TABLE UP-4-W

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – Overloaded Facilities, U.P. Western Zone

				Robust Economy		High Retirements		High Environmental		Slow Growth		DOE 20% Wind		Fuel & Invest. Limit.	
U.P. Zone	Map Item #	Criteria Exceeded/Need	Facility Outage	2018 % of Facility Rating	2024 % of Facility Rating	2018 % of Facility Rating	2024 % of Facility Rating	2018 % of Facility Rating	2024 % of Facility Rating	2018 % of Facility Rating	2024 % of Facility Rating	2018 % of Facility Rating	2024 % of Facility Rating	2018 % of Facility Rating	2024 % of Facility Rating
Western	1	Atlantic-Henry St. Tap 69 kV	Base Case, Atlantic-M38 138 kV, Atlantic 138/69 kV	113%	128%-200%	144%	152%					107%	116%		
Western	2	M38-North Lake 138 kV	M38-Perch Lake 138 kV		100%	150%	156%					144%	Did not solve		
Western	3	M38-Atlantic 69 kV	M38-Atlantic 138 kV, Atlantic 138/69 kV, M38 138/69 kV, M38-Winona 138 kV	147%-148%	240%	100%-142%	101%-153%	119%	121%-122%			98%-113%	121%-146%	139%-140%	145%
Western	4	Ontonagon-UPSCO Tap 69 kV	Victoria-Rockland Jct. 69 kV, Rockland Jct.-Rockland, 69 kV Rockland-Mass 69 kV	132%-133%	114%-115%										
Western	5	Ontonagon 138/69 kV	Victoria-Rockland Jct. 69 kV, Rockland Jct.-Rockland, 69 kV Rockland-Mass 69 kV	102%-103%											
Western	6	Atlantic 138/69 kV	M38-Winona, M38 138/69 kV, Base Case		99%-108%	101%	96%-102%						98%		
Western	7	Osceola-Centennial Mine Tap 69 kV	Atlantic-M38 138 kV, Atlantic 138/69 kV, Base Case, M38-Perch Lake 138 kV		95%-146%		100%								
Western	8	Atlantic-Elevation St. Tap 2 69 kV, Elevation St. Tap 2-Osceola 69kV	Atlantic-Elevation St. Tap 1 69 kV		105%-122%										
Western	9	Winona-Twin Lakes 69 kV, Twin Lakes-Portage Tap 69 kV, Portage Tap-Atlantic 69 kV	Atlantic-M38 138 kV, Atlantic 138/69 kV		140%-145%										
Western	10	Aspen-Crystal Falls 69 kV	Iron Grove 138/69 kV		101%-122%										

TABLE UP-4A-W

PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – Low Voltages, U.P. Western Zone

			Robust Economy		High Retirements		High Environmental		Slow Growth		DOE 20% Wind		Fuel & Invest. Limit.	
U.P. Zone	Criteria Exceeded/Need	Facility Outage	2018 % of Nominal Bus V	2024 % of Nominal Bus V	2018 % of Nominal Bus V	2024 % of Nominal Bus V	2018 % of Nominal Bus V	2024 % of Nominal Bus V	2018 % of Nominal Bus V	2024 % of Nominal Bus V	2018 % of Nominal Bus V	2024 % of Nominal Bus V	2018 % of Nominal Bus V	2024 % of Nominal Bus V
Western	Keweenaw, Centennial Mine, Osceola, MTU 69 kV bus voltages; Atlantic, Winona 138 kV bus voltages	Base Case		92.5%-95.3%	94.7%-95.9%	94.2%-95.7%					94.1%-95.5%	91.3%-95.8%		
Western	Keweenaw, Centennial Mine, MTU, Osceola, Henry St., Elevation St., Portage, Atlantic 69 kV bus voltages; Atlantic 138 kV bus voltage	M38-Atlantic 138 kV, Atlantic 138/69 kV	79.8%-88.9%	48.3%-60.1%	76.0%-84.3%	71.8%-80.4%	89.3%	88.8%			79.7%-87.6%	63.7%-71.9%	87.0%	85.6%-91.9%
Western	Keweenaw, Centennial Mine, Elevation St., Osceola 69 kV bus voltages	Atlantic-Elevation St. Tap #1 69 kV, Elevation St. Tap #1-Osceola 69 kV, Atlantic-Elevation St. Tap #2 69 kV	89.2%-91.8%	79.0%-91.5%	90.3%-92.0%	90.1%-91.7%					90.0%-92.0%	86.5%-90.3%	-91.9%	91.9%
Western	Aspen, Iron Grove, Twin Lakes, Lakota Rd. 138 kV bus voltages	Plains-Aspen 138 kV, Aspen-Iron Grove 138 kV	90.3%-91.9%	89.6%-91.6%		91.8%	91.4%-91.8%	91.3%-91.8%	90.7%-91.9%	90.7%-92.0%	91.2%-91.7%	90.1%-91.6%	91.7%	91.6%-91.7%
Western	Lakehead, Strawberry Hill, Iron Grove, Lincoln, Crystal Falls 69 kV bus voltages	Iron Grove 138/69 kV	88.0%-91.3%	81.8%-86.3%	91.5%-91.8%	90.8%-91.2%					90.8%-91.2%	87.2%-90.6%		91.7%-91.9%
Western	Conover, Lakota Rd., Land O'Lakes, Watersmeet, Bruce Crossing 69 kV bus voltages	Lakota Rd. 138/69 kV, Lakota Rd.-Conover 69 kV, Conover-Land O'Lakes 69 kV	88.8%-91.1%	74.8%-91.3%							86.2%-91.8%	Did not solve, 58.1%-70.9%		
Western	Keweenaw, Centennial Mine, MTU, Osceola, Henry St., Elevation St., Portage, Atlantic, M38, Baraga, L'Anse, Ontonagon, Twin Lakes, UPSCO, Winona, Lake Mine 69 kV bus voltages; Atlantic, M38, Winona, Stone Container, Ontonagon 138 kV bus voltages	M38-Perch Lake 138 kV		73.4%-90.9%	51.9%-67.2%	47.3%-63.4%					52.9%-67.5%	Did not solve		
Western	Keweenaw, Centennial Mine 69 kV bus voltages; Atlantic 138 kV bus voltage	M38-North Lake 138 kV		89.8%-91.2%	90.9%	90.6%					88.8%-91.2%	Did not solve		
Western	Winona, Stone Container, Ontonagon, Atlantic 138 kV bus voltages; Ontonagon, UPSCO 69 kV bus voltages	M38-Winona 138 kV, Winona-Ontonagon 138 kV			87.1%-91.9%	85.3%-89.7%	89.8%-90.2%	89.7%-90.0%			85.5%-90.2%	76.9%-85.1%		
Western	L'Anse 69 kV bus voltage; Atlantic 138 kV bus voltage	M38 138/69 kV				91.6%-91.9%					85.4%-90.6%	73.8%-85.8%		

Figure UP-4-W
Western U.P. – Overloaded Facilities,
All 2018/2024 Futures Cases

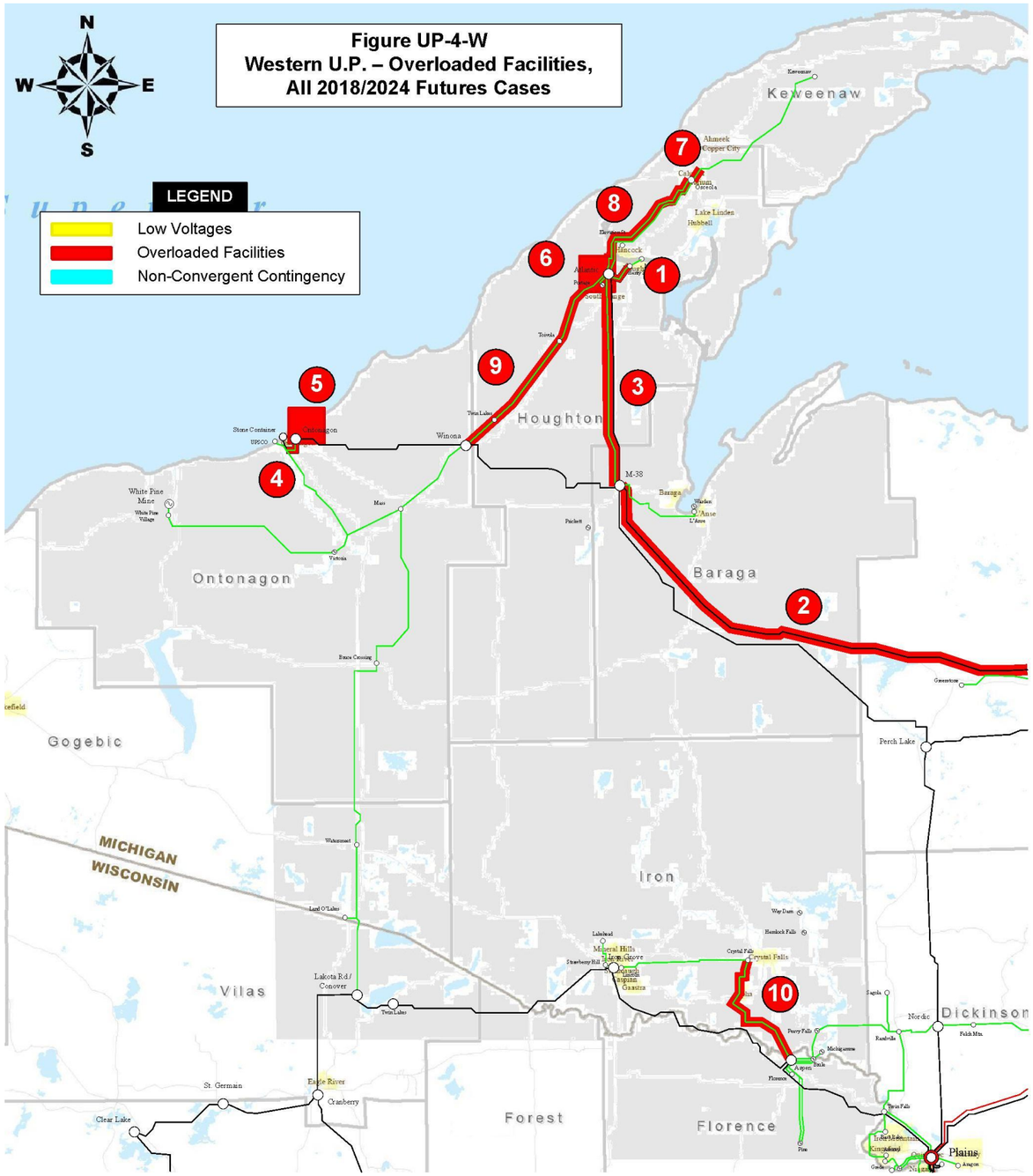

Figure UP-4A-W
Western U.P. – Low Voltages,
Non-Convergent Contingencies,
All 2018/2024 Futures Cases

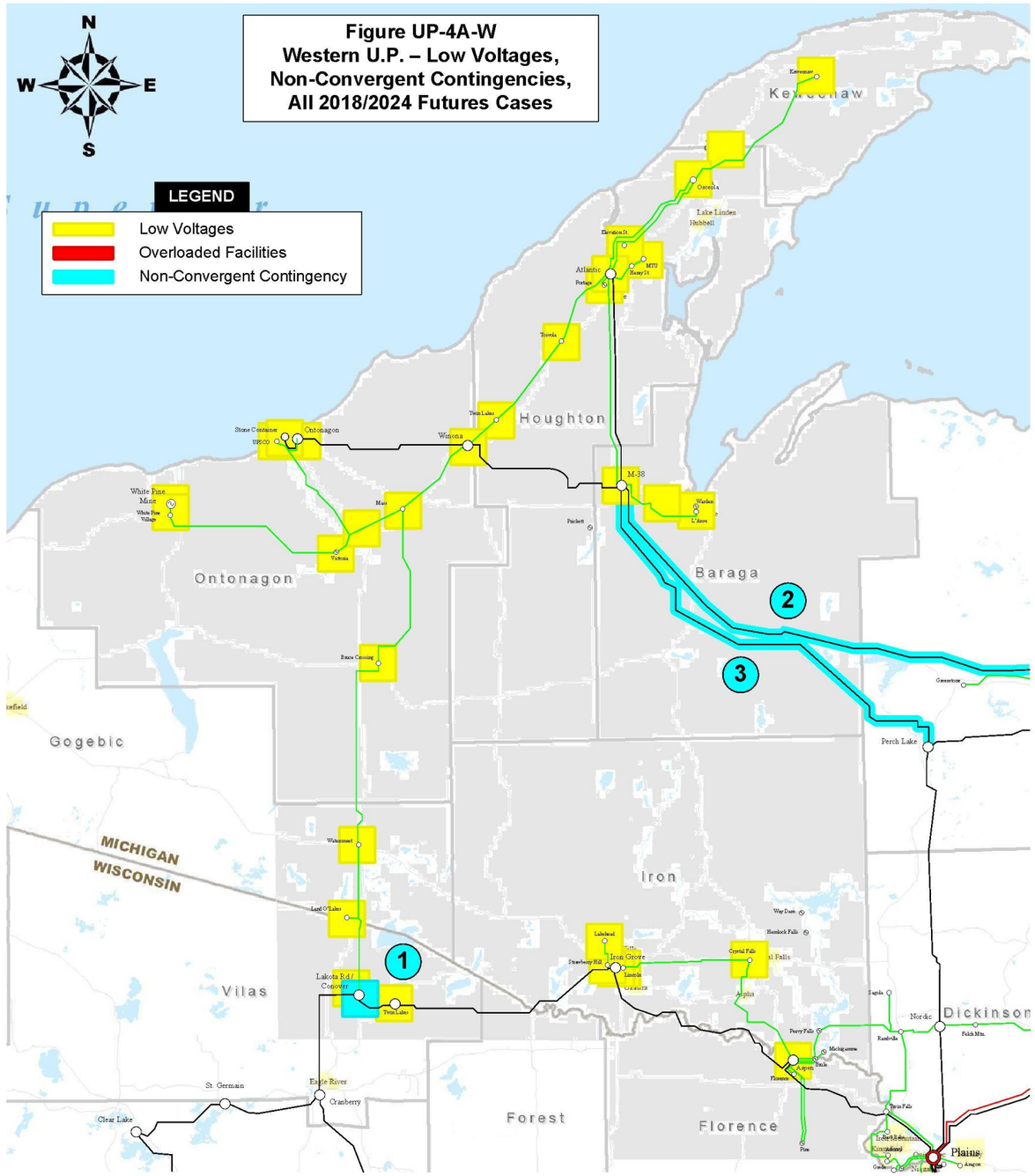

Table UP-8A-W: Western U.P. Area Preliminary Solution Sets – Summary

Atlantic69 Line (M38-Atlantic 69 kV) – U.P. Preliminary Solutions Groups

					Strategic Flexibility Future (Planning Needs N-1 @ Peak)							Asset Mgmt. Needs
U.P. Zone	Map Item #	Solutions Description	($M) Estimated Cost	In Service Year	Robust Economy Future Solutions Group	High Retirements Future Solutions Group	High Environmental Future Solutions Group	Slow Growth Future Solutions Group	DOE 20% Wind Future Solutions Group	Fuel & Investment Limitations Future Solutions Group		Asset Renewal needs for Atlantic69
Western	W-AR1	Minimum Asset Renewal projects on Atlantic69 line (remove spar arms, install crossarms, replace insulators, clearance issues)	$5-10M	2012-14	Not adequate	Not adequate	Not adequate	Adequate	Not adequate	Not adequate		Adequate
Western	W13, W-AR1	Uprate M38-Atlantic 69 kV line to 167 ° F (May not be structurally possible) + Minimum Asset Renewal projects	$10-15M	2013, 2012-14	Not adequate	Not adequate	Adequate	Not needed for Planning	Not adequate	Adequate		Adequate
Western	W9	Rebuild M38-Atlantic 69 kV line at 69 kV (22 mi)	$22M	2013	Not adequate	Adequate	More robust than needed	Not needed for Planning	Adequate	More robust than needed		More robust than needed
Western	W10	Rebuild M38-Atlantic 69 kV line at 138 kV (22 mi), add 2nd Atlantic 138/69 kV transformer	$30M	2013	Adequate	More robust than needed	More robust than needed	Not needed for Planning	More robust than needed	More robust than needed		More robust than needed

6530 Line (Conover-Mass 69 kV) – U.P. Preliminary Solutions Groups

					Strategic Flexibility Future (Planning Needs N-1 @ Peak)							Asset Mgmt. Needs
U.P. Zone	Map Item #	Solutions Description	($M) Estimated Cost	In Service Year	Robust Economy Future Solutions Group	High Retirements Future Solutions Group	High Environmental Future Solutions Group	Slow Growth Future Solutions Group	DOE 20% Wind Future Solutions Group	Fuel & Investment Limitations Future Solutions Group		Asset Renewal needs for 6530
Western	W-AR2	Minimum Asset Renewal projects on line 6530 (replace selected poles/bayonets/crossarms/insulators) $200k/mi	$10-15M	2015+	Not adequate	Not adequate	Adequate	Adequate	Not adequate	Adequate		Adequate
Western	W4, W-AR2	Reconductor Conover-Mass-Winona 69 kV line with 336 ACSR + Minimum Asset Renewal projects	$TBD	TBD, 2015+	Not adequate	Not adequate	Not needed for Planning	Not needed for Planning	Not adequate	Not needed for Planning		Adequate
Western	W4, W-AR2	New Conover-Mass-Winona 69 kV line (68 mi) + Minimum Asset Renewal projects	$60-65M	TBD, 2015+	Not adequate	Not adequate	Not needed for Planning	Not needed for Planning	Not adequate	Not needed for Planning		Adequate
Western	W1	Rebuild Lakota Rd.-Mass-Winona 69 kV line @ 138 kV (68 mi), add Mass 138 kV SS + 138/69 kV transformer	$70M	TBD	Adequate	Adequate	Not needed for Planning	Not needed for Planning	Adequate	Not needed for Planning		More robust than needed
Western	W1a	Rebuild Lakota Rd.-Mass-Winona 69 kV line @ 138/69 kV (68 mi), add Mass 138 kV SS + 138/69 kV transformer	$100M	TBD	More robust than needed	More robust than needed	Not needed for Planning	Not needed for Planning	More robust than needed	Not needed for Planning		More robust than needed

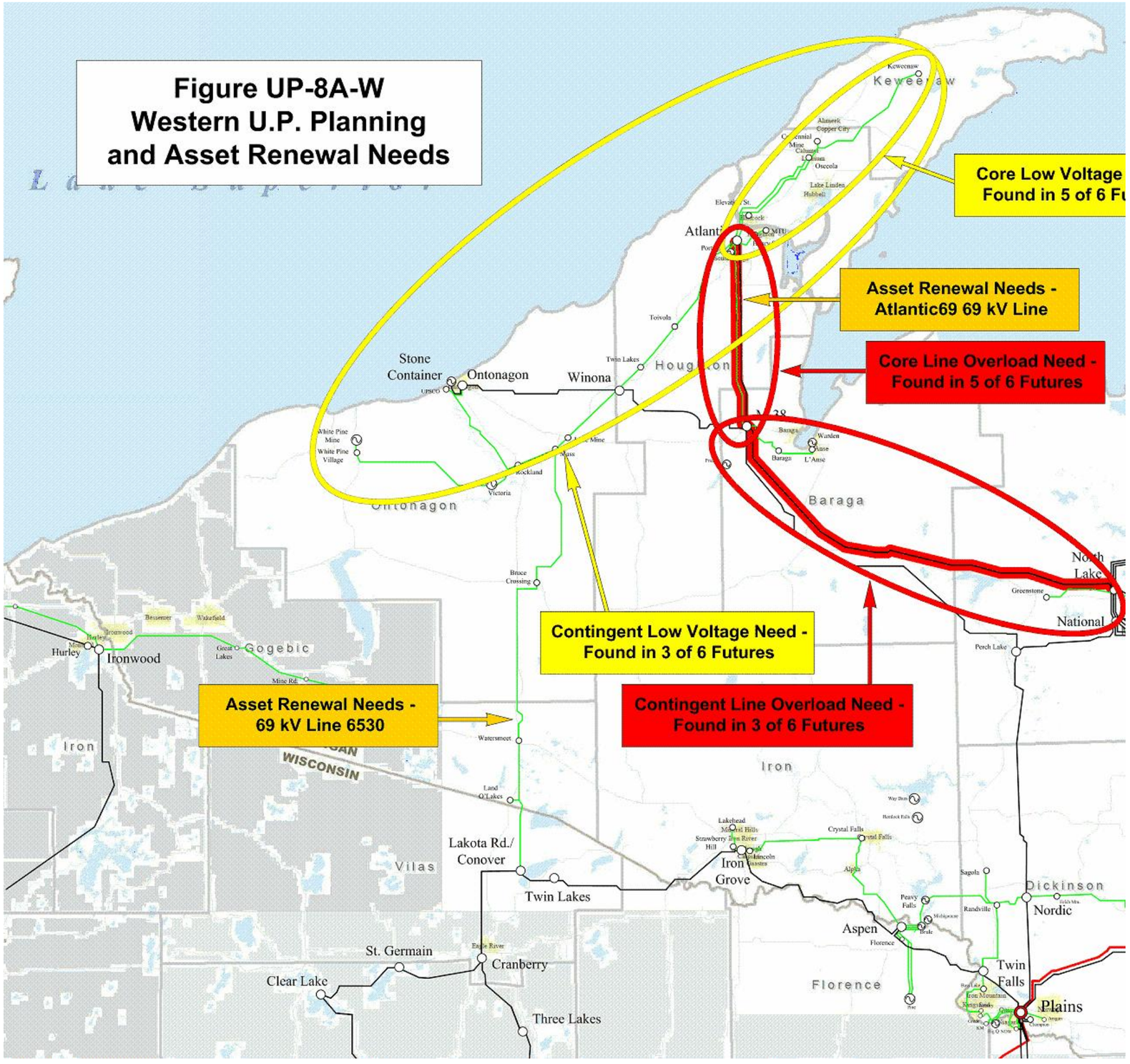
Figure UP-8A-W
Western U.P. Planning
and Asset Renewal Needs
Core Low Voltage
Found in 5 of 6 Fu
Asset Renewal Needs -
Atlantic69 69 kV Line
Core Line Overload Need -
Found in 5 of 6 Futures
Contingent Low Voltage Need -
Found in 3 of 6 Futures
Contingent Line Overload Need -
Found in 3 of 6 Futures
Asset Renewal Needs -
69 kV Line 6530
Keweenaw
Ahmeek
Copper City
Calumet
Osceola
Lake Linden
Hubbell
Atlantic
Toivola
Twin Lakes
Houghton
Stone
Container
Ontonagon
Winona
White Pine
Mine
White Pine
Village
Victoria
Ontonagon
Baraga
Warden
L'Anse
Bruce
Crossing
North
Lake
Greenstone
National
Perch Lake
Bessemer
Wakefield
Ironwood
Hurley
Gogebic
Great
Lakes
Mine Rd.
Iron
WISCONSIN
Watersmeet
Land
O'Lakes
Lakota Rd./
Conover
Vilas
Twin Lakes
Lakehead
Strawberry
Hill
Iron
Grove
Crystal Falls
Alpha
Sagola
Dickinson
Nordic
Randville
Peavy
Falls
Aspen
Florence
Twin
Falls
Iron Mountain
Plains
St. Germain
Eagle River
Cranberry
Clear Lake
Three Lakes
Florence

Figure UP-8B-W
Western U.P. System
Operations Needs

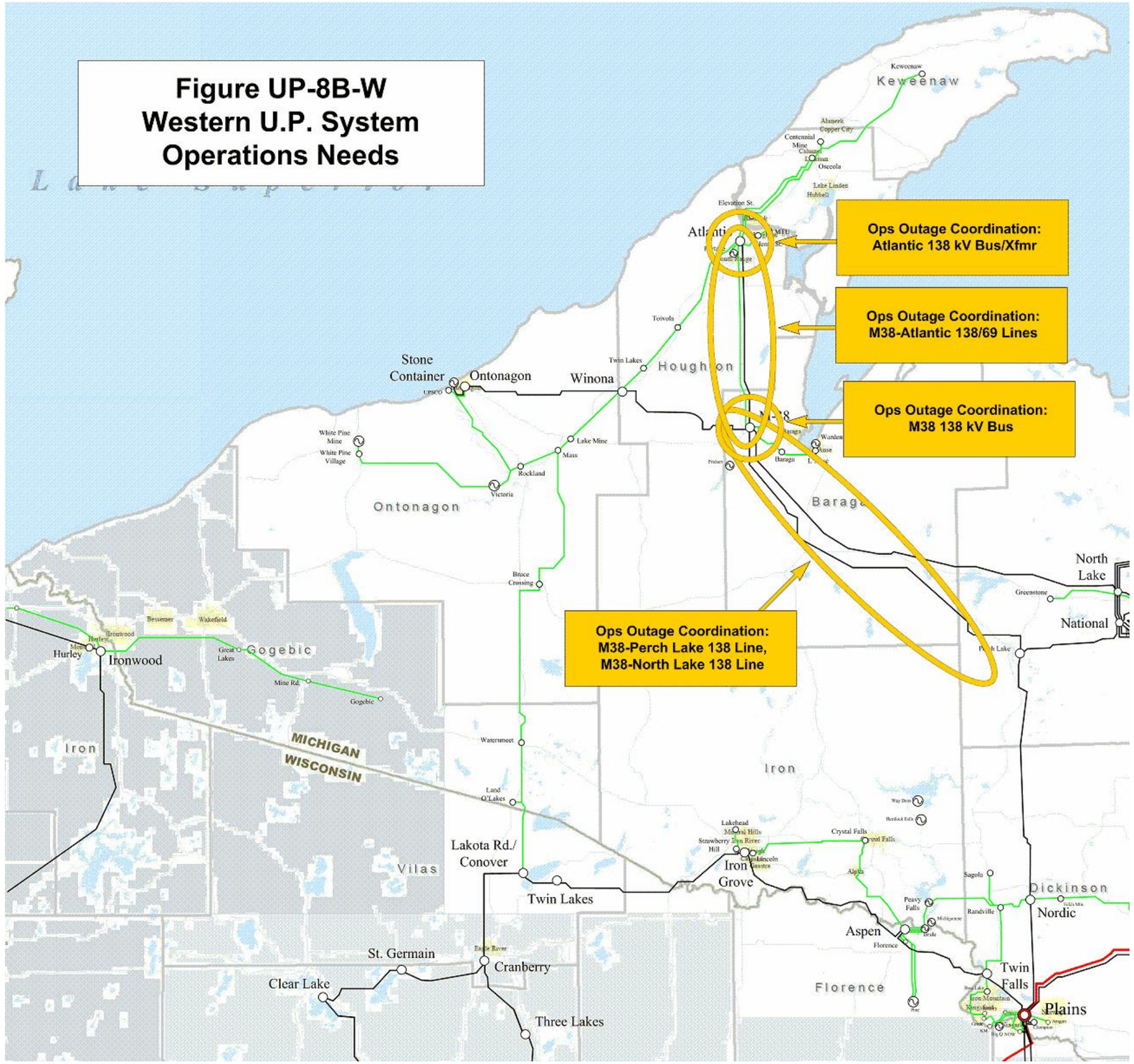

Figure UP-8C-W
Western U.P. Core Transmission Solutions Considered

Solution W10 requires the addition of a 2nd 138/69 kV transformer and associated substation work at Atlantic

W-AR1 Asset Renewal Projects on 69 kV Line Atlantic69

Solutions W1 and W1a require the addition of a 138/69 kV transformer and 138 kV substation at Mass

W13 Uprate M38-Atlantic 69 kV Line to 167° F

W9 Rebuild M38-Atlantic 69 kV Line @ 69 kV

W10 Rebuild M38-Atlantic 69 kV Line @ 138 kV

W4 New Conover-Mass-Winona 69 kV Line

W3 Reconductor Conover-Mass-Winona 69 kV Line

W1 Rebuild Lakota Rd.-Mass-Winona 69 kV @ 138 kV

W1a Rebuild Lakota Rd.-Mass-Winona 69 kV @ 138/69 kV

W-AR2 Asset Renewal Projects on 69 kV Line 6530