Right-Sized Alternatives to Eversource's planned X-178 115kV line complete rebuild:

Preface:

"NESCOE would like to continue to utilize PAC as a discussion forum to gain stakeholder feedback… NESCOE is interested in helping the asset condition process gain foresight when reviewing projects.

In the past, the ISO has attempted to right size projects, but was met with stakeholder opposition because imminent need was not proven. The ISO supports efforts to build out the system with a longer-term view because these assets are long-lasting. Since the material cost is a small percentage of the overall project cost, it is sensible to coordinate building out the system, so assets are sized correctly through their useful lives.

RTO counterparts around the country are also challenged with asset condition project concerns, similarity rooted in desire for increased visibility, transparency and confidence.

NESCOE plans to rely on ISO's planning expertise as it continues to push this initiative forward and reform the asset condition process." (May 18, 2023)

https://nhconservation.org/lib/exe/fetch.php?media=2023_05_18_meeting_minutes_final.pdf

Alternative #1:

Repair or replace the 43 category C structures, in the next maintenance cycle. Use wood structures, to reduce visual impacts and limit industrialization of the terrain. This can be done by helicopter.

This would eliminate the financial cost and environmental and social costs of:

- Construction of 49 miles (less wetland areas) of 16' wide, 9" deep, permanent roads, and 580 (minus wetland area structures) 100' x 100' graded construction "pads", which would require the elimination of vegetation and topsoil from these areas and cause further fragmentation of the 49 miles of the easement. (Topsoil is dozed over the exterior of the graveled construction areas after construction, when "feasible.")

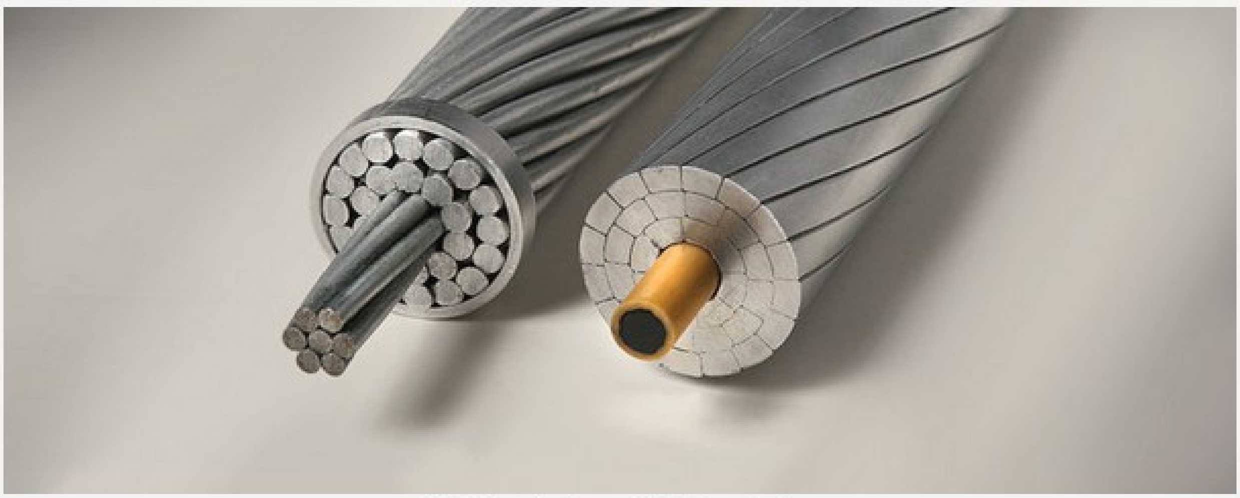
The cost would depend greatly on the location of the structures needing replacement. Since the structures in the White Mountain National Forest section of the X-178 (Bog Pond/Kinsman Ridge) were replaced in 1986, is it likely that the majority of structures needing replacement are on the Streeter Pond tap to Whitefield section, where access would be far less expensive than in WMNF. **Estimated cost: $14 m.**

Alternative #2:

Replace or repair the 43 Category C structures, with wood H-frames. Do not build roads and construction areas (around each structure.) This would eliminate the permanent increased industrialization of the easements and future costs for maintaining these new “assets.”

Reconductor the line with Southwire Yellowstone ACCC conductor.

Yellowstone, ACCC Conductor weighs: 630 lbs per 1,000’ and can carry 1373 amps.
The existing 1986 ASCR Conductor weighs: 1,100 lbs per 1,000’ and can carry 907 amps.
The proposed 1272 ACSS conductor weighs 1,633 lbs/1,000’ and can carry 2,200 amps



ACSR conductor and ACCC conductor.

By reducing the current conductor weight by 470 lbs, per 1,000’, Eversource’s proposed OPGW could be installed without structural overload. If the OPGW weighs 537 lbs per 1,000’ and the existing ground wire weighs 413 lbs per 1,000’, the overall weight on the line would be reduced by 354 lbs, and some structures that are rated C might not need to be replaced. Since the sag of the Yellowstone would be less than that of the existing conductor, some structure heights could be lowered, and decayed pole tops cut off, which might also eliminate the need to replace some structures. There may also be locations where structures could be eliminated, because of the reduced sag of the ACCC conductor. ACCC can be used with live-line reconductoring.

There are also other options for OPGW not presented by the Applicant. These include a lighter weight OPGW and stringing the OPGW elsewhere, as is done now; perhaps on Eversource 33 and 69 kV lines.

The applicant has not provided data on the % capacity of the line that is used monthly, so it is difficult to determine what need there is, if any, for increasing the carrying capacity of the conductor. Increasing capacity by 50% while reducing structural loading seems a superior alternative to the proposed complete rebuilds, especially considering developments in transmission efficiency.

The ACCC conductor would also lower line-losses by 25-40%, which would reduce costs, including externalized costs. According to the manufacturer, the increased cost of ACCC conductor would be recovered within several years.

Alternative #3:

Replace or repair the 43 Category C structures with wood H-frames and do not build roads and construction areas (around each structure.) This would eliminate permanent increased industrialization of the easements future costs for maintaining these new "assets."

Reconductor the line with Southwire Everglades, 991 lbs per 1,000', 1,819 amps. If the planned OPGW is strung on the line, and the weights given are correct, this would maintain the current load on the structures.

It is possible that Eversource had its engineering subcontractor evaluate reconductoring with ACCC type conductor.

Right-sizing Components of the Alternatives:

#1:Advanced Conductor

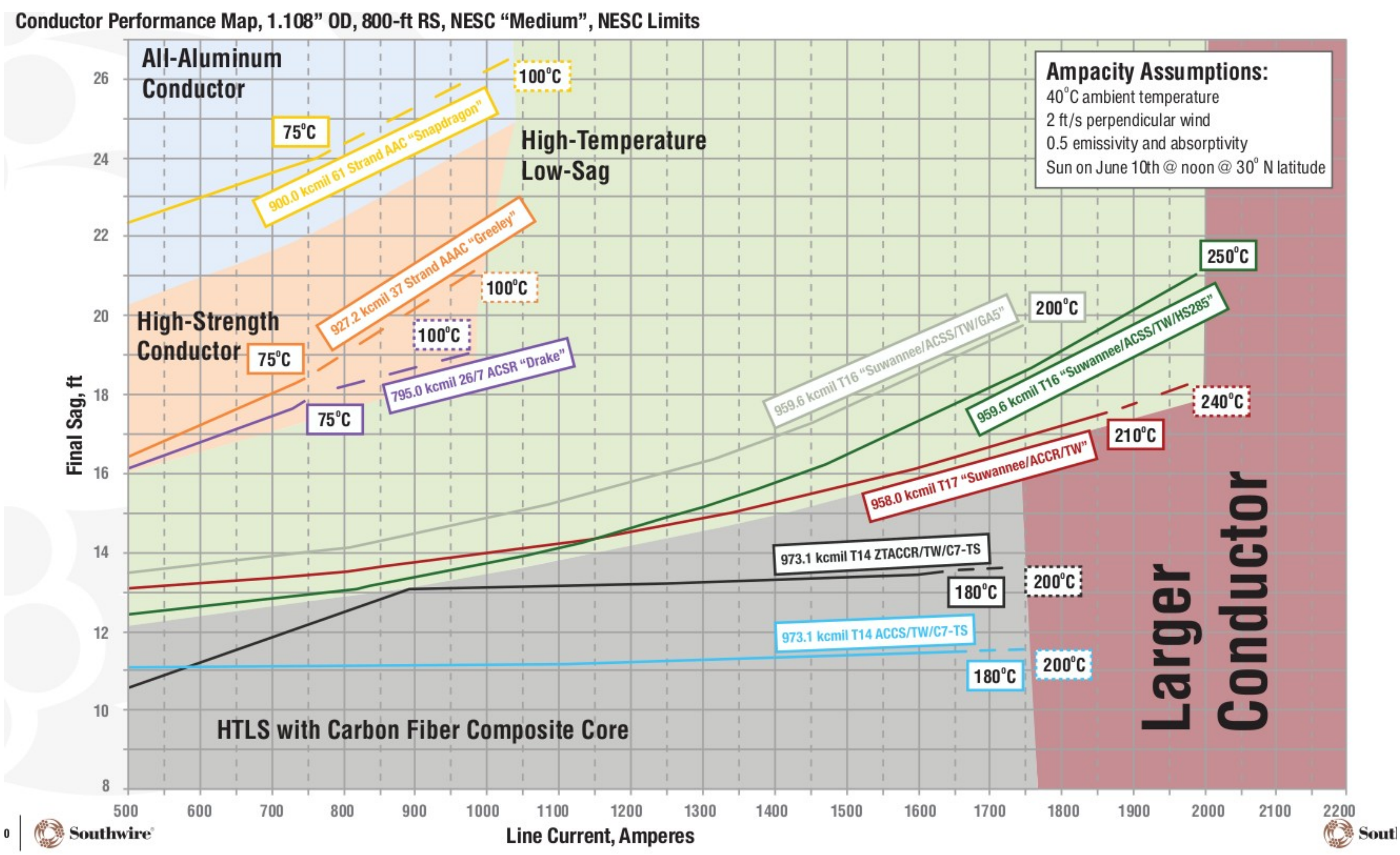
"**Replacing the steel core of the conductor with a carbon fiber composite core makes a big difference. The most used high-performance conductor, the ACCC® (aluminum-conductor-composite-core) conductor**, has a hybrid carbon fiber core and trapezoidal profile for the aluminum strands, allowing almost 28 % more aluminum without any diameter or weight penalty. It basically doubles the "ampacity", the power transfer capability, while at the same time reducing the line losses by 25-40 %. The thermal expansion is about 1/10 compared to an ACSR conductor.

The lower thermal expansion is a big deal, when it comes to sags, but even more important is the **radically different characteristic in terms of sags as a function of temperature.** For the ACSR conductor the sag is proportional to the temperature of the conductor. For the **ACCC®** conductor the sag is proportional to the temperature but only up to a **"knee point temperature**". Above that point **the sag basically remains constant**! It substantially reduces the risk for tree-to-line contacts at overloads.

Resilience can also be helped by the stronger high-performance conductors. Thanks to strength of the carbon fiber composite core, the ACCC conductor can take more physical stress from mechanical forces as well as wind. It was illustrated in 2013, when an oil tank, picked up by the intense winds of an EF-5 tornado, hit into a steel monopole of a 138 kV transmission line in Oklahoma. The pole was bent to a 45 degrees angle. The mechanical shock snapped the aluminum strands of the conductor, but the composite core prevented the monopole from hitting the ground and enabled a fast repair.

Probably, the biggest benefit of a high-performance conductor is the much higher “ampacity”. **The ability to move about twice the amount of power when reconductoring a transmission line utilizing existing towers or poles adds to the resilience of the whole system**. In November 2015 AEP (American Electric Power) completed the reconductoring of two 345 kV transmission lines, using ACCC conductor, in Lower Rio Grande Valley, Texas. The reconductoring, in total 240 miles of conductor, was done utilizing existing towers and right-of-way, while in energized state! For this project AEP received the 2016 EEI (Edison Electric Institute) Edison Award.” https://www.orkas.com/resilience-transmission-lines-and-conductors/

Note that the line clearances are calculated a 200 C, so the comparable sag of the ACCC and ACSS conductors at lower temps in the diagram below is irrelevant. The diagram below shows 956.6 kcmil ACSS/TW, which has less sag than the regular 1272 ACSS conductor Eversource has proposed for this project.



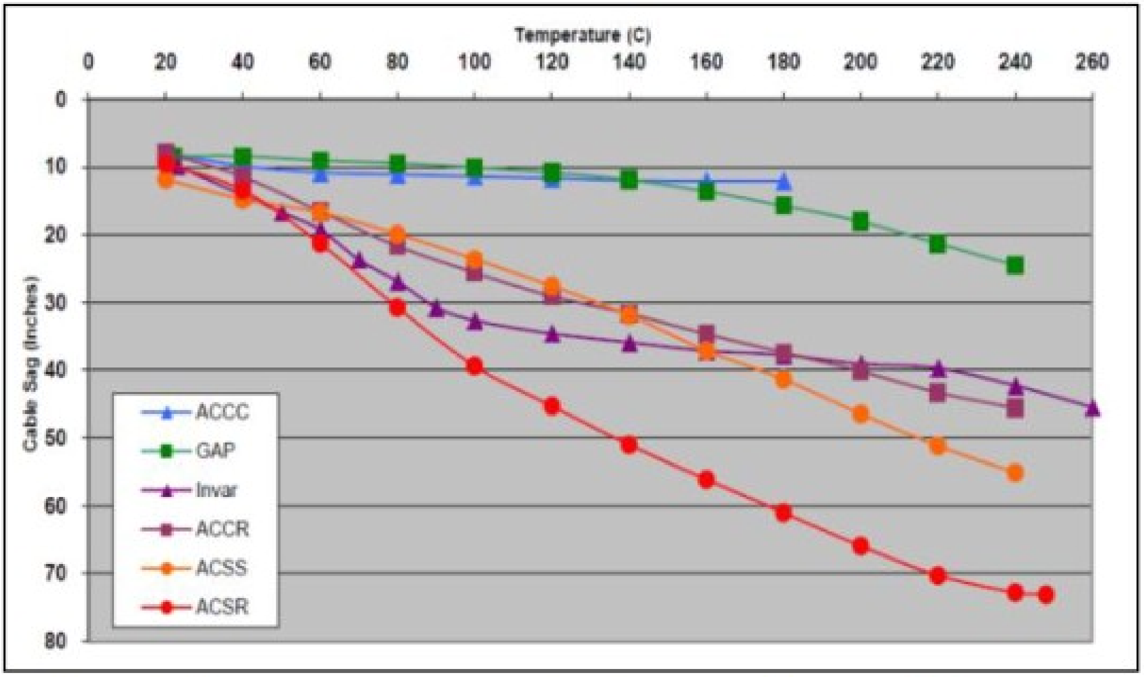
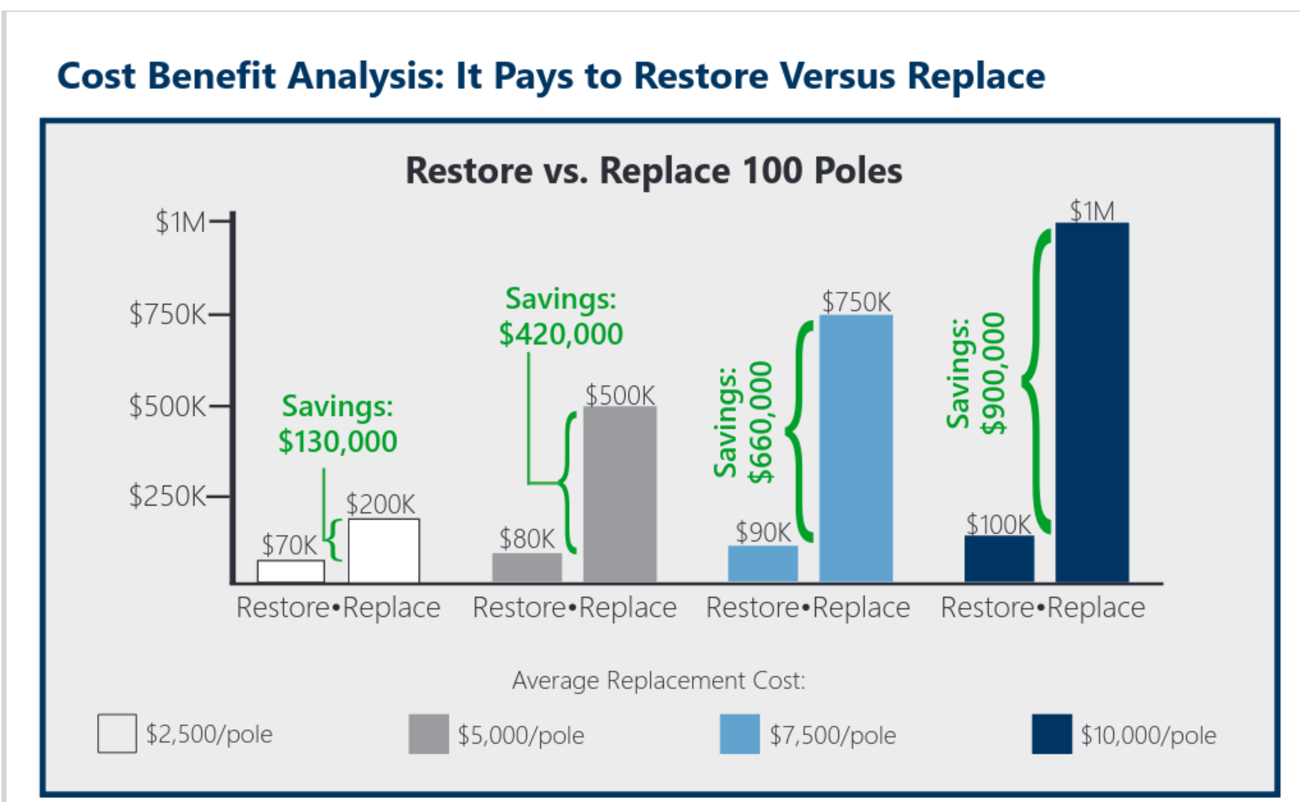
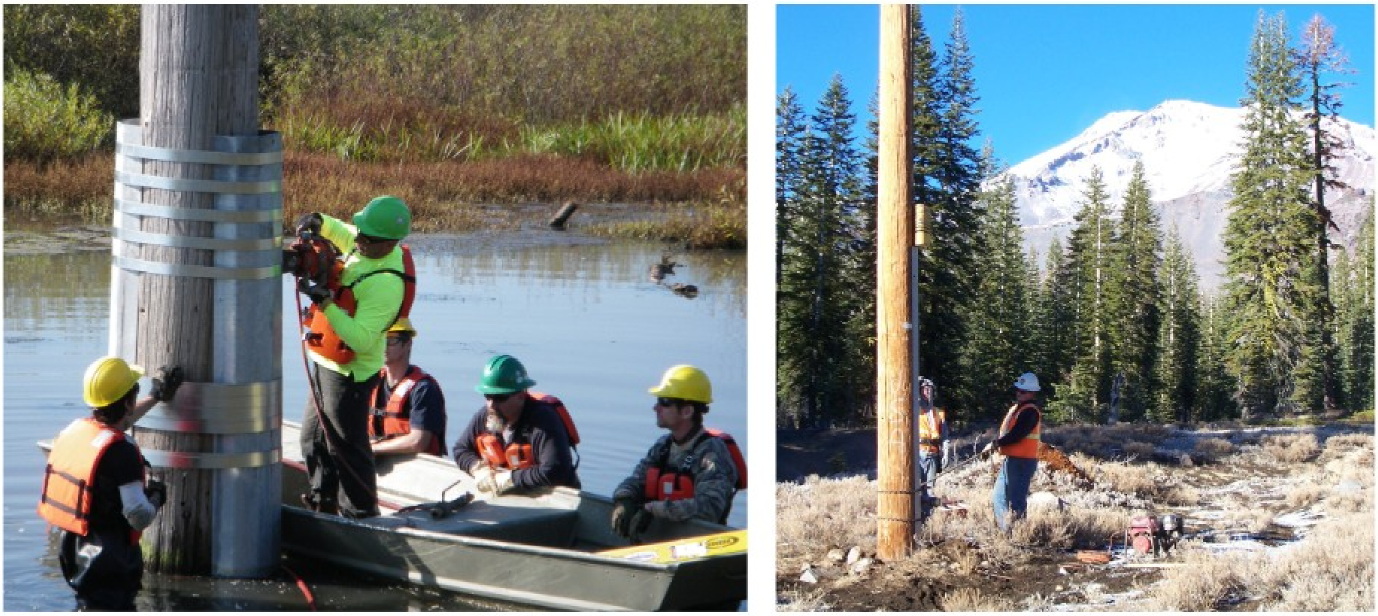


Figure 2 - Sag / temperature comparison of several conductors tested by Ontario Hydro at Kinectrics lab. The graph not only shows the substantially reduced sag, it also shows the particular ACCC® conductor tested operated at 60° to 80° C cooler than the other conductors tested under an equal 1,600 amp load conditions. (The conductors are listed in the sequence in which they appear from top to bottom)

#2. Repair rather than replace poles:





Poles in difficult locations such as hillsides, backyards or other difficult-to-access areas can be trussed to avoid costly, time-consuming replacements.

https://f.hubspotusercontent30.net/hubfs/20067784/Osmose_Nov2021/pdf/Pole%20Restoration%20brochure%202017.pdf

#3. Grid Enhancing Technologies:

"3.4. Key Findings on GETs

GETs maximize the capacity of existing rights of way, reducing the need for some new transmission projects and deferring the construction of others. Overall, these technologies are much less costly than new buildouts and have faster cost recovery potential (Tsuchida et al. 2023). They increase the flexibility of the existing system by providing multiple real-time power flow solutions based on the changing dynamics of the variables that affect the system. This flexibility is particularly important for economic efficiency as more intermittent, non-dispatchable renewables penetrate the grid and changes in power flows need to occur much faster (US DOE 2020). Many GETs are scalable, can be relocated to other lines due to their portability, and can even be removed and reinstalled, unlike capital-intensive investments. While lines are built or upgraded, GETs can minimize outages' frequency and length by optimizing grid reconfiguration. As new projects come into service, GETs can enhance their value, increasing the benefit–cost ratio of these traditional investments and potentially improving their approval rate (Tsuchida et al. 2023).

https://www.rff.org/publications/reports/expanding-the-possibilities-when-and-where-can-grid-enhancing-technologies-distributed-energy-resources-and-microgrids-support-the-grid-of-the-future/

Sag chart above: https://documents.dps.ny.gov/search/Home/ViewDoc/Find?id=%7B4B3A8A12-3090-40E7-841F-EC1BEED0C95B%7D&ext=pdf

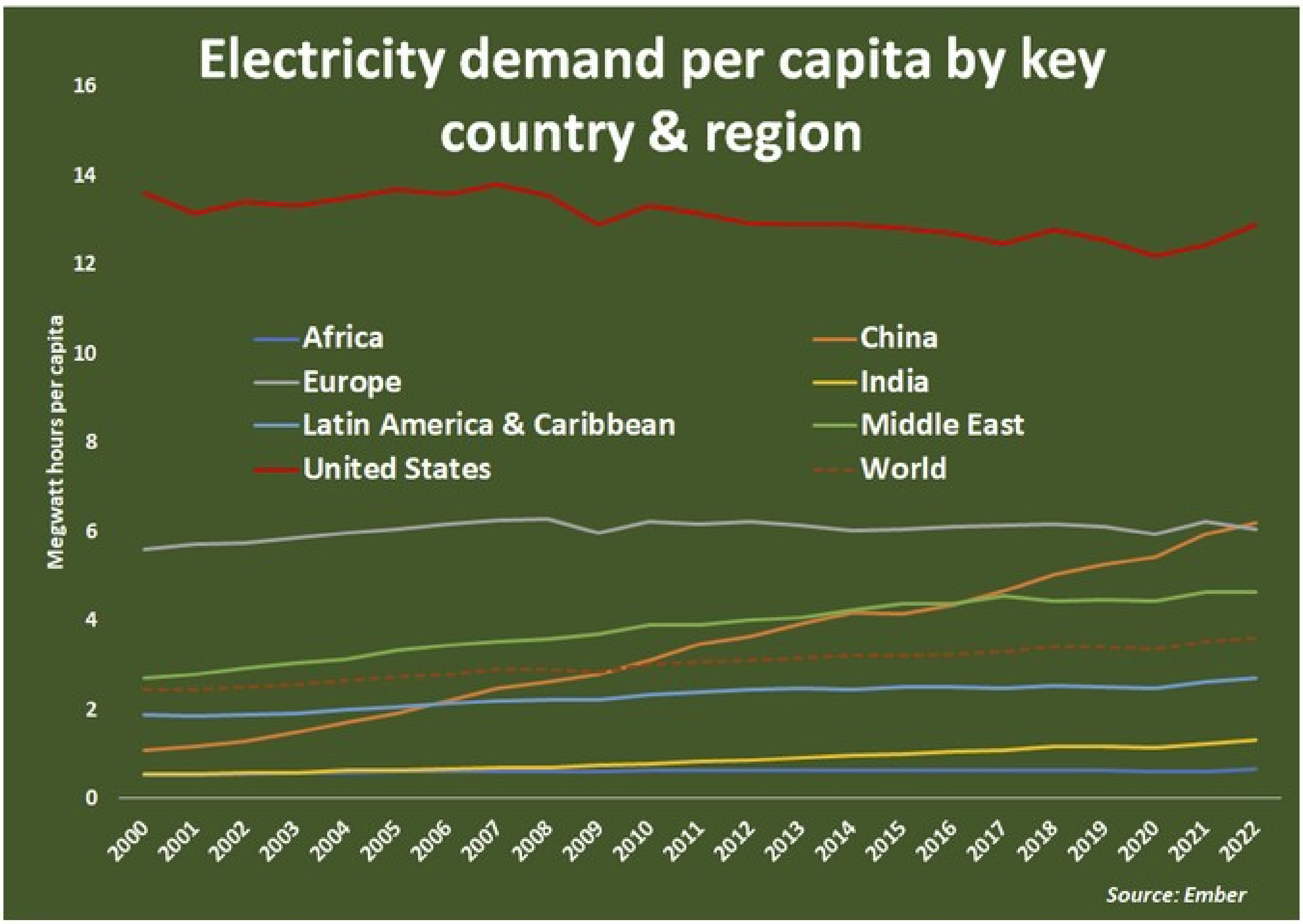
#4. Simultaneous HVAC/HVDC transmission:

"From the economic point of view, rather than constructing new HVAC line, converting existing HVAC line into simultaneous AC-DC transmission system has a price reduction of about 107,984,968.56 USD or 32.46% of the new HVAC line cost."

https://downloads.hindawi.com/journals/jece/2022/4571596.pdf

#5. Conservation and Efficiency:

"Each person in the United States consumes 12.87 megawatt hours of electricity per year, according to think tank Ember, which is three and a half times ...the global average, and over twice as much as the average person in Europe."



Electricity demand per capita by key country & region

https://www.reuters.com/markets/commodities/world-cant-afford-us-style-home-energy-consumption-habits-2023-05-19/

"Given that the supply curve for electricity does indeed consistently have an upward slope in the United States – that is, the marginal wholesale price of electricity is higher than the average price – it is clear from the model that any major reduction in demand for electricity will lead to lower electricity prices."

https://www.energy.gov/sites/default/files/2021-07/SEEAction-DRIPE.pdf

#6. Ensure conductor clearances do not exceed those required by Code:

Eversource pole/structure replacements and rebuilds routinely (in the only documentation supplied; the state land and water crossings) exceed necessary conductor clearances by 10'-18'. Higher clearances mean taller structures. Reducing conductor clearances to what is required by Code would reduce structure heights, viewshed damages, and structure costs.

O154 115kV LINE STATE LAND AND PUBLIC WATERBODY CROSSING STRUCTURE TABLE

EXHIBIT 7

Eversource O154 Line Rebuild - DOE State Land and Waterbody Crossing Details								
Existing Structure #	New Structure #	Structure Type	Height Change (feet)	Span (Pole to Pole)	Span Distance (feet)	Minimum NESC Table 232-1 Clearance (ft.)	ES Vertical Design Clearance (ft.)	Complies with NESC Table 232-1 (Y/N)
268	37	56.5' steel 2 pole, T, CLH1	15	37-38	642.6	18.6	28.8	Y
267	38	65.5' steel 2 pole, T, CLH1	10					
250	55	56.7' steel 2 pole, T, CLH1	15	55-56	460.7	20.1	28	Y
249	56	61.0' steel 2 pole, TG, CLH1	20					
248	57	61.0' steel 2 pole, T, CLH1	20	56-57	498	20.1	29.4	Y
247	58	65.5' steel 3 pole, P, CLH1	20	57-58	433.1	20.1	32.0	Y
246	59	61.0' steel 2 pole, T, CLH1	10	58-59	767	20.1	32.1	Y
232	73	52.0' steel 3 pole, ADS, CLH3	5	73-74	429.8	20.1	27.4	Y
231	74	52.0' steel 2 pole, T, CLH1	10					
230	75	61.0 steel 2 pole, T, CLH1	15	74-75	445.5	20.1	28.0	Y
229	76	70.0' steel 2 pole, T, CLH1	20	75-76	507.5	20.1	33.8	Y
228	77	61.0' steel 2 pole, T, CLH1	20	76-77	635.8	20.1	30.1	Y
227	78	61.0' steel 2 pole, T, CLH1	20	77-78	488.4	20.1	29.4	Y
226	79	64.8' steel 3 pole, BP, CLH1	25	78-79	455.6	20.1	26.8	Y
225	80	56.5' steel 2 pole, T, CLH1	15	79-80	294.4	20.1	38.2	Y
224	81	52.0' steel 2 pole, T, CLH1	10	80-81	465.7	20.1	32.2	Y
223	82	52.0' steel 2 pole, T, CLH1	10	81-82	363.4	20.1	26.5	Y
222	83	52.0' steel 2 pole, T, CLH1	10	82-83	423.1	20.1	29.6	Y

In 2018 Eversource stated that the steel structures last from 50-70 years. (Lee, N.H., ZBA minutes 12/18/19) The wood structures on the recently rebuilt O-154 and D-142 were 74 years old, the A-111; 69 years old, the B-112; 65 years old, the U-181, 72 years old, with only 1/3 of the structures (of unknown condition) replaced, the X-178 structures are 54 and 38 years old, with only 7.7% needing repair or replacement in the next maintenance cycle.

ACSS conductor specs; Pheasant is the planned conductor:

Code Word	Size (kcmil)	Strand-ing (Al/St)	Diameter (in) Individual Wires				Weight (lbs/1000 ft)			Rated Strength (lbs)			Resistance (OHMS/1000ft)		Ampacity @ 200°C (AMPS)
			Al	Steel	Steel Core	Comp Cable	Al	Steel	Total	Standard Strength	High* Strength	HS285** Strength	DC @ 20°C	AC @ 75°C	
Redbird/ACSS	954	24/7	0.1994	0.1329	0.3987	1.196	898.5	328.7	1227.2	26000	28000	32300	.0174	.0217	1859
Rail/ACSS	954	45/7	0.1456	0.0971	0.2912	1.165	898.5	175.3	1073.8	16700	18000	20400	.0175	.0220	1824
Towhee/ACSS	954	48/7	0.1410	0.1097	0.3290	1.175	898.5	223.7	1122.2	19700	21300	24300	.0175	.0218	1842
Cardinal/ACSS	954	54/7	0.1329	0.1329	0.3987	1.196	898.6	328.7	1227.2	26000	28000	32300	.0174	.0223	1825
Canvasback/ACSS	954	30/19	0.1783	0.1070	0.5350	1.248	900.7	579.4	1480.1	41100	45400	53100	.0172	.0214	1897
Snowbird/ACSS	1033.5	42/7	0.1569	0.0871	0.2614	1.203	973.4	141.3	1114.7	15400	16500	18500	.0162	.0204	1924
Ortolan/ACSS	1033.5	45/7	0.1515	0.1010	0.3031	1.212	973.4	190.0	1163.4	18100	19500	22000	.0162	.0204	1921
Curlew/ACSS	1033.5	54/7	0.1383	0.1383	0.4150	1.245	973.4	356.2	1329.6	28200	30300	35000	.0161	.0206	1924
Bluejay/ACSS	1113	45/7	0.1573	0.1048	0.3145	1.258	1048.3	204.5	1252.8	19500	21100	23800	.0150	.0190	2017
Finch/ACSS	1113	54/19	0.1436	0.0861	0.4307	1.292	1053.4	375.5	1428.9	30400	33200	38700	.0150	.0193	2015
Bunting/ACSS	1192.5	45/7	0.1628	0.1085	0.3256	1.302	1123.2	219.2	1342.4	21400	23500	25400	.0140	.0178	2110
Bittern/ACSS	1272	45/7	0.1681	0.1121	0.3363	1.345	1198.0	234.0	1432.0	22300	24000	27100	.0131	.0167	2201
Pheasant/ACSS	1272	54/19	0.1535	0.0921	0.4604	1.381	1203.9	429.2	1633.1	34100	37300	43000	.0131	.0169	2200

In 2011 Eversource (CL&P) stated that the life of a wood structure was 40 years and a steel structure 60 years:

https://portal.ct.gov/-/media/CSC/LifeCycle2011/lifecycle20110929UInterrogatoryresponsespdf.pdf

Eversource's data shows similar life-cycle costs for wood and steel H-frame structures:

Eversource Energy - Typical OH Transmission Types

Life-Cycle Cost Components - Estimated Overhead Construction Costs/ Typical Mile

Cost Category	115-kV H Frame - Wood or WPE Steel	115-kV Delta - Steel Monopole	345-kV H Frame - Wood or WPE Steel	345-kV Delta - Steel Monopole
Poles & Foundations	$1,098,718	$1,025,312	$1,314,095	$1,789,171
Conductor & Hardware	$374,464	$343,670	$663,053	$627,077
Site Work	$855,333	$796,971	$974,944	$904,084
Construction	$1,954,208	$1,563,719	$2,365,318	$2,405,711
Engineering	353,586	$330,756	$499,710	$505,960
Sales Tax	$0	$0	$0	$0
Project Management	$304,191	$274,071	$364,681	$384,697
Totals	**$4,940,500**	**$4,334,499**	**$6,181,801**	**$6,616,700**

ACCC type conductor specs; weight:

Shaped Wire Concentric-Lay-Stranded Compact Aluminum Conductor, Composite Supported (ACCS/TW/C7®-TS)

Code Word	Conductor Size, kcmil	Type No.	Cross-Sectional Area, in²		Layers of Al	Stranding		Diameter		Weight/1000 feet		
			Al	Total		No. of Al Strands	C7 Strands, in	C7 Core, in	Complete Conductor, in	Al, lb	C7, lb	Total, lb
Badlands/TW	336.4	22	0.2642	0.3218	2	16	7 x 0.1024	0.3071	0.685	317.4	40.6	358.0
Andes/TW	397.5	14	0.3122	0.3560	2	18	7 x 0.0892	0.2677	0.710	373.2	30.9	404.1
Joshua Tree/TW	397.5	16	0.3122	0.3627	2	18	7 x 0.0958	0.2874	0.718	373.5	35.6	409.1
Sequoia/TW	397.5	22	0.3122	0.3806	2	18	7 x 0.1115	0.3346	0.738	375.1	48.2	423.3
Rogers/TW	477.0	13	0.3746	0.4251	2	18	7 x 0.0958	0.2874	0.778	447.4	35.6	483.3
Yosemite/TW	477.0	15	0.3746	0.4322	2	18	7 x 0.1024	0.3071	0.787	448.1	40.6	488.7
Capitol Reef/TW	477.0	23	0.3746	0.4601	2	20	7 x 0.1247	0.3740	0.820	450.4	60.2	510.6
Tortugas/TW	636.0	10	0.4995	0.5500	2	20	7 x 0.0958	0.2874	0.880	596.7	35.6	632.3
Yellowstone/TW	636.0	12	0.4995	0.5571	2	16	7 x 0.1024	0.3071	0.887	596.9	40.6	637.5
Glacier/TW	636.0	15	0.4995	0.5762	2	20	7 x 0.1181	0.3543	0.905	597.4	54.1	651.5
Carlsbad/TW	636.0	22	0.4995	0.6100	2	22	7 x 0.1417	0.4252	0.948	600.1	77.8	677.9
Congaree/TW	641.7	11	0.5040	0.5616	2	16	7 x 0.1024	0.3071	0.890	602.2	40.6	642.8
Vinson/TW	714.0	10	0.5608	0.6184	2	16	7 x 0.1024	0.3071	0.933	669.9	40.6	710.5
Kilimanjaro/TW	795.0	7	0.6244	0.6682	2	20	7 x 0.0892	0.2677	0.962	745.1	30.9	776.0
Alps/TW	795.0	9	0.6244	0.6820	2	20	7 x 0.1024	0.3071	0.974	745.7	40.6	786.3
Wind Cave/TW	795.0	12	0.6244	0.7011	2	20	7 x 0.1181	0.3543	0.990	746.1	54.1	800.2
Denali/TW	795.0	16	0.6244	0.7268	2	20	7 x 0.1365	0.4094	1.010	747.0	72.2	819.2
Rocky/TW	795.0	22	0.6244	0.7607	2	24	7 x 0.1575	0.4724	1.044	750.1	96.1	846.2
Crater Lake/TW	954.0	7	0.7493	0.7997	3	34	7 x 0.0958	0.2874	1.058	898.6	35.6	934.1
Fuji/TW	954.0	12	0.7493	0.8421	2	20	7 x 0.1299	0.3898	1.077	895.3	65.4	960.7
Jasper/TW	954.0	16	0.7493	0.8680	2	22	7 x 0.1470	0.4409	1.104	896.4	83.7	980.1
Arches/TW	954.0	20	0.7493	0.8972	2	24	7 x 0.1640	0.4921	1.128	898.9	104.3	1003.2
Everglades/TW	973.1	14	0.7643	0.8747	2	20	7 x 0.1417	0.4252	1.108	913.7	77.8	991.5

Pole lifecycle cost data above from Cl&P dba Eversource Energy, Docket CSC LIFE-CYCLE 2022 Set CSC-01, CSC-033 and -004 Attachment, Page 1 of 1

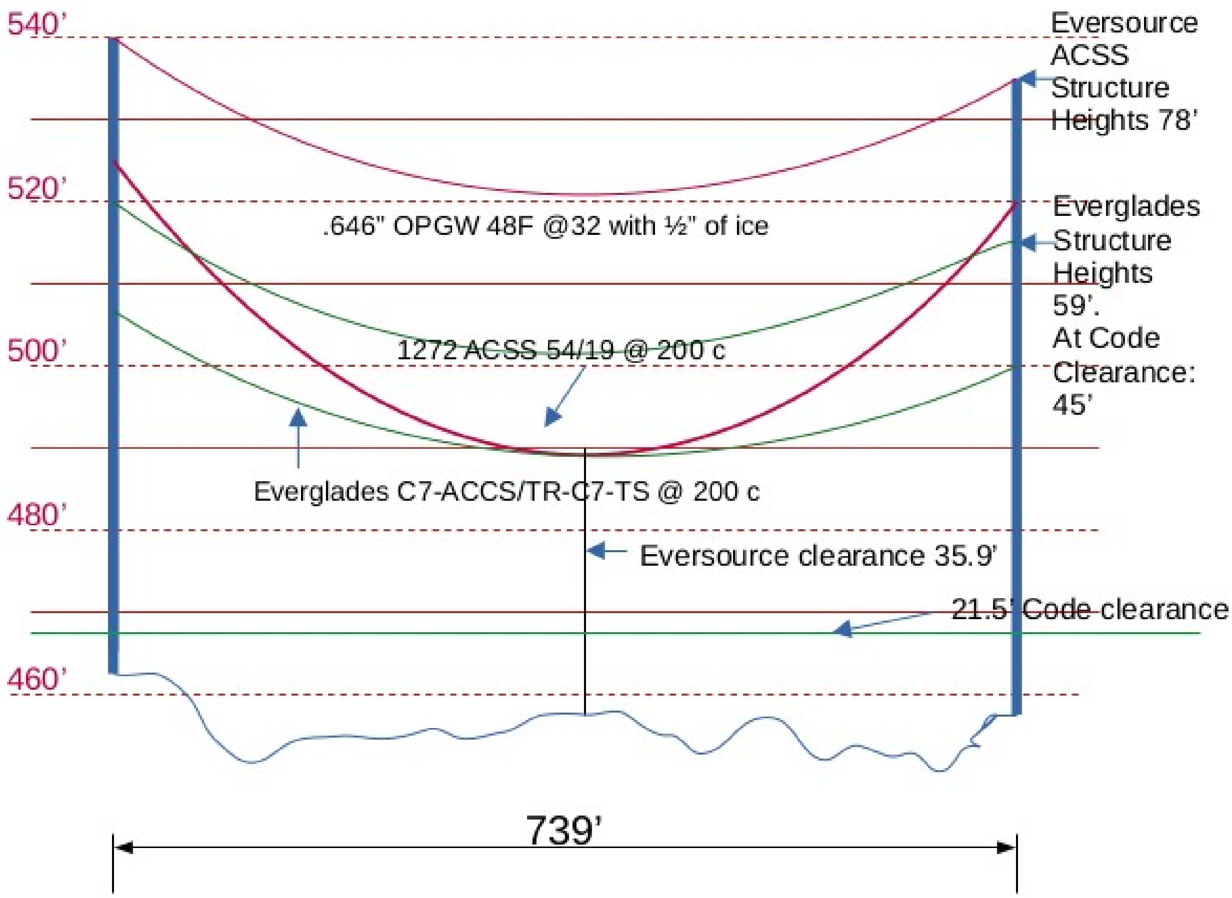
ACCC type conductor specs; ampacity and resistance:

RBS, lb	Resistance				GMR, ft	Reactance @ 1 ft Spacing 60 Hz		Ampacity		Type No.	Conductor Size, kcmil	Code Word
	dc @ 20°C, Ω/mile	ac–60 Hz @ 25°C, Ω/mile	ac–60 Hz @ 180°C, Ω/mile	ac–60 Hz @ 200°C, Ω/mile		Inductive Xa, Ω/mile	Capacitive X'a, MΩ-mile	@ 180°C, A	@ 200°C, A			
19,700	0.2652	0.2712	0.4419	0.4639	0.0236	0.4548	0.1055	875	919	22	336.4	Badlands/TW
15,900	0.2234	0.2287	0.3724	0.3910	0.0238	0.4537	0.1044	963	1013	14	397.5	Andes/TW
17,900	0.2235	0.2288	0.3726	0.3912	0.0243	0.4513	0.1041	966	1016	16	397.5	Joshua Tree/TW
23,400	0.2244	0.2296	0.3741	0.3927	0.0254	0.4457	0.1033	972	1023	22	397.5	Sequoia/TW
18,400	0.1861	0.1908	0.3104	0.3259	0.0260	0.4429	0.1017	1085	1141	13	477.0	Rogers/TW
20,600	0.1862	0.1909	0.3106	0.3261	0.0265	0.4406	0.1014	1088	1145	15	477.0	Yosemite/TW
29,100	0.1872	0.1917	0.3120	0.3276	0.0287	0.4308	0.1002	1100	1157	23	477.0	Capitol Reef/TW
19,400	0.1395	0.1437	0.2331	0.2447	0.0295	0.4276	0.0981	1300	1369	10	636.0	Tortugas/TW
21,600	0.1396	0.1437	0.2332	0.2447	0.0297	0.4268	0.0978	1304	1373	12	636.0	Yellowstone/TW
27,400	0.1397	0.1436	0.2332	0.2448	0.0310	0.4214	0.0972	1311	1381	15	636.0	Glacier/TW
36,900	0.1403	0.1440	0.2341	0.2458	0.0329	0.4144	0.0959	1328	1399	22	636.0	Carlsbad/TW
21,600	0.1383	0.1424	0.2311	0.2425	0.0298	0.4264	0.0977	1311	1380	11	641.7	Congaree/TW
22,100	0.1243	0.1283	0.2078	0.2181	0.0311	0.4213	0.0963	1403	1477	10	714.0	Vinson/TW
18,400	0.1115	0.1156	0.1868	0.1961	0.0316	0.4191	0.0954	1493	1574	7	795.0	Kilimanjaro/TW
22,600	0.1116	0.1155	0.1868	0.1961	0.0325	0.4158	0.0950	1499	1580	9	795.0	Alps/TW
28,400	0.1116	0.1154	0.1868	0.1961	0.0335	0.4119	0.0946	1507	1588	12	795.0	Wind Cave/TW
36,200	0.1118	0.1153	0.1869	0.1961	0.0348	0.4075	0.0940	1516	1598	16	795.0	Denali/TW
45,600	0.1122	0.1156	0.1875	0.1968	0.0367	0.4010	0.0930	1529	1612	22	795.0	Rocky/TW
21,300	0.0934	0.0975	0.1569	0.1646	0.0344	0.4091	0.0926	1679	1770	7	954.0	Crater Lake/TW
34,300	0.0930	0.0967	0.1560	0.1637	0.0365	0.4015	0.0921	1693	1785	12	954.0	Fuji/TW
41,400	0.0931	0.0966	0.1560	0.1637	0.0376	0.3983	0.0913	1706	1799	16	954.0	Jasper/TW
50,100	0.0934	0.0967	0.1563	0.1641	0.0394	0.3923	0.0907	1716	1810	20	954.0	Arches/TW
39,000	0.0912	0.0948	0.1530	0.1605	0.0379	0.3971	0.0912	1725	1819	14	973.1	Everglades/TW

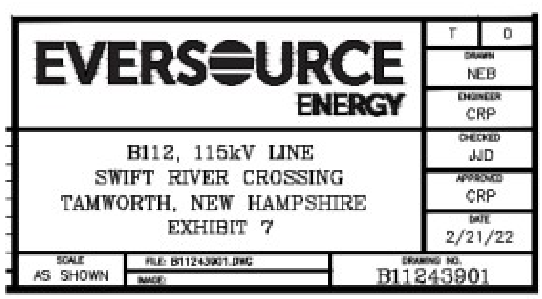
Eversource 2022 testimony on project planning:

“Certainly. Sometimes it, you know, I think it's fair to say that, at times in the past, we have not been as wide-ranging in our view as we could have been, and we are changing, we have changed that. So, we will look at the traditional, you know, what some would call the "poles-and-wires" solution to something. But it very well could be that, you know, strategic and intentional use and deployment of distributed resources could address particular needs on the system. It could well be that, if it's a capacity concern, that energy efficiency may be part of, perhaps all of the solution. So long as whatever these other solutions are can provide the kind of reliability that we need them to, then they are certainly part of the analysis in determining what should be built and at the lowest reasonable cost for doing so.” pgs 35-6.

https://www.puc.nh.gov/regulatory/Docketbk/2020/20-161/TESTIMONY/20-161_2022-09-30_EVERSOURCE_REBUTTAL-TESTIMONY-JOHNSON-LAVELLE-GERHARD.PDF



Measurements taken from:


EVERSOURCE ENERGY

B112, 115kV LINE
SWIFT RIVER CROSSING
TAMWORTH, NEW HAMPSHIRE
EXHIBIT 7

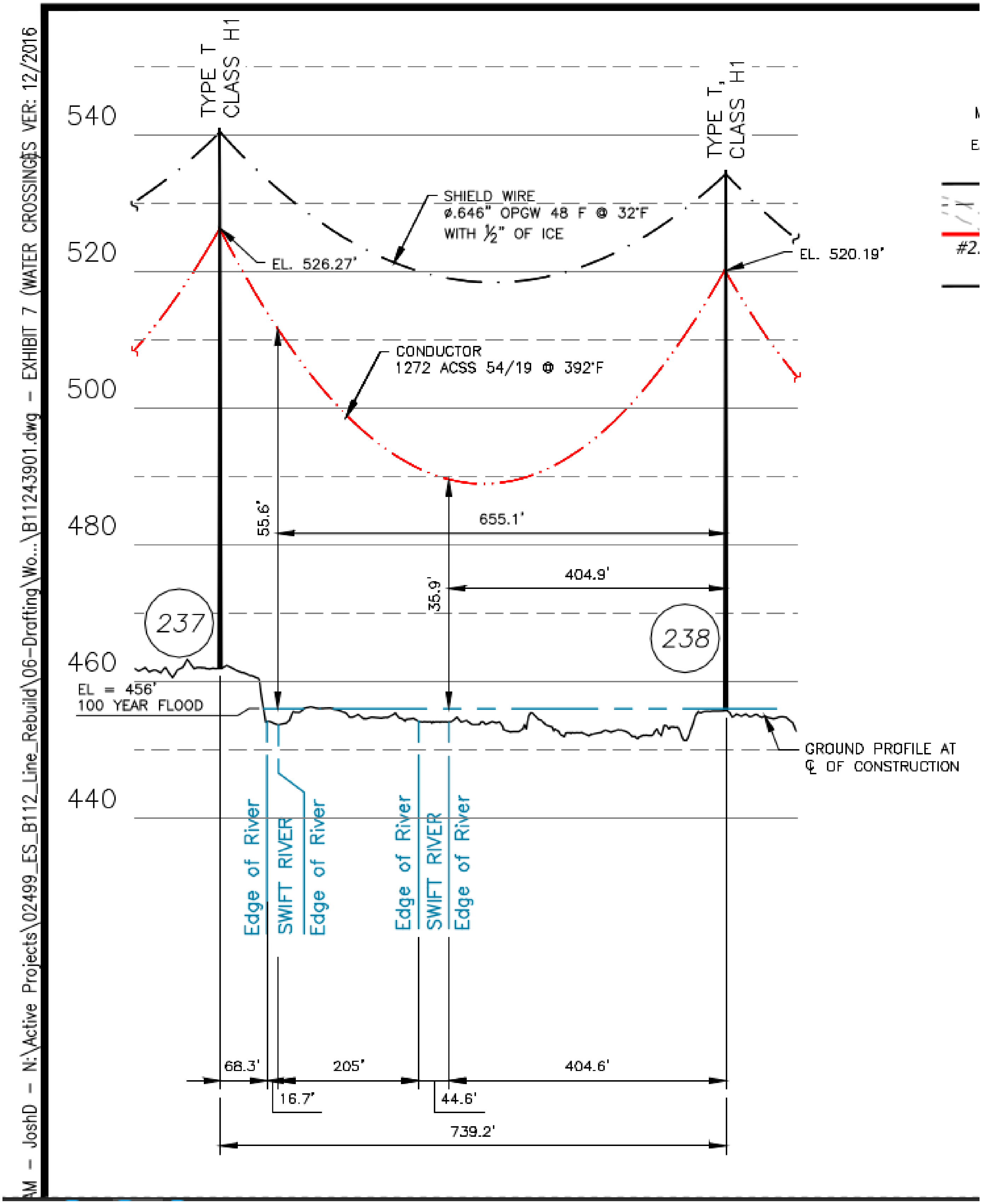
T	0
DRAWN	NEB
ENGINEER	CRP
CHECKED	JJD
APPROVED	CRP
DATE	2/21/22

SCALE AS SHOWN | FILE: B11243901.DWG | IMAGE: | DRAWING NO. B11243901

This profile is the best I could produce, as a non-engineer without the software possessed by transmission planning corporations.

The conductor connection heights on a given structure are also determined by the structure it connects to. Eversource refused to provide any profile drawings for the X-178.

kris pastoriza March 11, 2024



https://nhconservation.org/doku.php?id=eversource_asset_condition