Attachment 2

DRAFT, Alternatives To Proposed Western Loudoun Transmission Line, 5 April 2024,
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(With Pencil Notes of Theresa Ghiorzi in the margins)

(1) Intent is to avoid loss of property value, the damage to the agritourism business, and legal expenses resisting the transmission line (ie. SCC Costs associated with hiring lawyers, and expert witnesses and any subsequent court costs associated with appealing the decision Page 1:

- Such delays in the current plan to go through western Loudoun will incur inflation, planning, and legal costs that are not accounted for in the PJM plan. The PJM plan also does not consider the costs to the community for loss of property value, the damage to the agritourism business, and legal expenses resisting this transgression.

(2) Target the properties along the existing lines as there are fewer folks in that group Page 1:

maps). This would avoid the need for a new right of way in Loudoun County. It would be about 5 percent higher in cost compared to the PJM estimate for the western line because of the longer path but would avoid schedule delays and additional cost because of substantially less local opposition.) ← targeting

(3) Swoop around Doubs instead of connecting the line there same as solution of collaborating energy companies Page 1:

- The line could pass by Doubs rather than connect to the line there (in that regard similar to the line through western Loudoun County) to avoid additional expenses for space and equipment at Doubs.
- This approach would result in two lines of 500 kV towers through the existing rights of way in

(4) Create a "pilot" similar strategy as was used in Case 1: Leesburg Bypass 230kV (2004-2010) in the Lovettsville, May 1, 2024 presentatio and also as presented in the recent Aspen - Golden Case PUR-2024-00044 in the testimony of both and , the pilot was also in the arguments and direct testimony of the conservation groups Landsdowne Conservancy (aka. NoTowersOnRoute7) and the Piedmont Environmental Council. Page 2.

power. An advanced conductor "pilot" could replace the line going through western Loudoun by using the same alternative path through Doubs but just using the existing 500 kV towers through northern Loudoun County and the two sets of 500/230 kV towers between Doubs and Aspen that already will be built under the PJM plan.

(5) Same easement sharing concept as was in the Loudoun County Board of Supervisors Page 2:

Any approach diverting the western Loudoun County line toward Doubs would require coordination or sharing of work between Woodside and Aspen because other companies own the existing rights of way. This type of sharing has already been arranged from a point west of Gore, Virginia, through the West Virginia segment near Millville, and then into Virginia to the eastern side of the Short Hill Mountain ridge regarding use of the existing 138 kV right of way. Some type of arrangement would be needed for the 138 kV right of way from Short Hill Mountain to Doubs, and—in the case of the advanced conductors—for the right of way with the two sets of towers already in the PJM plan, all the way from Doubs to Aspen. A failure to achieve a sharing arrangement for an alternative approach in the corridor between Short Hill Mountain and Doubs could result in the need to expand the existing right of way to make room for a separate 500 kV line, creating an additional burden for the farms and residents of northern Loudoun County.

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Alternatives to Proposed Western Loudoun Transmission Line

PJM on 11 December 2023 approved a $5.1 billion plan (2022-RTEP-Window-3) that seeks to bring three additional 500 kilovolt (kV) transmission lines (for a total of six) into the data center area east of Leesburg, Virginia, plus other lines to move power around that area. The plan also seeks to solve grid reliability and stability issues that arise due to congestion at critical points in the grid. The western line in this plan involves a new right of way through western Loudoun County.

This massive project immediately began receiving pushback from community stakeholders and local governments, particularly in the case of western Loudoun County, where a concerted effort has been under way for more than 75 years to preserve open spaces and viewsheds in an historical area settled by the Quakers during the mid-18th Century. Large blocks of the land that would need to be traversed are in permanent conservation easements and historic districts and could even include the Waterford National Landmark. This land is also part of the Journey Through Hallowed Ground National Heritage Area. Over the past 40 years, western Loudoun has developed an agritourism business built around wineries, breweries, equine sports, and recreational trails (including the Appalachian Trail, the Regional W&OD Trail, the new Sweet Run State Park, and more than 250 miles of historical gravel roads), all of which count on their viewsheds.

- Despite its urgency to meet mid-2027 completion dates, PJM in November 2023 added three years to the schedule of the transmission line project for western Loudoun, in part because of anticipated resistance.
- Such delays in the current plan to go through western Loudoun will incur inflation, planning, and legal costs that are not accounted for in the PJM plan. The PJM plan also does not consider the costs to the community for loss of property value, the damage to the agritourism business, and legal expenses resisting this transgression.

Intent * Avoid SCC and court costs

The most apparent alternative to the line through western Loudoun County, as noted by PJM during its analysis, would be to follow the existing right of way to the Doubs substation in Maryland (see table and maps). This would avoid the need for a new right of way in Loudoun County. It would be about 5 percent higher in cost compared to the PJM estimate for the western line because of the longer path but would avoid schedule delays and additional cost because of substantially less local opposition. ← targeting the property along the lines

- The line could pass by Doubs rather than connect to the line there (in that regard similar to the line through western Loudoun County) to avoid additional expenses for space and equipment at Doubs.
- This approach would result in two lines of 500 kV towers through the existing rights of way in northern Loudoun, while placing conductors from the current 138 kV line next to or underneath the 500 kV conductors on one of those lines.
- Maryland and Virginia regulators would need to approve a third line to be built in the Doubs–Aspen corridor, which would require expanding that right of way. This third line would have to deal with limits in physical space in the corridor between the Potomac River and the Aspen substation, perhaps by using monopoles instead of wider lattice towers for all three lines along that 3-mile segment. It is not clear yet whether using monopoles would make enough room. Such monopoles in this segment would add a relatively small cost but would have the potential benefit of reducing the visual impact of the corridor on surrounding communities.

* Swoop Around Doubs Instead of Connecting

Advanced composite core conductors offer another approach to deliver more power at comparable cost without the need for a new right of way and the impact on adjacent communities. These conductors can carry as much as twice the power with lighter-weight conductors, fewer losses, and less sagging as compared with conventional (ACSR) conductors. These conductors can be used to span longer distances

(e.g., over a river), build lines with more space between towers, or carry higher currents to deliver more power. An advanced conductor "pilot" could replace the line going through western Loudoun by using the same alternative path through Doubs but just using the existing 500 kV towers through northern Loudoun County and the two sets of 500/230 kV towers between Doubs and Aspen that already will be built under the PJM plan.

- This would avoid the need for an additional 500 kV line and expanded rights of way in Jefferson, Loudoun, Frederick, and Montgomery Counties and would not require expanding the Doubs substation footprint to accommodate an additional line.
- The pilot, if full advantage were taken of the advanced conductors, could provide the equivalent of up to four transmission lines arriving at Aspen instead of just three under either the original or the backup PJM plans.
- The pilot probably would require expanding the current capacity of Doubs and Aspen beyond what is called for in the PJM plan to take advantage of the expanded line capacity. The pilot also might require some limited voltage compensation at Doubs.
- Analysis indicates the cost of the longer route through Doubs, the more expensive advanced conductors, and likely substation costs at Doubs and Aspen would be offset by not building the new line through western Loudoun.
- There are multiple suppliers of advanced conductors, including one that plans to build an additional manufacturing facility in the coming year somewhere in the eastern United States.

The energy companies, however, see the advanced conductors as not mature enough to take the risk with a 500 kV line, even though the Tennessee Valley Authority has been running a 500 kV pilot line for more than 10 years, and US and French manufacturers supplied advanced conductors for two 500 kV lines built in Indonesia in 2017 and 2018. The energy companies also would need to coordinate with PJM to get validation that the pilot approach would meet PJM's stability and reliability goals (the added capacity actually should help). Several variations are possible along the Doubs-Aspen segment, with a tradeoff in terms of power and cost in favor of a reduction in the perceived technical risk from the composite core technology. For example, a third conventional line could be built in parallel (as with the earlier alternative), or advanced conductors could be used on only one of the two planned lines in the corridor. Advanced conductors could also be used on one of the two lines in the last three miles to Aspen as a last resort to avoid the physical congestion that a third line might create.

Any approach diverting the western Loudoun County line toward Doubs would require coordination or sharing of work between Woodside and Aspen because other companies own the existing rights of way. This type of sharing has already been arranged from a point west of Gore, Virginia, through the West Virginia segment near Millville, and then into Virginia to the eastern side of the Short Hill Mountain ridge regarding use of the existing 138 kV right of way. Some type of arrangement would be needed for the 138 kV right of way from Short Hill Mountain to Doubs, and—in the case of the advanced conductors—for the right of way with the two sets of towers already in the PJM plan, all the way from Doubs to Aspen. A failure to achieve a sharing arrangement for an alternative approach in the corridor between Short Hill Mountain and Doubs could result in the need to expand the existing right of way to make room for a separate 500 kV line, creating an additional burden for the farms and residents of northern Loudoun County.

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Table 1: Comparison of Western Line Proposal To Alternatives Through Doubs

This table compares the three options for building transmission lines between the new Woodside and Aspen substations. The line from 502 Junction to Woodside is included in all cases. Estimated costs of building transmission lines in this analysis used American Electric Power (AEP) guidelines for the cost breakdown and the midpoint of a suggested range of line costs per mile. PJM in December 2023 estimated the cost of the western line to be $940 million. For advanced conductors, the analysis uses industry guidelines to assume these conductors cost 3.5 to 4.0 times conventional conductors, which adds about 30 to 36 percent to the cost of a transmission line. Money is saved by not needing to build other lines.

	Western Loudoun County Route That Avoids Doubs ACSR	Alternative With West Line Routed Through Doubs ACSR	Advanced Conductor on Existing West Line Routed Through Doubs Composite
Cost impact	Baseline = Cost of the western lines plus Woodside substation and line termination costs.	Adds about 5 percent relative to proposed Western Line.	Saves about 10 percent relative to proposed Western Line, not counting below substation costs.
Additional substation costs	All cases already include PJM estimate for 502 Junction, Woodside, and Aspen costs.	Avoid more substation costs by not connecting line to Doubs.	Also need voltage compensation and changes to accommodate higher current. Savings may be enough to cover.
Schedule Delay	PJM plan built in 3-year delay to account for public resistance, which would lead to increased costs for process and inflation.	Shorter delay given less public resistance and needing only to coordinate changes to the PJM plan.	Shorter delay with little or no public public resistance. Need to check on grid stability and coordinate changes to the PJM plan.
Impact on Loudoun Community	Significant impact on agritourism that depends on viewshed as well as on historic districts, heritage areas, landmarks, and parks.	Changing 138 kV to taller combined 500/138 kV towers in existing right of way (may be 30 feet wider).	No impact.
Equivalent Lines to Aspen	3	3	up to 4
Greenfield Rights of Way	Through Western Loudoun	No	No
Possible Need for Additional Expanded Rights of Way	Woodside to Northern Loudoun	Along 138 kV line in Northern Loudoun County. Expand for third line in Doubs–Aspen corridor. Probably need monopoles to fit in corridor east of Leesburg.	No
Industry Experience With Conductors	Yes, conventional	Yes, conventional	PJM companies lack experience, but available at Tennessee Valley Authority and overseas. Technical risk could be mitigated by limiting advanced conductors to one line in Doubs–Aspen corridor.
Work Sharing Issues Between Energy Companies	No, sharing already arranged for owner of 138 kV right of way between Gore and Short Hill Mountain.	Yes, with owner of northern Loudoun 138 kV right of way and with 3 companies building in the Aspen-Doubs corridor.	Yes, with 3 companies building in the Aspen-Doubs corridor and with owner of right of way between Woodside and Doubs.

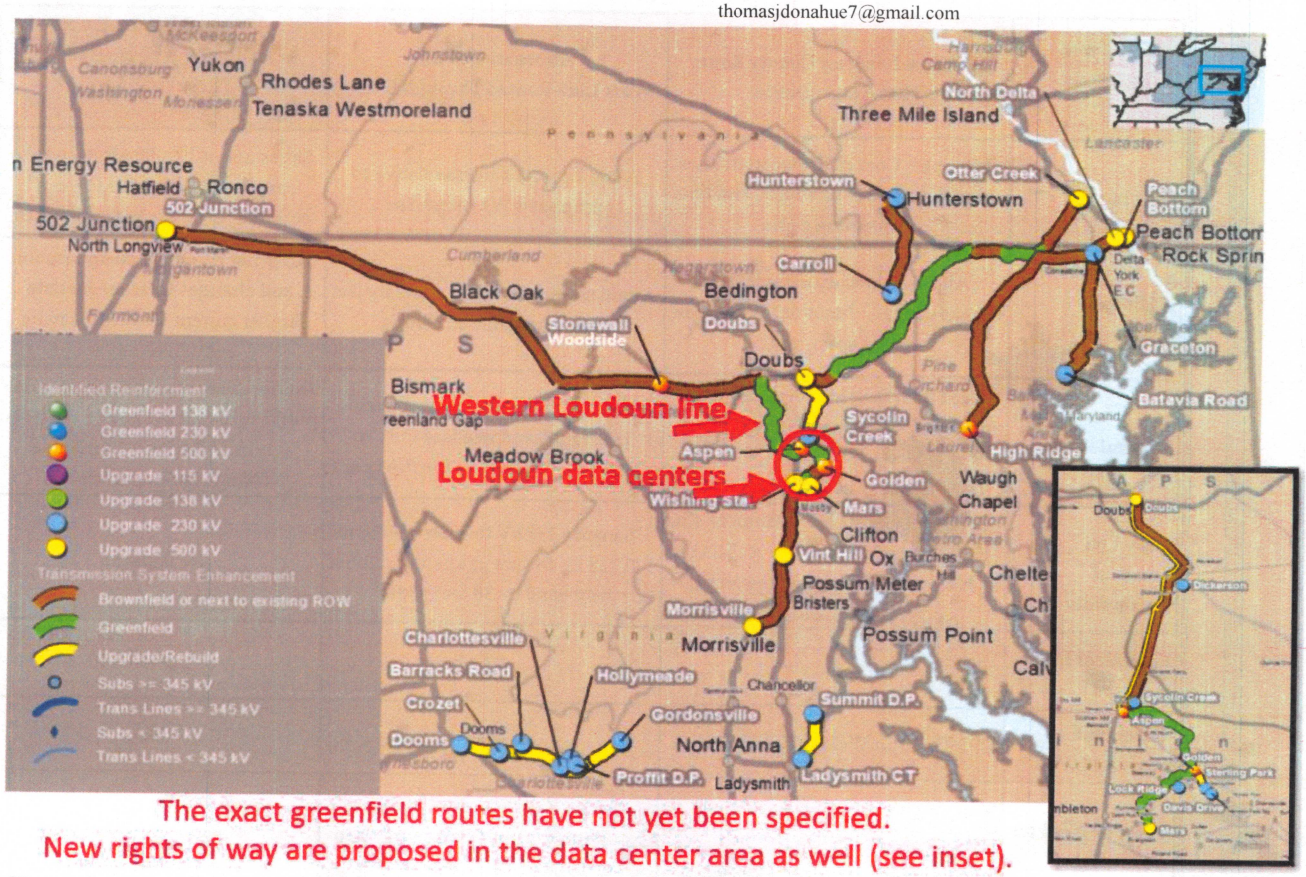

Figure 1: PJM's 2022-RTEP-Window-3 $5.1 billion plan brings three additional 500 kV transmission lines to Loudoun County (for a total of six), as approved by the PJM Board of Managers on 11 December 2023. The green corridors are new rights of way.

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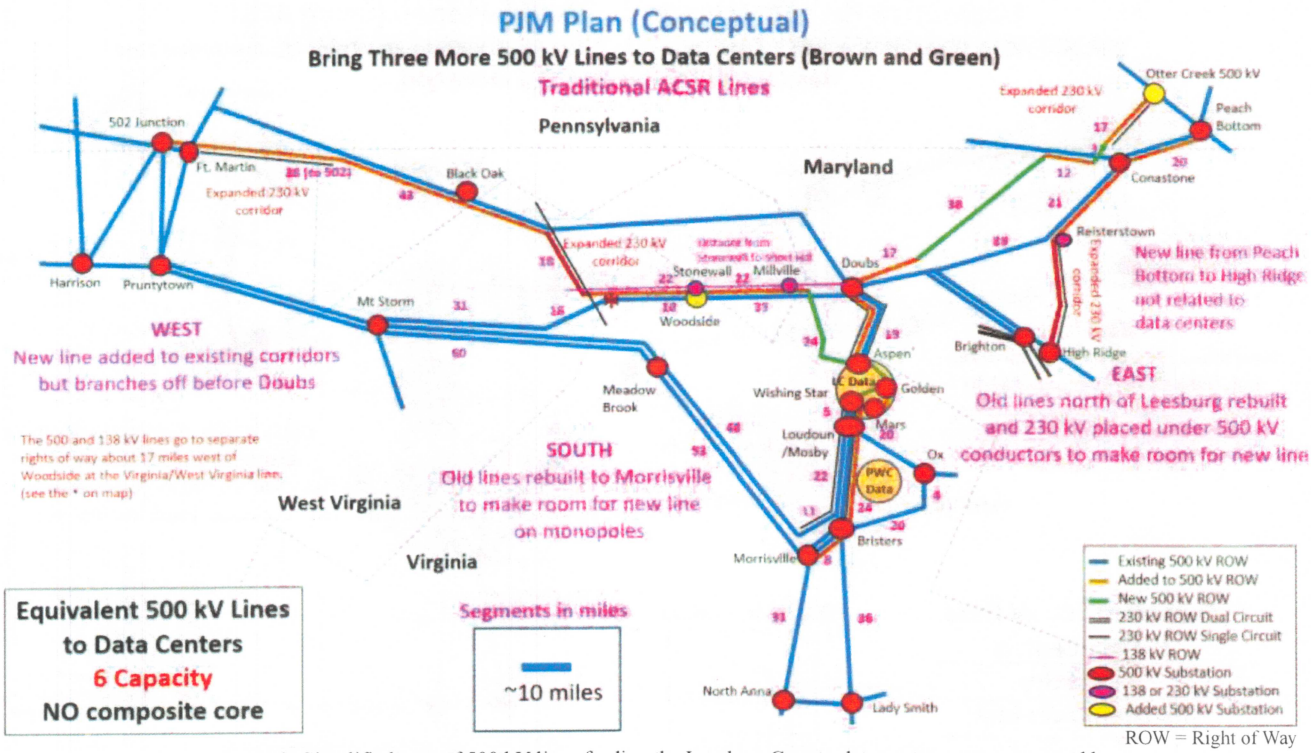

ROW = Right of Way

Figure 2: Simplified map of 500 kV lines feeding the Loudoun County data center area as proposed by PJM. The additional lines going to Loudoun County are shown in green (new rights of way) or brown (existing or expanded rights of way). Segments are marked in approximate miles.

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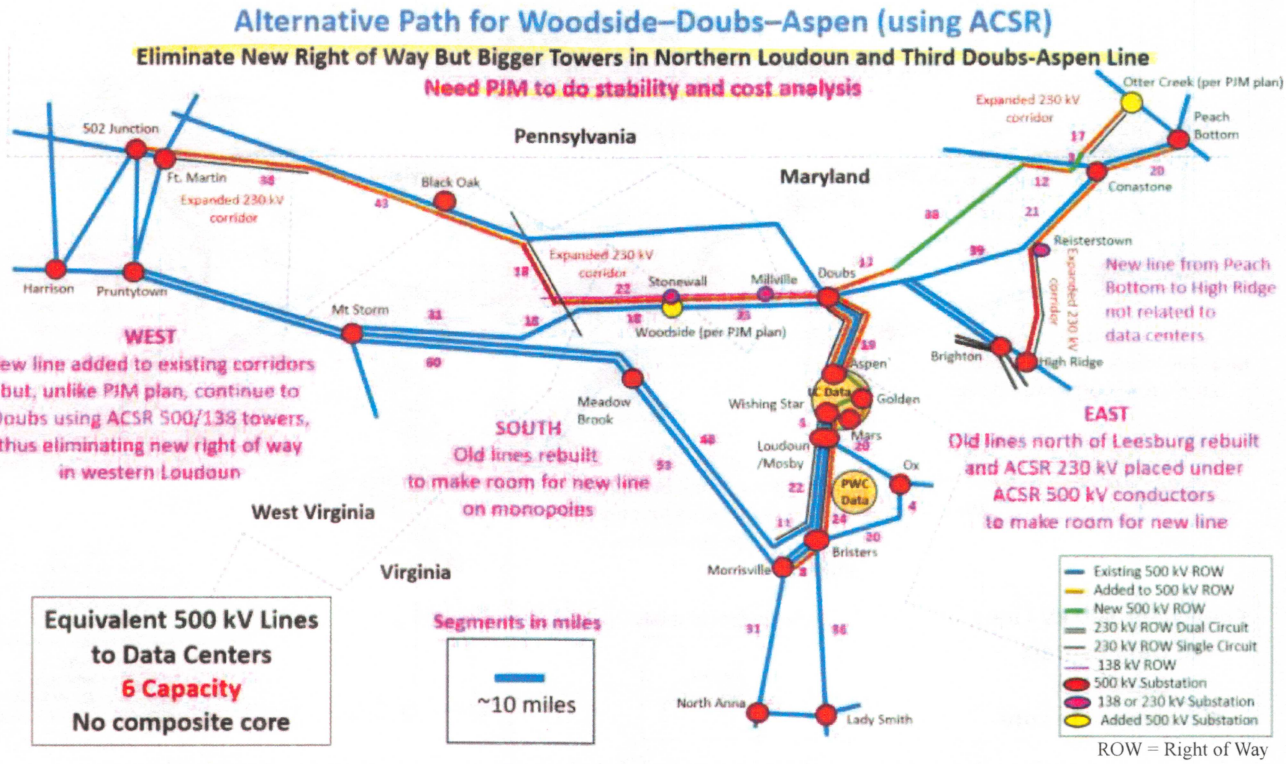
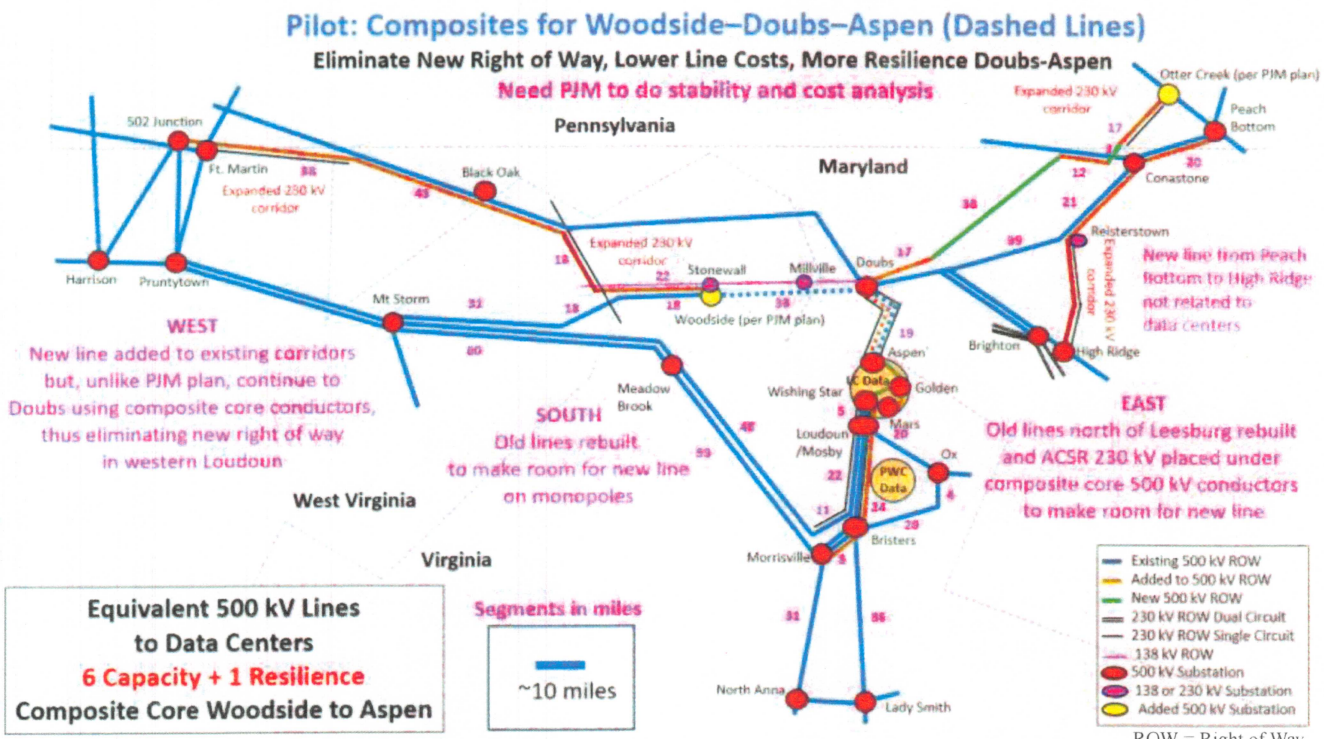


ROW = Right of Way

Figure 3: Simplified map showing the PJM plan but with the western line going through the Doubs substation on the way to Aspen rather than through western Loudoun County. This would require transforming the 138 kV line into a 500/138 kV line for about an additional 10 miles to reach Doubs. From Doubs, a third line would need to be added to the corridor going down to Aspen. The part of the corridor east of Leesburg could be physically crowded with three lines depending on the type of towers used. Monopoles would take less space but would be more expensive.



ROW = Right of Way

Figure 4: Simplified map of 500 kV lines feeding the Loudoun County data center area, modifying the PJM plan to eliminate the line cutting diagonally through western Loudoun by using composite core conductors (dashed lines) on the existing line between Woodside (new 500 kV substation) and Doubs and on one or two of the two lines that will run between Doubs and Aspen. Using both lines would enhance the capacity between Doubs and Aspen, thus providing additional resilience for this critical segment. It would save money and time by not creating a new right of way in western Loudoun. Additional substation work beyond what is called for in the PJM plan would be limited to providing higher current capacity at Doubs and Aspen and perhaps limited voltage compensation at Doubs. The composite conductor work requires coordination with the company building the line through Woodside and with the three companies selected to rebuild the Doubs to Aspen link. To reduce technical risk and coordination between Doubs and Aspen, a third conventional parallel line could be used instead.