Firelands Wind, LLC
Case No. 18-1607-EL-BGN

Application Part 4 of 17

Part 4 includes:

- **Exhibit A** **Wind Resource Map**
- **Exhibit B** **Feasibility Study**
- **Exhibit C** **System Impact Study**
- **Exhibit D** **Transportation Study**

Date Filed: January 31, 2019

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Exhibit A
Wind Resource Map

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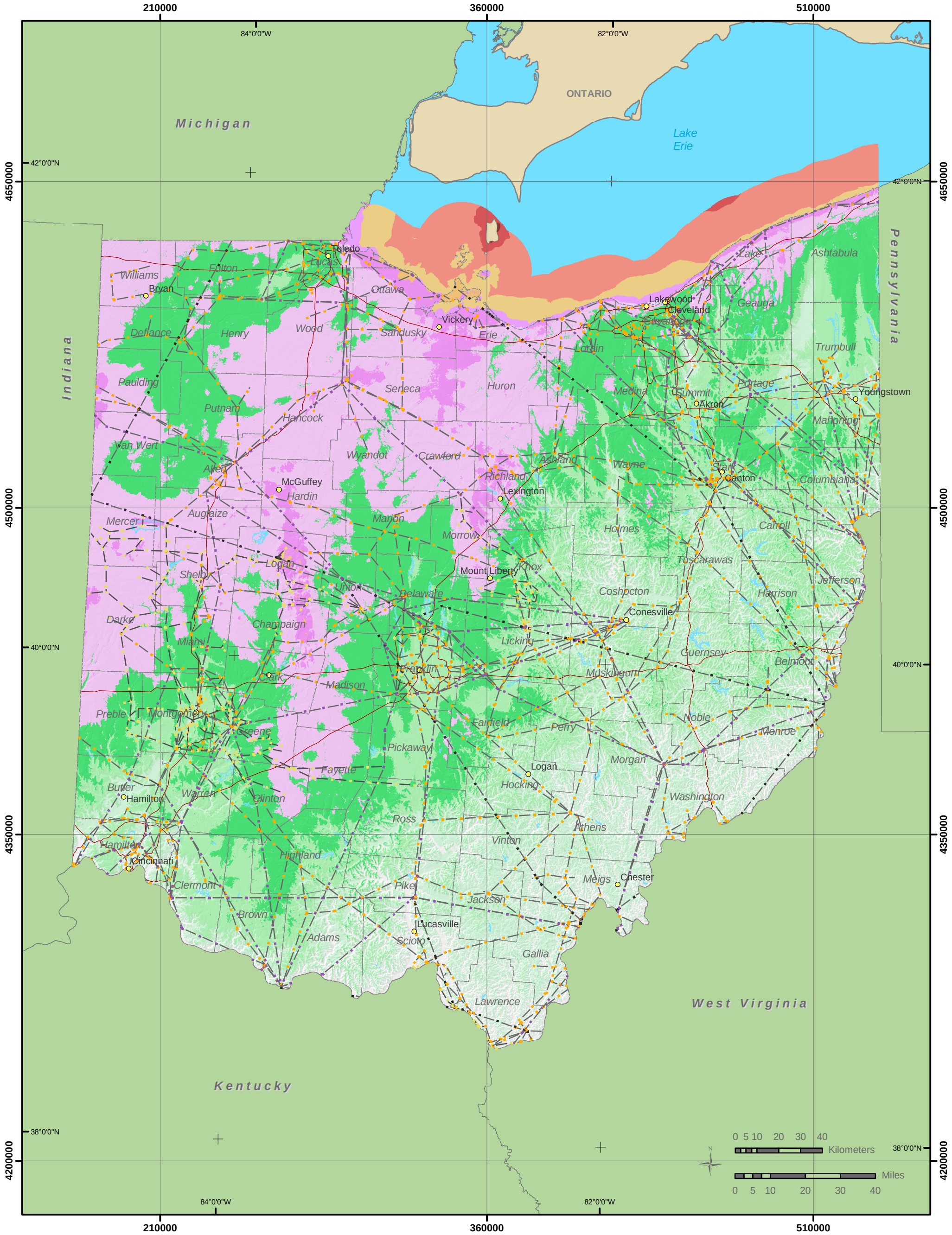
Exhibit A



Wind Resource of Ohio

Mean Annual Wind Speed at 100 Meters

Features
- City
- Interstate Highway
- County Boundary
- Water Body

Generalized Transmission Line

Category	
Under 100 kV	500 kV
100 kV-161 kV	735 kV +
230 kV-287 kV	Step-Up
345 kV	DC Line

Mean Speed at 100 m	mph	m/s
	< 12.3	< 5.5
	12.3 - 13.4	5.5 - 6.0
	13.4 - 14.5	6.0 - 6.5
	14.5 - 15.7	6.5 - 7.0
	15.7 - 16.8	7.0 - 7.5
	16.8 - 17.9	7.5 - 8.0
	17.9 - 19.0	8.0 - 8.5
	19.0 - 20.1	8.5 - 9.0
	20.1 - 21.3	9.0 - 9.5
	> 21.3	> 9.5

AWS Truewind

Projection: Tranverse Mercator,
UTM Zone 17 WGS84
Spatial Resolution of Wind Resource Data: 200m
This map was created by AWS Truewind using the MesoMap system and historical weather data. Although it is believed to represent an accurate overall picture of the wind energy resource, estimates at any location should be confirmed by measurement.
The transmission line information was obtained by AWS Truewind from the Global Energy Decisions Velocity Suite. AWS does not warrant the accuracy of the transmission line information.

Exhibit B
Feasibility Study

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Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AC2-103

Beaver – Davis Bessie 345kV

August 2017

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

The conduct of light load analysis as required under the PJM planning process is not performed during the Generation Interconnection Feasibility Study phase of the PJM study process. Additional reinforcement requirements for this Interconnection Request may be defined during the conduct of the light load analysis which shall be performed following execution of the System Impact Study agreement.

General

Firelands Wind, LLC, the Interconnection Customer (IC), has proposed a solar generating facility located in Erie County, Ohio. The installed facilities will have a total capability of 297.66 MW with 38.69 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 31, 2021. **This study does not imply a ATSI commitment to this in-service date.**

Point of Interconnection

AC2-103 will interconnect with the American Transmission Systems Inc.(ATSI) transmission system along the Beaver – Davis Besse 345kV line.

The point of interconnection is on the Beaver-Davis Bessie 345kV line, approximately 28.1miles from Beaver and 31.8miles from Davis Besse 345kV substations at the same point of interconnection as the Emerson Creek Wind Farm Beaver-Davis Besse 345kV (X1-027A) POI.

Cost Summary

The AC2-103 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 2,322,400
Non Direct Connection Network Upgrades	$ 0
Total Costs	**$ 2,322,400**

In addition, the AC2-103 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 41,800
Previously Identified Upgrades	$ 636,200
Total Costs	**$ 678,000**

Cost allocations for these upgrades will be provided in the System Impact Study Report.

Attachment Facilities

No Attachment Facilities are required to support this interconnection request.

Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Activity Cost	Tax (if applicable)	Total Cost
Expanding the Beaver-Davis Besse (X1-027A) 345kV three circuit breaker ring bus into 345kV four circuit breaker ring bus to accommodate one 345kv circuit breaker and a 345kV generation-tie line exit.	$ 2,322,400	$ 304,100	$ 2,626,500
Total Direct Connection Facility Costs	**$ 2,322,400**	**$ 304,100**	**$ 2,626,500**

Non-Direct Connection Cost Estimate

No Non-Direct Connection Facilities are required to support this interconnection request.

Interconnection Customer Facilities

The proposed project consists of a wind farm with 82 Wind Turbine Generator Systems (WTGs), 3.63MW each, with a total maximum facility output of 297.7MW. The Firelands Wind, LLC collector substation will consist of one collector substation at a voltage level of 34.5kV and two transformers will be stepping up the collector substation voltage (34.5kV) to the transmission voltage (345kV). The Firelands Wind Farm collection facility site GPS location is (41.2922000, -82.7304890), the facility is located 5.25Miles from the POI. A 5.25miles 345kV generator-tie transmission line will be built by Firelands Wind, LLC to interconnect their wind farm facility to the POI (Beaver-Davis Besse 345kV AC2-103).

Transmission Owner Scope of Work

To interconnect the Beaver-Davis Besse (AC2-103) project into the Beaver-Davis Besse 345kV line, it is required to expand the Beaver-Davis Besse 345kV (X1-027A) POI to accommodate one additional 345kV circuit breaker and a new 345kV line exit to the Beaver-Davis Besse 345kV (AC2-103) 345kV generation tie-line (shown in attachment 2). It is required to install standard 345kV line protection panel, 345kV circuit breaker relay, communication equipment, and to adjust terminal end relay setting. Firelands Wind shall design and build a 5.25 miles 345kV generator-tie line from their collector facility to the POI. Any cost estimate and scope of

work in this report doesn't include the customer collector facility and the 5.28 miles 345kV generation-tie transmission line.

Firelands Wind LLC, is responsible for any cost incurred by FE for the construction of the Beaver-Davis Besse (AC2-103) point of interconnection.

This report contains detailed connection requirements, direct connection costs and schedule, power flow analysis, short circuit analysis, and a cost and schedule for any associated system reinforcements for the requested POI.

Firelands Wind, LLC will be responsible for acquiring all easements, properties and permits that may be required to construct the proposed 345kV generation tie-line and associated generation facilities.

The Beaver – Davis Besse 345kV (AC2-103) project direct connection and attachment facilities includes:

- Expanding the Beaver-Davis Besse (X1-027A) 345kV three circuit breaker ring bus into 345kV four circuit breaker ring bus to accommodate one 345kV circuit breaker and a 345kV generation-tie line exit.
- Installing a 345kV line dead-end structure, 345kV circuit breaker, DSW's, MOABS, CVT'S and arresters.
- Installing 345kV line relay & control panel over fiber.
- Installing standard dual pilot 345kV SEL411L line relay & control and SEL501 breaker failure to trip (BFT).
- Install and terminate fiber communication at the POI. The 345kV generation tie-line fiber communication will be provided by the Firelands Wind, LLC.
- Prepare foundation, conduit and grounding for 345kV breaker, line dead-end and support structure.

The cost does not include communications installation and termination at the POI.

Transmission Owner Schedule

Based on the scope of the direct connection and attachment facility required for the Beaver-Davis Besse 345kV (AC2-103) interconnection project, it is expected to take a minimum of eighteen (18) months from the signing of a Connection Service Agreement (CSA) to complete the direct connection and attachment facilities. The schedule assumes that there will be no environmental issues with any of the properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection, attachment facility and network upgrades, and that PJM will allow all transmission system outages when requested. The schedule assumes engineering start date of 09/01/2020 to meet the requested in-service date.

Interconnection Customer Requirements

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

3. The Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

4. The purchase and installation of a fully rated 345kV circuit breaker to permit tripping of the entire plant.

5. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

6. The purchase and installation of a 345kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer generation levels.

7. The purchase and installation of a revenue class meter for each unit to measure the power delivered in compliance with the FE standards.

8. The purchase and installation of supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FE Transmission System Control Center.

9. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.

10. A compliance with the FE and PJM generator power factor and voltage control requirements.

11. The execution of a back-up retail service agreement with the electric distribution company to serve the customer load supplied from the AC2-103 generation project interconnection point when the units are out-of-service.

12. Firelands Wind, LLC will be responsible for meeting all FE criteria as defined in the FE Requirements for Transmission Connected Facilities document, including dynamic reactive capability. The FE dynamic reactive capability requires that a power factor range

of 0.95 leading (absorbing Vars) to 0.95 lagging (producing Vars) must be met at the generator's terminals.

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

ATSI Requirements

The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:

http://www.firstenergycorp.com/feconnect
http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx

System Protection Analysis and Requirements

The Beaver-Davis Besse 345kV (AC2-103) project will require a standard dual pilot SEL 411L line relay & control and a SEL501 breaker failure to trip (BFT) over fiber relay.

FE requires that all proposed facilities including the POI and the customer facilities must be designed in accordance with the FirstEnergy "Requirements for Transmission Connected Facilities" document, which can be found using the links above (ATSI Requirements).

Compliance Issues

Firelands Wind, LLC will be responsible for meeting all FE criteria as defined in the "FE Requirements for Transmission Connected Facilities" document. FE requires that a power factor range of 0.95 leading (absorbing Vars) to 0.95 lagging (producing Vars) must be met at the Generator's Terminals.

Firelands Wind, LLC must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required for standards compliance. For example, the Developer will need to properly locate and report the over and under-voltage and over and under-frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

Network Impacts

The Queue Project AC2-103 was evaluated as a 297.7 MW (Capacity 38.7 MW) injection tapping the Davis Besse – Beaver 345 kV line in the ATSI area. Project AC2-103 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-103 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
B2-SYS-345-810	CONTINGENCY 'B2-SYS-345-810' /* LINE 02HAYES TO 02DAV-BE 345 CK 1 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238654 CKT 1 /* 02HAYES 345 02DAV-BE 345 END
B3-SYS-345-700	CONTINGENCY 'B3-SYS-345-700' /* TRAN 02AVON 345 TO 02AVON 138 CK 91 DISCONNECT BRANCH FROM BUS 238551 TO BUS 238552 CKT 91 /* 02AVON 345 02AVON 138 END
B3-SYS-345-701	CONTINGENCY 'B3-SYS-345-701' /* TRAN 02AVON 345 TO 02AVON 138 CK 92 DISCONNECT BRANCH FROM BUS 238551 TO BUS 238552 CKT 92 /* 02AVON 345 02AVON 138 END
C2-CEI-345-001	CONTINGENCY 'C2-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345 DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345 END

Contingency Name	Description
C2-OEC-345-023	CONTINGENCY 'C2-OEC-345-023' /* BEAVER 345KV BRK B-121 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345 END
C2-OEC-345-031	CONTINGENCY 'C2-OEC-345-031' /* HAYES 345KV BRK B-3_6_ 12 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238654 CKT 1 /* 02HAYES 345 02DAV-BE 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1 /* 02HAYES 345 02BEAVER 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 239290 CKT 1 /* 02HAYES 345 02HAYES 138 END
C5-CEI-345-001	CONTINGENCY 'C5-CEI-345-001' /* AVON-BEAVER #1 AND #2 345KV LINE OUTAGES DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 1 /* 02AVON 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 2 /* 02AVON 345 02LAKEAVE 345 END
C5-OEC-345-001	CONTINGENCY 'C5-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345 END

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	N-1	B3-SYS-345-700	FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	99.31	100.07	ER	270	2.04	
2	LFFB	C2-CEI-345-001	FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	226.7	233.24	ER	270	39.19	7
3	DCTL	C5-CEI-345-001	FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	226.7	233.24	ER	270	39.19	
4	LFFB	C2-CEI-345-001	FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	103.17	107.28	ER	316	28.84	2
5	DCTL	C5-CEI-345-001	FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	103.17	107.28	ER	316	28.84	
6	LFFB	C2-CEI-345-001	FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	103.23	107.34	ER	316	28.84	6
7	DCTL	C5-CEI-345-001	FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	103.23	107.34	ER	316	28.84	
8	DCTL	C5-OEC-345-001	FE	02BEAVER-02BLKRVR 138 kV line	238570	239728	1	DC	113.43	116.2	ER	387	23.8	

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
9	LFFB	C2-OEC-345-031	FE	X1-027A TAP-02BEAVER 345 kV line	907060	238569	1	DC	92.87	101.86	ER	1742	156.68	1

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

#	Contingency Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Ref
10	DCTL	C5-OEC-345-001	FE	02BEAVER-02CARLIL 345 kV line	238569	238607	1	DC	106.79	114.47	ER	1139	87.52	3
11	LFFB	C2-OEC-345-023	FE	02BEAVER-02LAKEAVE 345 kV line	238569	239725	2	DC	101.7	108.12	ER	1742	111.77	4
12	LFFB	C2-CEI-345-001	FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	214.81	221.35	ER	270	39.19	8
13	DCTL	C5-CEI-345-001	FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	214.81	221.35	ER	270	39.19	

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Short Circuit

(Summary of impacted circuit breakers)

None

Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref
14	N-1	B3-SYS-345-701	FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	104.01	106.68	ER	270	15.99	
15	N-1	B2-SYS-345-810	FE	X1-027A TAP-02BEAVER 345 kV line	907060	238569	1	DC	91.87	100.94	ER	1742	157.94	

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#1, 2, 3	02USSTEEL-02LRN Q2 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • PJM baseline project (b2559) will not eliminate the identified overloads; the new rating is 435/500 SN/SE. The actual in service date is 05/31/2017. • PJM baseline project (b2896) will eliminate the identified overloads; the new rating for the Black River – US Steel 138 kV line will be 552/659 SN/SE. The scheduled in service date is 06/1/2021.	b2559 b2896	**$ 0**
#4, 5, 6, 7	02AD Q-2-02AVON 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • PJM baseline project (b2897) will eliminate the identified overloads; the new rating for the Admiral – Avon Q2 138 kV line will be 435/500 SN/SE. The scheduled in service date is 06/1/2021.	b2897	**$ 0**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#8	02BEAVER-02BLKRVR 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • PJM baseline project (b2673) and other upgrades will eliminate the identified overloads; the new rating for the Beaver – Black River 138 kV line will be 540/540 SN/SE. The scheduled in service date is 06/1/2020.	b2673	**$ 0**
#9	X1-027A TAP-02BEAVER 345 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • ATSI will propose to re-conductor the Beaver substation conductor (SCCIR) 954Kcmil ACSR 45/7 strand (the limiting element) with bundle 954kcmil ACSS 48/7 strand conductor, 2184MVA summer normal & 2326MVA summer emergency rating. After the proposed re-conductoring projects have been completed, the X1-027A-Beaver 345kV new line rating would be 1524MVA summer normal and 1878MVA summer emergency and the new limiting element will be the transmission line 954Kcmil ACSR 45/7 strand conductor. • The estimated cost to re-conductor the Beaver substation conductor on Beaver-X1-027(Davis Bessie) 345kV line is $41,800 (without tax).	TBD	**$ 41,800**
			Total New Network Upgrades	**$ 41,800**

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#10	02BEAVER-02CARLIL 345 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • ATSI will propose to upgrade the limiting elements at Beaver and Carlisle 345 kV substation on Beaver-Carlisle 345 kV line. The limiting elements are GCY51 ZR3 relay at Beaver and relay thermal (RT) CEYB, impedance relay (ZR) GCY and relay thermal blinder (RT BDD) at Carlisle 345kV substation. A new Dual SEL 345kV relay with UPLC will be installed at Beaver and Carlisle substation, the Carlisle 345/138kV transformer #1 over current differential relay (BDD) setting will be adjusted. After all proposed upgrade projects have been completed, the Beaver-Carlisle 345kV line new rating would be 1228 MVA summer normal and 1424 MVA summer emergency rating, the limiting element would be a wave-trap at Carlisle. • The estimated cost to upgrade the Beaver-Carlisle 345kv line relay is $504,700 (without tax).	TBD	**$ 504,700**
#11	02BEAVER-02LAKEAVE 345 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • ATSI will propose to re-conductor the existing (2) 954Kcmil ACSR substation conductor (SCCIR) at Beaver 345kV substation with (2) 954kcmil ACSS 48/7 strand conductor, 2156 MVA summer normal & 2295 MVA summer emergency rating and the Beaver - Lake Ave 345 kV ckt 2 (2) 954Kcmil ACSR 45/7 strand conductor line drop at Beaver with (2) 954Kcmil 54/7 ACSS conductor, 2184 MVA summer normal rating and 2326 MVA summer emergency rating. After the proposed conductor work has been completed, the Beaver - Lake Ave 345 kV ckt2 new line rating would be 1555 MVA summer normal and 1892 MVA summer emergency, the limiting element will be a substation conductor (SCCIR) 3500 SAC 127 conductor at Beaver substation. • The estimated cost to re-conductor the Beaver 345kV substation and line drop conductor on the Beaver-Lake Ave # 345kV line is $45,000 (without tax).	TBD	**$ 45,000**

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost
#12, 13	02USSTEEL-02LRN Q2 138 kV line	In order to mitigate the overloads of facilities above, the following reinforcements are required: • PJM baseline project (b2559) will not eliminate the identified overloads; the new rating is 435/500 SN/SE. The actual in service date is 05/31/2017. • PJM baseline project (b2896) will eliminate the identified overloads; the new rating for the US Steel – Lorain Q2 138 kV line will be 498/593 SN/SE. The scheduled in service date is 06/1/2021. • The proposed mitigation is to re-conductor the Lorain substation conductor (the limiting element). Once the proposed mitigation and the PJM RTEP b2896 work have been completed, the US Steel - Lorain Q2 138kV line rating would be 548/688 SN/SE. The estimated cost to re-conductor the Lorain substation conductor on the US Steel - Lorain 138kV line is $86,500 (without tax).	 b2559 b2896 TBD	**$ 86,500**
			Total New Network Upgrades	**$ 636,200**

Light Load Analysis - 2020

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

Stability and Reactive Power Requirement

Stability and Reactive study to be completed during later study phases

Steady-State Voltage Requirements

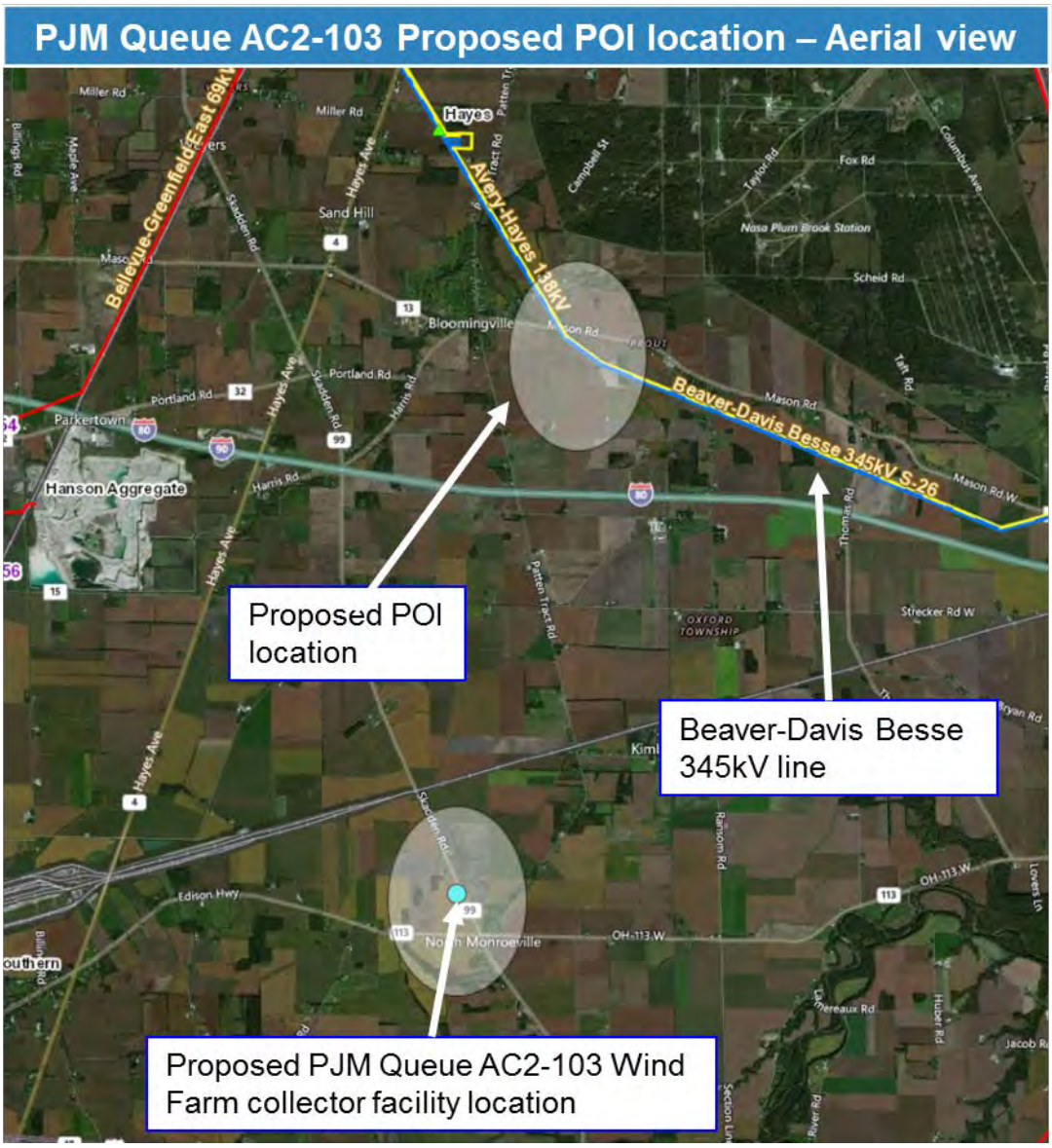
Steady-State Voltage study to be completed during later study phases

Affected System Analysis & Mitigation

MISO Impacts:

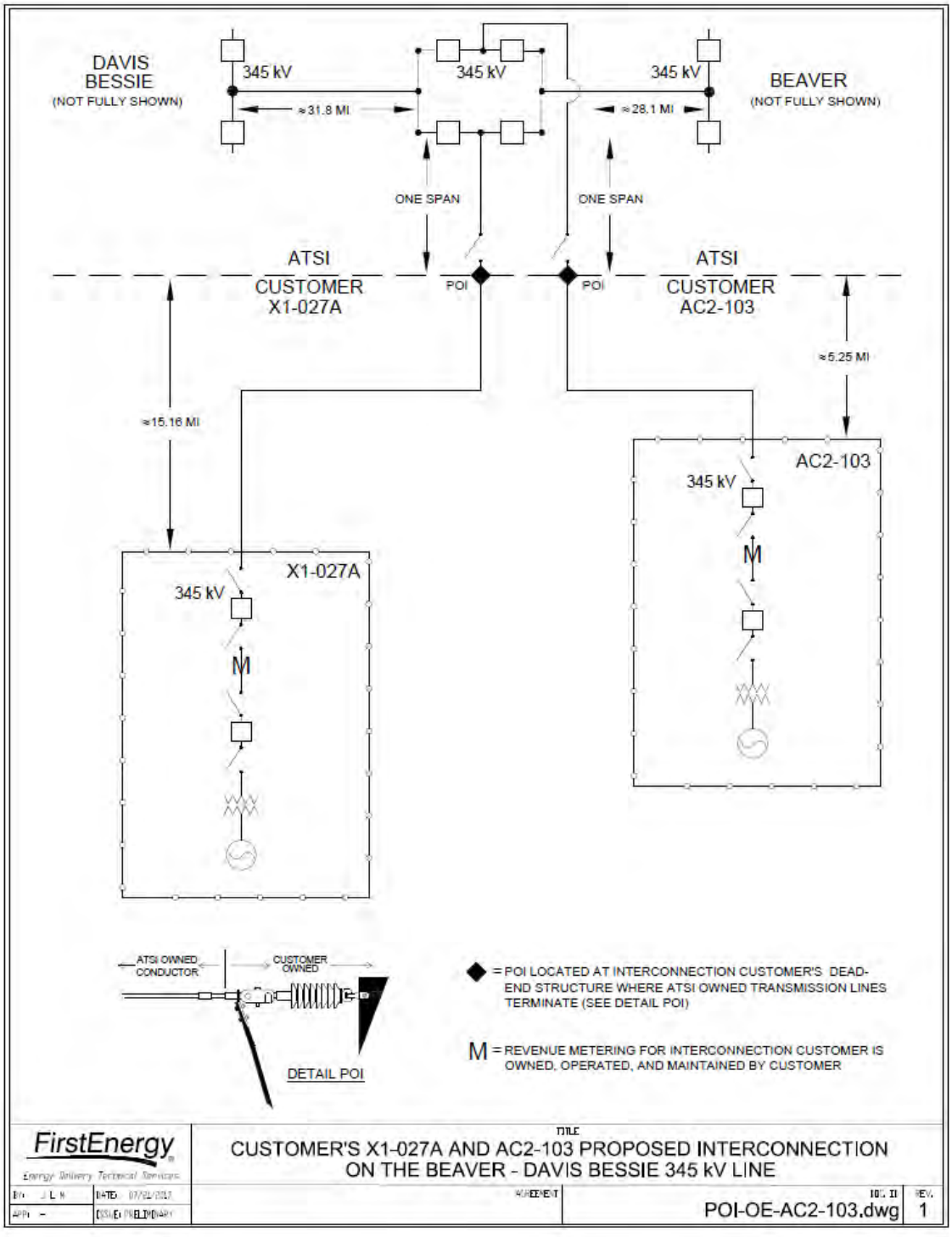
MISO Impacts to be determined during later study phases (as applicable).

Attachment 1. Project Location



Note: The Firelands Wind Farm Collection Facility is 5.28 miles away from the proposed POI

Attachment 2. Single Line Diagram



Attachment 3. Flowgate Details

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(FE - FE) The X1-027A TAP-02BEAVER 345 kV line (from bus 907060 to bus 238569 ckt 1) loads from 92.87% to 101.86% (**DC power flow**) of its emergency rating (1742 MVA) for the line fault with failed breaker contingency outage of 'C2-OEC-345-031'. This project contributes approximately 156.68 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
241902	02_Y1-069 GE	29.8
238564	02BAYSG1	25.09
240968	02BG2 GEN	1.26
240969	02BG4 G1	0.32
240970	02BG4 G2&3	0.63
240971	02BG4 G4&5	0.63
240950	02BG5	3.86
240973	02BG6 AMPO	5.61
239276	02COLLW 11	-3.2
239297	02CPPW41	-3.93
238670	02DVBSG1	46.33
238885	02LEMOG1	5.72
238886	02LEMOG2	5.72
238887	02LEMOG3	5.72
238888	02LEMOG4	5.72
238979	02NAPMUN	6.34
240975	02PGE GEN	8.71
931791	AC2-103 C	20.37
931792	AC2-103 E	136.31

Bus Number	Bus Name	Full Contribution
907062	X1-027A E1	57.27
907065	X1-027A E2	57.27
907067	X1-027A E3	57.27
907069	X1-027A E4	57.27
LTF	Y3-032	43.08
701261	Y4-027 C	0.3
701262	Y4-027 E	1.2
701341	Y4-035 C	0.1
701342	Y4-035 E	0.4
701421	Y4-043 C	0.07
701422	Y4-043 E	0.2
701431	Y4-044 C	2.56
701432	Y4-044 E	7.67
701491	Y4-050 C	1.7
701492	Y4-050 E	5.11
701531	Y4-054 C	0.89
701532	Y4-054 E	2.66
701571	Y4-058	8.6
701581	Y4-059	26.08

Bus Number	Bus Name	Full Contribution
998321	J496	13.69
998541	J533	11.83
998571	J537	17.63
998581	J538	11.61
998591	J540	2.45
961591	J589	12.69
961341	J601	9.01
961351	J602	14.33
961401	J608	5.28
247567	V2-006 C	2.14
247961	V2-006 E	14.33
901803	W1-072A	8.12
907061	X1-027A C1	1.5
907064	X1-027A C2	1.5
907066	X1-027A C3	1.5
907068	X1-027A C4	1.5

Bus Number	Bus Name	Full Contribution
701601	Y4-061	13.1
701662	Y4-067 E	23.51
701781	Y4-079	10.5
701791	Y4-080	2.71
701851	Y4-086	8.23
701861	Y4-087	7.88
701881	Y4-089	13.21
701891	Y4-090	2.48
701901	Y4-091	0.12
LTF	Z1-043	13.96
921102	AA1-056	9.75
923092	AB1-107 CT1	49.68
923094	AB1-107 CT2	57.13
923096	AB1-107 ST1	68.09
LTF	AB2-013	7.98
926941	AC1-181	0.7

Appendix 2

(FE - FE) The 02AD Q-2-02AVON 138 kV line (from bus 238524 to bus 238552 ckt 1) loads from 103.17% to 107.28% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'C2-CEI-345-001'. This project contributes approximately 28.84 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	9
238571	02BEAVGA	1.37
238572	02BEAVGB	1.43
240968	02BG2 GEN	0.45
240969	02BG4 G1	0.11
240970	02BG4 G2&3	0.23
240971	02BG4 G4&5	0.23
240950	02BG5	1.39
240973	02BG6 AMPO	2.03
239276	02COLLW 11	-2.2
239297	02CPPW41	-2.86
238979	02NAPMUN	2.15

Bus Number	Bus Name	Full Contribution
247551	U4-028 C	0.72
247940	U4-028 E	4.84
247552	U4-029 C	0.72
247941	U4-029 E	4.84
247548	V4-010 C	1.57
247947	V4-010 E	10.51
901803	W1-072A	2.54
907062	X1-027A E1	10.54
907065	X1-027A E2	10.54
907067	X1-027A E3	10.54
907069	X1-027A E4	10.54
LTF	Y3-032	13.66

Bus Number	Bus Name	Full Contribution
240975	02PGE GEN	3.14
239175	02WLORG-6	2.26
931791	AC2-103 C	3.75
931792	AC2-103 E	25.09

Bus Number	Bus Name	Full Contribution
921102	AA1-056	2.99
923092	AB1-107 CT1	17.74
923094	AB1-107 CT2	17.51
923096	AB1-107 ST1	20.86

Appendix 3

(FE - FE) The 02BEAVER-02CARLIL 345 kV line (from bus 238569 to bus 238607 ckt 1) loads from 106.79% to 114.47% (**DC power flow**) of its emergency rating (1139 MVA) for the tower line contingency outage of 'C5-OEC-345-001'. This project contributes approximately 87.52 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	22.44
240968	02BG2 GEN	1.13
240969	02BG4 G1	0.28
240970	02BG4 G2&3	0.57
240971	02BG4 G4&5	0.57
240950	02BG5	3.45
240973	02BG6 AMPO	5.02
238670	02DVBSG1	34.4
238979	02NAPMUN	5.41
240975	02PGE GEN	7.78
239171	02WLORG-2	5.47
239172	02WLORG-3	5.62
239173	02WLORG-4	5.6
239174	02WLORG-5	5.62
931051	AC2-015 C OP	4.83
931052	AC2-015 E OP	5.63
931791	AC2-103 C	11.38
931792	AC2-103 E	76.15
998321	J496	11.23
998571	J537	14.47
998581	J538	9.63
961591	J589	10.43
961341	J601	7.39
961351	J602	11.77
247926	U1-059 E	3.51

Bus Number	Bus Name	Full Contribution
907068	X1-027A C4	0.84
907062	X1-027A E1	31.99
907065	X1-027A E2	31.99
907067	X1-027A E3	31.99
907069	X1-027A E4	31.99
LTF	Y3-032	35.02
701261	Y4-027 C	0.25
701262	Y4-027 E	0.99
701341	Y4-035 C	0.08
701342	Y4-035 E	0.33
701421	Y4-043 C	0.06
701422	Y4-043 E	0.17
701431	Y4-044 C	2.1
701432	Y4-044 E	6.29
701491	Y4-050 C	1.4
701492	Y4-050 E	4.19
701531	Y4-054 C	0.73
701532	Y4-054 E	2.18
701571	Y4-058	7.06
701581	Y4-059	21.4
701601	Y4-061	10.75
701781	Y4-079	8.65
701791	Y4-080	2.22
701861	Y4-087	6.48
701881	Y4-089	10.84

Bus Number	Bus Name	Full Contribution
247551	U4-028 C	1.53
247940	U4-028 E	10.23
247552	U4-029 C	1.53
247941	U4-029 E	10.23
247567	V2-006 C	1.83
247961	V2-006 E	12.27
247548	V4-010 C	3.32
247947	V4-010 E	22.2
247942	W1-056 E	1.29
901803	W1-072A	6.59
907061	X1-027A C1	0.84
907064	X1-027A C2	0.84
907066	X1-027A C3	0.84

Bus Number	Bus Name	Full Contribution
701891	Y4-090	2.04
701901	Y4-091	0.1
921102	AA1-056	7.83
922573	AA2-186 E	1.71
923092	AB1-107 CT1	44.29
923094	AB1-107 CT2	45.86
923096	AB1-107 ST1	54.65
925751	AC1-051 C	0.72
925752	AC1-051 E	4.82
926941	AC1-181	0.6
927071	AC1-195 C	0.73
927072	AC1-195 E	5.32

Appendix 4

(FE - FE) The 02BEAVER-02LAKEAVE 345 kV line (from bus 238569 to bus 239725 ckt 2) loads from 101.7% to 108.12% (**DC power flow**) of its emergency rating (1742 MVA) for the line fault with failed breaker contingency outage of 'C2-OEC-345-023'. This project contributes approximately 111.77 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
241902	02_Y1-069 GE	30.51
238564	02BAYSG1	28.48
240968	02BG2 GEN	1.43
240969	02BG4 G1	0.36
240970	02BG4 G2&3	0.72
240971	02BG4 G4&5	0.72
240950	02BG5	4.38
240973	02BG6 AMPO	6.38
239276	02COLLW 11	-4.21
239297	02CPPW41	-5.18
238670	02DVBSG1	43.84
238979	02NAPMUN	6.91
240975	02PGE GEN	9.89
239171	02WLORG-2	6.99
239172	02WLORG-3	7.18
239173	02WLORG-4	7.17

Bus Number	Bus Name	Full Contribution
907068	X1-027A C4	1.07
907062	X1-027A E1	40.85
907065	X1-027A E2	40.85
907067	X1-027A E3	40.85
907069	X1-027A E4	40.85
LTF	Y3-032	44.85
701261	Y4-027 C	0.31
701262	Y4-027 E	1.23
701341	Y4-035 C	0.1
701342	Y4-035 E	0.41
701421	Y4-043 C	0.07
701422	Y4-043 E	0.21
701431	Y4-044 C	2.61
701432	Y4-044 E	7.84
701491	Y4-050 C	1.74
701492	Y4-050 E	5.22

Bus Number	Bus Name	Full Contribution
239174	02WLORG-5	7.19
931051	AC2-015 C OP	6.11
931052	AC2-015 E OP	7.13
931791	AC2-103 C	14.53
931792	AC2-103 E	97.24
998321	J496	13.99
998541	J533	12.12
998571	J537	18.02
998581	J538	11.99
998591	J540	2.52
961591	J589	13
961341	J601	9.21
961351	J602	14.67
961401	J608	5.42
247551	U4-028 C	1.93
247940	U4-028 E	12.92
247552	U4-029 C	1.93
247941	U4-029 E	12.92
247567	V2-006 C	2.38
247961	V2-006 E	15.9
247548	V4-010 C	4.17
247947	V4-010 E	27.9
901803	W1-072A	8.41
907061	X1-027A C1	1.07
907064	X1-027A C2	1.07
907066	X1-027A C3	1.07

Bus Number	Bus Name	Full Contribution
701531	Y4-054 C	0.91
701532	Y4-054 E	2.72
701571	Y4-058	8.79
701581	Y4-059	26.66
701601	Y4-061	13.39
701662	Y4-067 E	24.11
701781	Y4-079	10.77
701791	Y4-080	2.76
701851	Y4-086	8.44
701861	Y4-087	8.07
701881	Y4-089	13.5
701891	Y4-090	2.54
701901	Y4-091	0.12
LTF	Z1-043	15.19
LTF	Z1-112	5.75
921102	AA1-056	9.98
LTF	AA1-071	3.84
922573	AA2-186 E	2.21
923092	AB1-107 CT1	56.21
923094	AB1-107 CT2	58.48
923096	AB1-107 ST1	69.69
LTF	AB2-013	8.68
925751	AC1-051 C	0.91
925752	AC1-051 E	6.11
926941	AC1-181	0.77

Appendix 5

(FE - FE) The 02BEAVER-02BLKRVR 138 kV line (from bus 238570 to bus 239728 ckt 1) loads from 113.43% to 116.2% (**DC power flow**) of its emergency rating (387 MVA) for the tower line contingency outage of 'C5-OEC-345-001'. This project contributes approximately 23.8 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	7.58
238571	02BEAVGA	2.04

Bus Number	Bus Name	Full Contribution
931791	AC2-103 C	3.09
931792	AC2-103 E	20.71

Bus Number	Bus Name	Full Contribution
238572	02BEAVGB	2.12
240968	02BG2 GEN	0.38
240969	02BG4 G1	0.1
240970	02BG4 G2&3	0.19
240971	02BG4 G4&5	0.19
240950	02BG5	1.17
240973	02BG6 AMPO	1.7
239276	02COLLW 11	-1.56
239297	02CPPW41	-1.97
240975	02PGE GEN	2.63
239175	02WLORG-6	3.37

Bus Number	Bus Name	Full Contribution
247548	V4-010 C	1.33
247947	V4-010 E	8.92
901803	W1-072A	2.12
907062	X1-027A E1	8.7
907065	X1-027A E2	8.7
907067	X1-027A E3	8.7
907069	X1-027A E4	8.7
921102	AA1-056	2.5
923092	AB1-107 CT1	14.95
923094	AB1-107 CT2	14.62
923096	AB1-107 ST1	17.43

Appendix 6

(FE - FE) The 02LRN Q2-02AD Q-2 138 kV line (from bus 238915 to bus 238524 ckt 1) loads from 103.23% to 107.34% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'C2-CEI-345-001'. This project contributes approximately 28.84 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	9
238571	02BEAVGA	1.37
238572	02BEAVGB	1.43
240968	02BG2 GEN	0.45
240969	02BG4 G1	0.11
240970	02BG4 G2&3	0.23
240971	02BG4 G4&5	0.23
240950	02BG5	1.39
240973	02BG6 AMPO	2.03
239276	02COLLW 11	-2.2
239297	02CPPW41	-2.86
238979	02NAPMUN	2.15
240975	02PGE GEN	3.14
239175	02WLORG-6	2.26
931791	AC2-103 C	3.75
931792	AC2-103 E	25.09

Bus Number	Bus Name	Full Contribution
247551	U4-028 C	0.72
247940	U4-028 E	4.84
247552	U4-029 C	0.72
247941	U4-029 E	4.84
247548	V4-010 C	1.57
247947	V4-010 E	10.51
901803	W1-072A	2.54
907062	X1-027A E1	10.54
907065	X1-027A E2	10.54
907067	X1-027A E3	10.54
907069	X1-027A E4	10.54
LTF	Y3-032	13.66
921102	AA1-056	2.99
923092	AB1-107 CT1	17.74
923094	AB1-107 CT2	17.51
923096	AB1-107 ST1	20.86

Appendix 7

(FE - FE) The 02BLKRVR-02USSTEEL 138 kV line (from bus 239728 to bus 239734 ckt 1) loads from 226.7% to 233.24% (**DC power flow**) of its emergency rating (270 MVA) for the line fault with failed breaker contingency outage of 'C2-CEI-345-001'. This project contributes approximately 39.19 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	12.23
238571	02BEAVGA	1.85
238572	02BEAVGB	1.93
240968	02BG2 GEN	0.62
240969	02BG4 G1	0.16
240970	02BG4 G2&3	0.31
240971	02BG4 G4&5	0.31
240950	02BG5	1.89
240973	02BG6 AMPO	2.75
239276	02COLLW 11	-2.85
239297	02CPPW41	-3.63
238979	02NAPMUN	2.92
240975	02PGE GEN	4.26
239175	02WLORG-6	3.06
931051	AC2-015 C OP	3.46
931052	AC2-015 E OP	4.03
931791	AC2-103 C	5.09
931792	AC2-103 E	34.09
247542	U4-001 C	1.54
247934	U4-001 E	10.33
247551	U4-028 C	0.98
247940	U4-028 E	6.58
247552	U4-029 C	0.98

Bus Number	Bus Name	Full Contribution
247941	U4-029 E	6.58
247567	V2-006 C	1.04
247961	V2-006 E	6.98
247548	V4-010 C	2.13
247947	V4-010 E	14.27
901803	W1-072A	3.45
907062	X1-027A E1	14.32
907065	X1-027A E2	14.32
907067	X1-027A E3	14.32
907069	X1-027A E4	14.32
LTF	Y3-032	18.53
915951	Y3-092	31.54
915952	Y3-092 E	31.54
921102	AA1-056	4.06
922573	AA2-186 E	1.07
923092	AB1-107 CT1	24.11
923094	AB1-107 CT2	23.77
923096	AB1-107 ST1	28.33
923821	AB2-019	1.77
925751	AC1-051 C	0.51
925752	AC1-051 E	3.39
926941	AC1-181	0.33

Appendix 8

(FE - FE) The 02USSTEEL-02LRN Q2 138 kV line (from bus 239734 to bus 238915 ckt 1) loads from 214.81% to 221.35% (**DC power flow**) of its emergency rating (270 MVA) for the line fault with failed breaker contingency outage of 'C2-CEI-345-001'. This project contributes approximately 39.19 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	12.23
238571	02BEAVGA	1.85
238572	02BEAVGB	1.93
240968	02BG2 GEN	0.62
240969	02BG4 G1	0.16
240970	02BG4 G2&3	0.31
240971	02BG4 G4&5	0.31
240950	02BG5	1.89
240973	02BG6 AMPO	2.75
239276	02COLLW 11	-2.85
239297	02CPPW41	-3.63
238979	02NAPMUN	2.92
240975	02PGE GEN	4.26
239175	02WLORG-6	3.06
931051	AC2-015 C OP	3.46
931052	AC2-015 E OP	4.03
931791	AC2-103 C	5.09
931792	AC2-103 E	34.09
247542	U4-001 C	1.54
247934	U4-001 E	10.33
247551	U4-028 C	0.98
247940	U4-028 E	6.58
247552	U4-029 C	0.98

Bus Number	Bus Name	Full Contribution
247941	U4-029 E	6.58
247567	V2-006 C	1.04
247961	V2-006 E	6.98
247548	V4-010 C	2.13
247947	V4-010 E	14.27
901803	W1-072A	3.45
907062	X1-027A E1	14.32
907065	X1-027A E2	14.32
907067	X1-027A E3	14.32
907069	X1-027A E4	14.32
LTF	Y3-032	18.53
915951	Y3-092	31.54
915952	Y3-092 E	31.54
921102	AA1-056	4.06
922573	AA2-186 E	1.07
923092	AB1-107 CT1	24.11
923094	AB1-107 CT2	23.77
923096	AB1-107 ST1	28.33
923821	AB2-019	1.77
925751	AC1-051 C	0.51
925752	AC1-051 E	3.39
926941	AC1-181	0.33

Exhibit C
System Impact Study

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Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AC2-103

Beaver – Davis Bessie 345kV

November 2018

Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the Feasibility Study, but the actual allocation will be deferred until the System Impact Study is performed.

The System Impact Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

Firelands Wind, LLC, the Interconnection Customer (IC), has proposed a solar generating facility located in Erie County, Ohio. The installed facilities will have a total capability of 297.66 MW with 38.69 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 31, 2021. **This study does not imply a ATSI commitment to this in-service date.**

Point of Interconnection

AC2-103 will interconnect with the American Transmission Systems Inc.(ATSI) transmission system along the Beaver – Davis Besse 345kV line.

The point of interconnection is on the Beaver-Davis Bessie 345kV line, approximately 28.1miles from Beaver and 31.8miles from Davis Besse 345kV substations at the same point of interconnection as the Emerson Creek Wind Farm Beaver-Davis Besse 345kV (X1-027A) POI.

Cost Summary

The AC2-103 project will be responsible for the following costs:

Description	Cost	Tax (if applicable)	Total Cost
Attachment Facilities	$ 0	$ 0	$ 0
Direct Connection Network Upgrades	$ 10,863,300	$ 1,393,900	$ 12,257,200
Non Direct Connection Network Upgrades	$ 757,400	$ 97,300	$ 854,700
Allocation for New System Upgrades	$ 0	$ 0	$ 0

Description	Cost	Tax (if applicable)	Total Cost
Contribution for Previously Identified Upgrades	$ 0	$ 0	$ 0
Total Costs	**$ 11,620,700**	**$ 1,491,200**	**$ 13,111,900**

General Information

Interconnection Customer ("IC"): Firelands Wind LLC Queue Position: AC2-103

Interconnected Transmission Owner ("TO"): American Transmission Systems, Incorporated ("ATSI")

Impacted TO(s) (if applicable): American Transmission Systems, Incorporated ("ATSI")

PJM Zone: ATSI

FE Operating Company or Planning Region: Ohio Edison

Customer Connection Request

Requested Backfeed Date: N/A Requested Commercial Operation Date: 12/31/2021

This study does not imply a FirstEnergy commitment to these dates.

New Facilities		Existing Facilities	
Capacity:	38.69 MW	Capacity:	N/A
Energy:	297.66 MW	Energy:	N/A
MFO[1]:	297.66 MW	MFO:	N/A
Fuel:	Wind	Prior Queue Position(s):	N/A

Point of Interconnection

Primary Point of Interconnection: Beaver-Davis Bessie 345 kV

[1] Maximum Facility Output

Attachment Facilities

There are no Attachment Facilities are required to support this interconnection.

Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Activity Cost	Tax (if applicable)	Total Cost
Construct three (3) breaker 345kV ring bus substation for future four (4) breaker expansion @ AC2-103	$ 8,890,100	$ 1,140,600	$ 10,030,700
Construct a line tap to the proposed AC2-103 switching station. Construct one span from the proposed AC2-103 switching station to the customer POI. @ Beaver-Davis Besse (S-26) 345kV Line Tap to Customer POI	$ 1,383,500	$ 177,600	$ 1,561,100
Project Management, Commissioning, Environmental, Forestry, and SCADA.	$ 589,700	$ 75,700	$ 665,400
Total Direct Connection Facility Costs	**$ 10,863,300**	**$ 1,393,900**	**$ 12,257,200**

Non-Direct Connection Cost Estimate

There are no Non-Direct Connection Facilities are required to support this interconnection.

Description	Activity Cost	Tax (if applicable)	Total Cost
Standard dual SEL421 panel with UPLC for pilot scheme and DTT for the AC2-103 line @ Beaver SS	$ 285,600	$ 36,700	$ 322,300
Standard dual SEL421 panel with UPLC for pilot scheme and DTT for the AC2-103 line @ Davis Bessie SS	$ 285,600	$ 36,700	$ 322,300
Estimated MPLS router at AC2-103 substation to provide SCADA transport for new RTU. Next MPLS hops for SCADA backhaul are assumed to be at Avery substation and Hayes substation.	$ 186,200	$ 23,900	$ 210,100
Total Non-Direct Connection Facility Costs	**$ 757,400**	**$ 97,300**	**$ 854,700**

Transmission Owner Scope of Work

The interconnection of the project will be accomplished by constructing a new 345 kV three (3) breaker ring bus and looping the Beaver-Davis Bessie 345 kV line into the new station. The new substation will be located approximately 28.1 miles from Beaver substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated attachment facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed three breaker ring bus site.

A summary of the connection facilities that will be required for the Primary POI and their estimated costs are shown on the previous page. Based on this scope of work, it is expected to take a minimum of 20 months after the signing of an Interconnection Construction Service Agreement. This includes preliminary payment that compensates FE for the first three months of the engineering design work that is related to the construction of the AC2-103 interconnection substation. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection and network upgrades, and that PJM will allow all transmission system outages when requested.

Interconnection Customer Requirements

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

3. The Interconnection Customer seeking to interconnect a wind generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per item 5.iv. of Schedule H to the Interconnection Service Agreement.

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

FE Requirements

The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements

may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:

http://www.firstenergycorp.com/feconnect
http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx.

System Protection

The IC must design it's Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. Preliminary Protection requirements will be provided as part of the Facilities Study. Detailed Protection Requirements will be provided once the project enters the construction phase.

The IC has requested a non-standard GSU transformer winding configuration. This transformer is in violation of section 14.2.6 of FE's "Requirements for Transmission Connected Facilities" document and will not be accepted. The GSU transformer must have a grounded wye connection on the high (utility) side and a delta connection on the low (generator) side.

Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated [PRI POI VOLTAGE] kV circuit breaker to protect the AC2-103 generator lead line. A single circuit breaker must be used to protect this line; if the project has several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.

2. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

3. The purchase and installation of supervisory control and data acquisition ("SCADA") equipment to provide information in a compatible format to the FE Transmission System Control Center.

4. Compliance with the FE and PJM generator power factor and voltage control requirements.

5. The execution of a back-up service agreement to serve the customer load supplied from the AC2-103 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

Power Factor Requirements

The IC shall design its wind-powered non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the FE transmission system.

Network Impacts

The Queue Project AC2-103 was evaluated as a 297.7 MW (Capacity 38.7 MW) injection into the X1-027A 345 kV substation (which is a tap of the Davis Besse – Beaver 345 kV line) in the ATSI area. Project AC2-103 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AC2-103 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Contingency Descriptions

The following contingencies resulted in overloads:

Contingency Name	Description
C5-OEC-345-001	CONTINGENCY 'C5-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345 END

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None.

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

None.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

	Contingency		Affected		Bus			Power	Loading %		Rating		MW	
#	Type	Name	Area	Facility Description	From	To	Circuit	Flow	Initial	Final	Type	MVA	Contribution	Ref
1	DCTL	C5-OEC-345-001	FE - FE	02BEAVER-02BLKRVR 138 kV line	238570	239728	1	AC	95.87	100.86	ER	387	22.74	1

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper table in the Attachment.

Affected System Analysis & Mitigation

MISO Impacts:

MISO Impacts to be determined during later study phases (as applicable).

Short Circuit

(Summary of impacted circuit breakers)

None

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None

Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

See Attachment 4

Stability and Reactive Power Requirement for Low Voltage Ride Through

(Summary of the VAR requirements based upon the results of the dynamic studies)

See Attachment 4

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

Violation #	Overloaded Facility	Upgrade Description	Network Upgrade Number	Upgrade Cost	AC2-103 Allocation
#1	Beaver – Black River 138 kV	In order to mitigate the overloads of facilities above, the following reinforcements are required: PJM 2020 baseline upgrade B2673 (Rebuild line section from Beaver to Brownhelm Jct) and 2021 baseline ugrade B2898 (Reconductor Beaver – Black River line) resolve the overload. The new expected SE rating with these baseline upgrades is 573 MVA and is sufficient for AC2-103. The present projected in-service date for B2673 is June 2020 and the present projected in-service date for B2898 is June 2021. AC2-103 has no full cost responsibility for these baseline upgrades. However, AC2-103 may be responsible for an advancement cost to advance B2898 from summer 2021 to summer 2020. AC2-103 may need these baseline upgrades in-service in order to be fully deliverable to the PJM system. If AC2-103 comes into service prior to the completion of B2673 and/or B2898, an interim study will be required.	B2673 B2898		**$ 0**
				Total New Network Upgrades	**$ 0**

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

None

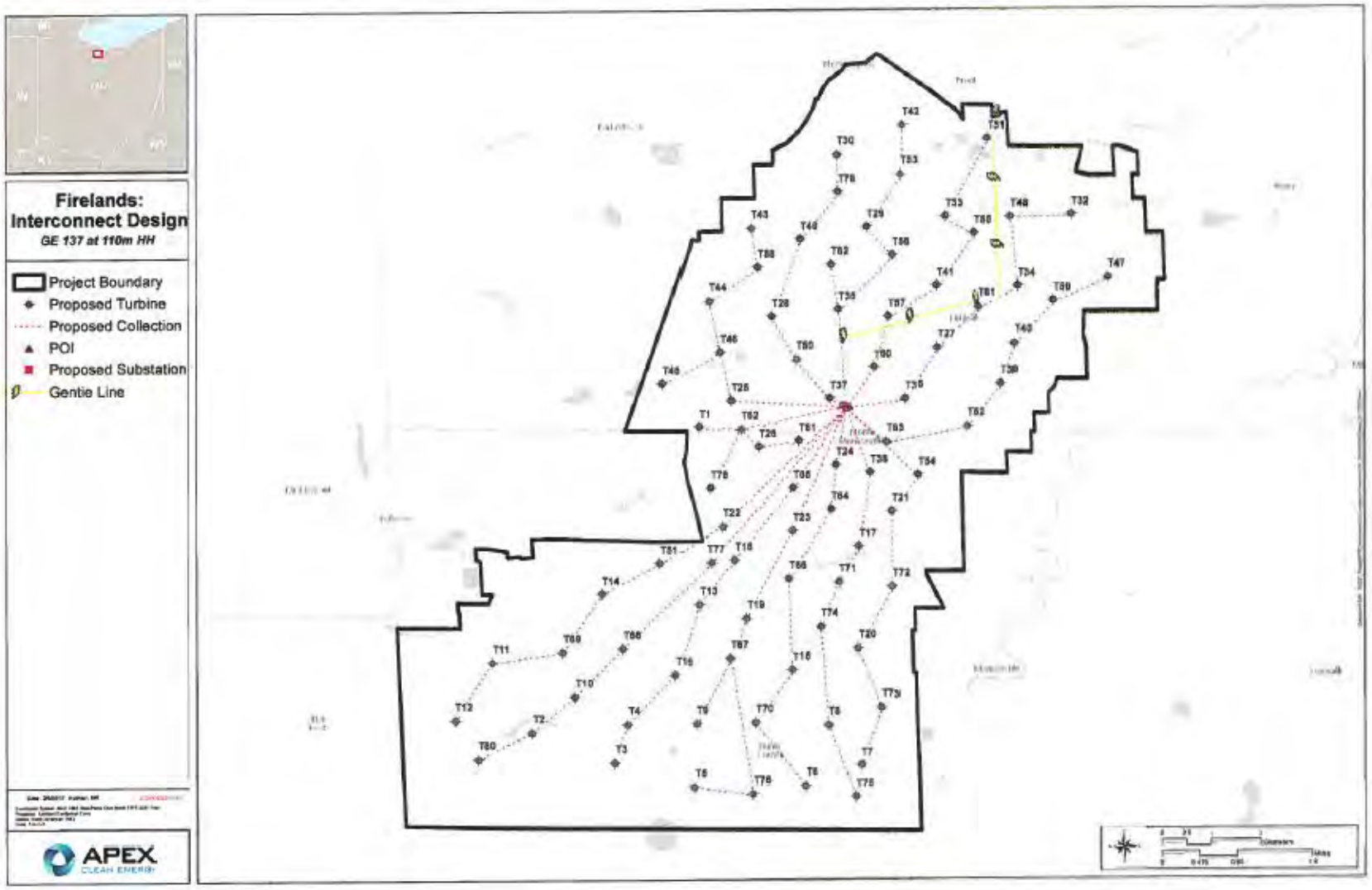
Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

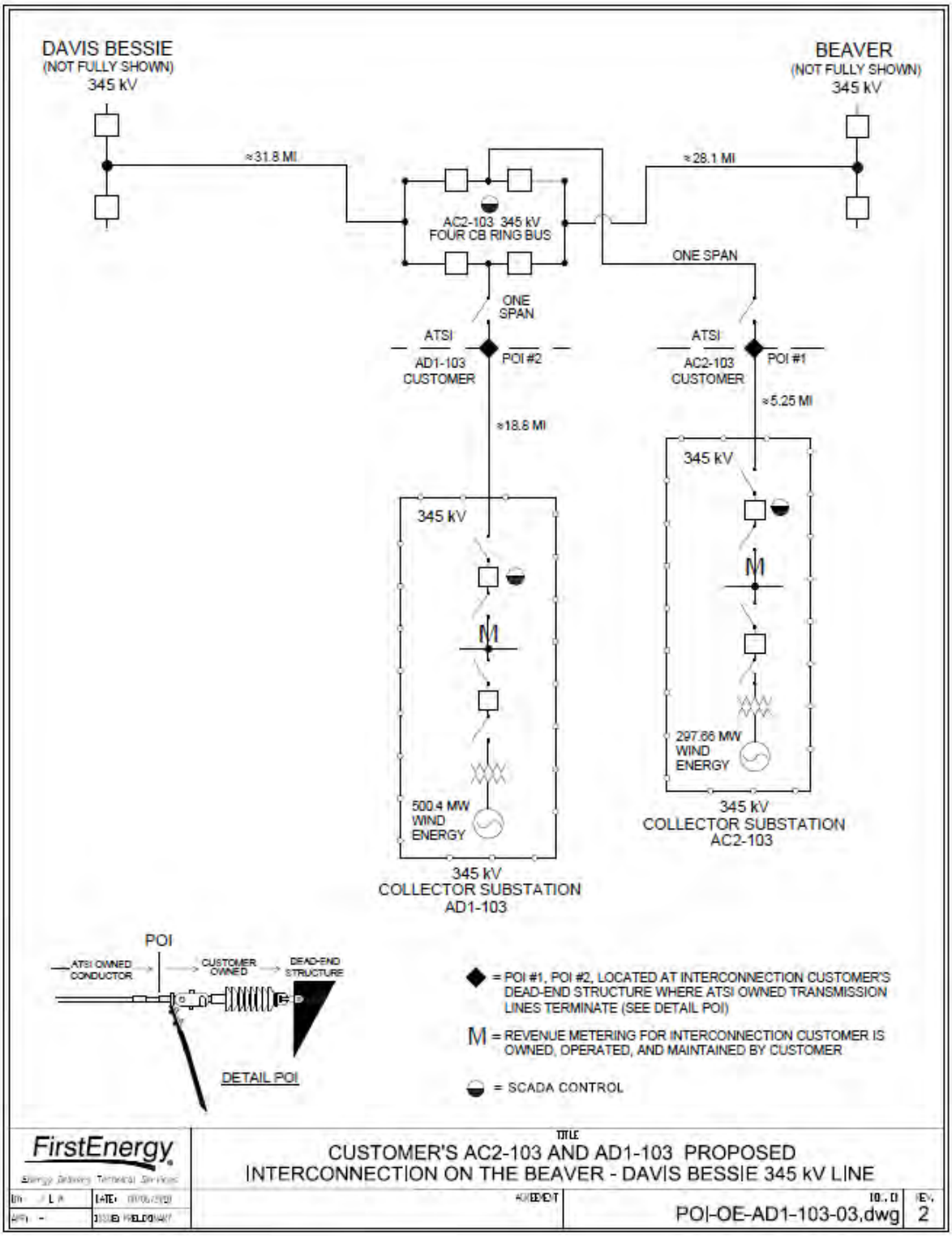
Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

None

Attachment 1. Project Location



Attachment 2. Single Line Diagram



Attachment 3. Flowgate Details

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators.

It should be noted the project/generator MW contributions presented in the body of the report and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 1

(FE - FE) The 02BEAVER-02BLKRVR 138 kV line (from bus 238570 to bus 239728 ckt 1) loads from 95.87% to 100.86% (AC power flow) of its emergency rating (387 MVA) for the tower line contingency outage of 'C5-OEC-345-001'. This project contributes approximately 22.74 MW to the thermal violation.

Bus Number	Bus Name	Full Contribution
238571	02BEAVGA	2.16
238572	02BEAVGB	2.25
240968	02BG2 GEN	0.36
240969	02BG4 G1	0.09
240970	02BG4 G2&3	0.18
240971	02BG4 G4&5	0.18
240950	02BG5	1.11
240973	02BG6 AMPO	1.62
239276	02COLLW 11	-1.47

Bus Number	Bus Name	Full Contribution
239297	02CPPW41	-1.85
240975	02PGE GEN	2.5
239175	02WLORG-6	3.57
932791	AC2-103 C	2.96
932792	AC2-103 E	19.79
901803	W1-072A	2.01
921102	AA1-056	2.39
923092	AB1-107 CT1	14.14
923094	AB1-107 CT2	30.83

Attachment 4. Dynamic Simulation Analysis

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Executive Summary

Generator Interconnection Request AC2-103 is for a 297.66 MW Maximum Facility Output (MFO) solar powered generating facility with a Point of Interconnection (POI) on the Davis Besse – Beaver 345 kV circuit in the ATSI system, Huron County, Ohio. AC2-103 and X1-027A would share the same POI switching station.

This report describes a dynamic simulation analysis of AC2-103 as part of the overall system impact study.

The load flow scenario for the analysis was based on the RTEP 2020 Summer Peak case, modified to include applicable queue projects. AC2-103 has been dispatched online at maximum power output, with POI voltage of (1.014 p.u.), consistent with the default generator reference voltage specified in PJM Manual 03 Transmission Operations Section 3.3.3 for generator connections to the PJM 345 kV system.

The AC2-103 queue project was tested for compliance with NERC, PJM and other applicable criteria. The range of contingencies evaluated was limited to that necessary to assess compliance and each was limited to a 20-second simulation time period.

Simulated NERC Standard TPL-001 faults include:

1. Three-phase (3ph) fault with normal clearing (Category P1)
2. Operating of a line section w/o a fault, Single-line-to-ground (slg) on Bus Section and Breaker. (Category P2)
3. Single-line-to-ground (slg) with delayed clearing as a result of breaker failure (Category P4)
4. Single-line-to-ground (slg) with delayed clearing as a result of protection failure (Category P5)
5. Single-line-to-ground (slg) with normal clearing for common structure (Category P7)

Note: For generator interconnection studies, Category P3 and P6 faults will be studied on an as needed basis. In this study, P2 contingencies are covered by P1 and P4 contingencies.

The system was tested for a system intact condition and the fault types listed above. Specific fault descriptions and breaker clearing times used for this study are provided in the result table.

No relevant High Speed Reclosing (HSR) contingencies were identified.

For all simulations, the queue project under study along with the rest of the PJM system were required to maintain synchronism and with all states returning to an acceptable new condition following the disturbance.

For the remaining fault contingencies tested on the 2020 Summer Peak case:

a) Post-contingency oscillations were positively damped with a damping margin of at least 3%.

b) The AC2-103 generator was able to ride through all faults (except for faults where protective action trips a generator(s)).

c) Following fault clearing, all bus voltages recover to a minimum of 0.7 per unit after 2.5 seconds (except where protective action isolates that bus).

d) No transmission element trips, other than those either directly connected or designed to trip as a consequence of that fault.

No mitigations were found to be required.

1. Introduction

Generator Interconnection Request AC2-103 is for a 297.66 MW Maximum Facility Output (MFO) solar powered generating facility with a Point of Interconnection (POI) on the Davis Besse – Beaver 345 kV circuit in the ATSI system, Huron County, Ohio. AC2-103 and X1-027A would share the same POI switching station.

This analysis is effectively a screening study to determine whether the addition of AC2-103 will meet the dynamic requirements of the NERC, PJM and Transmission Owner reliability standards.

In this report the AC2-103 project and how it is proposed to be connected to the grid are first described, followed by a description of how the project is modeled in this study. The fault cases are then described and analyzed, and lastly a discussion of the results is provided.

2. Description of Project

Generator Interconnection Request AC2-103 is for a 297.66 MW Maximum Facility Output (MFO) solar powered generating facility with a Point of Interconnection (POI) on the Davis Besse – Beaver 345 kV circuit in the ATSI system, Huron County, Ohio. AC2-103 and X1-027A would share the same POI switching station.

Figure 1 shows the simplified one-line diagram of the AC2-103 loadflow model. Table 1 lists the parameters given in the impact study data and the corresponding parameters of the AC2-103 loadflow model.

The dynamic model for the AC2-103 plant is based on the GEWT PSS/E version 33 user defined models.

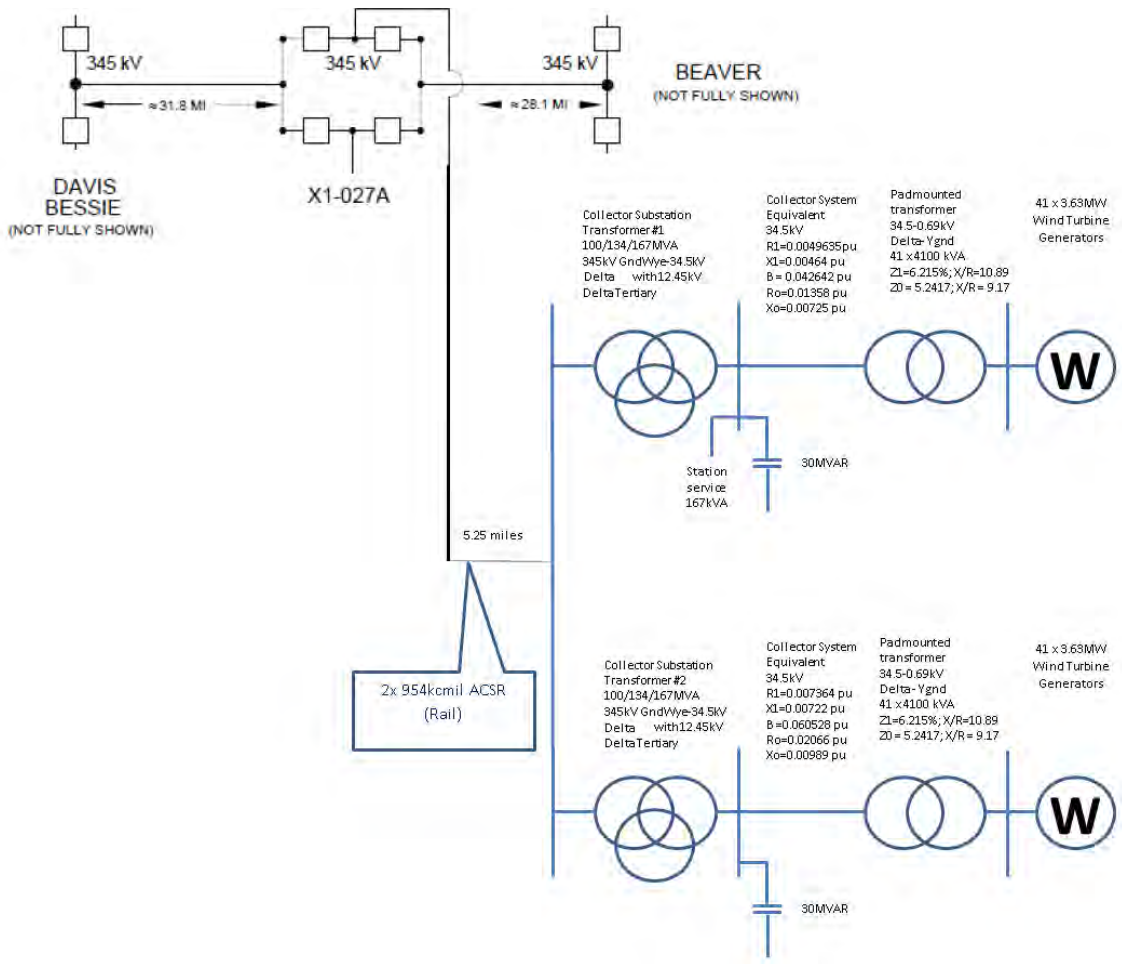

Figure 1: AC2-103 Plant Model

Table 1: AC2-103 Plant Model

	Impact Study Data	Model
Inverters	41 × 3.63 MW GE 3.63 MW wind turbine MVA base = 4.033 MVA Vt = 0.69 kV 41 × 3.63 MW GE 3.63 MW wind turbine MVA base = 4.033 MVA Vt = 0.69 kV	Lumped equivalent representing 41 × 3.63 MW GE 3.63 MW wind turbine Pgen 148.83MW Pmax 148.83MW Pmin 0 MW Qmax 58.785MVAr Qmin - 58.785MVAr Mbase 165.36MVA Zsorce 0.0 + j 0.2 pu @Mbase Lumped equivalent representing 41 × 3.63 MW GE 3.63 MW wind turbine Pgen 148.83MW Pmax 148.83MW Pmin 0 MW Qmax 58.785MVAr Qmin - 58.785MVAr Mbase 165.36MVA Zsorce 0.0 + j 0.2 pu @Mbase
GSU transformer	41 x 34.5/0.69 kV two winding transformers Transformer base = 4.1 MVA Rating = 4.1 MVA Impedance = 0.00568 + j0.061894 pu @ MVA base Number of taps = 5 Tap step size = 0.025 41 x 34.5/0.69 kV two winding transformers Transformer base = 4.1 MVA Rating = 4.1 MVA Impedance = 0.00568 + j0.061894 pu @ MVA base Number of taps = 5 Tap step size = 0.025	Lumped equivalent representing 41 x 34.5/0.69 kV two winding transformers Transformer base = 168.1 MVA Rating = 168.1 MVA Impedance = 0.00568 + j0.061894 pu @ MVA base Number of taps = 5 Tap step size = 0.025 Lumped equivalent representing 41 x 34.5/0.69 kV two winding transformers Transformer base = 168.1 MVA Rating = 168.1 MVA Impedance = 0.00568 + j0.061894 pu @ MVA base Number of taps = 5 Tap step size = 0.025

	Impact Study Data	Model
Collector step-up transformer	2 x 345/34.5/12.45 kV three winding transformers Transformer base = 100 MVA Rating = 100 / 134 / 167 MVA Impedances: High – Low = 0.002251 + j 0.088471 pu High – Tertiary = 0.001208 + j 0.046784 pu Low – Tertiary = 0.002994+ j 0.115261 pu All impedances @ MVA base Number of taps = 5 Tap step size = 0.025	2 x 345/34.5/12.45 kV three winding transformers Transformer base = 100 MVA Rating = 100 / 134 / 167 MVA Impedances: High – Low = 0.002251 + j 0.088471 pu High – Tertiary = 0.001208 + j 0.046784 pu Low – Tertiary = 0.002994+ j 0.115261 pu All impedances @ MVA base Number of taps = 5 Tap step size = 0.025
Auxiliary Load	0.1 MW + 0.0 MVAr on LV side of GSU	0.1 MW + 0.0 MVAr on LV side of GSU
Station Load	0.06 MW + 0.00 MVAR on LV side of GSU	0.06 MW + 0.00 MVAR on LV side of GSU
Collector System Equivalent	Positive Sequence Impedance = 0.007364+ j 0.007220 pu Charging Susceptance = j 0.009890pu All impedances @ 100 MVA base	Positive Sequence Impedance = 0.007364+ j 0.007220 pu Charging Susceptance = j 0.009890pu All impedances @ 100 MVA base
Transmission Line	R= 0.000277 X= 0.000872 B= 0.022705	R= 0.000277 X= 0.000872 B= 0.022705

3. Loadflow and Dynamics Case Setup

The dynamics simulation analysis was carried out using PSS/E Version 33.7.

The load flow scenario and fault cases for this study are based on PJM's Regional Transmission Planning Process[2].

The selected load flow scenario is the RTEP 2020 Summer Peak case with the following modifications:

a) Addition of all applicable queue projects prior to AC2-103.

b) Addition of AC2-103 queue project.

c) Removal of withdrawn and subsequent queue projects in the vicinity of AC2-103.

d) Dispatch of units in the PJM system to maintain slack generators within limits.

The AC2-103 initial conditions are listed in Table 2, indicating maximum power output, with AC2-103 regulating POI voltage of (1.014 p.u.), consistent with the default generator reference voltage specified in PJM Manual 03 Transmission Operations Section 3.3.3 for generator connections to the PJM 345 kV system.

Table 2: AC2-103 machine initial conditions

Bus	Name	Unit	PGEN (MW)	QGEN (MVAR)	ETERM (p.u.)	POI Voltage (p.u.)
931798	AC2-103 GEN10.6900	1	148.83	20.2	1.05	1.0145
931799	AC2-103 GEN20.6900	1	148.83	20.2	1.05	1.0145

Generation within the vicinity of AC2-103 has been dispatched online at maximum output (PMAX). The dispatch of generation in the vicinity of AC2-103 is given in Attachment 3.

[2] Manual 14B: PJM Region Transmission Planning Process, Rev 33, May 5 2016, Attachment G : PJM Stability, Short Circuit, and Special RTEP Practices and Procedures.

4. Fault Cases

Tables 3 listed the contingencies and results that were studied, with representative worst case total clearing times provided by PJM. Each contingency was studied over a 20 second simulation time interval.

Simulated NERC Standard TPL-001 faults include:

1. Three-phase (3ph) fault with normal clearing (Category P1)
2. Operating of a line section w/o a fault, Single-line-to-ground (slg) on Bus Section and Breaker. (Category P2)
3. Single-line-to-ground (slg) with delayed clearing as a result of breaker failure (Category P4)
4. Single-line-to-ground (slg) with delayed clearing as a result of protection failure (Category P5)
5. Single-line-to-ground (slg) with normal clearing for common structure (Category P7)

Note: For generator interconnection studies, Category P3 and P6 faults will be studied on an as needed basis. In this study, P2 contingencies are covered by P1 and P4 contingencies.

The system was tested for a system intact condition and the fault types listed above. No relevant High Speed Reclosing (HSR) contingencies were studied.

5. Evaluation Criteria

This study is focused on AC2-103, along with the rest of the PJM system, maintaining synchronism and having all states return to an acceptable new condition following the disturbance. The recovery criteria applicable to this study are as per PJM's Regional Transmission Planning Process and Transmission Owner criteria:

a) The system with AC2-103 included is transiently stable and post-contingency oscillations should be positively damped with a damping margin of at least 3%.

b) The AC2-103 is able to ride through faults (except for faults where protective action trips AC2-103).

c) Following fault clearing, all bus voltages recover to a minimum of 0.7 per unit after 2.5 seconds (except where protective action isolates that bus).

d) No transmission element trips, other than those either directly connected or designed to trip as a consequence of that fault.

6. Summary of Results

Plots from the dynamic simulations are provided in Attachment 4, with results summarized in Table 3.

The frequency protection was disabled due to the PSSE deficiency in calculating frequencies for 3ph fault at POIs.

For the fault contingencies tested in this study:

a) Post-contingency oscillations were positively damped with a damping margin of at least 3%.

b) The AC2-103 generator was able to withstand all contingencies.

c) Following fault clearing, all bus voltages recover to a minimum of 0.7 per unit after 2.5 seconds (except where protective action isolates that bus).

d) No transmission element trips, other than those either directly connected or designed to trip as a consequence of that fault.

7. Mitigations

No Mitigations were found to be required.

Table 3: Fault list

P0: Steady State

Fault ID	Duration
P0.00	Steady State 20 sec run

P1: Three Phase Faults with normal clearing

Fault ID	Fault description	Clearing Time Normal (Cycles)	Results
P1.00	3ph @ X1-027A POI – X1-027A Main 345kV line, normal clear loss of X1-027A	5	Stable
P1.01	3ph @ X1-027A POI – AC2-103 345kV line, normal clear loss of AC2-103	5	Stable
P1.02	3ph @ X1-027A POI – Beaver 345kV line, normal clear	5	Stable
P1.03	3ph @ X1-027A POI – Davis Besse 345kV line, normal clear	5	Stable
P1.04	3ph @ Beaver – West Lorain 345kV line, normal clear loss of West Lorain unit 2, 3, 4, 5	5	Stable
P1.05	3ph @ Beaver – Lake Ave 345kV line #1, normal clear	5	Stable
P1.06	3ph @ Beaver – Lake Ave 345kV line #2, normal clear	5	Stable
P1.07	3ph @ Beaver – Carlisle 345kV line, normal clear	5	Stable
P1.08	3ph @ Beaver – X1-027A POI 345kV line, normal clear	5	Stable
P1.09	3ph @ Beaver – Hayes 345kV line, normal clear	5	Stable
P1.10	3ph @ Beaver 345/138kV TF #1, normal clear	5	Stable
P1.11	3ph @ Beaver 345/138kV TF #2, normal clear	5	Stable
P1.12	3ph @ Lake Ave – Beaver 345kV line #1, normal clear	5	Stable
P1.13	3ph @ Lake Ave – Beaver 345kV line #2, normal clear	5	Stable
P1.14	3ph @ Lake Ave – Avon 345kV line #1, normal clear	5	Stable
P1.15	3ph @ Lake Ave – Avon 345kV line #2, normal clear	5	Stable

Fault ID	Fault description	Clearing Time Normal (Cycles)	Results
P1.16	3ph @ Lake Ave 345/138kV TF #1, normal clear	5	Stable
P1.17	3ph @ Lake Ave 345/138kV TF #2, normal clear	5	Stable
P1.18	3ph @ Avon – Lake Ave 345kV line #1, normal clear	5	Stable
P1.19	3ph @ Avon – Lake Ave 345kV line #2, normal clear	5	Stable
P1.20	3ph @ Avon 345/138kV TF #91, normal clear	5	Stable
P1.21	3ph @ Avon 345/138kV TF #92, normal clear	5	Stable
P1.22	3ph @ Avon – Juniper 345kV line, normal clear	5	Stable
P1.23	3ph @ Avon unit 9 GSU, normal clear loss of Avon unit 9	5	Stable
P1.24	3ph @ Hayes – Beaver 345kV line, normal clear	5	Stable
P1.25	3ph @ Hayes – Davis Besse 345kV line, normal clear	5	Stable
P1.26	3ph @ Hayes 345/138kV TF, normal clear	5	Stable
P1.27	3ph @ Davis Besse – X1-027A POI 345kV line, normal clear	5	Stable
P1.28	3ph @ Davis Besse – Hayes 345kV line, normal clear	5	Stable
P1.29	3ph @ Davis Besse – Bayshore 345kV line, normal clear	5	Stable
P1.30	3ph @ Davis Besse – Lemoyne 345kV line, normal clear	5	Stable
P1.31	3ph @ Davis Besse unit GSU, normal clear loss of the unit	5	Stable
P1.32	3ph @ Bayshore – Lallendorf 345kV line #1, normal clear	5	Stable
P1.33	3ph @ Bayshore – Lallendorf 345kV line #2, normal clear	5	Stable
P1.34	3ph @ Bayshore – Davis Besse 345kV line, normal clear	5	Stable
P1.35	3ph @ Bayshore 345/138kV TF #1, normal clear	5	Stable
P1.36	3ph @ Bayshore 345/138kV TF #2, normal clear	5	Stable
P1.37	3ph @ Lemoyne – Midway 345kV line, normal clear	5	Stable

Fault ID	Fault description	Clearing Time Normal (Cycles)	Results
P1.38	3ph @ Lemoyne – Dowling 345kV line, normal clear	5	Stable
P1.39	3ph @ Lemoyne – Davis Besse 345kV line, normal clear	5	Stable
P1.40	3ph @ Lemoyne – Majestic 345kV line, normal clear	5	Stable
P1.41	3ph @ Lemoyne – Fostoria Central 345kV line, normal clear	5	Stable
P1.42	3ph @ Lemoyne – Troy 345kV line, normal clear loss of Lemoyne units	5	Stable
P1.43	3ph @ Lemoyne 345/138kV TF #1, normal clear	5	Stable
P1.44	3ph @ Lemoyne 345/138kV TF #2, normal clear	5	Stable

P4: SLG Stuck Breaker (SB) Faults at Backup Clearing

Fault ID	Fault description	Clearing Time Normal/Delayed (Cycles)	Results
P4.01	SLG @ X1-027A POI 345kV, normal clear loss of X1-027A – Davis Besse 345kV line, SB @ X1-027A POI 345kV, delayed clear loss of X1-027A	5/14	Stable
P4.02	SLG @ X1-027A POI 345kV, normal clear loss of X1-027A – Davis Besse 345kV line, SB @ X1-027A POI 345kV, delayed clear loss of AC2-103	5/14	Stable
P4.03	SLG @ X1-027A POI 345kV, normal clear loss of X1-027A – Beaver 345kV line, SB @ X1-027A POI 345kV, delayed clear loss of X1-027A	5/14	Stable
P4.04	SLG @ X1-027A POI 345kV, normal clear loss of X1-027A – Beaver 345kV line, SB @ X1-027A POI 345kV, delayed clear loss of AC2-103	5/14	Stable
P4.05	SLG @ Beaver 345kV N Bus, normal clear, SB @ Beaver 345kV, delayed clear loss of Beaver 345/138kV TF #1	5/14	Stable
P4.06	SLG @ Beaver 345kV N Bus, normal clear, SB @ Beaver 345kV, delayed clear loss of West Lorain unit 2, 3, 4, 5	5/14	Stable

Fault ID	Fault description	Clearing Time Normal/Delayed (Cycles)	Results
P4.07	SLG @ Beaver 345kV N Bus, normal clear, SB @ Beaver 345kV, delayed clear loss of Beaver – Lake Ave 345kV line #1	5/14	Stable
P4.08	SLG @ Beaver 345kV N Bus, normal clear, SB @ Beaver 345kV, delayed clear loss of Beaver – Lake Ave 345kV line #2	5/14	Stable
P4.09	SLG @ Beaver 345kV S Bus, normal clear loss of Beaver 345/138kV TF #2, SB @ Beaver 345kV, delayed clear loss of Beaver – Hayes 345kV line	5/14	Stable
P4.10	SLG @ Beaver 345kV S Bus, normal clear loss of Beaver 345/138kV TF #2, SB @ Beaver 345kV, delayed clear loss of Beaver – X1-027A POI 345kV line	5/14	Stable
P4.11	SLG @ Beaver 345kV S Bus, normal clear loss of Beaver 345/138kV TF #2, SB @ Beaver 345kV, delayed clear loss of Beaver – Carlisle 345kV line	5/65	Stable
P4.12	SLG @ Beaver 345kV S Bus, normal clear loss of Beaver 345/138kV TF #2, SB @ Beaver 345kV, delayed clear loss of Beaver – Lake Ave 345kV line #2	5/14	Stable
P4.13	SLG @ Beaver 345/138kV TF #1, normal clear, SB @ Beaver 345kV, delayed clear loss of Beaver – Hayes 345kV line	5/14	Stable
P4.14	SLG @ Beaver – West Lorain 345kV line, normal clear loss of West Lorain unit 2, 3, 4, 5, SB @ Beaver 345kV, delayed clear loss of Beaver – X1-027A 345kV line	5/14	Stable
P4.15	SLG @ Beaver – Lake Ave 345kV line #1, normal clear, SB @ Beaver 345kV, delayed clear loss of Beaver – Carlisle 345kV line	5/14	Stable
P4.16	SLG @ Lake Ave 345/138kV TF #1, normal clear, SB @ Lake Ave, delayed clear loss of Lake Ave – Beaver 345kV line #1	5/14	Stable
P4.17	SLG @ Lake Ave 345/138kV TF #1, normal clear, SB @ Lake Ave, delayed clear loss of Lake Ave – Beaver 345kV line #2	5/14	Stable
P4.18	SLG @ Lake Ave 345/138kV TF #2, normal clear, SB @ Lake Ave, delayed clear loss of Lake Ave – Avon 345kV line #1	5/14	Stable
P4.19	SLG @ Lake Ave 345/138kV TF #2, normal clear, SB @ Lake Ave, delayed clear loss of Lake Ave – Avon 345kV line #2	5/14	Stable

Fault ID	Fault description	Clearing Time Normal/Delayed (Cycles)	Results
P4.20	SLG @ Lake Ave – Avon 345kV line #1, normal clear, SB @ Lake Ave, delayed clear loss of Lake Ave – Beaver 345kV line #1	5/14	Stable
P4.21	SLG @ Lake Ave – Avon 345kV line #2, normal clear, SB @ Lake Ave, delayed clear loss of Lake Ave – Beaver 345kV line #2	5/14	Stable
P4.22	SLG @ Avon – Lake Ave 345kV line #1, normal clear, SB @ Avon, delayed clear loss of Avon unit 9	5/14	Stable
P4.23	SLG @ Avon – Lake Ave 345kV line #1, normal clear, SB @ Avon, delayed clear loss of Avon – Lake Ave 345kV line #2	5/14	Stable
P4.24	SLG @ Avon – Lake Ave 345kV line #2, normal clear, SB @ Avon, delayed clear loss of Avon 345/138kV TF 91	5/14	Stable
P4.25	SLG @ Avon – Juniper 345kV line, normal clear, SB @ Avon, delayed clear loss of Avon 345/138kV TF 91	5/14	Stable
P4.26	SLG @ Avon – Juniper 345kV line, normal clear, SB @ Avon, delayed clear loss of Avon 345/138kV TF 92	5/14	Stable
P4.27	SLG @ Avon 345/138kV TF 92, normal clear, SB @ Avon, delayed clear loss of Avon unit 9	5/14	Stable
P4.28	SLG @ Carlisle – North Medina 345kV line, normal clear, SB @ Carlisle, delayed clear loss of Carlisle 345kV bus	5/14	Stable
P4.29	SLG @ Hayes 345kV, normal clear loss of Hayes 345/138kV TF, SB @ Hayes 345kV, delayed clear loss of Hayes – Beaver 345kV line	5/14	Stable
P4.30	SLG @ Hayes 345kV, normal clear loss of Hayes 345/138kV TF, SB @ Hayes 345kV, delayed clear loss of Hayes – Davis Besse 345kV line	5/14	Stable
P4.31	SLG @ Hayes 345kV, normal clear loss of Hayes – Davis Besse 345kV line, SB @ Hayes 345kV, delayed clear loss of Hayes – Beaver 345kV line	5/14	Stable
P4.32	SLG @ Hayes 345kV, normal clear loss of Hayes – Beaver 345kV, SB @ Hayes 345kV, delayed clear loss of line Hayes – Davis Besse 345kV line	5/14	Stable

Fault ID	Fault description	Clearing Time Normal/Delayed (Cycles)	Results
P4.33	SLG @ Davis Besse 345kV bus 1, normal clear, SB @ Davis Besse, delayed clear loss of Davis Besse – Hayes 345kV line	5/14	Stable
P4.34	SLG @ Davis Besse 345kV bus 1, normal clear, SB @ Davis Besse, delayed clear loss of Davis Besse – Lemoyne 345kV line	5/14	Stable
P4.35	SLG @ Davis Besse 345kV bus 1, normal clear, SB @ Davis Besse, delayed clear loss of Davis Besse unit	5/14	Stable
P4.36	SLG @ Davis Besse 345kV bus 2, normal clear, SB @ Davis Besse, delayed clear loss of Davis Besse – Hayes 345kV line	5/14	Stable
P4.37	SLG @ Davis Besse 345kV bus 2, normal clear, SB @ Davis Besse, delayed clear loss of Davis Besse – Bayshore 345kV line	5/14	Stable
P4.38	SLG @ Davis Besse 345kV bus 2, normal clear, SB @ Davis Besse, delayed clear loss of Davis Besse – X1-027A POI 345kV line	5/14	Stable
P4.39	SLG @ Davis Besse – Bayshore 345kV line, normal clear, SB @ Davis Besse, delayed clear loss of Davis Besse unit	5/14	Stable
P4.40	SLG @ Davis Besse – Lemoyne 345kV line, normal clear, SB @ Davis Besse, delayed clear loss of Davis Besse – X1-027A POI 345kV line	5/14	Stable
P4.41	SLG @ Bayshore 345kV, normal clear loss of Bayshore 345/138kV TF #1, SB @ Bayshore, delayed clear loss of Bayshore – Lallendorf 345kV line #1	5/14	Stable
P4.42	SLG @ Bayshore 345kV, normal clear loss of Bayshore 345/138kV TF #1, SB @ Bayshore, delayed clear loss of Bayshore – Lallendorf 345kV line #2	5/14	Stable
P4.43	SLG @ Bayshore 345kV, normal clear loss of Bayshore 345/138kV TF #2, SB @ Bayshore, delayed clear loss of Bayshore – Lallendorf 345kV line #1	5/14	Stable
P4.44	SLG @ Bayshore 345kV, normal clear loss of Bayshore 345/138kV TF #2, SB @ Bayshore, delayed clear loss of Bayshore – Davis Besse 345kV line	5/14	Stable
P4.45	SLG @ Bayshore 345kV, normal clear loss of Bayshore – Lallendorf 345kV line #2, SB @ Bayshore, delayed clear loss of Bayshore – Davis Besse 345kV line	5/14	Stable

Fault ID	Fault description	Clearing Time Normal/Delayed (Cycles)	Results
P4.46	SLG @ Lemoyne 345kV, normal clear loss of Lemoyne 345/138kV TF #1, SB @ Lemoyne 345kV, delayed clear loss of Lemoyne – Davis Besse 345kV line	5/14	Stable
P4.47	SLG @ Lemoyne 345kV, normal clear loss of Lemoyne 345/138kV TF #1, SB @ Lemoyne 345kV, delayed clear loss of Lemoyne – Majestic 345kV line	5/14	Stable
P4.48	SLG @ Lemoyne 345kV, normal clear loss of Lemoyne 345/138kV TF #2, SB @ Lemoyne 345kV, delayed clear loss of Lemoyne – Davis Besse 345kV line	5/14	Stable
P4.49	SLG @ Lemoyne 345kV, normal clear loss of Lemoyne 345/138kV TF #2, SB @ Lemoyne 345kV, delayed clear loss of Lemoyne – Midway 345kV line	5/14	Stable
P4.50	SLG @ Lemoyne 345kV, normal clear loss of Lemoyne – Midway 345kV line, SB @ Lemoyne 345kV, delayed clear loss of Lemoyne – Dowling 345kV line	5/14	Stable
P4.51	SLG @ Lemoyne 345kV, normal clear loss of Lemoyne – Dowling 345kV line, SB @ Lemoyne 345kV, delayed clear loss of Lemoyne units	5/14	Stable
P4.52	SLG @ Lemoyne 345kV, normal clear loss of Lemoyne – Fostoria Central 345kV line, SB @ Lemoyne 345kV, delayed clear loss of Lemoyne units	5/14	Stable
P4.53	SLG @ Lemoyne 345kV, normal clear loss of Lemoyne – Fostoria Central 345kV line, SB @ Lemoyne 345kV, delayed clear loss of Lemoyne – Majestic 345kV line	5/14	Stable

P5: SLG Fault with Delayed (Zone 2) Clearing

Fault ID	Fault description	Clearing Time Normal (Cycles)	Results
P5.01	SLG @ 80% of X1-027A POI – Beaver 345kV line, relay failure @ X1-027A POI, delayed clear	5/65	Stable
P5.02	SLG @ 80% of X1-027A POI – Davis Besse 345kV line, relay failure @ X1-027A POI, delayed clear	5/65	Stable
P5.03	SLG @ 80% of Beaver – X1-027A POI 345kV line, relay failure @ Beaver, delayed clear	5/65	Stable
P5.04	SLG @ 80% of Beaver – Hayes 345kV line, relay failure @ Beaver, delayed clear	5/65	Stable
P5.05	SLG @ 80% of Beaver – Lake Ave 345kV line #1, relay failure @ Beaver, delayed clear	5/65	Stable
P5.06	SLG @ 80% of Beaver – Lake Ave 345kV line #2, relay failure @ Beaver, delayed clear	5/65	Stable

Fault ID	Fault description	Clearing Time Normal (Cycles)	Results
P5.07	SLG @ 80% of Beaver – Carlisle 345kV line, relay failure @ Beaver, delayed clear	5/65	Stable
P5.08	SLG @ 80% of Davis Besse – X1-027A POI 345kV line, relay failure @ Davis Besse, delayed clear	5/65	Stable
P5.09	SLG @ 80% of Davis Besse – Hayes 345kV line, relay failure @ Davis Besse, delayed clear	5/65	Stable
P5.10	SLG @ 80% of Davis Besse – Bayshore 345kV line, relay failure @ Davis Besse, delayed clear	5/65	Stable
P5.11	SLG @ 80% of Davis Besse – Lemoyne 345kV line, relay failure @ Davis Besse, delayed clear	5/65	Stable

P7: Tower Failure

Fault ID	Fault description	Clearing Time Normal (Cycles)	Results
P7.01	CONTINGENCY 'C5-CEI-345-001' /* AVON-Lake Ave #1 AND #2 345KV LINE OUTAGES	5	Stable
P7.02	CONTINGENCY 'C5-CEI-345-002' /* AVON-JUNIPER AND AVON-Lake Ave #1 345KV LINE OUTAGES	5	Stable
P7.03	CONTINGENCY 'C5-CEI-345-010' /* AVON-JUNIPER AND HARDING-CHAMBERLIN 345KV LINE OUTAGES	5	Stable
P7.04	CONTINGENCY 'C5-CEI-345-011' /* AVON-JUNIPER AND EMILY-FOX 138KV LINE OUTAGES	5	Stable
P7.05	CONTINGENCY 'C5-OEC-138-015' /* BEAV-CARL, BEAV-DAVISBESSE 345	5	Stable
P7.06	CONTINGENCY 'C5-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2	5	Stable
P7.07	CONTINGENCY 'C5-TE-138-021' /* BAYSH - Y1-069 1 & 2 345	5	Stable
P7.08	CONTINGENCY 'C5-TE-138-022' /* Y1-069-MONROE/LEMOYNE-MAJ 345	5	Stable
P7.09	CONTINGENCY 'C5-TE-138-023' /* Y1-069-FOSTORIA/LEMOYNE-MAJ 345	5	Stable
P7.10	CONTINGENCY 'C5-TE-138-024' /* Y1-069-FOSTORIA/LEMOYNE-FOSTORIA 345	5	Stable

Fault ID	Fault description	Clearing Time Normal (Cycles)	Results
P7.11	Beaver – Hayes 345kV line Beaver – X1-027A POI 345kV line	5	Stable
P7.12	Beaver – Hayes 345kV line Davis Besse – X1-027A POI 345kV line	5	Stable
P7.13	Davis Besse – Hayes 345kV line Davis Besse – X1-027A POI 345kV line	5	Stable

Attachment 1. PSS/E Model One Line Diagram

Attachment 2. PSS/E Dynamic Model

```
/*********************************************
/*AC2-103
/*GE 3.63MW X 82 in total
/*Modeled as two Main TFs, each takes 41*3.63MW
/*********************************************
    931798 'USRMDL' 1  'GEWTG2'  1 1 4 18 3 5
       0    41         0        0
        3.6300      0.80000      0.50000      0.90000       1.2200       1.2000
        2.0000      0.40000      0.80000       10.000      0.20000E-01   0.0000
        0.0000      0.50000      0.16700      0.90000      0.92500       0.0000    /
    931798 'USRMDL' 1  'GEWTE2'  4 0 12 67 18 9
            931798         0              0              1              0              0
             0         0             0              1              0             0
       0.50000        2.000       1.0000       0.0000       0.0000      0.50000E-01   3.0000
       0.60000       1.1200       0.40000E-01  0.43600     -0.43600      1.1000      0.20000E-01
       0.45000            -0.45000          60.000            0.41000            0.90000
        1.1000            40.000            0.50000          1.4500             0.50000E-01
        0.50000E-01         1.0000           0.15000          0.96000            0.99600
        1.0040             1.0400           1.00000          1.0000             1.00000
        0.40000            1.0000           0.20000          1.0000             0.25000
       -1.0000             14.0000          25.000           3.0000            -0.90000
        8.0000             0.2000           10.000           1.0000             1.7000
        1.22               1.2500           5.0000           0.0000             0.0000
        0.000              0.25000E-02       1.0000           5.5000             0.10000
       -1.0000             0.10000          0.0000           0.10000           -0.10000
        0.70000            0.12000         -0.12000    /
    931798 'USRMDL' 1 'GEWTT1'          5    0    1    5    4    3   0
         2.0400        0.0000        0.0000        1.8800        1.5000    /
    931798 'USRMDL' 1 'GEWGD1'         505    0    1    6    0    4   0
         9999.0        5.0000        30.000        9999.0        9999.0
         30.000    /
    931798 'USRMDL' 1 'GEWTA2'         505    0    0    9    1    4
         20.000        0.0000        27.000       -4.0000        0.0000        1.2250
         67.000        121.80        1200.0      /
    931798 'USRMDL'  0 'GEWTP2'        505    0    1    10   3    3   0
         0.30000        150.00        25.000        3.0000        30.000
        -4.0000         27.000       -10.000        10.000        1.0000     /
  93179800 'USRMSC' 'GEWPLT2' 512  0  2  0  0  17             931798       '1 '     /

    93179801  'VTGTPAT'
         931798        931798  '1 '
       0.10000       5.0000      0.50000      0.80000E-01/
    93179802  'VTGTPAT'
         931798        931798  '1 '
       0.20000       5.0000      0.693179800      0.80000E-01/
    93179803  'VTGTPAT'
         931798        931798  '1 '
       0.40000       5.0000      1.00000      0.80000E-01/
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93179804  'VTGTPAT'
     931798       931798  '1 '
   0.60000      5.0000     1.70000      0.80000E-01/
93179805  'VTGTPAT'
     931798       931798  '1 '
   0.75000      5.0000     2.20000      0.80000E-01/
93179806  'VTGTPAT'
     931798       931798  '1 '
   0.85000      5.0000     10.0000      0.80000E-01/
93179807  'VTGTPAT'
     931798       931798  '1 '
   0.90000      5.0000     600.0000      0.80000E-01/
93179808  'VTGTPAT'
     931798       931798  '1 '
   0.00000      1.1010      1.000      0.80000E-01/
93179809  'VTGTPAT'
     931798       931798  '1 '
   0.00000      1.1500      0.5000      0.80000E-01/
93179810  'VTGTPAT'
     931798       931798  '1 '
   0.00000      1.17500     0.2000      0.80000E-01/
93179811  'VTGTPAT'
     931798       931798  '1 '
   0.00000      1.200       0.1000      0.80000E-01/
93179812  'VTGTPAT'
     931798       931798  '1 '
   0.00000      1.3000      0.0100      0.80000E-01/
      93179813 'FRQTPAT'  931798 931798 '1' 55.0 65.0  0.10   0.08 /
      93179814 'FRQTPAT'  931798 931798 '1' 57.0 63.0  60.0   0.08 /


931799 'USRMDL' 1  'GEWTG2'  1 1 4 18 3 5
   0    41        0       0
    3.6300     0.80000     0.50000     0.90000      1.2200      1.2000
    2.0000     0.40000     0.80000      10.000     0.20000E-01   0.0000
    0.0000     0.50000     0.16700     0.90000     0.92500      0.0000    /
931799 'USRMDL' 1  'GEWTE2'  4 0 12 67 18 9
        931799        0             0             1             0             0
         0        0             0             1             0             0
   0.50000       2.000       1.0000       0.0000       0.0000      0.50000E-01   3.0000
   0.60000       1.1200      0.40000E-01  0.43600     -0.43600     1.1000      0.20000E-01
   0.45000          -0.45000          60.000           0.41000          0.90000
    1.1000          40.000           0.50000          1.4500           0.50000E-01
    0.50000E-01       1.0000          0.15000          0.96000          0.99600
    1.0040           1.0400          1.00000          1.0000           1.00000
    0.40000          1.0000          0.20000          1.0000           0.25000
   -1.0000           14.0000         25.000           3.0000          -0.90000
    8.0000           0.2000          10.000           1.0000           1.7000
    1.22             1.2500          5.0000           0.0000           0.0000
    0.000            0.25000E-02      1.0000          5.5000           0.10000
   -1.0000           0.10000         0.0000           0.10000         -0.10000
```

```
    0.70000          0.12000         -0.12000    /
 931799 'USRMDL' 1 'GEWTT1'         5    0    1    5    4    3   0
    2.0400       0.0000       0.0000       1.8800       1.5000    /
 931799 'USRMDL' 1 'GEWGD1'        505    0    1    6    0    4   0
    9999.0       5.0000       30.000       9999.0       9999.0
    30.000    /
 931799 'USRMDL' 1 'GEWTA2'        505    0    0    9    1    4
    20.000       0.0000       27.000      -4.0000       0.0000       1.2250
    67.000       121.80       1200.0     /
 931799 'USRMDL'  0 'GEWTP2'       505    0    1    10   3    3   0
    0.30000       150.00       25.000       3.0000       30.000
   -4.0000       27.000      -10.000       10.000       1.0000    /
93179900 'USRMSC' 'GEWPLT2' 512  0  2  0  0  17            931799      '1 '    /

 93179901  'VTGTPAT'
    931799       931799  '1 '
   0.10000      5.0000     0.50000     0.80000E-01/
 93179902  'VTGTPAT'
    931799       931799  '1 '
   0.20000      5.0000     0.693179900     0.80000E-01/
 93179903  'VTGTPAT'
    931799       931799  '1 '
   0.40000      5.0000     1.00000     0.80000E-01/
 93179904  'VTGTPAT'
    931799       931799  '1 '
   0.60000      5.0000     1.70000     0.80000E-01/
 93179905  'VTGTPAT'
    931799       931799  '1 '
   0.75000      5.0000     2.20000     0.80000E-01/
 93179906  'VTGTPAT'
    931799       931799  '1 '
   0.85000      5.0000     10.0000     0.80000E-01/
 93179907  'VTGTPAT'
    931799       931799  '1 '
   0.90000      5.0000     600.0000     0.80000E-01/
 93179908  'VTGTPAT'
    931799       931799  '1 '
   0.00000      1.1010      1.000     0.80000E-01/
 93179909  'VTGTPAT'
    931799       931799  '1 '
   0.00000      1.1500      0.5000     0.80000E-01/
 93179910  'VTGTPAT'
    931799       931799  '1 '
   0.00000      1.17500     0.2000     0.80000E-01/
 93179911  'VTGTPAT'
    931799       931799  '1 '
   0.00000      1.200       0.1000     0.80000E-01/
 93179912  'VTGTPAT'
    931799       931799  '1 '
   0.00000      1.3000      0.0100     0.80000E-01/
     93179813 'FRQTPAT'  931798 931798 '1' 55.0 65.0  0.10   0.08 /
```

93179814 'FRQTPAT' 931798 931798 '1' 57.0 63.0 60.0 0.08 /

Attachment 3. PSS/E Case Dispatch

Bus Number	Bus Name	Id	In Service	PGen (MW)	PMax (MW)	PMin (MW)	QGen (Mvar)	QMax (Mvar)	QMin (Mvar)
238554	02AVONG7 13.800	7	1	94.6	94.6	0	0	40.26	0
238555	02AVONG9 20.000	9	1	672.1	672.1	0	49.96	308.5	-263
238564	02BAYSG1 18.000	1	1	136	136	0	44.76	62.33	-29.8
238571	02BEAVGA 13.800	A	1	51.6	51.6	10	-6	23.91	-6
238572	02BEAVGB 13.800	B	1	53.6	53.6	10	-6	22.2	-6
238601	02FRMENG 1 18.000	1	1	184.7	184.7	0	-1.2	121.7	-88.7
238602	02FRMENG 2 18.000	2	1	184.7	184.7	0	-1.2	121.7	-88.7
238603	02FRMENG 3 23.000	3	1	344	344	0	-1.2	233.3	-173
238670	02DVBSG1 25.000	1	1	960	960	0	203.9	478.8	52.6
238683	02EASTG5 24.000	S5	1	0	0	0	20.98	519	-150
238885	02LEMOG1 18.000	1	1	160	160	90	30.01	100	-45
238886	02LEMOG2 18.000	2	1	160	160	90	30.01	100	-45
238887	02LEMOG3 18.000	3	1	160	160	90	30.01	100	-45
238888	02LEMOG4 18.000	4	1	160	160	90	30.01	100	-45
238965	02MNFDG1 18.000	1	1	906	906	400	147.1	260	-435
238966	02MNFDG2 18.000	2	1	907	907	400	147.1	250	-435
238967	02MNFDG3 18.000	3	1	892	892	400	147.1	270	-435
238979	02NAPMUN 138.00	1	1	25	25	24	0.327	14	-10
238979	02NAPMUN 138.00	2	1	12	12	10	0.157	5	-6
239035	02PERRG1 22.000	1	1	1331	1331	1294	-21.6	600	-270
239087	02SAMMG3 20.000	3	1	206.6	206.6	55	68.25	114.7	-39.3
239088	02SAMMG4 20.000	4	1	201.1	201.1	77	68.25	116.5	-40.9
239089	02SAMMG5 24.000	5	1	329.4	329.4	135	68.25	183.1	-70.5
239090	02SAMMG6 20.000	6	1	666.4	666.4	250	68.25	391.1	-185
239091	02SAMMG7 20.000	7	1	673.4	673.4	250	68.25	359.3	-210
239171	02WLORG-2 13.800	2	1	82.6	82.6	45	-26.5	63.94	-26.5
239172	02WLORG-3 13.800	3	1	84.9	84.9	45	-26.6	64.34	-26.6
239173	02WLORG-4 13.800	4	1	84.7	84.7	45	-26.2	62.87	-26.2
239174	02WLORG-5 13.800	5	1	85	85	45	-26.4	63.71	-26.4
239175	02WLORG-6 13.800	6	1	85	85	45	-26.3	63.14	-26.3
239267	02AVG10 13.800	10	1	21	21	0	5	5	5
239293	02BS-PKR 4.1600	99	1	14.6	14.6	0	1.64	8	-4
240950	02BG5 69.000	1	1	11	11	0	0.24	20	0
240950	02BG5 69.000	2	1	11	11	0	0.24	12.7	0
241908	02LLF_W4-0044.1600	1	1	19.2	19.2	0	0	0	0
247270	05RPMNG1 18.000	1	1	151.1	151.1	75	17.61	88.48	-57.3

247271	05RPMNG2 18.000	2	1	151	151	75	17.61	105.1	-56.2
247272	05RPMNG3 18.000	3	1	151	151	75	17.61	84.87	-56.8
247549	V3-028 C 345.00	1C	1	7.6	7.6	0	0	0	0
247932	U2-072_GEN 0.6600	1	1	300	300	0	0	0	0
247940	U4-028 0.6900	1	1	100.8	100.8	0	0	0	0
247941	U4-029 0.6900	1	1	100.8	100.8	0	0	0	0
247948	V3-028 E 345.00	1E	1	12.4	12.4	0	0	0	0
253900	15BVRVL1 22.000	1	1	999	999	998	215.6	412	37.8
253901	15BVRVL2 22.000	2	1	999	999	999	215.6	411	38.2
256338	18PALISD 22.000	1	1	837	837	150	65.38	349.2	-312
264500	19COLFX 41.570	11	1	12.1	12.1	0	0	0	0
264759	19MON12P 345.00	11	1	12.05	12.05	0	0	0	0
264854	19ENFPP 22.000	1	1	1146	1146	1102	430	430	-40
264871	19MON1 26.000	1	1	752.3	752.3	350	261.5	327	-184
264872	19MON2 26.000	2	1	741.9	741.9	370	261.5	452	-175
264873	19MON3 26.000	3	1	782.2	782.2	325	243.5	492	-150
264874	19MON4 26.000	4	1	762	762	350	243.5	441	-164
907210	X1-027A WT1 0.6000	1	1	126	126	1	0	0	0
907211	X1-027A WT2 0.6000	1	1	126	126	1	0	0	0
907212	X1-027A WT3 0.6000	1	1	126	126	1	0	0	0
907213	X1-027A WT4 0.6000	1	1	126	126	1	0	0	0
913441	AA1-056_ST1 19.000	1	1	336.2	336.2	0	25.57	220	-163
913442	AA1-056_CT2 19.000	1	1	324.3	324.3	0	33.49	202	-151
913443	AA1-056_CT1 19.000	1	1	324.3	324.3	0	33.49	202	-151
918001	AA1-006 69.000	1	1	0.4	0.4	0	0.192	0.192	-0.13
929595	U2-041 GEN 0.6900	1	1	151	151	0	43.39	49.4	-49.4
929596	U2-041 GEN 0.6900	1	1	149	149	0	43.39	48.6	-48.6
931798	AC2-103 GEN10.6900	1	1	148.8	148.8	0	22.75	58.79	-58.8
931799	AC2-103 GEN20.6900	1	1	148.8	148.8	0	22.75	58.79	-58.8

Exhibit D
Transportation Study

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ROUTE EVALUATION STUDY

FOR THE:
PROPOSED EMERSON CREEK WIND PROJECT
OPSB SUBMITTAL
HURON AND ERIE COUNTIES, OHIO

PREPARED FOR:
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JANUARY 2019

HULL
Environment / Energy / Infrastructure

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1.0 INTRODUCTION

1.1 Project Description and Purpose

Apex Clean Energy, Inc. is planning development of the Emerson Creek Wind Project, an approximately 297.6-megawatt (MW) wind farm electric generation facility. The Emerson Creek Wind Project is planned to include up to 71 wind turbines with 87 turbine locations proposed, along with associated infrastructure such as access roads, electrical collection lines and a switchyard. This study offers a conservative outlook as it contemplates all 87 locations and turbines being built. The project facilities are located in Huron and Erie Counties, Ohio. A Project Map is included as **Figure 1**.

The objective of this study is to support an application to the Ohio Power Siting Board (OPSB) for a Certification of Compatibility and Public Need (Certificate Application), as codified at Ohio Administrative Code (OAC) 4906, as follows:

1. OAC 4906-4-06(F)(3): The applicant shall evaluate and describe the anticipated impact to roads and bridges associated with construction vehicles and equipment delivery. Describe measures that will be taken to improve inadequate roads and repair roads and bridges to at least the condition present prior to the project.

2. OAC 4906-4-06(F)(4): The applicant shall list all transportation permits required for construction and operation of the project and describe any necessary coordination with appropriate authorities for temporary or permanent road closures, lane closures, road access restrictions, and traffic control necessary for construction and operation of the proposed facility.

For the purpose of this report, the following definitions have been used when describing the project (based on OAC 4906-1-01:

- **Project Area** means all land within a contiguous geographic boundary that contains the facility, associated setbacks, and properties under lease or agreement that contain any components of the facility.

- **Facility** means the proposed major utility facility and all associated facilities.

- **Associated Facility** means, for an electric power generation plant or wind farm: rights-of-way, land, permanent access roads, structures, tanks, distribution lines and substations necessary to interconnect the facility to the electric grid, water lines, pollution control equipment, and other equipment used for the generation of electricity.

1.2 Methodology

The wind turbines will be located in groups at various locations in the Project Area and access to the proposed wind turbines for construction and operation will be from State, county and township roads and, where

necessary, new private gravel access roads. Construction of the facility will cause temporary increases in truck traffic on area roadways due to the delivery of materials and equipment.

This evaluation identifies the probable public routes that can be used to construct and operate the facility. It is assumed that vehicle traffic will originate from an Interstate or 4-lane divided State highway. From these routes, 2-lane State highways will be used to travel to the Project Area. State, county and township roads will be used to access private leased parcels that make up the Project Area.

For purposes of this evaluation, Interstate, 4-lane and 2-lane State highways were not evaluated because it is assumed that these roadways are sufficient to accommodate the construction and operational traffic with respect to load capacity, geometry and condition.

For the County and Township roads, this evaluation includes a desktop study and on-site visual assessment of the probable routes, bridges and culverts in the Project Area. The desktop review includes review of the participating parcels at the time of this revision. This evaluation includes the general condition based on visual assessment of culverts and bridges, general pavement conditions, vertical changes in grade, and overhead height obstructions. The evaluation identifies locations where improvements to the road are likely needed to accommodate the size of the delivery and construction vehicles. Research for state permits that are necessary for hauling the materials and equipment is also included in the evaluation.

1.3 Vehicle Types

The size and types of vehicles needed to deliver the turbine equipment depend on the specific project and the model and manufacturer of the turbine being transported. Turbine components can be classified as follows:

1.3.1 Wind Turbine Equipment

- Blade Sections – Blades are transported on trailers with one to three blades per vehicle. Blades typically control the length of the design vehicle, and the radii of the curves along the travel route to the site. Specialized transport vehicles are designed with articulating (manual or self-steering) rear axles to allow maneuverability through curves.

- Tower Sections – Towers are typically transported in as many as four sections depending on the supplier. Towers generally do not control design vehicle length but may control design vehicle height and/or width.

- Nacelle and Hub – The turbine nacelle, hub, and related elements are typically the heaviest components transported. Generally, the nacelle and hub are transported separately, and the nacelle is the heaviest component.

- Escort Vehicles – Light trucks with signs and banners that travel immediately in front or behind oversized loads to provide warning to motorists of the oversized vehicle.

1.3.2 Construction Equipment and Materials

- Construction of Site Access Roads – Conventional trucks carrying stone, gravel and miscellaneous construction equipment.

- Crane – Cranes are used for assembly of the wind turbine towers and are transported in sections over several trips to the site.

- Concrete trucks for tower foundations.

- Vehicles transporting construction staff and other incidental truck trips.

1.4 Design Vehicle Characteristics

Transportation of turbine components and associated construction material involves numerous conventional and specialized transportation vehicles. Wind turbine components (such as the tower sections, blade, and nacelle) are transported separately. The actual dimensions and specifications of the design vehicles may vary, depending on the specific wind turbine supplier and components.

Apex has selected the Vestas V150-4.2MW turbine model for this study, though a final turbine selection has not been made for the project and other turbine models are proposed as well for this project. Apex shared vendor-provided information on the selected turbine model, including wind turbine component dimensions and weights, but the vendor was unable to provide detailed information on the design vehicle characteristics. Therefore, Apex also provided information for the Nordex N149 turbine model, which included more information on the specialized transport vehicles needed for wind turbine components of this size. Based on the information provided and previous experience with these types of projects, Apex asked Hull to make assumptions for the design vehicle characteristics for this study. These assumptions are shown in the table below.

The blade for the selected wind turbine model is approximately 240-foot (73-m) long. Based on the information available, the design vehicle used for this evaluation has a 185-foot trailer component and total length of 207 feet. Additionally, the bade tip overhangs the end of the trailer approximately 50.5 feet, for a total transport length of 257.5 feet. For purposes of this study, blade delivery trucks were assumed to have rear-steering capabilities.

An experienced transportation provider will be used for the delivery of materials and turbine elements. For the purpose of this investigation, low-profile flatbed or open-bottom (Schnabel) truck trailers will be used to

offset overhead clearance limitations. Also, multi-axle trailers will be used to distribute oversized loads to acceptable levels, as stipulated by state special hauling permits.

Design Vehicle Characteristics

	Approximate Dimension of Component to be Transported, Inclusive of Vehicle				
Vehicle Characteristic	**Blade**	**Nacelle**		**Tower Sections**	**Crane**
		Without Drive Train	**Drive Train Only**		
Width of vehicle, inclusive of load	13.8'	14.1'	11.5'	14.1'	Unknown
Height of vehicle, inclusive of load	15'	15.4'	12.5'	15.1'	Unknown
Length, inclusive of load and bumpers	257.5'	110'	110'	188'	Unknown
Total Weight of vehicle with 3 or more axles	79,000 lbs	207,000 lbs	222,000 lbs	228,000 lbs	Unknown

2.0 PROBABLE ROUTE EVALUATION

2.1 Roadway Characteristics

An evaluation and visual assessment of the probable routes were conducted by traveling the roadways listed below (see **Figures 1** and **2** for location of probable routes). **Table 1** summarizes the existing conditions of the roadways. Roads where there are potential concerns are summarized below.

TR-31 (Dogtown Rd)

This road exhibits traverse cracking with extensive pavement cracking repairs. Rutting was observed along both sides of the road. At the time of inspection, a culvert appeared to have been recently installed and the pavement had not been replaced over the top of the culvert. The road may be susceptible to further deterioration due to increased heavy equipment traffic.

CR-64 (Pontiac Section Line Rd)

This road is in poor condition and exhibits significant raveling, pavement cracking, and rutting, particularly the section of pavement west of CR-30. The road may be susceptible to further deterioration with increased heavy equipment traffic.

TR-32 (Townline Rd 32)

This narrow, one-lane road exhibits significant deterioration along the edges, extensive cracking, and settling. The asphalt road terminates to a short gravel lane adjacent to a residential property.

Willoughby Rd (TR-75)

This road is in poor condition and exhibits bleeding, significant raveling, edge cracking, rutting, and base failure. Patching was observed throughout various road sections. This road is narrow and jogs around a corner near the intersection with Willard West Road which may present turning movement restrictions. Extensive road improvements may be necessary prior to increasing heavy equipment traffic.

2.2 Bridge and Road Load Restrictions

The Huron and Erie County Engineers were contacted to determine if there are any restrictions on bridges and roadways on the routes that were evaluated. At the time of this report, no information had been provided by the County Engineers. However, the following bridges were listed as "Structurally Deficient", according to information available through the Ohio Department of Transportation (ODOT) website:

Structure File Number (SFN)	Road	Bridge Length (ft)	Sufficiency Rating (%)
3935043	CR-64	14	038.1
3940624	CR-30	57	022.8

Bridge locations are shown on **Figure 2.**

According to the Federal Highway Administration, a bridge is classified as structurally deficient if it meets the following criteria: has not been constructed or had major reconstruction within the past 10 years; has a sufficiency rating at or below 80.0; has a condition rating of 4 or less for the deck, superstructures, substructures, or culverts and retaining walls; and has an appraisal rating of 2 or less for the Structural Condition or Waterway Adequacy. See ODOT's Structure Management System 2018 Structure Inventory Coding Guide for detailed information on bridge ratings and see **Appendix C** for the most recent bridge inspection reports for the five bridges listed in the above table. A summary of visual observations for the bridges within the Project Area are shown in **Table 2.**

2.3 Culvert Characteristics

Culverts (where visible) were visually examined to determine its condition and if adequate cover is present. For purposes of this evaluation, adequate cover means there is more than one foot of cover over the culvert (inclusive of the pavement). The condition of the culvert was limited to a visual review to determine if there is distortion in the shape (e.g., out of round) or evidence of corrosion (for steel culverts). The condition of concrete culverts is limited to evidence of cracking or surface spalling. Culvert inspections for all roadways potentially used for the Project are summarized in **Table 3.** Culverts noted to be in poor condition are summarized below.

CR-30 (Section Line Rd 30)

A concrete box culvert between TR-102 and CR-8 is in poor condition, with embankments that appear to be unstable, overgrowth of vegetation, and a headwall that appears to be tilting significantly.

CR-7 (N Greenfield Rd)

A corrugated metal pipe culvert just east of CR-30 is in poor condition, due to excessive rust, unstable embankment, and a flagstone headwall in poor condition.

TR-25 (Opperman Rd)

A cast iron pipe culvert located between SR-4 and CR-30 is in poor condition. There appears to be broken pieces of pipe visible both at the inlet structure and at the culvert outlet.

TR-78 (Willard West Rd)

A reinforced concrete pipe located between CR-30 and TR-75 is in poor condition. The culvert outlet is overgrown with vegetation and may be silted in.

2.4 Overhead and Width Restrictions

The roads were investigated for height limitations. Permanent structures that cross over the road and restrict the clearance for oversized loads (such as bridges and overpasses) were not found along the evaluated routes. For overhead cables, the national standard for minimum clearance over roads is 15.5 feet, and cables cross over the studied routes in numerous locations. The height of the cables was not measured; however, there were no overhead cables that appeared to be obstructive. In the event a cable presents an obstruction, utility providers can temporarily or permanently raise the cables and/or move the poles. Therefore, cables should not be a limiting feature for use of the roads.

The roads were also investigated for width restrictions. A number of single-lane roads exist in the project area, with pavement widths at or less than 12 ft (See **Table 1** for roadway pavement widths). Although transport load widths can be as wide as 14.1 ft, the transport vehicles can travel on roads with single-lane pavement widths. There were no width restrictions above the ground surface. Therefore, no width restrictions are anticipated along the preferred transportation routes in the project area.

2.5 Posted Caution Signs

There were multiple locations where posted caution signs were observed on the roadways that were reviewed. They are summarized in the table below.

Road	Posted Signs	Weight Limit (tons)
CR-15	WEIGHT LIMIT	25
TR-44	WEIGHT LIMIT	25
TR-23	NO THRU TRUCKS	N/A
TR-25	NO THRU TRUCKS	N/A
SR-162	WEIGHT LIMIT	15,22,25,38
TR-97	WEIGHT LIMIT/NO THRU TRUCKS	18
TR-37	WEIGHT LIMIT/NO THRU TRUCKS	18
TR-96	WEIGHT LIMIT/NO THRU TRUCKS	18

3.0 POTENTIAL IMPACTS TO ROADWAYS

The development of a wind-powered, electric generating facility has the potential to create transportation impacts because of short-term construction activities. The following sections estimate the traffic for construction vehicles during the project, summarize permitting and road use agreements, and outline steps for mitigating potential impacts to roadways.

3.1 Estimated Future Traffic

To deliver the turbine components, concrete, gravel, equipment, and construction workers to each turbine site during the construction of the facility, these roads will experience increased truck traffic. The exact construction vehicles have not yet been determined, but the following provides an order-of-magnitude estimate for the trip generation for each truck type:

- Gravel trucks with capacity of approximately 10 cubic yards (CY) per truck and an estimated gross weight of 75,000 pounds (lbs), for access road construction (estimated total of 5,900 trips throughout construction).
- Concrete trucks for construction of tower foundations with capacity of approximately 8 CY per truck and an estimated gross weight of 75,000 lbs (estimated total of approximately 6,700 trips throughout construction).
- Flatbed trucks (multiple axles to distribute loads) for transporting turbine components. These trucks can have gross weights up to 360,000 lbs; lengths (inclusive of tractor) up to 258 feet; widths up to 14.1 feet; and heights up to 15.4 feet. The estimated trips for each turbine component and total for the project are as follows:

Turbine Component	Assumption	Total Trips (Project)
Blades	3 loads per turbine	261
Towers	4 tower sections per turbine	348
Nacelle and Hub	3 loads per turbine	261

- Pickup trucks for equipment and tools.
- Trucks and cars for transporting construction workers.
- Oversize trucks for crane assembly/erection.

A final delivery route has not yet been finalized, but it is likely that delivery of turbine components to the Project Area will be from the northeast by way of Interstate-80/90 (Ohio Turnpike) to State Route 4 or from the northwest by way of Interstate-80/90 (Ohio Turnpike) to State Route 53, then State Route 20. Within the Project Area, several county and township roads and new gravel access roads will likely be used to deliver components to each turbine site. Prior to construction, such factors as highway limitations, planned

work schedules for state and local roadways, road widening, intersection improvements, utility re-locations, railroad crossing geometry and potential delays, and bridge/culvert reinforcement will be assessed by the selected transportation company.

Oversized construction vehicles could cause minor delays on public roads in the vicinity of the project, but these are unlikely to be significant given the relatively low traffic volume through the area. Most of the impacts will be to transportation infrastructure due to roadway improvements for oversized vehicles. Temporary turn-outs may be installed to allow uninterrupted flow of traffic, and spot radii widening may be used to accommodate the turning radius of over-length vehicles. Overhead utility line re-location projects will be needed in some areas to accommodate over-height vehicles and turning radii. Culvert and/or bridge reinforcement projects are also likely along main delivery routes for heavy vehicles.

There are locations along the identified routes where component delivery vehicles and construction traffic will cross into opposing lanes of traffic. With the assistance of Law Enforcement Officers (LEO), escorts, and/or flaggers, the maintenance of traffic (MOT) concerns will be adequately addressed.

During operation and maintenance of the facility, there will be very little increase in traffic as wind-powered electric generating facilities are normally unmanned. There will be occasional maintenance vehicles and additional traffic will be negligible.

3.2 Permits and Agreements

Prior to construction, the contractor will obtain all necessary permits from ODOT and the County Engineer. The County Engineer may require a Road Use and Maintenance Agreement (RUMA) for construction activities. This agreement will include procedures for temporary road closures, lane closures, road access restrictions and traffic control. For driveway access on County and Township roads, a permit will be required from the County Engineer.

Road crossing permits (e.g., for collection lines) will require a permit from ODOT or the County Engineer.

Special Hauling Permits are required when loads exceed legal dimensions or weights. The table below summarizes the characteristics of vehicle characteristics without Special Hauling Permits for State of Ohio highways.

DIMENSIONAL CRITERIA FOR VEHICLES WITHOUT SPECIAL HAULING PERMITS

Vehicle Characteristic	State Highway Limit
Width of vehicle, inclusive of load	8.5 Feet
Height of vehicle, inclusive of load	13.5 Feet
Length of vehicle, inclusive of load and bumpers	85 Feet
Total Weight of vehicle with 3 or more axles	80,000 Pounds

Based on the limits above and the transport vehicle characteristics, transportation of the blades, nacelles, tower sections, and cranes will require Special Hauling Permits for a variety of criteria. Each vehicle must receive an individual Special Hauling Permit from the ODOT Central Office. Permits are issued by ODOT for various vehicle criteria, but all permits have the name "Special Hauling Permit."

The specifications of the Special Hauling Permit depend on the characteristics of the vehicle, its cargo, and the duration of the delivery schedule. If any vehicle exceeds 120,000 pounds, 14 feet wide, or 14.5 feet in height, a permit via the "super load" process is required. The Special Hauling Permit fees and the Special Hauling Permit application are included in **Appendix B**.

3.3 Proposed Mitigation

Prior to construction, the selected transportation provider will obtain all necessary permits from ODOT and the County Engineers. Permits will likely be required for oversized loads; new access points, improving existing roadways, and crossing highways with buried electrical interconnects. The Final Transportation Routing Plan will be provided to the government agencies prior to the start of the project.

All roads should be monitored during construction for deterioration to ensure they are safe for local traffic. The volume and/or weight of construction traffic may cause accelerated pavement deterioration or stress on drainage structures that could necessitate temporary repairs. After completion of construction activities, there may be improvements required to return the roadways and drainage structures to pre-construction conditions. These requirements will be outlined in the RUMA with the County Engineers.

In the event impacts do occur, the following mitigation techniques will be utilized to avoid or minimize transportation-related impacts and/or to provide long-term improvement to the local road system:

3.3.1 Insufficient Roadway Width

- Widening roadway width to accommodate construction vehicles.
- Rerouting over-width vehicles to wider roadways.

3.3.2 Insufficient Vertical Clearance

- Temporarily relocating overhead utility lines and poles.
- Permanently relocating overhead utility lines and poles.
- Rerouting over-height vehicles to roadways with sufficient vertical clearance.

3.3.3 Poor Pavement Condition or Insufficient Pavement Durability

- Roadside drainage improvements
- Pavement Patching
- Replacing pavement prior to construction (may include subgrade improvements).
- Replacing pavement during or after construction if damaged by construction traffic (may include subgrade improvements).
- Rerouting heavy-loaded vehicles to avoid insufficient pavement.

3.3.4 Insufficient Cover over Drainage Structures

- Adding temporary gravel and/or asphalt cover over structures.
- Using bridge jumpers to clear structures.
- Replacing structures during or after construction if damaged by construction traffic.
- Rerouting heavy-loaded vehicles to avoid structures.

3.3.5 Poor Structure Condition

- Replacing structure during or after construction if damaged by construction traffic.
- Using bridge jumpers to clear structures.
- Rerouting heavy-loaded vehicles to avoid structures.

3.3.6 Inadequate Bridge Capacity

- Using bridge jumpers to clear bridges.

- Rerouting heavy-loaded vehicles to avoid bridges.

3.3.7 Insufficient Roadway Geometry

- Constructing appropriate turning radii at intersections where construction traffic is anticipated. This includes clearing and grubbing of existing vegetation; grading of the terrain to accommodate the improvement; extension of existing drainage pipes and/or culverts; re-locating utility poles if necessary; re-establishment of ditch line if necessary; and construction of a suitable roadway surface to carry the construction traffic, based on the existing geotechnical conditions.

- Rerouting over-sized vehicles to avoid insufficient roadway geometry.

- Profile adjustments to roadways with insufficient vertical geometry.

4.0 CONCLUSIONS

Based on information collected during the field investigation, vehicle assumptions, and information available from ODOT and County Engineers, sufficient infrastructure exists via Interstate, State and local roads to construct the facility. A number of intersection radii improvements will be required. Specialized transport vehicles are available to offset vertical clearance limitations at overpasses and bridges along the probable routes, such as Interstate-80/90, State Route 53, and U.S. Route 20. These vehicles are also capable of distributing the weights of loads to acceptable levels along the probable routes.

Interstate 80 will be the primary route used to approach the project. Alternatively, the Project Area can be accessed from the west side via U.S. Route 20. State Route 4 will serve as the primary travel route north and south once inside the Project Area.

A transportation provider experienced with oversized loads will be engaged to provide a Final Transportation Routing Plan including all State, County, and Township roads. The Plan will be performed in conjunction with the special hauling permit process for the Ohio Department of Transportation (and other state DOTs for out-of-state deliveries). Construction plans will be prepared for any roadway or intersection improvements. These improvements could be temporary or permanent. All temporary improvements will be restored to their pre-construction condition following completion of construction. All work will be coordinated and approved by the appropriate regulatory agency prior to construction.

All roads should be monitored during construction for deterioration to ensure they are safe for local traffic. The volume and/or weight of construction traffic may cause accelerated pavement deterioration or stress on drainage structures that could necessitate temporary repairs. After completion of construction activities, there may be improvements required to return the roadways and drainage structures to pre-construction conditions.

TABLES

TABLE 1
ROADWAY CHARACTERISTICS

Road	From	To	No. of Lanes	Pavement Width (ft)	Speed Limit	Pavement Type	Pavement Condition
SR-269	TR-23	TR-178	2	25	55	Asphalt	Excellent
TR-38	TR-97	TR-32	2	20	NP	Asphalt	Good
TR-37	TR-97	CR-15	2	18	NP	Chip & Seal	Good
TR-10	CR-8	TR-106	1	12	45	Chip & Seal	Good
CR-8	CR-30	TR-194	2	20	50	Asphalt	Good
TR-194	CR-8	CR-7	1	11	NP	Chip & Seal	Good
TR-96	SR-269	TR-37	2	20	NP	Chip & Seal	Good
TR-25	SR-4	CR-30	2	16	45	Asphalt	Good
TR-25	CR-30	TR-40	2	19.5	50	Chip & Seal	Good
TR-22	TR-23	TR-24	2	18	50	Chip & Seal	Good
TR-44	SR-113	CR-15	2	20	NP	Asphalt	Good
TR-44	CR-15	I-90	2	20	NP	Chip & Seal	Good
TR-40	US-20	TR-41	2	18	NP	Chip & Seal	Good
TR-9	TR-194	CR-30	1	10	NP	Chip & Seal	Good
CR-30	US-224	CR-16	2	21.25	50	Asphalt	Good
TR-67	CR-30	TR-68	2	17	50	Asphalt	Good
TR-97	TR-37	TR-38	2	22	NP	Asphalt	Good
SR-113	SR-4	TR-44	2	26	NP	Asphalt	Good
SR-162	CR-30	Access Road	2	24	NP	Asphalt	Good
SR-224	CR-30	TR-13	2	30	55	Asphalt	Good
SR-99	SR-113	TR-30	2	27	55	Asphalt	Good
SR-4	I-90	CR-64	2	26	55	Asphalt	Good
CR-15	SR-4	TR-114	2	24	NP	Chip & Seal	Good
CR-15	TR-38	TR-37	2	22	NP	Chip & Seal	Good
TR-26	SR-162	Access Road	2	18	45	Chip & Seal	Good
US-20	TR-22	SR-4	4	40	60	Asphalt	Good
TR-69	CR-8	TR-102	1	11	35	Chip & Seal	Good
TR-41	TR-40	Access Road	2	18	NP	Asphalt	Good
TR-23	SR-4	SR-269	2	20	45	Chip & Seal	Good
CR-40	TR-25	Access Road	2	20	50	Chip & Seal	Fair
TR-44	TR-31	TR-198	1	14	45	Chip & Seal	Fair
TR-70	CR-8	TR-102	1	11	45	Chip & Seal	Fair
TR-31	TR-44	Access Road	2	18.5	45	Asphalt	Fair
CR-8	TR-194	TR-10	2	19	50	Asphalt	Fair
TR-29	TR-67	Access Road	2	17.5	50	Chip & Seal	Fair
TR-71	SR-162	TR-102	1	10.5	45	Asphalt	Fair
CR-64	CR-30	TR-31	2	19.25	50	Asphalt	Fair
TR-22	TR-23	CR-39	2	18.5	50	Chip & Seal	Fair
CR-30	CR-16	TR-25	2	20.75	50	Chip & Seal	Fair
TR-67	TR-6	CR-30	2	19.5	50	Chip & Seal	Fair
CR-7	CR-30	Access Road	2	20	50	Asphalt	Fair
SR-162	CR-30	TR-26	2	23.5	50	Asphalt	Fair

Road	From	To	No. of Lanes	Pavement Width (ft)	Speed Limit	Pavement Type	Pavement Condition
SR-547	CR-30	TR-32	2	25.75	55	Asphalt	Fair
TR-6	TR-122	TR-67	1	13	35	Asphalt	Fair
TR-78	CR-30	TR-75	1	9.75	35	Chip & Seal	Fair
TR-31	CR-64	TR-44	2	19.5	45	Asphalt	Poor
CR-64	SR-4	Access Road	2	19	50	Chip & Seal	Poor
TR-32	SR-547	Access Road	1	10	35	Asphalt	Poor

Notes:

NP – Not Posted

Pavement Condition:

Excellent – recently paved

Good – pavement appears stable with minor cracking

Fair – pavement appears stable but may have a higher amount of cracking, especially at the pavement edge, potholes may be present

Poor – pavement is severely distressed with excessive cracks, potholes, rutting, and deterioration

TABLE 2
BRIDGES SUMMARY

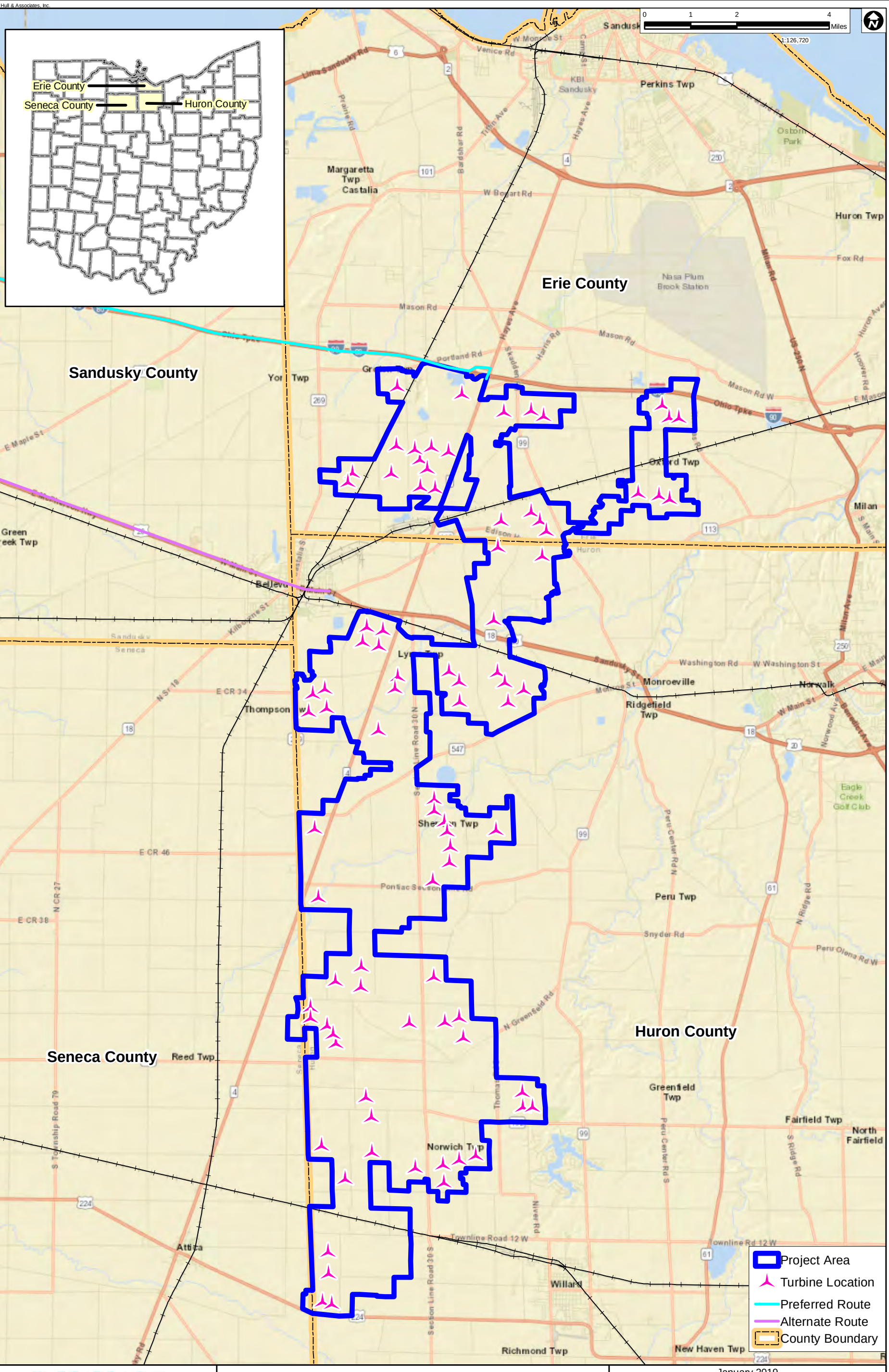
Road	Bridge Condition	Pavement Condition	Description
CR-15	Excellent	Good	Brand new concrete bridge
CR-7	Excellent	Good	Great condition
CR-7	Excellent	Good	Great condition, pavement good
SR-4	Excellent	Good	Pavement width is 40', excellent condition
CR-30	Good	Good	Recently updated bridge, good condition
CR-30	Good	Good	
CR-30	Good	Good	Railroad overpass
SR-4	Good	Good	Pavement width 29' from concrete wall to concrete median, good condition
SR-4	Good	Good	Pavement 44' wide, good condition
SR-99	Good	Good	Good condition
TR-194	Good	Good	
TR-67	Good	Good	Concrete, 27 ft guardrail to guardrail
CR-30	Good	Fair	Pavement cracking
CR-40	Good	Fair	Some cracking along abutments
TR-25	Good	Fair	
CR-64	Good	Poor	Pavement is poor, due to lip, deterioration
TR-96	Good	Poor	Good condition
TR-25	Fair	Good	
CR-30	Fair	Fair	Asphalt, 18 ft wide pavement
CR-30	Fair	Fair	Some cracking of pavement, bleeding
CR-8	Fair	Fair	
SR-113	Fair	Fair	Fair condition
SR-162	Fair	Fair	Metal hanging from north side
SR-4	Fair	Fair	Some cracking along abutments
SR-547	Fair	Fair	Flag stone
TR-69	Fair	Fair	
CR-30	Fair	Poor	Pavement cracking along abutments, tar bleeding
CR-40	Fair	Poor	Flag stone
CR-7	Fair	Poor	Poor asphalt condition, 20 ft wide
SR-224	Poor	Good	Concrete pavement, deteriorating on both sides, cracking, exposed rebar
SR-4	Poor	Fair	Cracking in abutments, exposed and sagging rebar

TABLE 3
CULVERTS SUMMARY

Road	Culvert Type*	Culvert Condition	Stable Embankment?	Pavement Condition	Description
TR-194	HDPE	Excellent	Yes	Good	
CR-7	HDPE	Excellent	Yes	Good	
CR-64	C-Box	Excellent	Yes	Good	
TR-22	RCP	Excellent	No	Good	
TR-44	C-Box	Excellent	Yes	Good	
TR-44	HDPE	Excellent	Yes	Good	
TR-44	RCP	Excellent	Yes	Good	
CR-30	HDPE	Excellent	Yes	Good	
CR-15	CMP	Excellent	Yes	Good	
CR-15	RCP	Excellent	Yes	Good	
TR-31	HDPE	Excellent	No	Poor	Potentially under construction
SR-113	RCP	Good	Yes	Excellent	
SR-113	RCP	Good	Yes	Excellent	
TR-38	CMP	Good	Yes	Good	
TR-38	RCP	Good	Yes	Good	
TR-38	RCP	Good	Yes	Good	
TR-38	RCP	Good	Yes	Good	
TR-10	C-Box	Good	Yes	Good	
TR-31	Cast Iron	Good	Yes	Good	
TR-31	C-Box	Good	Yes	Good	
TR-194	RCP	Good	Yes	Good	
TR-96	RCP	Good	Yes	Good	
CR-7	HDPE	Good	Yes	Good	HDPE on one side, CMP on other side
CR-7	RCP	Good	Yes	Good	
TR-44	RCP	Good	Yes	Good	
TR-44	RCP	Good	Yes	Good	
TR-44	RCP	Good	Yes	Good	
TR-44	RCP	Good	Yes	Good	
TR-44	RCP	Good	Yes	Good	
CR-30	C-Box	Good	Yes	Good	
CR-30	C-Box	Good	Yes	Good	
CR-30	RCP	Good	Yes	Good	
CR-30	RCP	Good	Yes	Good	
SR-99	CMP	Good	Yes	Good	
SR-99	RCP	Good	Yes	Good	
CR-15	RCP	Good	Yes	Good	
CR-15	RCP	Good	Yes	Good	
CR-15	RCP	Good	Yes	Good	
CR-15	RCP	Good	Yes	Good	
TR-23	C-Box	Good	Yes	Good	
TR-23	HDPE	Good	Yes	Good	
TR-70	Cast Iron	Good	Yes	Fair	
TR-70	C-Box	Good	Yes	Fair	

Road	Culvert Type*	Culvert Condition	Stable Embankment?	Pavement Condition	Description
TR-70	C-Box	Good	Yes	Fair	
TR-70	HDPE	Good	Yes	Fair	
TR-31	CMP Arch	Good	No	Fair	
TR-31	HDPE	Good	Yes	Fair	Some deterioration of pavement along edge
TR-29	C-Box	Good	Yes	Fair	
TR-29	C-Box	Good	Yes	Fair	
CR-30	Cast Iron	Good	Yes	Fair	
CR-30	Cast Iron	Good	Yes	Fair	
CR-30	C-Box	Good	Yes	Fair	
CR-30	CMP Arch	Good	Yes	Fair	
CR-30	HDPE	Good	Yes	Fair	
TR-67	C-Box	Good	Yes	Fair	
SR-162	HDPE	Good	Yes	Fair	
SR-4	RCP	Good	Yes	Fair	2 culverts
SR-4	RCP	Good	Yes	Fair	Cracking along pavement over culvert
SR-547	C-Box	Good	Yes	Fair	
SR-547	C-Box	Good	Yes	Fair	
TR-69	CMP	Good	Yes	Fair	Displaced grate
TR-69	CMP Arch	Good	Yes	Fair	
TR-69	HDPE	Good	Yes	Fair	
CR-30	HDPE	Good	Yes	Fair	
CR-8	HDPE	Good	Yes	Poor	
CR-64	CMP	Good	Yes	Poor	
CR-64	CMP	Good	Yes	Poor	2 culverts
CR-30	CMP	Good	Yes	Poor	
TR-78	RCP	Good	Yes	Poor	
CR-7	CMP	Fair	Yes	Good	
TR-22	HDPE	Fair	No	Good	
SR-4	C-Box	Fair	Yes	Good	
SR-4	RCP	Fair	Yes	Good	
SR-4	RCP	Fair	Yes	Good	
SR-547	C-Box	Fair	Yes	Good	
TR-75	Cast Iron	Fair	Yes	Good	
TR-29		Fair	Yes	Fair	
TR-71	C-Box	Fair	Yes	Fair	Flagstone
TR-67	HDPE	Fair	Yes	Fair	
SR-162	Cast Iron	Fair	No	Fair	Possibly inhabited by a groundhog
CR-30	C-Box	Fair	Yes	Poor	
TR-75	RCP	Fair	No	Poor	Culvert embankment shifted, not sitting upright
TR-78	RCP	Fair	No	Poor	Culvert embankment shifted, not sitting upright
TR-78	Cast Iron	Fair	No	Poor	

FIGURES



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January 2019

Route Evaluation Study
Apex Clean Energy, Inc.

Potential Routes Overview

Proposed Emerson Creek Wind Project
Seneca, Huron, and Erie Counties, Ohio

Figure 1

Produced using ArcGIS 10.5

File Name: ACX007_08_Fig01_Routes.mxd

Edited: 1/4/2019 By: rkaip

0 0.75 1.5 3 Miles

1:95,040

Sandusky County

Erie County

Seneca County

Huron County

481649M

481643W

472345X

472351B

473655V

3935043

3940624

142144W

Project Area
Turbine Location
Intersection Diagram (See Figures)
Preferred Route
Alternate Route
US or State Route
County or Township Road
Proposed Turbine Access Road
Direction of Equipment Delivery
Railroad Crossing (AARDOT ID#)
Structurally Deficient Bridge (See Appendix C)
County Boundary

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January 2019

Route Evaluation Study
Apex Clean Energy, Inc.

Potential Routes (Project Area)

Proposed Emerson Creek Wind Project
Seneca, Huron, and Erie Counties, Ohio

Figure 2

Produced using ArcGIS 10.5
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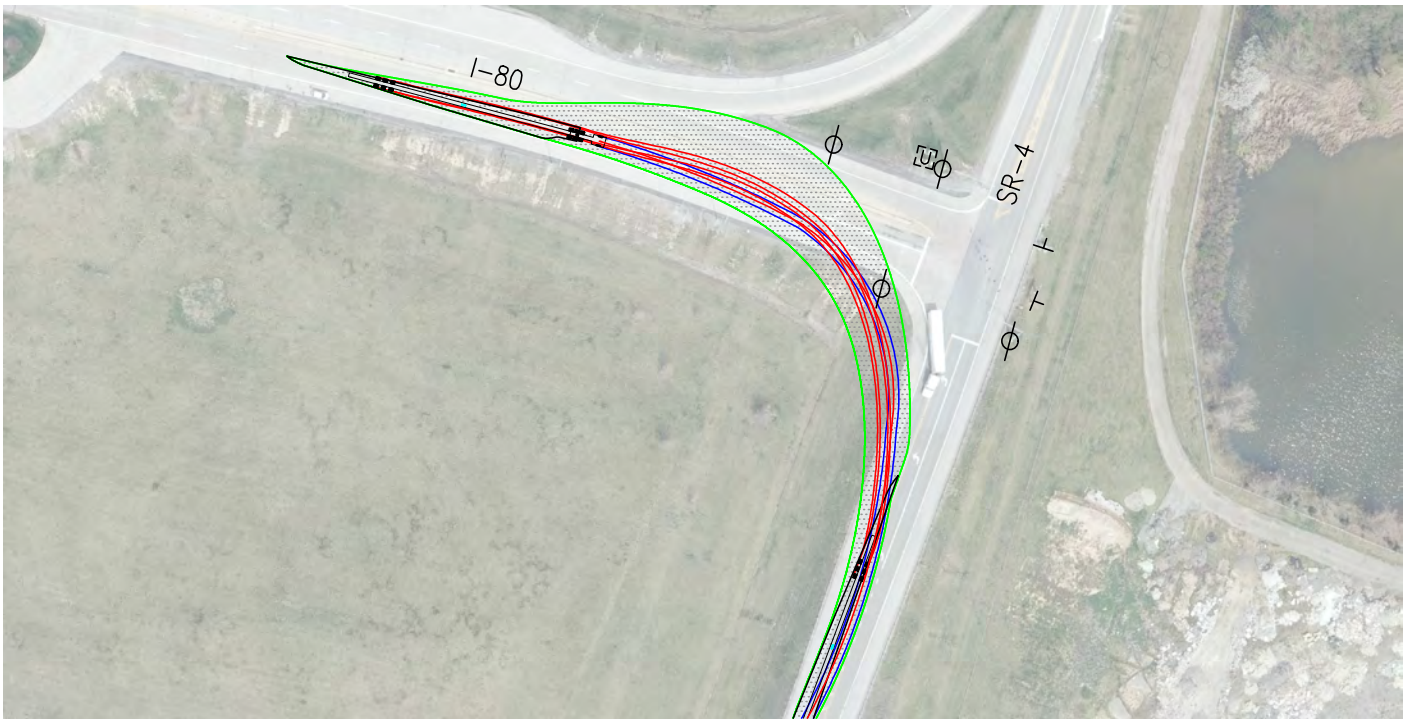
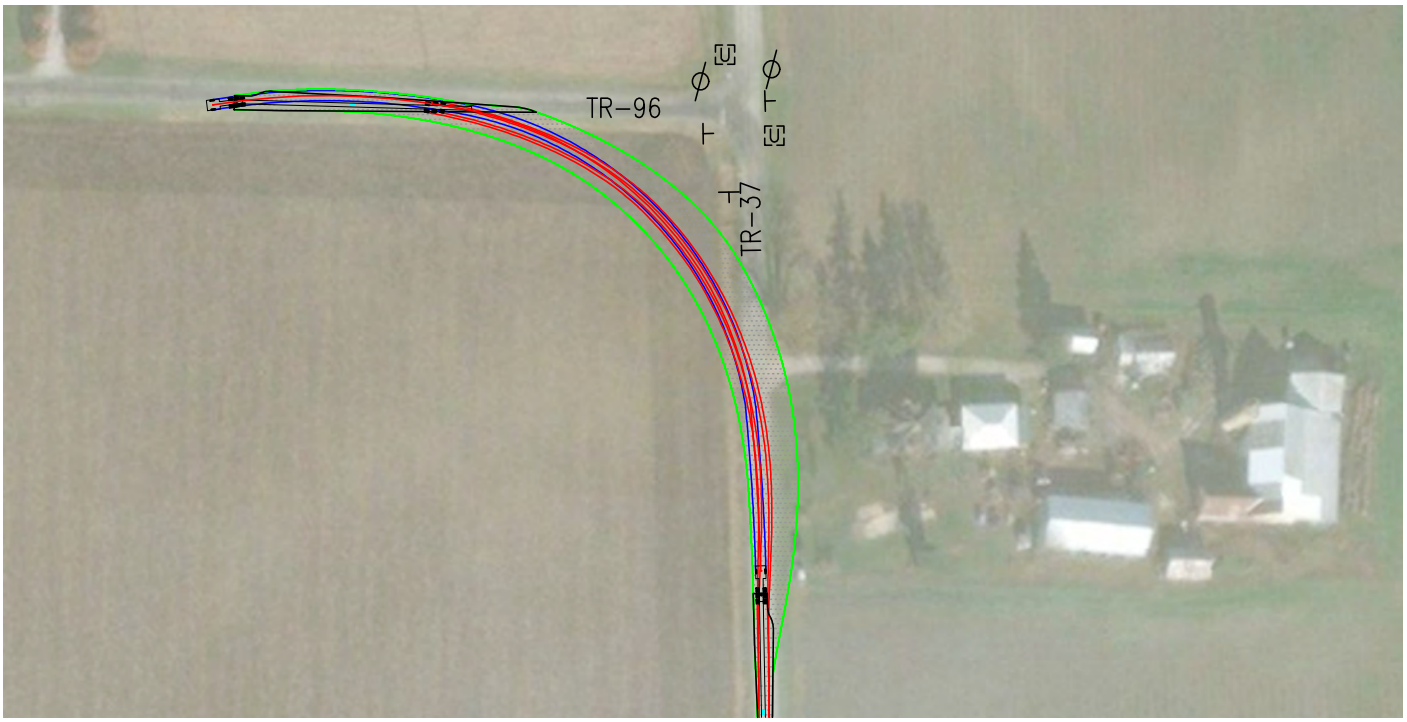


INTERSTATE 80 EXIT RAMP EASTBOUND TO STATE ROUTE 4 SOUTHBOUND



TOWNSHIP ROAD 37 NORTHBOUND TO TOWNSHIP ROAD 96 WESTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
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DRAWN BY: AET	FIGURE
DATE: 1/17/2019	3

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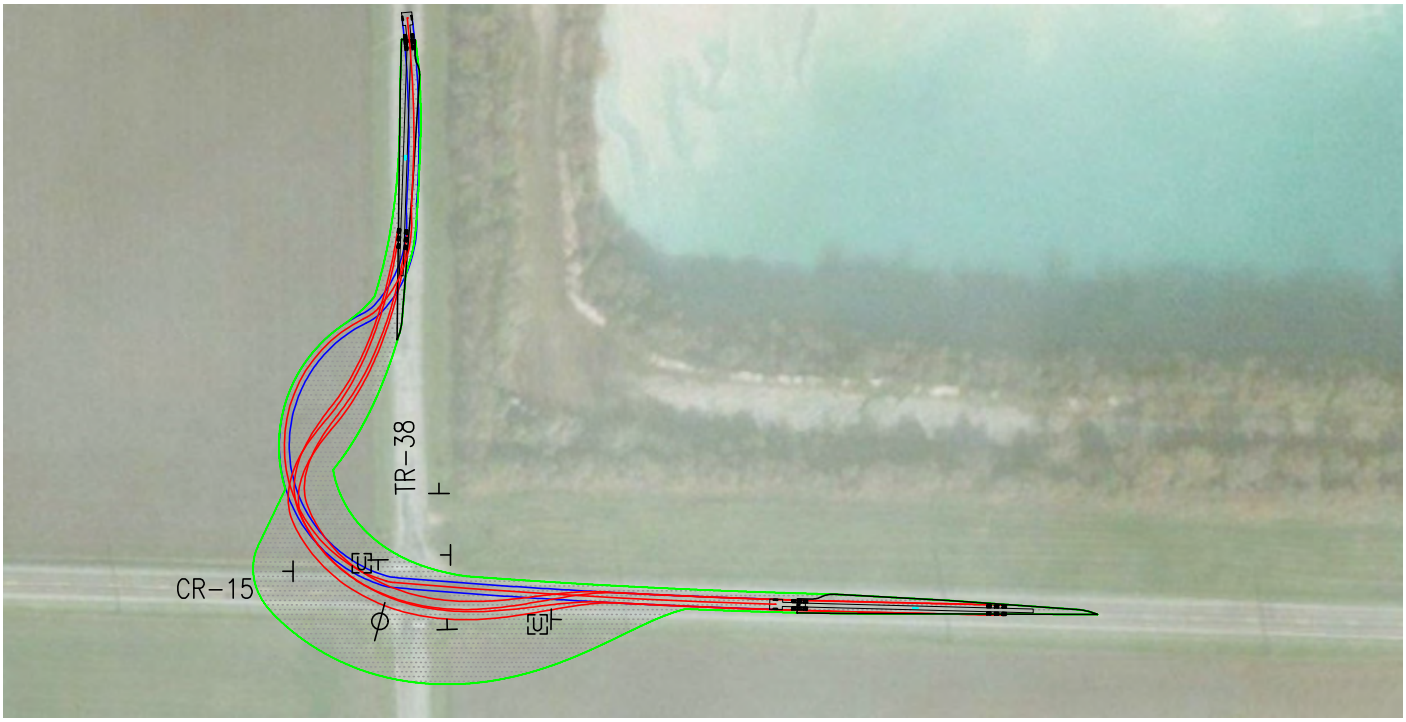
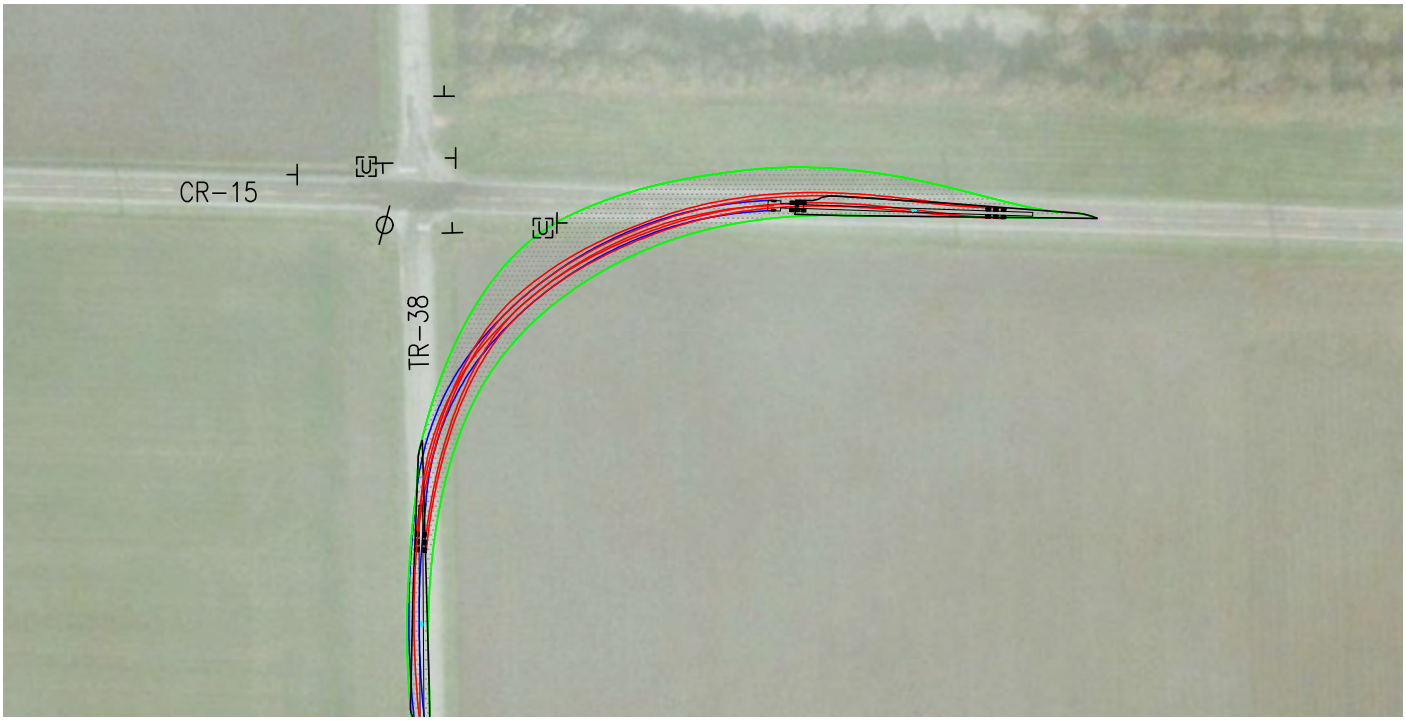


COUNTY ROAD 15 WESTBOUND TO TOWNSHIP ROAD 38 NORTHBOUND



COUNTY ROAD 15 WESTBOUND TO TOWNSHIP ROAD 38 SOUTHBOUND

LEGEND

- UTILITY POLE
- UTILITY BOX
- ROAD SIGN
- FRONT TIRE PATH
- REAR TIRE PATH
- BLADE TIP/LOAD PATH

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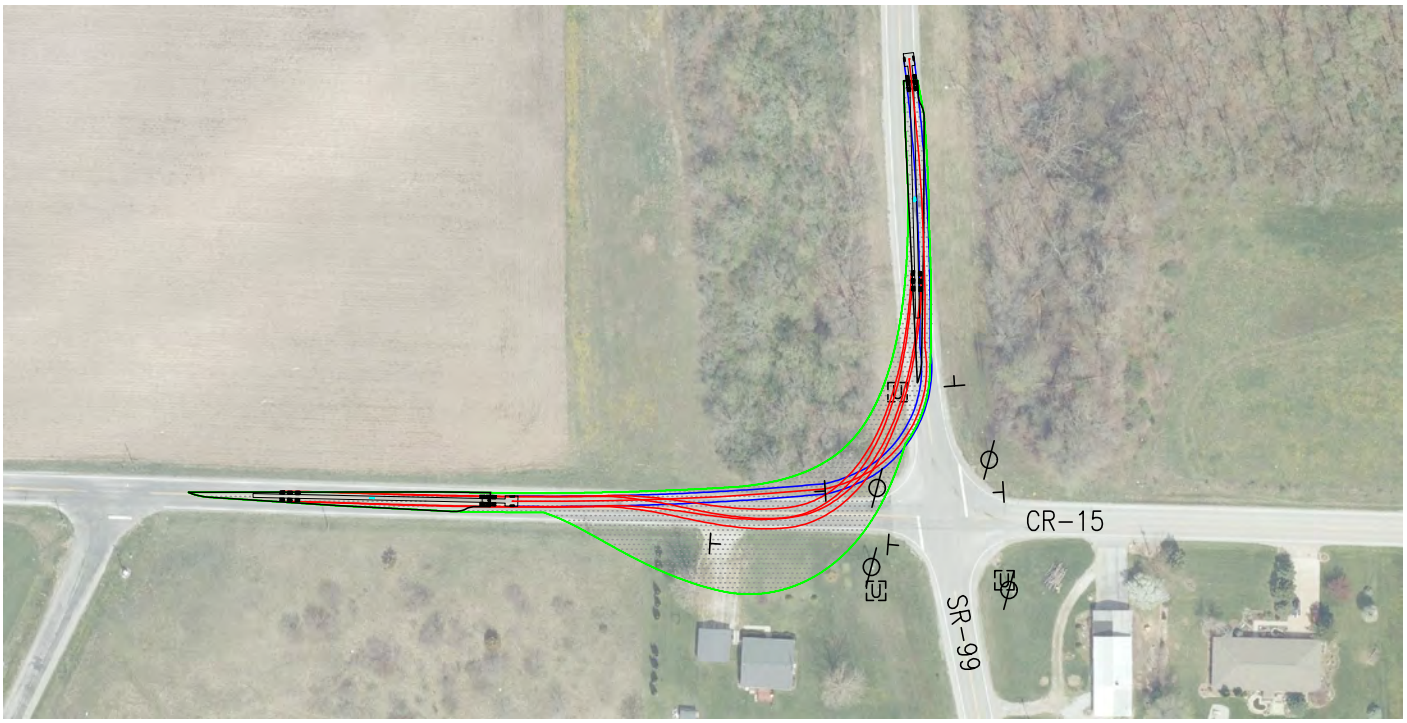
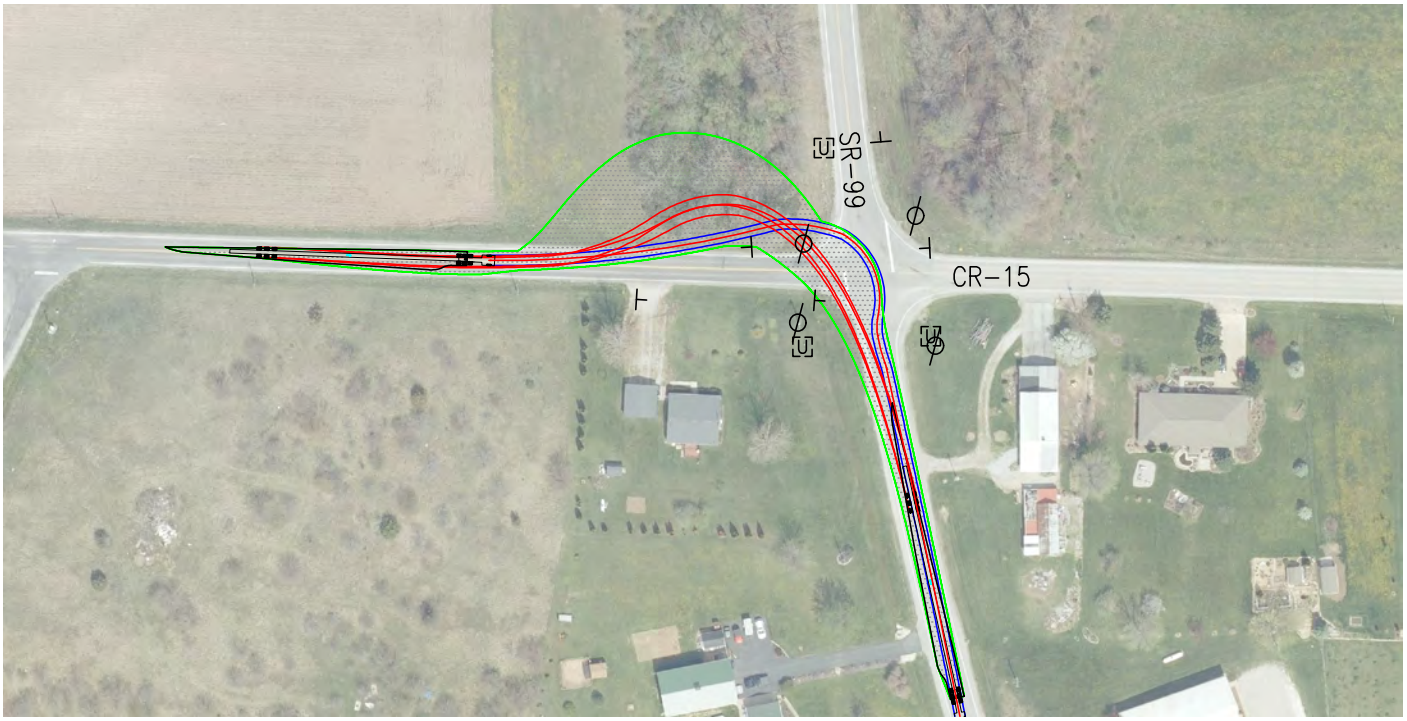


COUNTY ROAD 15 EASTBOUND TO STATE ROUTE 99 NORTHBOUND



COUNTY ROAD 15 EASTBOUND TO STATE ROUTE 99 SOUTHBOUND

LEGEND

- UTILITY POLE
- UTILITY BOX
- ROAD SIGN
- FRONT TIRE PATH
- REAR TIRE PATH
- BLADE TIP/LOAD PATH

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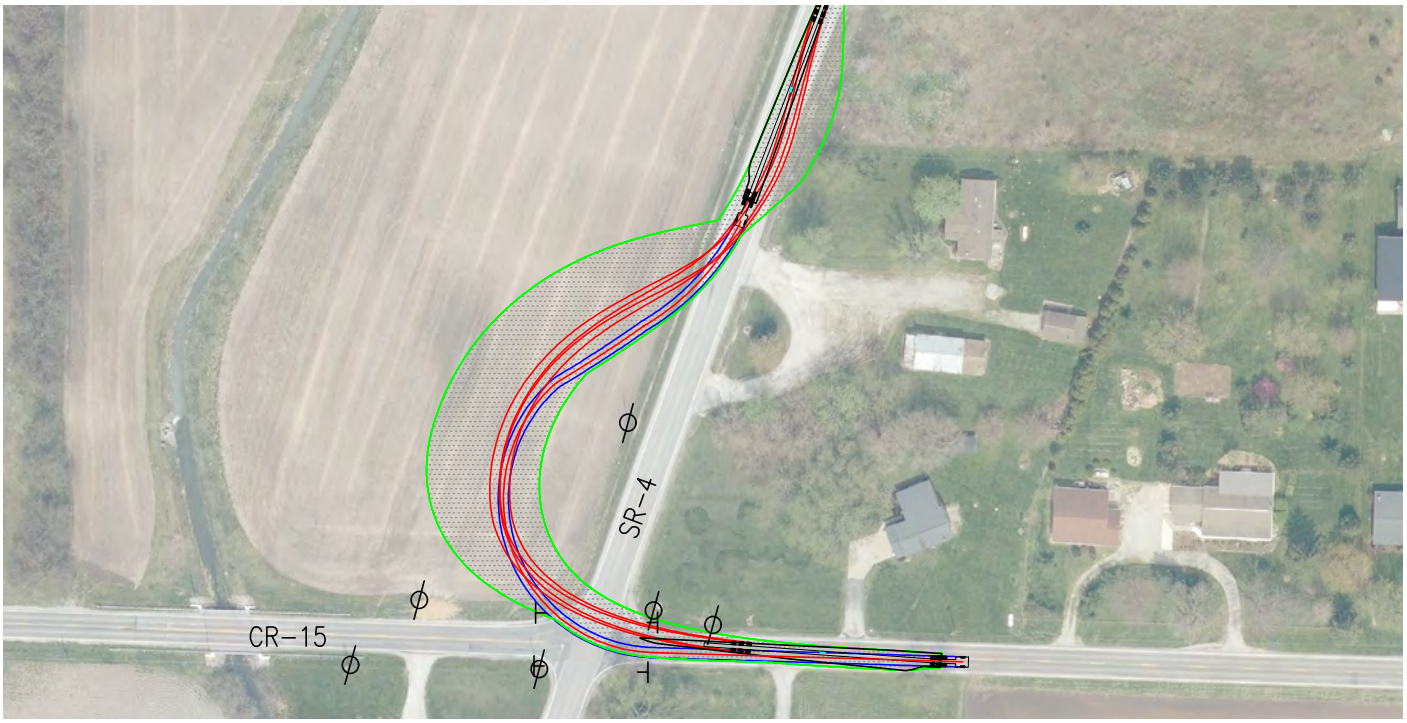
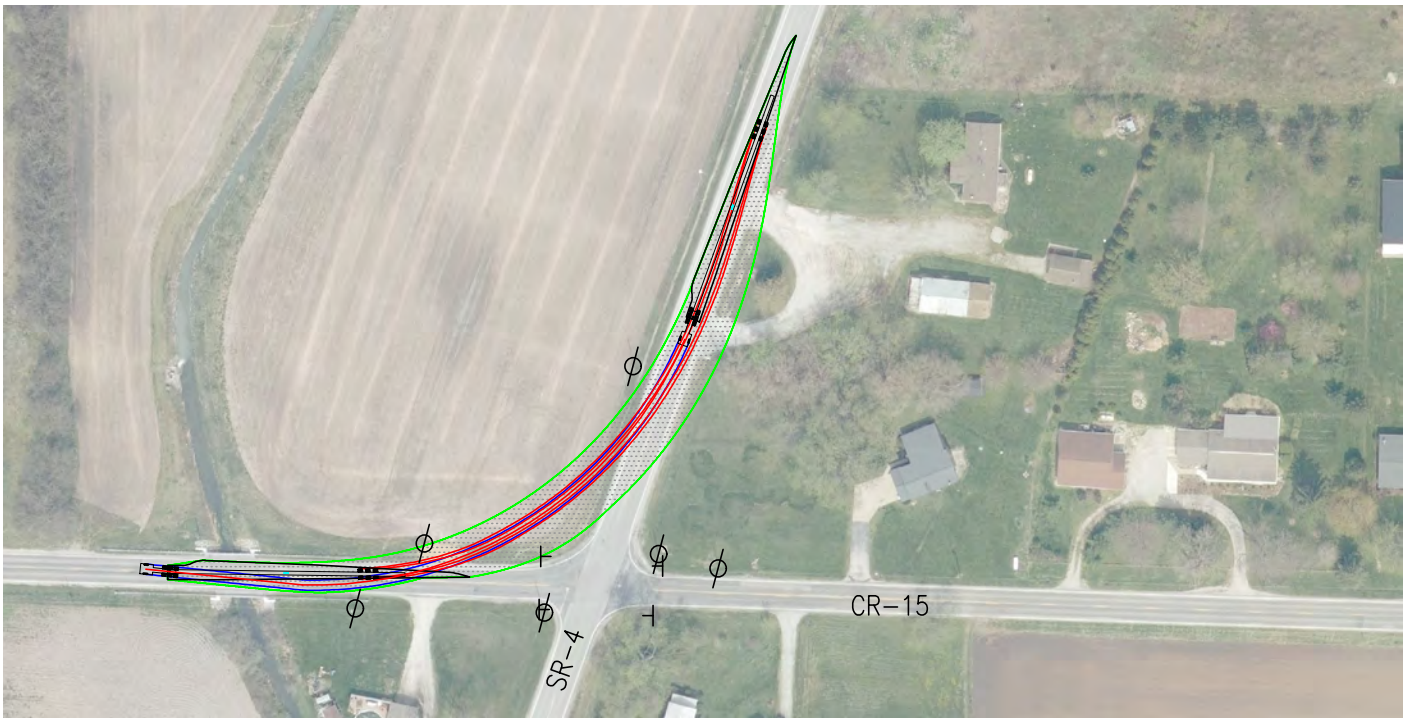


STATE ROUTE 4 SOUTHBOUND TO COUNTY ROAD 15 EASTBOUND



STATE ROUTE 4 SOUTHBOUND TO COUNTY ROAD 15 WESTBOUND

LEGEND

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⊡	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

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DATE: 1/17/2019	6

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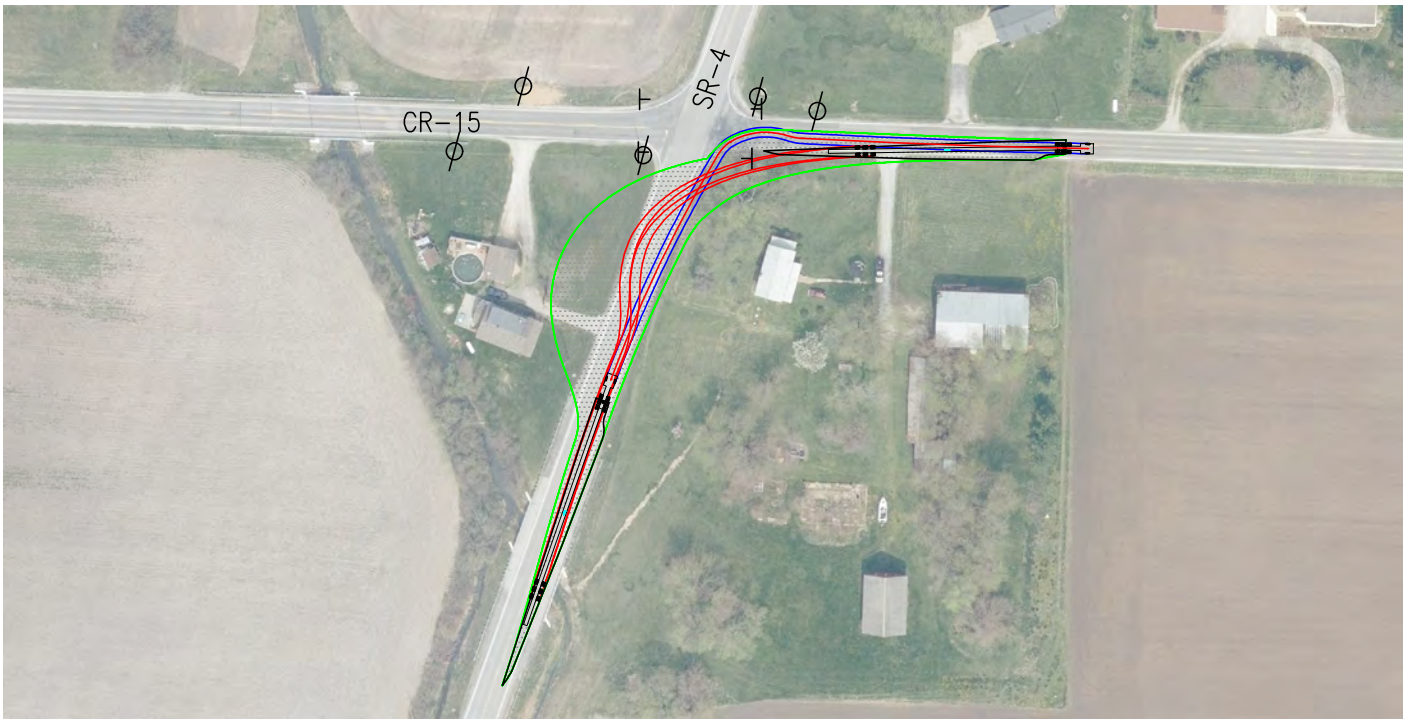
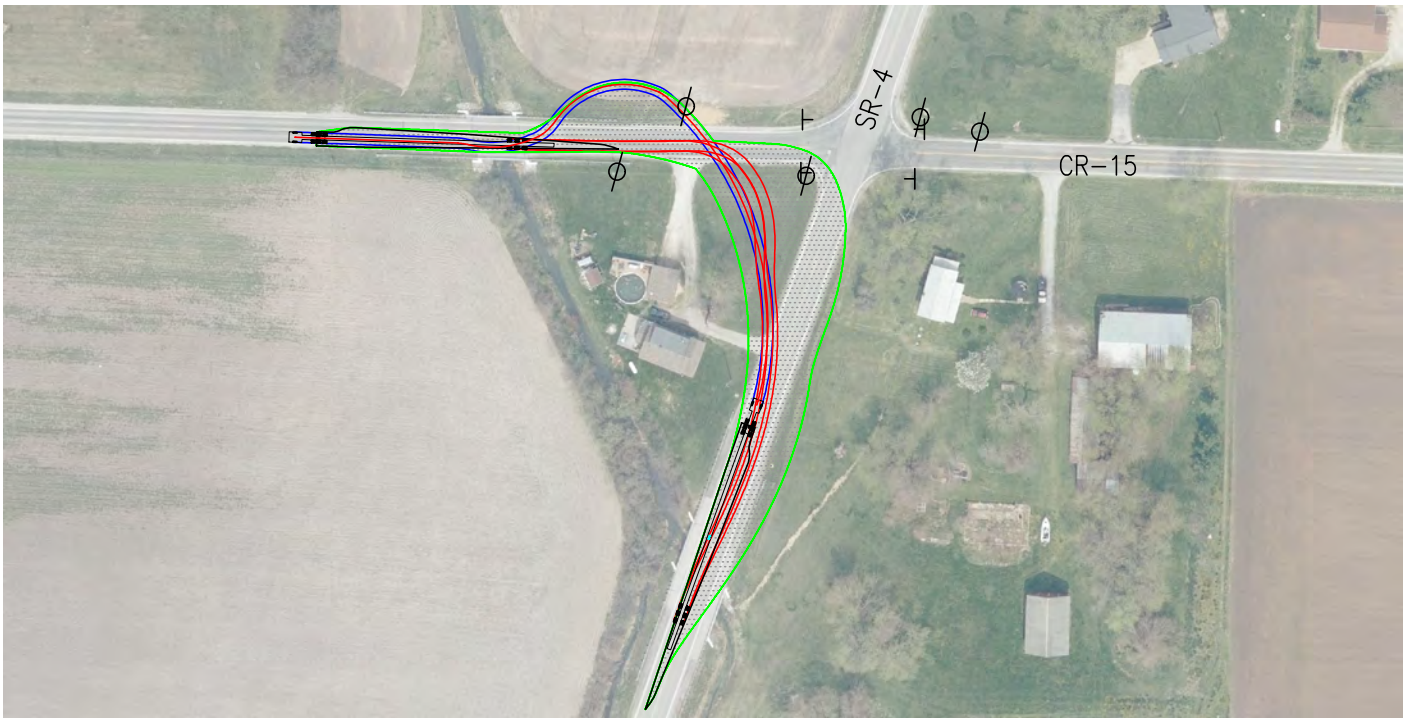


STATE ROUTE 4 NORTHBOUND TO COUNTY ROAD 15 EASTBOUND



STATE ROUTE 4 NORTHBOUND TO COUNTY ROAD 15 WESTBOUND

LEGEND

- UTILITY POLE
- UTILITY BOX
- ROAD SIGN
- FRONT TIRE PATH
- REAR TIRE PATH
- BLADE TIP/LOAD PATH

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DATE: 1/17/2019	7

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TOWNSHIP ROAD 44 NORTHBOUND TO COUNTY ROUTE 15 EASTBOUND

TOWNSHIP ROAD 31 NORTHBOUND TO TOWNSHIP ROAD 44 EASTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
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DATE: 1/17/2019	8

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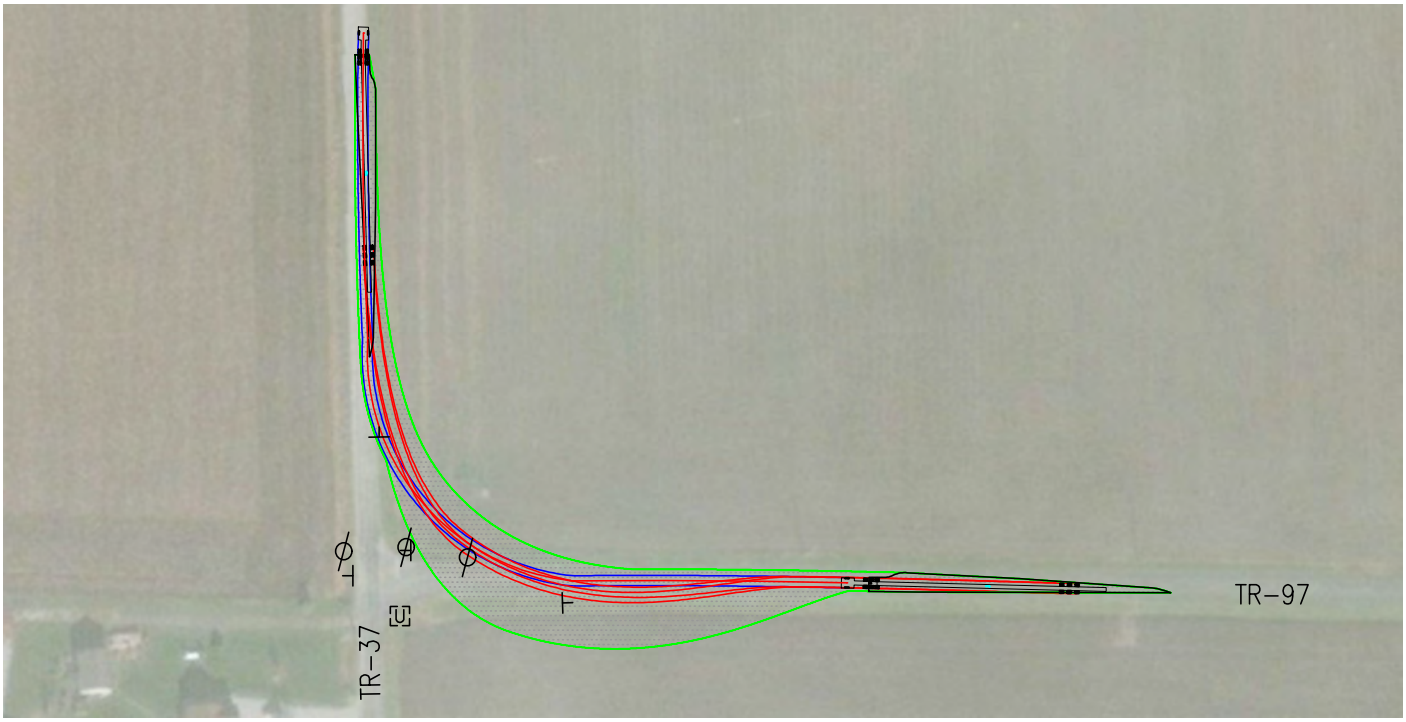
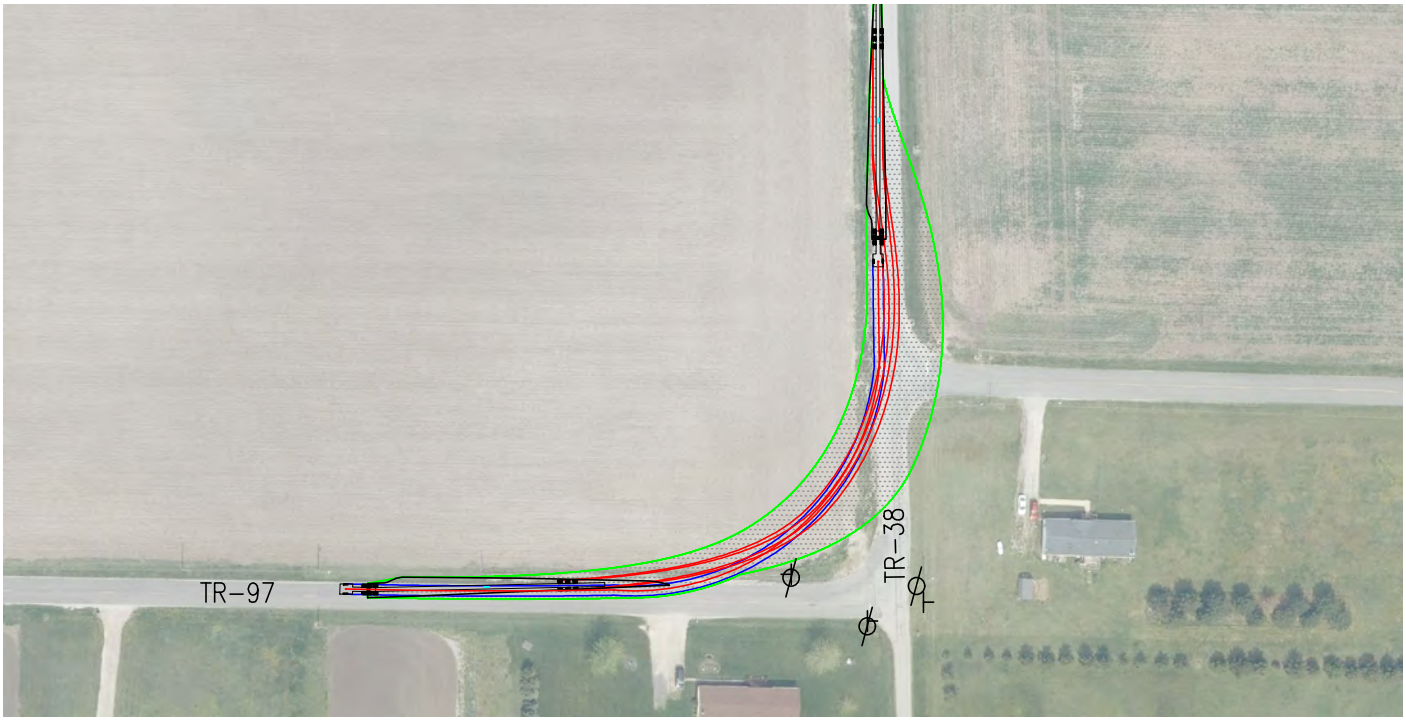


TOWNSHIP ROAD 97 WESTBOUND TO TOWNSHIP ROAD 37 NORTHBOUND



TOWNSHIP ROAD 38 SOUTHBOUND TO TOWNSHIP ROAD 97 WESTBOUND

LEGEND

- UTILITY POLE
- UTILITY BOX
- ROAD SIGN
- FRONT TIRE PATH
- REAR TIRE PATH
- BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	9

ROUTE EVALUATION STUDY
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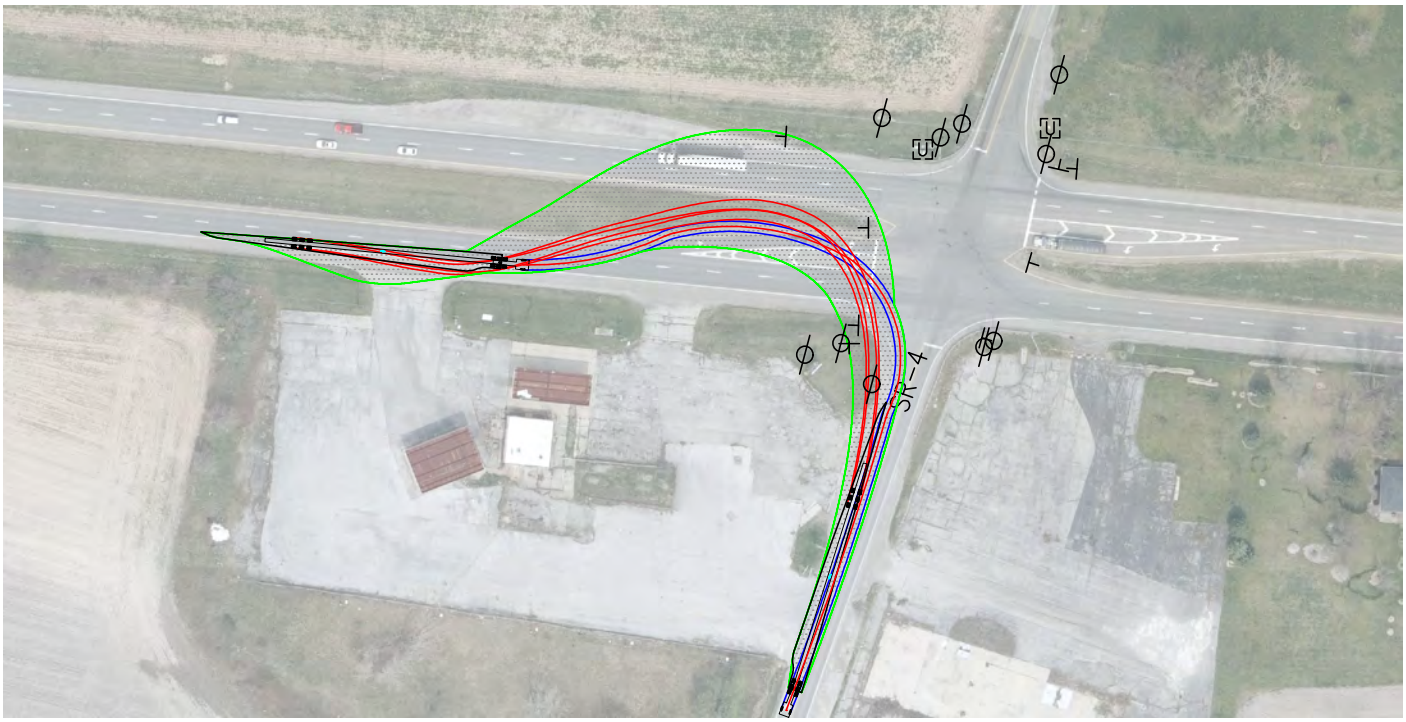
U.S. ROUTE 20 EASTBOUND TO STATE ROUTE 4 NORTHBOUND



U.S. ROUTE 20 EASTBOUND TO STATE ROUTE 4 SOUTHBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
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DATE: 1/17/2019	10

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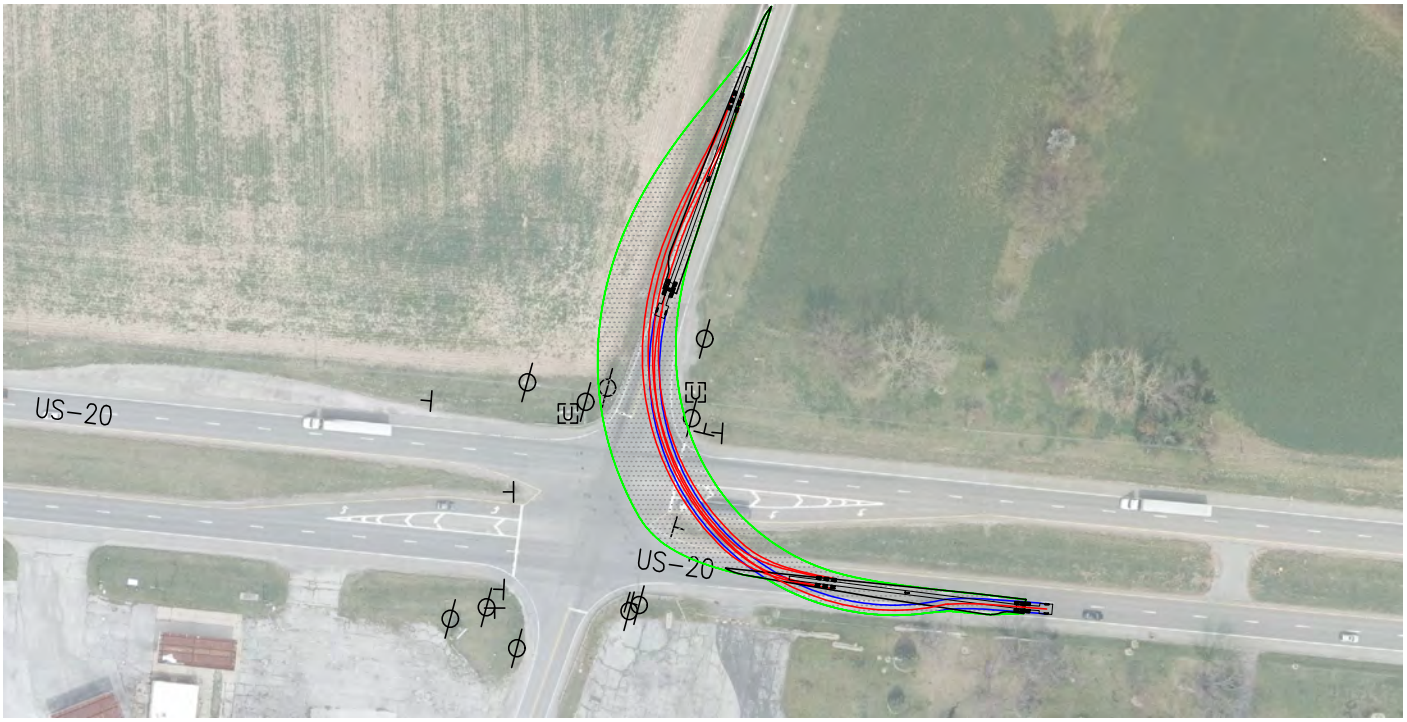
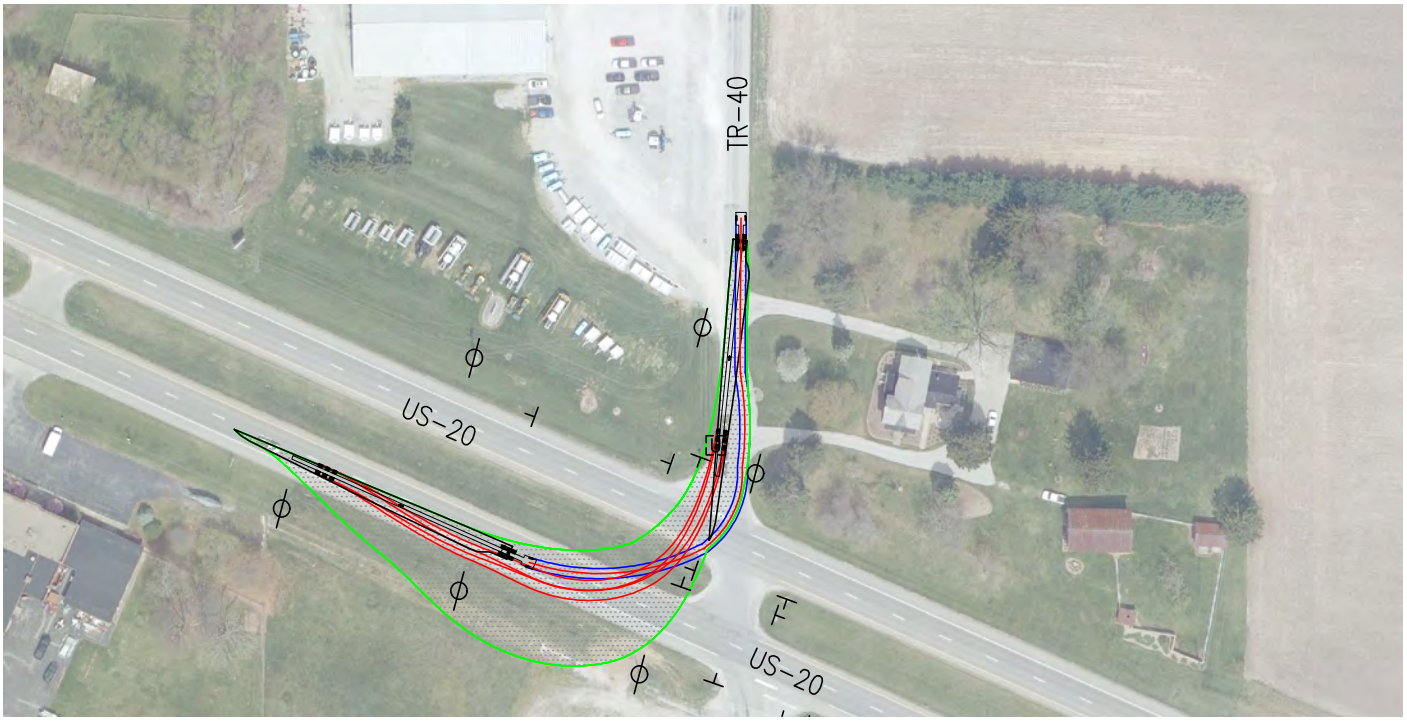


STATE ROUTE 4 SOUTHBOUND TO U.S. ROUTE 20 EASTBOUND



U.S. ROUTE 20 EASTBOUND TO STATE ROUTE 4 SOUTHBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	11

ROUTE EVALUATION STUDY
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TOWNSHIP ROAD 23 WESTBOUND TO TOWNSHIP ROAD 22 NORTHBOUND

TOWNSHIP ROAD 23 WESTBOUND TO TOWNSHIP ROAD 22 SOUTHBOUND

LEGEND

- UTILITY POLE
- UTILITY BOX
- ROAD SIGN
- FRONT TIRE PATH
- REAR TIRE PATH
- BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	12

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TOWNSHIP ROAD 23 WESTBOUND TO STATE ROUTE 269 SOUTHBOUND

TOWNSHIP ROAD 40 NORTHBOUND TO TOWNSHIP ROAD 41 EASTBOUND

LEGEND

UTILITY POLE	FRONT TIRE PATH
UTILITY BOX	REAR TIRE PATH
ROAD SIGN	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	13

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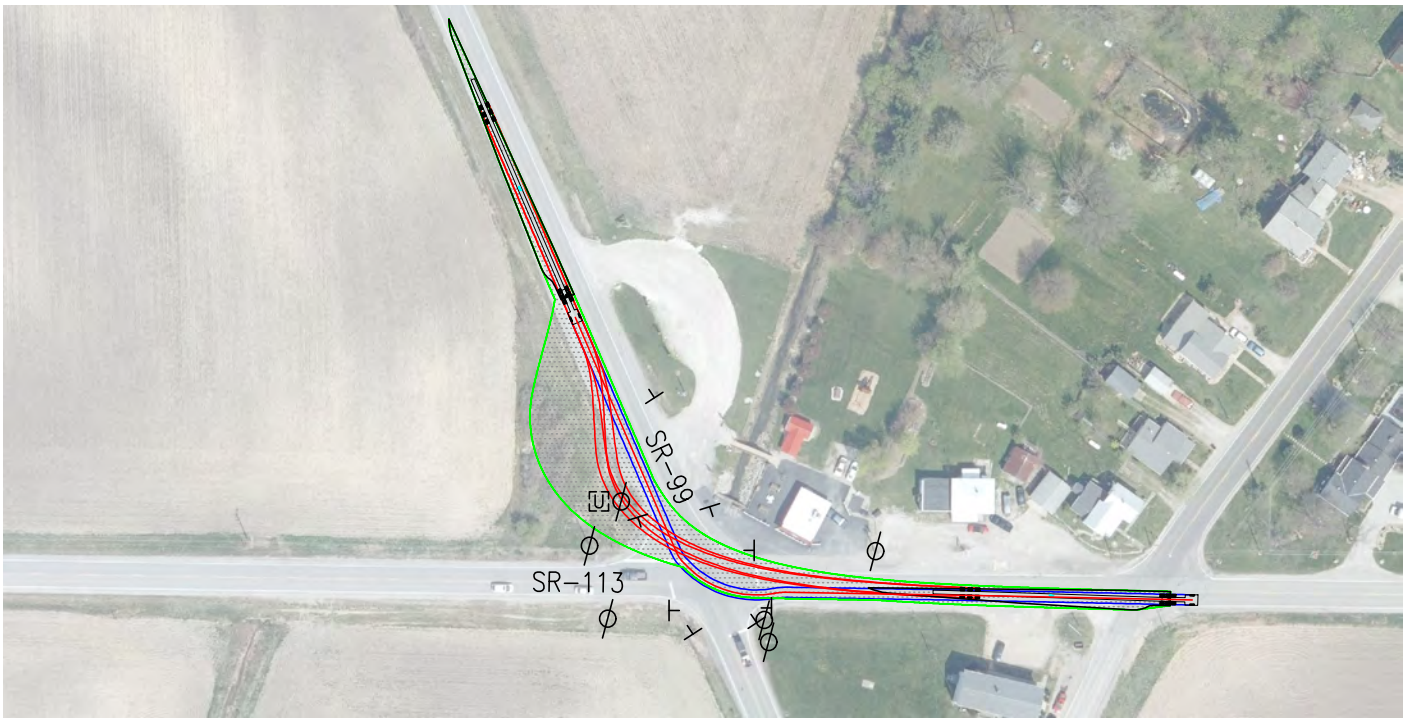
STATE ROUTE 99 SOUTHBOUND TO STATE ROUTE 113 WESTBOUND



STATE ROUTE 99 SOUTHBOUND TO STATE ROUTE 113 EASTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	14

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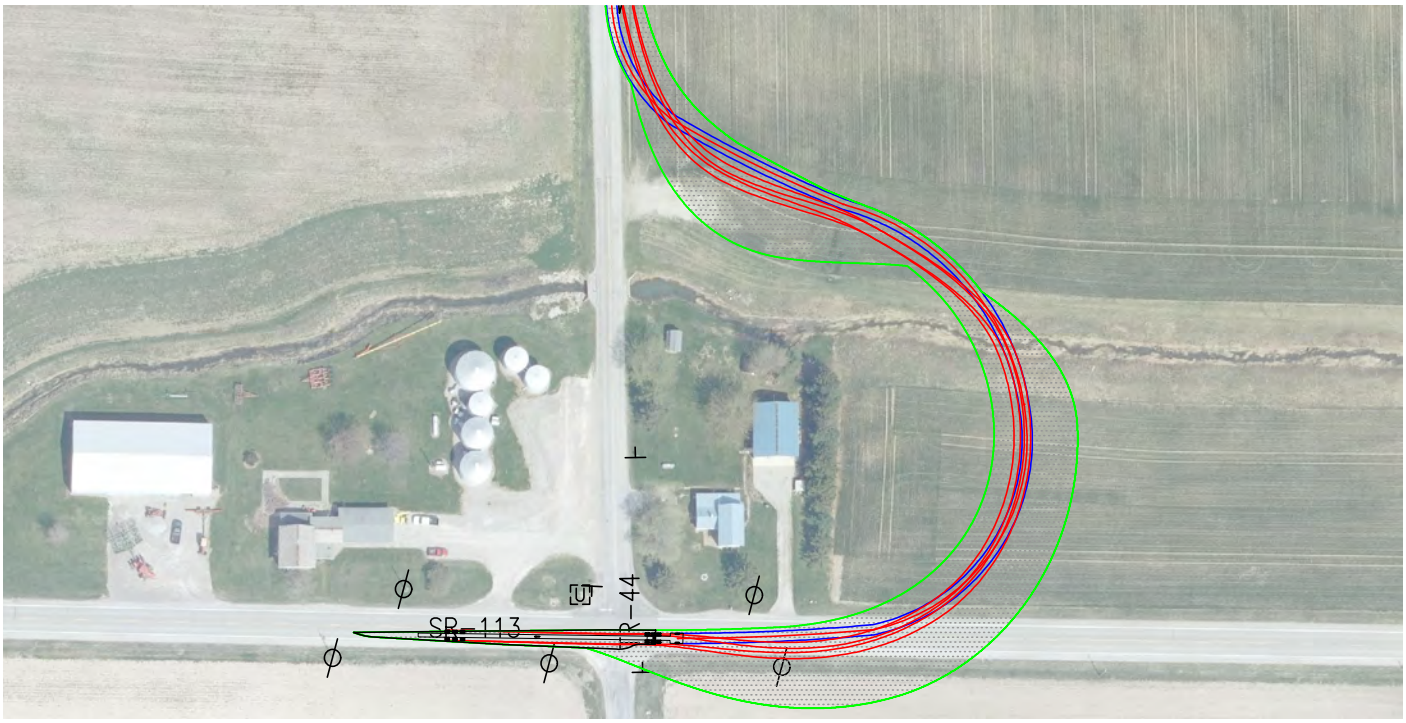

STATE ROUTE 113 EASTBOUND TO TOWNSHIP ROAD 44 NORTHBOUND

STATE ROUTE 547 EASTBOUND TO TOWNSHIP ROAD 32 NORTHBOUND

LEGEND

- UTILITY POLE
- UTILITY BOX
- ROAD SIGN
- FRONT TIRE PATH
- REAR TIRE PATH
- BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	15

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TOWNSHIP ROAD 25 EASTBOUND TO COUNTY ROAD 40 NORTHBOUND

TOWNSHIP ROAD 25 EASTBOUND TO COUNTY ROAD 30 SOUTHBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
UB	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	16

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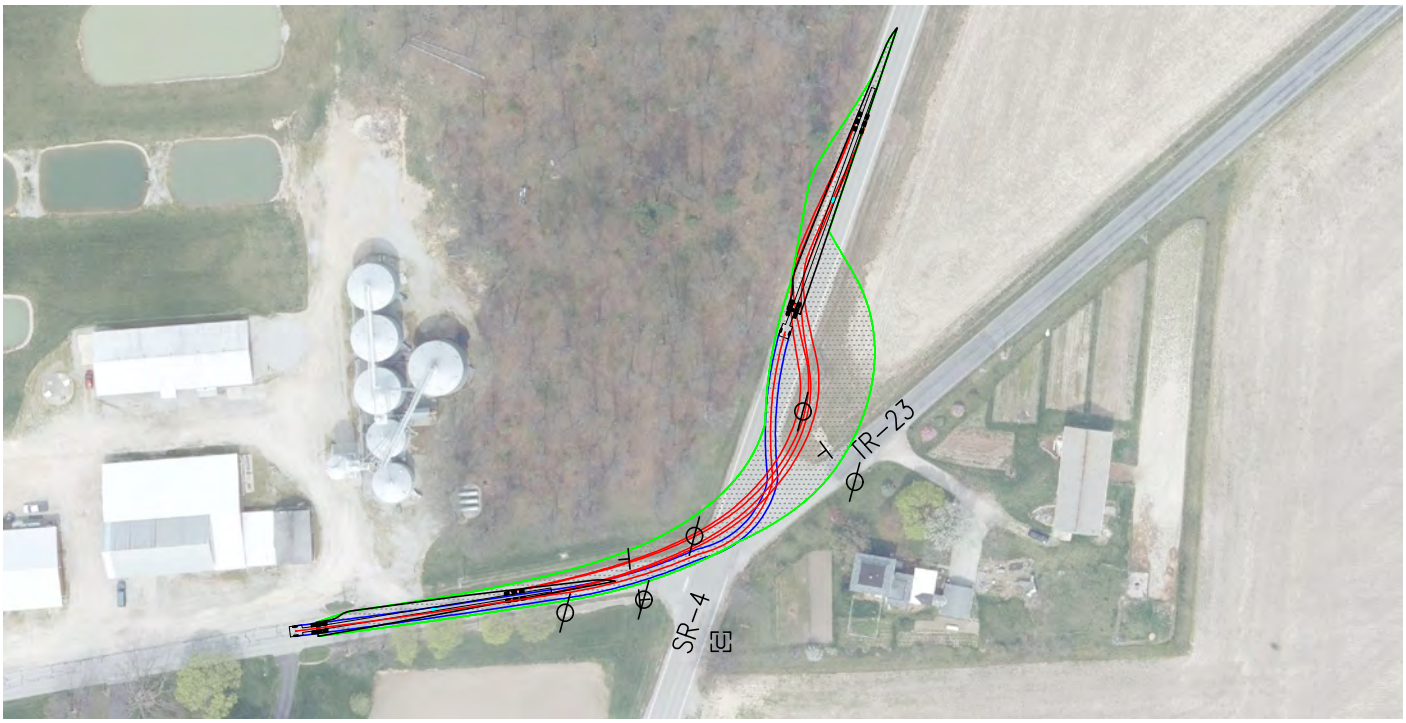

STATE ROUTE 4 SOUTHBOUND TO TOWNSHIP ROAD 23 WESTBOUND

STATE ROUTE 4 SOUTHBOUND TO TOWNSHIP ROAD 25 EASTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
UB	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	17

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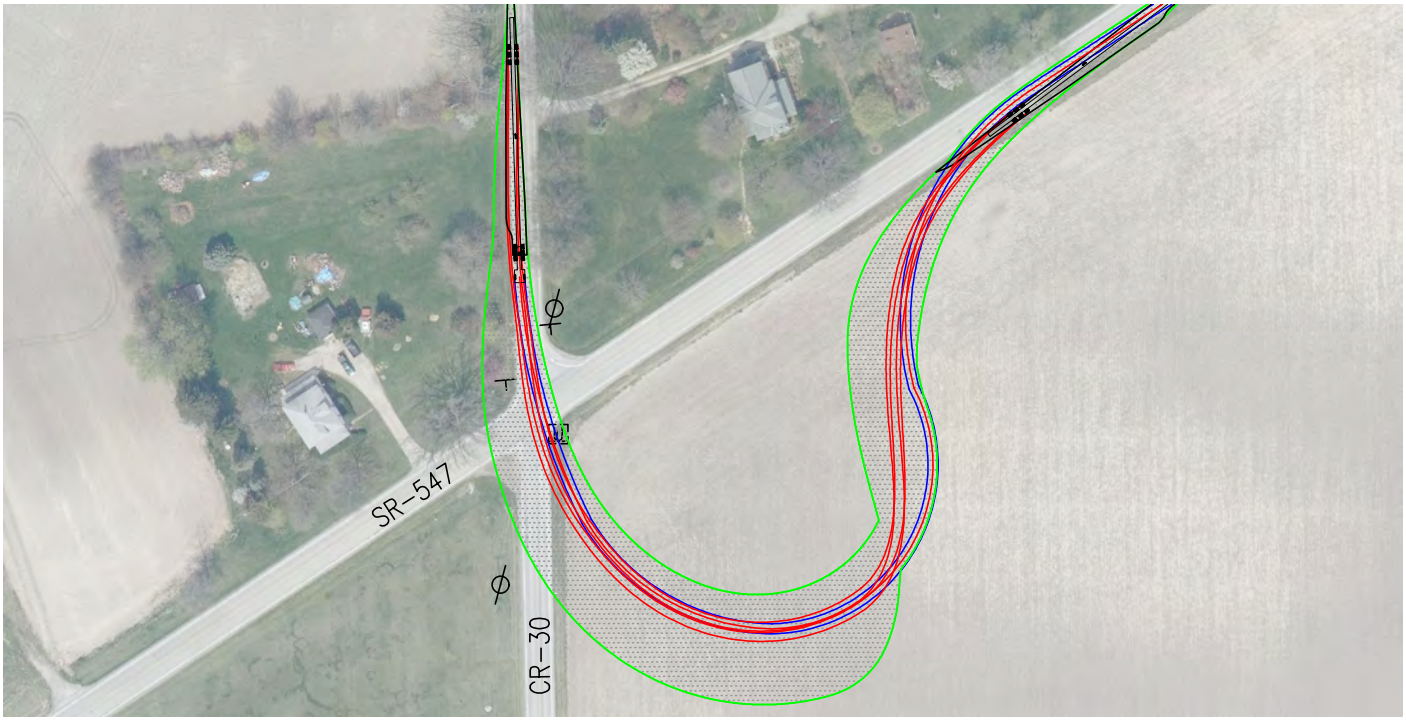

COUNTY ROAD 30 SOUTHBOUND TO STATE ROUTE 547 EASTBOUND

COUNTY ROAD 30 SOUTHBOUND TO COUNTY ROAD 64 EASTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	18

ROUTE EVALUATION STUDY
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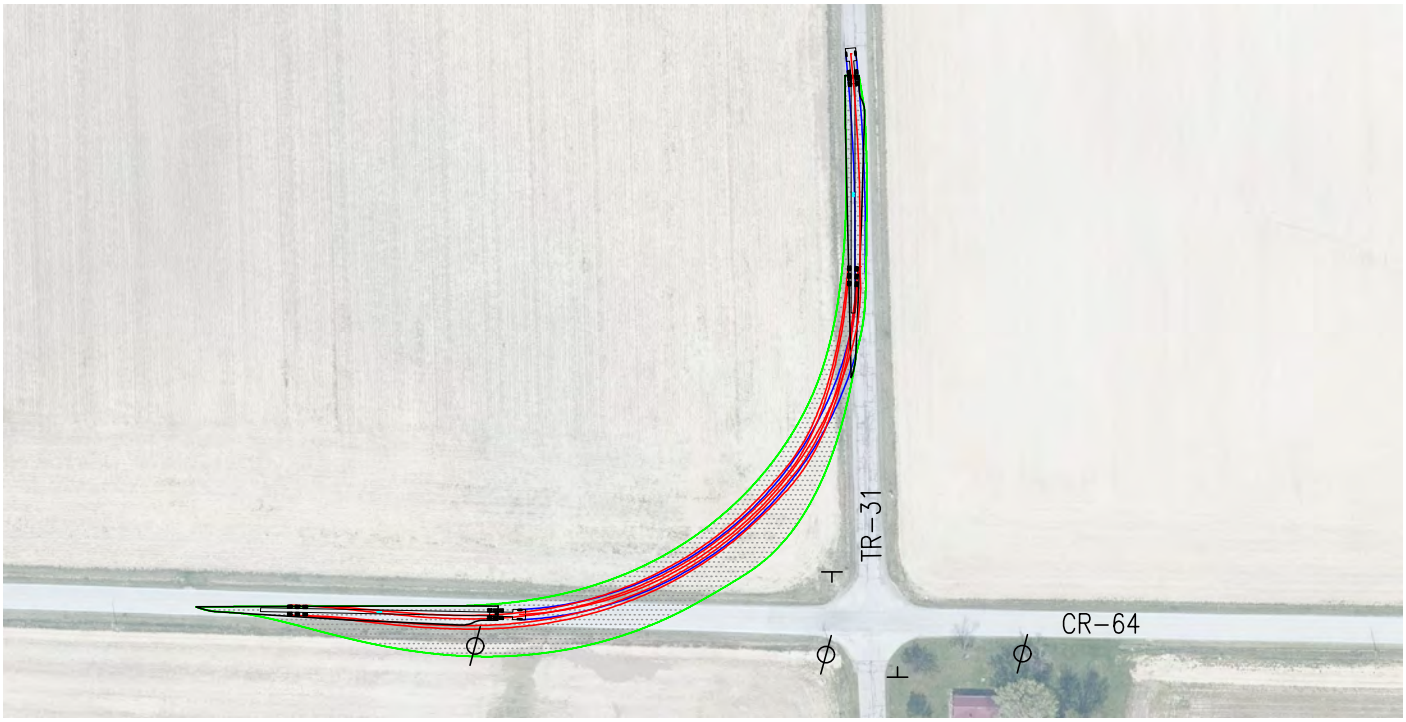
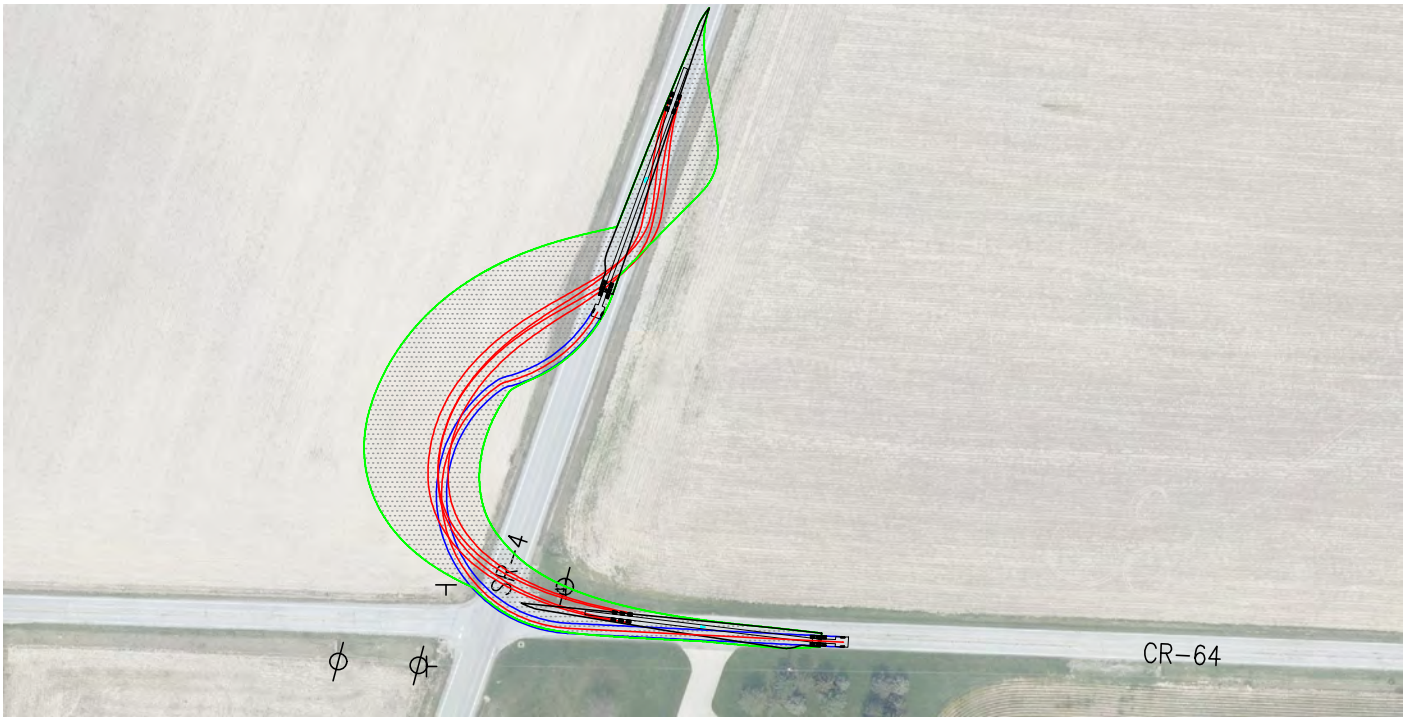


COUNTY ROAD 64 EASTBOUND TO TOWNSHIP ROAD 31 NORTHBOUND



STATE ROUTE 4 SOUTHBOUND TO COUNTY ROAD 64 EASTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	19

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COUNTY ROAD 30 SOUTHBOUND TO TOWNSHIP ROAD 67 EASTBOUND

COUNTY ROAD 30 SOUTHBOUND TO TOWNSHIP ROAD 67 WESTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
▭	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	20

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TOWNSHIP ROAD 67 WESTBOUND TO TOWNSHIP 29 NORTHBOUND

TOWNSHIP ROAD 67 WESTBOUND TO TOWNSHIP ROAD 205 NORTHBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	21

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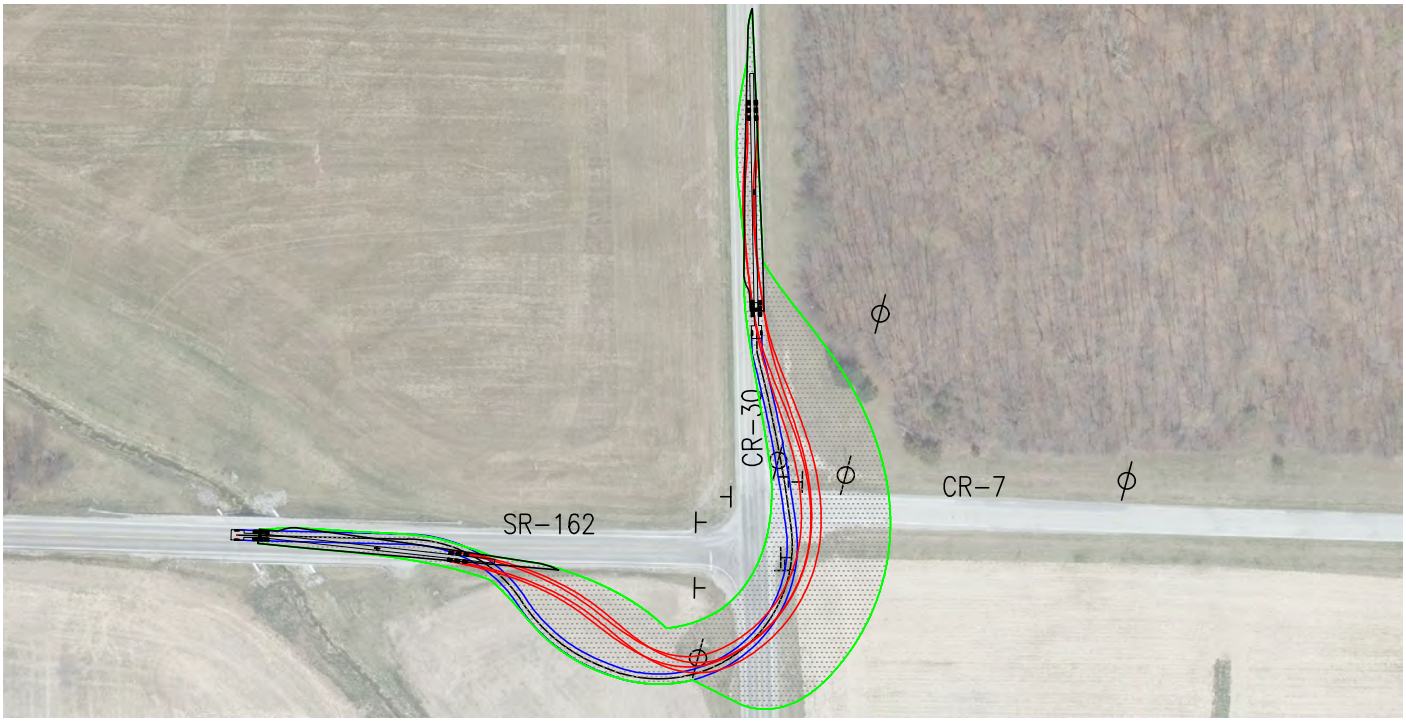
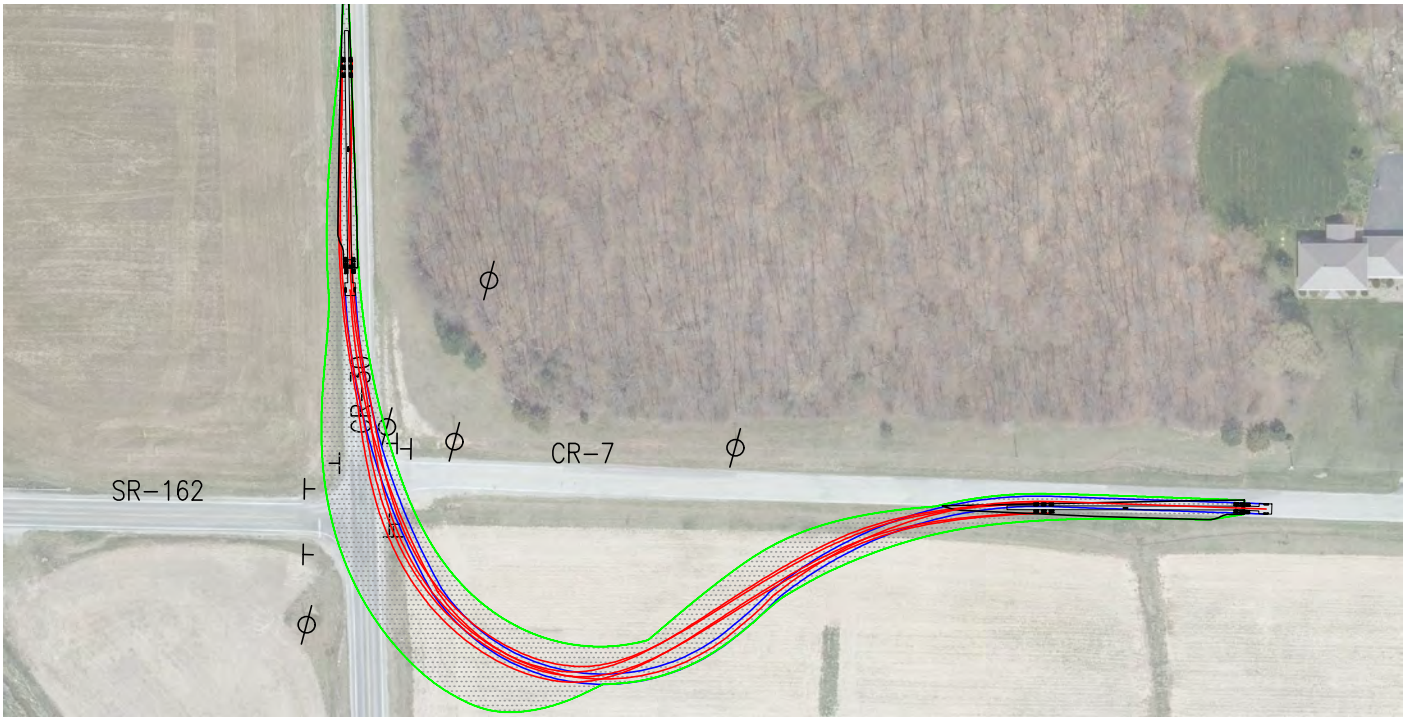


COUNTY ROAD 30 SOUTHBOUND TO STATE ROUTE 162 WESTBOUND



COUNTY ROAD 30 SOUTHBOUND TO STATE COUNTY ROAD 7 EASTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
UB	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	22

ROUTE EVALUATION STUDY
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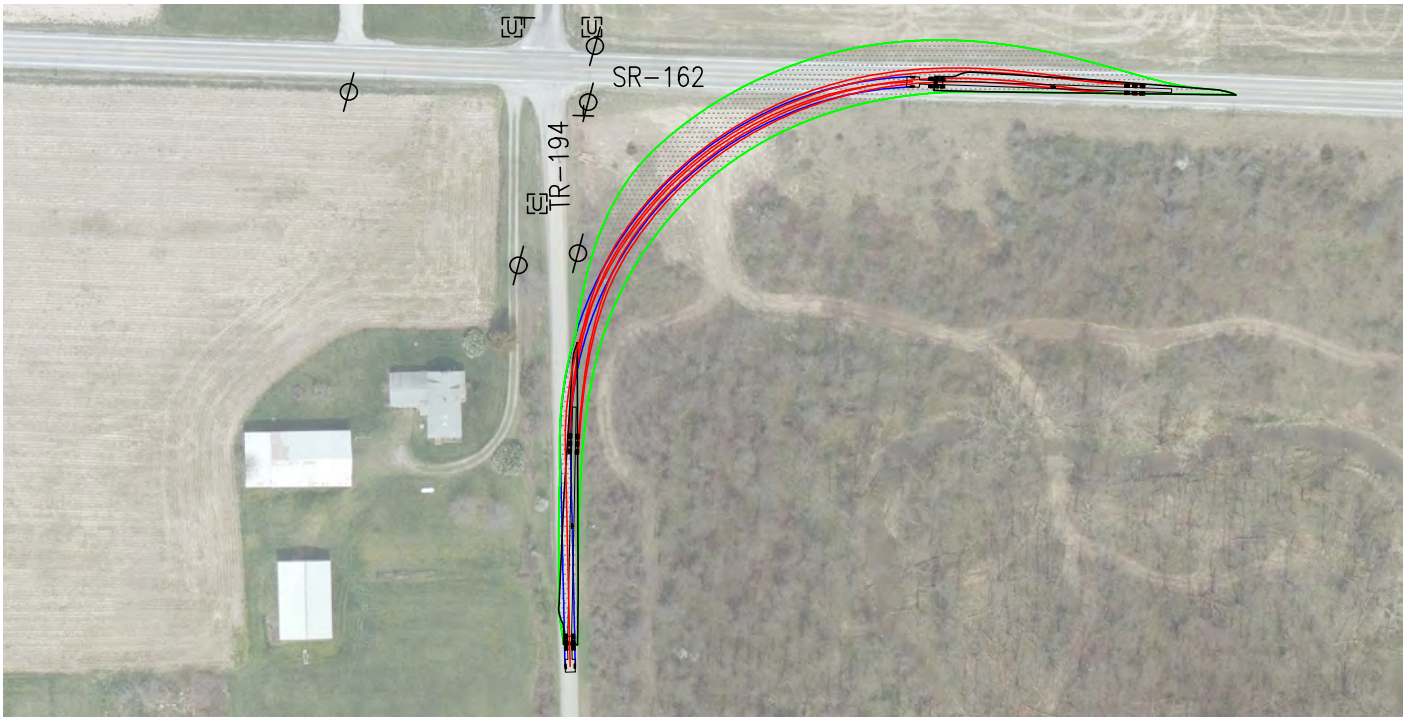
TOWNSHIP ROAD 67 WESTBOUND TO TOWNSHIP ROAD 6 SOUTHBOUND



STATE ROUTE 162 WESTBOUND TO TOWNSHIP ROAD 194 SOUTHBOUND

LEGEND

- UTILITY POLE
- UTILITY BOX
- ROAD SIGN
- FRONT TIRE PATH
- REAR TIRE PATH
- BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	23

ROUTE EVALUATION STUDY
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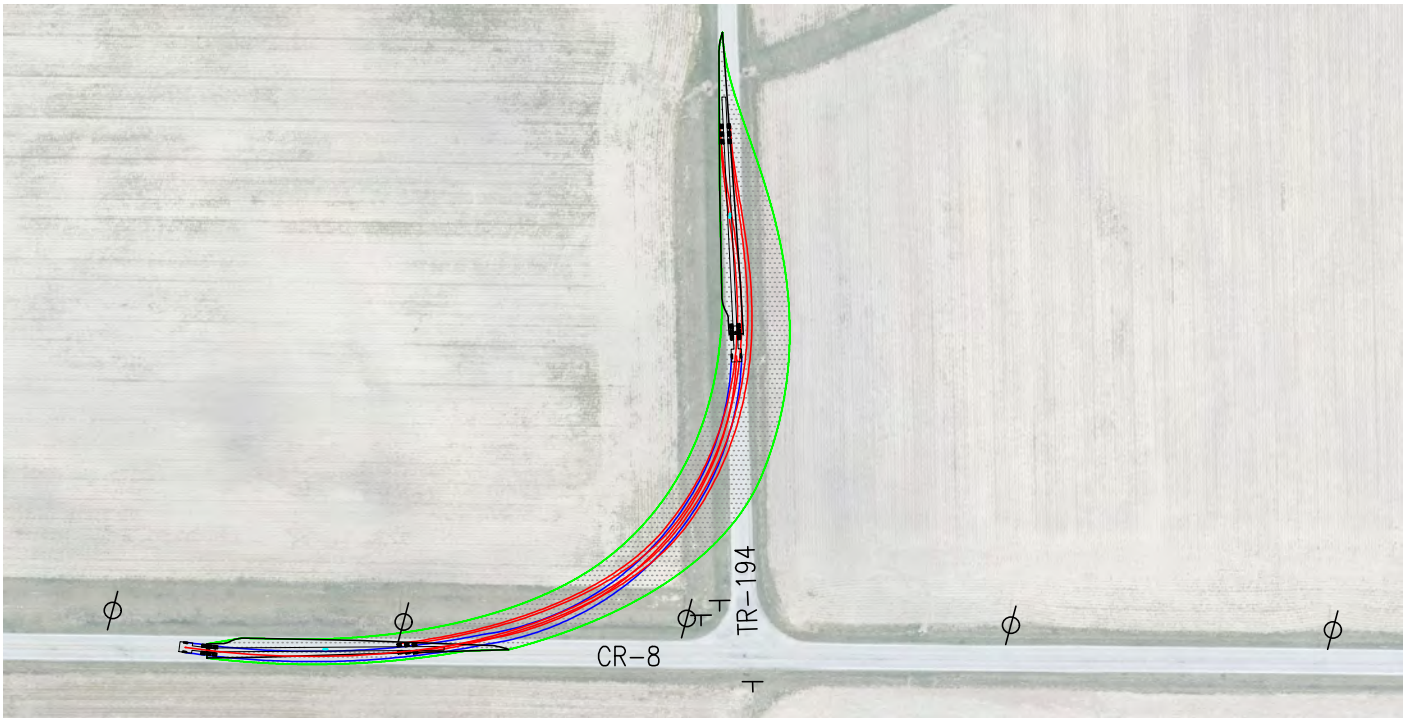

TOWNSHIP ROAD 194 SOUTHBOUND TO COUNTY ROAD 8 WESTBOUND

TOWNSHIP ROAD 194 SOUTHBOUND TO TOWNSHIP ROAD 9 EASTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
UB	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	24

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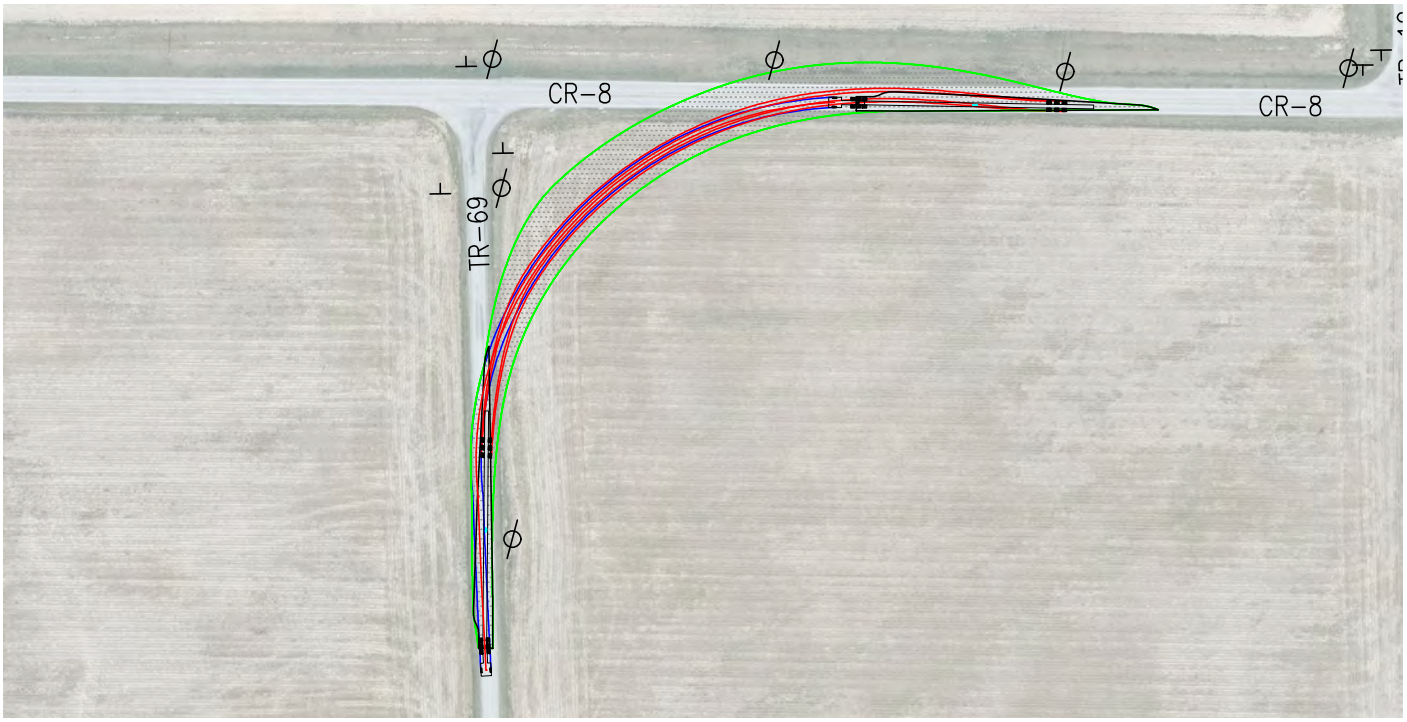

COUNTY ROAD 8 WESTBOUND TO TOWNSHIP ROAD 69 SOUTHBOUND

TOWNSHIP ROAD 194 SOUTHBOUND TO TOWNSHIP ROAD 9 EASTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	25

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COUNTY ROAD 8 EASTBOUND TO TOWNSHIP ROAD 70A SOUTHBOUND

COUNTY ROAD 8 WESTBOUND TO TOWNSHIP ROAD 10 SOUTHBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
UB	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	26

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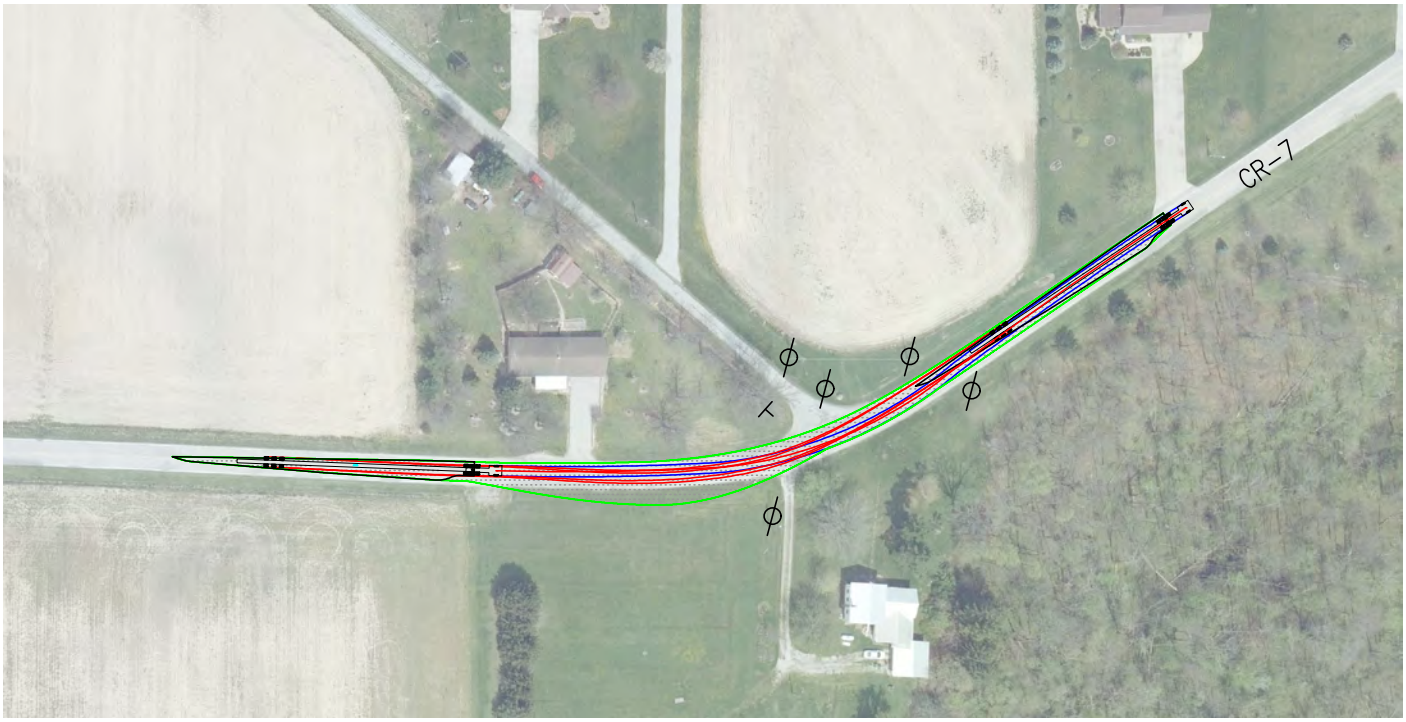
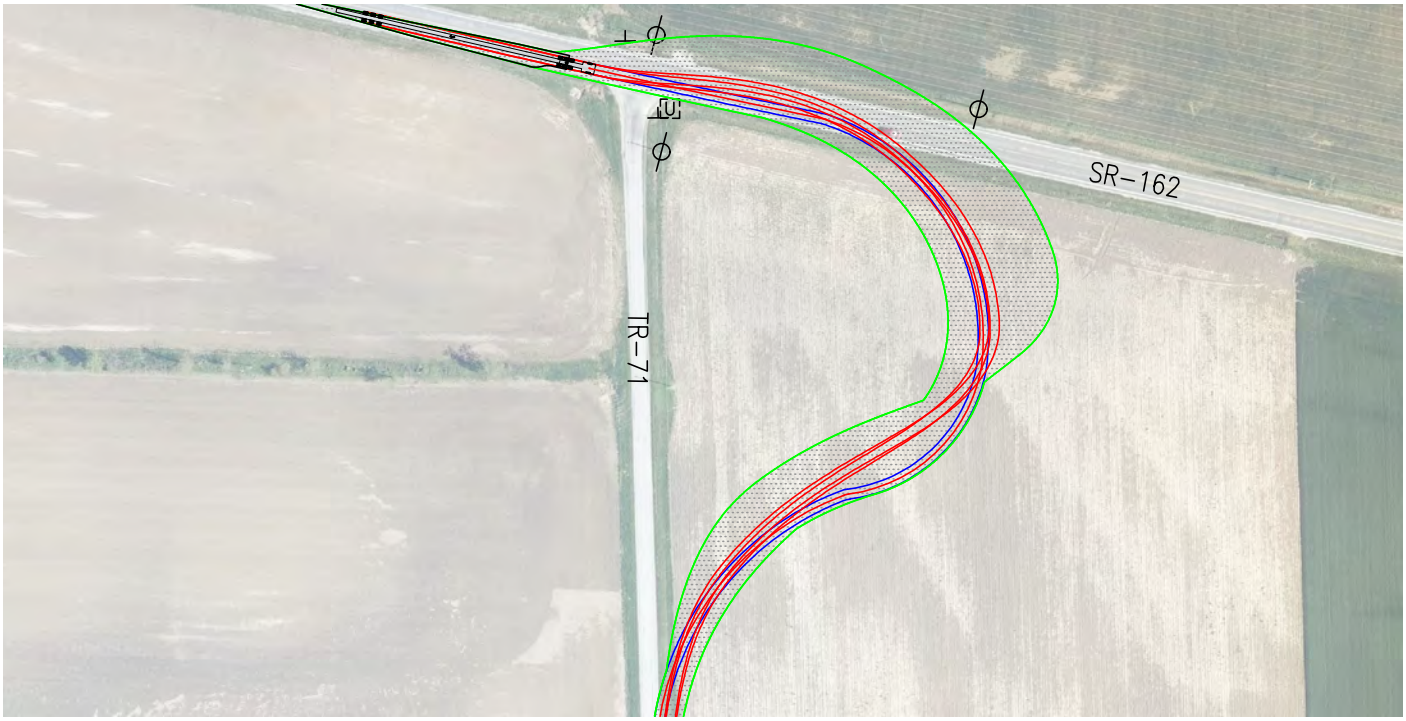


COUNTY ROAD 7 EASTBOUND



STATE ROUTE 162 EASTBOUND TO TOWNSHIP ROAD 71 SOUTHBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
UB	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	27

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STATE ROUTE 162 EASTBOUND TO COUNTY ROAD 68 NORTHBOUND

STATE ROUTE 162 EASTBOUND TO TOWNSHIP ROAD 26 NORTHBOUND

LEGEND

- UTILITY POLE
- UTILITY BOX
- ROAD SIGN
- FRONT TIRE PATH
- REAR TIRE PATH
- BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	28

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TOWNSHIP ROAD 75 SOUTHBOUND TO U.S. ROUTE 224 WESTBOUND

COUNTY ROAD 30 SOUTHBOUND TO TOWNSHIP ROAD 78 WESTBOUND

LEGEND

ϕ	UTILITY POLE	———	FRONT TIRE PATH
⊟	UTILITY BOX	———	REAR TIRE PATH
⊣	ROAD SIGN	———	BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	29

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TOWNSHIP ROAD 78 WESTBOUND TO TOWNSHIP ROAD 75 SOUTHBOUND

TOWNSHIP ROAD 78 WESTBOUND TO TOWNSHIP ROAD 75 NORTHBOUND

LEGEND

- UTILITY POLE
- UTILITY BOX
- ROAD SIGN
- FRONT TIRE PATH
- REAR TIRE PATH
- BLADE TIP/LOAD PATH

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: AET	FIGURE
DATE: 1/17/2019	30

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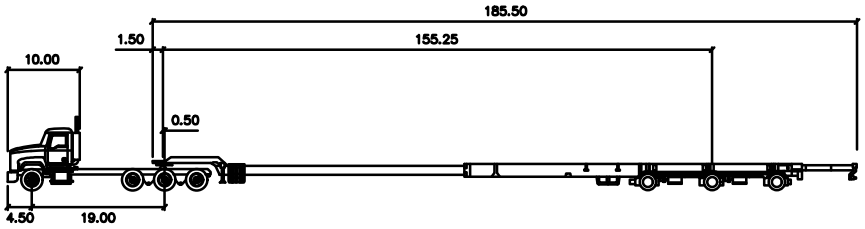
APPENDIX A

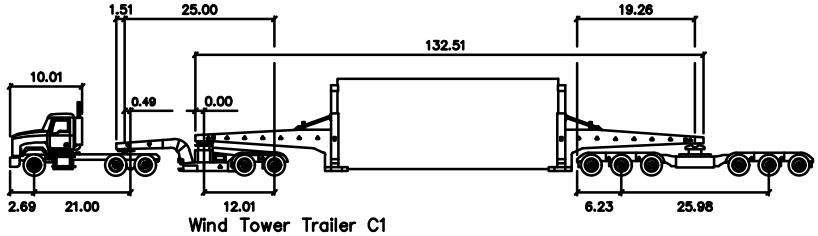
Transport Vehicle Profiles



70m wind blade trailer

feet

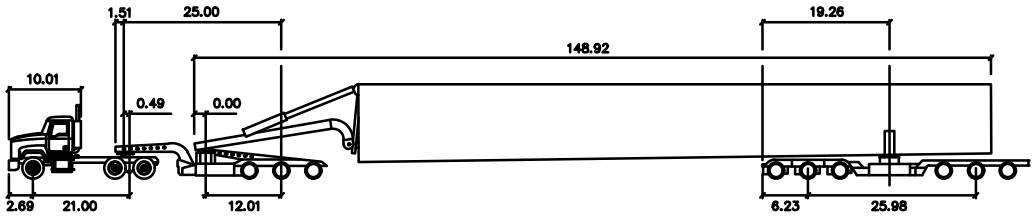
First Unit Width	: 8.00	Lock to Lock Time	: 6.0
Trailer Width	: 3.00	Steering Angle	: 40.0
First Unit Track	: 8.00	Articulating Angle	: 70.0
Trailer Track	: 8.00		



Wind Tower Trailer C1

feet

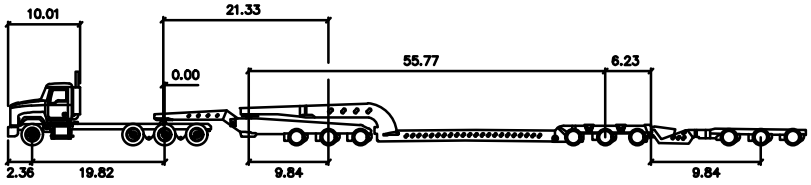
Tractor Width	: 8.01	Lock to Lock Time	: 6.0
Trailer Width	: 2.99	Steering Angle	: 40.0
Tractor Track	: 8.01	Articulating Angle	: 70.0
Trailor Track	: 8.01		



Wind Tower Trailer B1

feet

First Unit Width	: 8.01	Lock to Lock Time	: 6.0
Trailer Width	: 4.00	Steering Angle	: 40.0
First Unit Track	: 8.01	Articulating Angle	: 70.0
Trailer Track	: 10.01		



Booster Trailer C6

feet

First Unit Width	: 8.50	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 40.0
First Unit Track	: 8.50	Articulating Angle	: 70.0
Trailer Track	: 8.50		

LAYOUT BY: DWS	PROJECT NO.
CHECKED BY: DWS	ACX007
DRAWN BY: DWS	APPENDIX
DATE: 11/19/2018	A

ROUTE EVALUATION STUDY
APEX CLEAN ENERGY, INC.

HURON, ERIE, AND SENECA COUNTIES
OHIO

TRANSPORT VEHICLE PROFILES

HULL
Environment / Energy / Infrastructure

6397 EMERALD PARKWAY
SUITE 200
DUBLIN, OHIO 43016
PHONE: (614) 793-8777
FAX: (614) 793-9070
www.hullinc.com

F:\Clients\Active\ACX\ACX007\Design\Drawing\Sheets\2018-10-24_ACX007_AutoTurn Figures\ACX007_AutoTurn Figures_North.dwg, App B, dstarkey, Nov 19, 2018 - 9:42am

APPENDIX B

ODOT Special Hauling Permit Fees & Special Hauling Permit Application

OHIO DEPARTMENT OF TRANSPORTATION

SPECIAL HAULING PERMIT SECTION 1980 WEST BROAD ST., MAIL STOP 5140
COLUMBUS, OHIO 43223
TELEPHONE (614) 351-2300 FACSIMILE (614) 728-4099
www.dot.state.oh.us/permits

SPECIAL HAULING PERMIT FEE SCHEDULE

(Per Ohio Administrative Code 5501:2-1-10)

Effective January 27, 2014

PERMIT TYPE	ROUTINE WEIGHTS / DIMENSIONS		SUPERLOAD WEIGHTS / DIMENSIONS Over 120,000 lbs; Over 14' wide or Over 14'6" high			
	One Way	& Return	One Way		& Return	
SINGLE TRIP						
OS Only	$65	$100	$135		$200	
OS/OW	$135	$200	$135	+ TM**	$200	+ TM**
Steel/Aluminum Coil	$65	N/A*	N/A*		N/A*	
Multi-State OS Only	$65	N/A*	N/A*		N/A*	
Multi-State OS/OW	$135	N/A*	N/A*		N/A*	
Emergency	$250	$365	N/A*		N/A*	
CONTINUING (90 DAY)						
OS Only	$250	$375	N/A*		N/A*	
OS/OW	$500	$750	N/A*		N/A*	
Steel/Aluminum Coil	$125	N/A*	N/A*		N/A*	
Michigan Legal	$125	$125	$165		$165	
International Sealed Container	$500	N/A*	N/A*		N/A*	
CONTINUING ANNUAL (365 DAY)						
OS Only	$970	$1,170	N/A*		N/A*	
OS/OW	$1,970	$2,970	N/A*		N/A*	
Steel/Aluminum Coil	$470	N/A*	N/A*		N/A*	
Michigan Legal	$470	$470	$630		$630	
Continuing (45 Day)						
International Sealed Container	$250	N/A*	N/A*		N/A*	
BLANKET PERMITS (365 DAY)						
Boat	$100	Included	N/A*		N/A*	
Construction Equipment	$100	Included	N/A*		N/A*	
Farm Equipment	$100	Included	N/A*		N/A*	
Manufactured Building	$100	Included	N/A*		N/A*	
Marina	$100	Included	N/A*		N/A*	
REVISIONS* **						
All Permits	$10	$10	$50		$50	

*** If what is being revised will change the price of the original permit, a new permit must be obtained.*

* N/A - Not Available

** TM - Ton Mile = [(GVW - 120,000)/2000] times $0.04 per mile travelled

OS-1

Mail or Deliver To

Ohio Department of Transportation
Special Hauling Permit Section
1980 West Broad Street, Mail Stop 5140
Columbus, OH 43223
Telephone: 614-351-2300
We do not accept faxed applications

Please Type or Print Legibly / All Dimensions Must be in Feet and Inches

Applicant Name - Owner / Lessee / Insured (of Vehicle)			
Address (Mailing)			Application Date
City	State	Zip Code	Area Code/Telephone Number
Person Requesting Permit		DOT Number	

All Weights Legal? ☐ Yes	Various Trailers? ☐ Yes	Conveyance: ☐ Loaded ☐ Towed ☐ Self-Propelled

Vehicle Information

	Make	No. Axles	License Number	State	Length	Empty Weight	Width	Height
Power Unit								
Trailer 1								
Trailer 2								
Trailer 3								

Load Information	Make (if applicable)	Model (if applicable)	Length	Width	Height	Weight
Load						
Load Description						

Overall Vehicle Dimensions

Length	Width	Height	Weight	Front Overhang	Rear Overhang	Deck Height of Trailer	Minimum Underclearance	Max Trailer Width

Total Number of Axles = ____	***COMPLETE ONLY IF OVERWEIGHT (Please use an OS-1W if more than 9 axles)***								
	Axle 1 (Front)	Axle 2	Axle 3	Axle 4	Axle 5	Axle 6	Axle 7	Axle 8	Axle 9
Load (Axle Weights)									
Number of Tires									
Tire Width									
Spacing Between Axles									

ROUTING INFORMATION

FROM (Location, Municipality, State)	**TO (Location, Municipality, State)**

VIA HIGHWAY ROADS

Comments:

Desired Effective Date:	**Permit Transmittal:** ☐ Fax ☐ Mail ☐ Pick-Up Fax Number:

TYPE PERMIT: (check only one) ☐ **REVISION**

SINGLE TRIP:
- ☐ Trip
- ☐ Round Trip

CONTINUING:
- ☐ 90-Day
- ☐ 90-Day & Return (N/A for Steel Coil or MI Legal Weight)
- ☐ 365 Day
- ☐ 365-Day & Return (N/A for Steel Coil or MI Legal Weight)

BLANKET:
- ☐ Boat
- ☐ Construction Equipment
- ☐ Farm Equipment
- ☐ Manufactured Building
- ☐ Marina

Fee $ _____ **Paid By:** ☐ Escrow Account**
☐ Cash ☐ Check / Money Order *
☐ Credit Card** *(Additional Fee Applies)*
Card Type: ☐ Visa ☐ MC ☐ Am Ex ☐ Discover

Card Number: _____
Expiration Date: ____/____ Code: _____ (If applicable)

_____
Card Holder Signature

** Make checks payable to* **: Treasurer of State c/o ODOT**

** ODOT's Columbus Special Hauling Permit Office Only

DOT-1825 Rev. 6/09

APPENDIX C

Inspection Reports for Structurally Deficient Bridges

(203) Bridge (Dedicated) Name: | **BRIDGE INVENTORY AND APPRAISAL** | **Report Date: 11/16/2018**

Structure File Number: 3935043 | **Inventory Bridge Number: HUR C0064 03280**

Sufficiency Rating: 038.1 Deficiency Rating: SD | **PONTIAC S L / CO DI 47** | **Bridge Status: Active**

(2) District: 03
(3) County: 39-HURON
(9) Location: 0.3 Mi W Of Dogtown Road
(7) Facility Carried: Pontiac Sec Ln 64
(4) FIPS Code: HUR-T-72193-SHERMAN TWP
Owner: COUNTY
(208) Route On Bridge: County
(207) Route Under Bridge: Non Highway Traffic On Bridge (I.E.
(102) Direction of Traffic: 2 - 2-Way Traffic
(103) Temporary Structure:
(110) Designated National Network: Not National Network
(101) Parallel: N
(42A) Type Serv: (On): Highway
(42B) Type Serv (Under): Waterway

INVENTORY ROUTE DATA

(5A) Route On/Under: 1 - Route Carried "On" The Structure
(5B) Hwy Sys: 4 - County Highway (Township Highway)
(5D) Route No: C0064 (5E) Dir: Not Applic (5C) Des: Mainline
(6) Feature Int: Pontiac S L / Co Di 47
(200) CL: 03280 (201)Spec Des: (209) Interstate Mile:
(29) Avg. Daily Traffic(ADT): 271 (30) ADT Year: 2015
(235) Truck Traf: 20 (210) Corridor: N (104) NHS: route is not on the nhs
(26) Functional Class: rural - local (100) Strahnt: Route Is Not A Strahnet

INTERSECTED ROUTE DATA

(370A) Record Type: (370B) Hwy Sys:
(370D) Route No: (370E) Dir: (370C) Des:
(373) Feature Int:
(382) CL: 0000 (371) Interstate Mile: (387) Special Desig:
(379) Avg. Daily Traffic(ADT): 0 (380) ADT Year: 0
(381) Truck Traf: 0 (384) Corridor: (378) NHS: -
(375) Functional Class: (386) Strahnt:

CLEARANCE ON THE BRIDGE

Min. Hriz on Bridge: (335) NC: 0.0 Ft (47) Card: 23.7 Ft
(53) Prac Max Vert On Brg: 9999.9 Ft
Min Vrt Clr On Brg: (336) NC: 0.0 Ft (10) Card: 9999.9 Ft
Min Latl Clr: (338) Right NC: 0.0 Ft (337) Right Card: 3.0 Ft
(340) Left NC: 0.0 Ft (339) Left Card: 3.0 Ft

(45) Main Spans Number: 1 (43) Type: Concrete /Slab /Simple
(46) Approach Spans Nbr: 0 (44) Type: None /None /None
(307) Total Spans: 1 (48) Max Span: 11.0 Ft (49) Overall Leng: 14.0 Ft

SUBSTRUCTURE

Abut-Rear (532) Matl: Concrete (531) Type: Solid Wall (533) Fnd: Spread Footing
Abut-Fwd (527) Matl: Concrete (526) Type: Proprietary Wall W/Stub Type Abutments (528) Fnd: Spread Footing
Pier-Pred (535) Matl: None (534) Type: None (536) Fnd: None (Such As Most Culverts)
(663) Stream Velocity: 00000 fps (113) Scour: Bridge Foundations (Including Piles) On
(92B) Underwater Inspection: N Freq: 0 (655) Chan Prot: None
(93B) Date of last Underwater Insp: (657) Drainage Area: 001 Sq Mi

CLEARANCE UNDER THE BRIDGE

Min. Horiz Under Clear: (326) NC: 0.0 Ft (325) Card: 0.0 Ft
(328) Prac Max Vrt Under Clear: 0.0 Ft
Min Vert Under Clear: (327) NC: 0.0 Ft (54) Card: 0.0 Ft
Min Lat Under Clear: (329) Right NC: 0.0 Ft (55) Right Card: 0.0 Ft
(330) Left NC: 0.0 Ft (56) Left Card: 0.0 Ft

STRUCTURE INFORMATION

(19) Bypass Length: 5.0 Miles
(16) Latitude: 41 Deg 10 Min 45.06 Sec (17) Longitude: 82 Deg 46 Min 25.86 Sec
(20) Toll: On Free Road, The Structure Is Toll Free
(263) Date Built: 7/1/1900 (264) Major Reconstruction Date: 1/1/1963
(28A) No. Lanes On: 2 (28B)No. Lanes Under: 0
(301) Horiz Curve: 00D00M (34) Skew: 0 Deg
(32) App. Rdw Width: 25 Ft (51) Brg. Rdw Width: 23.8 Ft
(52) Deck Width: 24.3 Ft (424) Deck Area: 344 Sq. Ft
(406) Median Type: /Non Barrier /No Joint
(33) Bridge Median: No Median
Sidewalks: (50A) Left 0.0 Ft (50B) Right 0.0 Ft
Type Curb or Sidewalk:
(427) Left Matl: None (428) Type: None Or N/A (Rr, Pedestrian, Etc.)
(429) Right Matl: None (430) Type: None Or N/A (Rr, Pedestrian, Etc.)
(35) Flared: 0 (408) Composite: N - Non-Composite

LOAD RATING INFORMATION

(31) Design Load: HS20
(64) Opr Rat Fact/Ton: 9.999
(66) Inv Rat Fact/Ton: 9.999
(734) Ohio Percent of Legal Load: 100
(704) Year of Rating: 2004 (708) Rate Soft: Assigned Rating (No
(63) Opr Rat Method: No Rating Analysis Was Performed (Includ
(65) Inv Rat Method: No Rating Analysis Was Performed (Includ
Load Rater: (705) (706) (707) PE#: 0

APPRAISAL

(71) Waterway Adequacy: 9 Superior to present desirable criteria
(72) Approach Alignment: 9 Superior to present desirable criteria
(67) Calc Str Appraisal: 3 - Intolerable - high priority of corrective acti
(68) Calc Deck Geometry: 4 - Meets minimum tolerable limits
(69) Calc Underclearance: N - Not Applicable

APPROACH INFORMATION

(401) Approach Guardrail: None
(403) Approach Pavement: Bituminous (402) Grade: Good

CULVERT INFORMATION

(575) Culvert Type: Not A Culvert Or Rigid Frame (578) Length: 0.0 Ft
(580) Depth of Fill: 0.0 Ft (582) Headwalls: None Or Not Applicable (Not A Culvert)

GENERAL INFORMATION

(475) Main Member: Cast-In-Place Concrete Box Beam (477) Moment Plate: No Moment Plates
(414) Expansion Joint: None
(453) Bearing Devices: None

(407) Railing: Steel Guardrail On Steel, Concrete Or Ti
(409) Deck Drainage: Over The Side (Without Drip Strip)
(107) Deck Type: Concrete Cast-In-Place
Deck Protection: (108B) External: Not Applicable (Only For Bridges With No
(108C) Internal: Not Applicable (Applies Only To Bridges
(108A) Wearing Surface: Bituminous (Asphaltic Concrete) - Overla
(423) Thickness: 3.0 in (422) Date of Wearing Surface: 1/1/2004
(547) Slope Protection: Rip Rap (Dumped Rock Or Rock Channel Pro

(38) Navigation: 0 (39) Nav Vert Clr: 0.0 Ft (40) Nav Horiz Clear: 0.0 Ft
(92C) Spec Insp: N Freq: 0 (93C) Special Inspection Date:
(92A) Fracture Critical Insp: N Freq: 24 (93A) Fracture Critical Feature Inspection Date:
(474) Main Structure System: Not Applicable (I.E. Culvert, Beam, Slab (468) Hinges: Not Applicable (Structures With No Hinge
(487) Structural Steel Memb: None (465) Framing: None Or Not Applicable
(482) Paint: None Or Not Applicable (426) Bridge Railing Steel: N
(483) PCS Date:

GENERAL INFORMATION (CONTINUED)

(37) Hist Significance: Not Eligible For National Register Of Hi
(112) NBIS: N
(842) Hist/Designer: None N/A
(827) Hist Build Year:
(828) Hist Type:
(98A) Border Bridge State:
(98B) Border Bridge Resp:
(99) Border Bridge SFN:

PROPOSED IMPROVEMENTS

(114) Future ADT (On Bridge): 376 (115) Year of Future ADT: 2038

ORIGINAL PLANS INFORMATION

(250) Fabricator: HURON CO HWY
(249) Contractor: HURON CO HWY
(248) Ohio Original Construction Project No:
(252) Microfilm Reel:
(251) Standard Drawing:
Aperture Cards:
(246) Orig: N
(247) Repair: N
(245) Fabr: N
(709) Rating Source: 1 Plan Information Available For Load Rati

INSPECTION SUMMARY

(58) Deck: 3
(59) Superstructure: 3
(60) Substructure: 6
(62) Culvert: N
(61) Channel: 5
(C6) Approaches: 6
General Appraisal: 3
(41) Operational Status: A
(90) Inspection date: 12/21/2017
(91) Desig Insp Freq: 12 Mos

SURVEY ITEMS

(36A) Railings: Does Not Meet Acceptable Standards/Safet
(36B) Transitions: Does Not Meet Acceptable Standards/Safet
(36C) Guardrail: Does Not Meet Acceptable Standards/Safet
(36D) Guardrail Ends: Does Not Meet Acceptable Standards/Safet
(219) Temporary Barrier: N
(223) Temporary Shoring: N
(224) Temporary Sub Decking: N

(253) SFNs Replacing this retired bridge:
(255) SFNs That were replaced by this bridge:

UTILITIES

(265) Electric Line:	N
(266) Gas Line:	N
(269) Sanitary Sewer:	N
(267) Telephone Line:	N
(268) TV Cable:	N
(270) Water Line:	N
(271) Other Utilities:	N

SPECIAL FEATURES

(283) Lighting:	N
(431) Fence:	N
(433) Glare-Screen:	N
(436) Splash-Guard:	N
(459) Catwalks:	N
(271) Other-Feat:	N
(279) Signs-On:	N
(281) Signs-Under	N
(432) Fence-Ht on Bridge	0.0 FT
(434) Noise Barrier Walls	N

Insp 1st:	3 - County Agency
2nd:	
3rd:	
(21) Major Maint 1st:	3 - County Agency
2nd:	
3rd:	
(225) Routine Maint 1st:	3 - County Agency
2nd:	
3rd:	

(203) Bridge (Dedicated) Name: | **BRIDGE INVENTORY AND APPRAISAL** | **Report Date: 11/16/2018**

Structure File Number: 3940624 | **Inventory Bridge Number: HUR C0030 03300**

Sufficiency Rating: 022.8 Deficiency Rating: SD | **SEC LN 30 / SLATE RUN** | **Bridge Status: Active**

(2) District: 03
(3) County: 39-HURON
(9) Location: 0.2 Mi N Of Old Military
(7) Facility Carried: Section Line 30
(4) FIPS Code: HUR-T-57358-NORWICH TWP
Owner: COUNTY
(208) Route On Bridge: County
(207) Route Under Bridge: Non Highway Traffic On Bridge (I.E.
(102) Direction of Traffic: 2 - 2-Way Traffic
(103) Temporary Structure:
(110) Designated National Network: Not National Network
(101) Parallel: N
(42A) Type Serv: (On): Highway
(42B) Type Serv (Under): Waterway

INVENTORY ROUTE DATA

(5A) Route On/Under: 1 - Route Carried "On" The Structure
(5B) Hwy Sys: 4 - County Highway (Township Highway)
(5D) Route No: C0030 (5E) Dir: Not Applic (5C) Des: Mainline
(6) Feature Int: Sec Ln 30 / Slate Run
(200) CL: 03300 (201)Spec Des: (209) Interstate Mile:
(29) Avg. Daily Traffic(ADT): 1,804 (30) ADT Year: 2015
(235) Truck Traf: 135 (210) Corridor: N (104) NHS: route is not on the nhs
(26) Functional Class: rural - minor collector (100) Strahnt: Route Is Not A Strahnet

INTERSECTED ROUTE DATA

(370A) Record Type: (370B) Hwy Sys:
(370D) Route No: (370E) Dir: (370C) Des:
(373) Feature Int:
(382) CL: 0000 (371) Interstate Mile: (387) Special Desig:
(379) Avg. Daily Traffic(ADT): 0 (380) ADT Year: 0
(381) Truck Traf: 0 (384) Corridor: (378) NHS: -
(375) Functional Class: (386) Strahnt:

CLEARANCE ON THE BRIDGE

Min. Hriz on Bridge: (335) NC: 0.0 Ft (47) Card: 23.9 Ft
(53) Prac Max Vert On Brg: 9999.9 Ft
Min Vrt Clr On Brg: (336) NC: 0.0 Ft (10) Card: 9999.9 Ft
Min Latl Clr: (338) Right NC: 0.0 Ft (337) Right Card: 6.4 Ft
(340) Left NC: 0.0 Ft (339) Left Card: 4.4 Ft

STRUCTURE INFORMATION

(19) Bypass Length: 12.0 Miles
(16) Latitude: 41 Deg 07 Min 59.88 Sec (17) Longitude: 82 Deg 47 Min 08.54 Sec
(20) Toll: On Free Road, The Structure Is Toll Free
(263) Date Built: 7/1/1960 (264) Major Reconstruction Date: 1/1/1988
(28A) No. Lanes On: 2 (28B)No. Lanes Under: 0
(301) Horiz Curve: 00D00M (34) Skew: 0 Deg
(32) App. Rdw Width: 30 Ft (51) Brg. Rdw Width: 23.9 Ft
(52) Deck Width: 26.9 Ft (424) Deck Area: 1528 Sq. Ft
(406) Median Type: /Non Barrier /No Joint
(33) Bridge Median: No Median
Sidewalks: (50A) Left 0.0 Ft (50B) Right 0.0 Ft
Type Curb or Sidewalk:
(427) Left Matl: None (428) Type: None Or N/A (Rr, Pedestrian, Etc.)
(429) Right Matl: None (430) Type: None Or N/A (Rr, Pedestrian, Etc.)
(35) Flared: 0 (408) Composite: N - Non-Composite

(45) Main Spans Number: 1 (43) Type: Steel /Truss /Pony (Truss)
(46) Approach Spans Nbr: 0 (44) Type: None /None /None
(307) Total Spans: 1 (48) Max Span: 53.0 Ft (49) Overall Leng: 57.0 Ft

SUBSTRUCTURE

Abut-Rear (532) Matl: Concrete (531) Type: Solid Wall (533) Fnd: Spread Footing
Abut-Fwd (527) Matl: Concrete (526) Type: Gravity (528) Fnd: Unknown
Pier-Pred (535) Matl: None (534) Type: None (536) Fnd: None (Such As Most Culverts)
(663) Stream Velocity: 00000 fps (113) Scour: Bridge Foundations Determined To Be Stab
(92B) Underwater Inspection: N Freq: 0 (655) Chan Prot: None
(93B) Date of last Underwater Insp: (657) Drainage Area: 008 Sq Mi

CLEARANCE UNDER THE BRIDGE

Min. Horiz Under Clear: (326) NC: 0.0 Ft (325) Card: 0.0 Ft
(328) Prac Max Vrt Under Clear: 0.0 Ft
Min Vert Under Clear: (327) NC: 0.0 Ft (54) Card: 0.0 Ft
Min Lat Under Clear: (329) Right NC: 0.0 Ft (55) Right Card: 0.0 Ft
(330) Left NC: 0.0 Ft (56) Left Card: 0.0 Ft

LOAD RATING INFORMATION

(31) Design Load: HS20
(64) Opr Rat Fact/Ton: 0.760
(66) Inv Rat Fact/Ton: 0.460
(734) Ohio Percent of Legal Load: 100
(704) Year of Rating: 2010 (708) Rate Soft: Combination
(63) Opr Rat Method: Load Factor Rating (Lfr) Reported By Rf
(65) Inv Rat Method: Load Factor Rating (Lfr) Reported By Rf
Load Rater: (705) Pjw (706) (707) PE#: 0

APPRAISAL

(71) Waterway Adequacy: 9 Superior to present desirable criteria
(72) Approach Alignment: 9 Superior to present desirable criteria
(67) Calc Str Appraisal: 4 - Meets minimum tolerable limits
(68) Calc Deck Geometry: 4 - Meets minimum tolerable limits
(69) Calc Underclearance: N - Not Applicable

APPROACH INFORMATION

(401) Approach Guardrail: Steel Beam
(403) Approach Pavement: Bituminous (402) Grade: Good

CULVERT INFORMATION

(575) Culvert Type: Not A Culvert Or Rigid Frame (578) Length: 0.0 Ft
(580) Depth of Fill: 0.0 Ft (582) Headwalls: None Or Not Applicable (Not A Culvert)

GENERAL INFORMATION

(475) Main Member: Not Applicable (Culverts, Trusses, Arche (477) Moment Plate: No Moment Plates
(414) Expansion Joint: Sliding Metal Plate Angle
(453) Bearing Devices: Sliding (Bronze)

(407) Railing: Steel Guardrail On Steel, Concrete Or Ti
(409) Deck Drainage: Over The Side (Without Drip Strip)
(107) Deck Type: Laminated Timber Strip
Deck Protection: (108B) External: Not Applicable (Only For Bridges With No
(108C) Internal: Not Applicable (Applies Only To Bridges
(108A) Wearing Surface: Bituminous (Asphaltic Concrete) - Overla
(423) Thickness: 4.0 in (422) Date of Wearing Surface: 1/1/2003
(547) Slope Protection: Rip Rap (Dumped Rock Or Rock Channel Pro

(38) Navigation: 0 (39) Nav Vert Clr: 0.0 Ft (40) Nav Horiz Clear: 0.0 Ft
(92C) Spec Insp: N Freq: 0 (93C) Special Inspection Date:
(92A) Fracture Critical Insp: Y Freq: 24 (93A) Fracture Critical Feature Inspection Date: 8/12/2018
(474) Main Structure System: Two Trusses (Welded) (468) Hinges: Not Applicable (Structures With No Hinge
(487) Structural Steel Memb: Unknown (465) Framing: None Or Not Applicable
(482) Paint: Other Paint (426) Bridge Railing Steel: U
(483) PCS Date: 1/1/1988

GENERAL INFORMATION (CONTINUED)

(37) Hist Significance: Not Eligible For National Register Of Hi
(112) NBIS: Y
(842) Hist/Designer: Ohio Bridge Corp
(827) Hist Build Year: 1960
(828) Hist Type: Warren (Welded)
(98A) Border Bridge State:
(98B) Border Bridge Resp:
(99) Border Bridge SFN:

PROPOSED IMPROVEMENTS

(114) Future ADT (On Bridge): 2504 (115) Year of Future ADT: 2038

ORIGINAL PLANS INFORMATION

(250) Fabricator: OHIO BRIDGE
(249) Contractor: HURON CO HWY
(248) Ohio Original Construction Project No:
(252) Microfilm Reel:
(251) Standard Drawing:
Aperture Cards:
(246) Orig: N
(247) Repair: N
(245) Fabr: N
(709) Rating Source: 2 Field Measured Information For Load Rat

INSPECTION SUMMARY

(58) Deck: 5
(59) Superstructure: 4
(60) Substructure: 5
(62) Culvert: N
(61) Channel: 4
(C6) Approaches: 6
General Appraisal: 4
(41) Operational Status: A
(90) Inspection date: 8/12/2018
(91) Desig Insp Freq: 12 Mos

SURVEY ITEMS

(36A) Railings: Does Not Meet Acceptable Standards/Safet
(36B) Transitions: Does Not Meet Acceptable Standards/Safet
(36C) Guardrail: Does Not Meet Acceptable Standards/Safet
(36D) Guardrail Ends: Does Not Meet Acceptable Standards/Safet
(219) Temporary Barrier: N
(223) Temporary Shoring: N
(224) Temporary Sub Decking: N

(253) SFNs Replacing this retired bridge:
(255) SFNs That were replaced by this bridge:

UTILITIES

(265) Electric Line:	N
(266) Gas Line:	N
(269) Sanitary Sewer:	N
(267) Telephone Line:	N
(268) TV Cable:	N
(270) Water Line:	N
(271) Other Utilities:	N

SPECIAL FEATURES

(283) Lighting:	N
(431) Fence:	N
(433) Glare-Screen:	N
(436) Splash-Guard:	N
(459) Catwalks:	N
(271) Other-Feat:	N
(279) Signs-On:	N
(281) Signs-Under	N
(432) Fence-Ht on Bridge	0.0 FT
(434) Noise Barrier Walls	N

Insp 1st:	3 - County Agency
2nd:	
3rd:	
(21) Major Maint 1st:	3 - County Agency
2nd:	
3rd:	
(225) Routine Maint 1st:	3 - County Agency
2nd:	
3rd:	

Summary: Application - Part 4 of 17 electronically filed by Christine M.T. Pirik on behalf of Firelands Wind, LLC