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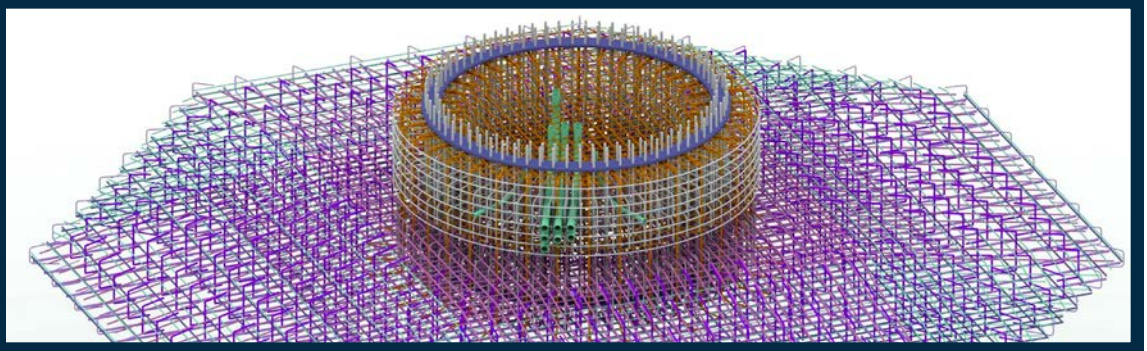


InRoads® Modeling Enables Mortenson Construction to Shrink Wind Farm Footprint

Mortenson Minimizes Disturbance of Federal Land by Designing Spring Valley Wind Project Using Bentley Software

Project Summary

Organization:
Mortenson Construction

Location:
Ely, Nevada, United States

Project Objective:

- Construct Nevada's first utility-scale wind farm on U.S. Bureau of Land Management property.
- Minimize disturbance of cultural, historical, and biological resources on federal land.
- Model each stage of construction to optimize equipment layout and reduce the footprint of the 66 turbines.

Products used:
Bentley Map®, Bentley View®, InRoads Suite, MicroStation®

Fast Facts

- The model provided a visual tool for communicating daily action plans to the field.
- Project construction affected 312 acres but left a permanent footprint of just 80 acres.
- Spring Valley Wind generates 151.8 megawatts, enough power for 45,000 homes, offsetting the annual equivalent of carbon dioxide emissions from 52,000 cars.

ROI

- The design reduced each turbine site by 1.1 acres – nearly 40 percent of the original disturbance area approved by the BLM.
- Teardrop-shaped laydown sites saved 77 acres from disturbance.
- Round foundation holes removed 25 percent less dirt and placed the spoil pile closer to the hole, saving time and money.
- Changing a design to mitigate biological disturbances took less than one day using InRoads vs. several days without a model.

3D Modeling Helps Overcome Unique Project Challenges

Minneapolis-based Mortenson Construction was enlisted to build the USD 225 million Spring Valley Wind project, a 152-megawatt wind farm with 66 turbines located 30 miles east of Ely, Nevada, United States, on 7,673 acres of Bureau of Land Management (BLM) property. Although Mortenson has constructed more than 125 wind farms across North America, the project presented the unusual challenge to tread lightly on a culturally, historically, and biologically sensitive site. Bentley software helped Mortenson to minimize ground-disturbing activities by reducing each turbine footprint by 40 percent and helped the project team improve communication among project stakeholders, which led to a stronger, more collaborative relationship with the BLM and, in turn, will set the stage for future work Mortenson performs on BLM land.

Working Within Disturbance Limits

The first utility-scale wind farm in Nevada and the first to be built on federal land, Spring Valley Wind runs north-south for about 110 miles between Schell Creek and the Snake Range mountains in eastern Nevada. The precedent had been set previously for wind farms on federal land, but at the time none were commercial grade. This project presented the opportunity to generate 151.8 megawatts, enough power for 45,000 homes.

On the Spring Valley Wind project, Mortenson was responsible for design and construction of the 66 wind turbines, associated site access roads, underground collection system, switch yard, 230-kilovolt substation, an operations and maintenance building, and meteorological tower. A temporary laydown yard, concrete batch plant, and gravel pits were also part of the project.

The challenge was to erect the 80-meter-tall, 306-ton turbines within the limited disturbance area approved by the BLM. With more than 245 million acres of federal land in its care, the BLM is the nation's largest land manager. During project construction, cultural monitors were engaged to observe all land-disturbing activities, and identify and classify any historical or cultural finds within the construction zone. Any time land was cleared or excavated, the monitors had to give approval for work to proceed. Mortenson determined that minimizing the size of each turbine site would reduce land disturbance, lower cultural monitoring costs, and reduce the risk of work stoppage due to cultural or biological finds.

Mortenson was able to minimize ground-disturbing activities by reducing turbine footprint by 40 percent.

Modeling the Optimal Site Plan

Mortensen used InRoads Suite to model the entire project, through each stage of construction for all 66 turbine sites. Bentley's civil engineering road and transportation infrastructure design software provided complete drafting capabilities, powerful mapping tools, and design automation critical to the project. The models incorporated access routes and staging areas for delivery vehicles, trucks, cranes, and individual pieces of equipment. Part laydown and equipment configuration were optimized for each site. Mortenson engaged superintendents and lead foremen in the process to ensure that the design assumptions were accurate and that the layouts were workable.

Using InRoads, Mortenson was able to shave 77 acres from the project and minimize the disturbance of cultural, historical, and biological resources. The model also made it possible to make design changes as situations arose in the field. Protecting wildlife was a priority, and the BLM required

"Bentley's solutions reduced the project footprint, the amount of field time spent being delayed by environmental, biological and cultural conflicts,and also improved communication amongst the stake holders, which led to a stronger more collaborative relationship with the BLM land managers. This set the stage for future work Mortenson performs on BLM land."

— Sera Maloney, Integrated Construction Manager, Mortenson Construction

InRoads enabled the team to deliver a 3D model for machine-controlled grading.

a team of biologists to be on site throughout the project to assist in identifying and reducing the impact on native species. One example was when a colony of pygmy rabbits was identified during project mobilization. Mortenson had to redesign roads and collection systems and relocate two turbines to skirt the habitat. Using the InRoads model allowed the team to make design changes quickly without impacting the project schedule and deliver the new model electronically for machine-controlled grading. A task that would have taken days to coordinate was accomplished within one day.

Avoiding Conflicts and Delays

The ability to avoid schedule delays was significant, since each season brought new potential impacts to native wildlife, which could delay the project. The historically field-coordinated task of threading rebar and electrical conduit for the turbine foundation bases typically requires frequent changes and could have easily caused delays. By modeling the foundation rebar and running clash detection, the project team was able to resolve conflicts before they occurred in the field. This helped to keep the schedule on track so that foundations were completed in the fall, before sage grouse became active in the winter and migratory birds entered the site in the spring.

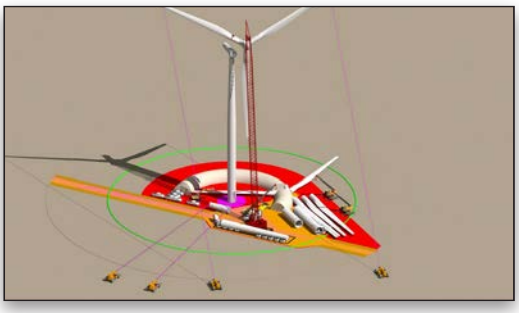
During spring migration, identified bird nests required a 200-foot buffer zone where no work or vehicle traffic could occur until a BLM variance was approved. This made it necessary to redirect traffic and relocate cranes, equipment, and materials. Mortenson held daily "plan-of-the-day" meetings between the site team and biologists to identify "go" and "no-go" areas. An interactive white board and the latest set of electronic plans facilitated communication with the field. Bentley software enabled the project team to interact visually with the design and site map, as well as mitigate the impact of these challenges by making design changes manageable.

Sera Maloney, Mortenson's senior integrated construction manager, noted: "Bentley solutions reduced the project footprint but also improved communication amongst stakeholders, which led to a stronger, more collaborative relationship with the BLM land managers. This set the stage for future work Mortenson performs on BLM land."

Turbines Have 40 Percent Smaller Footprint

Using Bentley software, Mortenson gained buy-in on a plan that reduced each turbine site by 1.1 acres – nearly 40 percent of the original disturbance area approved by the BLM. The teardrop-shaped sites saved a total of 77 acres from disturbance. The InRoads model enabled Mortenson to achieve an optimal design as well as respond with agility when design changes were necessary. In addition, using the InRoads model for machine controlled grading enhanced the accuracy and efficiency of earthmoving operations. Modeling thus helped to minimize costs associated with land disturbance, biological and cultural impacts, and construction delays.

"The amount of field time spent being delayed by environmental, biological, and cultural conflicts was dramatically mitigated by our commencing the project with an optimized laydown plan and by our agility in redesign when impacts were encountered," Maloney said. "Bentley software played an integral role in Spring Valley's successes in these key areas."



Changing a design to mitigate biological disturbances took less than one day using InRoads versus several days when a model was not used.

Spring Valley Wind exemplified how a project can be properly executed with minimal impact on the land. Equipped with the right software tools, Mortenson was able to attend to the details, such as digging round foundation holes instead of rectangular ones. This seemingly simple change removed 25 percent less dirt and placed the spoil pile closer to the hole, saving both time and money as well as treading more lightly on sensitive land.

Powering Nevada's Homes

Six years in the making, the Spring Valley Wind project boosted total wind power production on BLM land from 440 megawatts to 600 megawatts. Construction started during the summer of 2011 and was completed within a year. Commercial operation commenced in August 2012, with the wind power sold to NV Energy under a 20-year agreement. The state's largest electric utility is already delivering power from the wind farm to customers in northern Nevada and will start to power customers in the Las Vegas Valley upon completion of a new transmission line from Ely to Apex. Over the next 20 years, the Spring Valley Wind project will not only provide clean renewable energy, but also generate more than USD 20 million in tax revenue for White Pine County and Nevada's Renewable Energy Fund.

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