

## Transmission in Highway ROW: Design Considerations

There are a variety of considerations for transmission developers and departments of transportation to enable the safe and efficient deployment of transmission infrastructure into highway rights-of-way (ROWs).

This document provides information regarding transmission line design considerations for transmission lines in a highway or interstate ROW without causing undue burden or risk to the ongoing activities of the DOT.

Through discussions with state DOTs, the NextGen Highways team has identified that safety of employees and vehicles passengers, timing and magnitude of traffic impacts, ROW access, and impacts on future highway construction needs as the primary concerns for state DOTs.

In 2003, Wisconsin passed Act 89, prioritizing the siting of transmission lines within existing transmission and highway corridors across the state. Since the passage of this bill, a portion of 26 transmission projects have been sited in highway ROW, including eight projects sited within interstate ROW. In total, over 200 miles of highway and interstate ROW have been used to:

- Conserve forests and other undeveloped habitats
- Minimize the need for private land
- Minimize the environmental and viewshed impacts for the public • Utilize corridors that have already been disturbed

The NextGen Highways team has conducted a thorough review of the planning and design of the [Badger Coulee](#) transmission project, which is a 345 KV transmission project developed by American Transmission Company and Xcel Energy. The project runs approximately 180 miles from La Crosse County, WI to Dane County, WI, predominantly along and within the interstate highway right-of-way.

Prior to construction, a number of routes were considered and a detailed examination of highway ROW impacts for each route option were captured in a [constructability report](#).

*Please note, this document does not provide a detailed discussion of highway design, construction, and maintenance. This report only touches on these needs as they directly relate to transmission infrastructure in the highway ROW.*

# Transmission Design Considerations

During the transmission design process, the transmission developer must account for areas to avoid or route around, and future highway construction plans and expected needs. Areas to route around include military installations, scenic easements, highway crossings, interchange crossings, bridges, and clear zones (i.e. areas where placement of infrastructure would pose a safety risk to the public). These constraints can largely be addressed by modifying the transmission line route and/or design.

Summary of Highway ROW Consideration in Transmission Design				
Highway ROW Consideration	Description	Transmission Types Impacted	Solution Options	Number of Instances in Badger Coulee Route
Military Installations	Clearance restrictions limit the use of overhead lines	Overhead	Route modification including potentially outside highway ROW	85
Scenic Easements & Environmentally Sensitive Areas	In sensitive areas and where scenic easements exist or are planned, placement of transmission infrastructure along the ROW boundary may be challenging or infeasible	Overhead	Route modifications including potential for additional infrastructure elsewhere within the highway ROW or roadway crossings	34
Highway Crossings	Siting constraints on one side of the ROW may require a highway crossing to run along the other side of the highway ROW	Overhead, Underground	Design crossings to minimize construction and maintenance costs and ROW impact, including perpendicular crossings, to minimize the length of line crossing the highway	15
Interchange Crossings	Routing transmission around highway interchanges increases the cost and complexity of the project. DOTs are concerned with potential impacts on traffic flows during transmission and construction maintenance, and future interchange expansion or modification needs.	Overhead, Underground	Transmission may be routed through or around interchanges, depending on site-specific conditions	32

Bridge Constraints	Bridge construction and maintenance, including the use of cranes, should not be impacted by transmission infrastructure	Overhead	<p>Siting transmission lines a sufficient distance from bridges also ensures that the lines can continue operating during bridge construction and/or maintenance</p> <p>Transmission design may modify pole placement and/or horizontal offsets between transmission infrastructure and existing bridges (i.e., 75 ft for Badger Coulee line)</p>	
Clear Zones	Clear zones are areas that require a minimum set back distance for road-level structures from the roadway to mitigate vehicle safety risk. These requirements would apply to transmission towers within a highway ROW and for line overhang both at rest and when swinging due to crosswinds.	Overhead	DOT and utility determine appropriate clear zone width (46 ft for ILS 94 in WI) required. Wider clear zones may be required to avoid shoulder or travel lane overhang on curves. If sufficiently large clear zones are not feasible, permanent shielding may be required.	<p>Road level: continuous;</p> <p>Line overhang: 21</p>
Future Highway Expansion	Future traffic volume growth and aging of highway infrastructure will require maintenance and expansion of highways. These plans and needs are not always known well in advance.	Overhead, Underground	Close coordination between utility and DOT throughout the planning process to identify appropriate infrastructure location based on known DOT Plans. Future utility relocation may be required.	Continuous
Impacts on Other Utilities	Fiber optic lines, electrical distribution, or other utilities may already be located within a highway ROW. Inadequate planning	Overhead, Underground	<p>The DOT has unique knowledge of any other existing or planned utilities in the highway ROW. Transmission developers largely plan around them.</p> <p>Design of transmission may be limited or utility relocation may be required.</p>	Continuous

## Military Bases

Along the Badger Coulee transmission line route, there were two military bases in close proximity to the highway ROW. Fort McCoy, a major military training base, is located in Monroe County, WI and straddles I-90, an initial route option. Officials from Fort McCoy participated in ATC's public input process and identified several Accident Potential Zones (see page 39 of [this document](#)) which are restricted from any development that could potentially interfere with aircraft, per US Department of Defense policy. At that time, the transmission team decided to avoid Fort McCoy altogether and sought other priority transmission corridor opportunities.

## Scenic Easements & Environmentally Sensitive Areas

Scenic easements and environmentally sensitive areas along highway corridors can restrict the placement of man-made structures within the highway ROW. This introduces additional complexity and cost to the siting and routing process for the transmission line. The route may be modified to avoid these areas within or outside the highway ROW. Additional infrastructure may need to be located in the highway ROW to enable the modified routing.



(Photo courtesy of the Wisconsin Department of Transportation Transmission Playbook: Accommodation on Interstate and Freeway Right-of-Way)

In addition to the route design taking sensitive areas into account, the transmission developer also develops access, construction, protection, and restoration [plans](#) for sensitive areas along the route where construction will take place. These plans also include extensive monitoring following construction to ensure vegetation restoration efforts are successful.

## Highway Crossings

There are likely to be points along any transmission line routed within a highway ROW that the roadway will need to be crossed because one side or the other presents obstacles or other areas to avoid building in, such as environmentally sensitive areas and inhabited dwellings. Among the routes considered for the Badger Coulee line, between nine and twelve such crossings were identified.



(Photo courtesy of the Wisconsin Department of Transportation Transmission Playbook: Accommodation on Interstate and Freeway Right-of-Way)

The DOT's desire is to minimize infrastructure that has any potential to impact the roadway, including direct or potential physical impacts as well as visual impacts. As such, overhead line length above the roadway should be minimized by routing crossings perpendicular to the roadway. In some cases, a less perpendicular path may be desirable or acceptable based on transmission cost savings or reduced visual impact of the highway crossing.

## Interchange Crossings

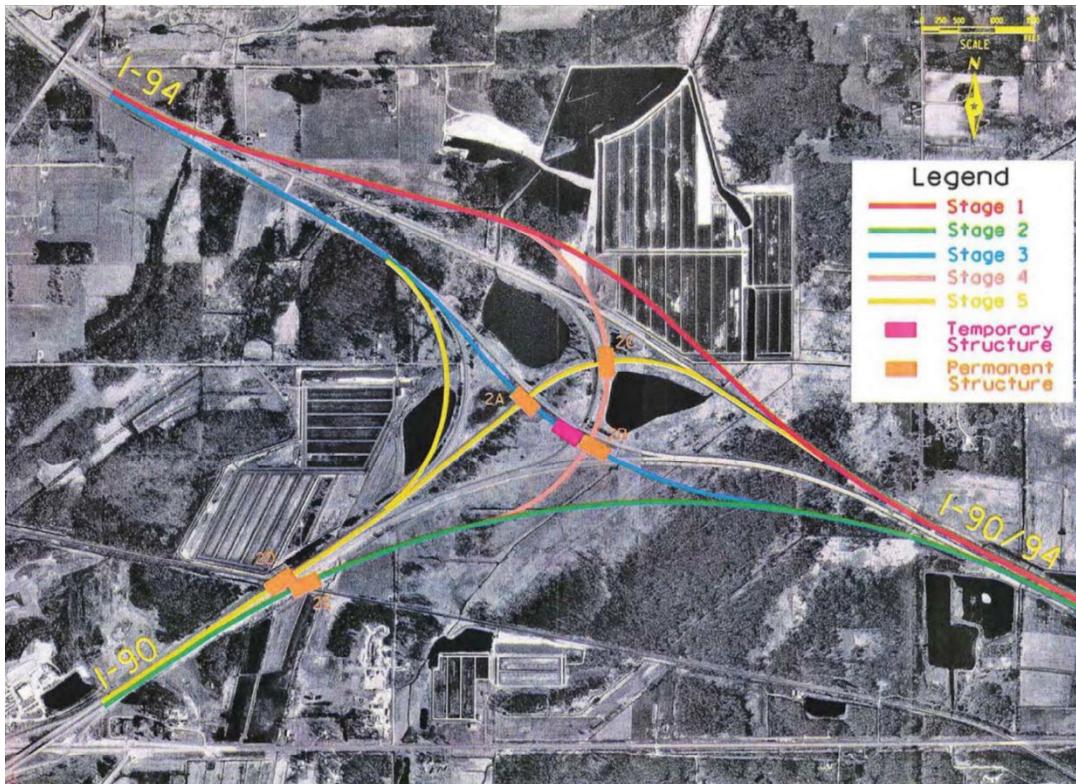
Similar to other constraints, a transmission line routed along the highway ROW will encounter interchanges. The Badger Coulee line demonstrated that there is some flexibility in transmission design as it is possible to route the line around or across the interchange based on site-specific conditions, cost, and complexity.

As ATC and WisDOT began coordination, WisDOT identified 32 instances of transmission facilities proposed to be built near and even through interchanges between the two proposed routes. Many of these interchanges had upgrades and expansions planned or expected to be needed in the future.



Routing around interchanges is not ideal for transmission developers as the design must become more complex and requires more expensive angle towers. WisDOT was willing to consider route designs that passed the transmission lines through interchanges.

In Wisconsin, the I-39/90/94 interchange in Portage, WI, both the transmission route alternatives proposed by Xcel Energy and ATC “totally encompassed this major Interstate system interchange”. WisDOT notified the utilities of its future interchange redesign and expansion would require relocation of transmission towers and lines (see figure below).



I-9094 Interchange Study: Wisconsin Department of Transportation – District 5 (Photo courtesy of the Wisconsin Department of Transportation Transmission Playbook: Accommodation on Interstate and Freeway Right-of-Way)

## Bridge Constraints

Bridge construction and maintenance requires the use of cranes and thus overhead 33 transmission near a bridge crossing a highway would pose a safety hazard.. Therefore, clearance between any overhead transmission is a key consideration in pole placement

design. The DOT may require the utility to implement horizontal offsets from the roadway for pole structures. For the Badger Coulee line, ATC and WisDOT agreed on a 75-foot offset.



US 12, Madison Beltline at Fish Hatchery Rd., ATC West Middleton to Rockdale (Photo courtesy of the Wisconsin Department of Transportation Transmission Playbook: Accommodation on Interstate and Freeway Right-of-Way)

## Clear Zones

To avoid safety risk for vehicles traveling on highways, clear zones are established which require a minimum set back from the roadway for road-level structures. Clear zones can also apply to overhead infrastructure, like a transmission conductor.

During the design process for a transmission line within a highway ROW, the utility coordinates with the DOT to determine appropriate clear zone locations and width. In Wisconsin, Xcel Energy and ATC worked with WisDOT to determine that a clear zone of 46 feet was sufficient for pole structures to be placed from the roadway along Interstates 30, 90 and 94, and US Highway 53. In addition to evaluation of collision risk with road-level structures, the utilities and DOT also examined locations with potential conductor overhand into the roadway. In this analysis, both static conditions and swing conditions, assuming 96 mph perpendicular winds blowing the conductor over the roadway. Eight such instances were identified along the 170-mile Badger Coulee line route.

## Future Highway Maintenance and Expansion

State DOTs have various planning processes and planning horizons for needed maintenance, construction, and expansion of highways in the state. Some future expansion projects are known several years ahead of time and can be incorporated into transmission line routing and design. However, like all infrastructure planners, the DOT will likely never have perfect insight into future highway expansion needs.

Where expansion needs are anticipated, for example, due to expected traffic volume growth, transmission structures can be placed to avoid expected future highway construction and operation. Close coordination is needed between the transmission developer and the state DOT throughout the transmission design and routing process to ensure optimal placement of pole structures within and along the highway ROW. The benefit of this early coordination was apparent for the Badger Coulee line, as noted in the Constructability Report:

“Early coordination with WisDOT has helped the applicants to better understand future WisDOT improvement and expansion plans for highways near the proposed transmission line. According to WisDOT’s six-year plan, no major expansion projects are planned along the portions of IH 39, IH 90, IH 94, and USH 53 where the applicants are considering placing the transmission line. This helps the applicants to plan the location of the line knowing that the existing highway configurations are not expected to change in the near future.”

## Impacts on Other Utilities

Several major fiber optic cables are buried within and just outside the WisDOT ROW along Interstate 94 between Madison, WI and Minneapolis, MN. Further, while the Badger Coulee line was being planned, Wisconsin Independent Network was also planning fiber optic expansion along the outer edge of the Interstate 90 ROW.

WisDOT was able to provide the transmission developers with detailed information on the location of these existing and planned fiber optic lines. The transmission developers were then able to largely avoid any digging near these lines altogether, and identify areas of close proximity so extra care not to damage the fiber optic lines could be taken during the construction process.