - Uplift (kips)	246	122.799	

Notes:
1) Foundation capacity determined by comparing analysis reactions to original design reactions.
2) Original foundation reactions have been factored by 1.35 per TIA-222-G section 15.5.1 for direct comparison of original ASD reactions to current LRFD reactions.

Structure Rating (max from all components) =	62.6%	Sufficient

Notes:
1) See additional documentation in "Appendix A - Analysis Output" for calculations supporting the percent capacity.

4.1) Recommendations

The existing tower and foundation are recommended for the proposed additional loads under the current loading conditions. Please refer to the analysis printout for more information.

4.2) Disclaimer

This report represents a feasibility analysis with certain assumptions made in order to ascertain the general ability of the structure to support the proposed loading. Prior to any installation a rigorous analysis must be completed fully analyzing the tower and all structural components including, but not limited, to the main structural members, connections, and foundations. No analysis has been completed at this time on the antenna mounts.

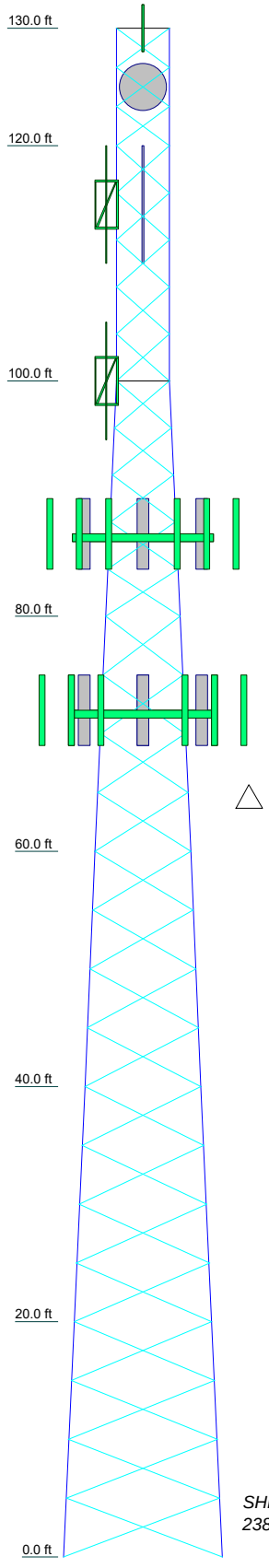
Installation procedures and related loading are not within the scope of this analysis. A contractor experienced in similar work should perform all installation work. The engineering services provided by TeleMtn Engineering, LLC are limited to the computer analysis and calculations of the structure with the proposed and existing loads. This analysis is considered void if the loading mentioned in this report is changed or is different as installed. For the purpose of this analysis it is assumed that the existing structure is properly maintained and is in good condition free of any defects, deterioration, discrepancies, and/or damage. Scope of this analysis does not include existing connections, except as noted in this report.

TeleMtn Engineering, LLC does not make any warranties, expressed or implied in connection with this engineering analysis report and disclaims any liability arising from deficiencies or any existing conditions of the original structure. TeleMtn Engineering, LLC will not be responsible for consequential or incidental damages sustained by any parties as a result of any data or conclusions included in this Report. The maximum liability of TeleMtn Engineering, LLC pursuant to this report shall be limited to the consulting fee received for the preparation of the report.

APPENDIX A

TOWER OUTPUT

Section	T1	T2	T3	T4	T5	T6	T7
Legs		SR 1 3/4	SR 2 1/4	SR 2 1/2	SR 2 3/4	SR 3	SR 3 1/4
Leg Grade	A572-50						
Diagonals	L2x2x3/16				L2 1/2x2 1/2x3/16	L2 1/2x2 1/2x1/4	
Diagonal Grade	A36						
Top Girts	L2x2x3/16	N.A.	L2x2x3/16	N.A.			
Face Width (ft)	13.5	4.5	6.3	8.1	9.9	11.7	
# Panels @ (ft)	3 @ 3.33333	10 @ 4		16 @ 5			
Weight (lb)	11895.3	523.6	930.5	1336.8	1515.7	1973.0	2602.0	3013.6



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
4' Lightning Rod	130	AHLOA	87
PM 601-1	125	FRIG	87
4' Grid	125	FHFB	87
14'x2" Omni	115	AHLOA	87
Standoff Mount	115	RNSNDC-7771-PF-48	87
14'x2" Omni	115	RNSNDC-7771-PF-48	87
Standoff Mount	115	RNSNDC-7771-PF-48	87
14'x2" Omni	100	SM 307-3	87
Standoff Mount	100	(2) TMBXX-6516 w/ Mt. Pipe	87
(2) TMBXX-6516 w/ Mt. Pipe	87	8'x1' Panel Antenna w/ Mt. Pipe	72
(2) TMBXX-6516 w/ Mt. Pipe	87	(3) 4ft x 1ft x 6in Antenna w/ Mount Pipe	72
FFHH-65C-R3 w/ Mount Pipe	87	8'x1' Panel Antenna w/ Mt. Pipe	72
FFHH-65C-R3 w/ Mount Pipe	87	(3) 4ft x 1ft x 6in Antenna w/ Mount Pipe	72
FFHH-65C-R3 w/ Mount Pipe	87	8'x1' Panel Antenna w/ Mt. Pipe	72
FRIG	87	SM 502-3	72
FHFB	87	(3) 4ft x 1ft x 6in Antenna w/ Mount Pipe	72
AHLOA	87		
FRIG	87		
FHFB	87		

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi	A36	36 ksi	58 ksi

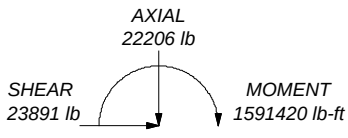
TOWER DESIGN NOTES

1. Tower is located in Denver County, Colorado.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 89 mph basic wind in accordance with the TIA-222-G Standard.
4. Deflections are based upon a 60 mph wind.
5. Tower Structure Class III.
6. Topographic Category 1 with Crest Height of 0.00 ft
7. Weld together tower sections have flange connections.
8. Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications.
9. Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards.
10. Welds are fabricated with ER-70S-6 electrodes.
11. TOWER RATING: 62.6%

ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 143417 lb
SHEAR: 14428 lb

UPLIFT: -122799 lb
SHEAR: 12605 lb



TORQUE 6266 lb-ft
REACTIONS - 89 mph WIND

TeleMtn Engineering

Phone: 303-596-6804
FAX:

Job: DN03433C			
Project:			
Client: T-Mobile	Drawn by: Zach Ford		App'd:
Code: TIA-222-G	Date: 08/27/19		Scale: NTS
Path: C:\Users\Zach Ford\Desktop\A. Zach Ford, LLC\Sites\TMO\DN03433C\Analysis\DN03433C.er			Dwg No. E-1

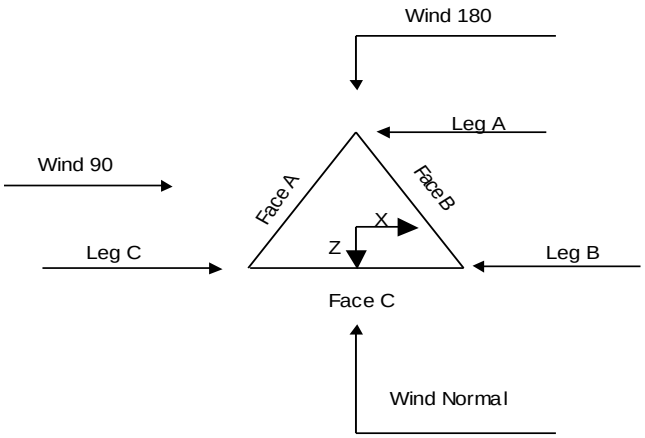
Tower Input Data

The main tower is a 3x free standing tower with an overall height of 130.00 ft above the ground line.
The base of the tower is set at an elevation of 0.00 ft above the ground line.
The face width of the tower is 4.50 ft at the top and 13.50 ft at the base.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

Tower is located in Denver County, Colorado.
Basic wind speed of 89 mph.
Structure Class III.
Exposure Category C.
Topographic Category 1.
Crest Height 0.00 ft.
Deflections calculated using a wind speed of 60 mph.
Weld together tower sections have flange connections..
Connections use galvanized A325 bolts, nuts and locking devices. Installation per TIA/EIA-222 and AISC Specifications..
Tower members are "hot dipped" galvanized in accordance with ASTM A123 and ASTM A153 Standards..
Welds are fabricated with ER-70S-6 electrodes..
Pressures are calculated at each section.
Stress ratio used in tower member design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

	Consider Moments - Legs		Distribute Leg Loads As Uniform		Use ASCE 10 X-Brace Ly Rules
	Consider Moments - Horizontals		Assume Legs Pinned	√	Calculate Redundant Bracing Forces
	Consider Moments - Diagonals	√	Assume Rigid Index Plate		Ignore Redundant Members in FEA
	Use Moment Magnification	√	Use Clear Spans For Wind Area	√	SR Leg Bolts Resist Compression
√	Use Code Stress Ratios	√	Use Clear Spans For KL/r		All Leg Panels Have Same Allowable
√	Use Code Safety Factors - Guys		Retension Guys To Initial Tension		Offset Girt At Foundation
	Escalate Ice	√	Bypass Mast Stability Checks	√	Consider Feed Line Torque
	Always Use Max Kz	√	Use Azimuth Dish Coefficients	√	Include Angle Block Shear Check
	Use Special Wind Profile	√	Project Wind Area of Appurt.		Use TIA-222-G Bracing Resist. Exemption
√	Include Bolts In Member Capacity		Autocalc Torque Arm Areas		Use TIA-222-G Tension Splice Exemption
	Leg Bolts Are At Top Of Section		Add IBC .6D+W Combination		Poles
√	Secondary Horizontal Braces Leg	√	Sort Capacity Reports By Component		Include Shear-Torsion Interaction
	Use Diamond Inner Bracing (4 Sided)		Triangulate Diamond Inner Bracing		Always Use Sub-Critical Flow
	SR Members Have Cut Ends		Treat Feed Line Bundles As Cylinder		Use Top Mounted Sockets
	SR Members Are Concentric		Ignore KL/ry For 60 Deg. Angle Legs		Pole Without Linear Attachments
					Pole With Shroud Or No Appurtenances
					Outside and Inside Corner Radii Are Known



Triangular Tower

Tower Section Geometry

Tower Section	Tower Elevation ft	Assembly Database	Description	Section Width ft	Number of Sections	Section Length ft
T1	130.00-120.00			4.50	1	10.00
T2	120.00-100.00			4.50	1	20.00
T3	100.00-80.00			4.50	1	20.00
T4	80.00-60.00			6.30	1	20.00
T5	60.00-40.00			8.10	1	20.00
T6	40.00-20.00			9.90	1	20.00
T7	20.00-0.00			11.70	1	20.00

Tower Section Geometry *(cont'd)*

Tower Section	Tower Elevation ft	Diagonal Spacing ft	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset in	Bottom Girt Offset in
T1	130.00-120.00	3.33	X Brace	No	No	0.0000	0.0000
T2	120.00-100.00	4.00	X Brace	No	No	0.0000	0.0000
T3	100.00-80.00	4.00	X Brace	No	No	0.0000	0.0000
T4	80.00-60.00	5.00	X Brace	No	No	0.0000	0.0000
T5	60.00-40.00	5.00	X Brace	No	No	0.0000	0.0000
T6	40.00-20.00	5.00	X Brace	No	No	0.0000	0.0000
T7	20.00-0.00	5.00	X Brace	No	No	0.0000	0.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 130.00-120.00	Solid Round	1 3/4	A572-50 (50 ksi)	Single Angle	L2x2x3/16	A36 (36 ksi)
T2 120.00-100.00	Solid Round	1 3/4	A572-50 (50 ksi)	Single Angle	L2x2x3/16	A36 (36 ksi)
T3 100.00-80.00	Solid Round	2 1/4	A572-50 (50 ksi)	Single Angle	L2x2x3/16	A36 (36 ksi)
T4 80.00-60.00	Solid Round	2 1/2	A572-50 (50 ksi)	Single Angle	L2x2x3/16	A36 (36 ksi)
T5 60.00-40.00	Solid Round	2 3/4	A572-50 (50 ksi)	Single Angle	L2 1/2x2 1/2x3/16	A36 (36 ksi)
T6 40.00-20.00	Solid Round	3	A572-50 (50 ksi)	Single Angle	L2 1/2x2 1/2x1/4	A36 (36 ksi)
T7 20.00-0.00	Solid Round	3 1/4	A572-50 (50 ksi)	Single Angle	L2 1/2x2 1/2x1/4	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
T1 130.00-120.00	Single Angle	L2x2x3/16	A36 (36 ksi)	Solid Round		A36 (36 ksi)
T3 100.00-80.00	Single Angle	L2x2x3/16	A36 (36 ksi)	Solid Round		A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in	Double Angle Stitch Bolt Spacing Redundants in
T1 130.00-120.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T2 120.00-100.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T3 100.00-80.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T4 80.00-60.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T5 60.00-40.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T6 40.00-20.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000
T7 20.00-0.00	0.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000	36.0000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
T1	Yes	Yes	1	1	1	1	1	1	1	1
130.00-120.00				1	1	1	1	1	1	1
T2	Yes	Yes	1	1	1	1	1	1	1	1
120.00-100.00				1	1	1	1	1	1	1
T3	Yes	Yes	1	1	1	1	1	1	1	1
100.00-80.00				1	1	1	1	1	1	1
T4	Yes	Yes	1	1	1	1	1	1	1	1
80.00-60.00				1	1	1	1	1	1	1
T5	Yes	Yes	1	1	1	1	1	1	1	1
60.00-40.00				1	1	1	1	1	1	1
T6	Yes	Yes	1	1	1	1	1	1	1	1
40.00-20.00				1	1	1	1	1	1	1
T7 20.00-0.00	Yes	Yes	1	1	1	1	1	1	1	1
				1	1	1	1	1	1	1

[1]*Note: K factors are applied to member segment lengths. K-braces without inner supporting members will have the K factor in the out-of-plane direction applied to the overall length.*

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U
T1	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
130.00-120.00														
T2	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
120.00-100.00														
T3	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
100.00-80.00														
T4 80.00-60.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T5 60.00-40.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T6 40.00-20.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T7 20.00-0.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Connection Type	Leg Bolt Size in	Leg No.	Diagonal Bolt Size in	Diagonal No.	Top Girt Bolt Size in	Top Girt No.	Bottom Girt Bolt Size in	Bottom Girt No.	Mid Girt Bolt Size in	Mid Girt No.	Long Horizontal Bolt Size in	Long Horizontal No.	Short Horizontal Bolt Size in	Short Horizontal No.
T1 130.00-120.00	Flange	1.0000 A325N	4	0.6250 A325N	1	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T2 120.00-100.00	Flange	1.0000 A325N	4	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T3 100.00-80.00	Flange	1.0000 A325N	4	0.6250 A325N	1	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T4 80.00-60.00	Flange	1.3750 A325N	6	0.6250 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T5 60.00-40.00	Flange	1.3750 A325N	6	0.8750 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T6 40.00-20.00	Flange	1.3750 A325N	6	0.8750 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T7 20.00-0.00	Flange	0.7500 A325N	0	0.8750 A325N	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
Safety Line 3/8	A	No	No	Ar (CaAa)	130.00 - 0.00	0.0000	0	1	1	0.3750	0.3750		0.22
Climbing Ladder	A	No	No	Ar (CaAa)	130.00 - 0.00	0.0000	0	1	1	5.7500	5.7500		7.90
Feedline Ladder (Af) ***	C	No	No	Af (CaAa)	130.00 - 0.00	0.0000	0	1	1	3.0000	3.0000		8.40
7/8" Coax	C	No	No	Ar (CaAa)	100.00 - 0.00	0.0000	0	4	2	0.5000	0.8750		0.32
7/8" Coax	C	No	No	Ar (CaAa)	115.00 - 100.00	0.0000	0	3	2	0.5000	0.8750		0.32
7/8" Coax *	C	No	No	Ar (CaAa)	125.00 - 115.00	0.0000	0	1	1	0.5000	0.8750		0.32
1.58" Hybrid Cable *	C	No	No	Ar (CaAa)	87.00 - 0.00	0.0000	0.05	1	1	1.5800	1.5800		1.61
LDF7-50A(1-5/8)	C	No	No	Ar (CaAa)	72.00 - 0.00	0.0000	-0.05	12	6	0.5000	1.9800		0.82

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight lb
T1	130.00-120.00	A	0.000	0.000	3.868	0.000	81.20
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	5.438	0.000	85.60
T2	120.00-100.00	A	0.000	0.000	7.831	0.000	162.40

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight lb
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	14.375	0.000	184.00
T3	100.00-80.00	A	0.000	0.000	7.982	0.000	162.40
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	18.106	0.000	204.87
T4	80.00-60.00	A	0.000	0.000	8.176	0.000	162.40
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	48.672	0.000	343.88
T5	60.00-40.00	A	0.000	0.000	8.444	0.000	162.40
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	67.680	0.000	422.60
T6	40.00-20.00	A	0.000	0.000	8.869	0.000	162.40
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	67.680	0.000	422.60
T7	20.00-0.00	A	0.000	0.000	9.478	0.000	162.40
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	67.680	0.000	422.60

Feed Line Center of Pressure

Section	Elevation ft	CP_X in	CP_Z in	CP_X Ice in	CP_Z Ice in
T1	130.00-120.00	-2.2109	0.3560	-2.1885	0.3731
T2	120.00-100.00	-2.3895	1.1229	-2.3400	1.1639
T3	100.00-80.00	-2.4589	1.6558	-2.3668	1.7326
T4	80.00-60.00	-1.8136	4.1788	-1.6587	4.3326
T5	60.00-40.00	-1.3149	5.0814	-1.0917	5.3055
T6	40.00-20.00	-1.5364	5.3615	-1.1658	5.7206
T7	20.00-0.00	-1.8160	5.5017	-1.2265	6.0553

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
T1	1	Safety Line 3/8	120.00 - 130.00	0.6000	0.6000
T1	2	Climbing Ladder	120.00 - 130.00	1.0000	0.6000
T1	3	Feedline Ladder (Af)	120.00 - 130.00	0.6000	0.6000
T1	7	7/8" Coax	120.00 - 125.00	0.6000	0.6000
T2	1	Safety Line 3/8	100.00 - 120.00	0.6000	0.6000
T2	2	Climbing Ladder	100.00 - 120.00	1.0000	0.6000
T2	3	Feedline Ladder (Af)	100.00 - 120.00	0.6000	0.6000
T2	6	7/8" Coax	100.00 - 115.00	0.6000	0.6000
T2	7	7/8" Coax	115.00 -	0.6000	0.6000

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
			120.00		
T3	1	Safety Line 3/8	80.00 - 100.00	0.6000	0.6000
T3	2	Climbing Ladder	80.00 - 100.00	1.0000	0.6000
T3	3	Feedline Ladder (Af)	80.00 - 100.00	0.6000	0.6000
T3	5	7/8" Coax	80.00 - 100.00	0.6000	0.6000
T3	9	1.58" Hybrid Cable	80.00 - 87.00	0.6000	0.6000
T4	1	Safety Line 3/8	60.00 - 80.00	0.6000	0.6000
T4	2	Climbing Ladder	60.00 - 80.00	1.0000	0.6000
T4	3	Feedline Ladder (Af)	60.00 - 80.00	0.6000	0.6000
T4	5	7/8" Coax	60.00 - 80.00	0.6000	0.6000
T4	9	1.58" Hybrid Cable	60.00 - 80.00	0.6000	0.6000
T4	11	LDF7-50A(1-5/8)	60.00 - 72.00	0.6000	0.6000
T5	1	Safety Line 3/8	40.00 - 60.00	0.6000	0.6000
T5	2	Climbing Ladder	40.00 - 60.00	1.0000	0.6000
T5	3	Feedline Ladder (Af)	40.00 - 60.00	0.6000	0.6000
T5	5	7/8" Coax	40.00 - 60.00	0.6000	0.6000
T5	9	1.58" Hybrid Cable	40.00 - 60.00	0.6000	0.6000
T5	11	LDF7-50A(1-5/8)	40.00 - 60.00	0.6000	0.6000
T6	1	Safety Line 3/8	20.00 - 40.00	0.6000	0.6000
T6	2	Climbing Ladder	20.00 - 40.00	1.0000	0.6000
T6	3	Feedline Ladder (Af)	20.00 - 40.00	0.6000	0.6000
T6	5	7/8" Coax	20.00 - 40.00	0.6000	0.6000
T6	9	1.58" Hybrid Cable	20.00 - 40.00	0.6000	0.6000
T6	11	LDF7-50A(1-5/8)	20.00 - 40.00	0.6000	0.6000
T7	1	Safety Line 3/8	0.00 - 20.00	0.6000	0.6000
T7	2	Climbing Ladder	0.00 - 20.00	1.0000	0.6000
T7	3	Feedline Ladder (Af)	0.00 - 20.00	0.6000	0.6000
T7	5	7/8" Coax	0.00 - 20.00	0.6000	0.6000
T7	9	1.58" Hybrid Cable	0.00 - 20.00	0.6000	0.6000
T7	11	LDF7-50A(1-5/8)	0.00 - 20.00	0.6000	0.6000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
4' Lightning Rod *125*	C	None		0.0000	130.00	No Ice	0.25	0.25	8.00
PM 601-1	A	From Leg	1.00 0.00 0.00	0.0000	125.00	No Ice	3.00	0.90	21.67
115									
Standoff Mount	A	From Leg	1.00 0.00 0.00	0.0000	115.00	No Ice	0.34	0.34	7.32
14'x2" Omni	A	From Leg	1.00 0.00 0.00	0.0000	115.00	No Ice	2.80	2.80	20.00
Standoff Mount	C	From Leg	1.00 0.00 0.00	0.0000	115.00	No Ice	0.34	0.34	7.32

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
14'x2" Omni	C	From Leg	1.00 0.00 0.00	0.0000	115.00	No Ice	2.80	2.80	20.00
100 Standoff Mount	C	From Leg	1.00 0.00 0.00	0.0000	100.00	No Ice	0.34	0.34	7.32
14'x2" Omni	C	From Leg	1.00 0.00 0.00	0.0000	100.00	No Ice	2.80	2.80	20.00
87 (2) TMBXX-6516 w/ Mt. Pipe	A	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	6.74	5.38	56.50
(2) TMBXX-6516 w/ Mt. Pipe	B	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	6.74	5.38	56.50
(2) TMBXX-6516 w/ Mt. Pipe	C	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	6.74	5.38	56.50
FFHH-65C-R3 w/ Mount Pipe	A	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	21.11	11.25	156.80
FFHH-65C-R3 w/ Mount Pipe	B	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	21.11	11.25	156.80
FFHH-65C-R3 w/ Mount Pipe	C	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	21.11	11.25	156.80
FRIG	A	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	2.39	0.97	57.32
FHFB	A	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	3.63	2.39	52.90
AHLOA	A	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	2.23	1.39	83.80
FRIG	B	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	2.39	0.97	57.32
FHFB	B	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	3.63	2.39	52.90
AHLOA	B	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	2.23	1.39	83.80
FRIG	C	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	2.39	0.97	57.32
FHFB	C	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	3.63	2.39	52.90
AHLOA	C	From Leg	3.00 0.00 0.00	0.0000	87.00	No Ice	2.23	1.39	83.80
RNSNDC-7771-PF-48	A	None		0.0000	87.00	No Ice	3.20	1.03	19.00

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft / Vert ft / ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight lb
RNSNDC-7771-PF-48	B	None		0.0000	87.00	No Ice	3.20	1.03	19.00
RNSNDC-7771-PF-48	C	None		0.0000	87.00	No Ice	3.20	1.03	19.00
SM 307-3 *72*	C	None		0.0000	87.00	No Ice	26.22	26.22	540.00
(3) 4ft x 1ft x 6in Antenna w/ Mount Pipe	A	From Leg	3.00 0.00 0.00	0.0000	72.00	No Ice	6.02	4.77	59.20
8'x1' Panel Antenna w/ Mt. Pipe	A	From Leg	3.00 0.00 0.00	0.0000	72.00	No Ice	11.47	8.70	79.20
(3) 4ft x 1ft x 6in Antenna w/ Mount Pipe	B	From Leg	3.00 0.00 0.00	0.0000	72.00	No Ice	6.02	4.77	59.20
8'x1' Panel Antenna w/ Mt. Pipe	B	From Leg	3.00 0.00 0.00	0.0000	72.00	No Ice	11.47	8.70	79.20
(3) 4ft x 1ft x 6in Antenna w/ Mount Pipe	C	From Leg	3.00 0.00 0.00	0.0000	72.00	No Ice	6.02	4.77	59.20
8'x1' Panel Antenna w/ Mt. Pipe	C	From Leg	3.00 0.00 0.00	0.0000	72.00	No Ice	11.47	8.70	79.20
SM 502-3	C	None		0.0000	72.00	No Ice	33.02	33.02	557.70

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral ft / Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft^2	Weight lb
4' Grid	A	Grid	From Leg	1.00 0.00 0.00	0.0000		125.00	4.00	No Ice	12.57	40.00

Tower Pressures - No Ice

$G_H = 0.850$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
T1	125.00	1.326	27	46.458	A	6.144	2.917	2.917	32.19	3.868	0.000
130.00-120.00					B	6.144	2.917		32.19	0.000	0.000
					C	6.144	2.917		32.19	5.438	0.000
T2	110.00	1.291	26	92.917	A	9.709	5.833	5.833	37.53	7.831	0.000

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
120.00-100.00					B	9.709	5.833		37.53	0.000	0.000
					C	9.709	5.833		37.53	14.375	0.000
T3	90.00	1.238	25	111.754	A	11.557	7.510	7.510	39.39	7.982	0.000
100.00-80.00					B	11.557	7.510		39.39	0.000	0.000
					C	11.557	7.510		39.39	18.106	0.000
T4 80.00-60.00	70.00	1.174	24	148.171	A	11.361	8.345	8.345	42.35	8.176	0.000
					B	11.361	8.345		42.35	0.000	0.000
					C	11.361	8.345		42.35	48.672	0.000
T5 60.00-40.00	50.00	1.094	22	184.588	A	16.733	9.179	9.179	35.42	8.444	0.000
					B	16.733	9.179		35.42	0.000	0.000
					C	16.733	9.179		35.42	67.680	0.000
T6 40.00-20.00	30.00	0.982	20	221.005	A	19.385	10.013	10.013	34.06	8.869	0.000
					B	19.385	10.013		34.06	0.000	0.000
					C	19.385	10.013		34.06	67.680	0.000
T7 20.00-0.00	10.00	0.85	17	257.422	A	22.115	10.848	10.848	32.91	9.478	0.000
					B	22.115	10.848		32.91	0.000	0.000
					C	22.115	10.848		32.91	67.680	0.000

Tower Pressure - Service

$G_H = 0.850$

Section Elevation ft	z ft	K_Z	q_z psf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
T1	125.00	1.326	11	46.458	A	6.144	2.917	2.917	32.19	3.868	0.000
130.00-120.00					B	6.144	2.917		32.19	0.000	0.000
					C	6.144	2.917		32.19	5.438	0.000
T2	110.00	1.291	10	92.917	A	9.709	5.833	5.833	37.53	7.831	0.000
120.00-100.00					B	9.709	5.833		37.53	0.000	0.000
					C	9.709	5.833		37.53	14.375	0.000
T3	90.00	1.238	10	111.754	A	11.557	7.510	7.510	39.39	7.982	0.000
100.00-80.00					B	11.557	7.510		39.39	0.000	0.000
					C	11.557	7.510		39.39	18.106	0.000
T4 80.00-60.00	70.00	1.174	9	148.171	A	11.361	8.345	8.345	42.35	8.176	0.000
					B	11.361	8.345		42.35	0.000	0.000
					C	11.361	8.345		42.35	48.672	0.000
T5 60.00-40.00	50.00	1.094	9	184.588	A	16.733	9.179	9.179	35.42	8.444	0.000
					B	16.733	9.179		35.42	0.000	0.000
					C	16.733	9.179		35.42	67.680	0.000
T6 40.00-20.00	30.00	0.982	8	221.005	A	19.385	10.013	10.013	34.06	8.869	0.000
					B	19.385	10.013		34.06	0.000	0.000
					C	19.385	10.013		34.06	67.680	0.000
T7 20.00-0.00	10.00	0.85	7	257.422	A	22.115	10.848	10.848	32.91	9.478	0.000
					B	22.115	10.848		32.91	0.000	0.000
					C	22.115	10.848		32.91	67.680	0.000

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
T1	166.80	523.63	A	0.195	2.613	27	1	1	7.817	607.63	60.76	C
130.00-120.00			B	0.195	2.613		1	1	7.817			
			C	0.195	2.613		1	1	7.817			
T2	346.40	930.54	A	0.167	2.709	26	1	1	13.032	1108.61	55.43	C
120.00-100.00			B	0.167	2.709		1	1	13.032			
			C	0.167	2.709		1	1	13.032			
T3	367.27	1336.79	A	0.171	2.697	25	1	1	15.838	1253.75	62.69	C
100.00-80.00			B	0.171	2.697		1	1	15.838			
			C	0.171	2.697		1	1	15.838			
T4	506.28	1515.74	A	0.133	2.835	24	1	1	16.084	1537.23	76.86	C
80.00-60.00			B	0.133	2.835		1	1	16.084			
			C	0.133	2.835		1	1	16.084			
T5	585.00	1972.99	A	0.14	2.807	22	1	1	21.934	1899.60	94.98	C
60.00-40.00			B	0.14	2.807		1	1	21.934			
			C	0.14	2.807		1	1	21.934			
T6	585.00	2601.98	A	0.133	2.835	20	1	1	25.053	1872.61	93.63	C
40.00-20.00			B	0.133	2.835		1	1	25.053			
			C	0.133	2.835		1	1	25.053			
T7 20.00-0.00	585.00	3013.59	A	0.128	2.854	17	1	1	28.251	1769.64	88.48	C
			B	0.128	2.854		1	1	28.251			
			C	0.128	2.854		1	1	28.251			
Sum Weight:	3141.75	11895.26						OTM	587199.90 lb-ft	10049.07		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
T1	166.80	523.63	A	0.195	2.613	27	0.8	1	6.589	534.44	53.44	C
130.00-120.00			B	0.195	2.613		0.8	1	6.589			
			C	0.195	2.613		0.8	1	6.589			
T2	346.40	930.54	A	0.167	2.709	26	0.8	1	11.090	991.88	49.59	C
120.00-100.00			B	0.167	2.709		0.8	1	11.090			
			C	0.167	2.709		0.8	1	11.090			
T3	367.27	1336.79	A	0.171	2.697	25	0.8	1	13.526	1121.13	56.06	C
100.00-80.00			B	0.171	2.697		0.8	1	13.526			
			C	0.171	2.697		0.8	1	13.526			
T4	506.28	1515.74	A	0.133	2.835	24	0.8	1	13.812	1407.26	70.36	A
80.00-60.00			B	0.133	2.835		0.8	1	13.812			
			C	0.133	2.835		0.8	1	13.812			
T5	585.00	1972.99	A	0.14	2.807	22	0.8	1	18.588	1723.01	86.15	A
60.00-40.00			B	0.14	2.807		0.8	1	18.588			
			C	0.14	2.807		0.8	1	18.588			
T6	585.00	2601.98	A	0.133	2.835	20	0.8	1	21.176	1687.07	84.35	A
40.00-20.00			B	0.133	2.835		0.8	1	21.176			
			C	0.133	2.835		0.8	1	21.176			
T7 20.00-0.00	585.00	3013.59	A	0.128	2.854	17	0.8	1	23.828	1585.25	79.26	A
			B	0.128	2.854		0.8	1	23.828			
			C	0.128	2.854		0.8	1	23.828			
Sum Weight:	3141.75	11895.26						OTM	527937.19 lb-ft	9050.04		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
T1	166.80	523.63	A	0.195	2.613	27	0.85	1	6.896	552.74	55.27	C
130.00-120.00			B	0.195	2.613		0.85	1	6.896			
			C	0.195	2.613		0.85	1	6.896			
T2	346.40	930.54	A	0.167	2.709	26	0.85	1	11.575	1021.06	51.05	C
120.00-100.00			B	0.167	2.709		0.85	1	11.575			
			C	0.167	2.709		0.85	1	11.575			
T3	367.27	1336.79	A	0.171	2.697	25	0.85	1	14.104	1154.28	57.71	C
100.00-80.00			B	0.171	2.697		0.85	1	14.104			
			C	0.171	2.697		0.85	1	14.104			
T4	506.28	1515.74	A	0.133	2.835	24	0.85	1	14.380	1394.72	69.74	B
80.00-60.00			B	0.133	2.835		0.85	1	14.380			
			C	0.133	2.835		0.85	1	14.380			
T5	585.00	1972.99	A	0.14	2.807	22	0.85	1	19.424	1697.23	84.86	B
60.00-40.00			B	0.14	2.807		0.85	1	19.424			
			C	0.14	2.807		0.85	1	19.424			
T6	585.00	2601.98	A	0.133	2.835	20	0.85	1	22.145	1670.66	83.53	B
40.00-20.00			B	0.133	2.835		0.85	1	22.145			
			C	0.133	2.835		0.85	1	22.145			
T7 20.00-0.00	585.00	3013.59	A	0.128	2.854	17	0.85	1	24.934	1577.01	78.85	B
			B	0.128	2.854		0.85	1	24.934			
			C	0.128	2.854		0.85	1	24.934			
Sum Weight:	3141.75	11895.26						OTM	533677.04 lb-ft	9067.71		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
T1	166.80	523.63	A	0.195	2.613	11	1	1	7.817	240.14	24.01	C
130.00-120.00			B	0.195	2.613		1	1	7.817			
			C	0.195	2.613		1	1	7.817			
T2	346.40	930.54	A	0.167	2.709	10	1	1	13.032	438.13	21.91	C
120.00-100.00			B	0.167	2.709		1	1	13.032			
			C	0.167	2.709		1	1	13.032			
T3	367.27	1336.79	A	0.171	2.697	10	1	1	15.838	495.49	24.77	C
100.00-80.00			B	0.171	2.697		1	1	15.838			
			C	0.171	2.697		1	1	15.838			
T4	506.28	1515.74	A	0.133	2.835	9	1	1	16.084	607.53	30.38	C
80.00-60.00			B	0.133	2.835		1	1	16.084			
			C	0.133	2.835		1	1	16.084			
T5	585.00	1972.99	A	0.14	2.807	9	1	1	21.934	750.74	37.54	C
60.00-40.00			B	0.14	2.807		1	1	21.934			
			C	0.14	2.807		1	1	21.934			
T6	585.00	2601.98	A	0.133	2.835	8	1	1	25.053	740.07	37.00	C
40.00-20.00			B	0.133	2.835		1	1	25.053			
			C	0.133	2.835		1	1	25.053			

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
T7 20.00-0.00	585.00	3013.59	A	0.128	2.854	7	1	1	28.251	699.37	34.97	C
			B	0.128	2.854		1	1	28.251			
			C	0.128	2.854		1	1	28.251			
Sum Weight:	3141.75	11895.26						OTM	232065.52 lb-ft	3971.46		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
T1	166.80	523.63	A	0.195	2.613	11	0.8	1	6.589	211.22	21.12	C
130.00-120.00			B	0.195	2.613		0.8	1	6.589			
			C	0.195	2.613		0.8	1	6.589			
T2	346.40	930.54	A	0.167	2.709	10	0.8	1	11.090	392.00	19.60	C
120.00-100.00			B	0.167	2.709		0.8	1	11.090			
			C	0.167	2.709		0.8	1	11.090			
T3	367.27	1336.79	A	0.171	2.697	10	0.8	1	13.526	443.08	22.15	C
100.00-80.00			B	0.171	2.697		0.8	1	13.526			
			C	0.171	2.697		0.8	1	13.526			
T4	506.28	1515.74	A	0.133	2.835	9	0.8	1	13.812	556.16	27.81	A
80.00-60.00			B	0.133	2.835		0.8	1	13.812			
			C	0.133	2.835		0.8	1	13.812			
T5	585.00	1972.99	A	0.14	2.807	9	0.8	1	18.588	680.95	34.05	A
60.00-40.00			B	0.14	2.807		0.8	1	18.588			
			C	0.14	2.807		0.8	1	18.588			
T6	585.00	2601.98	A	0.133	2.835	8	0.8	1	21.176	666.74	33.34	A
40.00-20.00			B	0.133	2.835		0.8	1	21.176			
			C	0.133	2.835		0.8	1	21.176			
T7 20.00-0.00	585.00	3013.59	A	0.128	2.854	7	0.8	1	23.828	626.50	31.33	A
			B	0.128	2.854		0.8	1	23.828			
			C	0.128	2.854		0.8	1	23.828			
Sum Weight:	3141.75	11895.26						OTM	208644.48 lb-ft	3576.64		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft²	F lb	w plf	Ctrl. Face
T1	166.80	523.63	A	0.195	2.613	11	0.85	1	6.896	218.45	21.84	C
130.00-120.00			B	0.195	2.613		0.85	1	6.896			
			C	0.195	2.613		0.85	1	6.896			
T2	346.40	930.54	A	0.167	2.709	10	0.85	1	11.575	403.53	20.18	C
120.00-100.00			B	0.167	2.709		0.85	1	11.575			
			C	0.167	2.709		0.85	1	11.575			
T3	367.27	1336.79	A	0.171	2.697	10	0.85	1	14.104	456.18	22.81	C

Section Elevation ft	Add Weight lb	Self Weight lb	Face	e	C_F	q_z psf	D_F	D_R	A_E ft^2	F lb	w plf	Ctrl. Face
100.00-80.00			B	0.171	2.697		0.85	1	14.104			
			C	0.171	2.697		0.85	1	14.104			
T4	506.28	1515.74	A	0.133	2.835	9	0.85	1	14.380	551.20	27.56	B
80.00-60.00			B	0.133	2.835		0.85	1	14.380			
			C	0.133	2.835		0.85	1	14.380			
T5	585.00	1972.99	A	0.14	2.807	9	0.85	1	19.424	670.76	33.54	B
60.00-40.00			B	0.14	2.807		0.85	1	19.424			
			C	0.14	2.807		0.85	1	19.424			
T6	585.00	2601.98	A	0.133	2.835	8	0.85	1	22.145	660.26	33.01	B
40.00-20.00			B	0.133	2.835		0.85	1	22.145			
			C	0.133	2.835		0.85	1	22.145			
T7 20.00-0.00	585.00	3013.59	A	0.128	2.854	7	0.85	1	24.934	623.24	31.16	B
			B	0.128	2.854		0.85	1	24.934			
			C	0.128	2.854		0.85	1	24.934			
Sum Weight:	3141.75	11895.26						OTM	210912.91 lb-ft	3583.62		

Force Totals

Load Case	Vertical Forces lb	Sum of Forces X lb	Sum of Forces Z lb	Sum of Overturning Moments, M_x lb-ft	Sum of Overturning Moments, M_z lb-ft	Sum of Torques lb-ft
Leg Weight	6908.49					
Bracing Weight	4986.77					
Total Member Self-Weight	11895.26			4083.78	2188.46	
Total Weight	18505.20			4083.78	2188.46	
Wind 0 deg - No Ice		0.00	-14932.16	-992849.17	2188.46	-1970.16
Wind 30 deg - No Ice		6924.60	-12070.96	-811585.12	-463166.62	301.97
Wind 60 deg - No Ice		11354.12	-6609.47	-450018.27	-772611.91	1343.97
Wind 90 deg - No Ice		13105.91	-14.55	2264.88	-895417.76	2273.37
Wind 120 deg - No Ice		12220.43	7100.03	486697.86	-824074.83	3658.21
Wind 150 deg - No Ice		6932.43	12066.48	819193.02	-464146.03	3886.87
Wind 180 deg - No Ice		0.00	13916.34	939655.30	2188.46	1970.16
Wind 210 deg - No Ice		-6932.43	12066.48	819193.02	468522.95	-272.43
Wind 240 deg - No Ice		-12220.43	7100.03	486697.86	828451.76	-1338.15
Wind 270 deg - No Ice		-13105.91	-14.55	2264.88	899794.68	-2273.37
Wind 300 deg - No Ice		-11354.12	-6609.47	-450018.27	776988.84	-3664.03
Wind 330 deg - No Ice		-6924.60	-12070.96	-811585.12	467543.54	-3916.40
Total Weight	18505.20			4083.78	2188.46	
Wind 0 deg - Service		0.00	-5901.29	-394216.78	170.26	-778.62
Wind 30 deg - Service		2736.65	-4770.53	-322579.95	-183741.33	119.34
Wind 60 deg - Service		4487.23	-2612.11	-179686.20	-306036.29	531.15
Wind 90 deg - Service		5179.55	-5.75	-940.72	-354570.02	898.45
Wind 120 deg - Service		4829.60	2805.98	190510.59	-326374.79	1445.75
Wind 150 deg - Service		2739.75	4768.76	321915.01	-184128.40	1536.12
Wind 180 deg - Service		0.00	5499.84	369522.55	170.26	778.62
Wind 210 deg - Service		-2739.75	4768.76	321915.01	184468.92	-107.67
Wind 240 deg - Service		-4829.60	2805.98	190510.59	326715.31	-528.85
Wind 270 deg - Service		-5179.55	-5.75	-940.72	354910.54	-898.45
Wind 300 deg - Service		-4487.23	-2612.11	-179686.20	306376.80	-1448.05
Wind 330 deg - Service		-2736.65	-4770.53	-322579.95	184081.85	-1547.79

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.6 Wind 0 deg - No Ice
3	0.9 Dead+1.6 Wind 0 deg - No Ice
4	1.2 Dead+1.6 Wind 30 deg - No Ice
5	0.9 Dead+1.6 Wind 30 deg - No Ice
6	1.2 Dead+1.6 Wind 60 deg - No Ice
7	0.9 Dead+1.6 Wind 60 deg - No Ice
8	1.2 Dead+1.6 Wind 90 deg - No Ice
9	0.9 Dead+1.6 Wind 90 deg - No Ice
10	1.2 Dead+1.6 Wind 120 deg - No Ice
11	0.9 Dead+1.6 Wind 120 deg - No Ice
12	1.2 Dead+1.6 Wind 150 deg - No Ice
13	0.9 Dead+1.6 Wind 150 deg - No Ice
14	1.2 Dead+1.6 Wind 180 deg - No Ice
15	0.9 Dead+1.6 Wind 180 deg - No Ice
16	1.2 Dead+1.6 Wind 210 deg - No Ice
17	0.9 Dead+1.6 Wind 210 deg - No Ice
18	1.2 Dead+1.6 Wind 240 deg - No Ice
19	0.9 Dead+1.6 Wind 240 deg - No Ice
20	1.2 Dead+1.6 Wind 270 deg - No Ice
21	0.9 Dead+1.6 Wind 270 deg - No Ice
22	1.2 Dead+1.6 Wind 300 deg - No Ice
23	0.9 Dead+1.6 Wind 300 deg - No Ice
24	1.2 Dead+1.6 Wind 330 deg - No Ice
25	0.9 Dead+1.6 Wind 330 deg - No Ice
26	Dead+Wind 0 deg - Service
27	Dead+Wind 30 deg - Service
28	Dead+Wind 60 deg - Service
29	Dead+Wind 90 deg - Service
30	Dead+Wind 120 deg - Service
31	Dead+Wind 150 deg - Service
32	Dead+Wind 180 deg - Service
33	Dead+Wind 210 deg - Service
34	Dead+Wind 240 deg - Service
35	Dead+Wind 270 deg - Service
36	Dead+Wind 300 deg - Service
37	Dead+Wind 330 deg - Service

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
Leg C	Max. Vert	18	138757.49	11931.09	-6779.23
	Max. H_x	18	138757.49	11931.09	-6779.23
	Max. H_z	5	-105112.18	-8934.65	6207.31
	Min. Vert	7	-117046.37	-10348.99	5872.95
	Min. H_x	7	-117046.37	-10348.99	5872.95
	Min. H_z	18	138757.49	11931.09	-6779.23
Leg B	Max. Vert	10	138368.44	-12007.17	-6636.09
	Max. H_x	23	-117338.16	10430.82	5739.76
	Max. H_z	25	-105403.97	9060.75	5997.44
	Min. Vert	23	-117338.16	10430.82	5739.76
	Min. H_x	10	138368.44	-12007.17	-6636.09
	Min. H_z	10	138368.44	-12007.17	-6636.09

Location	Condition	Gov. Load Comb.	Vertical lb	Horizontal, X lb	Horizontal, Z lb
Leg A	Max. Vert	2	143416.70	-138.06	14427.68
	Max. H_x	21	5486.11	1558.47	396.44
	Max. H_z	2	143416.70	-138.06	14427.68
	Min. Vert	15	-122799.06	132.31	-12604.22
	Min. H_x	8	7231.84	-1564.22	523.49
	Min. H_z	15	-122799.06	132.31	-12604.22

Tower Mast Reaction Summary

Load Combination	Vertical lb	$Shear_x$ lb	$Shear_z$ lb	Overturning Moment, M_x lb-ft	Overturning Moment, M_z lb-ft	Torque lb-ft
Dead Only	18505.20	-0.00	0.00	4083.76	2188.42	-0.00
1.2 Dead+1.6 Wind 0 deg - No Ice	22206.24	-0.00	-23891.47	-1590193.61	2626.10	-3152.08
0.9 Dead+1.6 Wind 0 deg - No Ice	16654.68	-0.00	-23891.47	-1591418.74	1969.58	-3152.08
1.2 Dead+1.6 Wind 30 deg - No Ice	22206.24	11079.36	-19313.54	-1300170.88	-741942.67	483.25
0.9 Dead+1.6 Wind 30 deg - No Ice	16654.68	11079.36	-19313.54	-1301396.01	-742599.20	483.25
1.2 Dead+1.6 Wind 60 deg - No Ice	22206.24	18166.60	-10575.16	-721663.42	-1237055.57	2150.35
0.9 Dead+1.6 Wind 60 deg - No Ice	16654.68	18166.60	-10575.16	-722888.55	-1237712.10	2150.35
1.2 Dead+1.6 Wind 90 deg - No Ice	22206.24	20969.46	-23.28	1990.26	-1433545.10	3637.29
0.9 Dead+1.6 Wind 90 deg - No Ice	16654.68	20969.46	-23.28	765.13	-1434201.63	3637.29
1.2 Dead+1.6 Wind 120 deg - No Ice	22206.24	19552.69	11360.06	777083.72	-1319396.32	5852.95
0.9 Dead+1.6 Wind 120 deg - No Ice	16654.68	19552.69	11360.06	775858.60	-1320052.85	5852.95
1.2 Dead+1.6 Wind 150 deg - No Ice	22206.24	11091.90	19306.38	1309076.44	-743509.73	6218.78
0.9 Dead+1.6 Wind 150 deg - No Ice	16654.68	11091.90	19306.38	1307851.31	-744166.26	6218.78
1.2 Dead+1.6 Wind 180 deg - No Ice	22206.24	-0.00	22266.16	1501816.24	2626.10	3152.08
0.9 Dead+1.6 Wind 180 deg - No Ice	16654.68	-0.00	22266.16	1500591.12	1969.58	3152.08
1.2 Dead+1.6 Wind 210 deg - No Ice	22206.24	-11091.90	19306.38	1309076.44	748761.94	-435.99
0.9 Dead+1.6 Wind 210 deg - No Ice	16654.68	-11091.90	19306.38	1307851.31	748105.41	-435.99
1.2 Dead+1.6 Wind 240 deg - No Ice	22206.24	-19552.69	11360.06	777083.72	1324648.53	-2141.04
0.9 Dead+1.6 Wind 240 deg - No Ice	16654.68	-19552.69	11360.06	775858.60	1323992.01	-2141.04
1.2 Dead+1.6 Wind 270 deg - No Ice	22206.24	-20969.46	-23.28	1990.26	1438797.31	-3637.29
0.9 Dead+1.6 Wind 270 deg - No Ice	16654.68	-20969.46	-23.28	765.13	1438140.78	-3637.29
1.2 Dead+1.6 Wind 300 deg - No Ice	22206.24	-18166.60	-10575.16	-721663.42	1242307.78	-5862.26
0.9 Dead+1.6 Wind 300 deg - No Ice	16654.68	-18166.60	-10575.16	-722888.55	1241651.26	-5862.26

Load Combination	Vertical	$Shear_x$	$Shear_z$	Overturning Moment, M_x	Overturning Moment, M_z	Torque
	lb	lb	lb	lb-ft	lb-ft	lb-ft
1.2 Dead+1.6 Wind 330 deg - No Ice	22206.24	-11079.36	-19313.54	-1300170.88	747194.88	-6266.03
0.9 Dead+1.6 Wind 330 deg - No Ice	16654.68	-11079.36	-19313.54	-1301396.01	746538.35	-6266.03
Dead+Wind 0 deg - Service	18505.20	-0.00	-5901.30	-389911.49	2188.42	-778.58
Dead+Wind 30 deg - Service	18505.20	2736.65	-4770.53	-318274.60	-181723.33	119.36
Dead+Wind 60 deg - Service	18505.20	4487.23	-2612.11	-175380.72	-304018.39	531.15
Dead+Wind 90 deg - Service	18505.20	5179.55	-5.75	3364.91	-352552.17	898.43
Dead+Wind 120 deg - Service	18505.20	4829.60	2805.98	194816.40	-324356.92	1445.70
Dead+Wind 150 deg - Service	18505.20	2739.75	4768.76	326220.93	-182110.40	1536.06
Dead+Wind 180 deg - Service	18505.20	-0.00	5499.84	373828.51	2188.42	778.58
Dead+Wind 210 deg - Service	18505.20	-2739.75	4768.76	326220.93	186487.24	-107.69
Dead+Wind 240 deg - Service	18505.20	-4829.60	2805.98	194816.40	328733.76	-528.85
Dead+Wind 270 deg - Service	18505.20	-5179.55	-5.75	3364.91	356929.00	-898.43
Dead+Wind 300 deg - Service	18505.20	-4487.23	-2612.11	-175380.72	308395.23	-1448.00
Dead+Wind 330 deg - Service	18505.20	-2736.65	-4770.53	-318274.60	186100.17	-1547.74

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX lb	PY lb	PZ lb	PX lb	PY lb	PZ lb	% Error
1	0.00	-18505.20	0.00	0.00	18505.20	-0.00	0.000%
2	-0.00	-22206.24	-23891.46	0.00	22206.24	23891.47	0.000%
3	-0.00	-16654.68	-23891.46	0.00	16654.68	23891.47	0.000%
4	11079.36	-22206.24	-19313.53	-11079.36	22206.24	19313.54	0.000%
5	11079.36	-16654.68	-19313.53	-11079.36	16654.68	19313.54	0.000%
6	18166.59	-22206.24	-10575.15	-18166.60	22206.24	10575.16	0.000%
7	18166.59	-16654.68	-10575.15	-18166.60	16654.68	10575.16	0.000%
8	20969.45	-22206.24	-23.28	-20969.46	22206.24	23.28	0.000%
9	20969.45	-16654.68	-23.28	-20969.46	16654.68	23.28	0.000%
10	19552.68	-22206.24	11360.05	-19552.69	22206.24	-11360.06	0.000%
11	19552.68	-16654.68	11360.05	-19552.69	16654.68	-11360.06	0.000%
12	11091.89	-22206.24	19306.37	-11091.90	22206.24	-19306.38	0.000%
13	11091.89	-16654.68	19306.37	-11091.90	16654.68	-19306.38	0.000%
14	0.00	-22206.24	22266.14	0.00	22206.24	-22266.16	0.000%
15	0.00	-16654.68	22266.14	0.00	16654.68	-22266.16	0.000%
16	-11091.89	-22206.24	19306.37	11091.90	22206.24	-19306.38	0.000%
17	-11091.89	-16654.68	19306.37	11091.90	16654.68	-19306.38	0.000%
18	-19552.68	-22206.24	11360.05	19552.69	22206.24	-11360.06	0.000%
19	-19552.68	-16654.68	11360.05	19552.69	16654.68	-11360.06	0.000%
20	-20969.45	-22206.24	-23.28	20969.46	22206.24	23.28	0.000%
21	-20969.45	-16654.68	-23.28	20969.46	16654.68	23.28	0.000%
22	-18166.59	-22206.24	-10575.15	18166.60	22206.24	10575.16	0.000%
23	-18166.59	-16654.68	-10575.15	18166.60	16654.68	10575.16	0.000%
24	-11079.36	-22206.24	-19313.53	11079.36	22206.24	19313.54	0.000%
25	-11079.36	-16654.68	-19313.53	11079.36	16654.68	19313.54	0.000%
26	-0.00	-18505.20	-5901.29	0.00	18505.20	5901.30	0.000%
27	2736.65	-18505.20	-4770.53	-2736.65	18505.20	4770.53	0.000%
28	4487.23	-18505.20	-2612.11	-4487.23	18505.20	2612.11	0.000%
29	5179.55	-18505.20	-5.75	-5179.55	18505.20	5.75	0.000%
30	4829.60	-18505.20	2805.98	-4829.60	18505.20	-2805.98	0.000%
31	2739.75	-18505.20	4768.76	-2739.75	18505.20	-4768.76	0.000%
32	0.00	-18505.20	5499.84	0.00	18505.20	-5499.84	0.000%
33	-2739.75	-18505.20	4768.76	2739.75	18505.20	-4768.76	0.000%
34	-4829.60	-18505.20	2805.98	4829.60	18505.20	-2805.98	0.000%
35	-5179.55	-18505.20	-5.75	5179.55	18505.20	5.75	0.000%
36	-4487.23	-18505.20	-2612.11	4487.23	18505.20	2612.11	0.000%

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX lb	PY lb	PZ lb	PX lb	PY lb	PZ lb	% Error
37	-2736.65	-18505.20	-4770.53	2736.65	18505.20	4770.53	0.000%

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	130 - 120	1.854	26	0.1104	0.0120
T2	120 - 100	1.622	26	0.1099	0.0118
T3	100 - 80	1.172	26	0.0987	0.0099
T4	80 - 60	0.779	26	0.0830	0.0076
T5	60 - 40	0.449	26	0.0629	0.0054
T6	40 - 20	0.209	26	0.0406	0.0035
T7	20 - 0	0.063	26	0.0193	0.0018

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
130.00	4' Lightning Rod	26	1.854	0.1104	0.0120	Inf
125.00	4' Grid	26	1.738	0.1105	0.0119	Inf
115.00	Standoff Mount	26	1.506	0.1082	0.0115	221370
100.00	Standoff Mount	26	1.172	0.0987	0.0099	72124
87.00	(2) TMBXX-6516 w/ Mt. Pipe	26	0.910	0.0889	0.0085	82349
72.00	(3) 4ft x 1ft x 6in Antenna w/ Mount Pipe	26	0.638	0.0755	0.0067	67711

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
T1	130 - 120	7.549	3	0.4487	0.0484
T2	120 - 100	6.607	3	0.4469	0.0478
T3	100 - 80	4.777	3	0.4020	0.0399
T4	80 - 60	3.175	3	0.3384	0.0309
T5	60 - 40	1.828	3	0.2567	0.0220
T6	40 - 20	0.849	3	0.1658	0.0140
T7	20 - 0	0.257	3	0.0786	0.0073

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
130.00	4' Lightning Rod	3	7.549	0.4487	0.0484	509926
125.00	4' Grid	3	7.078	0.4491	0.0483	509926
115.00	Standoff Mount	3	6.137	0.4402	0.0465	56663
100.00	Standoff Mount	3	4.777	0.4020	0.0399	17880
87.00	(2) TMBXX-6516 w/ Mt. Pipe	3	3.708	0.3623	0.0345	20285
72.00	(3) 4ft x 1ft x 6in Antenna w/ Mount Pipe	3	2.600	0.3078	0.0271	16612

Bolt Design Data

Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt lb	Allowable Load per Bolt lb	Ratio Load / Allowable	Allowable Ratio	Criteria
T1	130	Leg	A325N	1.0000	4	220.03	53014.40	0.004	1	Bolt Tension
		Diagonal	A325N	0.6250	1	583.22	6830.86	0.085	1	Member Block Shear
		Top Girt	A325N	0.6250	1	34.15	12425.20	0.003	1	Bolt Shear
T2	120	Leg	A325N	1.0000	4	2653.26	53014.40	0.050	1	Bolt Tension
		Diagonal	A325N	0.6250	1	1517.10	6830.86	0.222	1	Member Block Shear
T3	100	Leg	A325N	1.0000	4	6225.31	53014.40	0.117	1	Bolt Tension
		Diagonal	A325N	0.6250	1	3004.44	6830.86	0.440	1	Member Block Shear
		Top Girt	A325N	0.6250	1	114.68	6830.86	0.017	1	Member Block Shear
T4	80	Leg	A325N	1.3750	6	8402.81	100230.00	0.084	1	Bolt Tension
		Diagonal	A325N	0.6250	1	4277.22	6830.86	0.626	1	Member Block Shear
T5	60	Leg	A325N	1.3750	6	12739.50	100230.00	0.127	1	Bolt Tension
		Diagonal	A325N	0.8750	1	4015.69	9073.83	0.443	1	Member Block Shear
T6	40	Leg	A325N	1.3750	6	16572.50	100230.00	0.165	1	Bolt Tension
		Diagonal	A325N	0.8750	1	4175.37	12098.40	0.345	1	Member Block Shear
T7	20	Diagonal	A325N	0.8750	1	4388.07	12098.40	0.363	1	Member Block Shear

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	130 - 120	1 3/4	10.00	3.33	91.4 K=1.00	2.4053	-1571.38	58740.50	0.027 [1]
T2	120 - 100	1 3/4	20.00	4.00	109.7	2.4053	-13244.60	44889.40	0.295 [1]

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T3	100 - 80	2 1/4	20.03	4.01	K=1.00 85.4	3.9761	-31284.00	104909.00	0.298 [1]
T4	80 - 60	2 1/2	20.03	5.01	K=1.00 96.1	4.9087	-60161.00	112394.00	0.535 [1]
T5	60 - 40	2 3/4	20.03	5.01	K=1.00 87.4	5.9396	-89096.10	152917.00	0.583 [1]
T6	40 - 20	3	20.03	5.01	K=1.00 80.1	7.0686	-115618.00	198961.00	0.581 [1]
T7	20 - 0	3 1/4	20.03	5.01	K=1.00 73.9 K=1.00	8.2958	-140504.00	250286.00	0.561 [1]

[1] $P_u / \phi P_n$ controls

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	130 - 120	L2x2x3/16	5.60	2.59	89.2 K=1.13	0.7150	-573.97	15245.30	0.038 [1]
T2	120 - 100	L2x2x3/16	6.02	2.79	93.8 K=1.10	0.7150	-1539.71	14577.70	0.106 [1]
T3	100 - 80	L2x2x3/16	7.31	3.53	110.7 K=1.03	0.7150	-3003.37	12156.40	0.247 [1]
T4	80 - 60	L2x2x3/16	9.33	4.55	138.7 K=1.00	0.7150	-4037.92	8393.91	0.481 [1]
T5	60 - 40	L2 1/2x2 1/2x3/16	10.89	5.29	128.3 K=1.00	0.9020	-4035.86	12286.00	0.328 [1]
T6	40 - 20	L2 1/2x2 1/2x1/4	12.52	6.09	148.9 K=1.00	1.1900	-4198.63	12118.70	0.346 [1]
T7	20 - 0	L2 1/2x2 1/2x1/4	14.19	6.92	169.1 K=1.00	1.1900	-4470.81	9405.72	0.475 [1]

[1] $P_u / \phi P_n$ controls

Top Girt Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	130 - 120	L2x2x3/16	4.50	4.11	125.3 K=1.00	0.7150	-34.15	10134.40	0.003 [1]
T3	100 - 80	L2x2x3/16	4.50	4.11	125.3 K=1.00	0.7150	-116.63	10134.40	0.012 [1]

[1] $P_u / \phi P_n$ controls

Tension Checks

Leg Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	130 - 120	1 3/4	10.00	3.33	91.4	2.4053	880.13	108238.00	0.008 [1]
T2	120 - 100	1 3/4	20.00	4.00	109.7	2.4053	10613.00	108238.00	0.098 [1]
T3	100 - 80	2 1/4	20.03	4.01	85.4	3.9761	24901.30	178924.00	0.139 [1]
T4	80 - 60	2 1/2	20.03	5.01	96.1	4.9087	50416.90	220893.00	0.228 [1]
T5	60 - 40	2 3/4	20.03	5.01	87.4	5.9396	76436.70	267281.00	0.286 [1]
T6	40 - 20	3	20.03	5.01	80.1	7.0686	99435.10	318086.00	0.313 [1]
T7	20 - 0	3 1/4	20.03	5.01	73.9	8.2958	120387.00	373310.00	0.322 [1]

[1] P_u / ϕP_n controls

Diagonal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	130 - 120	L2x2x3/16	5.60	2.59	52.7	0.4308	583.22	18739.00	0.031 [1]
T2	120 - 100	L2x2x3/16	6.02	2.79	56.7	0.4308	1517.10	18739.00	0.081 [1]
T3	100 - 80	L2x2x3/16	7.31	3.53	71.0	0.4308	3004.44	18739.00	0.160 [1]
T4	80 - 60	L2x2x3/16	8.95	4.37	87.3	0.4308	4277.22	18739.00	0.228 [1]
T5	60 - 40	L2 1/2x2 1/2x3/16	9.71	4.71	74.9	0.5359	4015.69	23310.60	0.172 [1]
T6	40 - 20	L2 1/2x2 1/2x1/4	12.52	6.09	97.5	0.7050	4175.37	30667.50	0.136 [1]
T7	20 - 0	L2 1/2x2 1/2x1/4	14.19	6.92	110.3	0.7050	4388.07	30667.50	0.143 [1]

[1] P_u / ϕP_n controls

Top Girt Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	130 - 120	L2x2x3/16	4.50	4.11	84.7	0.4308	17.83	18739.00	0.001 [1]
T3	100 - 80	L2x2x3/16	4.50	4.11	84.7	0.4308	114.68	18739.00	0.006 [1]

[1] P_u / ϕP_n controls

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	øP$_{allow}$ lb	% Capacity	Pass Fail
T1	130 - 120	Leg	1 3/4	3	-1571.38	58740.50	2.7	Pass
T2	120 - 100	Leg	1 3/4	27	-13244.60	44889.40	29.5	Pass
T3	100 - 80	Leg	2 1/4	60	-31284.00	104909.00	29.8	Pass
T4	80 - 60	Leg	2 1/2	96	-60161.00	112394.00	53.5	Pass
T5	60 - 40	Leg	2 3/4	123	-89096.10	152917.00	58.3	Pass
T6	40 - 20	Leg	3	150	-115618.00	198961.00	58.1	Pass
T7	20 - 0	Leg	3 1/4	177	-140504.00	250286.00	56.1	Pass
T1	130 - 120	Diagonal	L2x2x3/16	12	-573.97	15245.30	3.8 8.5 (b)	Pass
T2	120 - 100	Diagonal	L2x2x3/16	33	-1539.71	14577.70	10.6 22.2 (b)	Pass
T3	100 - 80	Diagonal	L2x2x3/16	68	-3003.37	12156.40	24.7 44.0 (b)	Pass
T4	80 - 60	Diagonal	L2x2x3/16	101	-4037.92	8393.91	48.1 62.6 (b)	Pass
T5	60 - 40	Diagonal	L2 1/2x2 1/2x3/16	128	-4035.86	12286.00	32.8 44.3 (b)	Pass
T6	40 - 20	Diagonal	L2 1/2x2 1/2x1/4	155	-4198.63	12118.70	34.6	Pass
T7	20 - 0	Diagonal	L2 1/2x2 1/2x1/4	182	-4470.81	9405.72	47.5	Pass
T1	130 - 120	Top Girt	L2x2x3/16	6	-34.15	10134.40	0.3	Pass
T3	100 - 80	Top Girt	L2x2x3/16	63	-116.63	10134.40	1.2 1.7 (b)	Pass
							Summary	
							Leg (T5) 58.3	Pass
							Diagonal (T4) 62.6	Pass
							Top Girt (T3) 1.7	Pass
							Bolt Checks 62.6	Pass
							RATING = 62.6	**Pass**

APPENDIX B

ADDITIONAL CALCULATIONS

CCIplate

Project Information

BU #	
Site Name	DN03433C
Order #	

Tower Information

Tower Type	Self Support
TIA-222 Rev	G

☐ Load Z Normalization

Applied Loads

	Comp.	Uplift
Axial (k)	143.42	122.80
Shear (k)	14.43	12.61

Anchor Rod Data

Quantity:	4
Diameter (in):	1.75
Material Grade:	A572-50
Grout Considered:	No
l_{ar} (in):	1.75
Eta Factor, η:	0.5
Thread Type:	N-Included
Configuration:	Symmetrical

Fy=50 ksi Fu=65 ksi

Anchor Rod Results

Axial, Pu_c (kips)	35.85
Shear, Vu (kips)	3.61
Moment, Mu (kip-in)	-
Axial Cap., φPn_t (kips)	98.80
Shear Cap., ϕVn (kips)	-
Moment Cap., ϕMn (kip-in)	-
Stress Rating	43.6%

Pass

APPENDIX C

SITE SUPPORTING DOCUMENTS

Hazards by Location

Search Information

Address: 4306 S Wolff St, Denver, CO 80236, USA

Coordinates: 39.6382805, -105.0487551

Elevation: ft

Timestamp: 2019-08-27T19:40:09.874Z

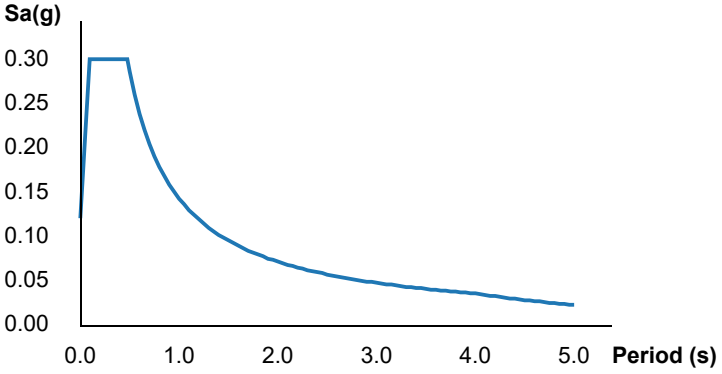
Hazard Type: Seismic

Reference Document: ASCE7-10

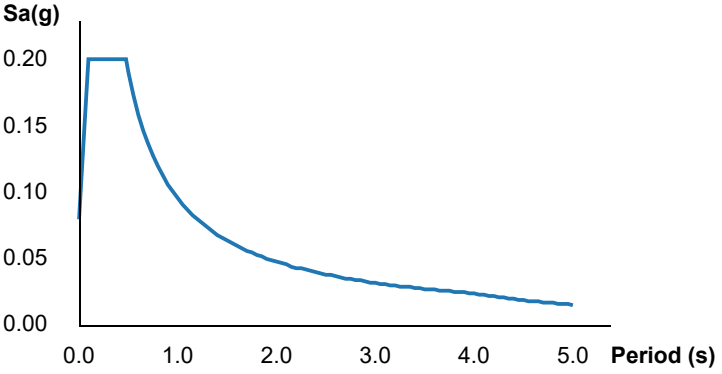
Risk Category: II

Site Class: D

MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.188	MCE_R ground motion (period=0.2s)
S_1	0.06	MCE_R ground motion (period=1.0s)
S_{MS}	0.301	Site-modified spectral acceleration value
S_{M1}	0.143	Site-modified spectral acceleration value
S_{DS}	0.201	Numeric seismic design value at 0.2s SA
S_{D1}	0.096	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2s
F_v	2.4	Site amplification factor at 1.0s

CR_S	0.905	Coefficient of risk (0.2s)
CR_1	0.898	Coefficient of risk (1.0s)
PGA	0.097	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.154	Site modified peak ground acceleration
T_L	4	Long-period transition period (s)
SsRT	0.188	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.208	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.06	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.067	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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Date: **August 23, 2019**

Charlie Augello
Insite Inc.
1S660 Midwest Road, Suite 140
Oakbrook Terrace, IL 60181
P: 720-236-9199

104 Broadway, Suite 600
Denver, CO 80203
P: 303-596-6804

Subject:	**Mount Structural Analysis Report**	
Carrier Designation:	**T-Mobile L600**	
	Carrier Site Number:	**DN03433C**
	Carrier Site Name:	**Denver Fire Station #28**
Site Data:	**4305 S. Wolff Street, Denver, Denver County, CO, 80236**	
	Latitude 39.6381250000° Longitude -105.0487666600°	
Structure Information:	**Structure Height & Type:**	**130ft Self-Support Tower**
	Mount Elevation:	**88.75ft**
	Mount Type:	**13.25ft T-Frame**

Dear Mr. Charlie Augello,

TeleMtn Engineering is pleased to submit this **"Mount Structural Analysis Report"** to determine the structural integrity of the T-Mobile antenna mounting system with the proposed appurtenance and equipment addition on the above-mentioned supporting tower structure. Analysis of the existing supporting tower structure is to be completed by others and therefore is not part of this analysis. Analysis of the antenna mounting system as a tie-off point for fall protection or rigging is not part of this document.

Based on this analysis, it has been determined that the structural capacity of the antenna mounting system that will support the existing and proposed loading to be:

T-Frame (typical) **68.0% Sufficient Capacity**
***Sufficient upon completion of the changes listed in the 'Recommendations' section of this report.**

This analysis has been performed in accordance with the 2015 IBC, and the 2016 Denver Building and Fire Code. This analysis utilizes an ultimate 3-second gust wind speed of 135mph (converted to an equivalent 105mph nominal 3-second gust wind speed per Section 1609.3.1 for use with TIA-222-G). Applicable standard references and design criteria are listed in Section 2) Analysis Criteria.

All new antennas and equipment shall be placed on the structure as shown in the drawings issued by this office. Please contact TeleMtn Engineering with any questions.

We at TeleMtn Engineering appreciate the opportunity of providing our continuing professional services to you and T-Mobile. If you have any questions or need further assistance on this or any other projects, please give us a call.

Mount structural analysis report prepared by: Jacob Leavengood, EIT
Respectfully Submitted by:

Khristopher Scott, PE
Principal Engineer
303-596-6804
kscott@telemtn.com

TABLE OF CONTENTS

1) INTRODUCTION

At the request of T-Mobile, TeleMtn Engineering, LLC has analyzed the existing structure including all proposed and existing loads as listed in section 2 of this report. This analysis has been completed in accordance with all applicable codes and standards as required by the local jurisdiction. If any of the provided information or assumptions incorrectly represents this mount TeleMtn Engineering must be notified immediately to evaluate the significance of the discrepancy.

The existing mounts are 13.25ft T-frames mounted to the supporting tower structure at 88.75ft in (3) sectors. The supporting structure is a 130ft self-support tower. This mount analysis has been completed based on the structural information shown in the mapping report completed by Paul J. Ford Company dated 08/08/2019.

2) ANALYSIS CRITERIA

Building Code:	2015 IBC
TIA-222 Revision:	TIA-222-G
Risk Category:	III
Nominal Wind Speed	105mph $V_{3\text{-sec}}$
Ultimate Wind Speed:	135mph V_{ult}
Exposure Category:	C
Topographic Category & Crest Height:	1 with a crest height of 0ft
Topographic Factor at Base:	1.000
Site Ground Elevation:	5494.63 ft
Ice Thickness:	0in[1]
Wind Speed with Ice:	50mph
Seismic Ss:	0.188[2]
Seismic S1:	0.060
Live Loading Wind Speed:	30mph
Man-Live Load at Mid/End-Points:	250lb
Man-Live Load at Mount Pipes:	500lb

Notes:
1) Per TIA-222-G-4 section 2.6.4, ice loads may be ignored since the design ice thickness is less than or equal to 0.25in.
2) Per TIA-222-G-4 section 2.7.3, seismic effects may be ignored since S_S is less than 1.0g.

Table 1 - Proposed Equipment Configuration

Mount Level (ft)	Appurtenance Level (ft)	Number	Manufacturer	Model	Mount Type
87	87	6	Andrew	TMBXX-6516-A2M Antenna	T-Frame
		3	Commscope	FFHH-65C-R3 Antenna	
		3	Nokia	FRIG RRU	
		3	Commscope	TMAT1921B78-21A TMA	
		3	Nokia	AHLOA RRU	Leg Mounted
		3	Nokia	FHFB RRU	
		2	Raycap	RNSNDC-7771-PF-48 COVP	

3) ANALYSIS PROCEDURE

Table 2 - Documents Provided

Document	Source	Reference	Date
Construction Drawings	TeleMtn Engineering	DN03433C	08/06/2019
Site Walk Pictures	Insite	DN03433C	05/15/2019
RFDS	T-Mobile	DN03433C Ver. 3.1	03/29/2019
Mount Mapping	Paul J. Ford Company	DN03433C	10/29/2018
Structural Analysis Report	Centerline Solutions	TMO-16-0071-19	06/19/2016
Previous Construction Drawings	Centerline Solutions	DN03433C	05/10/2016
Previous Construction Drawings	Centerline Solutions	DN03433C	10/22/2014
Structural Analysis Report	Centerline Solutions	TMO-14-0111-7	10/14/2014

3.1) Analysis Method

RISA-3D (Version 17.0.4), a commercially available analysis software package, was used to create a three-dimensional model of the antenna mounting system and calculate member stresses for various load cases. Selected analysis output is included in Appendices of this report.

MathCAD (Version 3.1 Prime), a commercially available analysis software package, was used to assist in conservative calculations of the antenna mounting system and calculate member stresses and roof pressures. Selected analysis output is included in Appendices of this report.

3.2) Assumptions

1) The antenna mounting system was properly fabricated, installed, and maintained in good condition in accordance with its original design, manufacturer's specifications, and all applicable codes and standards.
2) The configuration of antennas, mounts, and other appurtenances, are as specified in Tables 1 and the referenced drawings.
3) All member connections are assumed to have been designed to meet or exceed the load carrying capacity of the connected member unless otherwise specified in this report.
4) Steel grades have been assumed as follows:

Channel, Solid Round, Angle, Plate	ASTM A36 (GR 36)
HSS (Rectangular)	ASTM 500 (GR B-46)
Pipe	ASTM A53 (GR 35)
Connection Bolts	ASTM A325
Threaded Rods	ASTM A36 (GR 36)

This analysis may be affected if any assumptions are not valid or have been made in error. TeleMtn Engineering should be notified to determine the effect on the structural integrity of the antenna mounting system.

4) ANALYSIS RESULTS

Table 3 - Mount Component Stresses vs. Capacity (T-Frame)

Notes	Component	Mount Level (ft)	Capacity (%)	Pass / Fail
1 & 2	Antenna Mount Pipe - 2in Std. Pipe	87	68.0	Pass
	Cross Arm Pipe - 3in Std. Pipe		58.4	Pass
	Mast Pipe - 4in Std. Pipe		29.8	Pass
	Kicker Pipe - 1-1/2in Std. Pipe		37.8	Pass
	Anchor Bolts - 5/8in A36 Threaded Rods		14.0	Pass

Structure Rating (max from all components) =	59.1%	Sufficient

Notes:
1) See additional documentation in "Appendix C - Analysis Output" for calculations supporting the percent capacity.
2) Capacities listed represent the mount after modifications have been installed.

Table 4 - Mount Displacement and Deflection

Notes	Elevation (ft)	Appurtenance	Deflection			Displacement		
			X-Axis (in)	Y-Axis (in)	Z-Axis (in)	X-Axis (deg)	Y-Axis (deg)	Z-Axis (deg)
1	87	T-Frame	0.264	0.699	0.708	0.189	0.218	0.488

Notes:
1) The deflections listed are the envelope results using the service wind speed listed.
2) Capacities listed represent the mount after modifications have been installed.

4.1) Recommendations

The existing mounts are adequate, with modifications, to support the proposed loads in all sectors.

The existing cross arm pipes are to be removed and replaced with new 160in long, 3in std. (3.5in OD, 0.226in thick) pipes. The antenna mount pipes that the new FFHH-65C-R3 antennas are to be installed on are to be replaced with new 96in long, 2in std. (2.375in OD, 0.154in thick) pipes. The existing antenna pipes and cross over plates may be reused when adding the proposed antennas to the existing mount. However, all U-Bolts that are loosened or removed may NOT be reused and shall be replaced with new 36ksi minimum U-Bolts with matching flat washers, lock washers, and heavy hex nuts.

Please contact TeleMtn Engineering with any questions.

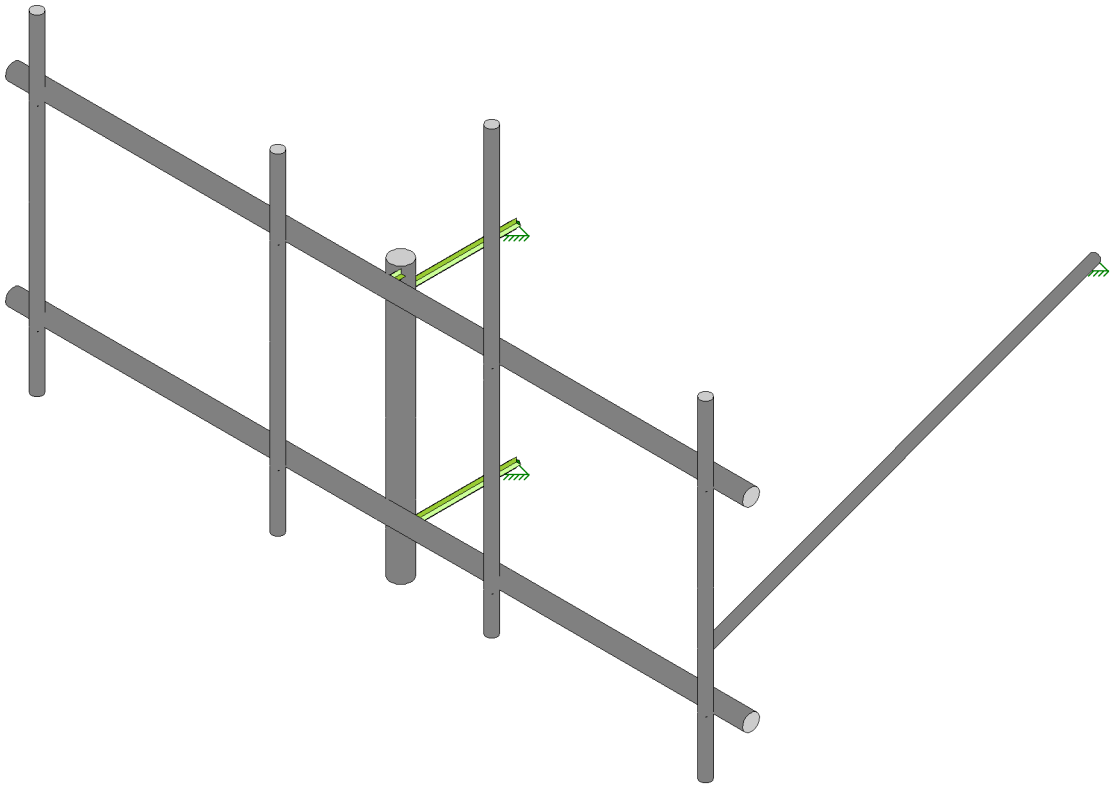
4.2) General Notes

TeleMtn Engineering performed this structural analysis of the mounting frames at which the antennas and equipment attach. These structures are assumed to have been properly constructed and designed in accordance with all applicable codes and standards. For the purpose of this analysis it is assumed that the existing structure is properly maintained per the TIA standard and manufacturer specifications, and is in good condition free of any defects, deterioration, discrepancies, and/or damage. The scope of this analysis is limited to the carrying capacity of the structural members referenced within the calculations of this report.

The General Contractor shall verify the existing dimensions, member sizes, connections, and conditions prior to commencing any work. Any discrepancies or defects shall be called to the attention of TeleMtn Engineering and shall be resolved before proceeding with the work. A contractor experienced in installation procedures and loading should provide temporary bracing, if necessary, for the structure and structural components until all final connections have been completed in accordance with the plans.

APPENDIX A

WIRE FRAME AND RENDERED MODELS



TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 1
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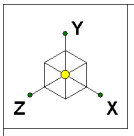

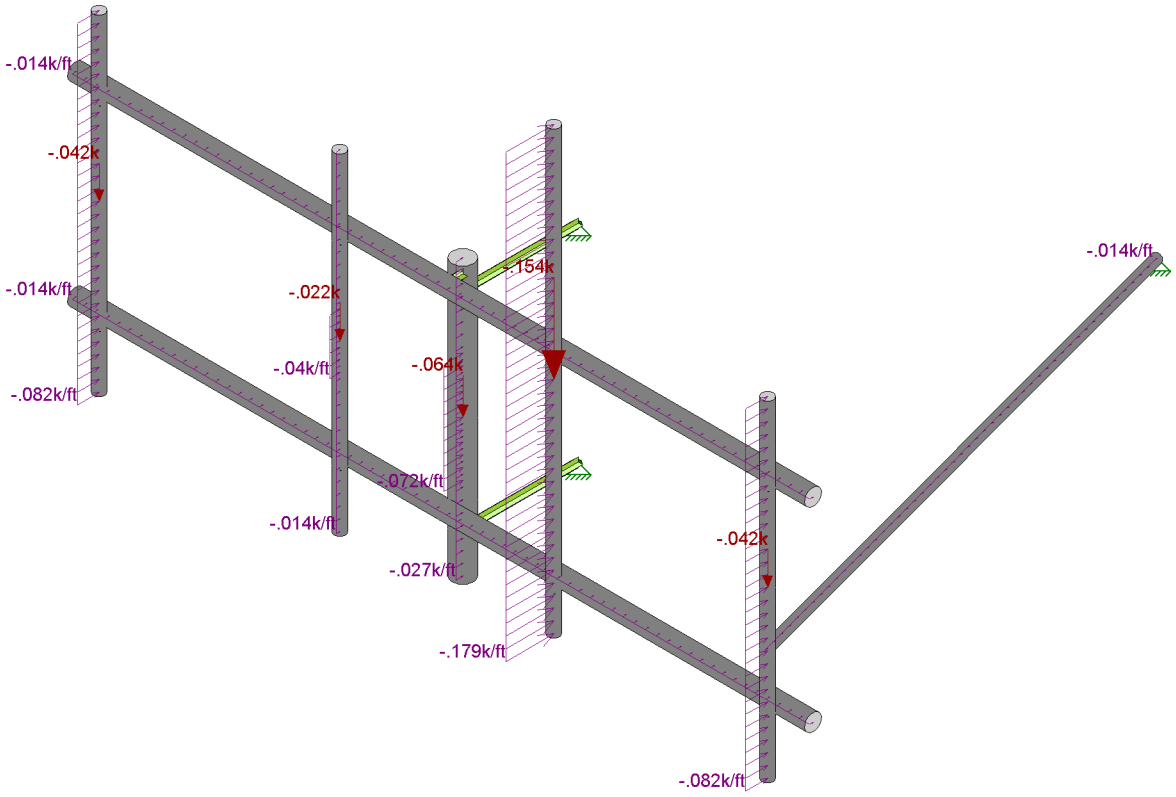

Loads: LC 2, 0 Deg - 1.2D+1.6Wo

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 2
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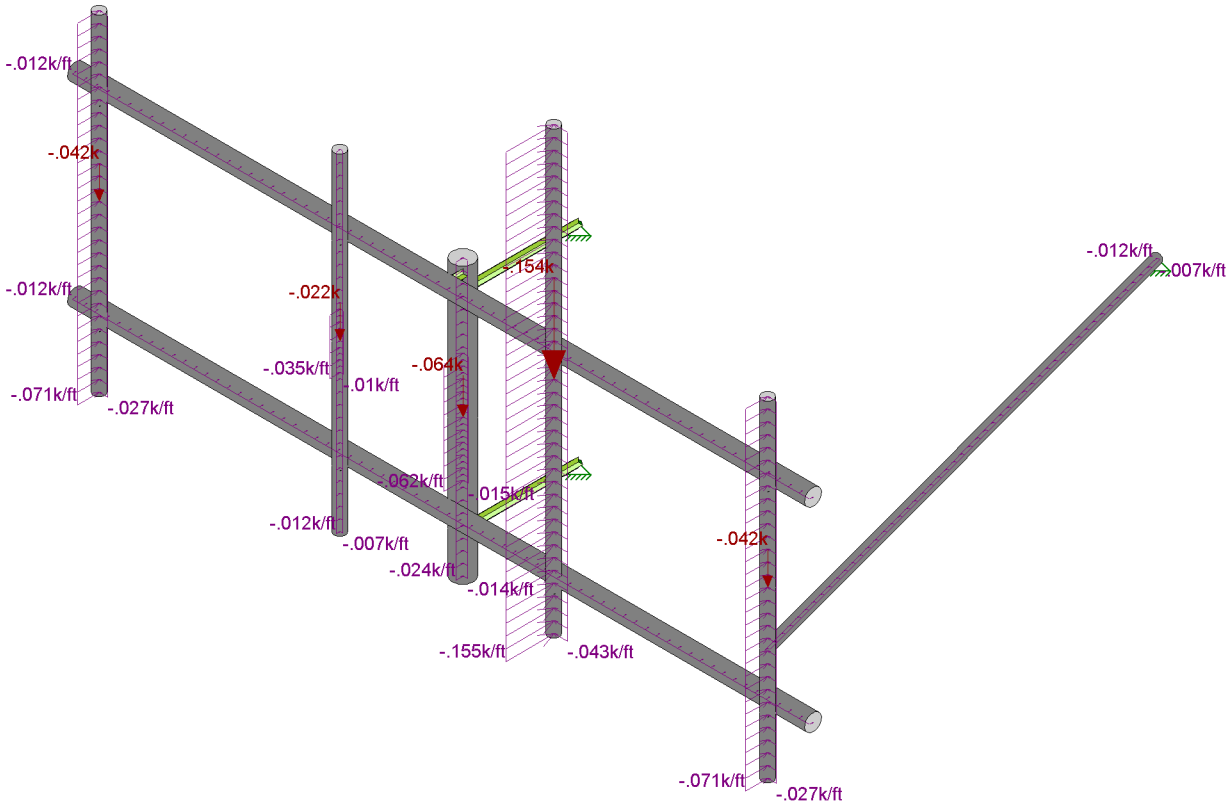

Loads: LC 3, 30 Deg - 1.2D+1.6Wo

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 3
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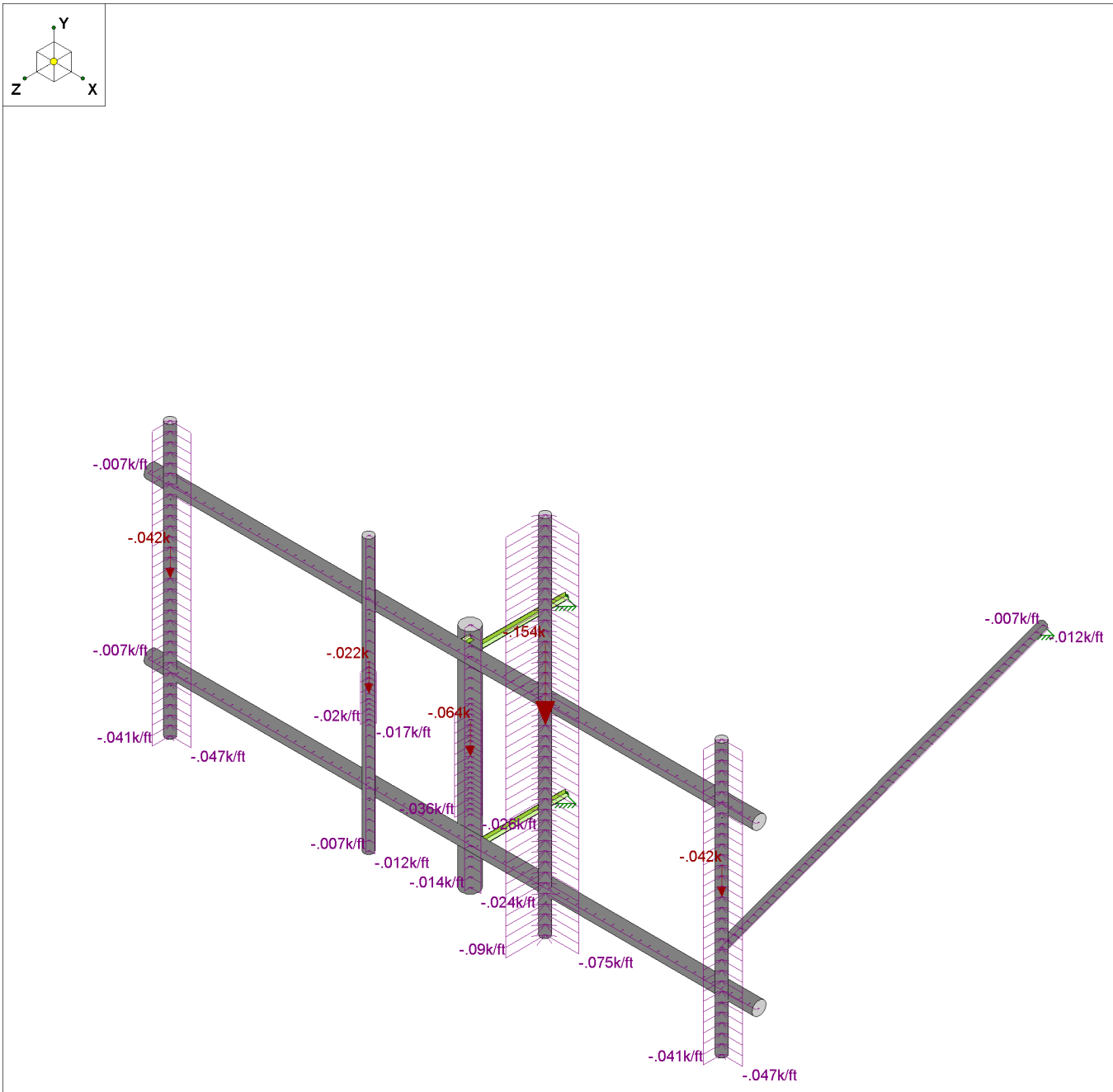

Loads: LC 4, 60 Deg - 1.2D+1.6Wo

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 4
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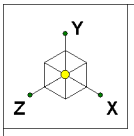

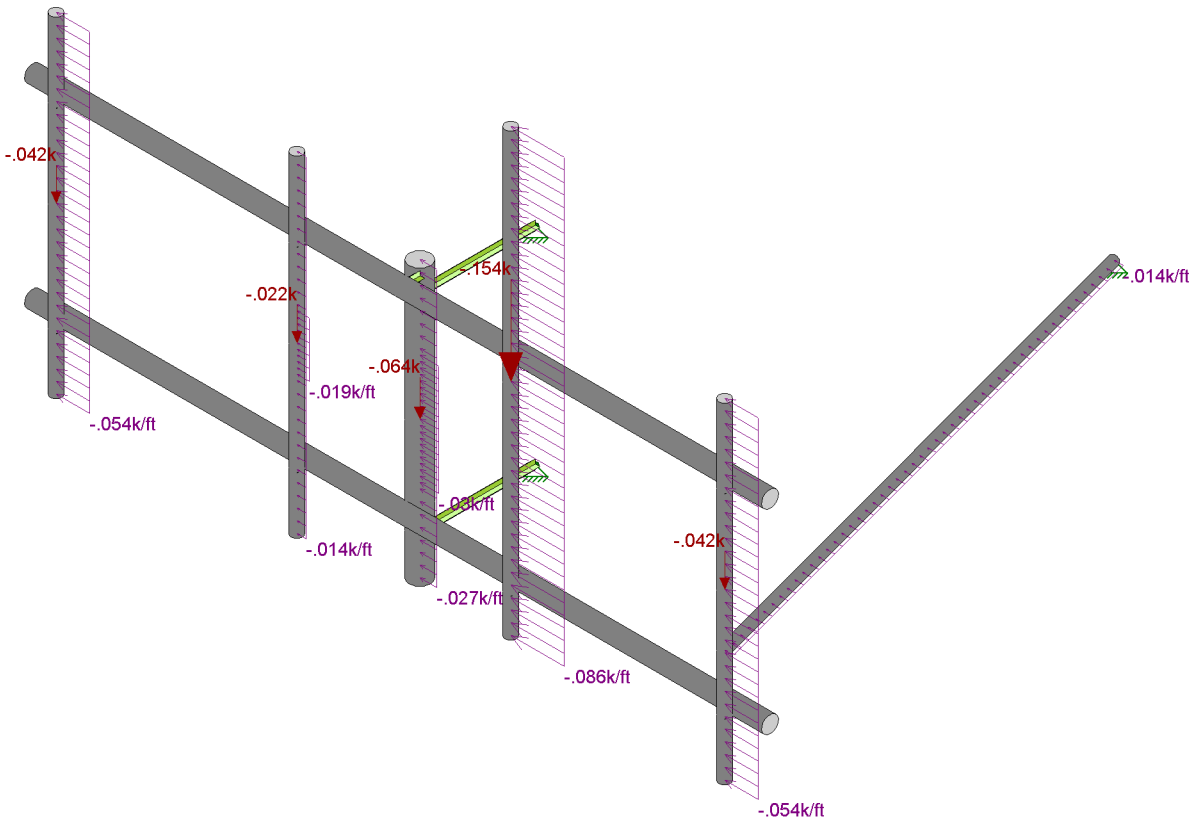

Loads: LC 5, 90 Deg - 1.2D+1.6Wo

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 5
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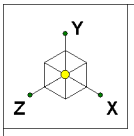

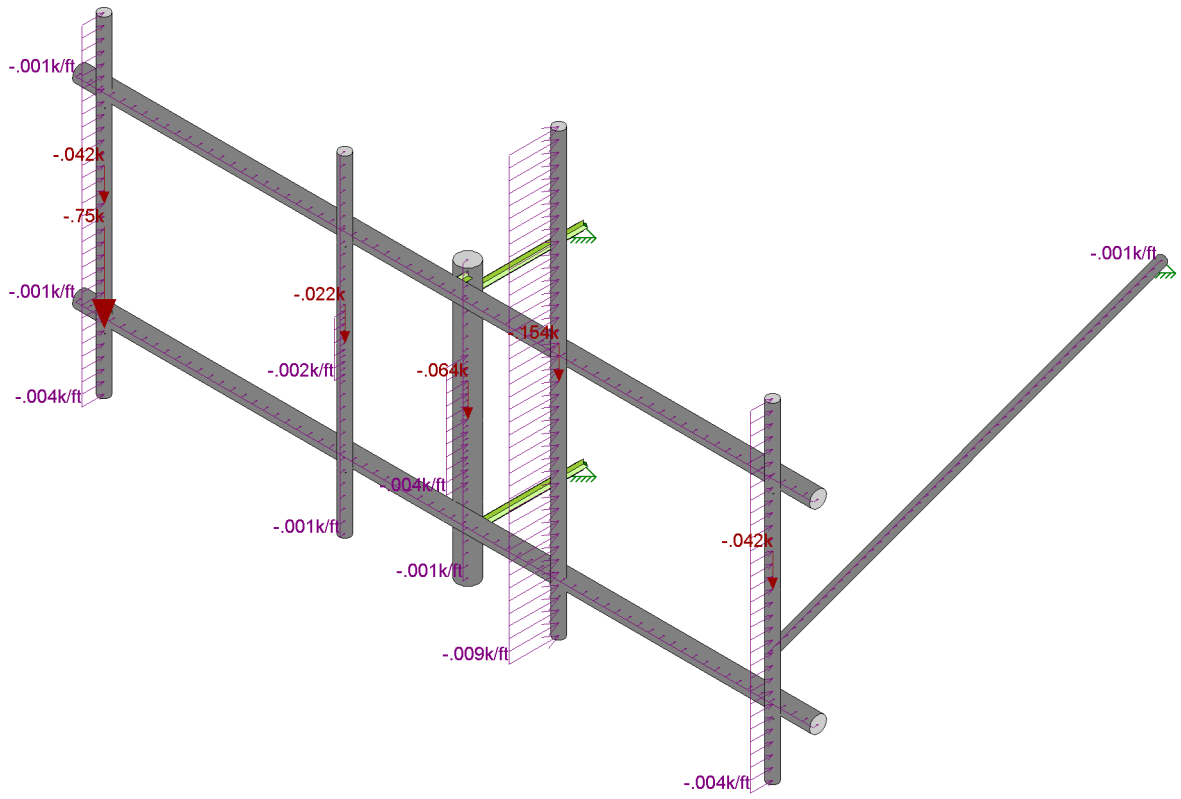

Loads: LC 14, 0 Deg - 1.2D+1.5Lm+1.0Wm

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 6
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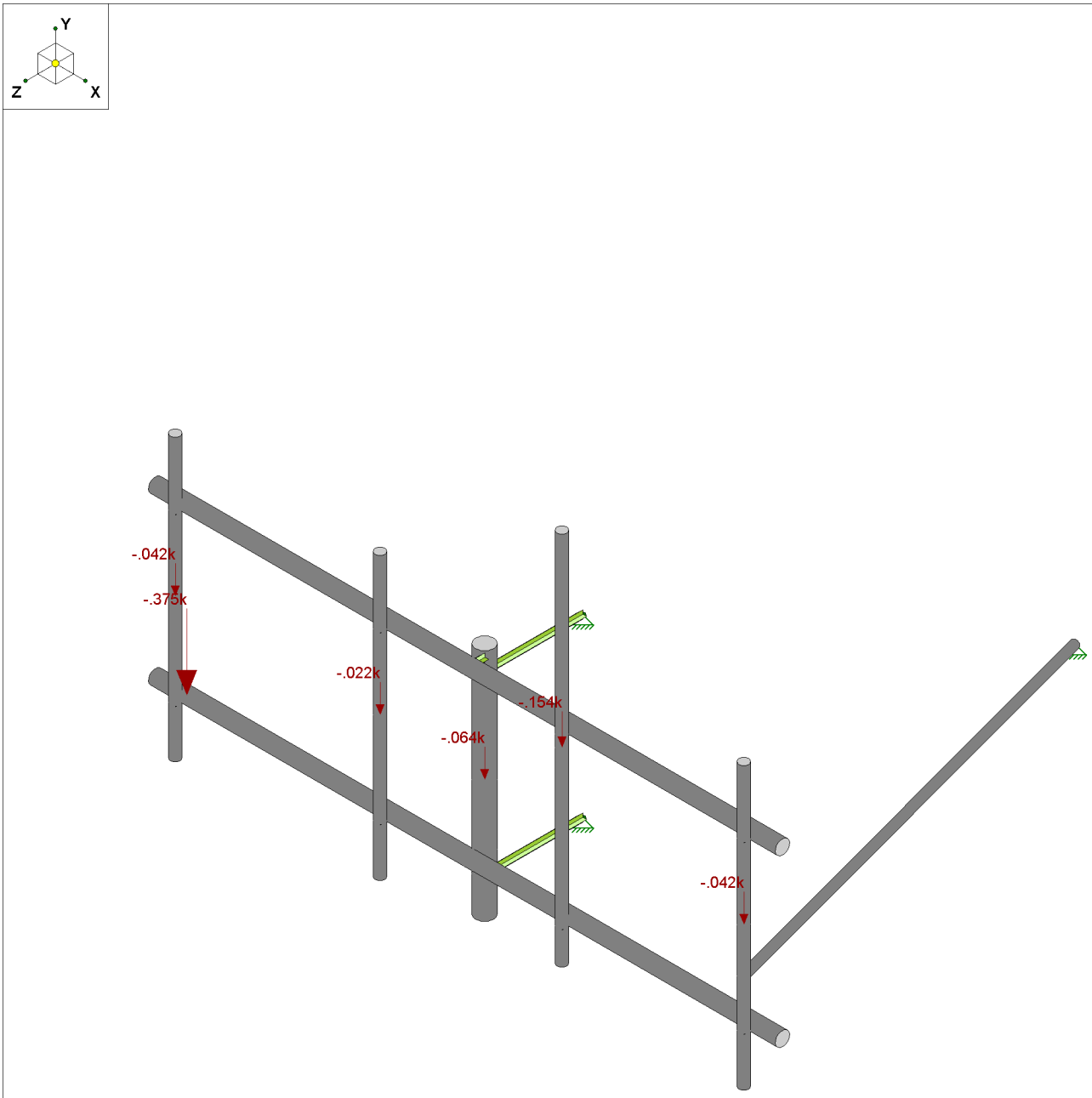

Loads: LC 26, 1.2D+1.5Lv

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 7
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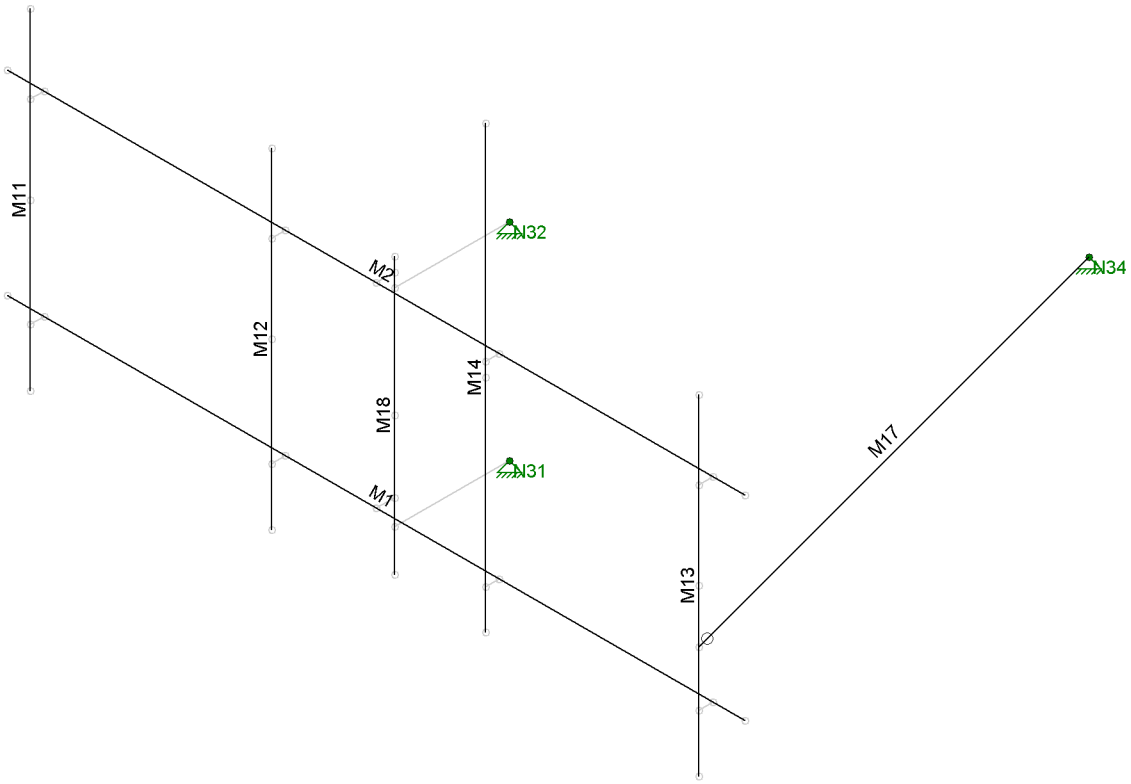

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 8
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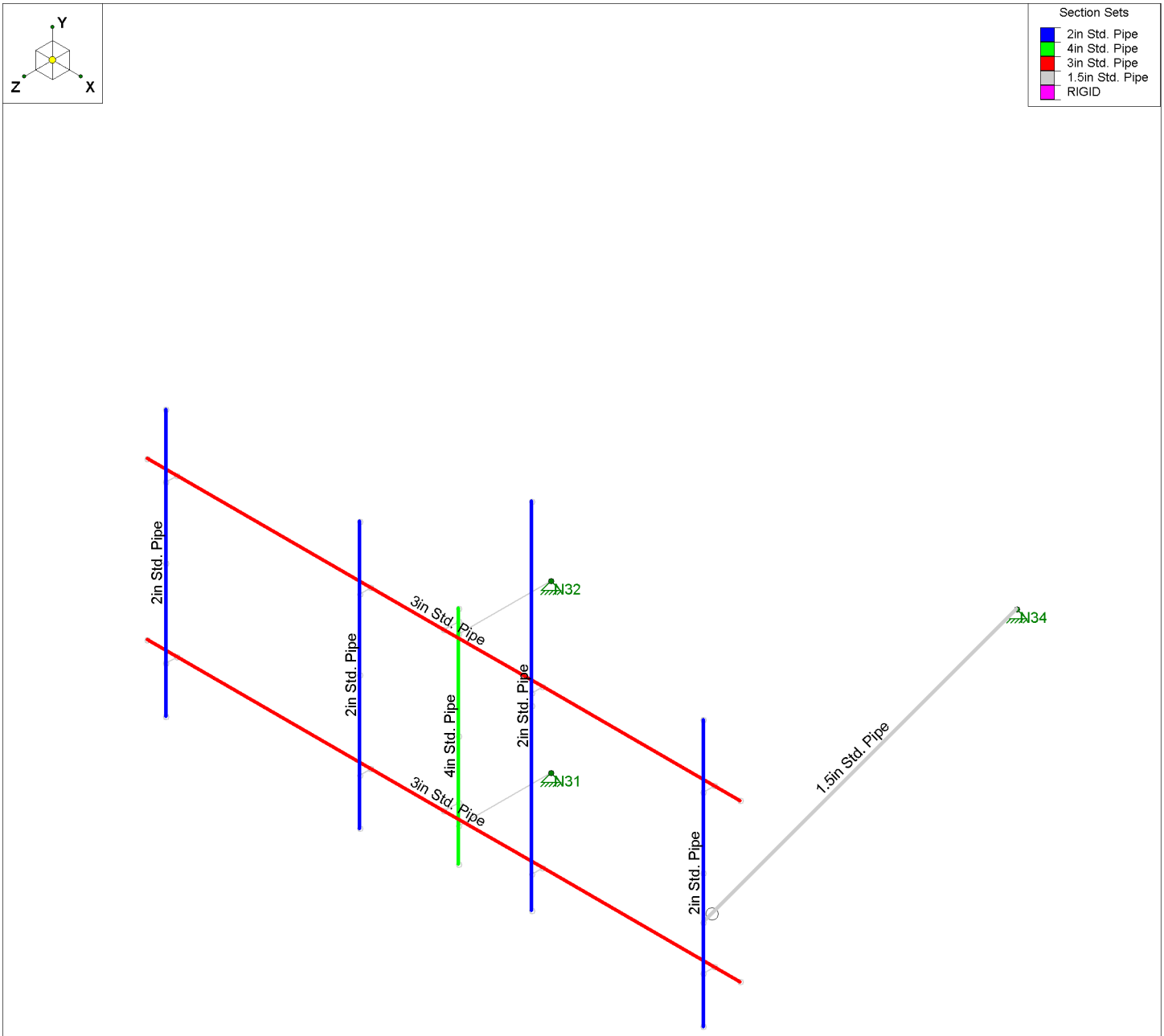

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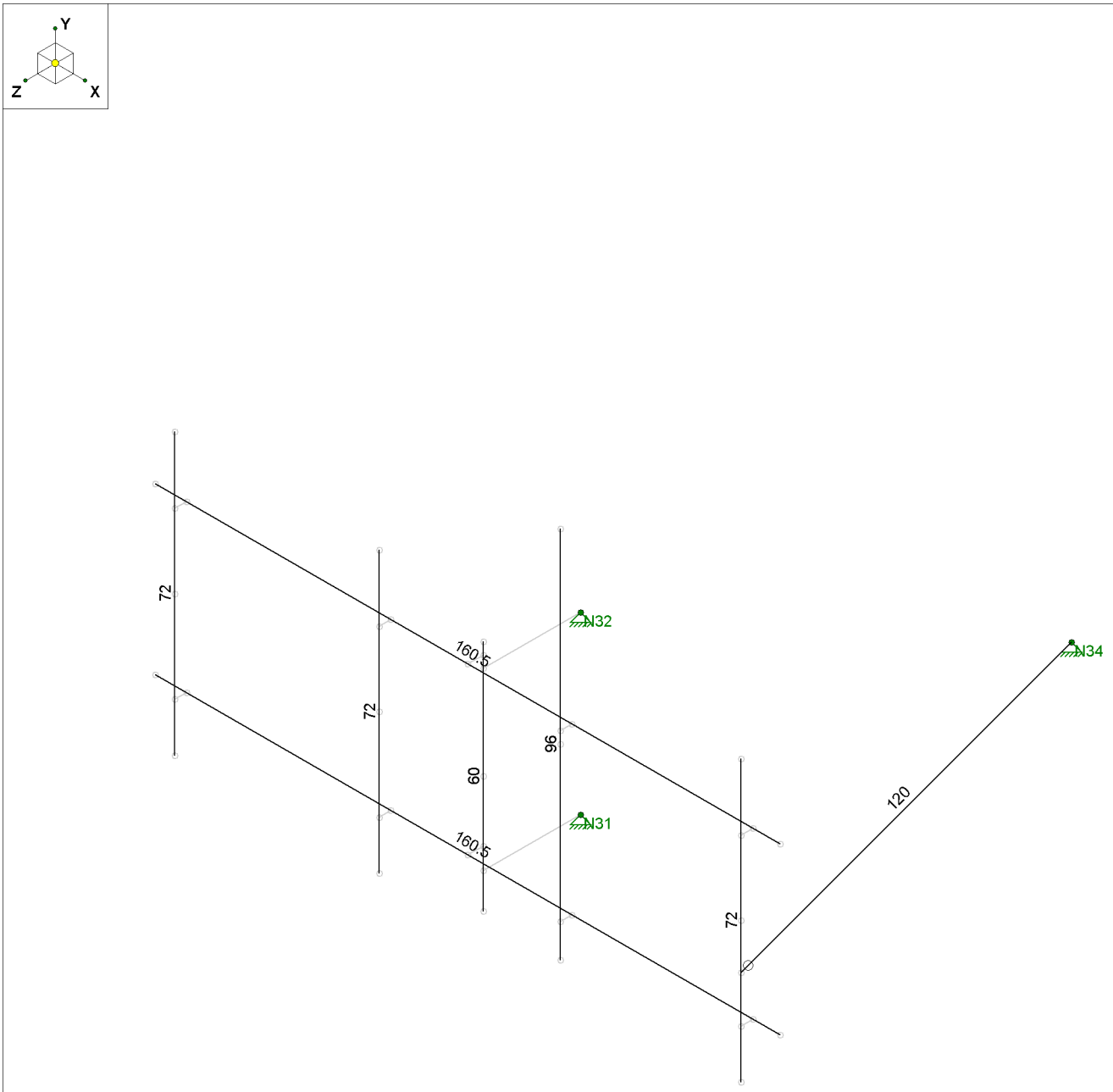

Member Length (in) Displayed

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 10
Jacob Leavengood, EIT		Aug 23, 2019 at 4:28 PM
		DN03433C_RISA_08.22.2019_Modi...

APPENDIX B

SOFTWARE INPUT CALCULATIONS

104 Broadway, Suite 600
Denver, CO 80203
P: 303-596-6804

Mount Analysis: Software Input Calculations

Design Loads:

Wind Load Factor, Design Wind:	$W \equiv 1.6$	TIA 2.3.2	
Wind Load Factor, Iced Conditions:	$W_i \equiv 1.0$		
Wind Load Factor, Live Loads:	$W_l \equiv 1.0$		
Wind 3-Sec Gust, Design Speed:	$V \equiv 105$	mph	(Equivalent to 135mph Vult)
Wind 3-Sec Gust, Iced Speed:	$V_i \equiv 50$	mph	(Equivalent to 65mph Vult)
Wind 3-Sec Gust, Live Loads:	$V_l \equiv 30$	mph	(Equivalent to 39mph Vult)
Elevation (Antenna Centerline):	$z \equiv 87\ \boldsymbol{ft}$		
Structure Class:	$Class \equiv$ "III"	TIA Table 2-1	
Exposure:	$Exp \equiv$ "C"	TIA 2.6.5.1	
Topographic Category:	$Topo \equiv$ "1"	TIA 2.6.6.2	
Crest Height (in ft):	$H \equiv 0$		
Gust Effect Factor:	$G \equiv 1.0$	TIA 2.6.9	
Wind Direction Factor, Kd:	$k_d \equiv 0.95$	TIA Table 2-2	
Importance Factor, I:	$I = 1.15$	TIA Table 2-3	
Velocity Pressure Coefficient, Kz:	$k_z = 1.229$	TIA 2.6.5.2	
Topographic Factor, Kzt:	$K_{zt} = 1$	TIA 2.6.6.4	
Design Ice Thickness:	$t_i \equiv 0.0\ \boldsymbol{in}$	TIA Annex B	
Escalated Ice Thickness:	$t_{iz} = 0\ \boldsymbol{in}$	TIA 2.6.8	

*Per TIA 2.6.4, ice loads may be ignored if design ice thickness is less than or equal to 0.25in.

Seismic Properties:

Seismic Load Factor:	$E \equiv 1.0$		
Total Height of Structure:	$h_{structure} \equiv 130\ \boldsymbol{ft}$		
Component Importance Factor:	$I_p \equiv 1.0$	ASCE 7-10 13.1.3	
Site Soils Classification:	$SC \equiv$ "D"	TIA Table 2-11	
Response Modification Coefficient:	$R \equiv 2.5$	ASCE 7-10 Table 13.6.1	
Amplification Factor:	$a \equiv 1.0$	ASCE 7-10 Table 13.6.1	
Seismic Spectral Responses	$S_S \equiv 0.188$	$S_{MS} \equiv 0.301$	$S_{DS} \equiv 0.201$
From USGS Design Maps:	$S_1 \equiv 0.060$	$S_{M1} \equiv 0.143$	$S_{D1} \equiv 0.096$
Acceleration-Based Site Coefficient:	$F_a := \frac{S_{MS}}{S_S} = 1.601$	ASCE 7-10 Eq. 11.4-1	
Velocity-Based Site Coefficient:	$F_v := \frac{S_{M1}}{S_1} = 2.383$	ASCE 7-10 Eq. 11.4-2	
Seismic Design Category:	$SDC =$ "B"	ASCE 7-10 Tables 11.6.1 and 11.6.2	

$Check_{Seismic1} \equiv \textbf{if}\left(S_S \le 1, \text{"Ignore Seismic Effects"}, \text{"Calculate Seismic Loads"}\right)$

$Check_{Seismic1} =$ "Ignore Seismic Effects" TIA 2.7.3

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Appurtenance Details:

Appurt 1: $h_1 := 59.5\ in$ $w_1 := 12.0\ in$ $d_1 := 6.5\ in$ $Profile_1 := \text{“f”}$ $wt_1 := 34.6\ lbf$
Antenna: TMBXX-6516-A2M
Qty. Per Sector: $n_1 := 2$
Profile Round or Flat (r/f)

Appurt 2: $h_2 := 95.9\ in$ $w_2 := 25.2\ in$ $d_2 := 9.3\ in$ $Profile_2 := \text{“f”}$ $wt_2 := 127.6\ lbf$
Antenna: FFHH-65C-R3
Qty. Per Sector: $n_2 := 1$
Profile Round or Flat (r/f)

Appurt 3: $h_3 := 18.1\ in$ $w_3 := 15.7\ in$ $d_3 := 6.4\ in$ $Profile_3 := \text{“f”}$ $wt_3 := 52.5\ lbf$
RRU: FRIG
Qty. Per Sector: $n_3 := 1$
Profile Round or Flat (r/f)

Appurt 4: $h_4 := 22.1\ in$ $w_4 := 12.1\ in$ $d_4 := 7.4\ in$ $Profile_4 := \text{“f”}$ $wt_4 := 83.8\ lbf$
RRU: AHLOA (Leg Mounted)
Qty. Per Sector: $n_4 := 1$
Profile Round or Flat (r/f)

Appurt 5: $h_5 := 35.0\ in$ $w_5 := 13.0\ in$ $d_5 := 7.9\ in$ $Profile_5 := \text{“f”}$ $wt_5 := 55.1\ lbf$
RRU: FHFB (Leg Mounted)
Qty. Per Sector: $n_5 := 1$
Profile Round or Flat (r/f)

Appurt 6: $h_6 := 9.1\ in$ $w_6 := 8.7\ in$ $d_6 := 4.1\ in$ $Profile_6 := \text{“f”}$ $wt_6 := 17.6\ lbf$
TMA: TMAT1921B78-21A
Qty. Per Sector: $n_6 := 1$
Profile Round or Flat (r/f)

Appurt 7: $h_7 := 20.4\ in$ $w_7 := 18.9\ in$ $d_7 := 5.8\ in$ $Profile_7 := \text{“f”}$ $wt_7 := 19.0\ lbf$
COVP: RNSNDC-7771-PF-48 (Leg Mounted)
Qty. Per Sector: $n_7 := 1$ (Beta & Gamma Only)
Profile Round or Flat (r/f)

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Member Properties (Pipe):

Total Length:	$l_{pipe} \equiv 60\ \textbf{\textit{in}}$	(Only the largest pipe on the mount is shown for clarity. All members have been considered.)
Diameter:	$OD_{pipe} \equiv 4.5\ \textbf{\textit{in}}$	
Unit Weight:	$wt_{pipe} \equiv 10.8\ \textbf{\textit{plf}}$	

Velocity Pressure, qz:

Velocity Pressure, Design Speed:	$q_z := 0.00256 \cdot k_z \cdot K_{zt} \cdot k_d \cdot V^2 \cdot I \cdot \textbf{\textit{psf}} = 37.897\ \textbf{\textit{psf}}$
Velocity Pressure, Live Loads:	$q_{zl} := 0.00256 \cdot k_z \cdot K_{zt} \cdot k_d \cdot V_l{}^2 \cdot I \cdot \textbf{\textit{psf}} = 3.094\ \textbf{\textit{psf}}$

Max Appurtenance Project Area, EPA:

Appurt 1 EPA:	$EPA_1 = 6.604\ \textbf{\textit{ft}}^2$
Appurt 2 EPA:	$EPA_2 = 21.708\ \textbf{\textit{ft}}^2$
Appurt 3 EPA:	$EPA_3 = 2.368\ \textbf{\textit{ft}}^2$
Appurt 4 EPA:	$EPA_4 = 2.228\ \textbf{\textit{ft}}^2$
Appurt 5 EPA:	$EPA_5 = 3.97\ \textbf{\textit{ft}}^2$
Appurt 6 EPA:	$EPA_6 = 0.66\ \textbf{\textit{ft}}^2$
Appurt 7 EPA:	$EPA_7 = 3.213\ \textbf{\textit{ft}}^2$
Pipe EPA:	$EPA_{pipe} = 2.25\ \textbf{\textit{ft}}^2$

Max Appurtenance Forces, F (Design Speed):

Appurt 1 Force:	$F_1 := q_z \cdot G \cdot EPA_1 = 250.283\ \textbf{\textit{lbf}}$
Appurt 2 Force:	$F_2 := q_z \cdot G \cdot EPA_2 = 822.696\ \textbf{\textit{lbf}}$
Appurt 3 Force:	$F_3 := q_z \cdot G \cdot EPA_3 = 89.744\ \textbf{\textit{lbf}}$
Appurt 4 Force:	$F_4 := q_z \cdot G \cdot EPA_4 = 84.451\ \textbf{\textit{lbf}}$
Appurt 5 Force:	$F_5 := q_z \cdot G \cdot EPA_5 = 150.449\ \textbf{\textit{lbf}}$
Appurt 6 Force:	$F_6 := q_z \cdot G \cdot EPA_6 = 25.003\ \textbf{\textit{lbf}}$
Appurt 7 Force:	$F_7 := q_z \cdot G \cdot EPA_7 = 121.765\ \textbf{\textit{lbf}}$
Pipe Force:	$F_p := q_z \cdot G \cdot EPA_{pipe} = 85.269\ \textbf{\textit{lbf}}$

Max Factored Appurtenance Forces, F (Design Speed):

Appurt 1 Factored Force:	$WF_1 := W \cdot q_z \cdot G \cdot EPA_1 = 400.453\ \textbf{\textit{lbf}}$
Appurt 2 Factored Force:	$WF_2 := W \cdot q_z \cdot G \cdot EPA_2 = \left(1.316 \cdot 10^3\right)\ \textbf{\textit{lbf}}$
Appurt 3 Factored Force:	$WF_3 := W \cdot q_z \cdot G \cdot EPA_3 = 143.591\ \textbf{\textit{lbf}}$
Appurt 4 Factored Force:	$WF_4 := W \cdot q_z \cdot G \cdot EPA_4 = 135.122\ \textbf{\textit{lbf}}$
Appurt 5 Factored Force:	$WF_5 := W \cdot q_z \cdot G \cdot EPA_5 = 240.719\ \textbf{\textit{lbf}}$
Appurt 6 Factored Force:	$WF_6 := W \cdot q_z \cdot G \cdot EPA_6 = 40.005\ \textbf{\textit{lbf}}$
Appurt 7 Factored Force:	$WF_7 := W \cdot q_z \cdot G \cdot EPA_7 = 194.823\ \textbf{\textit{lbf}}$
Factored Pipe Force:	$WF_p := W \cdot q_z \cdot G \cdot EPA_{pipe} = 136.431\ \textbf{\textit{lbf}}$

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Max Appurtenance Forces, Fl (Live Load Conditions):

Appurt 1 Force: $Fl_1 := q_{zl} \cdot G \cdot EPA_1 = 20.431\ \textbf{lbf}$
Appurt 2 Force: $Fl_2 := q_{zl} \cdot G \cdot EPA_2 = 67.159\ \textbf{lbf}$
Appurt 3 Force: $Fl_3 := q_{zl} \cdot G \cdot EPA_3 = 7.326\ \textbf{lbf}$
Appurt 4 Force: $Fl_4 := q_{zl} \cdot G \cdot EPA_4 = 6.894\ \textbf{lbf}$
Appurt 5 Force: $Fl_5 := q_{zl} \cdot G \cdot EPA_5 = 12.282\ \textbf{lbf}$
Appurt 6 Force: $Fl_6 := q_{zl} \cdot G \cdot EPA_6 = 2.041\ \textbf{lbf}$
Appurt 7 Force: $Fl_7 := q_{zl} \cdot G \cdot EPA_7 = 9.94\ \textbf{lbf}$
Pipe Force: $Fl_p := q_{zl} \cdot G \cdot EPA_{pipe} = 6.961\ \textbf{lbf}$

Max Factored Appurtenance Forces, Fl (Live Load Conditions):

Appurt 1 Factored Force: $WFl_1 := W_l \cdot q_{zl} \cdot G \cdot EPA_1 = 20.431\ \textbf{lbf}$
Appurt 2 Factored Force: $WFl_2 := W_l \cdot q_{zl} \cdot G \cdot EPA_2 = 67.159\ \textbf{lbf}$
Appurt 3 Factored Force: $WFl_3 := W_l \cdot q_{zl} \cdot G \cdot EPA_3 = 7.326\ \textbf{lbf}$
Appurt 4 Factored Force: $WFl_4 := W_l \cdot q_{zl} \cdot G \cdot EPA_4 = 6.894\ \textbf{lbf}$
Appurt 5 Factored Force: $WFl_5 := W_l \cdot q_{zl} \cdot G \cdot EPA_5 = 12.282\ \textbf{lbf}$
Appurt 6 Factored Force: $WFl_6 := W_l \cdot q_{zl} \cdot G \cdot EPA_6 = 2.041\ \textbf{lbf}$
Appurt 7 Factored Force: $WFl_7 := W_l \cdot q_{zl} \cdot G \cdot EPA_7 = 9.94\ \textbf{lbf}$
Factored Pipe Force: $WFl_p := W_l \cdot q_{zl} \cdot G \cdot EPA_{pipe} = 6.961\ \textbf{lbf}$

Seismic Unit Design Force, fs:

Calculated Unit Seismic Design Force: $f_{s\_calc} := \frac{0.4\ a \cdot S_{DS} \cdot I_p}{R} \cdot \left(1 + 2\left(\frac{z}{h_{structure}}\right)\right) = 0.075$
ASCE 7-10 Eqs. 13.3-1 to 13.3-3
Minimum Unit Seismic Design Force: $f_{s\_min} := 0.3\ S_{DS} \cdot I_p = 0.06$
Maximum Unit Seismic Design Force: $f_{s\_max} := 1.6 \cdot S_{DS} \cdot I_p = 0.322$
Unit Seismic Design Force: $f_s := min\left(f_{s\_max}, \max\left(f_{s\_calc}, f_{s\_min}\right)\right) = 0.075$

Factored Seismic Appurtenance Forces, Fs:

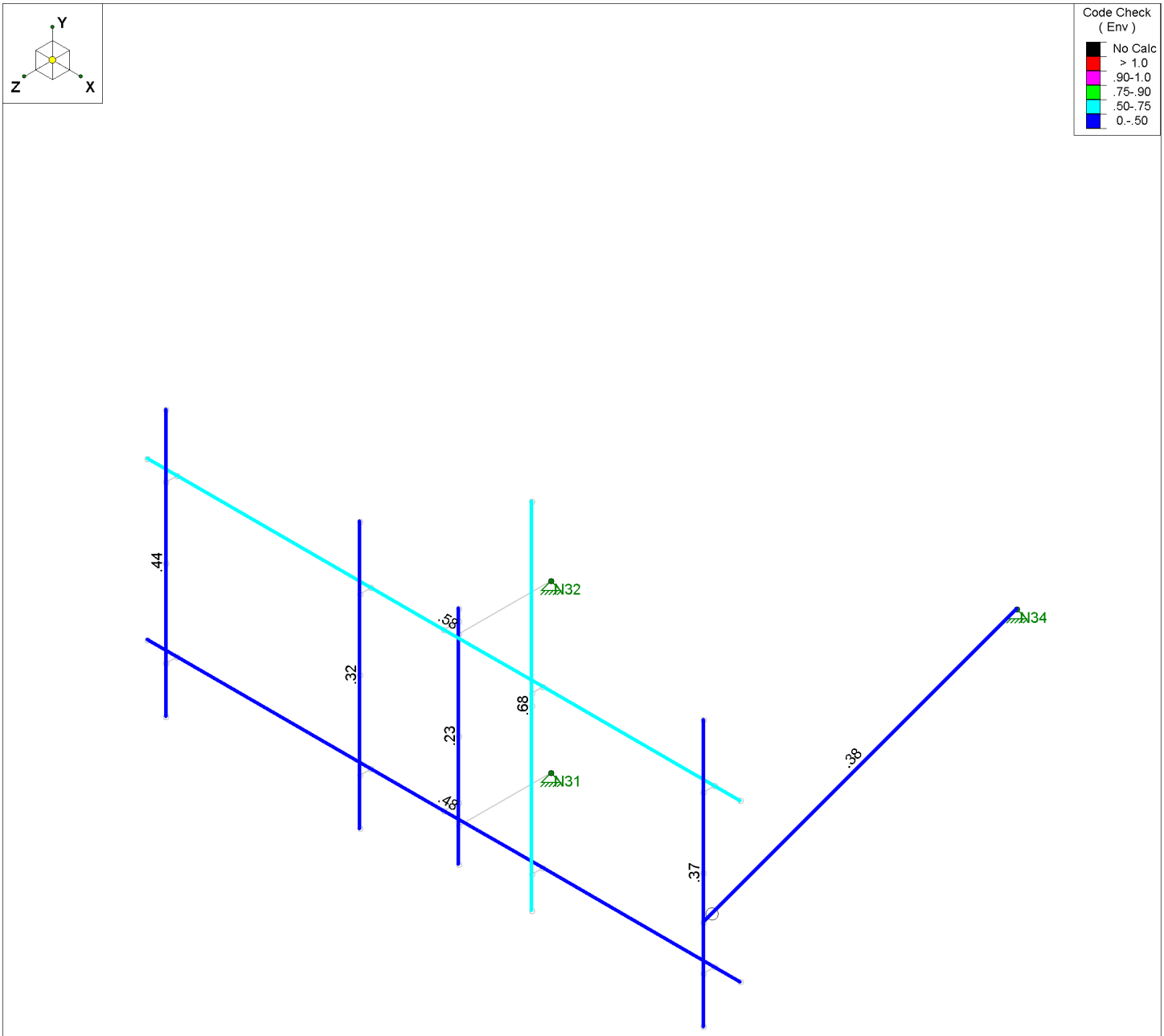
Appurt 1 Factored Force: $Fs_1 := E \cdot f_s \cdot wt_1 = 2.602\ \textbf{lbf}$
Appurt 2 Factored Force: $Fs_2 := E \cdot f_s \cdot wt_2 = 9.596\ \textbf{lbf}$
Appurt 3 Factored Force: $Fs_3 := E \cdot f_s \cdot wt_3 = 3.948\ \textbf{lbf}$
Appurt 4 Factored Force: $Fs_4 := E \cdot f_s \cdot wt_4 = 6.302\ \textbf{lbf}$
Appurt 5 Factored Force: $Fs_5 := E \cdot f_s \cdot wt_5 = 4.144\ \textbf{lbf}$
Appurt 6 Factored Force: $Fs_6 := E \cdot f_s \cdot wt_6 = 1.324\ \textbf{lbf}$
Appurt 7 Factored Force: $Fs_7 := E \cdot f_s \cdot wt_7 = 1.429\ \textbf{lbf}$
Pipe Factored Force: $Fs_p := E \cdot f_s \cdot wt_{pipe} \cdot l_{pipe} = 4.061\ \textbf{lbf}$

$Check_{Seismic2} := \textbf{if}\left(Fs_1 \le 0.5 \cdot WF_1, \text{“Wind Load Governs”}, \text{“Apply Seismic Loads”}\right)$

$Check_{Seismic2} = \text{“Wind Load Governs”}$ TIA 2.7.3

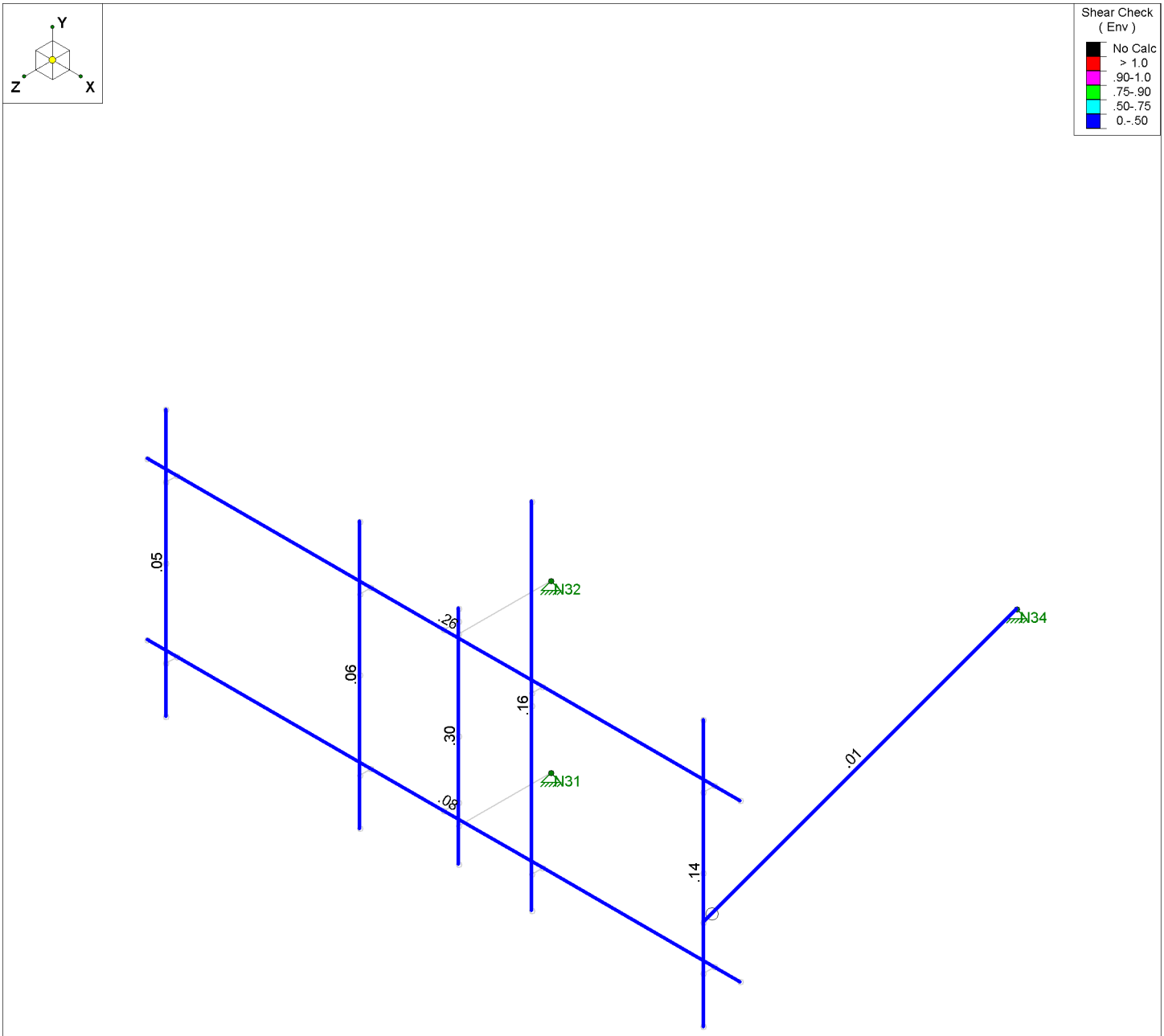
APPENDIX C

SOFTWARE ANALYSIS OUTPUT



Member Code Checks Displayed (Enveloped)
Results for LC 1, 1.4D

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 11
Jacob Leavengood, EIT		Aug 23, 2019 at 4:29 PM
		DN03433C_RISA_08.22.2019_Modi...



Member Shear Checks Displayed (Enveloped)
Results for LC 1, 1.4D

TeleMtn Engineering	DN03433C Denver Fire Station #28	SK - 12
Jacob Leavengood, EIT		Aug 23, 2019 at 4:30 PM
		DN03433C_RISA_08.22.2019_Modi...

(Global) Model Settings

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	97
Include Shear Deformation?	Yes
Increase Nailing Capacity for Wind?	Yes
Include Warping?	Yes
Trans Load Btwn Intersecting Wood Wall?	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Include P-Delta for Walls?	Yes
Automatically Iterate Stiffness for Walls?	Yes
Max Iterations for Wall Stiffness	3
Gravity Acceleration (in/sec^2)	386.4
Wall Mesh Size (in)	24
Eigensolution Convergence Tol. (1.E-)	4
Vertical Axis	Y
Global Member Orientation Plane	XZ
Static Solver	Sparse Accelerated
Dynamic Solver	Accelerated Solver

Hot Rolled Steel Code	AISC 14th(360-10): LRFD
Adjust Stiffness?	Yes(Iterative)
RISAConnection Code	AISC 14th(360-10): LRFD
Cold Formed Steel Code	AISI S100-16: LRFD
Wood Code	AWC NDS-18: ASD
Wood Temperature	< 100F
Concrete Code	ACI 318-14
Masonry Code	TMS 402-16: Strength
Aluminum Code	AA ADM1-15: ASD - Building
Stainless Steel Code	AISC 14th(360-10): LRFD
Adjust Stiffness?	Yes(Iterative)

(Global) Model Settings, Continued

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parme Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections?	Yes
Use Cracked Sections Slab?	No
Bad Framing Warnings?	No
Unused Force Warnings?	Yes
Min 1 Bar Diam. Spacing?	No
Concrete Rebar Set	REBAR_SET_ASTMA615
Min % Steel for Column	1
Max % Steel for Column	8

Seismic Code	ASCE 7-16
Seismic Base Elevation (in)	Not Entered
Add Base Weight?	Yes
Ct X	.02
Ct Z	.02
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	3
R Z	3
Ct Exp. X	.75
Ct Exp. Z	.75
SD1	1
SDS	1
S1	1
TL (sec)	5
Risk Cat	I or II
Drift Cat	Other
Om Z	1
Om X	1
Cd Z	4
Cd X	4
Rho Z	1
Rho X	1

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (/1E..	Density[k/ft...	Yield[ksi]	Ry	Fu[ksi]	Rt
1	A992	29000	11154	.3	.65	.49	50	1.1	65	1.1
2	A36 Gr.36	29000	11154	.3	.65	.49	36	1.5	58	1.2
3	A572 Gr.50	29000	11154	.3	.65	.49	50	1.1	65	1.1
4	A500 Gr.B RND	29000	11154	.3	.65	.527	42	1.4	58	1.3
5	A500 Gr.B Rect	29000	11154	.3	.65	.527	46	1.4	58	1.3
6	A53 Gr.B	29000	11154	.3	.65	.49	35	1.6	60	1.2
7	A1085	29000	11154	.3	.65	.49	50	1.4	65	1.3
8	A913 Gr.65	29000	11154	.3	.65	.49	65	1.1	80	1.1

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	2in Std. Pipe	PIPE_2.0	None	None	A53 Gr.B	Typical	1.02	.627	.627	1.25
2	PL3/8x6	PL3/8x6	None	None	A36 Gr.36	Typical	2.25	.026	6.75	.101
3	4in Std. Pipe	PIPE_4.0	None	None	A53 Gr.B	Typical	2.96	6.82	6.82	13.6
4	3in Std. Pipe	PIPE_3.0	None	None	A53 Gr.B	Typical	2.07	2.85	2.85	5.69
5	1.5in Std. Pipe	PIPE_1.5	None	None	A53 Gr.B	Typical	.749	.293	.293	.586

Load Combinations

	Description	Sol...	PD...	SR...	BLC	Fact...	BLC	Fact...	BLC	Fact...	BLC	Fact...	BLC	Fact...	BLC	Fact...	BLC	Fact...	BLC	Fact...	BLC	Fact...	BLC	Fact...
1	1.4D	Yes	Y		DL	1.4																		
2	0 Deg - 1....	Yes	Y		DL	1.2	W...	1.6	W...															
3	30 Deg - 1..	Yes	Y		DL	1.2	W...	1.386	W...	.8														
4	60 Deg - 1..	Yes	Y		DL	1.2	W...	.8	W...	1.386														
5	90 Deg - 1..	Yes	Y		DL	1.2	W...		W...	1.6														
6	120 Deg - ..	Yes	Y		DL	1.2	W...	-.8	W...	1.386														
7	150 Deg - ..	Yes	Y		DL	1.2	W...	-1.3...	W...	.8														
8	180 Deg - ..	Yes	Y		DL	1.2	W...	-1.6	W...															
9	210 Deg - ..	Yes	Y		DL	1.2	W...	-1.3...	W...	-.8														
10	240 Deg - ..	Yes	Y		DL	1.2	W...	-.8	W...	-1.3...														
11	270 Deg - ..	Yes	Y		DL	1.2	W...		W...	-1.6														
12	300 Deg - ..	Yes	Y		DL	1.2	W...	.8	W...	-1.3...														
13	330 Deg - ..	Yes	Y		DL	1.2	W...	1.386	W...	-.8														
14	0 Deg - 1....	Yes	Y		DL	1.2	LL	1.5	OL6	1	OL5													
15	30 Deg - 1..	Yes	Y		DL	1.2	LL	1.5	OL6	.866	OL5	.5												
16	60 Deg - 1..	Yes	Y		DL	1.2	LL	1.5	OL6	.5	OL5	.866												
17	90 Deg - 1..	Yes	Y		DL	1.2	LL	1.5	OL6		OL5	1												
18	120 Deg - ..	Yes	Y		DL	1.2	LL	1.5	OL6	-.5	OL5	.866												
19	150 Deg - ..	Yes	Y		DL	1.2	LL	1.5	OL6	-.866	OL5	.5												
20	180 Deg - ..	Yes	Y		DL	1.2	LL	1.5	OL6	-1	OL5													
21	210 Deg - ..	Yes	Y		DL	1.2	LL	1.5	OL6	-.866	OL5	-.5												
22	240 Deg - ..	Yes	Y		DL	1.2	LL	1.5	OL6	-.5	OL5	-.866												
23	270 Deg - ..	Yes	Y		DL	1.2	LL	1.5	OL6		OL5	-1												
24	300 Deg - ..	Yes	Y		DL	1.2	LL	1.5	OL6	.5	OL5	-.866												
25	330 Deg - ..	Yes	Y		DL	1.2	LL	1.5	OL6	.866	OL5	-.5												
26	1.2D+1.5Lv	Yes	Y		DL	1.2	LLS	1.5																

Envelope Member Section Forces

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-...	LC	y-y Mome...	LC	z-z Mome...	LC
1	M1	1	max	0	26	0	26	0	26	0	26	0	26	0	26
2			min	0	1	0	1	0	1	0	1	0	1	0	1
3		2	max	.455	23	-.051	6	.266	8	.051	11	.693	8	.326	25
4			min	-.089	5	-.428	24	-.267	2	-.084	26	-.667	2	.017	8
5		3	max	.771	23	.334	9	.602	4	.307	13	2.509	10	1.55	20
6			min	-.359	12	-.643	20	-.522	10	-.265	7	-2.729	4	.221	4
7		4	max	.434	6	.082	5	.481	5	.185	13	1.1	11	.111	13
8			min	-.299	12	.05	11	-.455	11	-.172	7	-1.134	5	-.056	7
9		5	max	0	26	0	26	0	26	0	26	0	26	0	26
10			min	0	1	0	1	0	1	0	1	0	1	0	1
11	M2	1	max	0	26	0	26	0	26	0	26	0	26	0	26

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-...	LC	y-y Mome...	LC	z-z Mome...	LC
12			min	0	1	0	1	0	1	0	1	0	1	0	1
13		2	max	.122	11	-.057	12	.32	8	.049	12	.777	8	.369	20
14			min	-.457	17	-.446	18	-.319	2	-.056	18	-.807	2	.028	13
15		3	max	.659	5	.288	3	1.186	3	1.115	13	3.325	9	1.139	14
16			min	-.965	11	-.341	14	-1.255	9	-1.018	7	-3.196	3	.146	8
17		4	max	.203	5	.088	11	.351	5	.479	12	1.023	11	.131	6
18			min	-.346	11	.057	5	-.371	11	-.456	6	-1.007	5	-.044	12
19		5	max	0	26	0	26	0	26	0	26	0	26	0	26
20			min	0	1	0	1	0	1	0	1	0	1	0	1
21	M11	1	max	0	26	0	18	0	11	0	26	0	26	0	26
22			min	0	1	0	12	0	26	0	1	0	1	0	1
23		2	max	.032	12	.452	23	.096	2	.014	2	.032	11	.587	23
24			min	-.361	18	-.007	5	-.095	8	-.016	8	-.111	17	.066	5
25		3	max	.026	12	.449	17	.089	19	.014	2	.05	2	.016	5
26			min	-.409	18	.041	11	-.035	13	-.016	8	-.043	8	-.088	23
27		4	max	-.022	12	.454	17	.15	8	.014	2	.157	19	-.04	11
28			min	-.416	18	-.04	11	-.149	2	-.016	8	-.091	13	-.762	17
29		5	max	0	26	0	12	0	17	0	26	0	26	0	26
30			min	0	1	0	18	0	10	0	1	0	1	0	1
31	M12	1	max	0	26	0	18	0	10	0	26	0	26	0	26
32			min	0	1	0	12	0	15	0	1	0	1	0	1
33		2	max	.18	20	.314	23	.112	17	.046	18	.057	13	.417	24
34			min	-.036	2	.022	5	-.023	12	-.033	12	-.142	19	.057	6
35		3	max	.174	20	.313	15	.113	19	.046	18	.027	15	.007	6
36			min	-.064	2	.042	9	-.053	13	-.033	12	-.006	9	-.053	23
37		4	max	.146	20	.314	17	.115	19	.046	18	.198	19	-.058	10
38			min	-.07	2	.015	11	-.089	13	-.033	12	-.103	13	-.521	16
39		5	max	0	26	0	12	0	17	0	26	0	26	0	26
40			min	0	1	0	18	0	10	0	1	0	1	0	1
41	M13	1	max	0	26	0	18	0	7	0	26	0	26	0	26
42			min	0	1	0	12	0	13	0	1	0	1	0	1
43		2	max	.047	5	.228	12	.509	6	.133	7	.378	7	-.078	4
44			min	.016	11	-.364	6	-.492	12	-.131	13	-.403	13	-.108	1
45		3	max	.026	5	.044	6	.453	12	.133	7	.221	6	.084	6
46			min	-.049	11	-.187	12	-.429	6	-.131	13	-.212	12	-.057	12
47		4	max	-.023	5	.122	5	.391	12	.133	7	.421	12	.283	11
48			min	-.055	11	-.264	11	-.367	6	-.131	13	-.376	6	-.042	5
49		5	max	0	26	0	12	0	13	0	26	0	26	0	26
50			min	0	1	0	18	0	7	0	1	0	1	0	1
51	M14	1	max	0	26	0	18	0	7	0	26	0	26	0	26
52			min	0	1	0	12	0	13	0	1	0	1	0	1
53		2	max	.24	9	-.057	4	.062	9	.153	7	.048	5	.008	4
54			min	-.017	3	-.106	10	-.035	16	-.154	13	-.065	11	-.09	10
55		3	max	.231	9	.11	5	.412	8	.153	7	.446	8	.289	11
56			min	-.179	3	-.273	11	-.359	2	-.154	13	-.356	2	-.044	5
57		4	max	.01	1	.173	11	.359	2	0	26	.359	8	.173	11
58			min	.008	2	-.173	5	-.359	8	0	1	-.359	2	-.173	5
59		5	max	0	26	0	11	0	2	0	26	0	26	0	26
60			min	0	1	0	5	0	8	0	1	0	1	0	1
61	M17	1	max	1.098	12	.018	1	.07	12	0	26	0	26	0	26
62			min	-1.09	6	.015	2	-.07	6	0	1	0	1	0	1
63		2	max	1.089	12	.009	1	.035	12	0	26	.13	12	-.029	26

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-...	LC	y-y Mome...	LC	z-z Mome...	LC
64			min	-1.081	6	.008	2	-.035	6	0	1	-.13	6	-.033	1
65		3	max	1.08	12	0	26	0	26	0	26	.174	12	-.038	26
66			min	-1.071	6	0	1	0	1	0	1	-.174	6	-.045	1
67		4	max	1.07	12	-.008	26	.035	6	0	26	.13	12	-.029	26
68			min	-1.062	6	-.009	1	-.035	12	0	1	-.13	6	-.033	1
69		5	max	1.061	12	-.015	26	.07	6	0	26	0	26	0	26
70			min	-1.053	6	-.018	1	-.07	12	0	1	0	1	0	1
71	M18	1	max	0	26	0	18	0	20	0	26	0	26	0	26
72			min	0	1	0	12	0	2	0	1	0	1	0	1
73		2	max	.178	5	.491	17	.911	20	1.568	18	.067	2	.739	17
74			min	-.174	11	-.251	12	.073	2	-1.118	12	-1.288	20	-.51	11
75		3	max	.163	5	.495	17	.917	20	1.568	18	.1	2	.131	5
76			min	-.252	11	-.312	11	-.033	2	-1.118	12	-.23	8	-.164	11
77		4	max	.084	5	.498	17	1.01	8	1.568	18	1.003	20	.286	12
78			min	-.268	11	-.376	11	-.139	2	-1.118	12	-.017	2	-.498	18
79		5	max	0	26	0	12	0	2	0	26	0	26	0	26
80			min	0	1	0	18	0	8	0	1	0	1	0	1

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N31	max	.67	5	.735	19	1.106	4	0	26	0	26	0	26
2		min	-1.118	23	.193	13	-.122	10	0	1	0	1	0	1
3	N32	max	1.268	5	.765	25	1.798	2	0	26	0	26	0	26
4		min	-1.503	11	.204	7	-2.768	8	0	1	0	1	0	1
5	N34	max	.226	13	.018	1	1.078	12	0	26	0	26	0	26
6		min	-.222	7	.013	12	-1.071	6	0	1	0	1	0	1
7	Totals:	max	1.79	5	1.498	18	3.348	2						
8		min	-1.79	11	.748	12	-3.348	8						

APPENDIX D

ADDITIONAL CALCULATIONS

104 Broadway, Suite 600
Denver, CO 80203
P: 303-596-6804

Mount Analysis: Additional Calculations

Risa Output:

Max X Reaction (shear): $R_x \equiv 1.503\ \textbf{kip}$
Max Y Reaction (shear): $R_y \equiv 0.765\ \textbf{kip}$
Max Z Reaction (tensile): $R_z \equiv 2.768\ \textbf{kip}$
Max Moment X: $M_x \equiv 0.000\ \textbf{kip} \cdot \textbf{ft}$
Max Moment Y: $M_y \equiv 0.000\ \textbf{kip} \cdot \textbf{ft}$
Max Moment Z: $M_z \equiv 0.000\ \textbf{kip} \cdot \textbf{ft}$

Bolt Properties:

Bolt Diameter: $Dia_{bolt} \equiv 0.625\ \textbf{in}$
Bolt Grade: $Grade_{bolt} \equiv \text{“A36”}$
Bolt Area: $A_{bolt} = 0.307\ \textbf{in}^2$
Number Bolts: $N_{bolt} \equiv 2$
Vertical Bolt Spacing (c/c): $d_{bolt\_y} \equiv 0\ \textbf{in}$
Horizontal Bolt Spacing (c/c): $d_{bolt\_x} \equiv 7\ \textbf{in}$

Bolts Check:

Bolt Shear Load:

$$Sload_{bolt} := \sqrt{\left(\frac{R_x}{N_{bolt}}\right)^2 + \left(\frac{R_y}{N_{bolt}}\right)^2} = 0.843\ \textbf{kip}$$

Bolt Tensile Load:

$$Tload_{bolt} := \left(\frac{R_z}{N_{bolt}}\right) = 1.384\ \textbf{kip}$$

Conservative check for 5/8in A36 threaded rods, allowable load per AISC 14th Edition.

$Bolt_{shear} = 6.006\ \textbf{kip}$ > $Sload_{bolt} = 0.84\ \textbf{kip}$

$Bolt_{tension} = 10.009\ \textbf{kip}$ > $Tload_{bolt} = 1.38\ \textbf{kip}$

$$Check_{bolt} := \textbf{if}\left(\left(\frac{Sload_{bolt}}{Bolt_{shear}}\right)^2 + \left(\frac{Tload_{bolt}}{Bolt_{tension}}\right)^2 \le 1.0\,, \text{“OK”}\,, \text{“NG”}\right) = \text{“OK”}$$

$$Capacity_{bolt} := \max\left(\left(\frac{Sload_{bolt}}{Bolt_{shear}}\right)^2 + \left(\frac{Tload_{bolt}}{Bolt_{tension}}\right)^2, \left(\frac{Sload_{bolt}}{Bolt_{shear}}\right), \left(\frac{Tload_{bolt}}{Bolt_{tension}}\right)\right) = 14.04\%$$

APPENDIX E

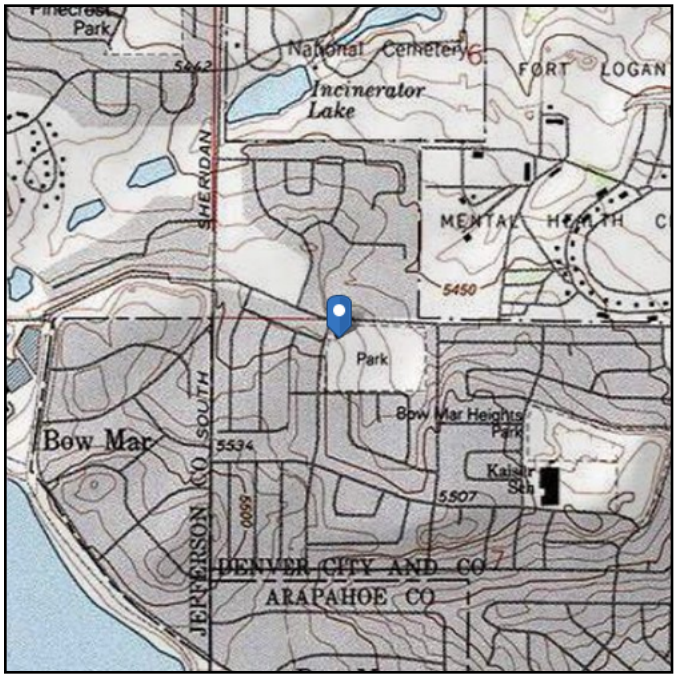
SITE SUPPORTING DOCUMENTATION

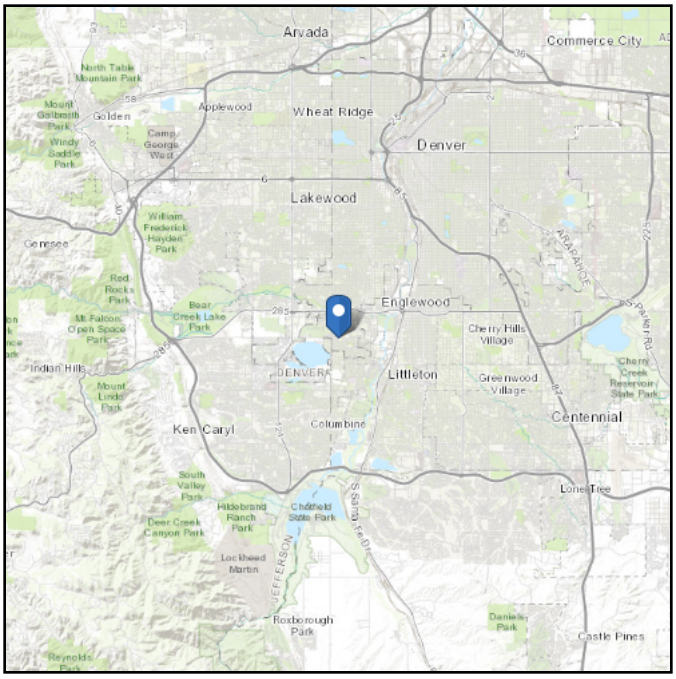
ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-10
Risk Category: III
Soil Class: D - Stiff Soil

Elevation: 5494.63 ft (NAVD 88)
Latitude: 39.638125
Longitude: -105.048767





Wind

Results:

135mph per local codes

Wind Speed:	120 Vmph
10-year MRI	76 Vmph
25-year MRI	84 Vmph
50-year MRI	90 Vmph
100-year MRI	96 Vmph

Data Source: ASCE/SEI 7-10, Fig. 26.5-1B and Figs. CC-1–CC-4, incorporating errata of March 12, 2014

Date Accessed: Thu Aug 22 2019

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-10 Standard. Wind speeds correspond to approximately a 3% probability of exceedance in 50 years (annual exceedance probability = 0.000588, MRI = 1,700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-10 Section 26.2.

Mountainous terrain, gorges, ocean promontories, and special wind regions should be examined for unusual wind conditions.

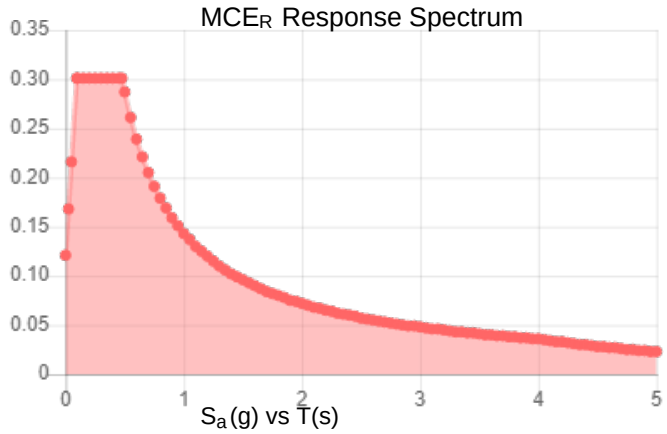
Seismic

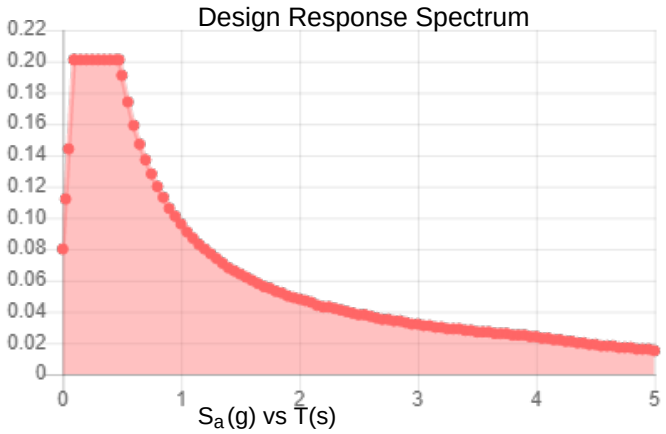
Site Soil Class: D - Stiff Soil

Results:

S_S :	0.188	S_{DS} :	0.201
S_1 :	0.06	S_{D1} :	0.096
F_a :	1.6	T_L :	4
F_v :	2.4	PGA :	0.097
S_{MS} :	0.301	PGA_M :	0.154
S_{M1} :	0.143	F_{PGA} :	1.6
		I_e :	1.25

Seismic Design Category B





Data Accessed: Thu Aug 22 2019

Date Source: USGS Seismic Design Maps based on ASCE/SEI 7-10, incorporating Supplement 1 and errata of March 31, 2013, and ASCE/SEI 7-10 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-10 Ch. 21 are available from USGS.

Ice

Results:

Ice Thickness:	0.00 in.
Concurrent Temperature:	5 F
Gust Speed:	50 mph
Data Source:	Standard ASCE/SEI 7-10, Figs. 10-2 through 10-8
Date Accessed:	Thu Aug 22 2019

Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

In the mountain west, ice thicknesses may exceed the mapped values in the foothills and passes. However, at elevations above 5,000 ft, freezing rain is unlikely.

Values provided are equivalent radial ice thicknesses due to freezing rain with concurrent 3-second gust speeds, for a 50-year mean recurrence interval, and temperatures concurrent with ice thicknesses due to freezing rain. Thicknesses for ice accretions caused by other sources shall be obtained from local meteorological studies. Ice thicknesses in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.

Mount Mapping

BU#: DN03433C

Site Information

Site Name:	DN03433C
Site Address:	4306 S. Wolff Street, Denver, CO 80236
Site Coordinates:	39.638125, -105.0487667
Tower Type:	Self Support
Tower Height:	130'
Tower Manufacturer:	UNKNOWN
Mount Elevation:	88'-7 1/2"

Project Notes:

See attached tables, elevation and profile drawings for further details.

Sheet Index	
Sheet No.	Description
CS-1	Cover Sheet
SD-1-SD-4	Schematic Drawing
E-1-E-2	Equipment Information
P-1-P-4	Photographs

NO SITE TAG

Document #	ENG-FRM-10272
Revision	Initial Release
Issue Date	10/29/2018
Dept. Owner	Director of Engineering
Distribution	Public

Customer:
T-MOBILE

Prepared by:
PAUL J. FORD & COMPANY
250 EAST BROAD STREET, SUITE 600
COLUMBUS, OH 43215

Job # 19.0536.TGX-140-R00

Prepared for:
TeleMtn Engineering LLC

Revisions

Rev.	Date	Drawn	Checked	Description
00	08/08/19	PP	KM	1st RELEASE
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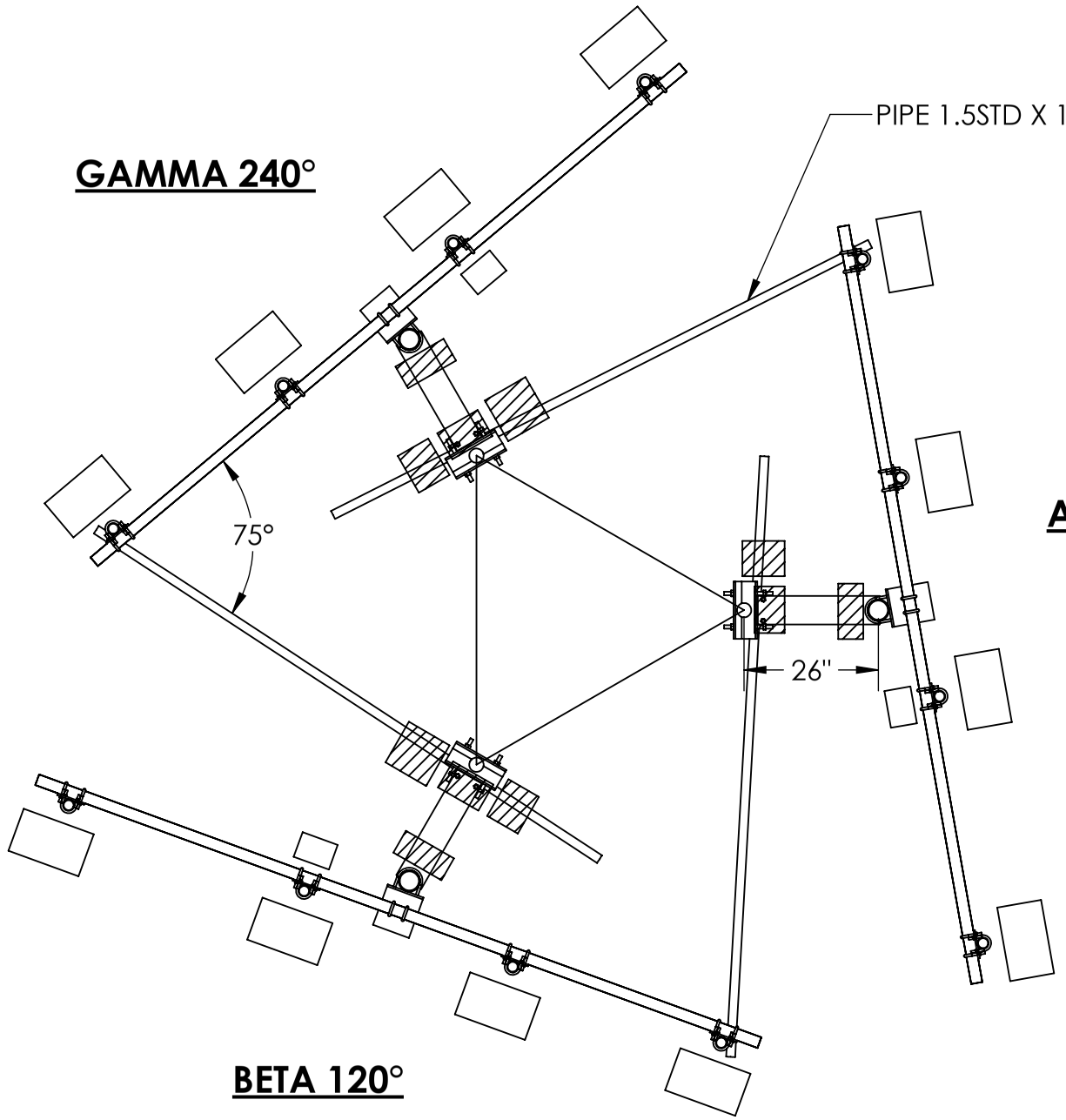
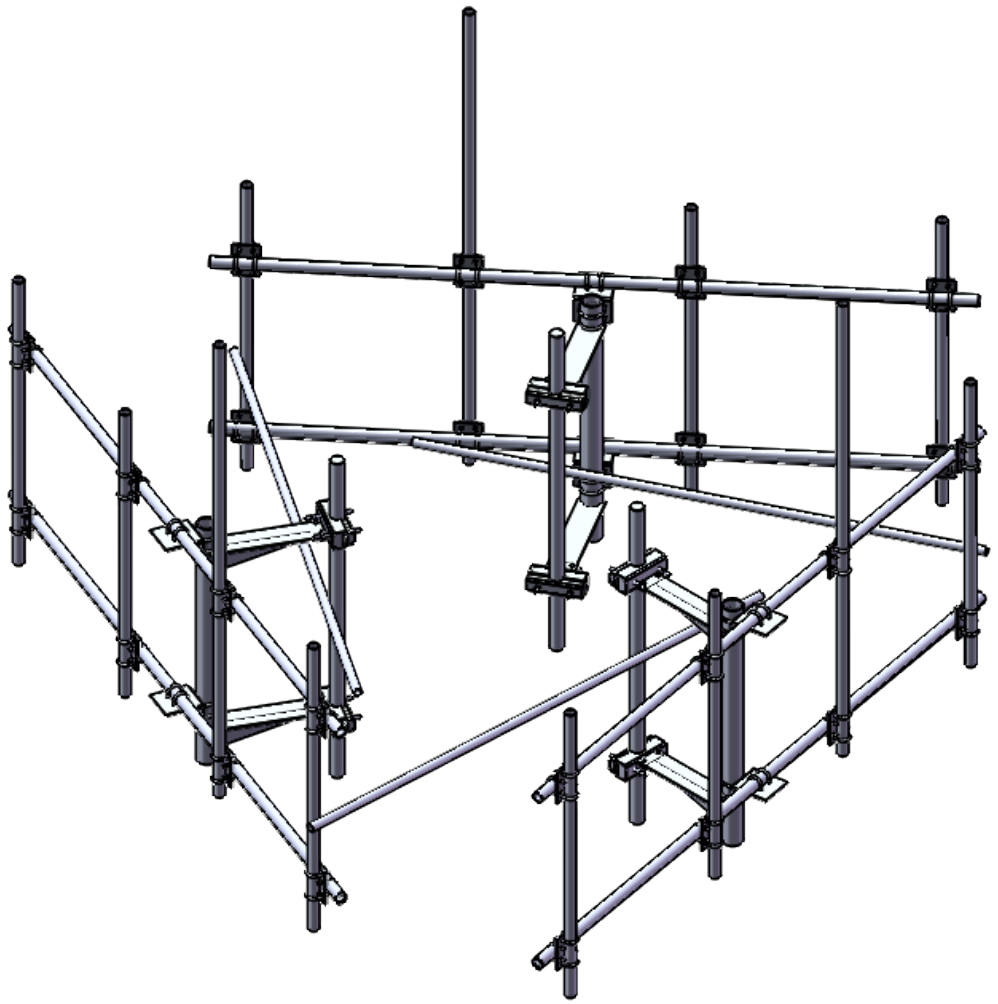
Mapping Date	Sheet Number
08/07/2019	CS-1



MOUNT PLAN VIEW



ISO VIEW

Prepared by:

PAUL J. FORD & COMPANY

Job # 19.0536.TGX-140-R00

Prepared for:

TeleMtn Engineering LLC

Revisions

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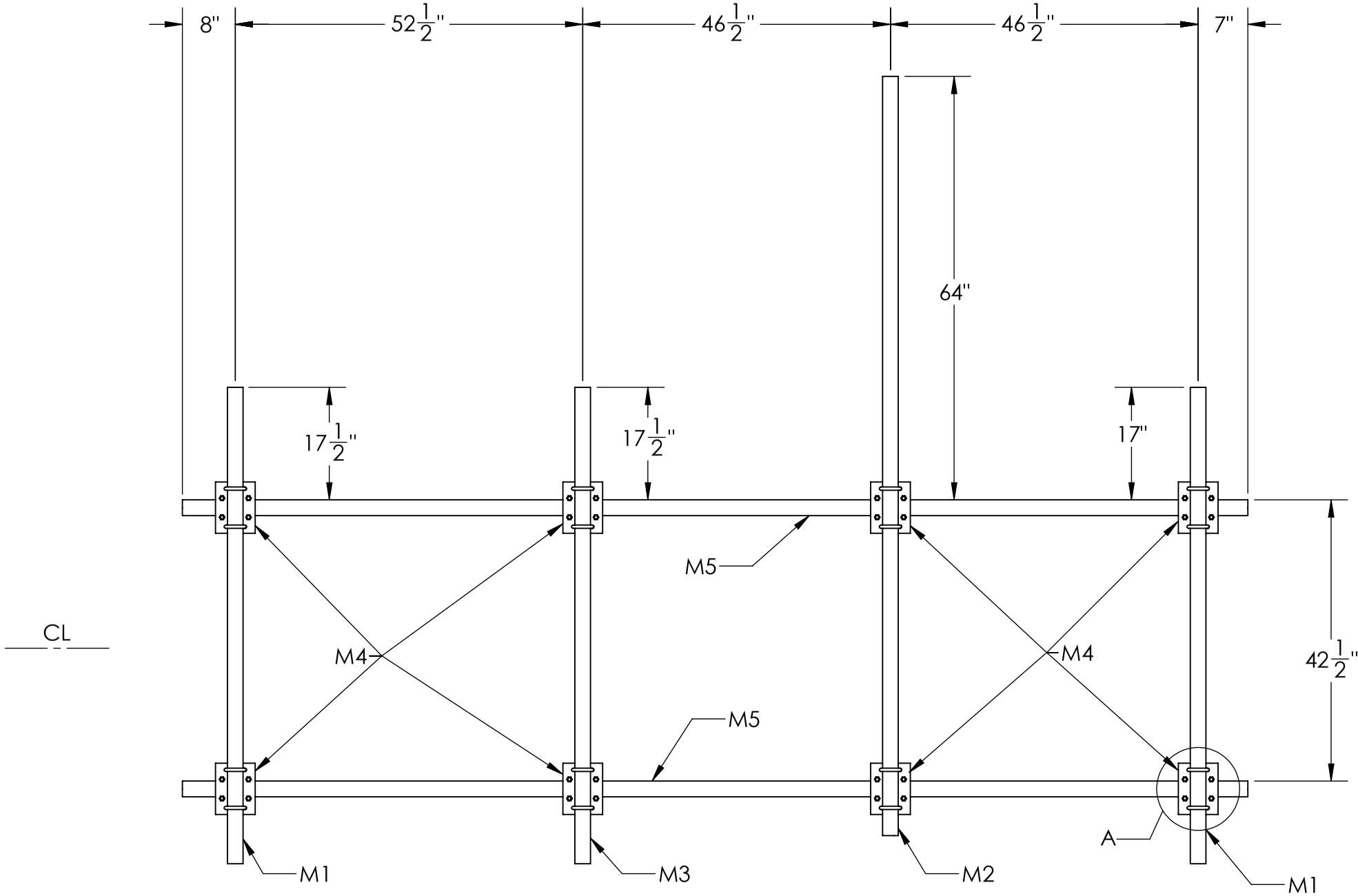
BU #: DN03433C

Site Name: DN03433C

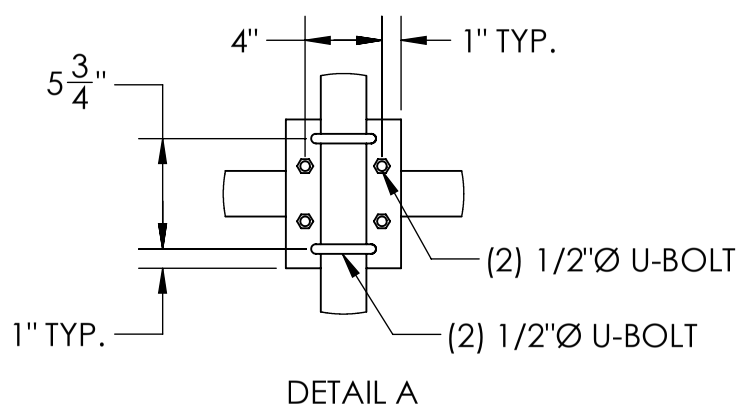
Customer:T-MOBILE

Schematic Drawings

Mapping Date	Sheet Number
08/07/2019	SD-1



ELEVATION VIEW



DETAIL A

MEMBER INFORMATION	
M1	PIPE 2.375"Ø x 0.14" x 72" LONG
M2	PIPE 2.375"Ø x 0.13" x 114 3/4" LONG
M3	PIPE 2.375"Ø x 0.16" x 72 1/4" LONG
M4	PL 6" x 3/8" x 7 3/4" LONG
M5	PIPE 2.375"Ø x 0.17" x 160 1/2" LONG

Prepared by:

PAUL J. FORD & COMPANY

Job # 19.0536.TGX-140-R00

Prepared for:

TeleMtn Engineering LLC

Revisions

Rev.	Date	Drawn	Checked	Description
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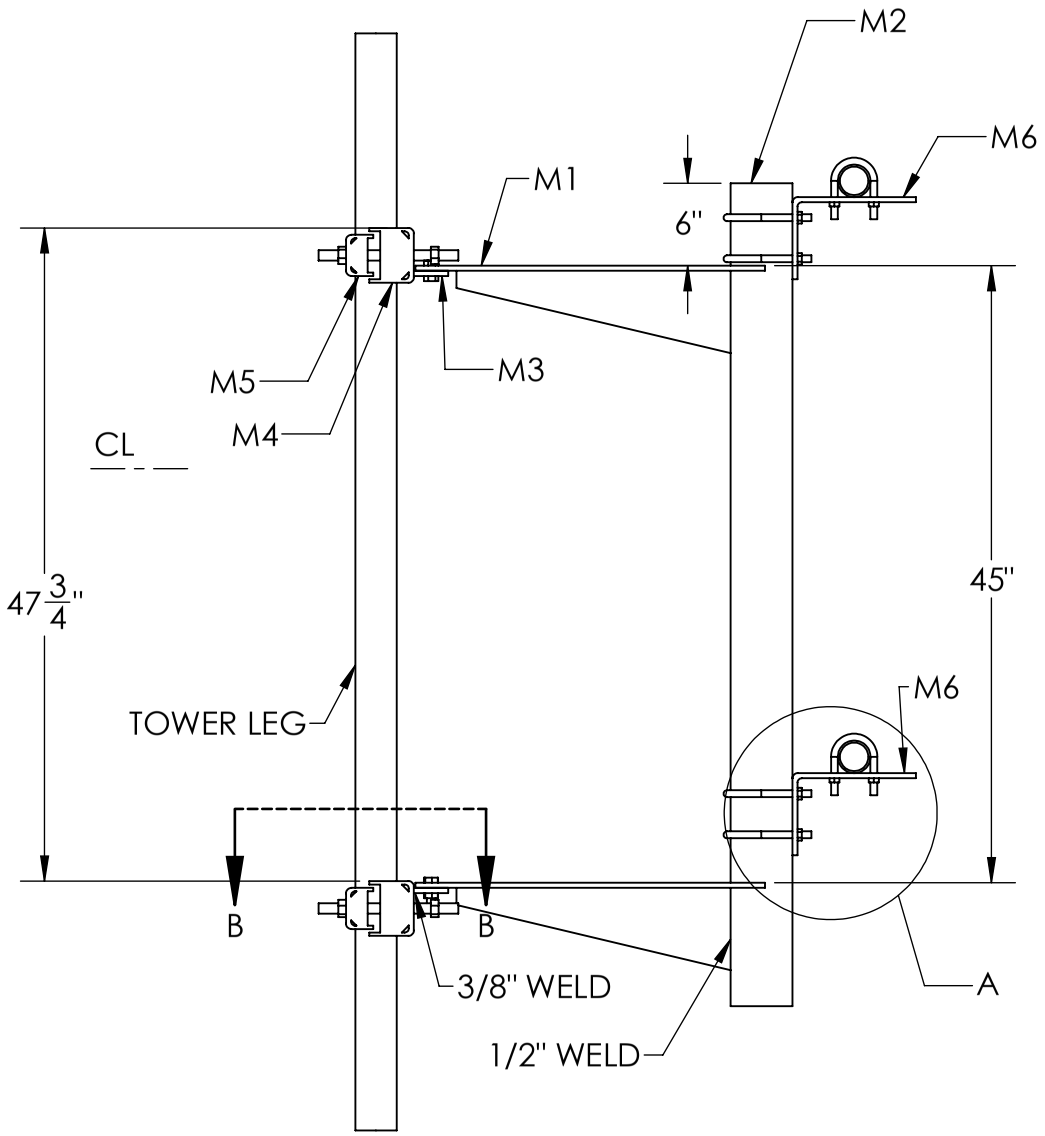
BU #: DN03433C

Site Name: DN03433C

Customer:T-MOBILE

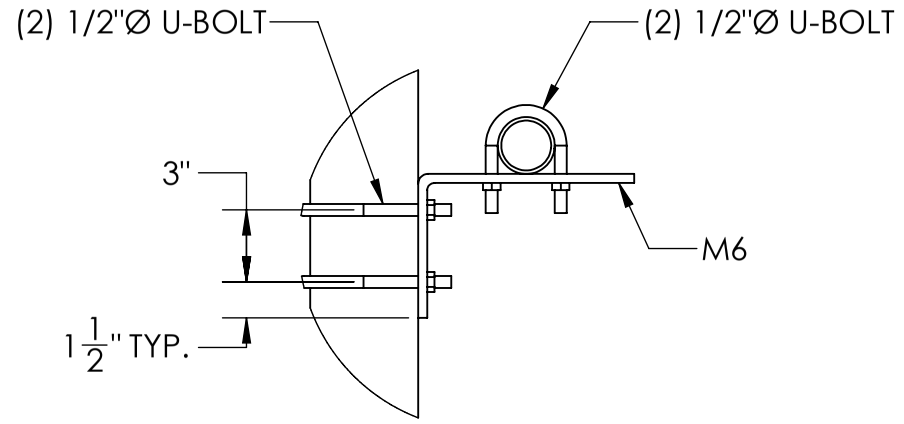
Schematic Drawings

Mapping Date	Sheet Number
08/07/2019	SD-2

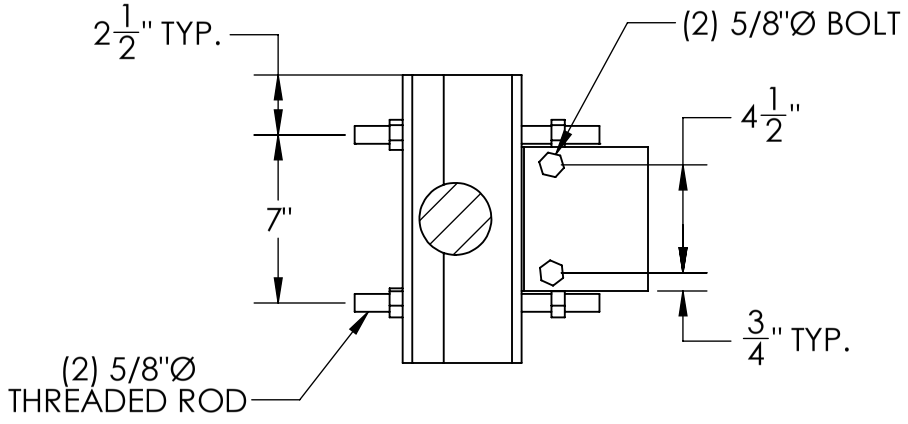


STAND-OFF VIEW

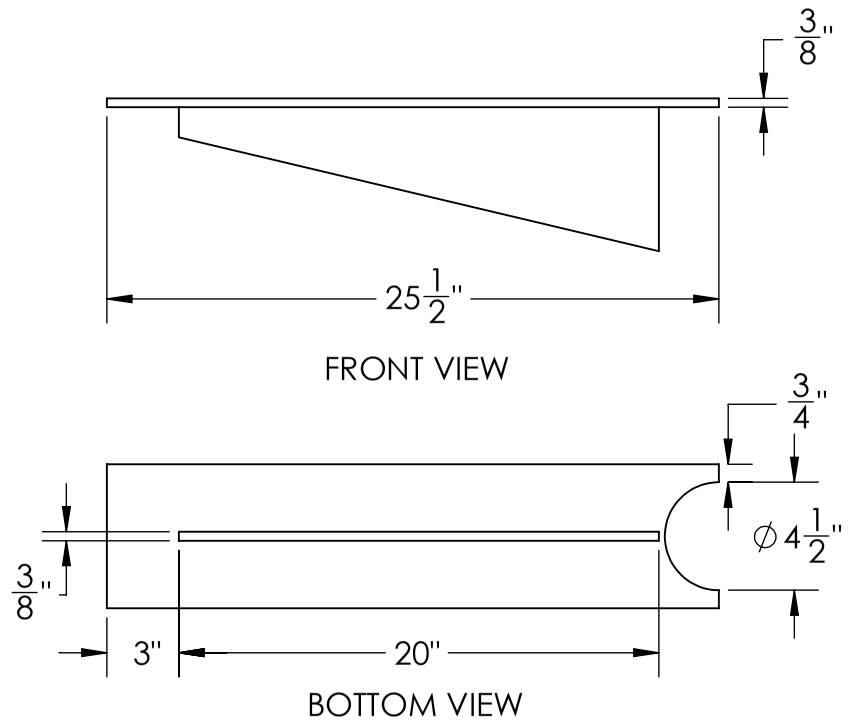
MEMBER INFORMATION	
M1	SEE DETAIL ABOVE
M2	PIPE 4.5"Ø x 0.25" x 60" LONG
M3	PL 2 1/2" x 3/8" x 6" LONG
M4	BENT C 4" x 3 1/2" x 1/4" x 12" LONG
M5	BENT C 3" x 2" x 1/4" x 12" LONG
M6	BENT L 9" x 6" x 3/8" x 8" LONG (SLV)



DETAIL A



SECTION B-B



FRONT VIEW

BOTTOM VIEW

M1 MEMBER DETAIL

Prepared by:

PAUL J. FORD & COMPANY

Job # 19.0536.TGX-140-R00

Prepared for:

TeleMtn Engineering LLC

Revisions

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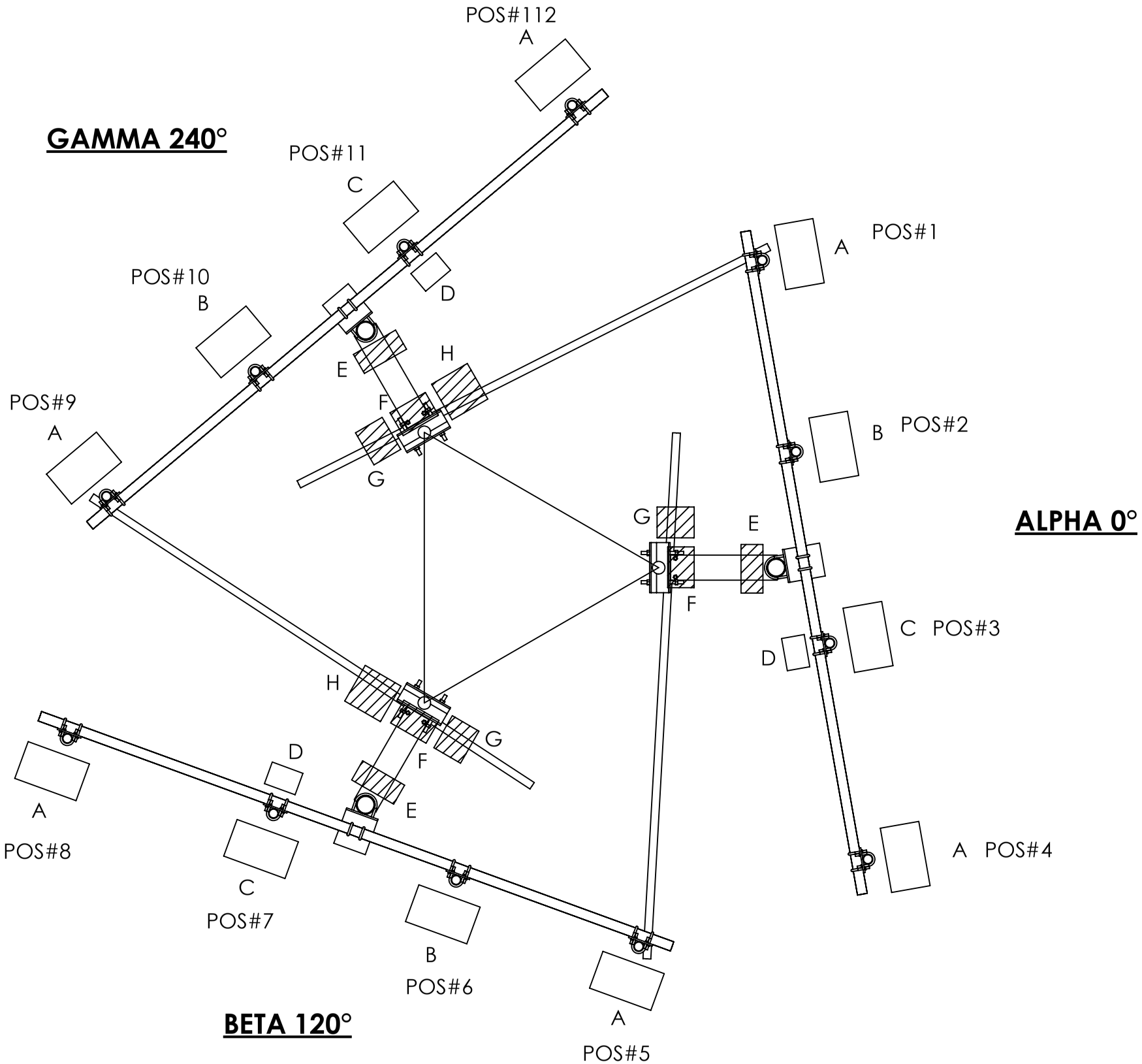
BU #: DN03433C

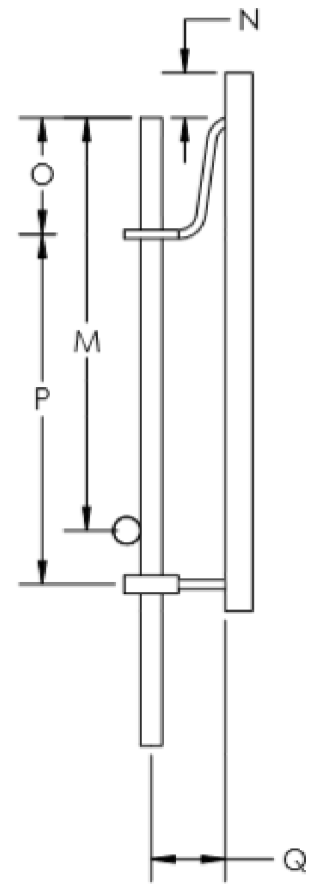
Site Name: DN03433C

Customer:T-MOBILE

Schematic Drawings

Mapping Date	Sheet Number
08/07/2019	SD-3





ANTENNA PLAN VIEW

Prepared by:

PAUL J. FORD & COMPANY

Job # 19.0536.TGX-140-R00

Prepared for:

TeleMtn Engineering LLC

Revisions

Rev.	Date	Drawn	Checked	Description
00	08/08/19	PP	KM	1st RELEASE
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BU #: DN03433C

Site Name: DN03433C

Customer:T-MOBILE

Schematic Drawings

Mapping Date	Sheet Number
08/07/2019	SD-4

Mount CL	Mount Type	Mount Manufacturer / Model	Face Width	# of Mount Pipes			
				Alpha	Beta	Gamma	Delta
88'-7 1/2"	STAND-OFF	UNKNOWN	65"	4	4	4	N/A

Alpha Sector Equipment Information

Equip. Mark	CL	Qty.	Manufacturer	Model	Dimensions	Type	Location	Az.	Equipment & Pipe Location				
									"M"	"N"	"O"	"P"	"Q"
A	90'-2"	1	ANDREW	TMBXX-6516-A2M	50.9" H x 12" W x 6.5" D	PANEL	POS # 1	0°	17"	3/4"	1 3/4"	42"	5 1/2"
A	89'-11 1/2"	1	ANDREW	TMBXX-6516-A2M	50.9" H x 12" W x 6.5" D	PANEL	POS # 4	0°	17 1/2"	-2"	4 1/2"	42"	5 1/2"
B	91'-9 1/2"	1	ANDREW	LNX-6515DS-A1M	96.4" H x 11.9" W x 7.1" D	PANEL	POS # 2	0°	64"	-4"	26 3/4"	70"	4 1/2"
C	89'-11 1/2"	1	ANDREW	TMBX-6516-R2M	51.4" H x 6.6" W x 3.3" D	PANEL	POS # 3	0°	17 1/2"	-1 3/4"	2"	48 1/2"	5 1/2"
D	89'-1/2"	1	ANDREW	TMAT1921xB68-21A	9.1" H x 8.7" W x 4.1" D	TMA	POS # 3	-	-	-	-	-	-
E	89'-6"	1	NOKIA	FRIG	18.91" H x 15.25" W x 6" D	RRU	-	-	-	-	-	-	-
F	91'-10 1/2"	1	NOKIA	FHFB	34.3" H x 12.6" W x 7.8" D	RRU	-	-	-	-	-	-	-
G	90'-0"	1	NOKIA	FRLB	15.75" H x 15.75" W x 5.9" D	RRU	-	-	-	-	-	-	-

Beta Sector Equipment Information

Equip. Mark	CL	Qty.	Manufacturer	Model	Dimensions	Type	Location	Az.	Equipment & Pipe Location				
									"M"	"N"	"O"	"P"	"Q"
A	90'-2"	1	ANDREW	TMBXX-6516-A2M	50.9" H x 12" W x 6.5" D	PANEL	POS # 5	120°	17"	3/4"	1 3/4"	42"	5 1/2"
A	89'-11 1/2"	1	ANDREW	TMBXX-6516-A2M	50.9" H x 12" W x 6.5" D	PANEL	POS # 8	120°	17 1/2"	-2"	4 1/2"	42"	5 1/2"
B	91'-9 1/2"	1	ANDREW	LNX-6515DS-A1M	96.4" H x 11.9" W x 7.1" D	PANEL	POS # 6	120°	64"	-4"	26 3/4"	70"	4 1/2"
C	89'-11 1/2"	1	ANDREW	TMBX-6516-R2M	51.4" H x 6.6" W x 3.3" D	PANEL	POS # 7	120°	17 1/2"	-1 3/4"	2"	48 1/2"	5 1/2"
D	89'-1/2"	1	ANDREW	TMAT1921xB68-21A	9.1" H x 8.7" W x 4.1" D	TMA	POS # 7	-	-	-	-	-	-
E	89'-6"	1	NOKIA	FRIG	18.91" H x 15.25" W x 6" D	RRU	-	-	-	-	-	-	-
F	91'-10 1/2"	1	NOKIA	FHFB	34.3" H x 12.6" W x 7.8" D	RRU	-	-	-	-	-	-	-
G	90'-0"	1	NOKIA	FRLB	15.75" H x 15.75" W x 5.9" D	RRU	-	-	-	-	-	-	-
H	83'-6"	1	RAYCAP	RNSNDC-7771-PF-48	20.38" H x 18.86" W x 5.83" D	COVP	-	-	-	-	-	-	-

Gamma Sector Equipment Information

Equip. Mark	CL	Qty.	Manufacturer	Model	Dimensions	Type	Location	Az.	Equipment & Pipe Location				
									"M"	"N"	"O"	"P"	"Q"
A	90'-2"	1	ANDREW	TMBXX-6516-A2M	50.9" H x 12" W x 6.5" D	PANEL	POS # 9	240°	17"	3/4"	1 3/4"	42"	5 1/2"
A	89'-11 1/2"	1	ANDREW	TMBXX-6516-A2M	50.9" H x 12" W x 6.5" D	PANEL	POS # 12	240°	17 1/2"	-2"	4 1/2"	42"	5 1/2"
B	91'-9 1/2"	1	ANDREW	LNX-6515DS-A1M	96.4" H x 11.9" W x 7.1" D	PANEL	POS # 10	240°	64"	-4"	26 3/4"	70"	4 1/2"
C	89'-11 1/2"	1	ANDREW	TMBX-6516-R2M	51.4" H x 6.6" W x 3.3" D	PANEL	POS # 11	240°	17 1/2"	-1 3/4"	2"	48 1/2"	5 1/2"
D	89'-1/2"	1	ANDREW	TMAT1921xB68-21A	9.1" H x 8.7" W x 4.1" D	TMA	POS # 11	-	-	-	-	-	-
E	89'-6"	1	NOKIA	FRIG	18.91" H x 15.25" W x 6" D	RRU	-	-	-	-	-	-	-
F	91'-10 1/2"	1	NOKIA	FHFB	34.3" H x 12.6" W x 7.8" D	RRU	-	-	-	-	-	-	-
G	90'-0"	1	NOKIA	FRLB	15.75" H x 15.75" W x 5.9" D	RRU	-	-	-	-	-	-	-
H	83'-6"	1	RAYCAP	RNSNDC-7771-PF-48	20.38" H x 18.86" W x 5.83" D	COVP	-	-	-	-	-	-	-

Prepared by:

PAUL J. FORD & COMPANY

Job # 19.0536.TGX-140-R00

Prepared for:

TeleMtn Engineering LLC

Revisions

Rev.	Date	Drawn	Checked	Description
00	08/08/19	PP	KM	1st RELEASE
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BU #: DN03433C

Site Name: DN03433C

Customer: T-MOBILE

EQUIPMENT INFORMATION

Mapping Date	Sheet Number
08/07/2019	E-1

	Jumpers from main feedline to Antenna	Jumpers from main feedline to Antenna supporting equipment	Antenna supporting equipment to antenna supporting equipment	Jumpers from COVP (surge protector) to Antenna supporting	Jumpers from Antenna supporting equipment to Antenna
Alpha	Qty.: -	Qty.: 2	Qty.: -	Qty.: 4	Qty.: 12
	Length: -	Length: 4' typ.	Length: -	Length: 12' typ.	Length: 8' typ.
	Size: -	Size: 1/2 typ.	Size: -	Size: 1/2 typ.	Size: 1/2 typ.
	Make: -	Make: UNKNOW N	Make: -	Make: UNKNOW N	Make: UNKNOW N
Beta	Qty.: -	Qty.: 2	Qty.: -	Qty.: 4	Qty.: 12
	Length: -	Length: 4' typ.	Length: -	Length: 12' typ.	Length: 8' typ.
	Size: -	Size: 1/2 typ.	Size: -	Size: 1/2 typ.	Size: 1/2 typ.
	Make: -	Make: UNKNOW N	Make: -	Make: UNKNOW N	Make: UNKNOW N
Gamma	Qty.: -	Qty.: 2	Qty.: -	Qty.: 4	Qty.: 12
	Length: -	Length: 4' typ.	Length: -	Length: 12' typ.	Length: 8' typ.
	Size: -	Size: 1/2 typ.	Size: -	Size: 1/2 typ.	Size: 1/2 typ.
	Make: -	Make: UNKNOW N	Make: -	Make: UNKNOW N	Make: UNKNOW N

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PAUL J. FORD & COMPANY

Job # 19.0536.TGX-140-R00

Prepared for:

TeleMtn Engineering LLC

Revisions

Rev.	Date	Drawn	Checked	Description
00	08/08/19	PP	KM	1st RELEASE
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BU #: DN03433C

Site Name: DN03433C

Customer:T-MOBILE

JUMPER INFORMATION

Mapping Date	Sheet Number
08/07/2019	E-2

TOWER PROFILE

ALPHA SECTOR

BETA SECTOR

GAMMA SECTOR

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00	08/08/19	PP	KM	1st RELEASE
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BU #: DN03433C

Site Name: DN03433C

Customer: T-MOBILE

PHOTOGRAPHS

Mapping Date	Sheet Number
08/07/2019	P-1

MOUNT ELEVATION

FACE WIDTH

MOUNT PHOTO

MOUNT PHOTO

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Rev.	Date	Drawn	Checked	Description
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BU #: DN03433C

Site Name: DN03433C

Customer: T-MOBILE

PHOTOGRAPHS

Mapping Date	Sheet Number
08/07/2019	P-2

MOUNT PHOTO

MOUNT PHOTO

MOUNT PHOTO

COMPOUND

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Rev.	Date	Drawn	Checked	Description
00	08/08/19	PP	KM	1st RELEASE
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BU #: DN03433C

Site Name: DN03433C

Customer: T-MOBILE

PHOTOGRAPHS

Mapping Date	Sheet Number
08/07/2019	P-3

FEEDLINES

GROUND EQUIPMENT

GROUND EQUIPMENT

GROUND EQUIPMENT

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Job # 19.0536.TGX-140-R00

Prepared for:

TeleMtn Engineering LLC

Revisions

Rev.	Date	Drawn	Checked	Description
00	08/08/19	PP	KM	1st RELEASE
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BU #: DN03433C

Site Name: DN03433C

Customer: T-MOBILE

PHOTOGRAPHS

Mapping Date	Sheet Number
08/07/2019	P-4

Exhibit B — City's Minimum Technical Standards

Note: Some standards may not apply to your facility due to frequency of operation or type of service.

1.0 General

1.1 Posting of Information. The following information shall be posted on or near your cabinet:

Copy of FCC license (if applicable)
Equipment Identification Card with the following information:

Transmit and receive frequencies (or frequency bands in case of wireless operators)
Type of service
Authorized output power & ERP
Antenna model number
Transmission line model number and type
Name of licensee
Contact information for responsible person (name, phone, email)

Unidentified equipment shall be considered unauthorized and may be red tagged and removed after 30 days.

1.2 Installations at City Fire Stations. The City may require that the Tenant (Licensee) upgrade City radio equipment to ensure interference-free coexistence. Specifically, there is a problem with installing an isolator on the existing 900 MHz Alligator Model 1888 MAS transceiver used at most City fire stations. The isolator must be installed only on the transmit line, but the transceiver uses a duplexed (switched) output whereby both the transmitter and the receiver share the same antenna line. Similarly, separate cavity filters are required for the receiver and transmitter, but it is not possible to install both on a single duplexed line. For this reason, the City usually directs that the Alligator Model 1888 be replaced with a Model 1800 Master unit with separate transmit and receive antenna ports. A duplexer cavity filter should be used to combine transmit and receive into the existing antenna. Contact the City's Technical Representative for recommended vendors for these components.

1.3 Changes. Notify the City's Technical Representative immediately of any changes to frequencies, antennas or other equipment configuration. Obtain City's approval prior to making those changes as required by the Lease (License). Approved changes shall be shown on an updated Equipment ID Card.

2.0 Mobile Wireless Services

2.1 Land Mobile Radio Filter and Isolator Requirements. For land mobile radio (LMR), as a minimum, each transmitter shall employ a dual stage isolator followed by a single cavity

bandpass filter. All transmitters shall have built-in or external harmonic (low pass) filters. The low pass filter must be a true low pass filter, not a notch filter tuned to just one or two harmonic frequencies. Harmonic rejection shall be at least 60 dB at the second harmonic and at least 50 dB at the third harmonic. The following minimum isolator and bandpass cavity filter specifications apply:

30-50 MHz
Isolators - None required.
TX cavity - minimum of 20 dB rejection at + 0.5 MHz

72-76 MHz
Isolators - Minimum of 25 dB
TX cavity - minimum of 20 dB rejection at + 0.5 MHz

138-174, 216-222 MHz
Dual Stage Isolators - minimum of 60 dB
TX cavity - minimum of 20 dB rejection at + 1.5 MHz

406-512 MHz
Dual Stage Isolators - minimum of 60 dB
TX cavity - minimum of 20 dB rejection at + 3.5 MHz

698-941 MHz (excluding airphone)
Dual Stage Isolators - minimum of 60 dB
Tx cavity - minimum of 20 dB rejection at + 6 MHz

Explanation. The bandpass filter and lowpass filter must follow the isolator because ferrite isolators are nonlinear and can create harmonics. Please note that most bandpass cavity filters will pass odd harmonics of the tuned frequency, so an external lowpass filter following the isolator is also required. Transmitter combiners will be considered on a case-by-case basis. Please provide all combiner technical information to the City's Technical Representative.

2.2 Airphone (849-851 MHz transmit, 894-896 MHz receive)
Transmitter out-of-band emissions shall not cause harmful interference to cellular base station receivers (824-849 MHz). Tenant (Licensee) shall submit plans, including bandpass filter response curves, to the City's Technical Representative for approval prior to installation. Tenant (Licensee) shall install adequate receiver bandpass filtering to preclude receiver desensitization or receiver intermodulation caused indirectly by cellular base stations on the site.

2.3 LMR Duplexers. Notch duplexers are not adequate. The duplexer must also have a bandpass characteristic to ensure other transmit signals do not enter the transmitter or over drive the receiver This is especially important for VHF repeaters which are vulnerable to FM broadcast signals and other closely-spaced VHF transmitters.

2.4 Personal Wireless Services. These services include, but are not limited to the 698-806, 806-

869, 1710-1755, 1850-2000, 2110-2155, 2500-2600 MHz bands (excluding 700 and 800 MHz public safety bands). Because the wireless provider is assumed to have exclusive use of a band of frequencies, out-of-band emissions are expected to be attenuated significantly by the manufacturer's standard combiners, duplexers and cross-band couplers. Ferrite isolators may not be required. Submit your plans to the City's Technical Representative for approval.

2.5 Unlicensed Band (License-Free) Radios. Unlicensed band radios and shared-band services, including, but not limited to those operating in the 902-928 MHz, 2.4-2.4835 GHz, 3.5 GHz, 4.9 GHz (public safety only) and 5 GHz bands are not allowed unless specifically authorized in the Tenant's (Licensee's) Lease (License). When authorized, Tenant (Licensee) shall not change operating frequencies without first getting approval from City. License-free radios are notorious for their poor quality in a harsh RF environment and specific make, model and technical specifications must be provided to the City's Technical Representative for approval. Additional protective devices, shielded CAT 6 cable and shielded NEMA cases may be required before such devices can be installed on the tower.

2.6 Receivers. The site may have relatively high radio frequency (RF) levels in all mobile radio bands. Your receiver amplifier must be robust to work in this environment. Ensure the receiver has good intermodulation (IM) rejection and high 1 dB compression point. If interference is encountered and we find the receiver is not performing up to the standards exhibited by state-of-the-art equipment, the City may require receiver improvements or upgrades before requiring changes to other tenant (licensee) equipment or configurations. This requirement applies to both new and existing tenants (licensees).

Filters are required for mobile radio receivers. Single receivers must employ a minimum of a single 7" diameter (or equivalent) cavity bandpass filter with a rejection curve corresponding to 1 dB insertion loss or better. Additional filter isolation may be required in special cases. Receiver multicouplers must use a bandpass filter (preselector) prior to the multicoupler amplifier.

2.7 Antennas. Select antennas designed to minimize passive intermodulation generation. Note that antennas that pass intermodulation tests at the factory may not provide good intermodulation rejection after years of exposure to heat, cold, vibration from wind, and humidity. Only new antennas are allowed for new installations. Select antennas specifically designed to reject intermodulation over the life of the antenna. Unless the antenna is a duplex configuration, transmit and receive antennas should be separated vertically on the tower. If the tower is owned by the City, the City will designate antenna locations. Antennas must be DC grounded to the tower for lightning protection.

2.8 Transmission Lines. Coaxial cable should be grounded at the top and the bottom of the run with an Andrew ground kit or equivalent. Ensure that ground conductors run straight down with no sharp bends because bends will increase the impedance of the grounding conductor. We also require that the line be marked so we can identify it later. We suggest bands of colored electrical tape at the bottom, middle and top of the run (similar to a resistor color code). Install a Huber-Suhner (or equivalent) coaxial surge arrestor at the bulkhead. All exterior transmission lines must be solid outer conductors. If possible, receive and transmit lines should be separated by at

least one foot from cabinet to antenna.

2.9 Connectors. Connectors are often sources of RF leakage and passive intermodulation. UHF connectors (PL259) are not allowed on connections external to the radio cabinet. Type "N" connectors are allowed below 512 MHz. 7/16 DIN connectors should be used at 698 MHz and above and are required above 1.7 GHz. Connectors using dissimilar metal contacts or ferrous materials (e.g., nickel plating) are not allowed. The preferred connector uses a silver plated body with gold plated inner conductor. Brass bodies and silver or brass inner conductors are also allowed.

2.10 Additional Protective Devices May Be Required. The specifications above are minimum requirements. Additional protective devices may be required based upon evaluation of the following information:

Theoretical TX mixes, particularly second and third order
Antenna location and type
Combiner/multicoupler configurations
Transmitter specifications
Receiver specifications
Historical problems
Transmitter to transmitter isolation
Transmitter to antenna isolation
Transmitter to receiver isolation
Calculated and measured level of IM products
Transmitter output power
Transmitter ERP
Spectrum analyzer measurements
VSWR measurements
Existing cavity selectivity
Antenna to antenna proximity

3.0 FM & IBOC Broadcast (Part 73, ERP > 1 kW)

3.1 FM Broadcast Transmitters. FM and IBOC Broadcast transmitters will be either combined with other stations into a common antenna or stand-alone. If combined, the combiner design shall be approved by the City's Technical Representative. If stand-alone, the transmitter shall employ a bandpass cavity filter with the following minimum performance specifications:

3.1.1. Rejection. The bandpass filter shall provide the following minimum rejection for Class C, C0 and C1 stations:

From Center +/-	Minimum Rejection
800 kHz	22 dB
1 MHz	28 dB
1.2 MHz	32 dB

1.4 MHz 38 dB
1.6 MHz 43 dB

Note that four cavities are required to meet this specification. Class C2 and C3 stations may use three-cavity filters. These filter requirements also apply to stations with FM & IBOC combined outputs. A stand alone IBOC transmitter and antenna shall comply with the following requirements: IBOC ERP greater than 5,000 Watts: 4 cavity filter (see rejection above), IBOC ERP less than or equal to 5,000 Watts: 3 cavity filter.

3.1.2 Gain Flatness. +/-0.5 dB from +/-200 kHz from center frequency.

3.1.3. Group Delay Flatness. No greater than +/- 150 nanoseconds (symmetrical) in +/- 200 kHz (I.e., minimum to maximum delay difference shall be no greater than 300 nanoseconds in the band f_c - 200 kHz to f_c + 200 kHz.

3.1.4. VSWR. No greater than 1.1:1 in +/- 200 kHz (assuming filter is terminated in perfect 50 ohm load).

3.1.5. Insertion Loss. No greater than 0.3 dB in +/- 200 kHz.

The transmitter should comply with current FCC rules regarding out-of-band emissions at transmitter output (before the bandpass cavity filter). The external filter is required to provide further rejection of out-of-band emissions to ensure electromagnetic compatibility with other users on the site.

3.2 FM Broadcast Antennas. FM Broadcast antennas mounted below 250' AGL (center of radiation) shall employ short element spacing to reduce downward radiation and ensure compliance with CFR 47, Parts 1.1307-1.1310. This requirement does not apply to stations that employ a single element antenna. Examples of short element spacing are a 6 bay antenna with half-wavelength spacing or an 8 bay antenna with 3/4 wavelength spacing. Submit a plot of predicted power density versus distance at ground level for City's Technical Representative approval.

4.0 Full-Power Television

4.1 Full-power television transmitters shall include band pass and low pass filters.

4.2 For television transmitters, measured out-of-band emissions (including harmonics) greater than 3 MHz from the respective channel edge shall be more than 80 dB below the measured power over the entire channel. Both measurements shall use a 6 MHz measurement bandwidth.

5.0 Low Power Television (analog and digital)

5.1 Low Power Television (LPTV) transmitters and television translators must have low pass filters that attenuate all harmonics and spurious products at least 80 dB below the power

measured at the carrier frequency. To facilitate measurements of spurious products, each LPTV and translator transmitter shall have installed a line section and appropriate directional coupler element. For routine use, the line section may employ a standard DC element and be connected to a wattmeter capable of measuring forward and reflected power. In addition, the Tenant (Licensee) shall own or have access to an RF load capable of dissipating the full power of the transmitter for troubleshooting purposes.

6.0 Grounding, Bonding and Shielding

6.1 Shielding. RF interference can get directly into the electronics of a receiver or transmitter. Cabinet shielding must be in place and maintained to the manufacturer's specifications. Do not leave cabinet doors open because open cabinet doors defeat the shielding.

6.2 Grounding. Equipment grounding and bonding should be accomplished in accordance with Mil Std 188-124, Military Handbook 419 and Motorola R56. Contact the City's Technical Representative for guidance on grounding and bonding at your particular facility.

7.0 Site Work

7.1 Tower Work Insurance and Experience Requirements. All tower riggers or installers of antennas, transmission lines, cabinets, wiring or similar hardware or apparatus must meet the minimum basic requirements of the City. These will include, but not be limited to, the following:

- The rigging company must have a current Certificate of Insurance on file with the City. The certificate will include, but not be limited to the following:

    1. General Comprehensive & Liability: $5,000,000
    2. Vehicle Liability: $1,000,000
    3. Workman's Compensation Insurance (By Statute)

- Demonstrated experience on similar tower types and similar work activity on similar towers within the past two years with a list of at least two recent clients or professional references with actual knowledge of experience and necessary qualifications, or in lieu thereof; previous working relationship with the City and known by the City's personnel.

City reserves the right, at its sole discretion, to reject the use of any person or tower rigging company on City-owned towers or properties.

7.2 Work Standards. The installation of any and all materials on the tower and in the accompanying shelter must be pre-authorized and approved by the City's Technical Representative. The following guidelines will be strictly enforced:

7.2.1 Equipment or cabinets mounted on platforms will be constructed of galvanized or stainless steel and will be securely attached to the tower members or platforms with J-bolts, U-

bolts or similar clamping devices which do not penetrate tower members or any part of the galvanized coating. All mounting hardware must be hot-dipped galvanized or stainless steel (NOT PLATED). All mounting nuts, bolts, washers or similar must be Grade 5 or better.

7.2.2 Antennas and the mounting thereof must be approved in advance of installation. Data in reference to antenna type, weight, wind loading, gain, bandwidth and mounting details must be provided to the City's Technical Representative and may not be modified or replaced without expressed written permission of City. Installation of antennas on City-owned towers may require a new structural study at the Tenant (Licensee)‘s expense.

7.2.3 Transmission lines and hardware must be approved in advance of installation by the City's Technical Representative and must be specified as to manufacturer, size and type and shown on the City’s New Tenant Questionnaire. All the mounting hardware must be of appropriate type and design to support the transmission lines with strain-reliefs installed at the manufacturer’s recommended intervals. Under no circumstances will stainless steel automotive-type hose clamps be used to secure transmission lines or cables to tower members. Where not previously designated, all lines will be positioned on the tower to minimize wind loading and provide a minimum of obstruction to climbing or removal/replacement of other lines. Each line will be mounted independently of other lines on the tower. Cable trays, waveguide entrances, tower ladders, elevator rails and other similar members are to be kept clear of all cables on the tower. Stainless steel lashing ties are acceptable for use on the tower but are not to be used as strain reliefs.

7.2.4 Antenna jumper cables or cables to/from crossband couplers or similar devices on the tower will be kept to minimum required lengths and will be made of solid shield outer conductor cables with outer jackets capable of withstanding severe weather and ultraviolet rays. All such cable types must be pre-approved by the City.

7.2.5 UNDER NO CIRCUMSTANCES –

- will welding or drilling of tower members be allowed;
- will modifications to the tower, bridge, building entrance fittings or similar be permitted;
- will transmission line splices (a pair of connectors at other than the top or bottom of the run on the tower) be permitted except by prior approval or necessitated by damage only repairable by splicing;
- will any tampering, retuning, rerouting or other modifications be permitted to equipment owned by City or other tenants.

7.2.6 All installations will be performed in accordance with good engineering practice and within the guidelines of this document. Any deviation from these minimum requirements and technical standards must be approved in writing prior to installation or modification.

7.3 Removal of Unused Antennas and Lines. Tenant (Licensee) shall remove all unused antennas, transmission lines and associated mounting hardware from City's tower within 90 days of the date an antenna is no longer in service.

7.4 NO PRESENT INSTALLATION WILL BE "GRANDFATHERED" and must conform to these work standards within a reasonable time period to be determined by the City's Technical Representative. Periodic inspections may be performed to ensure that all installations meet technical standards.

8.0 Shelters

8.1 Cable Dressing Inside Building or Shelter. All wiring and cables within a given rack will be properly dressed and/or bundled with cable ties with excess cut close to the barbs. Twisted wire, tape, rope, twine, phone wire and similar bits of debris usually available on site ARE NOT ACCEPTABLE substitutes for proper securing hardware. All inter-rack cables and wiring must be properly routed and utilize the cable trays provided even if between adjacent racks. Overhead cables and RF lines must be easily removed or reworked within the cable trays. Proper care must be taken to ensure that new cables added to the trays are not stressed or intertwined with existing cables. OVERHEAD CABLES MAY NOT CROSS PERPENDICULARS OR BE SUSPENDED IN MID AIR WITHOUT SUPPORTS. NO SUPPORTS MAY BE INSTALLED WITHOUT PRIOR APPROVAL. All long cable runs must be properly identified at each end indicating the opposite cable end address. All cabling within the building must be cut to proper length except phasing harnesses, where required.

9.0 Towers

9.1 Tenant (Licensee) may not erect new towers without the City's prior written consent, which may be granted or denied in City's sole discretion, and towers that are approved may only be constructed after plans for the tower have been approved by the City and by the zoning authority.

9.2 New towers shall comply with TIA-222-G or the most recent edition adopted by the local zoning authority. Changes to an existing tower, including addition or replacement of antennas requires that TIA-222-G or the most recent edition be used. Tenant (Licensee)-owned towers that present an immediate safety hazard shall be corrected by Tenant (Licensee) regardless of the status of the current lease or the particular edition of TIA-222 in use at the time of tower construction. Installation of antennas on City-owned towers may require a new structural study at the Tenant (Licensee)'s expense.

10.0 Permits

10.1 Tenant (Licensee) shall comply with all local and Federal regulations. Tenant (Licensee) is responsible for acquiring all applicable permits, including, but not limited to FCC construction permits and building permits. Tenant (Licensee) is also responsible for performing any required studies, including RF exposure and RF interference studies required by the FCC, local government, and City. Tenant (Licensee) shall furnish all applicable permits, studies, and

approvals to the City for approval before starting any construction, including antenna installation.

11.0 Radio Frequency Safety

11.1 The engineering, design, configuration, installation, and maintenance of high power (> 1 kW ERP) radio facilities on the site shall be accomplished in a manner that minimizes downward radiation. Changes to proposed systems may be directed by City to comply with this objective.

11.2 Everyone on the site shall follow these guidelines:

- All personnel entering the site must be authorized
- Obey all posted signs
- Assume all antennas are active unless proven otherwise
- Before working on an antenna, notify the owner and disable the transmitter
- Use a radio frequency (RF) personal monitor when working near antennas
- Never operate transmitters without shields

11.3 Power densities on towers can be much higher than at ground level. For this reason, tower climbers should request power reductions from high-power tenants and carry RF personal monitors when climbing towers. The City's Technical Representative can tell you which transmitters should be turned down before climbing the tower.

11.4 Federal Government guidelines regarding human exposure to radio frequency energy are found in the Code of Federal Regulations (CFR) Title 47, Parts 1.1307-1.1310.

Figure 1 - Warning Sign to be Posted at Base of Tower
(Available from Tessco, Holaday, Narda and other Sources)

EXHIBIT C

RADIO FREQUENCY INTERFERENCE ANALYSIS REPORT

T-Mobile
Site ID: DN03433C
Site Name: Denver_Fire_28

August 29, 2022

Prepared By:
Centerline Communications, LLC
750 W Center St, Suite 301
West Bridgewater, MA 02379
612-618-3126
Report Writer: Samuel Cosgrove

Table of Contents

1.0 Executive Summary

This report presents a radio frequency interference (RFI) analysis which was performed on the DN03433C_Denver_Fire_28 site. 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	15.3
Receiver Desensitization	N/A	Passed	No Interference was predicted	49.4
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
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
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
Receiver Bandwidth	Receiver Dependent
Antenna Patterns Considered	No (Worst Case)
Measured Antenna Isolation Data	No
Filters/Multicouplers Considered	Yes
Number of Simultaneous Transmitters Mixed	5
Highest Intermodulation Order Tested	7
Condense Intermodulation Hit Quantity	Yes - 1000/Order
TX IM Bandwidth Multiplication	Yes
Tx/Rx Systems Excluded	None
Site File Name	DN03433C_Denver_Fire_28.dta
Report File Name	DN03433C_Denver_Fire_28.docx
WirelessSiteRFI Software Version	10.0.10

2.0 Site Description

The communication systems located at this site are described in this section as well as the configuration of the antenna systems.

The site parameters are:

Site Name: DN03433C_Denver_Fire_28
Owner: RMTN Properties, LLC
Site Description: 130' Lattice Tower
Address: 4306 S. Wolff Street
Denver, CO 80236
Latitude: 39:38:17.25 N
Longitude: 105:02:55.56 W
Elevation: 1673’ AMSL
Notes: T-Mobile is proposing to replace (12) existing antennas with (6) new antennas and (6) new RRH units.

2.1 Communications Systems

System	Provider	Technology	Frequency Band
1	T-Mobile	LTE-600 NR-600	617 - 652; 663 - 698 MHz - 600 MHz Band
2	T-Mobile	LTE-700	698 - 806 MHz - 700 MHz Band
3	T-Mobile	LTE-1900 UMTS-1900 GSM-1900	1850 - 1995 MHz - PCS
4	T-Mobile	LTE-2100	1710 - 2155 MHz - AWS1
5	T-Mobile	LTE-2500 NR-2500	2496 - 2690 MHz - BRS/EBS
6	Verizon	LTE-700	698 - 806 MHz - 700 MHz Band
7	Verizon	CDMA-850	835 - 890 MHz - Cellular Block B
8	Verizon	LTE-850	835 - 890 MHz - Cellular Block B
9	Verizon	LTE-850	1850 - 1995 MHz - PCS
10	Verizon	LTE-2100	1710 - 2180 MHz - AWS1 / AWS3
11	Verizon	CBRS	3550 - 3700 MHz - 3.5 GHz - CBRS
12	Verizon	C-Band	3700 - 3980 MHz - C-Band
13	Verizon	NR-28000	28GHz - mmWave
14	Denver 150 MHz Receive Only Land Mobile Radio	FM Land Mobile	150 - 174 MHz - Land Mobile
15	Denver 450 MHz Land Mobile Radio	FM Land Mobile	420 - 470 MHz - Land Mobile
16	Denver 850 MHz Trunked P25	800 MHz Trunking	806 - 896 MHz - Land Mobile
17	Denver 8CALL90 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
18	Denver 8TAC91 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
19	Denver 8TAC92 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
20	Denver 8TAC93 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
21	Denver 8TAC94 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
22	Denver 930 MHz Trunked	Two-Way Paging	928 - 932 MHz - Paging
23	Denver BRDWY 700 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
24	Denver DHA 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
25	Denver Fire Repeaters 700 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile

26	Denver Jail Control	FM Land Mobile	420 - 470 MHz - Land Mobile
27	Denver Jail Tactical	FM Land Mobile	420 - 470 MHz - Land Mobile
28	Denver METRO RPTR 1 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
29	Denver MM 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
30	Denver P25 ASR 850 MHz Trunked P25	800 MHz Trunking	806 - 896 MHz - Land Mobile
31	Denver P25 Simulcast 850 MHz Trunked P25	800 MHz Trunking	806 - 896 MHz - Land Mobile
32	Denver R.A.C.E.S. Conventional	FM Land Mobile	150 - 174 MHz - Land Mobile
33	Denver RMS 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
34	Denver STAC Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
35	Denver STN 2 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
36	Denver STN 26 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
37	Denver STN 28 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
38	Denver VLAW31(NLEEC) Conventional	FM Land Mobile	150 - 174 MHz - Land Mobile
39	Denver VMED28(HEAR) Conventional	FM Land Mobile	150 - 174 MHz - Land Mobile
40	Denver WRCE950 Public Safety 4000 MHz	Microwave	3700 - 4200 MHz - 4 GHz Microwave

2.2 Antenna Systems

Ant #	Mfg	Antenna Model	Gain (dBd)	Hgt (ft)	Orient (deg)	Sec-tor	Ant Use	Transmission Line Type	Line Loss (/100')	Line Length (ft)
1	Commscope	FFHH-65C-R3	12.88	87	340	A	Dplx	1/2 in. Foam	1.7	10
2	Commscope	FFHH-65C-R3	12.88	87	100	B	Dplx	1/2 in. Foam	1.7	10
3	Commscope	FFHH-65C-R3	12.88	87	220	C	Dplx	1/2 in. Foam	1.7	10
4	Commscope	FFHH-65C-R3	13	87	340	A	Dplx	1/2 in. Foam	1.7	10
5	Commscope	FFHH-65C-R3	13	87	100	B	Dplx	1/2 in. Foam	1.7	10
6	Commscope	FFHH-65C-R3	13	87	220	C	Dplx	1/2 in. Foam	1.7	10
7	Commscope	FFHH-65C-R3	15.72	87	340	A	Dplx	1/2 in. Foam	3.4	10
8	Commscope	FFHH-65C-R3	15.72	87	100	B	Dplx	1/2 in. Foam	3.4	10
9	Commscope	FFHH-65C-R3	15.72	87	220	C	Dplx	1/2 in. Foam	3.4	10
10	Commscope	FFHH-65C-R3	16.13	87	340	A	Dplx	1/2 in. Foam	3.8	10
11	Commscope	FFHH-65C-R3	16.13	87	100	B	Dplx	1/2 in. Foam	3.8	10
12	Commscope	FFHH-65C-R3	16.13	87	220	C	Dplx	1/2 in. Foam	3.8	10
13	Nokia	AEHC	22.14	87	340	A	Dplx	NA	NA	NA
14	Nokia	AEHC	22.14	87	100	B	Dplx	NA	NA	NA
15	Nokia	AEHC	22.14	87	220	C	Dplx	NA	NA	NA
16	JMA	MX10FRO660-xx	11.8	72	310	A	Dplx	1/2 in. Foam	2.34	10
17	JMA	MX10FRO660-xx	11.8	72	310	A	Dplx	1/2 in. Foam	2.34	10
18	JMA	MX10FRO660-xx	11.8	72	70	B	Dplx	1/2 in. Foam	2.34	10
19	JMA	MX10FRO660-xx	11.8	72	70	B	Dplx	1/2 in. Foam	2.34	10
20	JMA	MX10FRO660-xx	11.8	72	190	C	Dplx	1/2 in. Foam	2.34	10
21	JMA	MX10FRO660-xx	11.8	72	190	C	Dplx	1/2 in. Foam	2.34	10
22	Antel	BXA-80063-4CF	13	65	310	A	Dplx	1-5/8 in. Foam	0.72	95
23	Antel	BXA-80063-4CF	13	65	70	B	Dplx	1-5/8 in. Foam	0.72	95
24	Antel	BXA-80063-4CF	13	65	190	C	Dplx	1-5/8 in. Foam	0.72	95
25	JMA	MX10FRO660-xx	12.9	72	310	A	Dplx	1/2 in. Foam	2.15	10
26	JMA	MX10FRO660-xx	12.9	72	310	A	Dplx	1/2 in. Foam	2.15	10
27	JMA	MX10FRO660-xx	12.9	72	70	B	Dplx	1/2 in. Foam	2.15	10
28	JMA	MX10FRO660-xx	12.9	72	70	B	Dplx	1/2 in. Foam	2.15	10
29	JMA	MX10FRO660-xx	12.9	72	190	C	Dplx	1/2 in. Foam	2.15	10
30	JMA	MX10FRO660-xx	12.9	72	190	C	Dplx	1/2 in. Foam	2.15	10
31	JMA	MX10FRO660-xx	15.3	72	310	A	Dplx	1/2 in. Foam	3.4	10
32	JMA	MX10FRO660-xx	15.3	72	70	B	Dplx	1/2 in. Foam	3.4	10
33	JMA	MX10FRO660-xx	15.3	72	190	C	Dplx	1/2 in. Foam	3.4	10
34	JMA	MX10FRO660-xx	15.1	72	310	A	Dplx	1/2 in. Foam	3.8	10
35	JMA	MX10FRO660-xx	15.1	72	70	B	Dplx	1/2 in. Foam	3.8	10
36	JMA	MX10FRO660-xx	15.1	72	190	C	Dplx	1/2 in. Foam	3.8	10
37	JMA	MX10FRO660-xx	12	72	310	A	Dplx	1/2 in. Foam	4.75	10
38	JMA	MX10FRO660-xx	12	72	70	B	Dplx	1/2 in. Foam	4.75	10
39	JMA	MX10FRO660-xx	12	72	190	C	Dplx	1/2 in. Foam	4.75	10
40	Ericsson	AIR6449	23.55	72	310	A	Dplx	NA	NA	NA
41	Ericsson	AIR6449	23.55	72	70	B	Dplx	NA	NA	NA
42	Ericsson	AIR6449	23.55	72	190	C	Dplx	NA	NA	NA
43	Samsung	SM6701 half array	26.65	72	310	A	Dplx	NA	NA	NA
44	Samsung	SM6701 half array	26.65	72	70	B	Dplx	NA	NA	NA
45	Samsung	SM6701 half array	26.65	72	190	C	Dplx	NA	NA	NA
46	Generic	Omni	10	100	0		Rx	7/8 in. Foam	0.45	130
47	Generic	Omni	10	150	0		Dplx	7/8 in. Foam	0.45	180
48	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
49	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
50	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
51	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
52	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
53	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
54	Generic	Omni	10	100	0		Dplx	7/8 in. Foam	0.45	130
55	Generic	Omni	10	303	0		Dplx	7/8 in. Foam	0.45	333
56	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
57	Generic	Omni	10	3	0		Dplx	7/8 in. Foam	0.45	33
58	Generic	Omni	10	100	0		Dplx	7/8 in. Foam	0.45	130
59	Generic	Omni	10	100	0		Dplx	7/8 in. Foam	0.45	130

60	Generic	Omni	10	100	0		Dplx	7/8 in. Foam	0.45	130
61	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
62	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
63	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
64	Generic	Omni	10	100	0		Dplx	7/8 in. Foam	0.45	130
65	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
66	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
67	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
68	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
69	Generic	Omni	10	200	0		Dplx	7/8 in. Foam	0.45	230
70	Generic	Omni	10	100	0		Dplx	7/8 in. Foam	0.45	130
71	Generic	Omni	10	100	0		Dplx	7/8 in. Foam	0.45	130
72	Generic	Microwave	37.5	100	0		Dplx	RG-8/U	0.001	130

3.0 Transmitter Frequencies

Freq #	Ant #	Provider	Model	Technology	Channel Label	ID	Frequency	Power (Watts)	BW (kHz)
1	1	T-Mobile	Nokia	NR-600		A	624.500000	40	5000
2	1	T-Mobile	Nokia	NR-600		B	629.500000	40	5000
3	1	T-Mobile	Nokia	LTE-600		C	634.500000	40	5000
4	2	T-Mobile	Nokia	NR-600		D	624.500000	40	5000
5	2	T-Mobile	Nokia	NR-600		E	629.500000	40	5000
6	2	T-Mobile	Nokia	LTE-600		F	634.500000	40	5000
7	3	T-Mobile	Nokia	NR-600		G	624.500000	40	5000
8	3	T-Mobile	Nokia	NR-600		H	629.500000	40	5000
9	3	T-Mobile	Nokia	LTE-600		I	634.500000	40	5000
10	4	T-Mobile	Nokia	LTE-700		J	731.000000	40	5000
11	5	T-Mobile	Nokia	LTE-700		K	731.000000	40	5000
12	6	T-Mobile	Nokia	LTE-700		L	731.000000	40	5000
13	7	T-Mobile	Nokia	LTE-1900		M	1957.500000	40	15000
14	7	T-Mobile	Nokia	UMTS-1900		N	1982.500000	40	5000
15	7	T-Mobile	Nokia	GSM-1900		O	1987.500000	40	5000
16	8	T-Mobile	Nokia	LTE-1900		P	1957.500000	40	15000
17	8	T-Mobile	Nokia	UMTS-1900		Q	1982.500000	40	5000
18	8	T-Mobile	Nokia	GSM-1900		R	1987.500000	40	5000
19	9	T-Mobile	Nokia	LTE-1900		S	1957.500000	40	15000
20	9	T-Mobile	Nokia	UMTS-1900		T	1982.500000	40	5000
21	9	T-Mobile	Nokia	GSM-1900		U	1987.500000	40	5000
22	10	T-Mobile	Nokia	LTE-2100		V	2115.000000	40	10000
23	10	T-Mobile	Nokia	LTE-2100		W	2150.000000	40	10000
24	11	T-Mobile	Nokia	LTE-2100		X	2115.000000	40	10000
25	11	T-Mobile	Nokia	LTE-2100		Y	2150.000000	40	10000
26	12	T-Mobile	Nokia	LTE-2100		Z	2115.000000	40	10000
27	12	T-Mobile	Nokia	LTE-2100		AA	2150.000000	40	10000
28	13	T-Mobile	Nokia	NR-2500		AB	2499.000000	160	5000
29	13	T-Mobile	Nokia	NR-2500		AC	2608.000000	160	10000
30	13	T-Mobile	Nokia	NR-2500		AD	2623.750000	160	10000
31	13	T-Mobile	Nokia	NR-2500		AE	2635.000000	160	10000
32	13	T-Mobile	Nokia	LTE-2500		AF	2646.000000	160	10000
33	13	T-Mobile	Nokia	LTE-2500		AG	2657.000000	160	10000
34	13	T-Mobile	Nokia	LTE-2500		AH	2668.000000	160	10000
35	14	T-Mobile	Nokia	NR-2500		AI	2499.000000	160	5000
36	14	T-Mobile	Nokia	NR-2500		AJ	2608.000000	160	10000
37	14	T-Mobile	Nokia	NR-2500		AK	2623.750000	160	10000
38	14	T-Mobile	Nokia	NR-2500		AL	2635.000000	160	10000
39	14	T-Mobile	Nokia	LTE-2500		AM	2646.000000	160	10000
40	14	T-Mobile	Nokia	LTE-2500		AN	2657.000000	160	10000
41	14	T-Mobile	Nokia	LTE-2500		AO	2668.000000	160	10000
42	15	T-Mobile	Nokia	NR-2500		AP	2499.000000	160	5000
43	15	T-Mobile	Nokia	NR-2500		AQ	2608.000000	160	10000
44	15	T-Mobile	Nokia	NR-2500		AR	2623.750000	160	10000
45	15	T-Mobile	Nokia	NR-2500		AS	2635.000000	160	10000
46	15	T-Mobile	Nokia	LTE-2500		AT	2646.000000	160	10000
47	15	T-Mobile	Nokia	LTE-2500		AU	2657.000000	160	10000
48	15	T-Mobile	Nokia	LTE-2500		AV	2668.000000	160	10000
49	16	Verizon	Samsung	LTE-700		AW	751.000000	40	10000
50	18	Verizon	Samsung	LTE-700		AX	751.000000	40	10000
51	20	Verizon	Samsung	LTE-700		AY	751.000000	40	10000
52	22	Verizon	Samsung	CDMA-850	Chan 384	AZ	881.520000	16	1230
53	22	Verizon	Samsung	CDMA-850	Chan 425	BA	882.750000	16	1230
54	23	Verizon	Samsung	CDMA-850	Chan 384	BC	881.520000	16	1230
55	23	Verizon	Samsung	CDMA-850	Chan 425	BD	882.750000	16	1230
56	24	Verizon	Samsung	CDMA-850	Chan 384	BF	881.520000	20	1230
57	24	Verizon	Samsung	CDMA-850	Chan 425	BG	882.750000	20	1230
58	25	Verizon	Samsung	LTE-850		BI	887.500000	40	5000
59	27	Verizon	Samsung	LTE-850		BJ	887.500000	40	5000
60	29	Verizon	Samsung	LTE-850		BK	887.500000	40	5000
61	31	Verizon	Samsung	LTE-1900		BL	1967.500000	40	5000

62	31	Verizon	Samsung	LTE-1900		BM	1972.500000	40	5000
63	32	Verizon	Samsung	LTE-1900		BN	1967.500000	40	5000
64	32	Verizon	Samsung	LTE-1900		BO	1972.500000	40	5000
65	33	Verizon	Samsung	LTE-1900		BP	1967.500000	40	5000
66	33	Verizon	Samsung	LTE-1900		BQ	1972.500000	40	5000
67	34	Verizon	Samsung	LTE-2100		BR	2125.000000	40	10000
68	34	Verizon	Samsung	LTE-2100		BS	2175.000000	40	10000
69	35	Verizon	Samsung	LTE-2100		BT	2125.000000	40	10000
70	35	Verizon	Samsung	LTE-2100		BU	2175.000000	40	10000
71	36	Verizon	Samsung	LTE-2100		BV	2125.000000	40	10000
72	36	Verizon	Samsung	LTE-2100		BW	2175.000000	40	10000
73	37	Verizon	Samsung	CBRS		BX	3515.000000	5	10000
74	37	Verizon	Samsung	CBRS		BY	3525.000000	5	10000
75	37	Verizon	Samsung	CBRS		BZ	3535.000000	5	10000
76	37	Verizon	Samsung	CBRS		CA	3545.000000	5	10000
77	37	Verizon	Samsung	CBRS		CB	3555.000000	5	10000
78	37	Verizon	Samsung	CBRS		CC	3565.000000	5	10000
79	37	Verizon	Samsung	CBRS		CD	3575.000000	5	10000
80	37	Verizon	Samsung	CBRS		CE	3585.000000	5	10000
81	38	Verizon	Samsung	CBRS		CF	3515.000000	5	10000
82	38	Verizon	Samsung	CBRS		CG	3525.000000	5	10000
83	38	Verizon	Samsung	CBRS		CH	3535.000000	5	10000
84	38	Verizon	Samsung	CBRS		CI	3545.000000	5	10000
85	38	Verizon	Samsung	CBRS		CJ	3555.000000	5	10000
86	38	Verizon	Samsung	CBRS		CK	3565.000000	5	10000
87	38	Verizon	Samsung	CBRS		CL	3575.000000	5	10000
88	38	Verizon	Samsung	CBRS		CM	3585.000000	5	10000
89	39	Verizon	Samsung	CBRS		CN	3515.000000	5	10000
90	39	Verizon	Samsung	CBRS		CO	3525.000000	5	10000
91	39	Verizon	Samsung	CBRS		CP	3535.000000	5	10000
92	39	Verizon	Samsung	CBRS		CQ	3545.000000	5	10000
93	39	Verizon	Samsung	CBRS		CR	3555.000000	5	10000
94	39	Verizon	Samsung	CBRS		CS	3565.000000	5	10000
95	39	Verizon	Samsung	CBRS		CT	3575.000000	5	10000
96	39	Verizon	Samsung	CBRS		CU	3585.000000	5	10000
97	40	Verizon	Samsung	C-Band		CV	3710.000000	200	20000
98	40	Verizon	Samsung	C-Band		CW	3730.000000	200	20000
99	40	Verizon	Samsung	C-Band		CX	3750.000000	200	20000
100	40	Verizon	Samsung	C-Band		CY	3770.000000	200	20000
101	40	Verizon	Samsung	C-Band		CZ	3790.000000	200	20000
102	40	Verizon	Samsung	C-Band		DA	3810.000000	200	20000
103	40	Verizon	Samsung	C-Band		DB	3830.000000	200	20000
104	40	Verizon	Samsung	C-Band		DC	3850.000000	200	20000
105	40	Verizon	Samsung	C-Band		DD	3870.000000	200	20000
106	40	Verizon	Samsung	C-Band		DE	3890.000000	200	20000
107	40	Verizon	Samsung	C-Band		DF	3910.000000	200	20000
108	40	Verizon	Samsung	C-Band		DG	3930.000000	200	20000
109	40	Verizon	Samsung	C-Band		DH	3950.000000	200	20000
110	40	Verizon	Samsung	C-Band		DI	3970.000000	200	20000
111	41	Verizon	Samsung	C-Band		DJ	3710.000000	200	20000
112	41	Verizon	Samsung	C-Band		DK	3730.000000	200	20000
113	41	Verizon	Samsung	C-Band		DL	3750.000000	200	20000
114	41	Verizon	Samsung	C-Band		DM	3770.000000	200	20000
115	41	Verizon	Samsung	C-Band		DN	3790.000000	200	20000
116	41	Verizon	Samsung	C-Band		DO	3810.000000	200	20000
117	41	Verizon	Samsung	C-Band		DP	3830.000000	200	20000
118	41	Verizon	Samsung	C-Band		DQ	3850.000000	200	20000
119	41	Verizon	Samsung	C-Band		DR	3870.000000	200	20000
120	41	Verizon	Samsung	C-Band		DS	3890.000000	200	20000
121	41	Verizon	Samsung	C-Band		DT	3910.000000	200	20000
122	41	Verizon	Samsung	C-Band		DU	3930.000000	200	20000
123	41	Verizon	Samsung	C-Band		DV	3950.000000	200	20000
124	41	Verizon	Samsung	C-Band		DW	3970.000000	200	20000
125	42	Verizon	Samsung	C-Band		DX	3710.000000	200	20000
126	42	Verizon	Samsung	C-Band		DY	3730.000000	200	20000
127	42	Verizon	Samsung	C-Band		DZ	3750.000000	200	20000

128	42	Verizon	Samsung	C-Band		EA	3770.000000	200	20000
129	42	Verizon	Samsung	C-Band		EB	3790.000000	200	20000
130	42	Verizon	Samsung	C-Band		EC	3810.000000	200	20000
131	42	Verizon	Samsung	C-Band		ED	3830.000000	200	20000
132	42	Verizon	Samsung	C-Band		EE	3850.000000	200	20000
133	42	Verizon	Samsung	C-Band		EF	3870.000000	200	20000
134	42	Verizon	Samsung	C-Band		EG	3890.000000	200	20000
135	42	Verizon	Samsung	C-Band		EH	3910.000000	200	20000
136	42	Verizon	Samsung	C-Band		EI	3930.000000	200	20000
137	42	Verizon	Samsung	C-Band		EJ	3950.000000	200	20000
138	42	Verizon	Samsung	C-Band		EK	3970.000000	200	20000
139	43	Verizon	Samsung	28GHz		EL	27562.500000	1.6	25000
140	43	Verizon	Samsung	28GHz		EM	27587.500000	1.6	25000
141	43	Verizon	Samsung	28GHz		EN	27612.500000	1.6	25000
142	43	Verizon	Samsung	28GHz		EO	27637.500000	1.6	25000
143	43	Verizon	Samsung	28GHz		EP	27662.500000	1.6	25000
144	43	Verizon	Samsung	28GHz		EQ	27687.500000	1.6	25000
145	43	Verizon	Samsung	28GHz		ER	27712.500000	1.6	25000
146	43	Verizon	Samsung	28GHz		ES	27737.500000	1.6	25000
147	43	Verizon	Samsung	28GHz		ET	27762.500000	1.6	25000
148	43	Verizon	Samsung	28GHz		EU	27787.500000	1.6	25000
149	43	Verizon	Samsung	28GHz		EV	27812.500000	1.6	25000
150	43	Verizon	Samsung	28GHz		EW	27837.500000	1.6	25000
151	43	Verizon	Samsung	28GHz		EX	27862.500000	1.6	25000
152	43	Verizon	Samsung	28GHz		EY	27887.500000	1.6	25000
153	43	Verizon	Samsung	28GHz		EZ	27912.500000	1.6	25000
154	44	Verizon	Samsung	28GHz		FA	27562.500000	1.6	25000
155	44	Verizon	Samsung	28GHz		FB	27587.500000	1.6	25000
156	44	Verizon	Samsung	28GHz		FC	27612.500000	1.6	25000
157	44	Verizon	Samsung	28GHz		FD	27637.500000	1.6	25000
158	44	Verizon	Samsung	28GHz		FE	27662.500000	1.6	25000
159	44	Verizon	Samsung	28GHz		FF	27687.500000	1.6	25000
160	44	Verizon	Samsung	28GHz		FG	27712.500000	1.6	25000
161	44	Verizon	Samsung	28GHz		FH	27737.500000	1.6	25000
162	44	Verizon	Samsung	28GHz		FI	27762.500000	1.6	25000
163	44	Verizon	Samsung	28GHz		FJ	27787.500000	1.6	25000
164	44	Verizon	Samsung	28GHz		FK	27812.500000	1.6	25000
165	44	Verizon	Samsung	28GHz		FL	27837.500000	1.6	25000
166	44	Verizon	Samsung	28GHz		FM	27862.500000	1.6	25000
167	44	Verizon	Samsung	28GHz		FN	27887.500000	1.6	25000
168	44	Verizon	Samsung	28GHz		FO	27912.500000	1.6	25000
169	45	Verizon	Samsung	28GHz		FP	27562.500000	1.6	25000
170	45	Verizon	Samsung	28GHz		FQ	27587.500000	1.6	25000
171	45	Verizon	Samsung	28GHz		FR	27612.500000	1.6	25000
172	45	Verizon	Samsung	28GHz		FS	27637.500000	1.6	25000
173	45	Verizon	Samsung	28GHz		FT	27662.500000	1.6	25000
174	45	Verizon	Samsung	28GHz		FU	27687.500000	1.6	25000
175	45	Verizon	Samsung	28GHz		FV	27712.500000	1.6	25000
176	45	Verizon	Samsung	28GHz		FW	27737.500000	1.6	25000
177	45	Verizon	Samsung	28GHz		FX	27762.500000	1.6	25000
178	45	Verizon	Samsung	28GHz		FY	27787.500000	1.6	25000
179	45	Verizon	Samsung	28GHz		FZ	27812.500000	1.6	25000
180	45	Verizon	Samsung	28GHz		GA	27837.500000	1.6	25000
181	45	Verizon	Samsung	28GHz		GB	27862.500000	1.6	25000
182	45	Verizon	Samsung	28GHz		GC	27887.500000	1.6	25000
183	45	Verizon	Samsung	28GHz		GD	27912.500000	1.6	25000
184	47	Denver 450 MHz Land Mobile Radio	Generic	FM Land Mobile		GF	460.425000	100	20
185	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GG	851.562500	100	20
186	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GH	852.125000	100	20
187	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GI	852.375000	100	20
188	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GJ	853.150000	100	20
189	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GK	853.275000	100	20
190	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GL	853.425000	100	20
191	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GM	853.725000	100	20
192	49	Denver 8CALL90 Conventional	Generic	800 MHz Trunking		GN	854.237500	100	20
193	50	Denver 8TAC91 Conventional	Generic	800 MHz Trunking		GO	854.237500	100	20

194	51	Denver 8TAC92 Conventional	Generic	800 MHz Trunking		GP	854.237500	100	20
195	52	Denver 8TAC93 Conventional	Generic	800 MHz Trunking		GQ	854.237500	100	20
196	53	Denver 8TAC94 Conventional	Generic	800 MHz Trunking		GR	854.237500	100	20
197	54	Denver 930 MHz Trunked	Generic	Two-Way Paging		GS	928.756250	50	13
198	55	Denver BRDWY 700 MHz Trunked	Generic	800 MHz Trunking		GT	771.800000	100	20
199	56	Denver DHA 850 MHz Trunked	Generic	800 MHz Trunking		GU	854.237500	100	20
200	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GV	799.318750	100	20
201	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GW	799.856250	100	20
202	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GX	800.506250	100	20
203	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GY	800.756250	100	20
204	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GZ	801.181250	100	20
205	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		HA	801.431250	100	20
206	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		HB	802.431250	100	20
207	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		HC	802.681250	100	20
208	58	Denver Jail Control	Generic	FM Land Mobile		HD	460.037500	100	20
209	59	Denver Jail Tactical	Generic	FM Land Mobile		HE	453.412500	100	20
210	60	Denver METRO RPTR 1 Conventional	Generic	800 MHz Trunking		HF	851.887500	100	20
211	61	Denver MM 850 MHz Trunked	Generic	800 MHz Trunking		HG	855.912500	100	20
212	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HH	852.775000	100	20
213	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HI	853.325000	100	20
214	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HJ	853.862500	100	20
215	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HK	854.437500	100	20
216	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HL	855.237500	100	20
217	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HM	855.487500	100	20
218	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HN	855.987500	100	20
219	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HO	856.212500	100	20
220	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HP	856.737500	100	20
221	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HQ	857.137500	100	20
222	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HR	858.712500	100	20
223	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HS	859.262500	100	20
224	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HT	854.062500	100	20
225	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HU	854.562500	100	20
226	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HV	855.462500	100	20
227	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HW	855.737500	100	20
228	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HX	856.137500	100	20
229	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HY	856.237500	100	20
230	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HZ	856.637500	100	20
231	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IA	856.712500	100	20
232	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IB	857.062500	100	20
233	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IC	857.462500	100	20
234	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		ID	857.737500	100	20
235	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IE	858.137500	100	20
236	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IF	858.212500	100	20
237	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IG	858.737500	100	20
238	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IH	859.212500	100	20
239	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		II	859.612500	100	20
240	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IJ	859.712500	100	20
241	64	Denver R.A.C.E.S. Conventional	Generic	FM Land Mobile		IK	147.300000	100	20
242	65	Denver RMS 850 MHz Trunked	Generic	800 MHz Trunking		IL	858.087500	100	20
243	65	Denver RMS 850 MHz Trunked	Generic	800 MHz Trunking		IM	858.337500	100	20
244	65	Denver RMS 850 MHz Trunked	Generic	800 MHz Trunking		IN	859.087500	100	20
245	65	Denver RMS 850 MHz Trunked	Generic	800 MHz Trunking		IO	859.637500	100	20
246	66	Denver STAC Conventional	Generic	800 MHz Trunking		IP	854.237500	100	20
247	67	Denver STN 2 850 MHz Trunked	Generic	800 MHz Trunking		IQ	856.787500	100	20
248	68	Denver STN 26 850 MHz Trunked	Generic	800 MHz Trunking		IR	855.687500	100	20
249	69	Denver STN 28 850 MHz Trunked	Generic	800 MHz Trunking		IS	851.187500	100	20
250	70	Denver VLAW31(NLEEC) Conventional	Generic	FM Land Mobile		IT	155.475000	100	20
251	71	Denver VMED28(HEAR) Conventional	Generic	FM Land Mobile		IU	155.340000	100	20
252	72	Denver WRCE950 Public Safety 4000 MHz	Generic	Microwave		IV	4950.000000	.25	20000
253	72	Denver WRCE950 Public Safety 4000 MHz	Generic	Microwave		IW	4980.000000	.25	20000

4.0 Receiver Frequencies

Freq #	Ant #	Provider	Model	Technology	Channel Label	ID	Frequency	Sen (dBm)	BW (kHz)
1	1	T-Mobile	Nokia	NR-600		A	670.500000	-110	5000
2	1	T-Mobile	Nokia	NR-600		B	675.500000	-110	5000
3	1	T-Mobile	Nokia	LTE-600		C	680.500000	-110	5000
4	2	T-Mobile	Nokia	NR-600		D	670.500000	-110	5000
5	2	T-Mobile	Nokia	NR-600		E	675.500000	-110	5000
6	2	T-Mobile	Nokia	LTE-600		F	680.500000	-110	5000
7	3	T-Mobile	Nokia	NR-600		G	670.500000	-110	5000
8	3	T-Mobile	Nokia	NR-600		H	675.500000	-110	5000
9	3	T-Mobile	Nokia	LTE-600		I	680.500000	-110	5000
10	4	T-Mobile	Nokia	LTE-700		J	701.000000	-110	5000
11	5	T-Mobile	Nokia	LTE-700		K	701.000000	-110	5000
12	6	T-Mobile	Nokia	LTE-700		L	701.000000	-110	5000
13	7	T-Mobile	Nokia	LTE-1900		M	1877.500000	-110	15000
14	7	T-Mobile	Nokia	UMTS-1900		N	1902.500000	-110	5000
15	7	T-Mobile	Nokia	GSM-1900		O	1907.500000	-110	5000
16	8	T-Mobile	Nokia	LTE-1900		P	1877.500000	-110	15000
17	8	T-Mobile	Nokia	UMTS-1900		Q	1902.500000	-110	5000
18	8	T-Mobile	Nokia	GSM-1900		R	1907.500000	-110	5000
19	9	T-Mobile	Nokia	LTE-1900		S	1877.500000	-110	15000
20	9	T-Mobile	Nokia	UMTS-1900		T	1902.500000	-110	5000
21	9	T-Mobile	Nokia	GSM-1900		U	1907.500000	-110	5000
22	10	T-Mobile	Nokia	LTE-2100		V	1715.000000	-110	10000
23	10	T-Mobile	Nokia	LTE-2100		W	1750.000000	-110	10000
24	11	T-Mobile	Nokia	LTE-2100		X	1715.000000	-110	10000
25	11	T-Mobile	Nokia	LTE-2100		Y	1750.000000	-110	10000
26	12	T-Mobile	Nokia	LTE-2100		Z	1715.000000	-110	10000
27	12	T-Mobile	Nokia	LTE-2100		AA	1750.000000	-110	10000
28	13	T-Mobile	Nokia	NR-2500		AB	2499.000000	-110	5000
29	13	T-Mobile	Nokia	NR-2500		AC	2608.000000	-110	10000
30	13	T-Mobile	Nokia	NR-2500		AD	2623.750000	-110	10000
31	13	T-Mobile	Nokia	NR-2500		AE	2635.000000	-110	10000
32	13	T-Mobile	Nokia	LTE-2500		AF	2646.000000	-110	10000
33	13	T-Mobile	Nokia	LTE-2500		AG	2657.000000	-110	10000
34	13	T-Mobile	Nokia	LTE-2500		AH	2668.000000	-110	10000
35	14	T-Mobile	Nokia	NR-2500		AI	2499.000000	-110	5000
36	14	T-Mobile	Nokia	NR-2500		AJ	2608.000000	-110	10000
37	14	T-Mobile	Nokia	NR-2500		AK	2623.750000	-110	10000
38	14	T-Mobile	Nokia	NR-2500		AL	2635.000000	-110	10000
39	14	T-Mobile	Nokia	LTE-2500		AM	2646.000000	-110	10000
40	14	T-Mobile	Nokia	LTE-2500		AN	2657.000000	-110	10000
41	14	T-Mobile	Nokia	LTE-2500		AO	2668.000000	-110	10000
42	15	T-Mobile	Nokia	NR-2500		AP	2499.000000	-110	5000
43	15	T-Mobile	Nokia	NR-2500		AQ	2608.000000	-110	10000
44	15	T-Mobile	Nokia	NR-2500		AR	2623.750000	-110	10000
45	15	T-Mobile	Nokia	NR-2500		AS	2635.000000	-110	10000
46	15	T-Mobile	Nokia	LTE-2500		AT	2646.000000	-110	10000
47	15	T-Mobile	Nokia	LTE-2500		AU	2657.000000	-110	10000
48	15	T-Mobile	Nokia	LTE-2500		AV	2668.000000	-110	10000
49	16	Verizon	Samsung	LTE-700		AW	781.000000	-110	10000
50	18	Verizon	Samsung	LTE-700		AX	781.000000	-110	10000
51	20	Verizon	Samsung	LTE-700		AY	781.000000	-110	10000
52	22	Verizon	Samsung	CDMA-850	Chan 384	AZ	836.520000	-110	1230
53	22	Verizon	Samsung	CDMA-850	Chan 425	BA	837.750000	-110	1230
54	23	Verizon	Samsung	CDMA-850	Chan 384	BC	836.520000	-110	1230
55	23	Verizon	Samsung	CDMA-850	Chan 425	BD	837.750000	-110	1230
56	24	Verizon	Samsung	CDMA-850	Chan 384	BF	836.520000	-110	1230
57	24	Verizon	Samsung	CDMA-850	Chan 425	BG	837.750000	-110	1230
58	25	Verizon	Samsung	LTE-850		BI	842.500000	-110	5000
59	27	Verizon	Samsung	LTE-850		BJ	842.500000	-110	5000
60	29	Verizon	Samsung	LTE-850		BK	842.500000	-110	5000
61	31	Verizon	Samsung	LTE-1900		BL	1887.500000	-110	5000

62	31	Verizon	Samsung	LTE-1900		BM	1892.500000	-110	5000
63	32	Verizon	Samsung	LTE-1900		BN	1887.500000	-110	5000
64	32	Verizon	Samsung	LTE-1900		BO	1892.500000	-110	5000
65	33	Verizon	Samsung	LTE-1900		BP	1887.500000	-110	5000
66	33	Verizon	Samsung	LTE-1900		BQ	1892.500000	-110	5000
67	34	Verizon	Samsung	LTE-2100		BR	1725.000000	-110	10000
68	34	Verizon	Samsung	LTE-2100		BS	1775.000000	-110	10000
69	35	Verizon	Samsung	LTE-2100		BT	1725.000000	-110	10000
70	35	Verizon	Samsung	LTE-2100		BU	1775.000000	-110	10000
71	36	Verizon	Samsung	LTE-2100		BV	1725.000000	-110	10000
72	36	Verizon	Samsung	LTE-2100		BW	1775.000000	-110	10000
73	37	Verizon	Samsung	CBRS		BX	3415.000000	-110	10000
74	37	Verizon	Samsung	CBRS		BY	3425.000000	-110	10000
75	37	Verizon	Samsung	CBRS		BZ	3435.000000	-110	10000
76	37	Verizon	Samsung	CBRS		CA	3445.000000	-110	10000
77	37	Verizon	Samsung	CBRS		CB	3455.000000	-110	10000
78	37	Verizon	Samsung	CBRS		CC	3465.000000	-110	10000
79	37	Verizon	Samsung	CBRS		CD	3475.000000	-110	10000
80	37	Verizon	Samsung	CBRS		CE	3485.000000	-110	10000
81	38	Verizon	Samsung	CBRS		CF	3415.000000	-110	10000
82	38	Verizon	Samsung	CBRS		CG	3425.000000	-110	10000
83	38	Verizon	Samsung	CBRS		CH	3435.000000	-110	10000
84	38	Verizon	Samsung	CBRS		CI	3445.000000	-110	10000
85	38	Verizon	Samsung	CBRS		CJ	3455.000000	-110	10000
86	38	Verizon	Samsung	CBRS		CK	3465.000000	-110	10000
87	38	Verizon	Samsung	CBRS		CL	3475.000000	-110	10000
88	38	Verizon	Samsung	CBRS		CM	3485.000000	-110	10000
89	39	Verizon	Samsung	CBRS		CN	3415.000000	-110	10000
90	39	Verizon	Samsung	CBRS		CO	3425.000000	-110	10000
91	39	Verizon	Samsung	CBRS		CP	3435.000000	-110	10000
92	39	Verizon	Samsung	CBRS		CQ	3445.000000	-110	10000
93	39	Verizon	Samsung	CBRS		CR	3455.000000	-110	10000
94	39	Verizon	Samsung	CBRS		CS	3465.000000	-110	10000
95	39	Verizon	Samsung	CBRS		CT	3475.000000	-110	10000
96	39	Verizon	Samsung	CBRS		CU	3485.000000	-110	10000
97	40	Verizon	Samsung	C-Band		CV	3710.000000	-110	20000
98	40	Verizon	Samsung	C-Band		CW	3730.000000	-110	20000
99	40	Verizon	Samsung	C-Band		CX	3750.000000	-110	20000
100	40	Verizon	Samsung	C-Band		CY	3770.000000	-110	20000
101	40	Verizon	Samsung	C-Band		CZ	3790.000000	-110	20000
102	40	Verizon	Samsung	C-Band		DA	3810.000000	-110	20000
103	40	Verizon	Samsung	C-Band		DB	3830.000000	-110	20000
104	40	Verizon	Samsung	C-Band		DC	3850.000000	-110	20000
105	40	Verizon	Samsung	C-Band		DD	3870.000000	-110	20000
106	40	Verizon	Samsung	C-Band		DE	3890.000000	-110	20000
107	40	Verizon	Samsung	C-Band		DF	3910.000000	-110	20000
108	40	Verizon	Samsung	C-Band		DG	3930.000000	-110	20000
109	40	Verizon	Samsung	C-Band		DH	3950.000000	-110	20000
110	40	Verizon	Samsung	C-Band		DI	3970.000000	-110	20000
111	41	Verizon	Samsung	C-Band		DJ	3710.000000	-110	20000
112	41	Verizon	Samsung	C-Band		DK	3730.000000	-110	20000
113	41	Verizon	Samsung	C-Band		DL	3750.000000	-110	20000
114	41	Verizon	Samsung	C-Band		DM	3770.000000	-110	20000
115	41	Verizon	Samsung	C-Band		DN	3790.000000	-110	20000
116	41	Verizon	Samsung	C-Band		DO	3810.000000	-110	20000
117	41	Verizon	Samsung	C-Band		DP	3830.000000	-110	20000
118	41	Verizon	Samsung	C-Band		DQ	3850.000000	-110	20000
119	41	Verizon	Samsung	C-Band		DR	3870.000000	-110	20000
120	41	Verizon	Samsung	C-Band		DS	3890.000000	-110	20000
121	41	Verizon	Samsung	C-Band		DT	3910.000000	-110	20000
122	41	Verizon	Samsung	C-Band		DU	3930.000000	-110	20000
123	41	Verizon	Samsung	C-Band		DV	3950.000000	-110	20000
124	41	Verizon	Samsung	C-Band		DW	3970.000000	-110	20000
125	42	Verizon	Samsung	C-Band		DX	3710.000000	-110	20000
126	42	Verizon	Samsung	C-Band		DY	3730.000000	-110	20000
127	42	Verizon	Samsung	C-Band		DZ	3750.000000	-110	20000

128	42	Verizon	Samsung	C-Band		EA	3770.000000	-110	20000
129	42	Verizon	Samsung	C-Band		EB	3790.000000	-110	20000
130	42	Verizon	Samsung	C-Band		EC	3810.000000	-110	20000
131	42	Verizon	Samsung	C-Band		ED	3830.000000	-110	20000
132	42	Verizon	Samsung	C-Band		EE	3850.000000	-110	20000
133	42	Verizon	Samsung	C-Band		EF	3870.000000	-110	20000
134	42	Verizon	Samsung	C-Band		EG	3890.000000	-110	20000
135	42	Verizon	Samsung	C-Band		EH	3910.000000	-110	20000
136	42	Verizon	Samsung	C-Band		EI	3930.000000	-110	20000
137	42	Verizon	Samsung	C-Band		EJ	3950.000000	-110	20000
138	42	Verizon	Samsung	C-Band		EK	3970.000000	-110	20000
139	43	Verizon	Samsung	28GHz		EL	27937.500000	-110	25000
140	43	Verizon	Samsung	28GHz		EM	28012.500000	-110	25000
141	43	Verizon	Samsung	28GHz		EN	28037.500000	-110	25000
142	43	Verizon	Samsung	28GHz		EO	28062.500000	-110	25000
143	43	Verizon	Samsung	28GHz		EP	28087.500000	-110	25000
144	43	Verizon	Samsung	28GHz		EQ	28112.500000	-110	25000
145	43	Verizon	Samsung	28GHz		ER	28137.500000	-110	25000
146	43	Verizon	Samsung	28GHz		ES	28162.500000	-110	25000
147	43	Verizon	Samsung	28GHz		ET	28187.500000	-110	25000
148	43	Verizon	Samsung	28GHz		EU	28212.500000	-110	25000
149	43	Verizon	Samsung	28GHz		EV	28237.500000	-110	25000
150	43	Verizon	Samsung	28GHz		EW	28262.500000	-110	25000
151	43	Verizon	Samsung	28GHz		EX	28287.500000	-110	25000
152	43	Verizon	Samsung	28GHz		EY	28312.500000	-110	25000
153	43	Verizon	Samsung	28GHz		EZ	28337.500000	-110	25000
154	44	Verizon	Samsung	28GHz		FA	27937.500000	-110	25000
155	44	Verizon	Samsung	28GHz		FB	28012.500000	-110	25000
156	44	Verizon	Samsung	28GHz		FC	28037.500000	-110	25000
157	44	Verizon	Samsung	28GHz		FD	28062.500000	-110	25000
158	44	Verizon	Samsung	28GHz		FE	28087.500000	-110	25000
159	44	Verizon	Samsung	28GHz		FF	28112.500000	-110	25000
160	44	Verizon	Samsung	28GHz		FG	28137.500000	-110	25000
161	44	Verizon	Samsung	28GHz		FH	28162.500000	-110	25000
162	44	Verizon	Samsung	28GHz		FI	28187.500000	-110	25000
163	44	Verizon	Samsung	28GHz		FJ	28212.500000	-110	25000
164	44	Verizon	Samsung	28GHz		FK	28237.500000	-110	25000
165	44	Verizon	Samsung	28GHz		FL	28262.500000	-110	25000
166	44	Verizon	Samsung	28GHz		FM	28287.500000	-110	25000
167	44	Verizon	Samsung	28GHz		FN	28312.500000	-110	25000
168	44	Verizon	Samsung	28GHz		FO	28337.500000	-110	25000
169	45	Verizon	Samsung	28GHz		FP	27937.500000	-110	25000
170	45	Verizon	Samsung	28GHz		FQ	28012.500000	-110	25000
171	45	Verizon	Samsung	28GHz		FR	28037.500000	-110	25000
172	45	Verizon	Samsung	28GHz		FS	28062.500000	-110	25000
173	45	Verizon	Samsung	28GHz		FT	28087.500000	-110	25000
174	45	Verizon	Samsung	28GHz		FU	28112.500000	-110	25000
175	45	Verizon	Samsung	28GHz		FV	28137.500000	-110	25000
176	45	Verizon	Samsung	28GHz		FW	28162.500000	-110	25000
177	45	Verizon	Samsung	28GHz		FX	28187.500000	-110	25000
178	45	Verizon	Samsung	28GHz		FY	28212.500000	-110	25000
179	45	Verizon	Samsung	28GHz		FZ	28237.500000	-110	25000
180	45	Verizon	Samsung	28GHz		GA	28262.500000	-110	25000
181	45	Verizon	Samsung	28GHz		GB	28287.500000	-110	25000
182	45	Verizon	Samsung	28GHz		GC	28312.500000	-110	25000
183	45	Verizon	Samsung	28GHz		GD	28337.500000	-110	25000
184	46	Denver 150 MHz Receive Only Land Mobile Radio	Generic	FM Land Mobile		GE	154.707000	-116	11
185	47	Denver 450 MHz Land Mobile Radio	Generic	FM Land Mobile		GF	465.425000	-116	20
186	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GG	806.562500	-119	20
187	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GH	807.125000	-119	20
188	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GI	807.375000	-119	20
189	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GJ	808.150000	-119	20
190	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GK	808.275000	-119	20
191	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GL	808.425000	-119	20
192	48	Denver 850 MHz Trunked P25	Generic	800 MHz Trunking		GM	808.725000	-119	20

193	49	Denver 8CALL90 Conventional	Generic	800 MHz Trunking		GN	809.237500	-119	20
194	50	Denver 8TAC91 Conventional	Generic	800 MHz Trunking		GO	809.237500	-119	20
195	51	Denver 8TAC92 Conventional	Generic	800 MHz Trunking		GP	809.237500	-119	20
196	52	Denver 8TAC93 Conventional	Generic	800 MHz Trunking		GQ	809.237500	-119	20
197	53	Denver 8TAC94 Conventional	Generic	800 MHz Trunking		GR	809.237500	-119	20
198	54	Denver 930 MHz Trunked	Generic	Two-Way Paging		GS	952.726250	-119	13
199	55	Denver BRDWY 700 MHz Trunked	Generic	800 MHz Trunking		GT	801.800000	-119	20
200	56	Denver DHA 850 MHz Trunked	Generic	800 MHz Trunking		GU	809.237500	-119	20
201	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GV	769.318750	-119	20
202	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GW	769.856250	-119	20
203	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GX	770.506250	-119	20
204	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GY	770.756250	-119	20
205	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		GZ	771.181250	-119	20
206	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		HA	771.431250	-119	20
207	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		HB	772.431250	-119	20
208	57	Denver Fire Repeaters 700 MHz Trunked	Generic	800 MHz Trunking		HC	772.681250	-119	20
209	58	Denver Jail Control	Generic	FM Land Mobile		HD	465.037500	-116	20
210	59	Denver Jail Tactical	Generic	FM Land Mobile		HE	453.412500	-116	20
211	60	Denver METRO RPTR 1 Conventional	Generic	800 MHz Trunking		HF	806.887500	-119	20
212	61	Denver MM 850 MHz Trunked	Generic	800 MHz Trunking		HG	810.912500	-119	20
213	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HH	807.775000	-119	20
214	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HI	808.325000	-119	20
215	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HJ	808.862500	-119	20
216	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HK	809.437500	-119	20
217	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HL	810.237500	-119	20
218	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HM	810.487500	-119	20
219	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HN	810.987500	-119	20
220	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HO	811.212500	-119	20
221	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HP	811.737500	-119	20
222	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HQ	812.137500	-119	20
223	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HR	813.712500	-119	20
224	62	Denver P25 ASR 850 MHz Trunked P25	Generic	800 MHz Trunking		HS	814.262500	-119	20
225	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HT	809.062500	-119	20
226	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HU	809.562500	-119	20
227	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HV	810.462500	-119	20
228	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HW	810.737500	-119	20
229	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HX	811.137500	-119	20
230	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HY	811.237500	-119	20
231	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		HZ	811.637500	-119	20
232	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IA	811.712500	-119	20
233	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IB	812.062500	-119	20
234	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IC	812.462500	-119	20
235	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		ID	812.737500	-119	20
236	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IE	813.137500	-119	20
237	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IF	813.212500	-119	20
238	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IG	813.737500	-119	20
239	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IH	814.212500	-119	20
240	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		II	814.612500	-119	20
241	63	Denver P25 Simulcast 850 MHz Trunked P25	Generic	800 MHz Trunking		IJ	814.712500	-119	20
242	64	Denver R.A.C.E.S. Conventional	Generic	FM Land Mobile		IK	147.300000	-119	20
243	65	Denver RMS 850 MHz Trunked	Generic	800 MHz Trunking		IL	813.087500	-119	20
244	65	Denver RMS 850 MHz Trunked	Generic	800 MHz Trunking		IM	813.337500	-119	20
245	65	Denver RMS 850 MHz Trunked	Generic	800 MHz Trunking		IN	814.087500	-119	20
246	65	Denver RMS 850 MHz Trunked	Generic	800 MHz Trunking		IO	814.637500	-119	20
247	66	Denver STAC Conventional	Generic	800 MHz Trunking		IP	809.237500	-119	20
248	67	Denver STN 2 850 MHz Trunked	Generic	800 MHz Trunking		IQ	811.787500	-119	20
249	68	Denver STN 26 850 MHz Trunked	Generic	800 MHz Trunking		IR	810.687500	-119	20
250	69	Denver STN 28 850 MHz Trunked	Generic	800 MHz Trunking		IS	806.187500	-119	20
251	70	Denver VLAW31(NLEEC) Conventional	Generic	FM Land Mobile		IT	155.475000	-116	20
252	71	Denver VMED28(HEAR) Conventional	Generic	FM Land Mobile		IU	155.340000	-116	20
253	72	Denver WRCE950 Public Safety 4000 MHz	Generic	Microwave		IV	4950.000000	-83	20000
254	72	Denver WRCE950 Public Safety 4000 MHz	Generic	Microwave		IW	4980.000000	-83	20000

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 Channel	Receive Frequency (MHz)	Transmitter Provider	Transmit Channel	Transmit Frequency (MHz)	Attn Required (dB)	Attn Provided (dB)	Signal Margin (dB)
None								

No transmitter noise interference problems were predicted.

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 Channel	Receive Frequency (MHz)	Transmitter Provider	Transmit Channel	Transmit Frequency (MHz)	Attn Required (dB)	Attn Provided (dB)	Signal Margin (dB)
None								

No receiver desensitization interference problems were predicted.

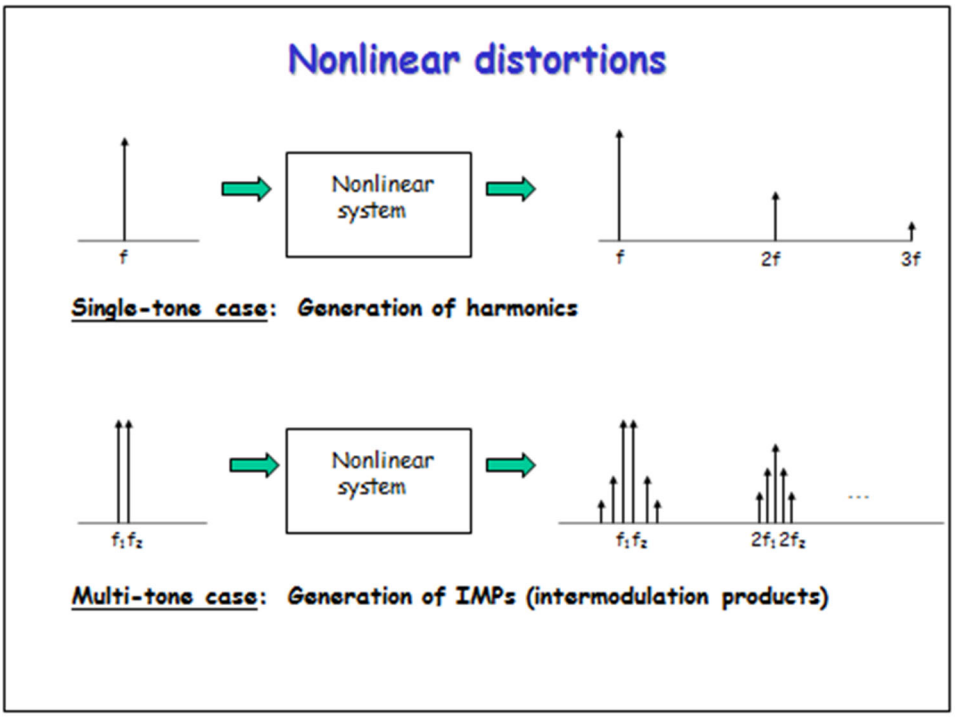
7.0 Intermodulation Interference Analysis

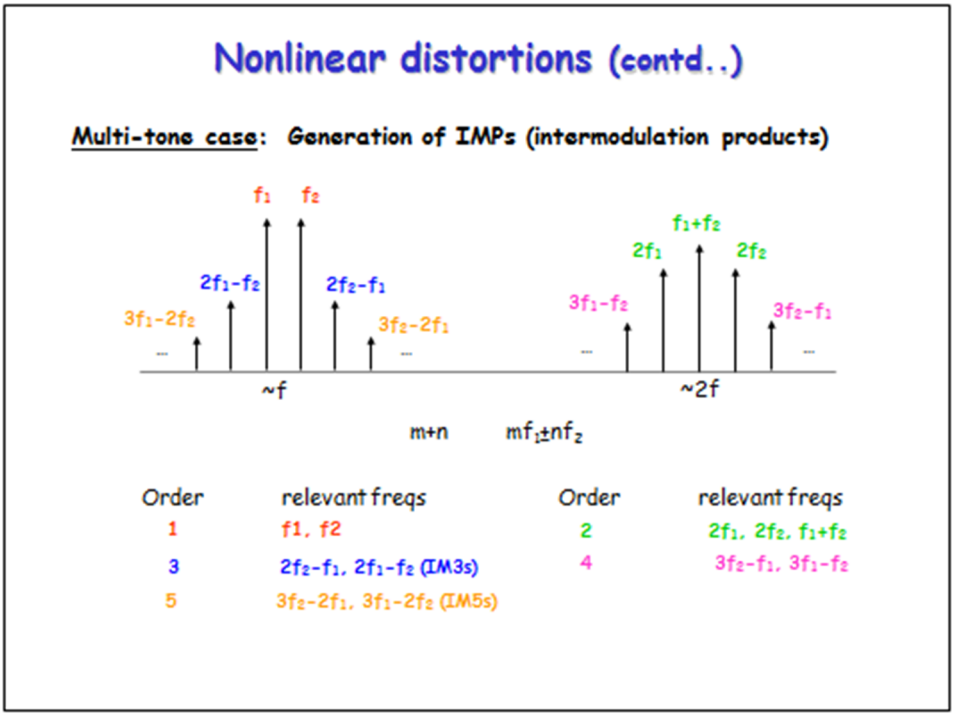
There are three basic categories of Intermodulation (IM) interference. They are receiver produced, transmitter produced, and "other" radiated IM. Transmitter produced IM is the result of one or more transmitters impressing a signal in the non-linear final output stage circuitry of another transmitter, 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 mixing are known as nonlinear distortions. The images below depict how these IM products are derived when passing through a nonlinear junction/system.





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. Receivers experiencing transmitter generated intermodulation interference are depicted in the following Table.

Tx 1 Source Mix Tx		Tx 2 Source		TX 3 Source		Tx 4 Source		Tx 5 Source		Intermod Hit		Affected Receiver		Attn Need
ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	Freq (MHz)	Ord	ID	Freq (MHz)	
None														

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. Receivers experiencing receiver generated intermodulation interference are depicted in the following Table.

Tx 1 Source		Tx 2 Source		TX 3 Source		Tx 4 Source		Tx 5 Source		Intermod Hit			Affected Receiver		Attn Need
ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	Freq (MHz)	Ord	ID	Freq (MHz)	
None															

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 simulation of Intermodulation (IM) interference, transmitter wideband noise and receiver desensitization interference occurring on each individual receiver when all transmitters at the site are active at the same instance in time. Even though individual interference modes may not be reported in other report sections, this summing analysis represents a worst-case interference scenario.

However, the probability of this interference occurrence for an individual receiver could be low since it depends on the utilization of the transmitters involved in the interference generation.

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 could possibly be degraded by the value shown.

The following Table presents this data:

Receiver		Interference Power Level (dBw)				
Channel Label	Freq (MHz)	Tx Noise	Rx Desense	IM Power	Aggregate	C / (I+N)
None						

11.0 Conclusion

T-Mobile's future deployment at DN03433C - Denver_Fire_28 will not result in any degradation or desensitization of existing communications systems. Any deviation from the provided data and specifications would require further analysis to determine any potential impacts.

Note: Centerline Communications' interference analysis of site DN03433C - Denver_Fire_28 was based on data and specifications provided by T-Mobile. When information was missing, assumptions and industry standards were used as complements.

EXHIBIT D

CERTIFICATE OF LIABILITY INSURANCE

5/1/2023

DATE (MM/DD/YYYY) 4/13/2022

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INSURED 1358772 T-Mobile US, Inc. Its Subsidiaries and Affiliates 12920 SE 38th Street Bellevue WA 98006	**INSURER(S) AFFORDING COVERAGE** — **NAIC #** **INSURER A :** Continental Casualty Company — 20443 **INSURER B :** The Continental Insurance Company — 35289 **INSURER C :** Transportation Insurance Company — 20494 **INSURER D :** **INSURER E :** **INSURER F :**

COVERAGES TMOBI **CERTIFICATE NUMBER:** 12217863 **REVISION NUMBER:** XXXXXXX

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A	X **COMMERCIAL GENERAL LIABILITY** CLAIMS-MADE X OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: POLICY PRO-JECT X LOC OTHER:	Y	Y	7012343900	5/1/2022	5/1/2023	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 10,000,000 $ 10,000,000 $ 25,000 $ 10,000,000 $ 20,000,000 $ 20,000,000
A	**AUTOMOBILE LIABILITY** X ANY AUTO OWNED AUTOS ONLY HIRED AUTOS ONLY SCHEDULED AUTOS NON-OWNED AUTOS ONLY	Y	Y	7012343878	5/1/2022	5/1/2023	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 5,000,000 $ XXXXXXX $ XXXXXXX $ XXXXXXX
B B B	X **UMBRELLA LIAB** X OCCUR **EXCESS LIAB** CLAIMS-MADE DED X RETENTION $ 10,000	Y	N	CUE 7014886953 SIR applies per policy terms & conditions	5/1/2022	5/1/2023	EACH OCCURRENCE AGGREGATE	$ 5,000,000 $ 5,000,000 $ XXXXXXX
B B C	**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? Y/N: N **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below	N/A	N	7012343895 (AOS) 7012343881 (CA) 7012447142 (AZ,MA,OR,WI)	5/1/2022 5/1/2022 5/1/2022	5/1/2023 5/1/2023 5/1/2023	X PER STATUTE OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	$ 2,000,000 $ 2,000,000 $ 2,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

The Certificate Holder and other entities defined by written contract, statute, permit application or written agreement are additional insureds on a primary and non-contributory basis under general liability and are additional insured under automobile liability as required by written contract. Waiver of Subrogation applies under general liability and automobile liability as required by written contract. **See Attached Endorsements** DN03108E - 501 Knox Court, Denver, CO 80204
DN03433C - 4306 S Wolff St, Denver, CO 80236

CERTIFICATE HOLDER

12217863
Denver Fire Department Headquarters
Chief of Department
745 W. Colfax Avenue
.
Denver CO 80204

CANCELLATION See Attachments

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

Denver Fire Department Headquarters Chief of Department 745 W. Colfax Avenue
.
Denver CO 80204

IMPORTANT NOTICE

Dear Certificate Holder for T-Mobile and its subsidiaries (including Sprint):

In our continued effort to provide timely certificate delivery, Lockton Companies is transitioning to paperless delivery of Certificates of Insurance going forward.

To ensure future renewals of this certificate, we need your email address. Please contact us via one of the methods below, referencing Certificate ID 12217863

- Email: *stl-edelivery@lockton.com*
- Phone: *314-812-3888*

If we do not receive your email address via one of the above methods prior to the client's next renewal, we will assume you no longer need the certificate.

If you received this certificate through an internet link where the current certificate is viewable, we have your email and no further action is needed.

The above inbox is for collecting email addresses for renewal electronic certificate delivery ONLY. You will not receive a response from this inbox.

Thank you for your cooperation.

Lockton Companies

POLICY HOLDER NOTICE – COUNTRYWIDE

It is understood and agreed that:

If the Named Insured has agreed under written contract to provide notice of cancellation to a party to whom the Agent of Record has issued a Certificate of Insurance, and if the Insurer cancels a policy term described on that Certificate of Insurance for any reason other than nonpayment of premium, then notice of cancellation will be provided to such Certificate holders at least 30 days in advance of the date cancellation is effective.

If notice is mailed, then proof of mailing to the last known mailing address of the Certificate holder on file with the Agent of Record will be sufficient to prove notice.

Any failure by the Insurer to notify such persons or organizations will not extend or invalidate such cancellation, or impose any liability or obligation upon the Insurer or the Agent of Record.

All other terms and conditions of the policy remain unchanged.

This endorsement, which forms a part of and is for attachment to the policy issued by the designated Insurers, takes effect on the Policy Effective date of said policy at the hour stated in said policy, unless another effective date (the Endorsement Effective Date) is shown below, and expires concurrently with said policy.

NOTICE OF CANCELLATION TO CERTIFICATEHOLDERS

It is understood and agreed that:

If you have agreed under written contract to provide notice of cancellation to a party to whom the Agent of Record has issued a Certificate of Insurance, and if we cancel a policy term described on that Certificate of Insurance for any reason other than nonpayment of premium, then notice of cancellation will be provided to such Certificateholders at least 30 days in advance of the date cancellation is effective.

If notice is mailed, then proof of mailing to the last known mailing address of the Certificateholder on file with the Agent of Record will be sufficient to prove notice.

Any failure by us to notify such persons or organizations will not extend or invalidate such cancellation, or impose any liability or obligation upon us or the Agent of Record.

All other terms and conditions of the policy remain unchanged.

This endorsement, which forms a part of and is for attachment to the policy issued by the designated Insurers, takes effect on the Policy Effective date of said policy at the hour stated in said policy, unless another effective date (the Endorsement Effective Date) is shown below, and expires concurrently with said policy.

EXHIBIT E

KUTAKROCK

Kutak Rock LLP
1801 California Street, Suite 3000, Denver, CO 80202-2652
office 303.297.2400

March 27, 2023

City and County of Denver
c/o Denver City Attorney's Office
1437 Bannock, Room 353
Denver, Colorado 80202

Re: Private Business Use Review: License Agreement between the City and County of Denver and T-Mobile West LLC relating to Fire Station #28

Ladies and Gentlemen:

We have been advised that the City and County of Denver (the "City") intends to enter into a License Agreement (the "Agreement") with T-Mobile West LLC (the "Licensee"). The City has requested that we advise whether the Agreement will generate private business use under Section 141 of the Internal Revenue Code of 1986 (the "Code") with respect to any federally tax-exempt bond or lease obligations of the City ("Obligations").

The Agreement grants a limited license to the Licensee for the use of certain telecommunications equipment owned by the City (the "Equipment") and installed at the City's Fire Station #28, located at 4306 South Wolff Street within the City (the "Fire Station"). The City has indicated that certain portions of the Fire Station have been financed or refinanced in whole or in part with Obligations, which may include the following: General Obligation Elevate Denver Bonds, Series 2018A; General Obligation Elevate Denver Bonds, Series 2019A; General Obligation Elevate Denver Bonds, Series 2019C; and General Obligation Elevate Denver Bonds, Series 2020A. The City has also indicated that no portion of the Equipment and no portion of the limited premises on which the Equipment is located has been financed or refinanced by Obligations.

The City has provided to us a draft copy of the Agreement and information regarding use of Obligation proceeds with respect to the Fire Station. Based on the draft Agreement and such information, we are of the opinion that the use contemplated by the Agreement will not generate private business use under Section 141 of the Code with respect to any Obligations. The opinion set forth in this paragraph assumes that (a) the execution version of the Agreement will not differ from the draft version of the Agreement provided to us and (b) the information regarding use of Obligation proceeds accurately reflects the City's final allocation of all such proceeds to expenditures. Furthermore, such opinion is based on existing laws on the date hereof, and we express no opinion as of any subsequent date or with respect to any pending or future proposed or final Treasury Regulations and legislation. This letter has been prepared solely for your use and may not be relied on by any other person without our prior written consent.

Very truly yours,

Kutak Rock LLP

MME