4.6 - Geology and Soils

4.6.1 - Introduction

This section describes the existing setting for geology and soils, and identifies potential effects to the sites and their surrounding areas from project implementation. It also considers impacts likely to be incurred in the future if additional sites are proposed or if existing sites are modified. Reference information was gathered and analyzed from the United States Geological Survey (USGS) and other sources.

4.6.2 - Regulatory Requirements

Universal Building Codes/California Building Codes

California Health and Safety Code Sections authorize the development of definitions of earthquake performance categories for earthquake ground motion. These manifest as Building Codes that are universally used throughout the state. The sensitivity of structures intended for uses such as habitation and emergency preparedness are held to the highest building code standards.

Riverside County Integrated Plan (RCIP)

According to the RCIP, the County Department of Building and Safety provides technical expertise in reviewing and enforcing the County Building and Fire Codes. These codes establish site-specific investigation requirements, construction standards, and inspection procedures to ensure that development does not pose a threat to the health, safety and welfare of the public. Every three years, the County's Building and Fire Codes are adapted from the Uniform Building and Fire Codes. They contain baseline minimum standards to guard against unsafe development.

Geotechnical Engineering Recommendations

The RCIP emphasizes the strict enforcement of existing building codes and standards. It also acknowledges that under certain circumstances, additional geotechnical investigation may be warranted, and stricter standards may be upheld for “critical facilities” such as communications towers. Additional reinforcement of foundations in areas of potential ground failure may be required. There are different levels of investigation for structural foundations and footings required by the County's Building Code. The engineer’s recommendations would be based on the highest appropriate level of investigation specified for the project.

Conditional Use Permits

Conditional Use Permits (CUP) function as compliance documents that specify additional conditions not covered by the geotechnical engineering recommendations, Building Codes, and CEQA. Among other things, a CUP states conditions for the construction and day-to-day operation of a facility that are specific to the facility.

4.6.3 - Existing Conditions

Regionally, the project sites are in the northernmost end of Southern California's Peninsular Ranges geomorphic province, and near the boundary of the Transverse Ranges geomorphic province. The Peninsular Ranges geomorphic province is characterized by elongated northwest to southeast trending geologic structures. In contrast, the Transverse Ranges geomorphic province is characterized by east to west trending geologic structures.

The Peninsular Ranges province extends from the Santa Monica Mountains approximately 900 miles south to the tip of Baja California. It is located on the Pacific (tectonic or crustal) Plate, which is moving to the northwest relative to the adjacent North American Plate. The well-known San Andreas Fault forms the boundary between the Pacific and the North American Plates. As a result, the Southern California area contains numerous regional and local faults, and experiences substantial ground movement during frequent seismic events.

Each project site is one acre or less in size and the sites are located in most cases many miles from each other. Sites with undesirable environmental impacts or constraints were generally screened out during the site selection process; however, the primary criterion for site selection was the ability to provide adequate radio coverage to areas critically in need.

Slope/Slope Stability

Slope stability is a function of percent slope incline, the structural stability of the soil and the basement rock. Slope stability is a consideration in site selection. Since the tower sites are typically on topographic highpoints (hills, ridges, etc.), this issue is not particularly applicable to the proposed project.

Soils

Southern California has great diversity of soil types that offer distinctly different qualities as foundations for structures. The mapped soil types at each site under consideration are listed in Table 4.6-1 using their Natural Resource Conservation Service map unit identification code is included in the table, and any notable geological constraints are listed in the adjacent column.

Faulting and Seismicity

All of Southern California is geologically and seismically active. The numerous faults in Southern California include active, potentially active, and inactive faults. The criteria for these major groups are based on criteria developed by the California Division of Mines and Geology (CDMG) for the Alquist-Priolo Earthquake Fault Zoning Program. Active faults are those that have demonstrated movement or surface displacement within Holocene time or about the last 11,000 years. A potentially active fault is a fault that has demonstrated surface displacement of Quaternary age deposits (last 1.6 million years). Inactive faults are those that are not known to have moved in the last 1.6 million years. These definitions are used to delineate Earthquake Fault Zones as mandated by the Alquist-Priolo Earthquake Zone Act, which requires fault investigation on sites located within Special Studies

Zones (sometimes referred to as "A-P Zones") to preclude new construction of certain habitable structures across the trace of active faults.

Southern California contains a number of major active northwest-southeast trending fault zones. The dominant geologic feature in this region is the active San Andreas Fault Zone (SAFZ), system, which marks the boundary between the Pacific and North American Plates. This fault zone consists of several major northwest-southeast trending, right lateral strike slip faults that have experienced repeated disturbances (i.e., earthquakes and lateral movement) in the last 200-300 years. The SAFZ and the San Jacinto Fault Zone (SJFZ) are the dominant geologic features affecting the landscape of Riverside County.

Faulting

Faults form in rocks when stresses overcome the internal strength of the rock, resulting in a fracture. Large faults develop in response to large regional stresses operating over a long time, such as those stresses caused by the relative displacement between tectonic plates. According to the elastic rebound theory, these stresses cause strain to build up in the earth's crust until enough strain has built up to exceed the strength along a fault and cause a brittle failure. The slip between the two stuck plates or coherent blocks generates an earthquake. Following an earthquake, strain will build once again until the occurrence of another earthquake. The magnitude of slip is related to the maximum allowable strain that can be built up along a particular fault segment. The greatest buildup in strain due to the largest relative motion between tectonic plates or fault blocks over the longest period will generally produce the largest earthquakes. The distribution of these earthquakes is a study of much interest for both hazard prediction and the study of active deformation of the earth's crust. Deformation is a complex process and strain caused by tectonic forces is not only accommodated through faulting, but also by folding, uplift, and subsidence, which can be gradual or in direct response to earthquakes.

Table 4.6-1 shows the relative distance from major faults of each potential tower site.

Seismic Hazards

The term seismicity describes the effects of seismic waves that radiate from an earthquake as it occurs. While most of the energy released during an earthquake results in the permanent displacement of the ground, as much as 10 percent of the energy may dissipate immediately in the form of seismic waves. Seismic hazards pose a substantial danger to property and human safety and are present because of the risk of naturally occurring geologic events and processes affecting human development. Therefore, the hazard is as influenced by the conditions of human development as by the frequency and distribution of major geologic events. Seismic hazards present in California include ground rupture along faults, strong seismic shaking, liquefaction, ground failure, landslides, and slope failure.

Table 4.6-1: Site Location Geological Attribute Information

Site Name	Latitude[2]	Longitude[2]	Elevation (feet)[3]	Soil Type[4]	Dist. (miles) to Quaternary Fault [5]	Potential earthquake magnitude (max)
Arlington	33° 55’ 04.2”	117° 27’ 31.2”	746	HgA	8.9 – CFZ 14.0 - SJFZ	6.5-7.5 magnitude
Avocado Flats	33° 26’ 57.2”	117° 16’ 21.0”	1,426	CmrG	6.5 - EFZ	6.5-7.5 magnitude
Big Maria	33° 45’ 04.0”	114° 31’ 27.1”	650	RdG	>50	Low risk (far from fault line)
Black Eagle	33° 52’ 33.2”	115° 31’ 57.1”	1,668	NOTCOM	25 - SAFZ	Low risk (far from fault line)
Black Jack	33° 49’ 34.7”	114° 51’ 39.6”	980	NOTCOM	>50	Low risk (far from fault line)
Blue Mountain	34° 01’ 20.0”	117° 17’ 46.5”	2,428	Cr	2.1 - SJFZ	6.5-7.5 magnitude
Box Springs	33° 57’ 42.4”	117° 16’ 50.6”	3,080	RtF	4.5 - SJFZ	6.5-7.5 magnitude
Brookside	33° 57’ 48.7”	117° 00’ 20.9”	2,584	TeG	.31 – SGPFZ; 1.5 - BFZ	6.0-7.0; 6.0-7.2 magnitude
Cajalco	33° 50’ 11.9”	117° 29’ 34.3”	1,215	TbF2	3 - CFZ	6.0-7.0 magnitude
Corn Springs	33° 40’ 53.0”	115° 14’ 55.1”	723	NOTCOM	25 - SAFZ	Low risk (far from fault line)
Corona	33° 52’ 44.8”	117° 34’ 48.0”	661	GdC	2 - CFZ	6.0-7.0 magnitude
El Cariso	33° 38’ 44.1”	117° 26’ 39.0”	3,070	153	3 - EFZ	6.5-7.5 magnitude
Elsinore Peak	33° 36’ 08.2”	117° 20’ 35.9”	3,557	143	2 – EFZ	6.5-7.5 magnitude
Estelle Mountain (A)	33° 45’ 33.0”	117° 25’ 34.0”	2,420	TbF2	1.7 – CFZ	6.0-7.0 magnitude
Estelle Mountain (B)	33° 45’ 41.0”	117° 26’ 03.2”	2,480	TbF2	1.7 – CFZ	6.0-7.0 magnitude
Glen Avon	34° 01’ 32.7”	117° 30’ 11.0”	1,111	CkF2	1 – CFZ	6.0-7.0 magnitude
Green River	33° 53’ 21.6”	117° 38’ 58.7”	700	Go	11 – SJFZ and CFZ	6.5-7.5 magnitude
Homeland	33° 44’ 50.0”	117° 07’ 39.3”	1,594	GyC2	7.5 – SJFZ	6.5-7.5 magnitude

Table 4.6-1 (Cont.): Site Location Geological Attribute Information

Site Name	Latitude[2]	Longitude[2]	Elevation (feet)[3]	Soil Type[4]	Dist. (miles) to Quaternary Fault [5]	Potential earthquake magnitude (max)
Iron Mountain	34° 09' 03.9"	115° 08' 27.1"	1,920	NOTCOM	33 – Cleghorn Lake Fault	Low risk (far from fault line)
Joshua Tree	34° 04' 52.9"	116° 20' 34.4"	4,893	NOTCOM	1.4 – Eureka Peak Fault, 4 – Pinto Mountain Fault	5.5-6.5; 6.5-7.5 magnitude
Lake Elsinore	33° 40' 04.0"	117° 19' 07.5"	1,558	LkF3	.35 - EFZ	6.5-7.5 magnitude
Lake Mathews	33° 50' 19.3"	117° 22' 10.9"	1,494	VsD2	8 – CFZ 15 – SJFZ	6.5-7.5 magnitude
Lake Riverside	33° 29' 30.7"	116° 47' 16.0"	3,693	MeD	9 – SJFZ	6.5-7.5 magnitude
Leona	33° 47' 59.9"	117° 19' 06.1"	2,262	LpE2	8 – EFZ	6.5-7.5 magnitude
Line	33° 25' 54.0"	115° 50' 08.2"	-199	ImC	.75 - SAFZ	6.8-8.0 magnitude
Margarita (MWD)	33° 28' 46.7"	117° 08' 46.2"	1,070	RtF	.30 – EFZ	6.5-7.5 magnitude
Margarita (SDSU)	33° 27' 58.1"	117° 08' 30.5"	1,600	RtF	.30 – EFZ	6.5-7.5 magnitude
Marshell	33° 47' 02.4"	117° 22' 43.4"	2,309	CbF2	5 – EFZ	6.5-7.5 magnitude
Mead Valley	33° 49' 56.7"	117° 17' 14.3"	1,670	MmD2	10 – EFZ AND SJFZ	6.5-7.5 magnitude
Mecca Landfill	33° 34' 19.2"	116° 00' 01.7"	45	BP, MaB	.68 mi - SAFZ	6.8-8.0 magnitude
Menifee	33° 38' 57.3"	117° 12' 19.9"	1,651	HnC	3.8 mi - EFZ	6.5-7.5 magnitude
Morongo	33° 55' 37.2"	116° 45' 13.6"	1,725	SrE	.5 – SGPFZ	6.0-7.0 magnitude
Paradise	33° 55' 03.7"	117° 31' 53.5"	1,383	RtF	5.5 - CFZ	6.0-7.0
Quail Valley	33° 41' 23.9"	117° 15' 27.3"	1,609	LpF2	3.5 – EFZ	6.5-7.5 magnitude
Rancho Carillo	33° 33' 35.0"	117° 27' 48.0"	2,490	116	10 – EFZ	6.5-7.5 magnitude
Ranger Peak	33° 50' 36.5"	116° 49' 30.6"	5,043	KoD	4.3 mi - HS&BFZ; 6 mi - SGPF	Unknown; 6.0-7.0 magnitude

Table 4.6-1 (Cont.): Site Location Geological Attribute Information

Site Name	Latitude[2]	Longitude[2]	Elevation (feet)[3]	Soil Type[4]	Dist. (miles) to Quaternary Fault [5]	Potential earthquake magnitude (max)
Red Mountain	33° 37’ 46.1”	116° 50’ 54.1”	4,507	DpG	4 – SJFZ	6.5-7.5 magnitude
Redondo Mesa	33° 29’ 46.5”	117° 20’ 42.8”	2,784	MuE	8 – EFZ	6.5-7.5 magnitude
Rice	34° 04’ 45.2”	114° 47’ 07.4”	916	NOTCOM	>25 – SAFZ	Low risk (far from fault line)
Road 177	33° 52’ 54.6”	115° 15’ 07.7”	603	NOTCOM	>25 – SAFZ	Low risk (far from fault line)
Santa Rosa Peak	33° 32’ 42.4”	116° 28’ 09.9”	7,494	DpG	2.5 – HS&BFZ 4.5 – SJFZ	Unknown; 6.5-7.5 magnitude
Santiago Peak	33° 42’ 41.9”	117° 31’ 51.8”	5,601	152	4 mi – EFZ	6.5-7.5 magnitude
Spring Hill	33° 29’ 32.3”	115° 16’ 22.3”	2,605	NOTCOM	22 mi	Low risk (far from fault line)
Sunnyslope	33° 59’ 48.6”	117° 26’ 42.7”	1,094	VsF2	10 – SJFZ	6.5-7.5
Temescal	33° 46’ 49.5”	117° 29’ 26.5”	1,064	AlE	.5 – EFZ	6.5-7.5 magnitude
Timoteo	33° 58’ 16.3”	117° 09’ 34.5”	2,300	BaG	.3 mi – SJFZ	6.5-7.5
Vaquero	33° 28’ 51.1”	117° 11’ 00”	1,955	LpF2	1.4 – EFZ	6.5-7.5 magnitude
Vidal Junction	34° 11’ 37.3”	114° 29’ 20.3”	941	NOTCOM	>50 – SAFZ	Low risk (far from fault line)
Whitewater	33° 55’ 26.2”	116° 37’ 01.1”	1,726	CnE	1.35 mi – BFZ .4 mi – GHF	6.0-7.2; 6.0-7.0 magnitude
Wiley’s Well	33° 36’ 18.5”	114° 54’ 09.3”	391	NOTCOM	>25 – SAFZ	Low risk (far from fault line)
Winchester	33° 44’ 10.0”	117° 03’ 48.7”	2,031	CbF2	5 - SJFZ	6.5-7.5 magnitude

Notes:
1 – Unless noted otherwise, all Assessor Parcel Numbers (APNs) are located within Riverside County (OC = Orange County; SBC = San Bernardino County; SDC = San Diego County
2 – All coordinates utilize NAD83 datum
3 – Elevation (in feet) above mean sea level
4 – Shorthand soil type codes for soil classifications on file with the United States Department of Agriculture

5 - Key:
BFZ = Banning Fault Zone
SJFZ = San Jacinto Fault Zone
SAFZ = San Andreas Fault Zone
CFZ = Chino Fault Zone
SGPFZ = San Gorgonio Pass Fault Zone
HS&BFZ = Hot Springs and Buck Fault Zone
EFZ = Elsinore Fault Zone

Historic seismic activity has affected the structure of many buildings and created a need for more stringent building codes in most of California. Building Codes for Seismic Safety were developed to deal with this hazard, and are considered standard engineering and construction practice in most of California.

Often, but not always, the distance from a fault will affect the hazard level at a site. For this reason, Table 4.6-1 includes the relative distances to the closest Alquist-Priolo fault zone for each of the proposed tower sites.

4.6.4 - Thresholds of Significance

According to the CEQA Guidelines' Appendix G, Environmental Checklist, to determine whether impacts to geology and soils are significant environmental effects, the following questions are analyzed and evaluated:

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:

   i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.

   ii. Strong seismic ground shaking?

   iii. Seismic-related ground failure, including liquefaction?

   iv. Landslides?

b) Result in substantial soil erosion or the loss of topsoil?

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse? Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

d) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?

4.6.5 - Project Impact Analysis

This section discusses potential impacts associated with the development of the project and provides mitigation measures where appropriate.

Earthquakes

Impact GS-1	**Expose people or structures to potential substantial adverse effects, including the risk of loss, injury or death involving:** **i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.** **ii) Strong seismic ground shaking?** **iii) Seismic-related ground failure, including liquefaction?** **iv) Landslides?** **[CEQA Geology and Soils Threshold 6(a)(i to iv)]**

Impact Analysis

The project sites do not involve the construction of habitable structures, just the construction of towers and support equipment outbuildings. As these structures are considered “critical facilities” in the General Plan, they need to be especially disaster resistant so that the communication network would function during a disaster such as an earthquake, fire, or other emergency when communications are critical. In effect, the facilities will be built to a higher standard than most habitable structures are. The towers and buildings that will be constructed will be subjected to extensive engineering review, including geological engineering of the tower bases, and will be constructed in accordance with standard codes and engineering protocols, as applicable. Geotechnical investigations will be conducted before construction of each site, study recommendations will be implemented during construction, and continued inspection and monitoring will occur after construction and during the lifetime of facility operation.

Without appropriate design and construction, tower collapse could present a potential hazard during an earthquake or other geologic event. As is standard practice for a project of this type, comprehensive boring and soils tests will be conducted prior to construction to determine the specific engineering properties associated with onsite soils. Using this information, appropriate foundations, footings, and other structural elements will be designed and constructed to the meet the specific requirements identified at each site. All towers and other structures associated with the project will be built to professional engineering standards that will meet or surpass the requirements of the Uniform Building Code (UBC). Therefore, the likelihood of a tower collapsing during an earthquake or other geologic event is very low.

No habitable structures are proposed as part of the project. However, in the unlikely event that a tower would collapse, it could present a hazard if it were to fall on adjacent residential structures. Following standard practice, all towers will be constructed with a sufficient buffer or fall zone between it and any adjacent residential structures to allow for a complete tower collapse without the danger of the tower falling on a habitable residential structure. The likelihood of a collapsing tower injuring or killing persons living in the area would be negligible. Therefore, impacts in this regard will be less than significant.

Level of Significance Before Mitigation
Less than significant impact.

Mitigation Measures
No mitigation is required.

Level of Significance After Mitigation
Less than significant impact.

Soil Erosion or Topsoil Loss

Impact GS-2	**Result in substantial soil erosion or the loss of topsoil? [CEQA Geology and Soils Threshold 6(b)]**

Impact Analysis
Development of the proposed project would require excavation and grading, with varying amounts of soil disturbance. Soil erosion or loss of topsoil may occur in areas where soil is disturbed. However, because the individual tower sites are so small (approximately 65 feet by 65 feet), the amount of grading and soil disturbance will be minimal.

The Regional Water Quality Control Board (RWQCB) has developed a list of Best Management Practices (BMPs) that are designed to protect against erosion during construction activities. As discussed in Section 4.4, *Biological Resources*, and Section 4.8, *Hydrology and Water Resources*, the implementation of BMPs will be required for the proposed project. The BMPs used during construction typically include gravel bags, silt fencing, and general housekeeping measures to prevent stormwater contact with construction materials, which could cause erosion or excessive runoff into area drainages.

Gravitational erosion can occur on sites with steep slopes. The maximum ratio for slope stability varies by soil type and moisture content, but is generally no more than 2-foot rise to 1-foot run. During the site selection process, natural slope gradient of the sites was taken into consideration, as slope can be considered a constraint. Sites with excessive slopes were avoided. Therefore, this concern is less than significant with regard to the proposed project.

Level of Significance Before Mitigation
Less than significant impact.

Mitigation Measures
No mitigation is required.

Level of Significance After Mitigation
Less than significant impact.

Unstable Geologic Location, Expansive Soils, and Septic Systems

Impact GS-3	**Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse? Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property? Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?** **[CEQA Geology and Soils Threshold 6(c), 6(d), and 6(e)]**

Impact Analysis

As is standard practice for a project of this type, comprehensive boring and soils tests will be conducted prior to construction to determine the specific engineering properties associated with onsite soils. Using this information, appropriate foundations, footings, and other structural elements will be designed and constructed to the meet the specific requirements identified at each site. All towers and other structures associated with the project will be built to professional engineering standards that will meet or surpass the requirements of the UBC. Regular inspection of the towers will be done to ensure the building materials maintain their integrity in interaction with the soil. Therefore, the likelihood of a tower collapsing during an earthquake or other geologic event is very low and the potential impacts in this regard are less than significant.

Sites with expansive soils require more stringent engineering of the footings and foundations. As indicated above, sampling of the sites will determine the specific engineering requirements of the individual sites. Over-excavation and compaction of the load bearing soil material, or similar corrective measures may be taken on the recommendation of the engineer based on the results of geotechnical exploration. The standardization of the building codes and the high standards required for “critical” facilities make the potential for adverse impacts caused by soil or geologic processes less than significant. The towers and buildings that will be subjected to extensive engineering review (including geological engineering) and will be constructed in accordance with standard codes and engineering protocols, as applicable.

Septic tanks or alternative waste water systems are not included in the project description. As no septic or wastewater disposal systems would be constructed with the project, there is no potential for adverse impact in this regard.

Level of Significance Before Mitigation

Less than significant impact.

Mitigation Measures

No mitigation is required.

Level of Significance After Mitigation

Less than significant impact.