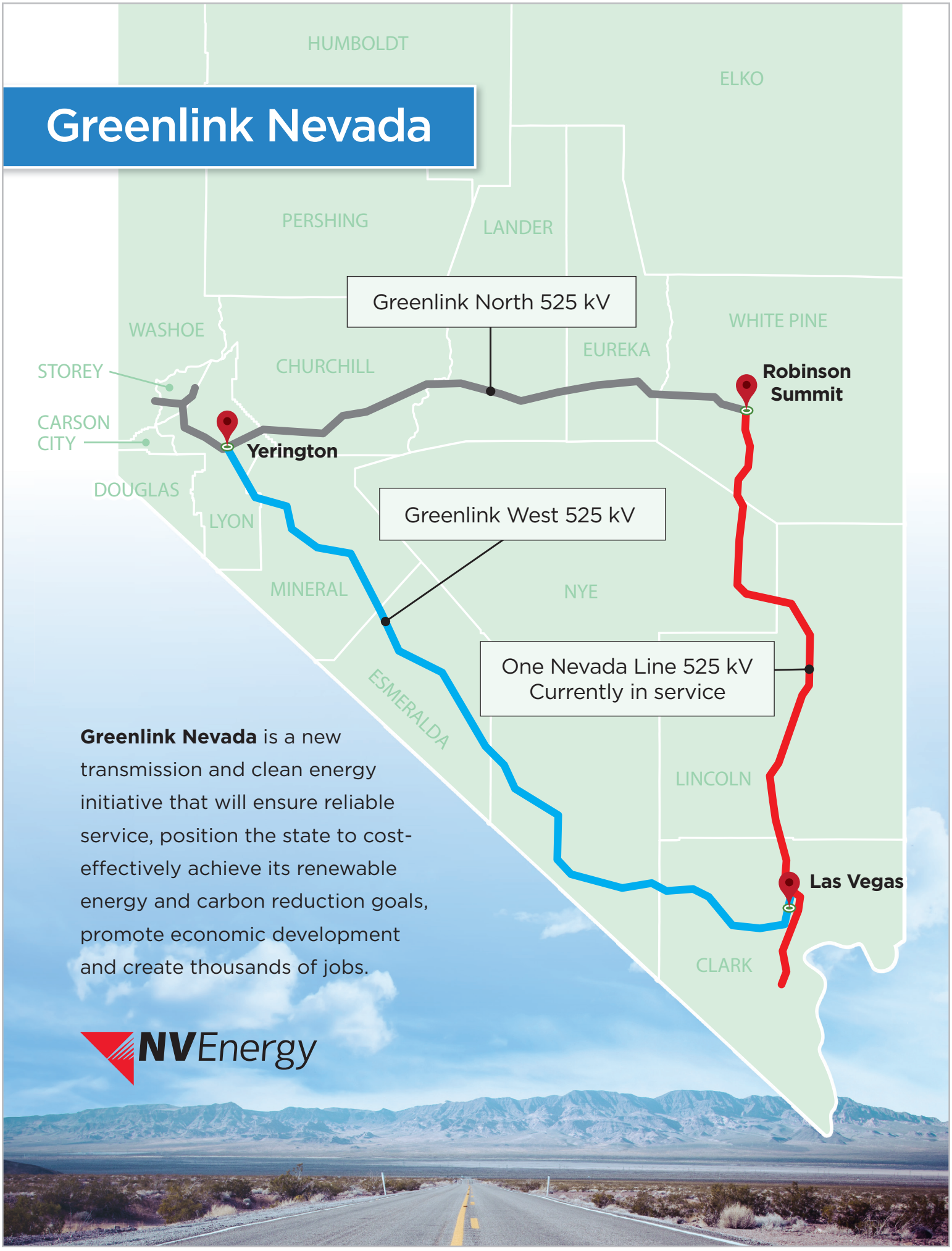
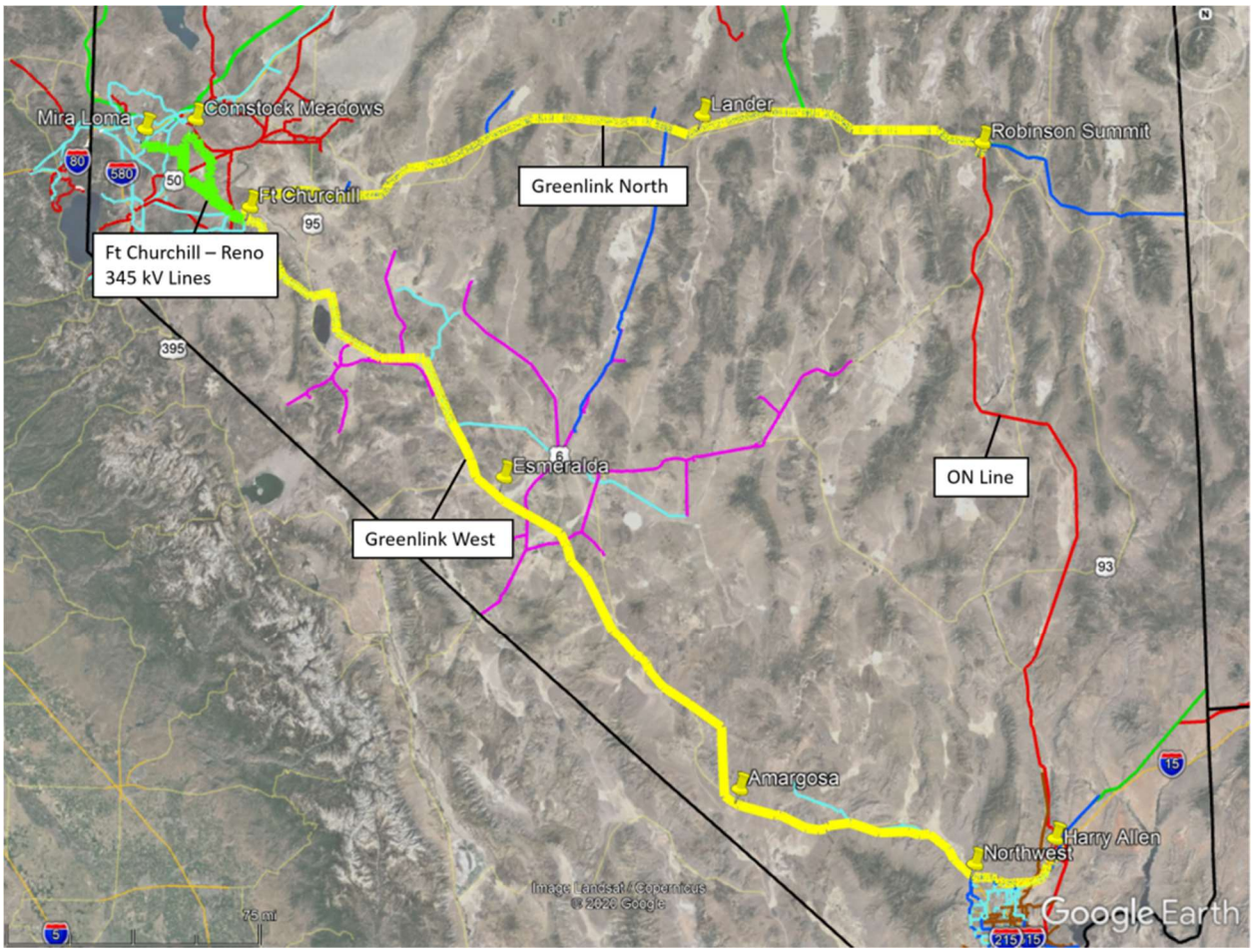
Greenlink Nevada



Greenlink Nevada is a new transmission and clean energy initiative that will ensure reliable service, position the state to cost-effectively achieve its renewable energy and carbon reduction goals, promote economic development and create thousands of jobs.

NVEnergy

Greenlink Nevada



October, 2020

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Executive Summary

The state of Nevada is facing unprecedented changes in both system growth and resource requirements. Further, the state of Nevada is adopting new policies that favor renewable energy to further carbon reduction objectives. By 2031, 1,000 MW of base load generation is planned for retirement in northern Nevada, however, approximately 1,450 MW of new load growth is currently under contract with Sierra, and Senate Bill 358 ("SB358") from the 2019 Legislative Session increased the renewable portfolio standard ("RPS") to 50 percent by 2030. While the goal of 50 percent by 2030 may be considered aggressive, SB358 also strives for an ultimate goal of reaching net zero carbon for all energy sold in the state by 2050. In order to reach net zero carbon, the amount of energy production from zero carbon dioxide emission resources must be equal to or greater than the total amount of electricity sold by providers of electric service in Nevada.

When SB358 was signed into law by Governor Sisolak on Earth Day, April 22, 2019, he stated "Today, Nevada sent a message to the country and world that the Silver State is open for business as a renewable leader, and our commitment to growing our clean energy economy transcends party lines."[1] This bill only sets the stage for a long journey towards an ultimate goal.

Shortly after, Senate Bill 254 ("SB254") was passed into law on June 5, 2019. SB254 adopts the vision of SB358 through action. Specifically, requiring the Nevada State Department of Conservation and Natural Resources ("NDCNR") to submit an annual report that includes a statewide inventory of greenhouse gas emissions and a projection of annual emissions for the next 20 years. While the objective of this report is clearly to drive the reduction of greenhouse gas emissions in the state, it also provides policies to support that direction. From the Companies' perspective, the most important policy areas are Integrated Resource Planning and Grid Modernization. These two areas are interdependent and in fact, Grid Modernization is a pre-requisite to accommodate the 30-year resource plan envisioned. NDCNR's report discusses resiliency, flexibility, reliability and foremost renewable integration. These factors can only be achieved through an interconnected grid that has the ability to share diverse resources over a vast geographic area. It is impossible to meet the goals of the state without strategic transmission infrastructure.

Resource diversity and transmission infrastructure each play a key role in allowing the Companies to achieve these state policy goals. While Nevada has an abundance of solar and geothermal resources, high quality wind and hydro resources are nearly absent within the state. Further, while battery technology continues to evolve, the Zero-Carbon Findings and Analysis by E3 in this filing demonstrates that solar and PV energy storage alone cannot effectively accomplish the

[1] State of Nevada (Apr. 22, 2019), http://gov.nv.gov/News/Press/2019/Governor_Sisolak_Signs_Bill_to_Raise_Nevada%E2%80%99s_Renewable_Portfolio_Standard_To_50__By_2030/

aggressive renewable goals established for the state. A balance must be created between resource types and the availability of those resources as the sun rises and sets through each day.

The only way to gain access to diverse renewable resources is through an interconnected western grid. Nevada's geographic location provides the opportunity to be a key player in the development of that grid and a key renewable energy provider in the west. At this point, the missing piece is the lack of transmission infrastructure in Nevada. The transmission infrastructure proposed in the Greenlink Nevada plan builds a foundation for the state to access diverse resources and increase the transfer of energy between Nevada and the developing western grid. Several regional projects in the western grid are already under development and propose connections to or though the state of Nevada.

In addition to achieving the state's renewable goals, under the Companies' Open Acess Transmission Tariff ("OATT"), the Companies have a federal obligation to plan for the electric service to all existing and future network customers. Network customers, which take Network Integration Transmission Service ("NITS") under the OATT, are treated with the same priority as the Companies' native load and pay for transmission service based on their proportionate share of the total system load. The Companies' native load is the largest network customer. The import limit in northern Nevada is 1,275 MW and is fully reserved based on 150 MW of Transmission Reliability Margin,[2] 600 MW of ON Line allocation and 525 MW of third-party firm reservations. The 525 MW of third-party reservations is forecasted to increase to more than 700 MW within 10 years. Investment in transmission infrastructure is the only possible way to increase the import into northern Nevada to meet this increasing transmission load growth.

The Companies have analyzed various transmission options with interconnections into northern Nevada. This analysis included system impacts on import, renewable integration, joint dispatch, relief of congested paths, directly facilitating retirement of conventional generation, ability to serve load, and ability to construct the facilities. The results of this analysis identified the need for the Ft. Churchill to Robinson 525 kV line named "Greenlink North" and the Ft. Churchill to Harry Allen 525 kV line named "Greenlink West" as the preferred backbone projects for Nevada. Both of the preferred projects also include 345 kV connections between a new Ft. Churchill Substation and the major Reno load pockets to accommodate load service and increased import. In addition to connecting the high-capacity transmission resources to the load pockets, the 345 kV ties increase the reliability in the Carson Valley, facilitate the retirement of the Ft. Churchill generators and increase renewable integration capacity into western and central Nevada. Together, Greenlink West, Greenlink North and the 345 kV ties between Ft. Churchill and Reno constitute Greenlink Nevada.

To address the immediate transmission need, the Companies are requesting Commission approval to construct the projects that make up Greenlink Nevada in two phases. Greenlink West and the 345 kV connections from Fort Churchill to Mira Loma substations and Fort Churchill to

[2] Defined under NERC Standard MOD-008-1.

Comstock Meadows #1 substations comprise of Phase I of Greenlink Nevada. This phase adds 725 MW of import capacity into northern Nevada and creates a second transmission connection between northern and southern Nevada, resulting in redundant 525 kV paths between the two systems. With the Companies operating as a single balancing authority, the single contingency of ON Line results in the loss of reserve sharing capability, northern system import capacity, joint dispatch savings and northern system stability. Greenlink West eliminates this single contingency impact and creates the essential connections for both the northern and southern systems to become key players in a western interconnected grid. If, or when, a Regional Transmission Organization ("RTO") is established in the West, Nevada's connected grid can further benefit from the capability of sharing resources over a larger geographic footprint, market flexibility and market diversity. Furthermore, this project specifically runs through three untapped Bureau of Land Management ("BLM") defined Solar Energy Zones ("SEZs") in Nevada: Amargosa Valley, Gold Point and Millers. To facilitate access to these SEZs, Greenlink West includes the construction of two collector stations along the route from Ft. Churchill to Northwest substations that provide access for renewable injection. Access to additional solar resources will drive the state towards its long-term vision of becoming a net exporter of energy resulting in economic development, increased tax base in particular for rural Nevada counties, job creation and export revenue.

Phase II of Greenlink Nevada includes the Greenlink North project, which results in a 525 kV triangular network around Nevada with the existing ON Line project and Greenlink West. The addition of Greenlink North also results in an incremental 800 MW of transmission import capacity for a total of 2800 MW. This project creates a strong connection between Robinson Summit Substation and major northern Nevada load pockets, while increasing renewable integration capability in central Nevada. Robinson Summit Substation is also considered a strategic future hub in the western interconnected grid due to its location and the currently planned regional transmission projects. Both LS Power's SWIP-North 525 kV project and TransCanyon's Cross-Tie 525 kV project propose connection into Robinson Summit Substation. These connections can create access to diverse resources such as wind and hydro that are not currently available within the state of Nevada, and as discussed in the Zero-Carbon Findings and Analysis completed by E3, are essential resources for the Companies to meet the state's 2050 net-zero carbon goal envisioned in SB358. As the demand for renewable resources increases and interconnection of the western grid is established, the next step of Greenlink Nevada will be the construction of Greenlink North.

Greenlink West is the first step toward creating the required increase in import capacity to meet current and future network load growth while creating redundant connections between northern and southern Nevada, accessing untapped renewable energy zones along western Nevada and promoting additional renewable integration in Yerington and the central Nevada area. In southern Nevada there are several commercial and industrial developments occurring in the

corridor between Harry Allen Substation and Northwest 525 kV Substation. While a renewable energy transmission corridor is established through the developing area, the window to access this corridor is closing. Under the National Defense Authorization Act of December, 2014, construction must be initiated by December 19, 2029 or the renewable corridor expires. As a result, there is an urgency for the Companies to begin the permitting of the Greenlink Phase I facilities immediately to ensure the full project can be constructed.

While Greenlink West solves the immediate concerns of import capacity and system reliability, Greenlink North is the next phase for Nevada that supports regional connections such as the SWIP-North or the Cross-Tie projects. As the western grid develops, the Greenlink North project will create access to diverse resources such as wind and hydro through complimenting regional transmission projects. This access along with increased import and export capacity out of Nevada provides the Company with more resource flexibility and better system reliability.

The overall Greenlink Nevada project is not only positive progress towards solving northern Nevada's import constraint, but also prepares the state for the renewable energy development and integration required to meet the state's aggressive goals sought in SB358. Net-zero carbon will not only require substantially more resources than load due to reduced effective load carrying capabilities, resulting in more transmission, but also future access to diverse forms of resources such as wind and hydro- diverse resources that can be counted on when solar energy is unavailable. In addition to providing access to diverse resources, the robustness of the transmission grid will increase system reliability and resource flexibility. Not only will the projects facilitate the retirement of existing fossil fuel generation at Ft. Churchill Generating Station and other locations, but they will also increase the overall reliability in the Carson Valley and Reno load pockets. In particular, the increased resource flexibility will support the reduction of energy rates to the Companies' customers.

Additional transmission increases both import capacity and export capacity. With vast access to solar resources across Nevada, the state will have the opportunity to harness this energy as a net exporter to the western grid, a benefit that is currently hindered by limited transmission access to renewable development.

While the construction alone of Greenlink Nevada will create substantial jobs and opportunities in Nevada, this transmission infrastructure will encourage even further economic opportunity. With the results of each generator interconnection request and associated transmission system upgrades, renewable developers are finding that the northern Nevada system is nearly out of transmission capacity. The proposed approach of preparing the system for renewable integration, as opposed to forcing resources and developers to drive transmission improvements, will fortify economic development within the state. Having the capability to absorb, transfer and

serve high levels of renewables will add to the attraction of Nevada and get the attention of large companies and employers looking to locate to the Silver State.[3]

Greenlink Nevada is the Companies' strategic and comprehensive approach to accommodating existing and future transmission network customers, increasing transmission systems reliability, creating access to diversified renewable resources, facilitating development of existing designated SEZs, facilitating conventional generation retirement and achieving Nevada's carbon reduction and eventual net-zero objectives.

Transmission Options Analyzed

NV Energy analyzed several transmission options for increasing capacity into northern Nevada. While Nevada has the advantage being geographically centered within the western grid and adjacent to California's nearly 50,000 MW load, a major disadvantage is the amount of BLM land, terrain and vastness of the region. Any transmission line constructed to connect outside of northern Nevada will be at minimum 200 miles long and is guaranteed to pass through substantial BLM land. Connections to northern California, Idaho and Utah were analyzed as well as increased connections between southern and northern Nevada.

Several options included connections at Ft. Churchill substation which acts as a centralized hub for the major transmission interconnection as well as accommodates additional connections to the major load pockets in the Reno and Tracy area. All options that included Ft. Churchill assumed 345 kV transmission from Ft. Churchill to Mira Loma and Ft. Churchill to Comstock Meadows.

Figure 1 displays the options reviewed.

[3] The report by Applied Analysis (ECON-8) provides more information on the economic, fiscal, and social benefits of Greenlink Nevada.

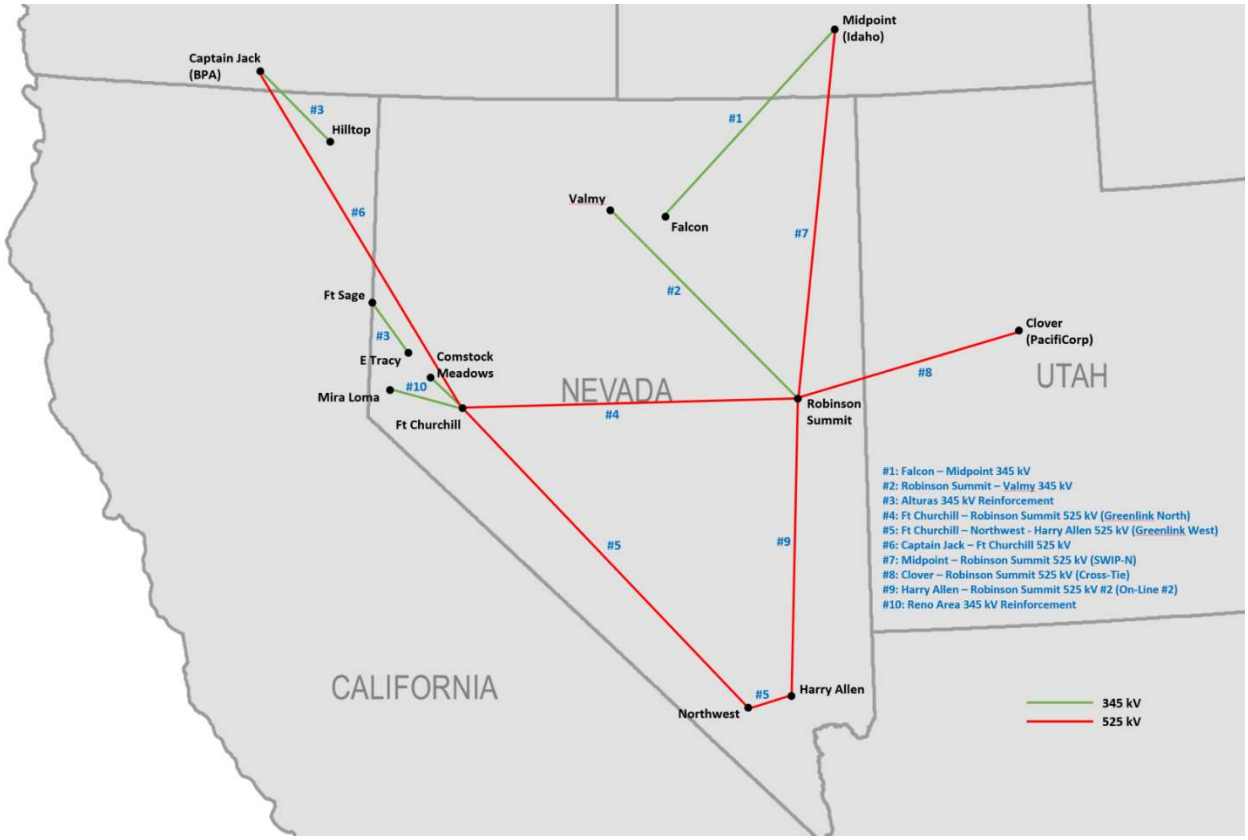


Figure 1 - Overview of Transmission Options Analyzed

#1: Falcon to Midpoint 345 kV line

This 230 mile 345 kV project would provide a second parallel line from the NV Energy system into Idaho Power. Midpoint has the electrical strength to support this additional interconnection. Currently Midpoint is not a major transactional hub for energy trading. This project would be within Department of Energy defined 368 corridors.

#2: Robinson to Valmy 345 kV line

This 210 mile 345 kV project would provide a second parallel line from the NV Energy system into Robinson Summit. Because both terminations of this project are internal to NV Energy, it does not access new electric providers. Both Valmy and Robinson Summit have the electrical strength to support this additional interconnection. Currently neither location is major transactional hub for energy trading.

This project would not be within Department of Energy defined 368 corridors. However the environmental analysis performed for the existing line was conducted in 2003 so these studies will provide a limited base for permitting.

With the planned reinforcements of the TransCanyon Cross-Tie and/or SWIP-North facilities Robinson Summit could become a major trading hub.

#3: Alturas 345 kV Reinforcement

This project would reinforce the existing Alturas 345 kV intertie by constructing a 70 mile Captain Jack to Hilltop 345 kV line and 45 mile East Tracy to Fort Sage 345 kV line. Captain Jack is considered part of the

California Oregon Border trading hub so an interconnection here would access multiple new electric providers. Captain Jack has the electrical strength to support this additional interconnection but would require significant substation upgrades to support the addition of a 525 to 345 kV XFMR and 345 kV terminals.

This project would significantly help voltage regulation for the Reno area loads.

Some elements of his project would be within Department of Energy defined 368 corridors. Some of these identified segments are defined as corridors of concern by the Department of Energy so permitting complexity would be higher. Additionally, the Tracy to Fort Sage segment is locally defined but not a Department of Energy 368 corridor.

#4: Ft. Churchill to Robinson 525 kV line (Greenlink North)

This 235 mile project would provide a second parallel line from the NV Energy system into Robinson Summit, effectively strengthening the existing ON Line 525 kV project. Because both terminations of this project are internal to NV Energy, it does not access new electric providers. Robinson Summit has the electrical strength to support this additional interconnection but Fort Churchill would need to be upgraded to both 525 kV and 345 kV and interconnected to the Reno area 345 kV facilities. Currently neither location is major transactional hub for energy trading.

This project would not be within Department of Energy defined 368 corridors but would follow existing NV Energy transmission.

With the planned reinforcements of the Cross-Tie and/or SWIP-North facilities Robinson Summit could become a major trading hub.

#5: Ft. Churchill to Northwest to Harry Allen 525 kV line (Greenlink West)

This project would provide a new line within the NV Energy system by providing a second strong path between Northern and Southern Nevada. This interconnection here would not access new electric providers. Harry Allen has the electrical strength to support this additional interconnection but Fort Churchill would need to be upgraded to 525 kV and 345 kV and interconnected to the Reno area 345 kV facilities.

This project would be within Department of Energy defined 368 corridors. One of the identified segments is defined as a Corridor of Concern by the Department of Energy. This segment is within Clark County around the Northwest Substation. Permitting of this segment will be highly complex.

This line route is adjacent to three Bureau of Land Management identified Solar Energy Zones that currently have no significant transmission for interconnection. These Solar Energy Zones are Millers, Gold Point and Amargosa Valley. Over 29,000 total acres have been identified as developable through this designation process at these sites.

#6: Ft. Churchill to Captain Jack 525 kV line

This 300 mile project would provide a new line from the NV Energy system into Captain Jack. Captain Jack is considered part of the California Oregon Border trading hub so an interconnection here would access multiple new electric providers. Captain Jack has the electrical strength to support this additional interconnection but Fort Churchill would need to be upgraded to 525 kV and 345 kV and interconnected to the Reno area 345 kV facilities.

This project would be within Department of Energy defined 368 corridors. Some of the identified segments are defined as Corridors of Concern by the Department of Energy so permitting complexity would be higher.

#7: Robinson to Midpoint 525 kV (SWIP-N)

This 280 mile 525 kV project would provide a new line from the NV Energy system at Robinson Summit to Midpoint. Because both terminations of this project are existing, it does not access new electric providers. Both Midpoint and Robinson Summit have the electrical strength to support this additional interconnection. Currently neither location is major transactional hub for energy trading. While this project does enhance ON Line capacity in both directions, it essentially bypasses the northern system and provides little to no additional import capacity.

This project would be within Department of Energy defined 368 corridors. Several segments are defined as Corridors of Concern by the Department of Energy. LS Power has secured significant permitting for this project.

#8 Robinson to Clover 525 kV (Cross-Tie)

This project would provide a new 215 mile line from the NV Energy system at Robinson Summit to the planned Clover substation in central Utah. Because both terminations of this project are existing, it does not access new electric providers. Both Mona and Robinson Summit have the electrical strength to support this additional interconnection. Currently neither location is major transactional hub for energy trading. While this project does enhance ON Line capacity in both directions, it essentially bypasses the northern system and provides little to no additional import capacity.

This project would be within Department of Energy defined 368 corridors. Several segments are defined as Corridors of Concern by the Department of Energy.

#9: Robinson to Harry Allen #2 (ON Line #2)

This 231 mile project would provide a new line in parallel with the existing ON Line project between Robinson Summit and Harry Allen. Because both terminations of this project are existing, it does not access new electric providers. Harry Allen has the electrical strength to support this additional interconnection. Currently Robinson Summit does not. If both Cross-tie and SWIP – North are constructed NV Energy would likely capture significant Point to Point revenues by constructing this line.

This project would be within Department of Energy defined 368 corridors. Several segments are defined as Corridors of Concern by the Department of Energy. NV Energy has secured a record of decision on this path that is currently held in abeyance by the Bureau of Land Management.

Transmission Options Results

Import analysis was performed on each transmission option. The Table 1 below summarizes the results.

Table 1 - Transmission Options Import Summary

Transmission Options Import Summary			
#	**Project**	**Line Miles**	**Increased Northern Import (MW)**
1	Falcon - Midpoint 345kV	230	375
2	Robinson - Valmy 345kV	210	325
3	Alturas 345kV Capacity Upgrade	115	225
4	Fort Churchill - Robinson 525kV	235	500
5	Fort Churchill - Northwest - Harry Allen 525kV	351	725
6	Fort Churchill - Captain Jack 525kV	300	725
7	Robinson - Midpoint 525kV (SWIP North)	275	25
8	Robinson - Clover 525kV (Cross-Tie)	214	25
9	Harry Allen - Robinson 525kV #2 (ON Line #2)	235	25

Additionally, a scoring system was developed for ranking the transmission options based on several factors, the results of this scoring is shown in Table 2 below.

Table 2 - Transmission Options Comparison Matrix

Transmission Options Analysis Matrix												
#	Project	Increases Import <100=0, 100-500=1, 500-1000=2	Renewable Integration in Nevada	Nevada Joint Dispatch	Relieves Congested Path	Accesses Existing Available Capacity	Facilitates Fossil Fuel Retirement	No Third Party Transmission Rate	Supports Major Load Pockets, Reno & Tracy	Access to Renewable Energy Zones	Follows existing Transmission	Total Score
1	Falcon - Midpoint 345kV	1	0	0	0	0	1	0	0	0	1	**3**
2	Robinson - Valmy 345kV	1	0	1	0	1	1	1	0	0	1	**6**
3	Alturas 345kV Capacity Upgrade	1	0	0	0	0	0	0	0	0	0	**1**
4	Fort Churchill - Robinson 525kV	2	1	1	0	1	1	1	1	0	1	**9**
5	Fort Churchill - Northwest - Harry Allen 525kV	2	1	1	1	1	1	1	1	1	0	**10**
6	Fort Churchill - Captain Jack 525kV	2	1	0	0	0	1	0	1	0	0	**5**
7	Robinson - Midpoint 525kV (SWIP North)	0	0	0	0	0	0	0	0	0	0	**0**
8	Robinson - Clover 525kV (Cross-Tie)	0	0	0	0	0	0	0	0	0	0	**0**
9	Harry Allen - Robinson 525kV #2 (ON Line #2)	0	0	0	1	1	0	1	0	1	1	**5**

The results of the ranking process identified Ft. Churchill to Robinson Summit 525 kV and Ft. Churchill to Northwest to Harry Allen 525 kV as the top two projects. While there is no official scoring system established for selecting transmission lines and results can be considered subjective, the company has identified these top two projects based on the analysis completed, current regional transmission activities and its transmission planning expertise.

While neither Ft. Churchill to Robinson nor Ft. Churchill to Harry Allen connect to systems outside of Nevada, both substantially increase northern Nevada import capacity. Under both scenarios, import is created by accessing existing markets and capacity in southern Nevada while increasing the transmission network within the state.

The northern Nevada system has been described as a donut within the western electric grid due to its limited sourcing and transfer capability. The connection of ON Line from Harry Allen to Robinson was one of the first steps to creating a transmission network into northern Nevada. Even though the ON Line project and the southern Nevada system has the capacity to source over 2000 MW once supporting upgrades are completed, the northern system limits the project. For example, the maximum south to north capacity on ON Line is only 600 MW because this is all the northern system can accept under the

most severe single contingency. Similarly, the north to south limit is only 900 MW because this is the highest amount of energy the northern system can source. The projects reviewed that don't include connection to Ft. Churchill with the 345 kV ties to Reno essentially just create another strong connection to a weak system, similar limitations will plague the northern systems capacity until it has been properly networked. Projects that included reinforcement into northern eastern Nevada may create increased import, but does efficiently transfer energy to the locations where load is growing. Connection of a high capacity source into Ft. Churchill and effectively networking and looping the existing 345 kV system between Mira Loma, Comstock Meadows and Ft. Churchill creates a high capacity system through Nevada while reinforcing the entire states transmission system.

NV Energy believes that the future of Nevada's economy and renewable capability are dependent on the states transmission systems capability to effectively and efficiently move energy throughout the state. Greenlink Nevada Phase I delivers the initial construction of the Ft. Churchill to Northwest to Harry Allen 525 kV line with associated Ft. Churchill to Reno 345 kV connections followed by the Ft. Churchill to Robinson 525 kV line. The Ft. Churchill to Northwest to Harry Allen project is proposed to be constructed first due to higher incremental import capacity, increased system reliability, and increased renewable integration through access of untapped solar energy zones in Nevada.

Ft. Churchill to Robinson 525 kV is expected to be required shortly after due to increased renewable portfolio goals and the need for greater connections between Nevada and the western grid and the need to access diverse resources such as wind and hydro energy.

Major Transmission Projects

Ft Churchill to Reno Area 345 kV Reinforcement

Ft Churchill Substation Expansion

Ft. Churchill substation's existing configuration accommodates the interconnection of the Ft. Churchill generating station which consists of two 110 MW natural gas combustion turbines. The substation also acts as a strategic hub for serving the Carson Valley load pocket with its interconnections to Buckeye and Brunswick substations. The existing substation cannot be expanded, as it is physically constrained, therefore is will be necessary to expand to available land, located just west of the existing 120 kV substation. This new layout will be required to integrate either of the proposed 525 kV transmission lines to the Reno area load pocket, the Ft Churchill substation must be rebuilt to include new 525 kV and 345 kV facilities and replace the existing 230 kV and 120 kV facilities. This is required both due to fault duty concerns at the existing Ft Churchill 120 kV substation and an inability to expand to meet the future needs of the transmission system. This rebuild is proposed to utilize a breaker and a half configuration for all voltages with future expansion capability.

The substation yard configuration is proposed to use a 345 kV "hub" voltage, with transformers to step up/down to 525 kV, 230 kV and 120 kV. This configuration was chosen to reduce the power transfer across XFMRs to both reduce losses and optimize flows within the substation. This aligns with the plan to build new 345 kV transmission into the Reno area load pocket to deliver the bulk energy delivery from the proposed 525 kV transmission lines. With the proposed upgrades, Ft. Churchill will become a strategic central hub within Nevada.

Ft Churchill – Mira Loma 345 kV & Ft Churchill – Comstock Meadows 345 kV 1 & 2 Lines

The Reno area transmission system can be reinforced by adding three new 345 kV transmission connections. The first is a 345 kV line from Ft Churchill to Mira Loma, and the second and third are 345 kV lines from Ft Churchill to Comstock Meadows.

The Ft Churchill – Mira Loma line adds a second source to the Mira Loma 345 kV substation and creates a new 345 kV loop to improve transmission system strength in the Reno area. This line is anticipated to be approximately 46 miles long based off of preliminary routing and siting analysis. This project has been proposed as part of prior NV Energy generator interconnection requests and is consistent with other long term Transmission System plans.

The Ft Churchill – Comstock Meadows lines add two 345 kV sources to the Comstock Meadows 345 kV substation. Comstock Meadows is centrally located within the Tracy area load pocket and has been identified as a key substation within the Tracy area transmission loop presented in the Tracy area master plan. These lines are anticipated to be approximately 38 miles long based off of preliminary routing and siting analysis. Comstock Meadows is integrated into the Reno area transmission system through the 345 and 120 kV transmission system in the Tracy area. Comstock Meadows was chosen as the termination for these two lines as it is both the substation that will serve the largest proposed load in the Tracy area and has the capability to integrate both of these lines.

These three new 345 kV lines are required to support either of the proposed 525 kV lines. While the 525 kV lines are both proposed to deliver bulk power to the Northern Nevada transmission system, the 345 kV lines into the Reno area are critical to distributing the 525 kV energy to the major load centers.

The connections between Ft. Churchill and the Reno transmission system are beneficial in two stages:

1. The initial stage is the creation of a strong outlet from the central Nevada system into the Reno load pocket. Several renewable generation projects have sought to interconnect with the 230 kV and 120 kV systems in central Nevada. Due to the limited capacity of this area of the system, additional generation cannot be injected without the construction of the Ft. Churchill to Mira Loma and Ft. Churchill to Comstock Meadows lines. Additionally, these connections would eliminate the existing summer must run requirement of Ft. Churchill generation and eventually facilitate the retirement of the generating station.
2. The second stage and benefit of these transmission connections is a pathway from a major transmission project to the Reno and Tracy area load pockets. Either of the high capacity projects discussed below will efficiently transfer energy from southern Nevada into the Reno and Tracy area's and increase the overall northern system import limit.

The proposed transmission connections at Ft. Churchill are shown in Figure 2 with the following color coding:

- Yellow: 525 kV (1 or 2 lines)
- Green: 345 kV (3 lines)
- Dark Blue: 230 kV (1 line)
- Light Blue: 120 kV (5 lines, 2 generators)
- Red: 60 kV (1 line, 1 generator)

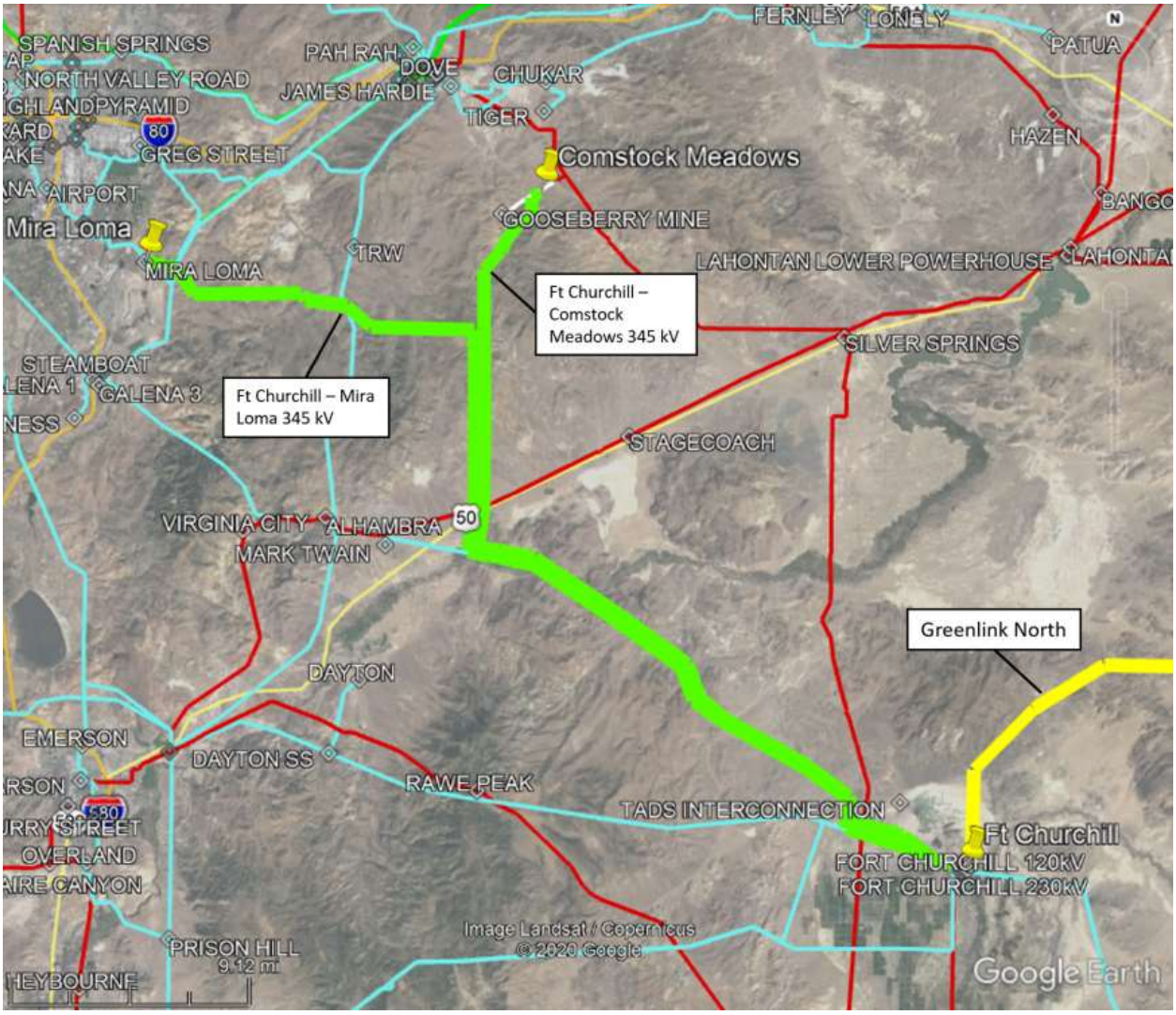


Figure 2 - Ft Churchill proposed transmission connections

Ft Churchill – Harry Allen 525 kV (Greenlink West)

The preferred option for strengthening the northern Nevada transmission system is constructing a new 525 kV series compensated line from Ft Churchill to Northwest substation in southern Nevada, and a new 525 kV line from Harry Allen to Northwest. This line is anticipated to be approximately 351 miles long (32 miles from Harry Allen to Northwest and 319 miles from Northwest to Ft. Churchill) based off of preliminary routing and siting analysis. This line is planned to accommodate two intermediate substations strategically placed to create access for future transmission expansions and integration of renewable resources. “Amargosa” is proposed to be located in the Amargosa Valley along Highway 95 adjacent to the Amargosa Valley Solar Energy Zone, and “Esmeralda” is proposed to be located west of Tonopah, NV, south of Highway 6 near the Millers Solar Energy Zone. Both of these substations are planned to accommodate 525/230 kV step down capability and access to 230 kV terminals.

This project creates a second 525 kV path between northern and southern Nevada in addition to existing On-Line and strengthens the overall northern transmission system. This would increase system import and provide a high capacity source to Ft Churchill substation to support the Reno load pockets. This project adds both electrical and geographical diversity to the interconnection between the northern and southern systems while greatly increasing the ability to deliver power to the Reno and Tracy area load pockets utilizing the 345 kV lines proposed.

The Harry Allen – Northwest 525 kV line provides a second connection between Harry Allen 525 kV and Northwest. Northwest substation currently has a single 525 kV source from Chuck Lenzie via Harry Allen and multiple 230 kV sources. Without the second 525 kV source, the transfer capability of Greenlink West would be severely limited by the loss of the single 525 kV source from Harry Allen and the reduced capability of the Northwest 230 kV system. This configuration also creates two 525 kV sources into Northwest, further strengthening the transmission grid. While Greenlink West could connect directly to Harry Allen, the connection to Northwest is preferred due to geographic diversity and the permitting concerns of connecting the southern terminus to Harry Allen. The anticipated north to south and south to north transfer capability with Greenlink West is identified in Table 3 below.

Table 3: Greenlink West – Southbound and Northbound Capacities

Project(s)		North / South Capacity	
ON Line	**Greenlink West**	**North to South Capacity (MW)**	**South to North Capacity (MW)**
✓		900	600
✓	✓	2000	1350

Greenlink West and the Ft. Churchill to Reno 345 kV lines are are displayed in Figure 4 below (shown in yellow):

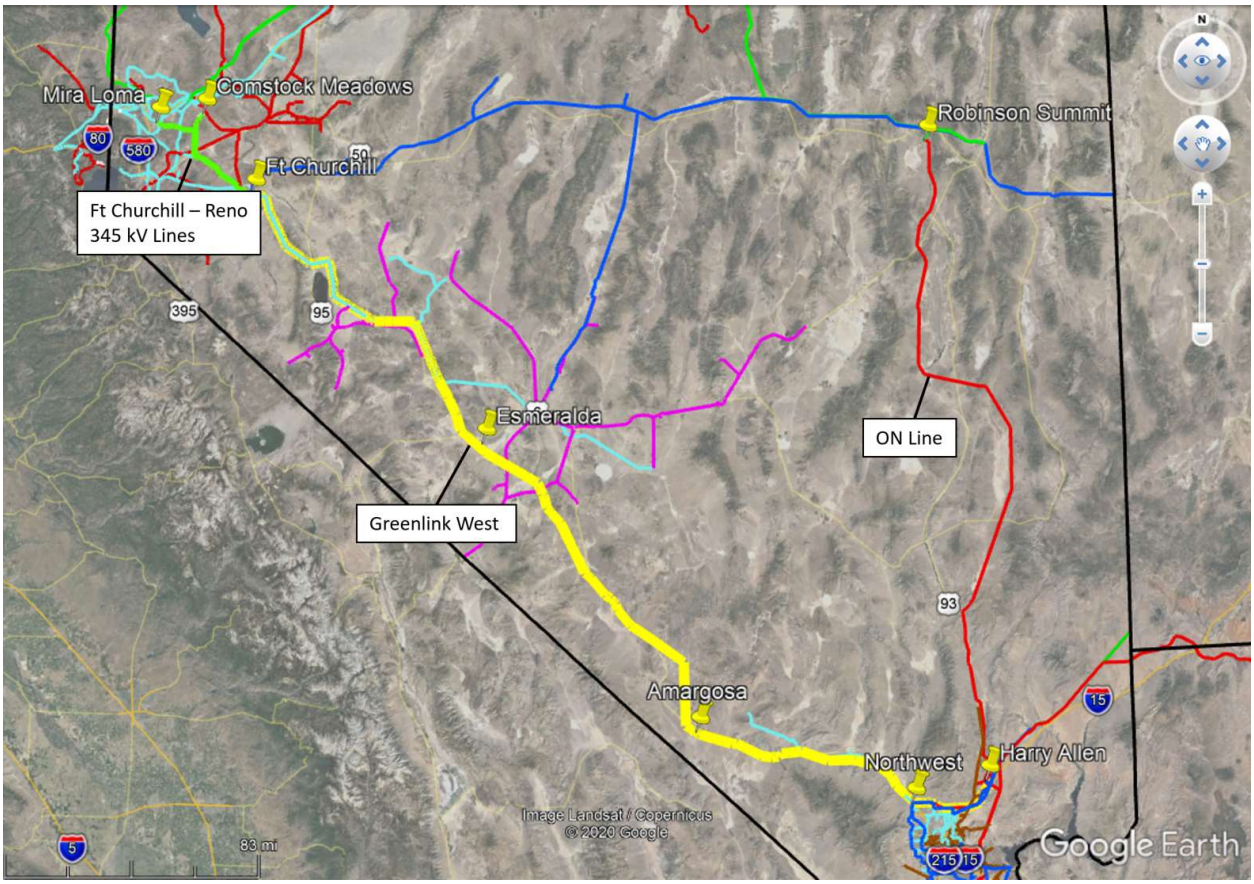


Figure 3 - Ft Churchill proposed transmission connections

Ft Churchill – Robinson Summit 525 kV

The second preferred option for strengthening the Northern Nevada transmission system is constructing a new 525 kV series compensated line from Ft Churchill to Robinson Summit. This line is anticipated to be approximately 235 miles long based off of preliminary routing and siting analysis. The project is planned to include an intermediate substation "Lander" to be located approximately 9 miles east of the existing Frontier 230 kV substation. Lander would include a 525/230 kV step down transformer and available 230 kV terminals for future interconnections. This intermediate substation creates an opportunity for future transmission expansion and the integration of renewable resources.

While this project does not have a connection external to the northern Nevada transmission system, this project does reinforce the existing Harry Allen – Robinson 525 kV line (On-Line) by increasing system import and providing a high capacity source to Ft Churchill substation to support the Reno loads via the 345 kV ties. While the existing On-Line has significant thermal capacity, in excess of 2000 MW, the line is limited significantly in transfer capability by the system limitations of its northern terminus at Robinson Summit. The Robinson Summit substation currently steps down to 345 kV and creates a choke point for power transfer that is well below the thermal rating of On-Line. Adding the Ft Churchill – Robinson Summit 525 kV line would strengthen the capacity of the Robinson Summit substation and allow NV Energy to increase the transfer capability of On-Line both northbound and southbound. This increased transfer capability would allow power to be delivered to the Reno and Tracy load pockets via the new 345 kV connections. The anticipated north to south and south to north transfer capability with Greenlink North is identified in Table 4 below. Figure 4 displays the Greenlink North 525 kV line along with Greenlink West and the Ft. Churchill to Reno 345 kV lines.

Table 4: Greenlink North - Southbound and Northbound Capacities

Project(s)		North / South Capacity	
ON Line	**Greenlink North**	**North to South Capacity (MW)**	**South to North Capacity (MW)**
✓		900	600
✓	✓	900	1100

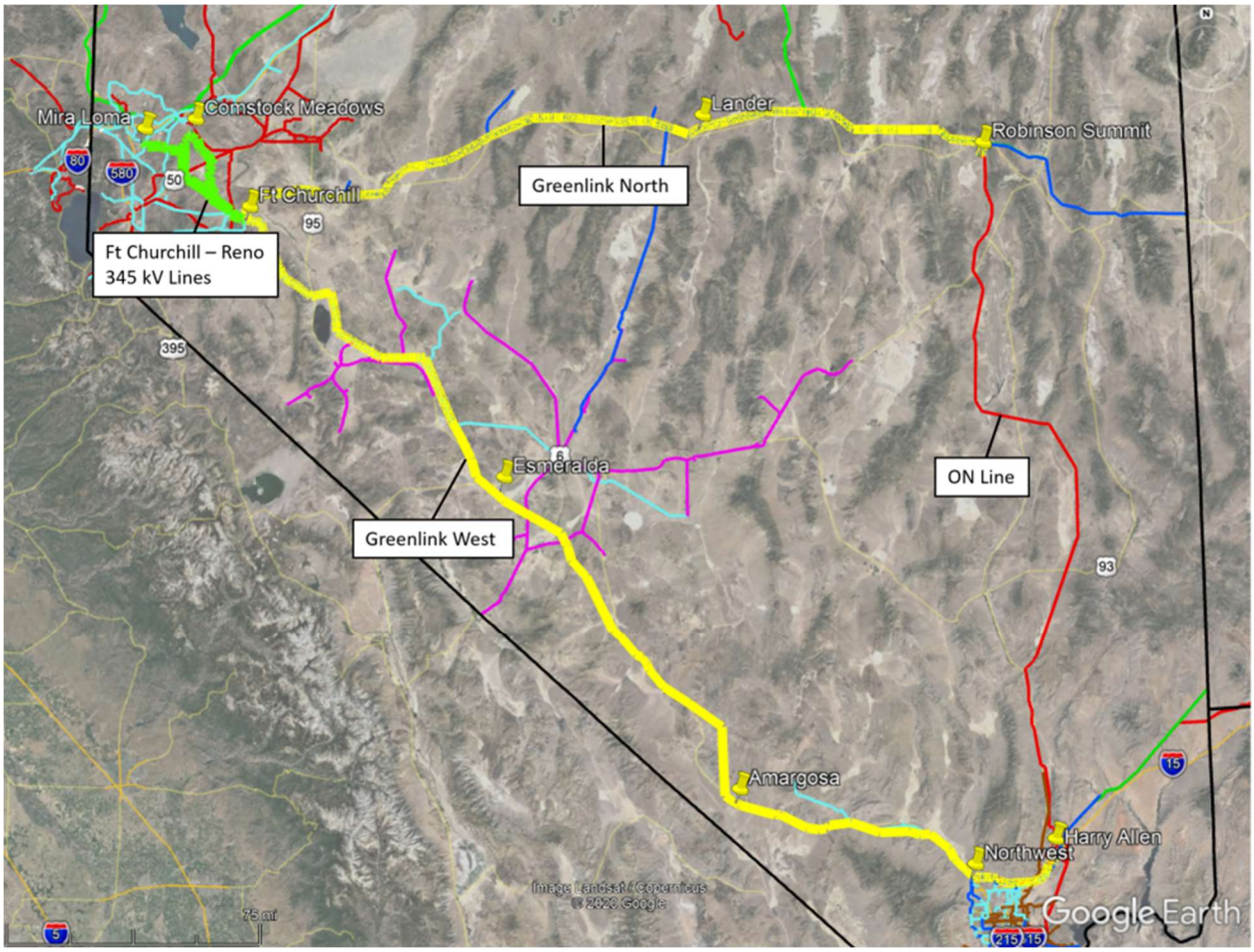


Figure 4 - Greenlink Nevada proposed projects

System Import

Existing Import Limit

The Northern Nevada transmission system has an import limit of 1275 MW. Of that 1275 MW, 150 MW is set aside for Northwest Power Pool reserves resulting in 1125 MW of usable import for serving Northern Nevada native and non-native load. All 1125 MW of import capacity is currently allocated on the existing ties for a combination of NV Energy and third party use. The 1275 MW import limit was re-assessed in as part of the 2nd Amendment to the 2018 Integrated Resource Plan, attached as Technical Appendix TRAN-1.

NV Energy has the obligation under FERC Order 888-A to plan and construct the transmission system to meet the needs of its native load and third party network customers. NV Energy's Open Access Transmission Tariff section 28.2 states that NV Energy as the transmission provider must include the network customers network load in its planning and shall, consistent with good utility practice, endeavor to construct and place into service sufficient transfer capability to deliver the network customer's network resources to serve network loads on a basis comparable to the transmission provider's delivery of its own generating and purchased resources to its native load customers

While NV Energy's northern transmission import capacity is fully reserved by both third parties and native load allocation, growth of both categories of load is forecasted over the next ten years. For 2019, the peak native load was 1808 MW and peak network transmission load was 377 MW. The peak 2030 native load is forecasted to be 1980 MW and network transmission load is forecasted to be 717[4] MW. Without additional transmission import capacity, NVE will be unable to serve any additional load from off system resources.

Constraints

When the On Line transmission project was built, the northern Nevada import limit was increased from 1000 MW to 1275 MW. The 525 kV ON Line project runs 231 miles from Harry Allen in southern Nevada to Robinson Summit in northern Nevada. Robinson Summit has two 525/345 kV step down transformers that connect two outlets; Robinson to Gonder 345 kV and Robinson to Falcon 345 kV. Robinson to Falcon is 70% series compensated and naturally carries the bulk of south to north ON Line transmission capacity. The most limiting contingency for import into northern Nevada is loss of the Robinson to Falcon 345 kV line. Under this contingency, all of the energy flowing on the Robinson to Falcon line is forced through the weaker Gonder 345 kV connection. This results in overloads and low system voltage throughout the existing northern system interties. In short, loss of Falcon – Robinson 345 kV stresses the remaining interties to their thermal or voltage limits and new major transmission facilities are required to create additional import capacity.

Existing Commitments

Of the 1275 MW of import capacity into northern Nevada, 150 MW is reserved for Northwest Power Pool Reserves, 600 MW is reserved for NV Energy native load use, and the remaining 525 MW is all allocated for third party use. There is currently 0 MW of available long term import.

Import Limit Increase Opportunities

An increase in import capacity can only be obtained by constructing a new intertie into northern Nevada, or constructing internal transmission that strengthens existing interties.

The Ft Churchill – Harry Allen 525 kV line creates a new intertie between northern and southern Nevada and studies have shown an increase in system import from 1275 MW to 2000 MW, or an increase of 725 MW. This project is essentially a second ON Line that is geographically diverse to the existing ON Line and terminates directly where the capacity is needed the most; the Reno and Tracy area load pockets via Ft. Churchill substation and the proposed 345 kV ties. In addition to increased import capacity, this project would also create additional transmission revenue via increased capacity from northern Nevada to southern Nevada. Currently, joint dispatch capability created by the ON Line project has shown savings anywhere from $17M-$22M annually. With the increased need to share resources between systems and more flexibility to transfer energy between SPPC and NPC, annual joint dispatch savings are anticipated to increase further. Under this configuration, the most limiting contingency for northern Nevada would be the Ft. Churchill to Northwest 525 kV line. Additionally, the Greenlink West 525 kV line creates an increase of import capacity in southern Nevada as well from 5200 MW to 6200 MW or 1000 MW.

[4] Includes pending network integration transmission service requests

The Ft Churchill to Robinson Summit 525 kV line strengthens On-Line and studies have shown an increase in system import from 1275 MW to 1775 MW, or an increase of 500 MW. Ft. Churchill to Robinson creates a parallel path with Falcon to Robinson into the northern Nevada system. With two strong sources into northern Nevada load pockets, the loss of either line can be sustained and south to north transfers can be increased from 600 MW to approximately 1000 MW. The new most limiting contingency for northern Nevada becomes the loss of the ON Line transmission line with an import limit of ~1775 MW

For the combination of the three 345 kV lines from Ft. Churchill to Reno, Ft. Churchill to Robinson and Ft. Churchill Northwest, studies have shown a maximum import capacity of approximately 2800 MW. This configuration creates a 525 kV triangle around the state of Nevada and in conjunction with third party transmission plans has the potential to become an energy highway for transfers to and from southern California and Arizona.

The import analysis performed above assumes that reactive support is strategically added within northern Nevada to support the increased import levels. Capacitor bank additions in the Tracy area and at the Valmy bus are needed to maintain adequate transmission system voltage both due to high levels of power flow on interties during maximum import and to replace the reactive power that would normally be generated by Tracy area and Valmy generators that are turned off during maximum import analysis.

Table 5 below summarizes the import capacities for the Greenlink Nevada Projects

Table 5: Greenlink Nevada Import Capacities

Greenlink North	Greenlink North	SPPC Import	NEVP Import
□		1275	5200
✓		1775	5200
□	✓	2000	6200
✓	✓	2800	6200

Interaction with Regional Transmission Plans

The Western US has several major transmission plans underway, some of which have significant impact on the northern Nevada transmission system. Specifically, proposed connections to Robinson substation complement the Ft. Churchill to Robinson 525 kV project. Both the 525 kV Cross-Tie project and the SWIP North projects propose a connection directly to Robinson substation:

Cross-Tie (Clover – Robinson Summit 525 kV)

Cross-Tie is a proposed 525 kV line between Clover Substation in central Utah, and Robinson Summit substation in Nevada. It is proposed to be approximately 214 miles at 50% series compensation, and includes 70% series compensation of On-Line and the addition of 345 kV PSTs on the Falcon – Robinson Summit 345 kV and Gonder – Robinson 345 kV lines. This equipment is required to protect northern Nevada bypassing it for transfers between Utah and southern Nevada.

The proposed Ft Churchill – Robinson Summit 525 kV line in conjunction with the proposed Clover – Robinson 525 kV line (Cross-Tie) strengthens On-Line and creates an additional intertie with PacifiCorp. It has shown a preliminary increase in system import from 1275 MW to 2000 MW, or an increase of 725 MW. Cross-Tie is a complimentary project to the proposed Ft Churchill – Robinson Summit 525 kV line and would increase the benefits associated with NV Energy's proposed project.

Without the presence of Robinson to Ft. Churchill, Cross-tie provides little to no increase in import capacity.

SWIP-North (Midpoint – Robinson Summit 525 kV)

SWIP-North was studied in conjunction with ON Line and capacity rights are allocated under an existing Transmission Use Agreement between NV Energy and LS Power. The proposed SWIP-N project is a 525 kV line between Midpoint Substation in Idaho, and Robinson Summit substation in Nevada. It is proposed to be approximately 275 miles at 70% series compensation, and includes 70% series compensation of On-Line and the addition of 345 kV PSTs on the Falcon – Robinson Summit 345 kV and Gonder – Robinson 345 kV lines. This equipment is required to protect northern Nevada bypassing it for transfers between Idaho and southern Nevada.

The proposed Ft Churchill – Robinson Summit 525 kV line in conjunction with Midpoint – Robinson 525 kV (SWIP-North) strengthens On-Line and creates an additional intertie with Idaho Power. It has shown a preliminary increase in system import from 1275 MW to 2000 MW, or an increase of 725 MW. SWIP-N is a complimentary project to the proposed Ft Churchill – Robinson Summit 525 kV line and would increase the benefits associated with NV Energy's proposed project. Under the Transmission Use Agreement, if SWIP-North was constructed, NV Energy would hold approximately 1000 MW of the lines total capacity.

Both projects have similar benefits to northern Nevada import capacity as well as create regional access to more diverse resources. Pacificorp is currently developing phased projects referred to as Gateway that enhance the capacity into both Clover and Midpoint.

PacifiCorp Gateway Projects

Gateway South is a 525 kV line planned to connect Aeolus substation in southeast Wyoming to Clover substation in central Utah. Pacificorp owns Aelous substation and is developing up to 3000 MW of wind generation to interconnect there. PacifiCorp plans to utilize this connection to bring approximately 1700 MW of wind produced energy into their major load pockets via Clover substation. PacifiCorp requested approval for Gateway South in their 2019 Integrated Resource Plan. Two additional phases of the Gateway project are also planned, but no regulatory approval has been requested.

Gateway Central reinforces existing connections between Populus substation in southeast Idaho and Clover substation in Utah. This project increases the total capacity of wind energy delivered to Clover from 1700 MW to 3000 MW by diversifying the path into Clover. Gateway West connects Aeolus to Populus to Midpoint to Hemingway. This connection ties Gateway South and Gateway Central together along with creating access to hydro energy via the Boardman to Hemingway project or B2H. B2H is being developed by PacifiCorp, Idaho Power and Bonneville Power Administration to connect Boardman substation in southern Washington to Hemingway substation in eastern Idaho.

The Gateway projects create diverse resource capacity to both Clover and Midpoint substations and respectively compliment both the Cross-tie and SWIP-North projects. Figure 5 shows the planned regional projects in correlation with NV Energy's current and planned 525 kV transmission.

TransWest Express discussion

The TransWest Express project is similar to Pacificorp's Gateway projects in that they intend to access Wind resources originating in Wyoming and connecting to central Utah. The TransWest Express project currently proposes a DC line from Wyoming to LADWP's IPP station in central Utah than 525 kV from IPP to Crystal 525 kV in southern Nevada to Eldorado 525 kV. This project attempts to access 3000 MW of wind energy and deliver it to southern Nevada and California. The project is fluid in that other connections can be made based on which parties are interested in benefiting from the line.

The TransWest Express project can create access to wind resources in southern Nevada through Crystal substation. There is also potential for an arrangement to be made for the project to connect through Clover substation and connect to Nevada via the Cross-Tie project. While this is only speculative, both projects are in development and subject to change based on need and third party investment.

Figure 5 - Overview of major regional transmission projects

Table 6 below shows a summary of import limits with the proposed NV Energy projects and those projects in conjunction with certain regional projects.

Table 6: Import Capacities with Cross-Tie or SWIP-North

Greenlink Nevada Summary				
Project(s)			Import Limit (MW)	Increase (MW)
Greenlink West	Greenlink North	Cross-Tie or SWIP-N		
			1275	
✓			2000	725
	✓		1775	500
✓	✓		2800	1525
	✓	✓	2000	725

Both Cross-Tie and SWIP-North result in the same increase in import. Both projects create a second strong source to Robinson allowing for higher overall imports into northern Nevada. The Gateway projects discussed do not connect directly to NVE's system, but both create capacity and access to new resources both at Clover substation in central Utah and Midpoint substation in southern Idaho. The TransWest Express project is similar in that it creates additional capacity at Clover and possibly Crystal substation in southern Nevada, but does not connect directly to northern Nevada.

While NV Energy is not currently participating in the development of any of the third party transmission projects discussed, they all do affect Nevada's access to diverse resources and how the state would ultimately fit in to the overall regional network or possibly a Regional Transmission Organization.

Greenlink Nevada 345 kV Alternatives

The highest capacity AC transmission utilized in the western grid is 525 kV and this is the planned voltage for almost all new planned regional transmission projects. NV Energy's northern system transmission backbone on the other hand is operated at 345 kV with some 230 kV. The only 525 kV in northern Nevada is the northern terminus of the ON Line 525 kV project. ON Line is also the highest capacity line connected into northern Nevada. At Robinson substation, the ON Line project terminates at two 525 MVA 525/345 kV transformers. Any energy entering or leaving northern Nevada is moved through these transformers.

Greenlink North or Ft. Churchill to Robinson could be constructed at either 345 kV or 525 kV. At 345 kV, the increase in import is 400 MW compared to 500 MW at 525 kV. The overall cost difference between the two projects estimates including the reduced Ft. Churchill substation scope is approximately 22%. While the 345 kV alternative provides a similar increase in system import, NV Energy is pursuing construction of the project at 525 kV.

The 525 kV option is preferred because it allows the energy flowing up on ON Line two outlets from Robinson substation; the 525 kV and the parallel 525/345 kV transformers. The additional 525 kV path creates additional capacity that is not constrained by the transformers. In the event a regional project such as SWIP-North or Cross-Tie is constructed, there will be three 525 kV lines at Robinson substation. The addition of the third line will result in an additional 225 MW of import into northern Nevada.

The full Greenlink Nevada Plan includes the construction of Greenlink West and eventually the construction of Greenlink North. Greenlink West will be a parallel connection with ON Line between

northern and southern Nevada. This segment will need to be constructed at 525 kV similar to ON Line due to the length of the line, and to ensure both paths can be equally utilized under the loss of one. With the assumption that Greenlink West will be constructed at 525 kV, Greenlink North, Greenlink West and ON Line will create a transmission triangle between northern and southern Nevada. If Greenlink north was constructed at 345 kV, it would create a choke point within the triangle and hinder energy from being transferred across the state of Nevada. The high capacity 525 kV lines would be limited to what the 345 kV system could handle under the loss of either ON Line or Greenlink West.

While there is a small savings with constructing the Greenlink North segment at 345 kV, it would be a short-sighted decision based on the overall transmission plans for Nevada as well as the potential regional transmission plans throughout the western grid. A 345 kV connection would result in the same internal weak system that northern Nevada is today and would require some form of mitigation or bypassing in order to protect it. As the overall system continues to develop, the 525 kV construction is the right answer for Nevada and the region.

Renewable Integration in Nevada

There are several BLM defined Solar Energy Zones (SEZ) in Nevada that are restricted due to transmission access. Both the Ft. Churchill to Robinson and the Ft. Churchill to Harry Allen projects create access to increased renewable integration.

Ft. Churchill to Harry Allen creates access to the Amargosa, Gold Point and Millers solar energy zones. The planned Esmerelda substation will be constructed adjacent to the Millers zone and Amargosa substation will be constructed adjacent to the Amargosa zone.

While Ft. Churchill to Robinson does not create new access to any defined Solar Energy Zone, it does reinforce the transmission and renewable integration capacity central Nevada.

BLM Solar Energy Zones

Figure 6 displays the BLM defined Solar Energy Zones in conjunction with the NVE Transmission projects. Figure 7 displays solar energy zones in relation to the planned collector substations along Greenlink West.

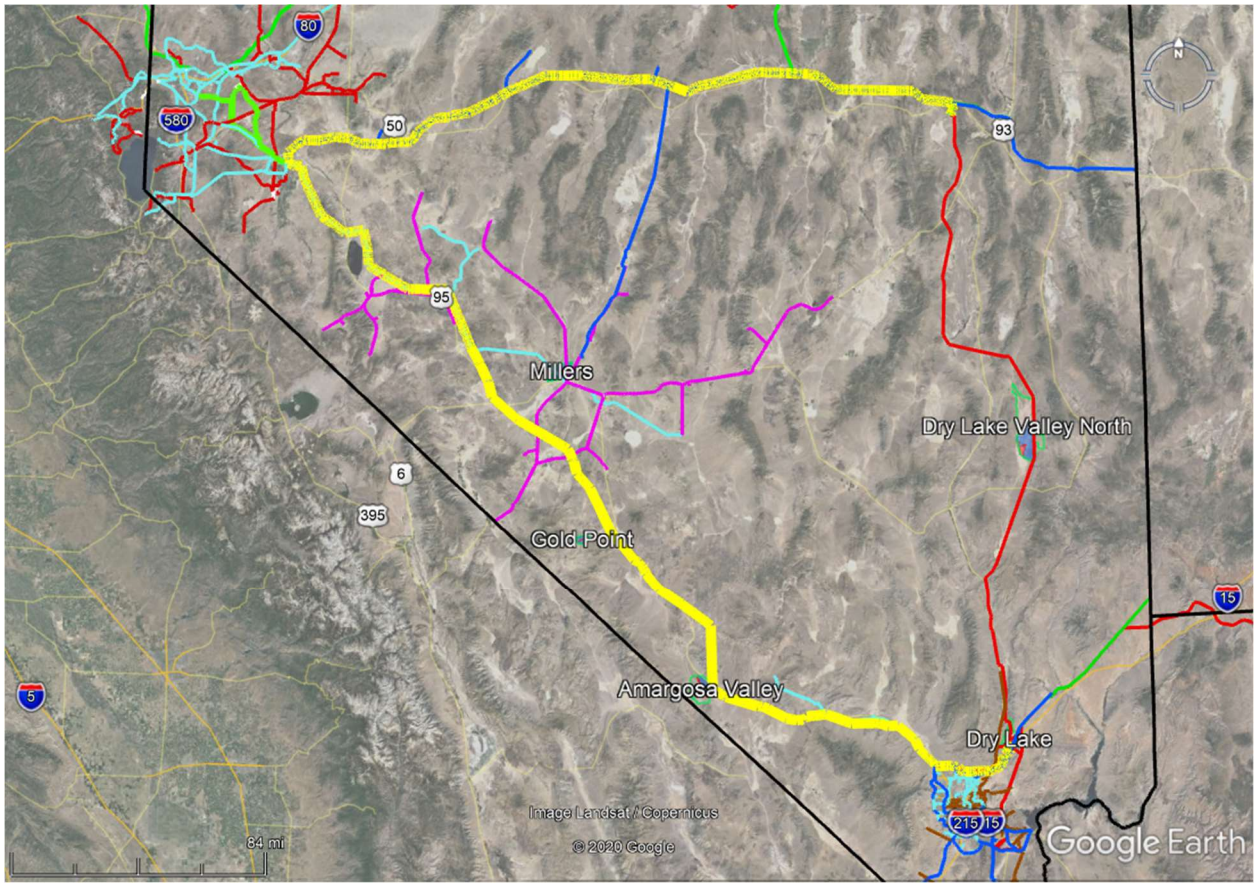


Figure 6 – Overview of BLM Solar Energy Zones in NV

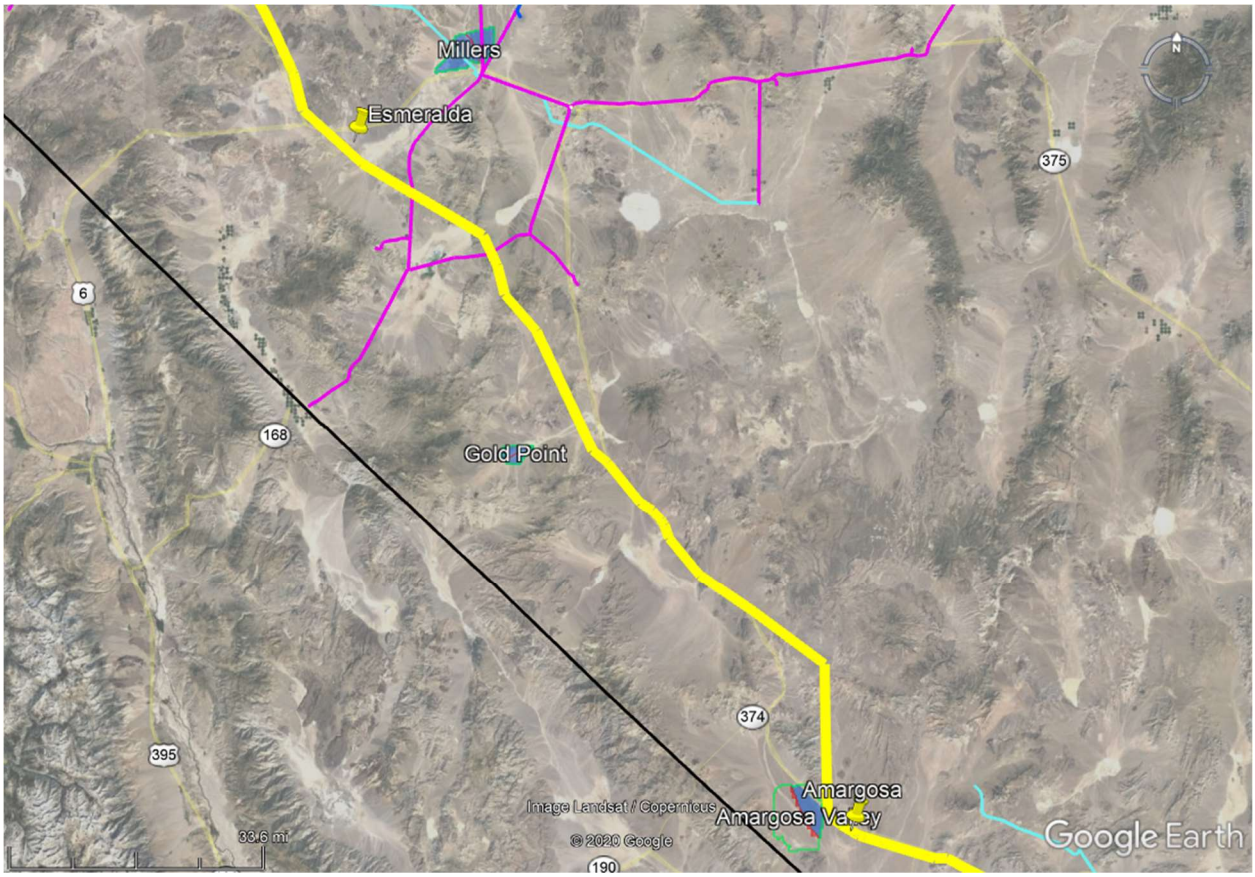


Figure 7 - Solar Energy Zones in relation to proposed NV Energy substations

Amargosa Valley

The Amargosa Valley SEZ is located in the Amargosa Desert in Nye County, near the Nevada/California border. It is approximately 10 miles southeast of Beatty, NV, and adjacent to Highway 95. This SEZ has a developable area of 8,479 acres. Using a rule of thumb of 100 MW of Solar PV potential per 640 acres (1 square mile), there is an estimated 1325 MW of PV potential within this SEZ. Figure 7 shows the location of the Amargosa Valley SEZ in relation to the proposed NV Energy Amargosa substation.

Gold Point

The Gold Point SEZ is located in Lida Valley in Esmeralda County, approximately 10 miles west of Highway 95. This SEZ has a developable area of 4,596 acres, giving it an estimated 700 MW of PV potential.

This SEZ is located approximately halfway between the proposed Amargosa and Esmeralda substations. Figure 7 shows the location of the Gold Point SEZ in relation to the proposed NV Energy Amargosa and Esmeralda substations.

Millers

The Millers SEZ is located in Big Smoky Valley in Esmeralda County, approximately 10 miles west of Tonopah, NV. This SEZ has a developable area of 16,543 acres, giving it an estimated 2600 MW of PV potential. This SEZ is also located near areas with high geothermal potential. Figure 7 shows the location of the Millers SEZ in relation to the proposed NV Energy Esmeralda substation.

Dry Lake

The Dry Lake SEZ is located in Clark County, encompassing the existing Harry Allen substation. This SEZ has already been developed significantly by existing PV projects and does not provide significant future potential for renewable integration. The ON Line project has already created access to the Dry Lake North SEZs.

Dry Lake Valley North

The Dry Lake Valley North SEZ is located in Dry Lake Valley in Lincoln County, approximately 15 miles southwest of Pioche, NV, and halfway between the Harry Allen and Robinson Summit substations. This SEZ has a developable area of 25,069 acres, giving it an estimated 3900 MW of PV potential. The ON Line project and existing transmission infrastructure in the Arrow Canyon area have already created access to the Dry Lake SEZ.

Resource Adequacy

NV Energy's generation fleet currently has a large number of retirements slated for both the near and short term planning horizon. These generation retirements will stress NV Energy's resource adequacy if they are not replaced, especially as northern Nevada's load continues to grow. Table 7 displays the current schedule of generation retirements.

Table 7: Scheduled Generator Requirements

Generator	Point of Interconnection	Total Output (MW)	Scheduled Retirement
Valmy G1	Valmy 345 kV	254	2021
Valmy G2	Valmy 345 kV	268	2025
Ft Churchill G1&G2	Ft Churchill 120 kV	226	2028
Tracy G3	Tracy 120 kV	108	2028
Tracy G4&G5	Tracy 120 kV	115	2031
Clark Mtn 3&4	E Tracy 120 kV	144	2034
	Total:	**1115**	

In total, there are 1,115 MW of proposed generation retirements in Northern Nevada scheduled to occur through 2034.

In parallel with substantial generation retirement, Northern Nevada is also experiencing considerable load growth, both due to a growing population and an influx of large customers in the Tracy area. Many of the customers in the Tracy area are data center loads with high load factors and rapid load absorption schedules. To date, over 1400 MW of large customers have already entered into HVD agreements with NV Energy for new load additions in the Tracy area.

With the combination of limited import capacity and generation retirement, these load additions will place a large strain on NV Energy's ability to serve load unless either additional generation resources are constructed, or new transmission facilities are built to create additional import capacity. Many of these customers have already indicated an interest in procuring their own power from non-NV Energy resources, presumably from imports.

As conventional generation is retired, it is slated to be replaced with renewable resources. Recently, NV Energy has executed many PPAs for renewable resources, primarily Solar PV. Thus far, the majority of these PPAs have been for resources in Southern Nevada due to the stronger transmission system providing significantly more available capacity for new generation projects. Due to ON Line being the only transmission path between northern and southern Nevada, there is a finite amount of southern generation that can be used to serve northern load. While generation additions are occurring most rapidly in southern Nevada, load growth is occurring most rapidly in northern Nevada. Additional transmission capacity between the two systems would improve the ability to utilize southern resources to serve northern load.

The majority of new renewables being constructed in Nevada are Solar PV. Due to Solar PV being an intermittent resource and much of the Northern Nevada load growth being large customers with high load factors, new Solar PV resources do not have the ability to serve these continuous loads outside of the hours of usable sunlight and relatively small amount of energy storage coupled with many of these new PV facilities. As a result, new Solar PV generators cannot be assumed to be a direct replacement for dispatchable generation that is scheduled to be retired.

While the schedule of load growth and the conventional generation retirements remain subject to change, it's clear that both load demand and the requirements for renewable generation will continue to increase over the coming years. The construction of Greenlink Nevada positions NV Energy to prepare for these changes by increasing the overall capacity between northern and southern Nevada as well as laying the foundation for accessing diverse resources such as wind and hydro energy.

On-Line Bidirectional Transfer Limitations

Despite On-Line being originally designed for a 2000 MW rating upon completion of SWIP-N, it is currently limited to significantly less than 2000 MW due to system limitations. On-Line is used by NV Energy for economic dispatch between northern and southern Nevada, sales of transmission rights to facilitate third party transactions across NV Energy's transmission system, and is a significant component in the import capacity of northern Nevada.

The southbound transfer limit on On-Line is currently 900 MW due to electrical limitations in sourcing the Robinson Summit substation by the 345 and 230 kV systems in the area. This limits the ability for NV Energy to economically dispatch generation from northern resources to southern loads. All 900 MW of southbound capacity is currently under contract. NV Energy holds 526 MW of southbound rights for native load and 374 MW is for third party use.

The northbound transfer limit on On-Line is currently 600 MW due to capacity limitations at the Robinson Substation due to the downstream 345 and 230 kV systems. This limits the ability for NV Energy to economically dispatch generation from southern resources to northern loads. NV Energy holds all 600 MW of northbound capacity rights for serving native load.

The construction of Greenlink West and the associated 345 kV connections to Reno increases north to south capacity from 900 MW to 2000 MW and south to north capacity from 600 MW to 1350 MW.

The construction of Greenlink North and the associated 345 kV connections to Reno increases south to north capacity from 600 MW to ~1100 MW.

Supplemental Required Analysis

SSR and EMT Studies

Due to the length of these proposed 525 kV transmission lines and proposed series compensation configurations, it will be necessary to have supplemental analysis performed by third party consultants.

Subsynchronous resonance (SSR) is a phenomena that can be induced in generators due to series compensated transmission lines and can cause significant damage. In order to evaluate this risk, a third party consultant must perform detailed analysis that includes analyzing any generators that are of concern in proximity to the series compensated transmission line, analyzing various system configurations that may induce SSR, and requires detailed modeling of the NV Energy transmission system that goes beyond the models that NV Energy maintains. This study work and any potential mitigations must be completed and identified prior to finalizing the design of the transmission project(s) identified in this report.

Electromagnetic Transient (EMT) analysis is required to identify any transient or sub-transient concerns during switching on the NV Energy system. These studies are performed by a third party consultant and requires modeling the NV Energy transmission system at a level of detail that goes beyond the models that NV Energy maintains. This study work and any potential mitigations must be completed and identified prior to finalizing the design of the transmission project(s) identified in this report.

Routing and Siting Analysis

Ft Churchill to Reno Area 345 kV Reinforcement

Preliminary routing and siting analysis for the proposed Ft Churchill – Mira Loma 345 kV line is recommending a line route that would primarily follow existing 120 kV transmission lines west out of Ft Churchill, then create new transmission corridor heading north, then cross west into Mira Loma substation creating new transmission corridor. This route is a combination of BLM and private land.

Preliminary routing and siting analysis for the proposed Ft Churchill – Comstock Meadows 345 kV line is recommending a line route that would primarily follow existing 120 kV transmission lines west out of Ft Churchill, then create new transmission corridor heading north, then cross east into Comstock Meadows substation creating new transmission corridor. This route is a combination of BLM and private land.

The study area for the routing and siting analysis performed is shown in Figure 8 below. The dashed black outline encompasses the study area and the blue highlighted lines show the potential routes that were identified.

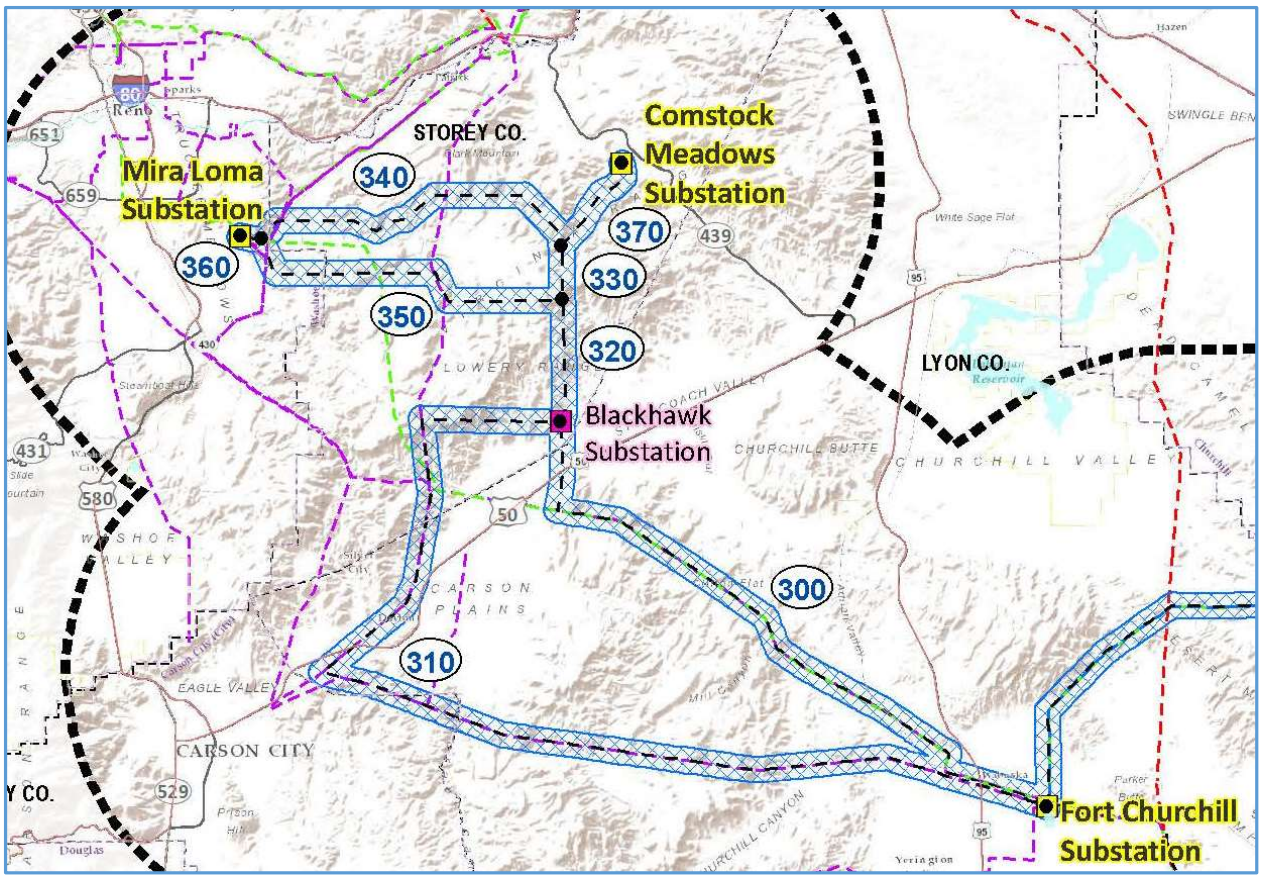


Figure 8 - Reno Area 345 kV Reinforcement routing and siting analysis study area

Ft Churchill – Northwest 525 kV (Greenlink West)

Preliminary routing and siting analysis for the proposed Ft Churchill – Northwest 525 kV line is recommending a line route that would primarily follow Highway 95 for the length of the route. This line route is primarily through BLM land but includes segments through BIA and DOD land. Some portions of this line would require the creation of new transmission corridor. There are alternative routing options near Walker Lake to avoid sections of BIA and DOD.

Preliminary routing and siting analysis for the proposed Harry Allen – Northwest 525 kV line is recommending a line route that would following existing 525 kV lines between the two substations. The line route is through a combination of BLM, DOD, and BIA land.

The study areas for the routing and siting analyses performed are shown in Figure 9 and Figure 10 below. The dashed black outline encompasses the study area and the blue highlighted lines show the potential routes that were identified.

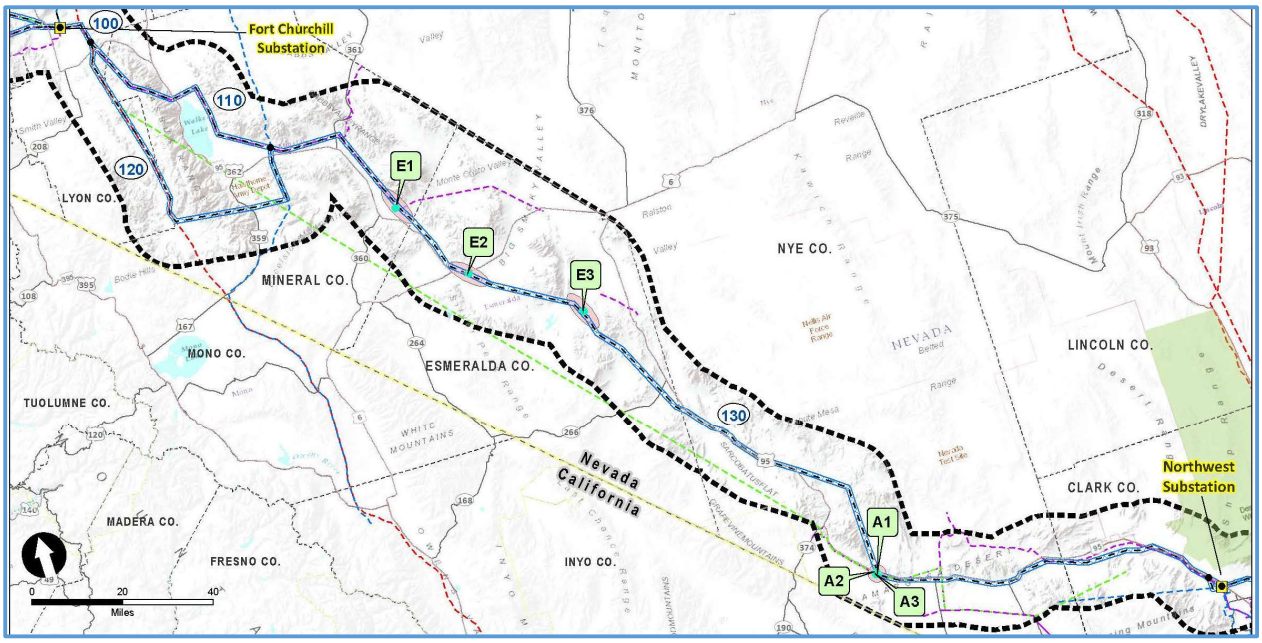


Figure 9 - Ft Churchill - Northwest 525 kV line routing and siting analysis study area

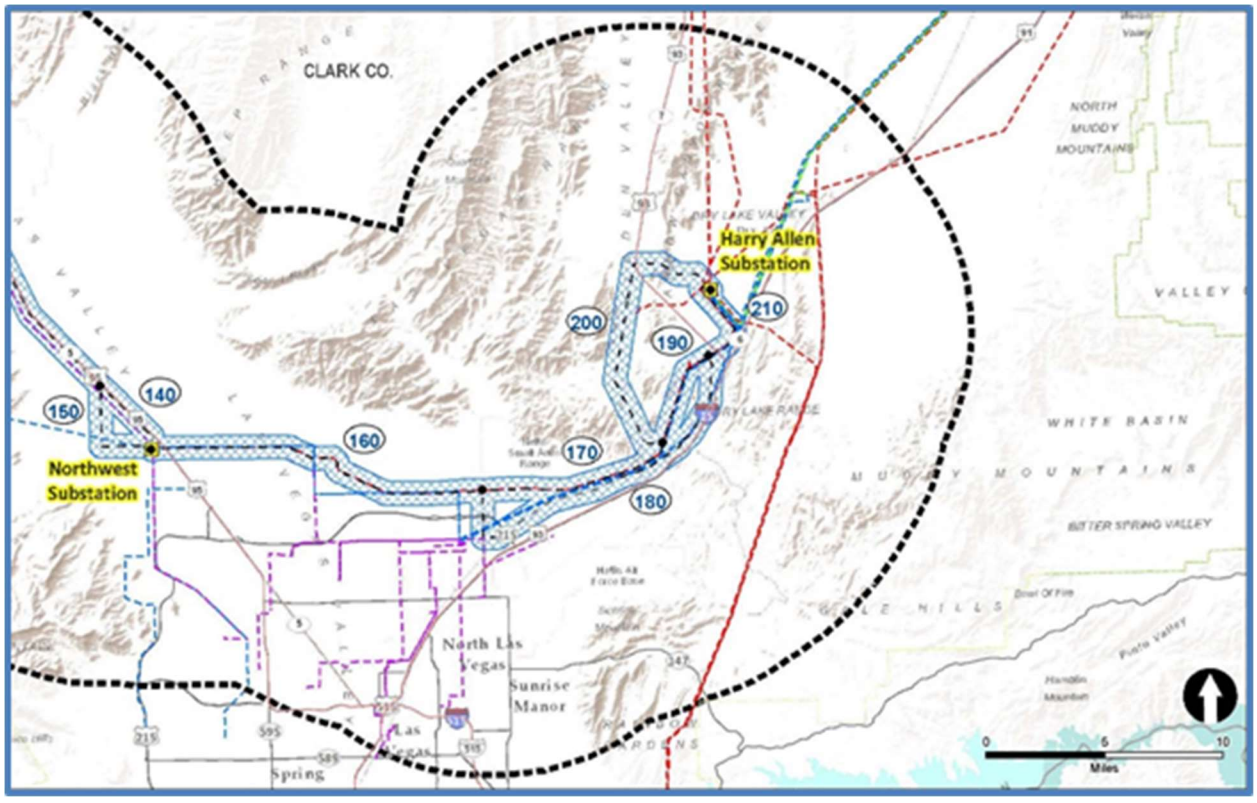


Figure 10 - Harry Allen - Northwest 525 kV line routing and siting analysis study area

Ft Churchill – Robinson Summit 525 kV

Preliminary routing and siting analysis for the proposed Ft Churchill – Robinson Summit 525 kV line is recommending a line route that parallels the existing 230 kV lines between the two substations for the entirety of the route. The line route is primarily through BLM land, with a section through US Forest Service land near Austin, NV, and a portion that crosses the Fallon Naval Air Station. There is a potential alternative of routing the line south of the Fallon Naval Air Station that would require new transmission corridor. Sage-grouse mitigation is anticipated for significant portions of the line.

The study area for the routing and siting analysis performed is shown in Figure 11 below. The dashed black outline encompasses the study area and the blue highlighted lines show the potential routes that were identified.

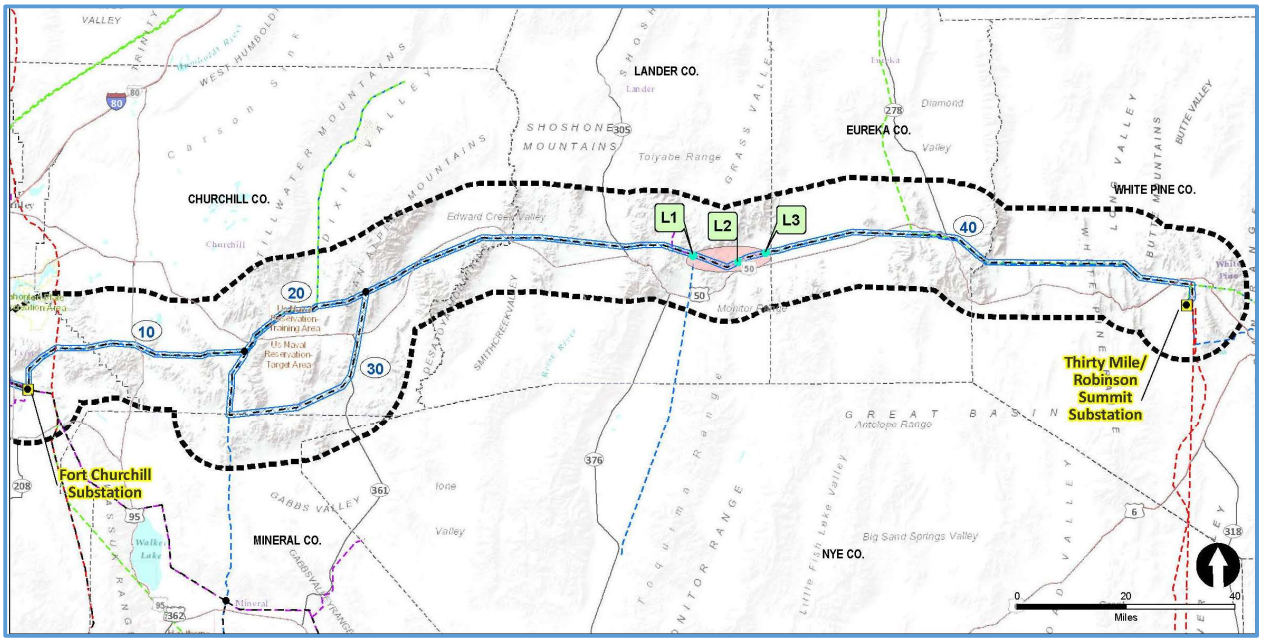
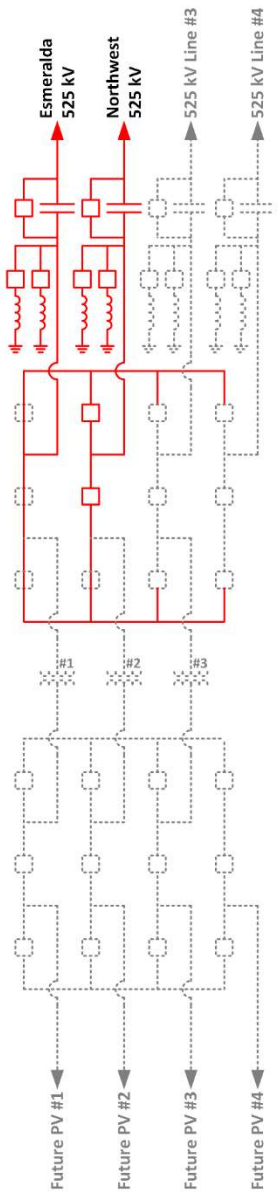


Figure 11 - Ft Churchill - Robinson Summit 525 kV line routing and siting analysis study area

Appendix A
Single Line Diagrams

NVEnergy	Amargosa	4/29/2020

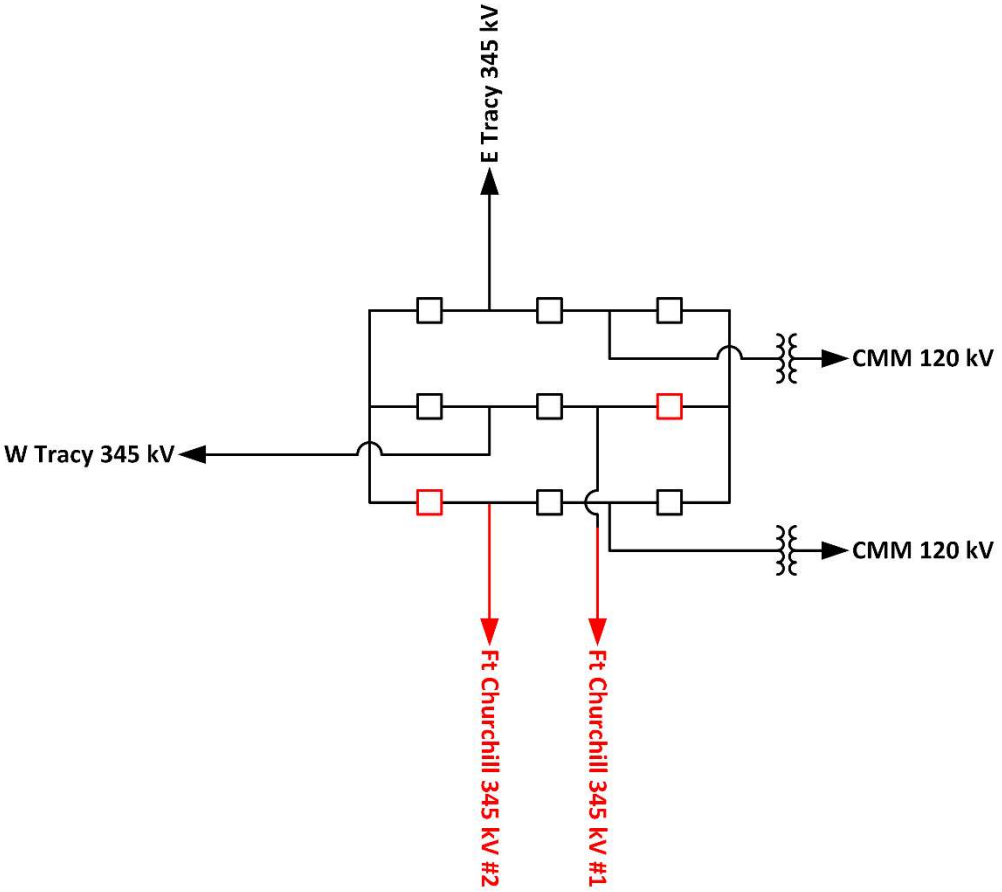


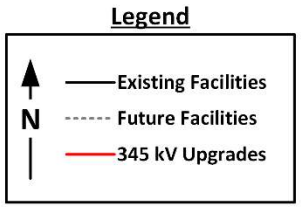
CIP-014 Site

Legend

- Future Facilities
- 525 kV Transmission
- 230 kV Transmission

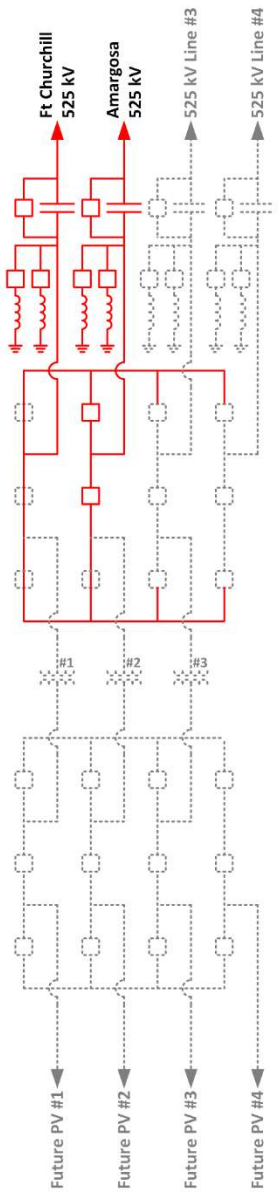
NVEnergy	Comstock Meadows	12/12/2019





CIP-014 Site

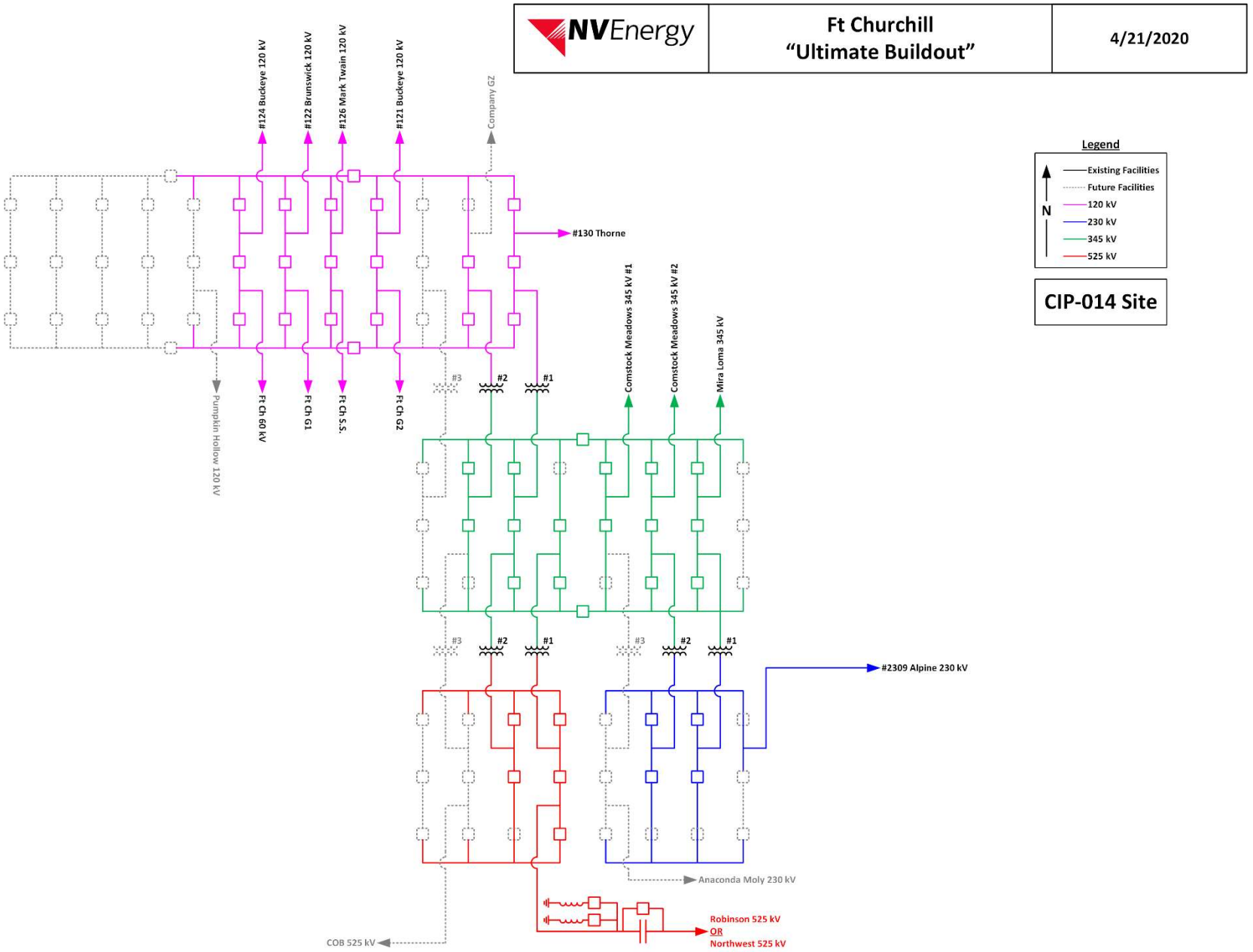
NVEnergy	Esmeralda	4/29/2020



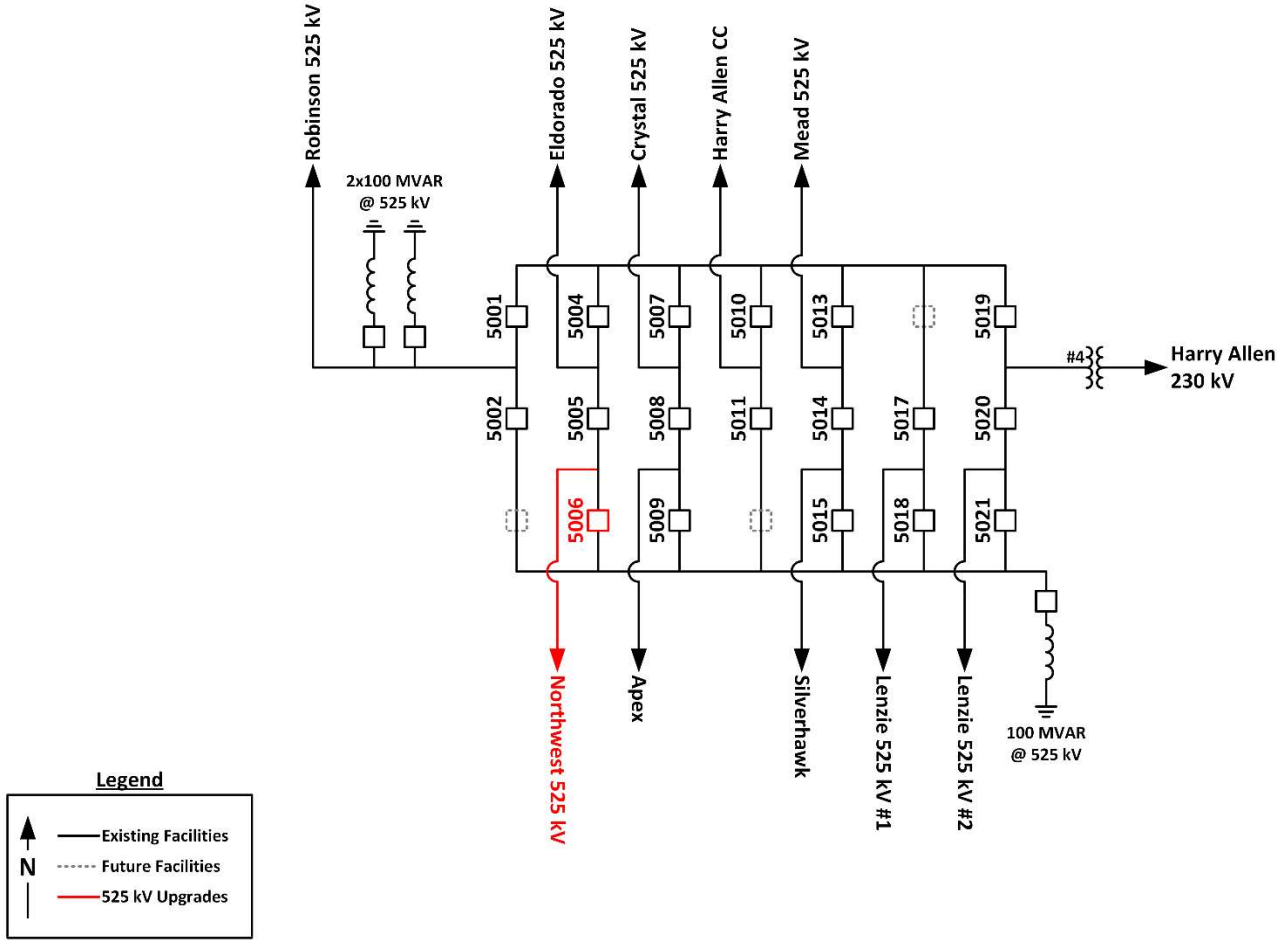
CIP-014 Site

Legend

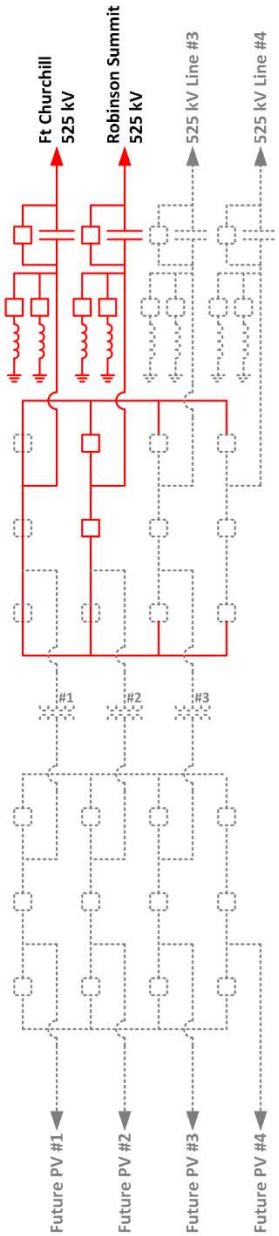
- Future Facilities
- 525 kV Transmission
- 230 kV Transmission


NVEnergy
Ft Churchill
"Ultimate Buildout"
4/21/2020
#124 Buckeye 120 kV
#122 Brunswick 120 kV
#126 Mark Twain 120 kV
#121 Buckeye 120 kV
Company GZ
#130 Thorne
Pumpkin Hollow 120 kV
Ft Ch 69 kV
Ft Ch G1
Ft Ch S.S.
Ft Ch G2
#3
#2
#1
Comstock Meadows 345 kV #1
Comstock Meadows 345 kV #2
Mira Loma 345 kV
#2309 Alpine 230 kV
Anaconda Moly 230 kV
Robinson 525 kV
OR
Northwest 525 kV
COB 525 kV
Legend
Existing Facilities
Future Facilities
120 kV
230 kV
345 kV
525 kV
N
CIP-014 Site

NVEnergy	Harry Allen	5/6/2019



NVEnergy	Lander	4/29/2020

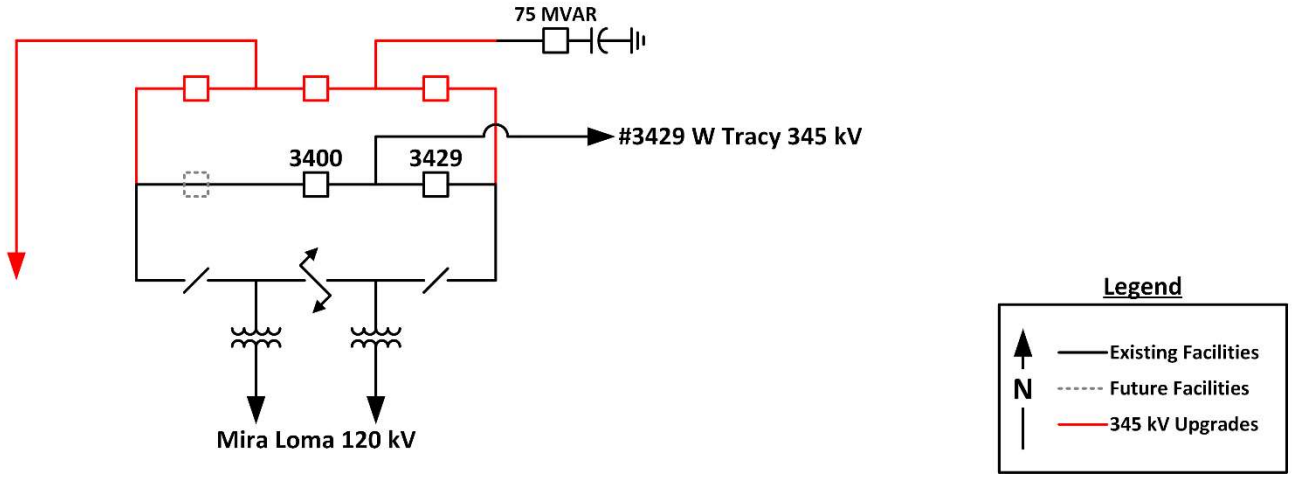


CIP-014 Site

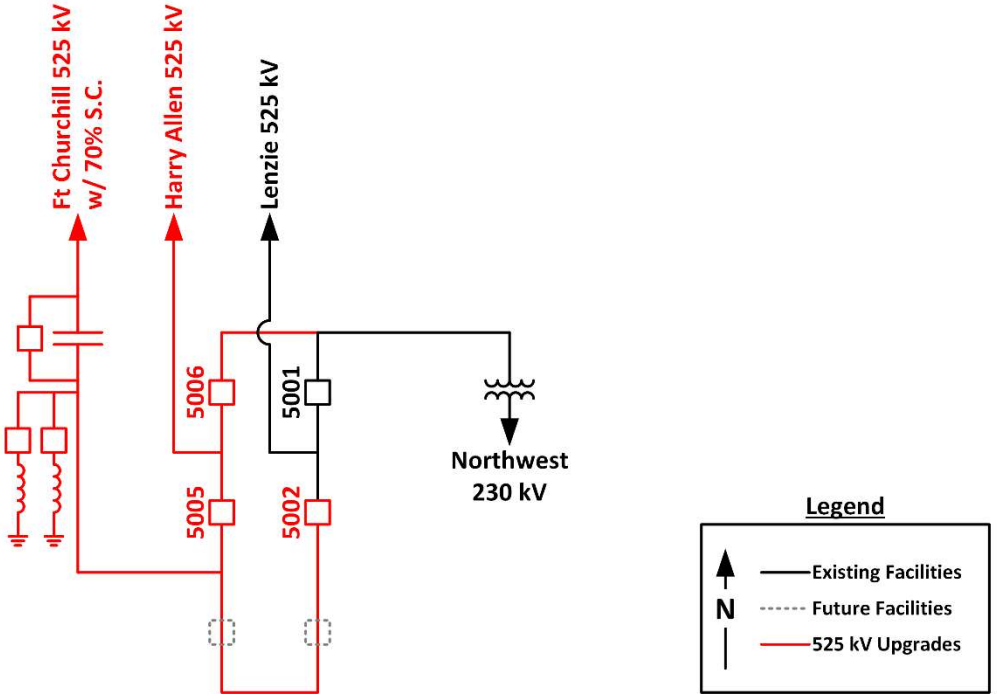
Legend

- Future Facilities
- 525 kV Transmission
- 230 kV Transmission

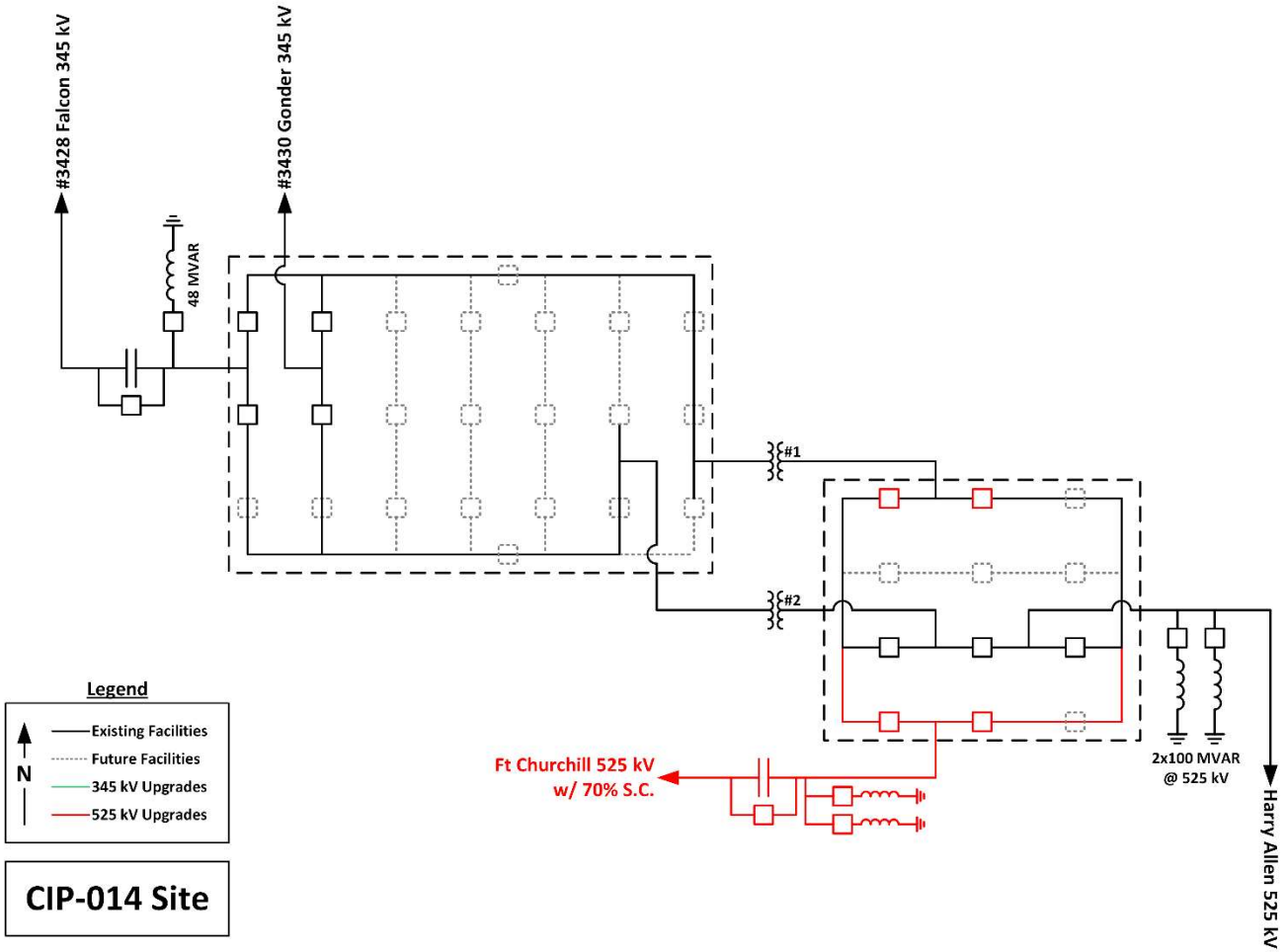
NVEnergy	Mira Loma	8/8/2019



NVEnergy	Northwest	9/23/2019



NVEnergy	Robinson Summit	9/23/2019



Appendix B
Preliminary Estimates and Cash Flows

Greenlink Nevada cash flow EXCLUDING CONTINGENCY with Phase I in service December, 2026 and Phase II in service December, 2031

Cash Flow Summary by Project	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total
Greenlink North (FTC - RS)	$ 650,993	$ 3,365,304	$ 10,776,478	$ 7,225,169	$ -	$ -	$ -	$ -	$ 19,053,996	$ 44,459,324	$ 303,283,079	$ 285,809,940	**$ 674,624,283**
Greenlink West (FTC to NW)	$ 1,930,089	$ 8,013,887	$ 74,752,588	$ 89,707,498	$ 229,892,859	$ 229,892,859	$ 229,892,859	$ -	$ -	$ -	$ -	$ -	**$ 864,082,639**
Greenlink West (HA to NW)	$ 219,620	$ 912,940	$ 8,705,047	$ 11,963,699	$ 29,686,074	$ 29,686,074	$ 29,686,074	$ -	$ -	$ -	$ -	$ -	**$ 110,859,529**
Northwest substation	$ 31,065	$ 573,380	$ 5,233,794	$ 7,339,151	$ 19,277,032	$ 19,277,032	$ 19,277,032	$ -	$ -	$ -	$ -	$ -	**$ 71,008,487**
Fort Churchill 525/345/230KV substation	$ 27,830	$ 1,110,491	$ 5,882,266	$ 10,743,649	$ 13,864,602	$ 79,226,299	$ 55,679,831	$ -	$ -	$ -	$ -	$ 43,353,044	**$ 209,888,013**
Fort Churchill to Comstock Meadows (Line 1)	$ 281,133	$ 1,162,076	$ 6,404,188	$ 7,371,025	$ 13,774,746	$ 13,774,746	$ 13,774,746	$ -	$ -	$ -	$ -	$ -	**$ 56,542,660**
Fort Churchill to Comstock Meadows (Line 2)	$ 281,133	$ 1,162,076	$ 5,026,713	$ 4,156,917	$ -	$ -	$ -	$ -	$ 1,377,475	$ 3,214,107	$ 20,662,119	$ 20,662,119	**$ 56,542,660**
Fort Churchill to Mira Loma	$ 286,666	$ 1,224,094	$ 7,083,313	$ 8,544,813	$ 17,947,439	$ 17,947,439	$ 17,947,439	$ -	$ -	$ -	$ -	$ -	**$ 70,981,201**
Annual Budget	**$ 3,708,529**	**$ 17,524,249**	**$ 123,864,388**	**$ 147,051,921**	**$ 324,442,753**	**$ 389,804,449**	**$ 366,257,981**	**$ -**	**$ 20,431,471**	**$ 47,673,431**	**$ 323,945,198**	**$ 349,825,103**	**$ 2,114,529,472**
Cumulative	**$ 3,708,529**	**$ 21,232,778**	**$ 145,097,166**	**$ 292,149,087**	**$ 616,591,840**	**$ 1,006,396,289**	**$ 1,372,654,270**	**$ 1,372,654,270**	**$ 1,393,085,740**	**$ 1,440,759,172**	**$ 1,764,704,370**	**$ 2,114,529,472**	

Greenlink Nevada cash flow INCLUDING 20% CONTINGENCY with Phase I in service December, 2026 and Phase II in service December, 2031.

Cash Flow Summary by Project	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total
Greenlink North (FTC - RS)	$ 781,191	$ 4,038,365	$ 12,931,774	$ 8,670,202	$ -	$ -	$ -	$ -	$ 22,864,795	$ 53,351,189	$ 363,939,695	$ 342,971,928	**$ 809,549,140**
Greenlink West (FTC to NW)	$ 2,316,107	$ 9,616,665	$ 89,703,105	$ 107,648,998	$ 275,871,431	$ 275,871,431	$ 275,871,431	$ -	$ -	$ -	$ -	$ -	**$ 1,036,899,167**
Greenlink West (HA to NW)	$ 263,544	$ 1,095,528	$ 10,446,057	$ 14,356,439	$ 35,623,289	$ 35,623,289	$ 35,623,289	$ -	$ -	$ -	$ -	$ -	**$ 133,031,435**
Northwest substation	$ 37,278	$ 688,056	$ 6,280,553	$ 8,806,981	$ 23,132,439	$ 23,132,439	$ 23,132,439	$ -	$ -	$ -	$ -	$ -	**$ 85,210,184**
Fort Churchill 525/345/230KV substation	$ 33,396	$ 1,332,590	$ 7,058,720	$ 12,892,379	$ 16,637,523	$ 95,071,559	$ 66,815,797	$ -	$ -	$ -	$ -	$ 52,023,652	**$ 251,865,616**
Fort Churchill to Comstock Meadows (Line 1)	$ 337,360	$ 1,394,491	$ 7,685,026	$ 8,845,230	$ 16,529,695	$ 16,529,695	$ 16,529,695	$ -	$ -	$ -	$ -	$ -	**$ 67,851,192**
Fort Churchill to Comstock Meadows (Line 2)	$ 337,360	$ 1,394,491	$ 6,032,056	$ 4,988,301	$ -	$ -	$ -	$ -	$ 1,652,970	$ 3,856,929	$ 24,794,543	$ 24,794,543	**$ 67,851,192**
Fort Churchill to Mira Loma	$ 343,999	$ 1,468,913	$ 8,499,976	$ 10,253,775	$ 21,536,926	$ 21,536,926	$ 21,536,926	$ -	$ -	$ -	$ -	$ -	**$ 85,177,441**
Annual Budget	**$ 4,450,235**	**$ 21,029,099**	**$ 148,637,266**	**$ 176,462,305**	**$ 389,331,303**	**$ 467,765,339**	**$ 439,509,577**	**$ -**	**$ 24,517,765**	**$ 57,208,118**	**$ 388,734,238**	**$ 419,790,123**	**$ 2,537,435,367**
Cumulative	**$ 4,450,235**	**$ 25,479,334**	**$ 174,116,599**	**$ 350,578,905**	**$ 739,910,208**	**$ 1,207,675,547**	**$ 1,647,185,124**	**$ 1,647,185,124**	**$ 1,671,702,888**	**$ 1,728,911,006**	**$ 2,117,645,244**	**$ 2,537,435,367**	