Michigan Public Service Commission
Case No.: U-16937
Exhibit No.: A-1

STOCKBRIDGE
MP 0

Stockbridge

- New 2 unit pump station
- Associated civil, structural, electrical, instrumentation controls, communications and SCADA equipment and installation
- Piping tie-in work including associated valves

EXISTING LINE 6B

FREEDOM JUNCTION
MP 35.2

Freedom Junction

- Associated civil, structural, electrical, instrumentation controls, communications and SCADA equipment and installation
- Piping tie-in work including associated valves

16" WOLVERINE

TO MARATHON REFINERY IN DETROIT

Romulus

- Custody transfer meter skid, quality building, and meter prover
- Associated civil, structural, electrical, instrumentation controls, communications and SCADA equipment and installation
- Piping tie-in work including associated valves

OPTION - 2

Romulus

- Custody transfer meter skid, quality building, and meter prover
- Associated civil, structural, electrical, instrumentation controls, communications and SCADA equipment and installation
- Piping tie-in work including associated valves

OPTION - 1

EXISTING LEASE TO ENBRIDGE SERVES TOLEDO MARKET

DETROIT

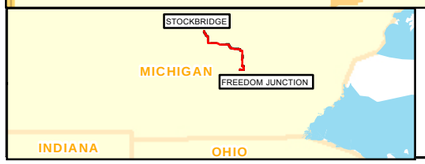
TOLEDO

CANADA

Michigan

Ohio

PRELIMINARY



NOTES

LEGEND

- Proposed Line 79 (Parallels Existing Line 17)
- Cities
- Counties
- States
- Lakes

0 4 8 Miles

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

Prepared By: LAKE SUPERIOR CONSULTING, LLC

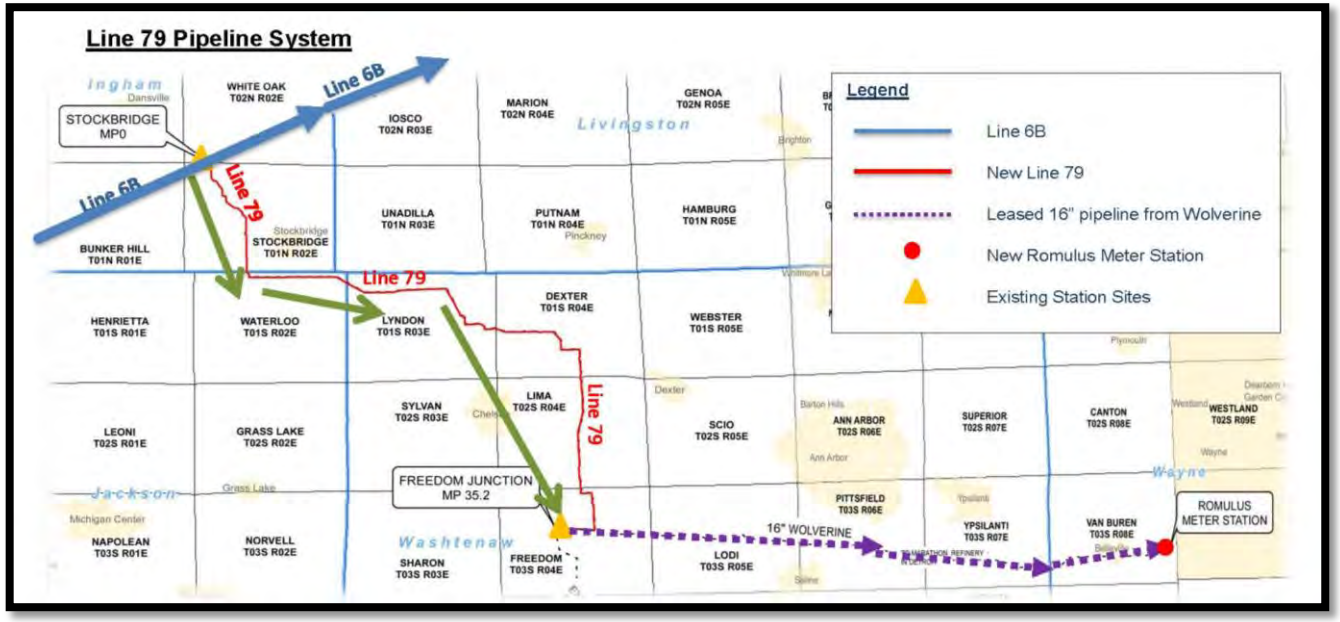
DWN BY: JDS DATE: 12/15/2011
REV BY: DATE:
APR BY: DATE:

ENBRIDGE

ENBRIDGE LINE 79
REGIONAL OVERVIEW MAP

SCALE: 1 IN = 8 MI | SHEET: 2 OF 18 | REV: 0

Line 79 Pipeline System Project
Project Description



As proposed in this Application, the Line 79 Pipeline System Project includes the construction of a new 20-inch diameter pipeline segment, the leasing of an existing 16-inch diameter pipeline segment, and the installation of new associated station facilities, all of which will comprise the new 64-mile pipeline system referenced as Line 79. The new pipeline system originates at the Stockbridge Pump Station and Terminal Facility ("Stockbridge Station") in Ingham County, Michigan, and extends to the east and south, terminating at a new meter station site near the city of Romulus in Wayne County, Michigan. As previously stated in Section III, Part A of the Application, Enbridge Energy Company, Inc. ("Enbridge") will be the operator of this 64-mile pipeline system located in the counties of Ingham, Jackson, Washtenaw and Wayne, Michigan. Enbridge Toledo hereby submits the following detailed project description.

DESCRIPTION OF NEW and LEASED PIPELINES

Construct approximately 35 miles of new 20-inch Pipeline – Stockbridge to Freedom Junction

Line 79 will originate at the Stockbridge Station with the construction of a new 35-mile long 20-inch-diameter pipeline segment, which will extend to the east and south to traverse the townships of Stockbridge in Ingham County, Waterloo in Jackson County, and Lyndon, Dexter, Lima and Freedom in Washtenaw County. The new pipeline segment will end at the existing Freedom Junction Station in Freedom Township, Washtenaw County, Michigan. At Freedom Junction, the new pipeline will connect with an existing 16-inch diameter pipeline, which Enbridge Toledo has leased from Wolverine. See the Table 1 below which provides more detailed information on the townships and counties traversed by the new Line 79.

Table No. 1
Townships and Counties Crossed

Begin Mile Post	Township & Range	County	State	Pipeline Length in Miles	Ending Mile Post	Township & Range	County	State
0.00	T-1-N, R-2-E	Ingham	MI	7.00	7.00	T-1-S, R-2-E	Jackson	MI
7.00	T-1-S, R-2-E	Jackson	MI	4.00	11.00	T-1-S, R-3-E	Washtenaw	MI
11.00	T-1-S, R-3-E	Washtenaw	MI	7.00	18.00	T-1-S, R-4-E	Washtenaw	MI
18.00	T-1-S, R-4-E	Washtenaw	MI	7.00	25.00	T-2-S, R-4-E	Washtenaw	MI
25.00	T-2-S, R-4-E	Washtenaw	MI	5.00	30.00	T-3-S, R-4-E	Washtenaw	MI
30.00	T-3-S, R-4-E	Washtenaw	MI	5.00	35.00	T-3-S, R-4-E	Washtenaw	MI

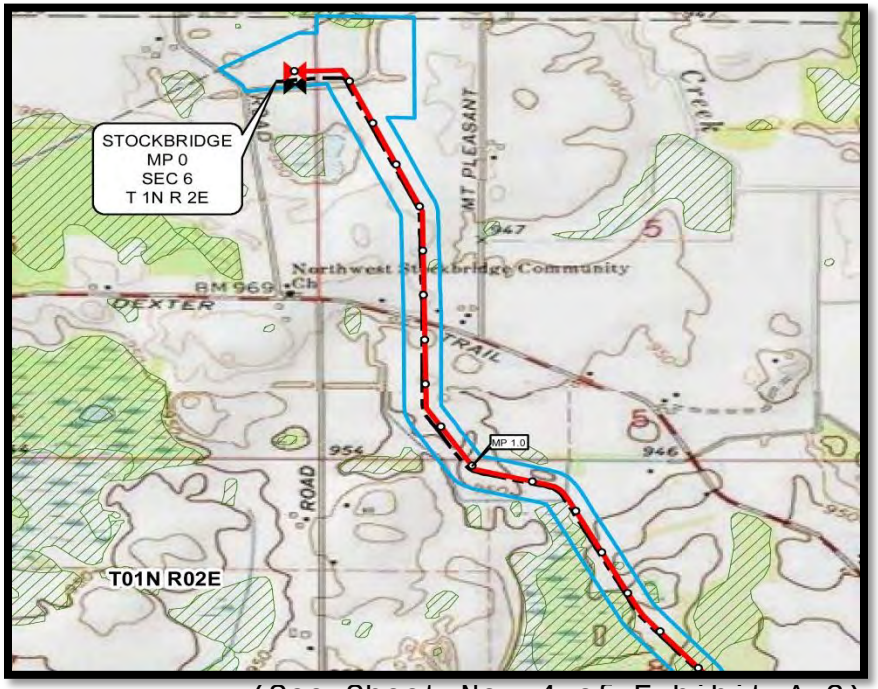
Leased approximately 29 miles of existing 16-inch Pipeline from Wolverine – Freedom Junction to new Romulus Meter Station Location

From the existing Freedom Junction Station, Enbridge Toledo has leased approximately 29 miles of an existing 16-inch-diameter pipeline segment from Wolverine. The leased segment will, in effect, extend Line 79 from Freedom Junction in Section 16, Township 3 South, Range 4 East, Washtenaw County, Michigan, further eastward for approximately 29 miles to traverse the townships of Freedom, Lodi, Pittsburg and Ypsilanti in Washtenaw County. The leased pipeline will then cross into Wayne County, where it will terminate at a new meter station near the city of Romulus in Van Buren Township, Wayne County, Michigan. Enbridge Toledo is considering two location sites in Wayne County, Michigan for its new Romulus Meter Station referenced as: Option No. 1, which is located in Section 24, Township 3 South Range 8 East, Van Buren Township; and Option No. 2, which is located in Section 25, Township 3 South Range 8 East, Van Buren Township. (*See* description of new Romulus meter station for more detailed information on this specific location.)

DESCRIPTION OF NEW STATION FACILITIES

As part of the Project scope, Enbridge Toledo plans to install certain minor station facilities at the following existing and new station sites.

Existing Stockbridge Station and Terminal Facility – Located in Section 6, Township 1 North, Range 2 East, Stockbridge Township, Ingham County, Michigan



(See Sheet No. 4 of Exhibit A-3)

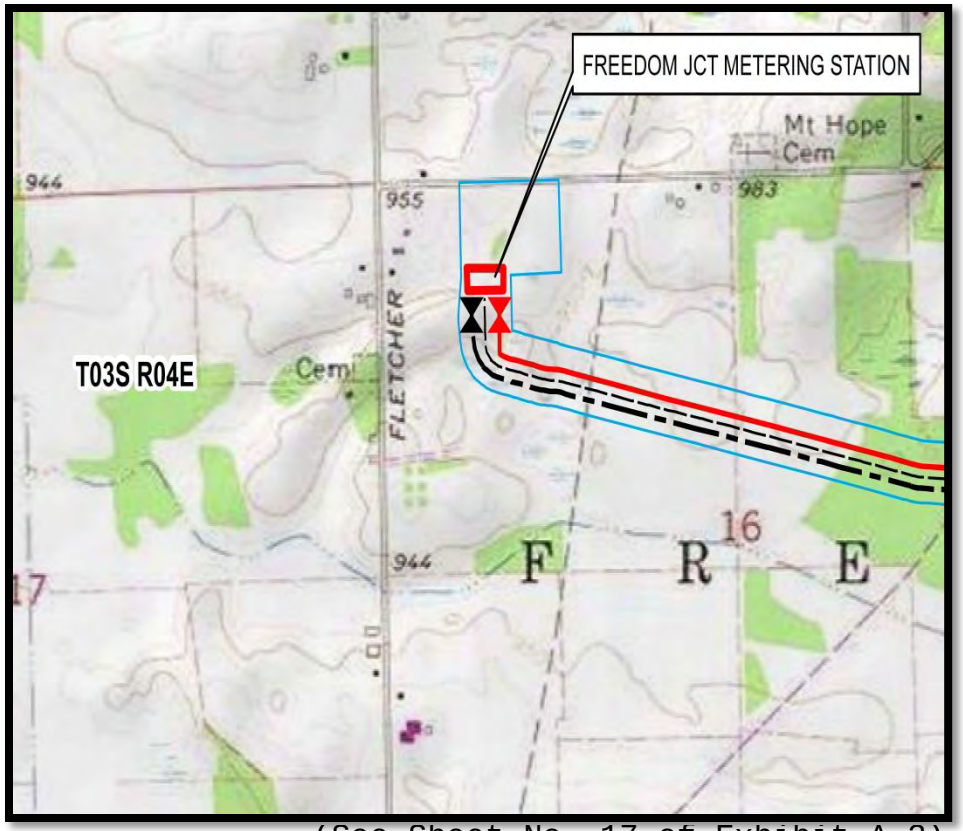
New Station Facilities:

- One new pump station with two pumping units
- Station piping for tie-in work including associated valves and appurtenances
- Associated civil, structural, electrical work, instrumentation controls, communications and SCADA equipment and installation

Land Requirements:

All of the above proposed station facilities at the existing Stockbridge Station will be located on land owned in fee by Enbridge affiliates. Thus, there will be no new land requirements at this location.

Existing Freedom Junction Station – Located in Section 16, Township 3 South, Range 4 East, Freedom Township, Washtenaw County, Michigan



(See Sheet No. 17 of Exhibit A-3)

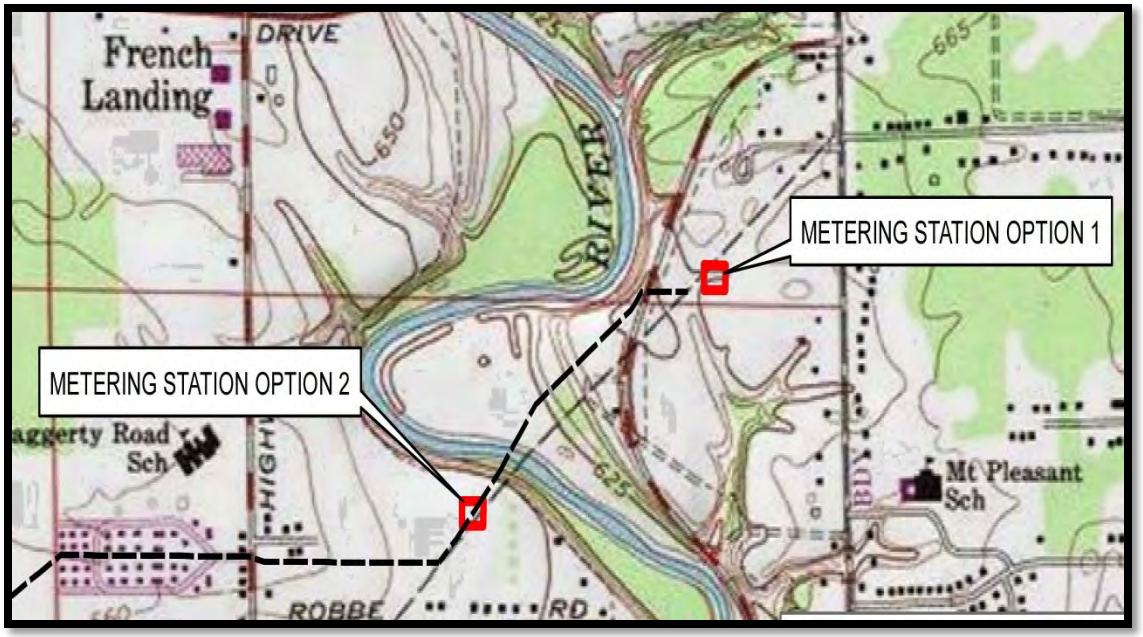
New Station Facilities to be Installed:

- Station piping including all valves and appurtenances to establish an interconnecting point between new 20-inch pipeline and existing 16-inch pipeline leased from Wolverine
- Associated civil, structural, electrical work, instrumentation controls, communications and SCADA equipment and installation

Land Requirements:

Enbridge Toledo plans to acquire a one acre tract of land adjacent to the existing above-ground valve site for Line 17 in Section 16, Township 3 South, Range 4 East, Freedom Township, Washtenaw County, Michigan. This one acre tract of land will be used for the new station facilities, which Enbridge Toledo plans to install at its existing Freedom Junction valve site. Enbridge Toledo is preparing to work with the underlying landowner to secure an Option Agreement to purchase this land in fee.

New Romulus Meter Station – Enbridge Toledo is considering two locations (Option No. 1 and Option No. 2) for siting its new Romulus meter station in Van Buren Township, Wayne County, Michigan. Enbridge Toledo is working with the affected landowners to enter into an agreement to purchase a 150-foot by 150-foot station site. A more detailed description of the new station facilities Enbridge Toledo is planning to install and the specific locations of these two potential station sites are shown on the Table 2 of this exhibit.



(See Sheet No. 18 of Exhibit A-3)

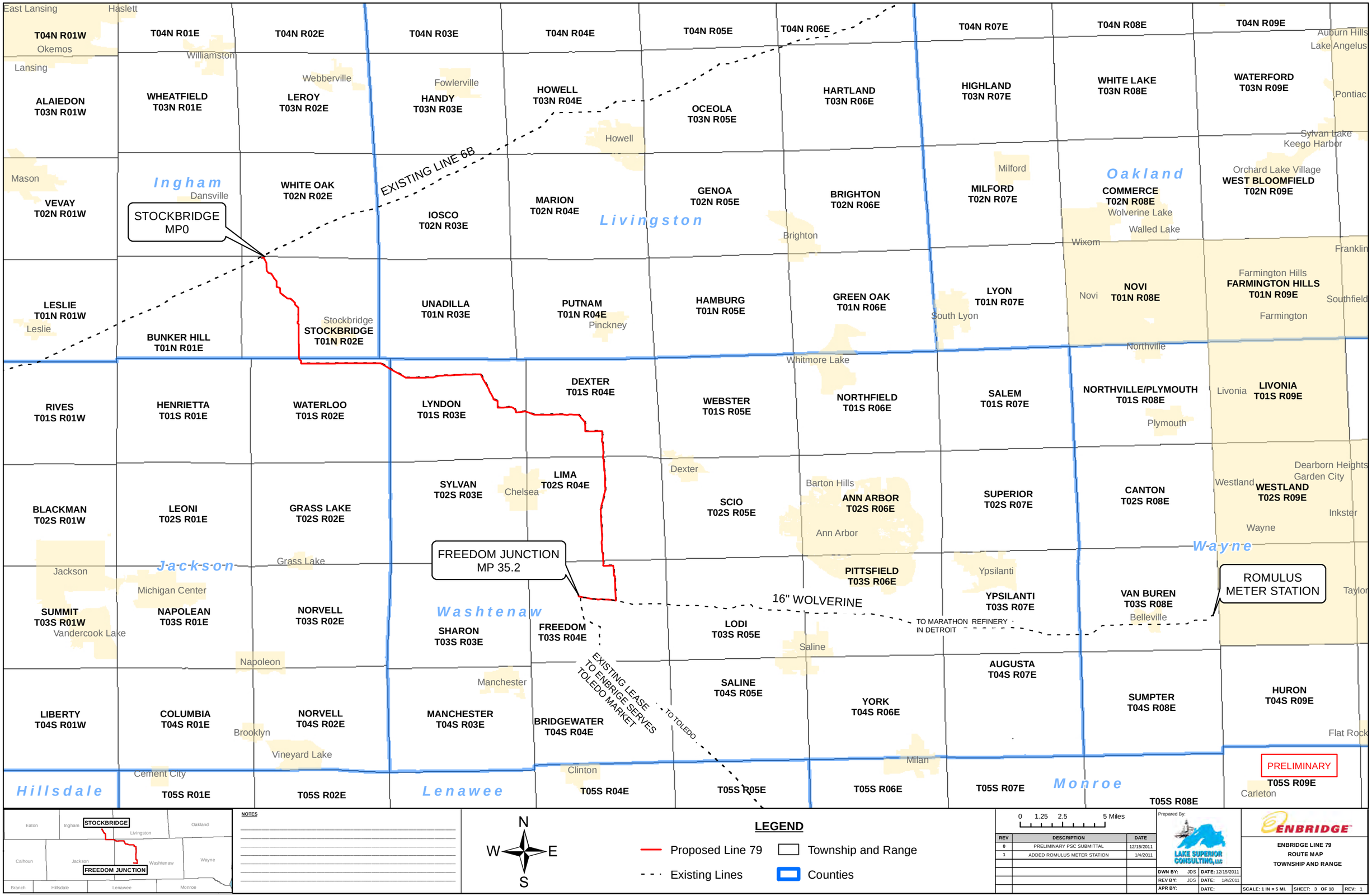
Table 2 - New Romulus Meter Station

Station Name	Location	New Station Facilities
Option No. 1	Section 24, Township 3 South, Range 8 East, Van Buren Township, Wayne County, Michigan	▪ New custody meter, including all valves and appurtenances ▪ Station piping for new interconnect with Sunoco Pipeline ▪ Station piping for new interconnect with Marathon Pipeline ▪ Associated civil, structural, electrical, instrumentation controls, Communications and SCADA equipment and installation
Option No. 2	Section 25, Township 3 South, Range 8 East, Van Buren Township, Wayne County, Michigan	

ENBRIDGE LINE 79 PIPELINE SYSTEM PROJECT

ROUTE MAP

TOWNSHIP AND RANGE


East Lansing
Haslett
Okemos
Lansing
Williamston
Webberville
Fowlerville
Howell
Mason
Dansville
Milford
Auburn Hills
Lake Angelus
Pontiac
Sylvan Lake
Keego Harbor
Orchard Lake Village
Wolverine Lake
Walled Lake
Wixom
Franklin
Farmington Hills
Novi
Southfield
Farmington
South Lyon
Northville
Whitmore Lake
Livonia
Plymouth
Dexter
Barton Hills
Ann Arbor
Dearborn Heights
Garden City
Westland
Inkster
Wayne
Ypsilanti
Taylor
Belleville
Saline
Brighton
Stockbridge
Chelsea
Grass Lake
Jackson
Michigan Center
Napoleon
Vandercook Lake
Manchester
Brooklyn
Vineyard Lake
Cement City
Clinton
Milan
Flat Rock
Carleton
Leslie
Pinckney
T04N R01W
T04N R01E
T04N R02E
T04N R03E
T04N R04E
T04N R05E
T04N R06E
T04N R07E
T04N R08E
T04N R09E
ALAIEDON T03N R01W
WHEATFIELD T03N R01E
LEROY T03N R02E
HANDY T03N R03E
HOWELL T03N R04E
OCEOLA T03N R05E
HARTLAND T03N R06E
HIGHLAND T03N R07E
WHITE LAKE T03N R08E
WATERFORD T03N R09E
VEVAY T02N R01W
WHITE OAK T02N R02E
IOSCO T02N R03E
MARION T02N R04E
GENOA T02N R05E
BRIGHTON T02N R06E
MILFORD T02N R07E
COMMERCE T02N R08E
WEST BLOOMFIELD T02N R09E
LESLIE T01N R01W
BUNKER HILL T01N R01E
STOCKBRIDGE T01N R02E
UNADILLA T01N R03E
PUTNAM T01N R04E
HAMBURG T01N R05E
GREEN OAK T01N R06E
LYON T01N R07E
NOVI T01N R08E
FARMINGTON HILLS T01N R09E
RIVES T01S R01W
HENRIETTA T01S R01E
WATERLOO T01S R02E
LYNDON T01S R03E
DEXTER T01S R04E
WEBSTER T01S R05E
NORTHFIELD T01S R06E
SALEM T01S R07E
NORTHVILLE/PLYMOUTH T01S R08E
LIVONIA T01S R09E
BLACKMAN T02S R01W
LEONI T02S R01E
GRASS LAKE T02S R02E
SYLVAN T02S R03E
LIMA T02S R04E
SCIO T02S R05E
ANN ARBOR T02S R06E
SUPERIOR T02S R07E
CANTON T02S R08E
WESTLAND T02S R09E
SUMMIT T03S R01W
NAPOLEAN T03S R01E
NORVELL T03S R02E
SHARON T03S R03E
FREEDOM T03S R04E
LODI T03S R05E
PITTSFIELD T03S R06E
YPSILANTI T03S R07E
VAN BUREN T03S R08E
LIBERTY T04S R01W
COLUMBIA T04S R01E
NORVELL T04S R02E
MANCHESTER T04S R03E
BRIDGEWATER T04S R04E
SALINE T04S R05E
YORK T04S R06E
AUGUSTA T04S R07E
SUMPTER T04S R08E
HURON T04S R09E
T05S R01E
T05S R02E
T05S R04E
T05S R05E
T05S R06E
T05S R07E
T05S R08E
T05S R09E
Ingham
Livingston
Oakland
Jackson
Washtenaw
Wayne
Hillsdale
Lenawee
Monroe
STOCKBRIDGE MP0
EXISTING LINE 6B
FREEDOM JUNCTION MP 35.2
16" WOLVERINE
TO MARATHON REFINERY IN DETROIT
ROMULUS METER STATION
EXISTING LEASE TO ENBRIGE SERVES TOLEDO MARKET
TO TOLEDO
PRELIMINARY
Eaton
Inghan
Oakland
Livingston
Calhoun
Jackson
Washtenaw
Wayne
Branch
Hillsdale
Lenawee
Monroe
NOTES
N
W
E
S
LEGEND
Proposed Line 79
Existing Lines
Township and Range
Counties
0 1.25 2.5 5 Miles
REV
DESCRIPTION
DATE
0 PRELIMINARY PSC SUBMITTAL 12/15/2011
1 ADDED ROMULUS METER STATION 1/4/2011
Prepared By:
LAKE SUPERIOR CONSULTING, LLC
DWN BY: JDS DATE: 12/15/2011
REV BY: JDS DATE: 1/4/2011
APR BY: DATE:
ENBRIDGE
ENBRIDGE LINE 79
ROUTE MAP
TOWNSHIP AND RANGE
SCALE: 1 IN = 5 MI
SHEET: 3 OF 18
REV: 1

ENBRIDGE LINE 79 PIPELINE SYSTEM PROJECT

USGS Topographical Maps

Pipeline Route

Sheet Nos. 4 - 15

STOCKBRIDGE
MP 0
SEC 6
T 1N R 2E

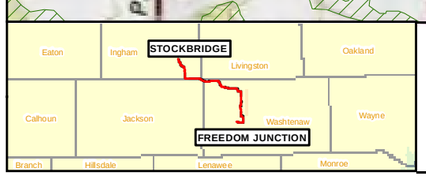
MP 1.0

MP 2.0

T01N R01E

T01N R02E

PRELIMINARY



NOTES

LEGEND

- Existing Line 17
- Proposed Line 79
- Proposed Line 79 Mile Post
- Existing Valve
- Proposed Valve
- Environmental Survey Corridor Boundary
- National Wetland Inventory

0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

Prepared By:
LAKE SUPERIOR CONSULTING, LLC

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

DWN BY: JDS	DATE: 12/15/2011		
REV BY:	DATE:		
APR BY:	DATE:	SCALE: 1 IN = 1,400 FT	SHEET: 4 OF 18	REV: 0

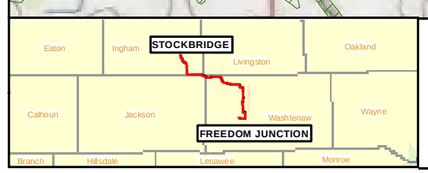
MP 3.0

MP 4.0

MP 5.0

T01N R02E

PRELIMINARY



NOTES

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0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

Prepared By:

LAKE SUPERIOR CONSULTING, LLC

DWN BY: JDS DATE: 12/15/2011

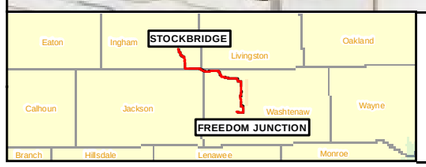
REV BY: DATE:

APR BY: DATE:

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

SCALE: 1 IN = 1,400 FT | SHEET: 5 OF 18 | REV: 0



NOTES

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REV	DESCRIPTION	DATE
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Prepared By: LAKE SUPERIOR CONSULTING, LLC

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

DWN BY: JDS	DATE: 12/15/2011	
REV BY:	DATE:	
APR BY:	DATE:	SCALE: 1 IN = 1,400 FT / SHEET: 6 OF 18 / REV: 0

T01N R02E

T01N R03E

T01S R02E

T01S R03E

MP 10.0

MP 11.0

MP 12.0

LIVINGSTON CO

JACKSON CO

WASHTENAW CO

USWA

UNADILLA STATE WILDLIFE AREA

GREGORY STATE WILDLIFE MANAGEMENT AREA

McIntyre Lake

Avery Lake

Boyce Lake

North Waterloo Cem

Oil Well

BOWDISH RD

FARNSWORTH RD

JAYCOX RD

LEEKE ROAD

KANE LAKE DRAIN

N

PRELIMINARY

Eaton | Ingham | Oakland | Livingston | Calhoun | Jackson | Washtenaw | Wayne | Branch | Hillsdale | Lenawee | Monroe

STOCKBRIDGE

FREEDOM JUNCTION

NOTES

LEGEND

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- Proposed Line 79 Mile Post
- Existing Valve
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0 700 1,400 Feet

REV	DESCRIPTION	DATE
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Prepared By: LAKE SUPERIOR CONSULTING, LLC

DWN BY: JDS DATE: 12/15/2011

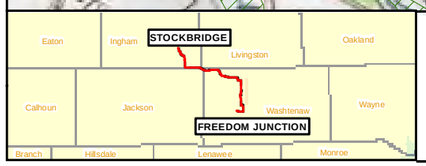
REV BY: DATE:

APR BY: DATE:

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

SCALE: 1 IN = 1,400 FT | SHEET: 7 OF 18 | REV: 0



NOTES

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0 700 1,400 Feet

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DWN BY:	JDS	DATE: 12/15/2011
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ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

SCALE: 1 IN = 1,400 FT | SHEET: 8 OF 18 | REV: 0

STATE RECREATION AREA

N

MP 16.0

MP 17.0

MP 18.0

MP 19

T01S R03E

T01S R04E

PRELIMINARY

Public Access

South Lake

Eagle Lake

Campground

Snyder Lake

Sullivan Lake

Sullivan Lake

Camp Crile

Landing Strip

Sandpit

Wild Goose Lake

Burkhart Lake

Twamley Lake

BM 1002

Roadside Park

Gravel Pit

Island Lake

Island Lake

JOSLIN ROAD

EMBURY ROAD

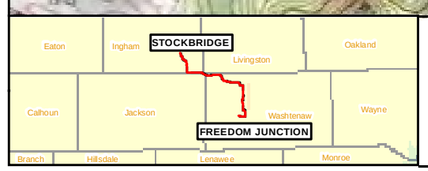
HASSEY ROAD

GOODENOW ROAD

NORTH TERRITORIAL ROAD

STOFER RD

R3E R4E



NOTES

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- Existing Valve
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- National Wetland Inventory

0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

Prepared By:

LAKE SUPERIOR CONSULTING, LLC

DWN BY: JOS DATE: 12/15/2011

REV BY: DATE:

APR BY: DATE:

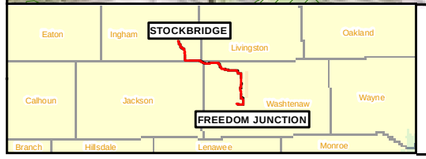
ENBRIDGE

ENBRIDGE LINE 79

ROUTE MAP

TOPOGRAPHICAL

SCALE: 1 IN = 1,400 FT | SHEET: 9 OF 18 | REV: 0



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- Proposed Valve
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0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

Prepared By: LAKE SUPERIOR CONSULTING, LLC

DWN BY: JDS DATE: 12/15/2011
REV BY: DATE:
APR BY: DATE:

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

SCALE: 1 IN = 1,400 FT | SHEET: 10 OF 18 | REV: 0

MP 20.0
MP 21.0
MP 22.0
MP 23.0
MP 24.0
T01S R04E
DETER
Riker Lake
RIKER ROAD
MADDEN RD
DONNER ROAD
COLBY ROAD
DEXTER ROAD
MC GINNESS ROAD
ISLAND LAKE
WATERLOO ROAD
PIPELINE
BM 906
Dexter Cem
March Pit
PRELIMINARY

N

Eaton	Ingham	STOCKBRIDGE	Livingston	Oakland
Calhoun	Jackson	Washtenaw	FREEDOM JUNCTION	Wayne
Branch	Hillsdale	Lenawee	Monroe	

NOTES

LEGEND

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- Proposed Line 79
- Proposed Line 79 Mile Post
- Existing Valve
- Proposed Valve
- Environmental Survey Corridor Boundary
- National Wetland Inventory

0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

Prepared By:
LAKE SUPERIOR CONSULTING, LLC

DWN BY: JDS DATE: 12/15/2011
REV BY: DATE:
APR BY: DATE:

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

SCALE: 1 IN = 1,400 FT | SHEET: 11 OF 18 | REV: 0

T01S R04E

T02S R04E

MP 25.0

MP 26.0

N

0 700 1,400 Feet

PRELIMINARY

NOTES

LEGEND

- Existing Line 17
- Proposed Line 79
- Proposed Line 79 Mile Post
- Existing Valve
- Proposed Valve
- Environmental Survey Corridor Boundary
- National Wetland Inventory

STOCKBRIDGE

FREEDOM JUNCTION

Eaton, Ingham, Livingston, Oakland, Calhoun, Jackson, Washtenaw, Wayne, Branch, Hillsdale, Lenawee, Monroe

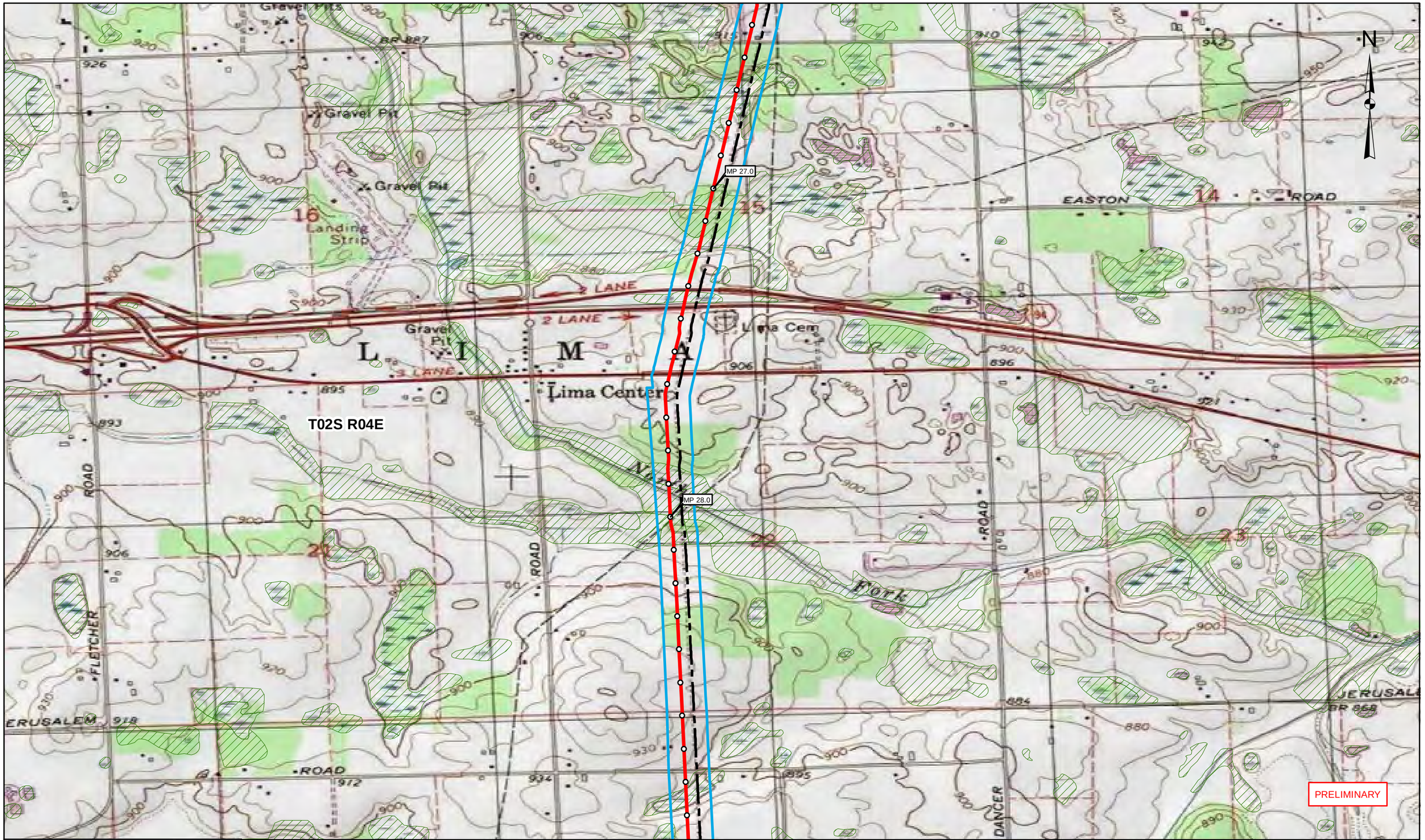
REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

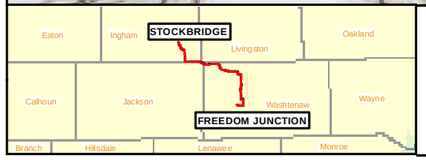
Prepared By: LAKE SUPERIOR CONSULTING, LLC

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

DWN BY: JDS	DATE: 12/15/2011		
REV BY:	DATE:		
APR BY:	DATE:	SCALE: 1 IN = 1,400 FT	SHEET: 12 OF 18	REV: 0





NOTES

LEGEND

- Existing Line 17
- Proposed Line 79
- Proposed Line 79 Mile Post
- Existing Valve
- Proposed Valve
- Environmental Survey Corridor Boundary
- National Wetland Inventory

0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

Prepared By:
LAKE SUPERIOR CONSULTING, LLC

DWN BY: JDS DATE: 12/15/2011
REV BY: DATE:
APR BY: DATE:

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

SCALE: 1 IN = 1,400 FT | SHEET: 13 OF 18 | REV: 0

MP 29.0

MP 30.0

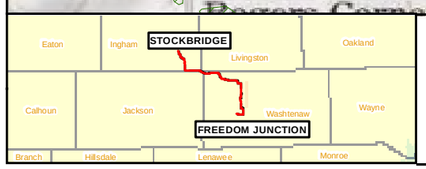
MP 31.0

T02S R04E

T03S R04E

N

PRELIMINARY



NOTES

LEGEND

- Existing Line 17
- Proposed Line 79
- Proposed Line 79 Mile Post
- Existing Valve
- Proposed Valve
- Environmental Survey Corridor Boundary
- National Wetland Inventory

0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

Prepared By:

LAKE SUPERIOR CONSULTING, LLC

DWN BY: JDS DATE: 12/15/2011

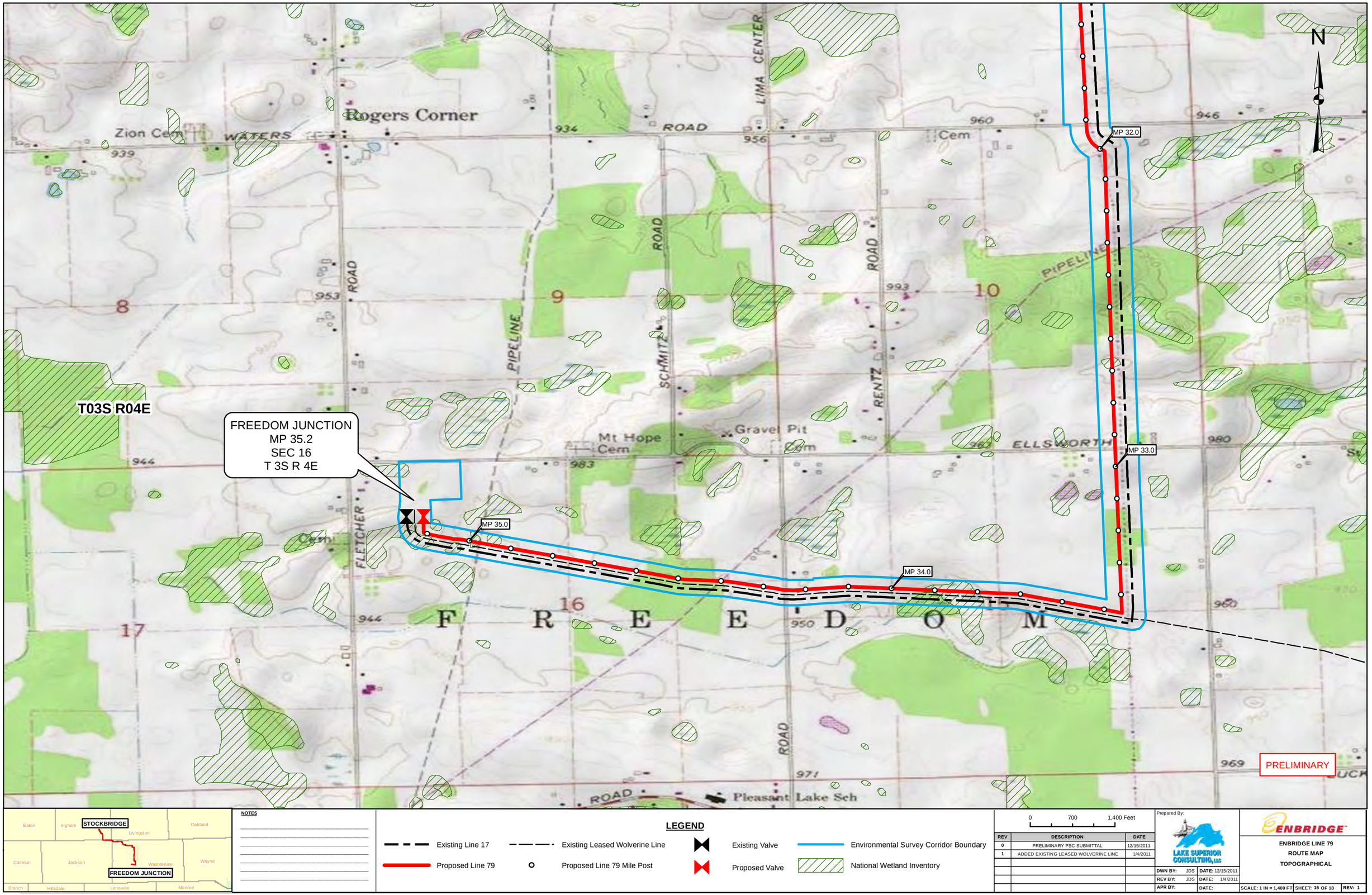
REV BY: DATE:

APR BY: DATE:

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

SCALE: 1 IN = 1,400 FT | SHEET: 14 OF 18 | REV: 0



NOTES

LEGEND

- Existing Line 17
- Existing Leased Wolverine Line
- Existing Valve
- Environmental Survey Corridor Boundary
- Proposed Line 79
- Proposed Line 79 Mile Post
- Proposed Valve
- National Wetland Inventory

0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011
1	ADDED EXISTING LEASED WOLVERINE LINE	1/4/2011

Prepared By:

LAKE SUPERIOR CONSULTING, LLC

DWN BY:	JDS	DATE: 12/15/2011	
REV BY:	JDS	DATE: 1/4/2011	
APR BY:		DATE:	

ENBRIDGE

ENBRIDGE LINE 79
ROUTE MAP
TOPOGRAPHICAL

SCALE: 1 IN = 1,400 FT | SHEET: 15 OF 18 | REV: 1

ENBRIDGE LINE 79 PIPELINE SYSTEM PROJECT

Sheet No.16 – Stockbridge Station – Civil Site Plan

Sheet No. 17 – Freedom Junction Station – Topographical Map

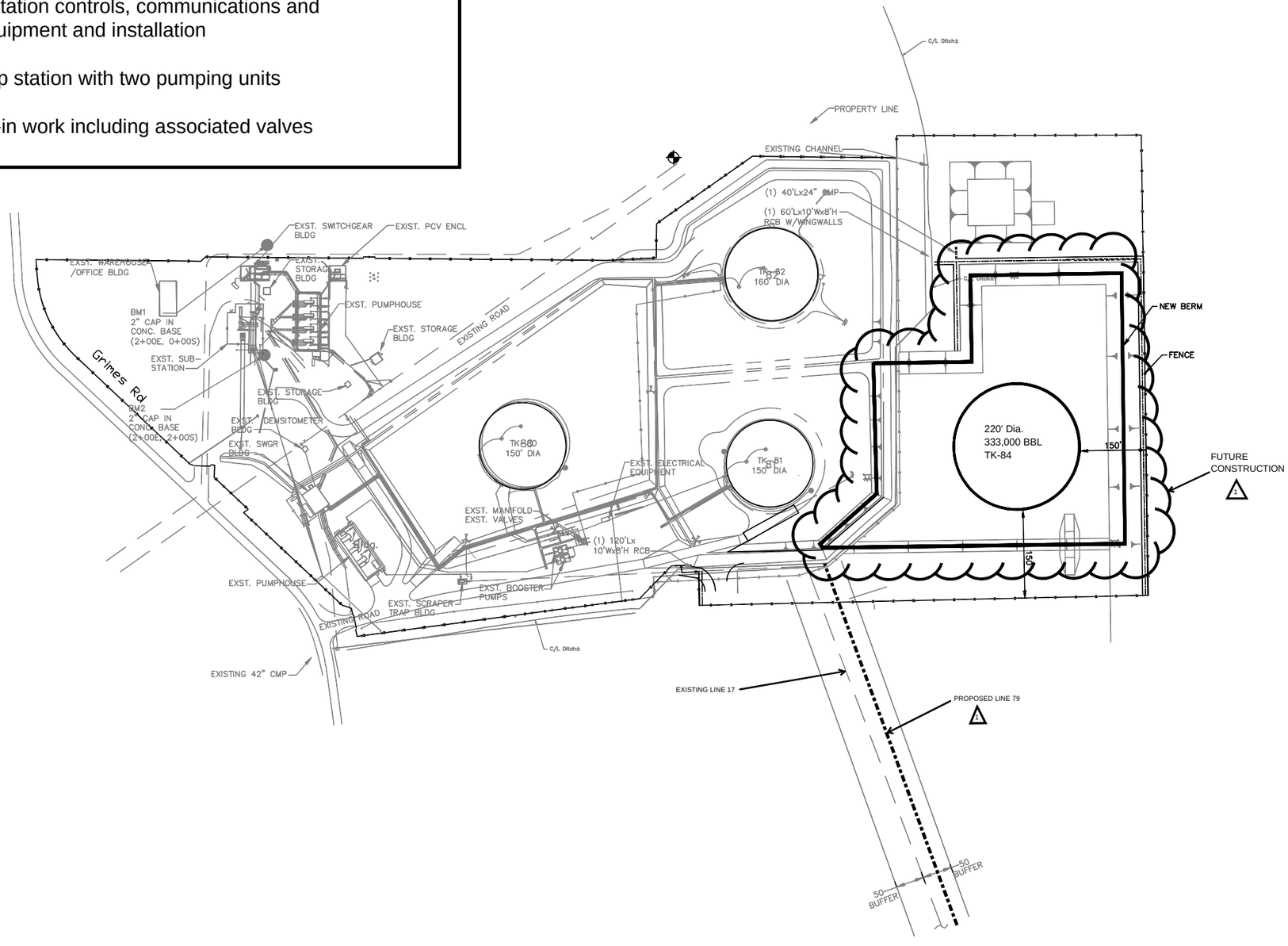
Sheet No.18 – Location of Two Potential Sites for New Romulus Meter Station – Topographical Map

Stockbridge Pump Station and Terminal Facility

Associated civil, structural, electrical, instrumentation controls, communications and SCAD equipment and installation

New pump station with two pumping units

Piping tie-in work including associated valves



PRELIMINARY DRAWING NOT FOR CONSTRUCTION

NO	REVISION	BY DATE	APPR
1	GENERAL REVISIONS	TDS 1/03/12	

ENBRIDGE

STOCKBRIDGE (MI) TERMINAL

CIVIL SITE PLAN

PROJECT:		
SCALE: NOT TO SCALE	DATE: 11-NOV-11	DRAWN: TDS
CHECK:	APPR: _	DATE:
APPR: _	DWG No.	SHEET 16 OF 18
APPR: _		

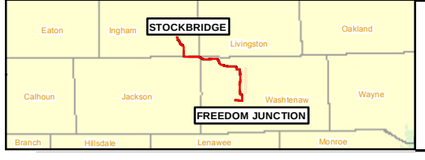
FREEDOM JCT

- Associated civil, structural, electrical, instrumentation controls, communications and SCADA equipment and installation
- Piping tie-in work including associated valves

FREEDOM JCT METERING STATION

T03S R04E

PRELIMINARY



NOTES

LEGEND

- Proposed Line 79
- Existing Line 17
- Environmental Survey Corridor Boundary
- Existing Leased Wolverine Line

0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011
1	ADDED EXISTING LEASED WOLVERINE LINE	1/4/2011

Prepared By: LAKE SUPERIOR CONSULTING, LLC

DWN BY:	JDS	DATE: 12/15/2011	
REV BY:	JDS	DATE: 1/4/2011	
APR BY:		DATE:	SCALE: 1 IN = 1,400 FT

SHEET: 17 OF 18 | REV: 1

ENBRIDGE

ENBRIDGE LINE 79
METERING STATION AT FREEDOM JCT

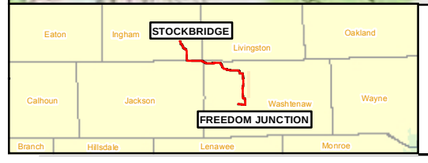
METERING STATION OPTION 1

METERING STATION OPTION 2

ROMULUS

- Custody transfer meter skid, quality building, and meter prover
- Associated civil, structural, electrical, instrumentation controls, communications and SCADA equipment and installation
- Piping tie-in work including associated valves

PRELIMINARY



NOTES

LEGEND

Existing Wolverine Line

0 700 1,400 Feet

REV	DESCRIPTION	DATE
0	PRELIMINARY PSC SUBMITTAL	12/15/2011

Prepared By: LAKE SUPERIOR CONSULTING, LLC

DWN BY:	JDS	DATE:	12/15/2011
REV BY:		DATE:	
APR BY:		DATE:	

ENBRIDGE

ENBRIDGE LINE 79
METERING STATION AT ROMULUS

SCALE: 1 IN = 1,400 FT | SHEET: 18 OF 18 | REV: 0

Michigan Public Service Commission

Case No.: U-16937

Exhibit No.: A-4

FACILITIES CONSTRUCTION

&

PIPELINE CONSTRUCTION

Michigan Public Service Commission
Case No.: U- 16937
Exhibit No.: A-4

SPECIFICATION FOR PIPELINE CONSTRUCTION (USA)

FACILITIES CONSTRUCTION

ENBRIDGE ENERGY, LIMITED PARTNERSHIP

PART 6

2008 SPECIFICATIONS FOR CONSTRUCTION

INDEX

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 1

EARTHWORK AND ROADS

March, 2004

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 1

EARTHWORK AND ROADS

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SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 1

EARTHWORK AND ROADS

6.1.1 GENERAL

EARTHWORK and ROADS as covered by this Section of the SPECIFICATIONS includes that required for structures, piping, electrical conduit, roads and site grading and finishing. **All backfill work referred to in Part 6 "Specifications for Construction" shall be done in strict accordance with this Section.**

Construction of roads, embankments or grading shall be done in accordance with the DRAWINGS and shall be true to the elevations as shown on the DRAWINGS.

The CONTRACTOR shall complete EARTHWORK and ROADS as outlined in the SCOPE OF WORK Clause of the GENERAL CONDITIONS of these SPECIFICATIONS.

6.1.2 DEFINITIONS

"BORROW" - Earth material obtained from a location remote to the job site and imported to the site for the purpose of fill or backfill.

"BACKFILL" - Replaced native or imported earth materials into an excavation up to the natural or specified grade of the land.

"GRADE" - The line of the surface of natural earth or the design line surface of fill material as indicated on the DRAWINGS.

"SUBGRADE" - The zone of natural (native) earth materials below the design subcut/excavation limit.

"BASE" - Select material directly below the grade line conforming to the DRAWINGS and prepared in accordance with the SPECIFICATIONS.

"SUBBASE" - Suitable native or imported earth material, in the subgrade zone below the base, prepared in accordance with the DRAWINGS and SPECIFICATIONS.

"SELECT MATERIAL" - Granular earth materials (as defined in Clause 6.1.6 B) free of clay, silt, roots, stumps or other organic material and other undesirable material.

"CLAY MATERIAL" - Cohesive material (≥85% passing #200 sieve) and having an Atterberg plasticity index greater than 10 and less than 25, as determined by ASTM D4318.

"SEPARATOR FABRIC" – A geotextile material used to separate fine grained subgrade material from a clean granular base and/or subbase (Ref. 6.1.5).

"CRUSHED ROCK (Stone)" - Mechanically crushed rock with angular, sharp edges, clean washed and well graded (Ref 6.1.6).

6.1.3 PREPARATION OF CONSTRUCTION SITE

A. Clearing and Grubbing

The CONTRACTOR shall, in the area within limits as shown on the DRAWINGS, cut, remove, haul away and otherwise dispose of in a manner acceptable to the COMPANY from the job site all rocks, trees, logs, stumps, brush, undergrowth, dead wood, roots, vegetation, rubbish and other organic or objectionable matter.

Burnable spoil shall be stockpiled in an approved off-site disposal area. All site burning shall be pre-approved by the COMPANY; otherwise the CONTRACTOR shall haul to the approved disposal site. The CONTRACTOR shall obtain all required burning and disposal permits.

B. Stripping and Spreading of Topsoil

Topsoil shall be stripped from all areas of construction (footings, slabs, berms, pavements, gravel surfacing, erosion control, etc.) and from other areas as shown on the DRAWINGS. Topsoil shall be stored in designated stockpiles on site or removed from site as directed by the COMPANY.

On areas which will subsequently be seeded or landscaped or designated to receive top soil, the subgrade shall be scarified to a depth of at least two inches for the bonding of the top soil with the subsoil. Areas to be seeded or landscaped shall receive a minimum of six inches of topsoil. All topsoil needed in addition to that available at the site shall be provided by the CONTRACTOR.

6.1.4 EXCAVATION

A. General

The use of explosives will not be allowed in any job site operation unless specifically approved by the COMPANY. Machine excavation will be permitted, but hand excavation is required near existing utilities. Only hydraulically operated machines will be allowed. (See Part 6 Section 8 "BLASTING NEAR PIPELINES AND BUILDINGS")

Grading in the vicinity of all excavations shall be controlled to prevent surface water from running into excavated areas. All excavations shall be kept free of water by pumping or ditching. Excavated material that is selected to be used for backfill shall be stockpiled at the site as directed by the COMPANY and such material shall be kept free of all trash, organic, or objectionable material.

Materials from excavations not suitable or not required for backfill shall be disposed of off site, subject to COMPANY approval at the CONTRACTOR'S expense.

Excavations shall conform to the limits as shown on the DRAWINGS or specified therein and shall not be made below the designated subgrade except for the removal of unstable material as directed by the COMPANY. Excavating of unsuitable materials shall continue until the desired subgrade is exposed and verified by the COMPANY or their representative.

Borrow, if required to complete the backfill, shall be provided by the CONTRACTOR. The source and quality of borrow material shall be sampled, tested and approved by the COMPANY prior to being delivered to the project site. The CONTRACTOR shall give the COMPANY five (5) days notice before utilizing borrow material from any COMPANY approved borrow pit.

At the completion of each work day or when otherwise left unattended, the CONTRACTOR shall mark and barricade, with plastic orange fencing, all excavations in accordance with current OSHA requirements.

B. Excavation for Structures

Excavation and shoring shall be kept as close as practicable to the lines of the structure foundation. Banks or backslopes shall be cut at a safe angle of repose or sufficiently shored to protect any WORK within the excavated area. Under no circumstances shall any excavation be carried to points below the elevation of the building footings or foundations unless unsuitable materials need to be removed to reach the required foundation material. Excavation limits shall be observed and approved by the COMPANY or their representative. Backfilling to re-establish footing elevations shall use a select material as directed by the COMPANY and compacted as specified in Section 6.1.12. All excavations and shoring must be done in accordance with current OSHA regulations.

C. Excavation for Piping and Conduit

All trash, rocks and hard clay lumps shall be removed from the ditch to prevent damage to the coating on the piping or conduit.

Where concrete encasement of conduit is called for, trenches shall be of sufficient depth to provide for the required cover.

6.1.5 SEPARATOR FABRIC

The geotextile fabric used to strengthen fine grained subgrades and separate fine grained subgrades from granular base and/or subbase shall be a non-woven material meeting the requirements of American Association of State Highway and Transportation Officials (AASHTO) Medium Survivability Level. Mirafi 170N, Trivera

1125, Phillips 7NP, Amoco 4552 or a Poly Felt TS 650 meets these requirements. Other equivalent fabric can be used if written approval is given by the COMPANY.

6.1.6 FILL AND BACKFILL

A. General

Fill or backfill shall not be placed before subgrade preparation has been approved by the COMPANY.

Conduit and piping shall be adequately supported by sand bags or wood cribbing to prevent them from distorting during backfilling. All walls or structures liable to be disturbed by tamping shall be shored.

Backfilling shall be placed and compacted simultaneously on each side of the foundation maintaining no more than one foot difference in elevation at any time.

All backfill material shall meet the approval of the COMPANY and these SPECIFICATIONS. Backfill material shall be free from frost, stumps, roots, sod and other organic matter. Moisture content of the backfill shall be adjusted by wetting or drying to achieve the specified compaction (see Clause 6.1.12). If difficulties are encountered achieving this compaction, the COMPANY will request clean sand to be used for backfill.

B. Classifications

The following gradation schedule is generic. Due to variations in gradation specifications from state to state the following schedule is issued as a guideline. Typical state highway approved gradations will usually meet the specifications hereafter. Gradiations not meeting the following schedule must be approved by the COMPANY prior to use.

All fill and backfill shall be done in accordance with the following classifications:

Material	Gradation Requirements	
	Sieve Size	Percent Passing
Pit Run	4"	100
	2"	80 - 100
	#4	60 - 100
	#200	0 - 10
Base Course (ASTM 2940)	2"	100
	1-1/2"	95 - 100
	3/4"	70 - 92
	3/8"	50 - 70
Base Course	#4	35 - 55

(continued)	#30	12 - 25
	#200	0 - 8
Clean Sand	3/4"	100
	#4	80 - 100
	#200	0 - 6
Crushed Rock	2"	100
	1"	40 - 75
	3/4"	10 - 50
	3/8"	0 - 15
	#4	0 5

6.1.7 PROTECTION OF STRUCTURES

Culverts, headwalls and other structures shall be constructed before backfill is placed. Backfill around culverts, headwalls or other structures shall be carefully and symmetrically placed in six to eight inch layers and shall be compacted to the degree specified herein (Ref. 6.1.11.).

6.1.8 SUBGRADE PREPARATION

In cut areas the subgrade shall be scarified and compacted for a depth of at least six inches by rolling or tamping with a sheep's foot roller or other equipment approved by the COMPANY.

All subgrade shall be proof rolled using a 20 to 30 ton roller to detect unstable and yielding areas, except as indicated on the DRAWINGS. Soft or unstable areas in the subgrade shall be removed and backfilled with select material as directed by the COMPANY. These areas shall be drained prior to backfilling of the select material as directed by the COMPANY.

Rough grades, including slopes and ditches, shall be formed and maintained to provide proper drainage.

Final rolling and shaping of subgrade shall be accomplished by blading and rolling. Rough subgrades shall be cleaned of all loose or foreign material and reshaped if rutted and selected material shall be added to meet the required grade. Shaping and compacting shall be done with blade graders, pneumatic rollers or bulldozers.

Subgrade surfaces shall be smooth and even and shall not vary more than two inches from the elevation as shown on the DRAWINGS.

6.1.9 FINISHING SLOPES AND SURFACES

All areas shall be finished to smooth, compacted surfaces in conformity with DRAWINGS. Blade grader or scraper finish of a smooth uniform appearance will be allowed on all slopes permitting the use of such equipment. Hand shovel finish will be required in areas that will not permit the use of scraper or blade operation.

Finish of shoulders, ditches and gutters will require hand shovel and raking finish if such are not adaptable to machine finish.

All finished work shall be drained and maintained in accordance with the DRAWINGS until acceptance of the work is made by the COMPANY.

Finish grade surface shall not vary more than one inch from the elevation shown on the DRAWINGS.

6.1.10 SITE GRADING AND CLEAN-UP

The entire work area shall be graded upon work completion in order to remove machine tracks and impressions and to provide effective drainage. Such work shall be done by hand in hot work areas or where the use of machinery will not achieve the desired result. Final surfacing will be required in areas and to depths as designated on the DRAWINGS. **ALL CLEAN-UP WORK SHALL BE TO THE SATISFACTION OF THE COMPANY.**

6.1.11 DRAINAGE STRUCTURES

Excavation and backfilling shall conform to conditions as set forth in the foregoing Clauses covering excavation, trenching and backfilling.

A. Materials

All pipe installed shall be of the size, type and class as shown on the DRAWINGS.

Non-reinforced concrete pipe shall conform to the latest ASTM - Specification - 14-95, Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.

Reinforced concrete pipe shall conform to the latest ASTM Specification C-76-98, Specification for Reinforced Culvert, Storm Drain, and Sewer Pipe.

Corrugated galvanized metal pipe shall conform to the latest ASTM Specification A760/760M-97, Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.

B. Installations

Bedding of the pipe shall conform to the details as shown on the DRAWINGS and shall provide a firm foundation, carefully shaped to line and grade. Bell holes, if required, shall be accurately excavated to size by hand.

C. Concrete Culverts

Concrete drainage culverts shall be laid carefully with hubs upgrade and ends fully and closely jointed. Joints shall be hot poured bituminous compounds, precast bituminous compound or cement mortar placed in accordance with

manufacturer's specifications. Bituminous joints shall be used where settlement may occur.

D. Corrugated Metal Pipe

Corrugated metal pipe shall be laid with the separate sections firmly jointed together. Joints shall be made by riveting or by means of connecting bands with bolted couplings in accordance with the manufacturer's recommendations.

When the pipe laps at circumferential joints, the inner lap shall be in the upstream side of the joint. Longitudinal laps shall be located at the horizontal axis.

E. Earth Gutters and Ditches

Shall be constructed as shown on the DRAWINGS and in accordance with applicable portions of these SPECIFICATIONS for EARTHWORK AND ROADS.

6.1.12 COMPACTION REQUIREMENTS AND TESTING

A. Requirements

Soil placed (backfill) for all excavations shall be compacted in lifts of no more than six inches (6"). Modified proctor values (ASTM 1557) shall be used for all compaction tests. Minimum compaction shall be as follows:

Location	Minimum Compaction
Entire site including under foundations, slabs and roadways	95%
Other non-structural areas (as called out on design drawings)	90%

Note: Where % Compaction = $\frac{\text{Field Density}}{\text{Modified Proctor Dry Density}}$

No vibratory equipment shall be used for compaction over hot lines.

B. Testing

The COMPANY will provide an independent testing and inspection laboratory to perform all compaction tests. A sufficient number of tests will be performed to ensure that the backfilled areas meet established requirements. If the test results do not meet such requirements, the areas in question shall be reworked and retested. Any required reworking and retesting shall be at the CONTRACTOR'S expense.

The independent testing and inspection laboratory will submit the test results in writing to the COMPANY as soon as practical.

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 2

BUILDINGS

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 2

BUILDINGS

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SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 2

BUILDINGS

6.2.1 GENERAL

The CONTRACTOR shall provide all materials and labor necessary to furnish a building as detailed on the DRAWINGS and in accordance with these SPECIFICATIONS. The building shall be of prefabricated steel, rigid frame construction. The building profile and general arrangement shall be in accordance with the DRAWINGS and sectional properties shall be determined strictly in accordance with the requirements of ASTM and AISC Specifications for the Design of Light Gauge Steel Structural Members.

The CONTRACTOR shall complete all BUILDING installations as outlined in the SPECIFIC CONDITIONS of these SPECIFICATIONS and as shown on the DRAWINGS.

6.2.2 STRUCTURAL DESIGN

The CONTRACTOR shall provide the COMPANY a structural loading analysis of the building from the building manufacturer, certified by a professional engineer registered in the jurisdiction in which the building is to be located. The design shall be in accordance with the following:

A. Regional climatic conditions in accordance with BOCA National Building Code, including snow, wind, seismic, equipment and building dead loads;

B. Federal, State and local codes and regulations

C. AISC S335-1989: Specifications for Structural Steel Buildings, and

D. ANSI SG-671-1989: Specifications for the Design of Cold Formed Steel Structural Members.

6.2.3 MATERIALS

A. Roof, Walls and Trim

Roof and wall cladding panels shall be prefinished, galvanized sheet steel fabricated from steel and conforming to ASTM A446M-89, Grade A. The panels shall be a minimum thickness of 24 gauge and have Class G90 zinc coating and an exterior baked on enamel finish of a color approved by the COMPANY.

Cladding trim and flashing shall be of the same material and finish as the roof and wall panels.

B. Doors and Frames

1. Pedestrian

Exterior door panels shall be standard 1-3/4" thick, 18 gauge galvanized steel, reinforced and stiffened. Doors shall be reinforced for full mortise plain bearing butts and cylindrical lockset keyed to match existing COMPANY facilities. Doors shall be insulated, bonderised, prime painted and have a baked enamel finish. Lockset shall be keyed alike with other COMPANY facilities.

All exterior building pedestrian doors shall be equipped with panic bars on the inside and automatic hydraulic door closures (unless specified otherwise) and have glass windows of 5/16" safety glass. Refer to DRAWINGS for details of interior doors.

2. Overhead Doors

a. Roll-Up Door

Roll-up overhead doors shall be constructed of a minimum of 20 gauge galvanized sheet steel slats. Door operation shall be manual chain hoist unless otherwise noted in the SPECIFIC CONDITIONS or as indicated on the DRAWINGS.

b. Sectional Door

Sectional overhead doors shall be constructed of a minimum of 20 gauge prefinished, galvanized sections. Door tracks shall be 3" galvanized sections. Door operation shall be manual chain hoist unless otherwise noted in the SPECIFIC CONDITIONS or as indicated on the DRAWINGS.

3. Windows

Windows shall have insulated safety glass with wire mesh reinforcement unless otherwise noted in the SPECIFIC CONDITIONS or as indicated on the DRAWINGS.

4. Insulation

Buildings requiring insulation shall have an interior liner as shown on the DRAWINGS. The panel profile shall be fluted and shall be 24 gauge of the same material and finish as the roof and wall panels. Insulation shall be protected with a vapor barrier placed on the warm side of the insulation.

Heated buildings shall be insulated with glass fiber with a minimum thermal

resistance of R-19 for walls and R-30 for the roof, unless otherwise noted on the DRAWINGS.

5. Heating, Ventilation and Air Conditioning

All heating systems to be specified on the DRAWINGS. It shall be the CONTRACTOR'S responsibility to verify the proper sizing of the unit.

Buildings shall be provided with wall mount louvers and/or an approved ridge ventilation system, if specified on the DRAWINGS. The louver and ridge vents shall include birdscreen covers and retainers.

All air conditioning systems shall be of a non CFC-12 type if air conditioning is specified on the DRAWINGS. It shall be the CONTRACTOR'S responsibility to verify the proper sizing of the unit.

6. Miscellaneous

The building shall be furnished with gutters, downspouts and snow canopies over pedestrian doors (on sidewalls only) with the same exterior finish as the roof and wall panels in a COMPANY approved color.

Buildings shall be provided with wall mount louvers if specified on the DRAWINGS. The louvers shall include birdscreen and retainers.

6.2.4 FABRICATION

All steel shall be designed, fabricated and erected in accordance with ASTM and AISC Specification for Design, Fabrication and Erection of Structural Steel for Buildings and comply with any federal, state and local codes or ordinance governing.

All roof covering shall be properly flashed and caulked at ridge and eave. Roof panels shall be manufactured in one continuous length from ridge to eave.

Wall panels shall be installed as one continuous length from base to eave and shall be interlocked. Panels shall be precut to length and prepunched for fastening.

Fasteners shall be steel bolts, nuts and tapping screws all zinc plated.

Closure strips shall be provided at all building penetrations, eaves, door openings and foundations. Closure strips shall be preformed, closed cell neoprene, shaped to fit the panel profile. Side laps of roof panels shall be sealed with a non-toxic, non-drying, pressure sensitive sealant tape.

All roof and wall openings shall be structurally framed.

Gutters shall be installed using a joint sealant at all laps and ends to ensure weather tightness.

6.2.5 PAINTING

Galvanized sheets shall be prefinished with Class G90 zinc coating. The panel shall have an exterior baked on enamel finish to the Kynar 500 series or equivalent coating with a 20 year warranty.

Structural steel members, including steel joists and equipment supports shall be cleaned of all rust, loose mill scale and foreign matter and shall receive one shop coat of primer and one coat of finish paint. All finish and colors shall be approved by the COMPANY.

Doors and frames shall receive one shop applied primer coat and two coats of exterior alkyd enamel paint in a COMPANY approved color.

6.2.6 ANCHOR BOLTS

The CONTRACTOR shall supply the necessary anchor bolts together with an anchor bolt setting plan to the COMPANY. The anchor bolts shall be installed by the CONTRACTOR during the construction of the foundation. Note: If the CONTRACTOR'S anchor bolt pattern varies from those shown on the DRAWINGS, the CONTRACTOR shall redesign and submit for approval modified foundation plans as soon as possible.

All welds, field bolts and scratches or rubs in the shop coat of paint shall be cleaned and touched up in the field with the same primer and finish coat.

All necessary grouting shall be done by the CONTRACTOR. The CONTRACTOR shall supply and install all necessary shim stock.

6.2.7 DRAWINGS

The CONTRACTOR shall submit for approval, prior to construction, two sets of prints of certified shop and erection drawings.

The drawings shall show the general outline of the building, structural members, anchor bolt layout and sufficient dimensions and details so that the drawings may be used for information to incorporate equipment and fixtures in the buildings.

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 3

CONCRETE

March, 2004

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 3

CONCRETE

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SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 3

CONCRETE

Concrete materials and methods of concrete construction and testing shall conform to the respective Standards as listed in this Section.

6.3.1 REFERENCES

A. American Concrete Institute (ACI)

1. ACI Detailing Manual, SP-66
2. ACI 211.1 - Standard Practice for Selecting Proportions
3. ACI 301 - Specifications for Structural Concrete for Buildings
4. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete
5. ACI 305 - Hot Weather Concreting
6. ACI 306 - Cold Weather Concreting
7. ACI 308 - Standard Practice for Curing Concrete
8. ACI 309 - Guide for Consolidation of Concrete
9. ACI 318 - Building Code Requirements Structural Concrete (ACI 318) and Commentary (ACI 318R)

B. American Society for Testing and Materials (ASTM)

1. ASTM A 82 - Specification for Steel Wire, Plain, for Concrete Reinforcement
2. ASTM A 185 - Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
3. ASTM A 615M - Specification for Deformed and Plain Billet – Steel Bars for Concrete Reinforcement
4. ASTM A 775M - Specification for Epoxy-Coated Reinforcing Steel
5. ASTM C31 - Test Methods for Making and Curing Test Specimens in the Field
6. ASTM C33 - Specification for Concrete Aggregates
7. ASTM C39 - Test Methods for Compressive Strength for Cylindrical Concrete Specimens
8. ASTM C42 - Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
9. ASTM C94 - Specifications for Ready-Mixed Concrete
10. ASTM C143 - Test Methods for Slump of Hydraulic Cement Concrete
11. ASTM C150 - Specification for Portland Cement
12. ASTM C171 - Specification for Sheet Materials for Curing Concrete

13. ASTM C231 - Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
14. ASTM C260 - Specification for Air-Entraining Admixtures for Concrete
15. ASTM C309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete
16. ASTM C494 - Specification for Chemical Admixtures for Concrete
17. ASTM C618 - Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
18. ASTM C1012 - Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
19. ASTM C1064 – Test Methods for Temperature of Freshly-Mixed Portland Cement Concrete

C. Concrete Reinforcing Steel Institute (CRSI)

1. CRSI Manual of Standard Practice, MSP-1

6.3.2 MATERIALS

A. Cement

The cement shall be Portland Cement conforming to the current ASTM Specification C-150, Type I, II, V or as specified by the DRAWINGS or SPECIFICATIONS.

Cement shall be stored in such a manner as to prevent deterioration or contamination with foreign matter. Cement that has become caked, partially set or otherwise deteriorated, or any material which has become damaged or contaminated shall be rejected for use.

B. Fly Ash

The CONTRACTOR may elect to replace a portion of the Portland cement within the range of 15% to 25% by weight of fly ash plus cement. Fly ash shall conform to the current ASTM Specification C618, Class C or F. For sulfate exposure, the pozzolan shall be Class F, or have been tested by ASTM C1012, or determined by service record to improve sulfate resistance.

C. Fine Aggregate

Sand for concrete work shall conform to the current ASTM Specification C-33, and shall be composed of clean uncoated grains of strong material. Fine aggregate subjected to the colorimetric test for organic impurities producing a color darker than the standard shall be rejected. Aggregate with a known history or detected as having a potential reactivity with alkalies in cements shall be identified and addressed in the concrete mix design submittal.

D. Coarse Aggregate

The coarse aggregate shall be gravel, crushed gravel or crushed stone with characteristics and grading conforming to the current ASTM Specification C-33. Aggregate with a known history or detected as having a potential reactivity with alkalies in cements shall be identified and addressed in the concrete mix design submittal.

E. Water

Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, soluble chlorides, organic materials, or other deleterious substances. Potable water is acceptable.

F. Admixtures

All admixtures shall be subject to the approval of the COMPANY. Admixtures shall have no adverse effect on the properties of the concrete, either fresh or hardened. Acceptable documentary evidence shall be presented with the materials submitted for approval to include evidence that the material has been used in similar work for not less than five years under similar climatic and ground conditions.

Chemical admixtures for concrete water reducing, superplasticizing, set retarding, and set accelerating, shall be prepared and used in accordance with manufacturers' recommendations and shall conform to the current ASTM specifications C-494. Calcium chloride is prohibited.

Air entraining admixtures shall be of a common manufacturer when used in conjunction with other chemical admixtures to prevent chemical incompatibility and shall conform to the current ASTM Specification C-260.

G. Reinforcing Bars

Reinforcing steel shall conform to the requirements of the current ASTM standard A615. Reinforcing steel shall be billet steel, Grade 60, unless otherwise shown on the Drawings. All reinforcement shall be clean and free of rust, oil or other substances which may adversely affect the bond between the steel and concrete.

Welded wire fabric for concrete reinforcement shall conform to the requirements of the current ASTM standard A-185. The wire within the fabric shall be cold drawn conforming to the specifications and dimensions described in the current ASTM standard A-82.

Epoxy coating of non-prestressed reinforcement shall be to ASTM A775/A775M.

Ties for reinforcement shall be 16 gauge or heavier, cold drawn, black annealed steel wire. Epoxy-coated reinforcing bars shall be tied with plastic-coated or epoxy-coated tie wire, or other acceptable materials. Chairs, bolsters, bar supports and spacers shall be in accordance with current additions of CRSI Manual of Standard Practice MSP-1 and ACI Detailing Manual SP-66.

6.3.3 DESIGN OF MIXES

Concrete shall be composed of Portland Cement, fine aggregate, coarse aggregate and water.

The CONTRACTOR, at his expense, shall have a COMPANY approved independent testing and inspection laboratory prepare the designs of mixes for the classes of concrete specified to be used. The concrete shall be designed to provide the strength for each class of concrete as shown on the DRAWINGS and SPECIFICATIONS. Concrete mix proportions shall be selected in accordance with ACI 211.1.

Mixes shall meet the requirements of ACI 301, Section 4, for materials, proportions, products and delivery of concrete.

A. For mix designs based on field experience, include individual strength test results, standard deviation and require average compressive strength f(cr) calculations.

B. For mix designs based on trial mixtures, include trial mix proportions, test results and graphical analysis and show required average compressive strength f(cr).

The CONTRACTOR shall submit two copies of the proposed concrete mix report to the COMPANY'S PROJECT ENGINEER for approval no later than seven days before the concrete is to be placed.

If ready mixed concrete is to be used the CONTRACTOR shall place the order in accordance to the Standard Specifications for Ready Mixed Concrete ASTM Designation C-94. The CONTRACTOR shall provide information to the supplier describing the characteristics of the required concrete. This includes specified compressive strength, cement type, aggregate size, slump, air content, maximum water/cement ratio, admixtures (if any) and any other specific information required to obtain the desired mix. The CONTRACTOR shall obtain from the concrete manufacturer copies of the mix design and materials report as outlined in ASTM designation C-94, Paragraph 5.4.2 and forward it to the COMPANY'S Project Engineer.

The following tables shall be used to determine the concrete characteristics if **not** provided in the Drawings or Specifications.

CONCRETE CHARACTERISTICS			
Application	Maximum Size Coarse Aggregate	28 Day Compressive Strength (psi)	Air Entrainment Required
Building Footings	1½"	3000	No
Interior Pump/Motor Foundations, Building Floor and Walls	¾"	4000	No
Working Slab	¾"	2000	No
All Exterior Concrete	¾"	4000	Yes

6.3.4 TESTING

The COMPANY will provide the independent testing laboratory to perform slump and air content and temperature tests according to ASTM C-143, C-231 and C-1064, respectively, on each batch delivered to the job. The COMPANY will witness all tests to assure the maximums are not exceeded.

Field Acceptance of Concrete

A. Air Content

Concrete not within ±1½% of the air-entrainment indicated on the mix design and tested in accordance with ASTM Specification C-23l shall not be used in the work.

B. Slump

Concrete not within 1" of the slump limits indicated on the mix design and tested in accordance with ASTM Specification C-143 shall not be used in the work. When a plasticizing admixture is permitted to increase the slump of concrete, concrete shall meet the above requirements before the admixture is added and a maximum slump of 8" at the point of delivery after the admixture is added, unless otherwise specified.

C. Temperature

When the average temperature is expected to drop below 40°F for more than three successive days, concrete shall be delivered to meet the following **minimum** temperatures immediately after placement:

Least Dimension of Section	Minimum Temperature
Less than 12"	55°F
12" - 36"	50°F
36" - 72"	45°F
Greater than 72"	40°F

The temperature of concrete as placed shall not exceed the above minimum values by more than 30°F.

The minimum requirement may be terminated when ambient temperatures above 50°F occur during more than half of any 24-hour duration.

Unless otherwise specified or permitted, the temperature of concrete as delivered shall not exceed 90°F.

Concrete not within the above temperature limits shall not be used in the work.

The COMPANY will provide the independent testing laboratory to prepare, cure and test concrete cylinders according to ASTM C-31 and C-39.

The location and number of tests will be determined by the COMPANY.

Not less than one test for each ten cubic yards of concrete, or fraction thereof for each class of concrete placed will be required, and in any event, not less than one test for each day's placement of each class of concrete. No less than four specimens will be made for each test. They will be taken when requested by the INSPECTOR, at any time and without previous notice, and suitably numbered.

The age of the test shall be 28 days (two specimen tested) but a 7-day test (one specimen tested) will be taken to provide the relation between time of cure and the strength of concrete. One specimen from each set will be held as a spare. If requested, additional specimens will be cast for early age strength information at the expense of the CONTRACTOR.

Acceptance of Concrete Strength

A. Standard Molded and Cured Cylinders

The strength level of concrete will be considered satisfactory when the average of all sets of three consecutive compressive strength test results equal or exceed the specified compressive strength and no individual strength test result falls below the specified compressive strength by more than 500 psi.

B. Core Tests

Strength level of concrete in the area represented by core tests will be considered adequate when the average compressive strength of the cores is

equal to at least 85 percent of specified compressive strength and if no single core is less than 75 percent of the specified compressive strength, Coring and testing shall be done in accordance with ASTM Specification C-42.

Action Required When Strength or Durability is Potentially Deficient

When strength or durability of the structure is considered potentially deficient, the COMPANY may require analysis and tests as identified in ACI 301, Section 1. If the concrete is found to be acceptable the tests and analysis will be paid for by the COMPANY. If the concrete is found not to be acceptable, the concrete in question shall be removed and replaced at the expense of the CONTRACTOR.

6.3.5 FORMS

Forms shall be properly braced, tied together and shall conform to the shape, lines and dimensions of the structure as called for on the DRAWINGS. The forms shall be substantially free from surface defects and sufficiently tight to prevent bleeding. Form ties shall not be anchored to the reinforcing steel.

Forms shall be clean and free of dirt, debris and foreign matter. Any splinters, nails or other objects protruding into the concrete which are not required for support shall be removed from the form surface.

Formed volume should not exceed the volume of concrete that may be placed in one placing. If the formed volume is greater than the volume of concrete to be placed, bulkheads complete with keys in walls, footings and slabs shall be set at the point of discontinuity of the concrete placements.

Forms shall be removed in such a manner as to ensure the complete safety of the structure. Forms should be left on as long as practical, however forms may not be removed for 24 hours (minimum) after the concrete is placed. All necessary steps shall be taken to prevent injury to the concrete during the removal of the forms, and after the forms are removed.

All falsework and supporting forms shall remain in place until concrete has reached the specified compressive strength. If a lower compressive strength is proposed for form removal, submit detailed plans for review and acceptance. Tests shall be conducted to determine the adequacy of the concrete's strength, based on methods included in ACI 301, Section 2.

6.3.6 REINFORCEMENT

All reinforcement shall be placed and installed in accordance to these SPECIFICIATIONS and ACI 318.

A. Cleaning and Bending Reinforcement

Metal reinforcement, at the time the concrete is placed, shall be free from rust, mud, oil or other deleterious substances that may destroy or reduce the

bond. **All bars shall be bent cold.** Bends for stirrups and ties shall have a bending radius at least three times the diameter of the bars. Bends for straight bars shall have a radius of at least five times the diameter of the bars. Straightening or rebending shall not be allowed to an extent which will injure the reinforcement. Bars with bends or kinks not shown on the DRAWINGS shall not be used.

B. Placing Reinforcement

Metal reinforcement shall be placed in accordance with the DRAWINGS. Reinforcement shall be accurately placed and adequately secured in position by concrete or metal chairs and spacers. In no case shall the clear distance between bars be less than one inch or less than 1-1/3 times the maximum size of the coarse aggregate. When reinforcement in beams or girders is placed in two or more layers, the clear distance between layers shall not be less than one inch and the bars in the upper layers shall be placed directly above those in the bottom layers.

C. Splices in Reinforcement

Necessary splices not shown on the DRAWINGS shall be lapped sufficiently to develop the strength of the bars by bond and securely wired. Splices in adjacent bars shall be staggered. Mechanical splices capable of developing 125% of the SMYS of the bars may be used. Adjacent sheets of wire mesh shall be lapped at least six inches and securely wired. The clear distance between bars shall also apply to the clear distance between a contact splice and adjacent contact splices or bars.

D. Concrete Protection for Reinforcement

Concrete cover over the reinforcing bars shall be in accordance with the DRAWINGS. The reinforcement of footings and other principle structural members in which the concrete is deposited against the ground shall have not less than three inches of concrete between it and the ground surface. If concrete surfaces, after the removal of the forms, are to be exposed to the weather, corrosive environments, or to be in contact with the ground, the reinforcement shall be protected with not less than two inches of concrete.

The concrete protective covering for reinforcement at surfaces not exposed directly to the ground or weather shall not be less than 1-1/2"

6.3.7 MIXING CONCRETE

A. Job Mixed Concrete

The mixing of concrete shall be done in a batch mixer of a COMPANY approved type. The volume of the mixed material for each batch shall not exceed the manufacturer's rated capacity of the mixer. A certified balance scale will be used to weigh the material.

The concrete shall be mixed until there is a uniform distribution of the material and shall be discharged completely before the mixer is recharged. For job mixed concrete the mixer shall be rotated at the speed recommended by the manufacturer and mixing shall be continued for at least three minutes after all materials are in the mixer.

B. Ready Mixed Concrete

Ready Mixed Concrete shall be mixed and transported in accordance with the requirements of the Standard Specifications for Ready Mixed Concrete, ASTM Designation C-94 and ACI 304. If the concrete is transported to the site as a dry mix, precaution shall be taken to prevent the loss of cement dust during the time of transportation.

The CONTRACTOR shall provide the COMPANY approved design mix reports from the supplier. Ready mixed concrete shall be placed no later than 1-1/2 hours after it is first mixed. If it is anticipated concrete placement will require more than the specified time, the CONTRACTOR must obtain the approval of the INSPECTOR and the Project Engineer to ensure adequate provisions are made to compensate for the lengthened mixing time.

6.3.8 CONVEYING

Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the segregation or loss of the materials.

Equipment for chuting, pumping and pneumatically conveying concrete shall be of such size and design as to ensure an almost continuous flow of concrete at the delivery end without segregation of the materials.

6.3.9 PLACEMENT

Concrete shall be deposited as near as practicable to its final position to avoid segregation due to free fall, rehandling or flowing. The concrete shall not be allowed to drop freely more than four feet. The concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into spaces between the bars. No concrete that has been partially hardened or contaminated by foreign material shall be deposited on the work, nor shall retempered concrete be used. Concrete shall not be deposited during the rain unless adequately protected and, in all cases, shall be protected from rain until it has hardened sufficiently so that it will not be damaged.

Once concreting has started, it shall be carried on as a continuous operation until the placing of the section is completed in such a manner that fresh concrete will not be deposited on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. The top surface shall be generally level. When construction joints are necessary, they shall be made in accordance with the Clause 6.3.9 of this SPECIFICATION.

6.3.10 CONSOLIDATION

All concrete shall be thoroughly compacted by a suitable means during the placing, and shall be thoroughly worked around the reinforcement and embedded fixtures and into the corners of the forms. The consolidation method should be compatible with the concrete mixture, placing conditions, form intricacy and amount of reinforcing. Detailed recommendations for equipment and procedures for consolidation are given in ACI 309. Vibrators should be used to aid in the placement of the concrete and shall be used under experienced supervision. The forms shall be so designed and constructed to withstand the vibration action. Care must be taken to prevent over vibration that may result in segregation and bleeding of the concrete. Vibrators should not be used to move concrete laterally.

Manual consolidation methods are generally only used on smaller nonstructural concrete placement. A grill tamp having a face composed of parallel rectangular steel bars 3/16" wide and spaced approximately 1/4 inch apart is recommended in preference to solid faced tamp.

6.3.11 JOINTS

Construction joints not indicated on the DRAWINGS shall be made and located so as not to impair the strength of the structure. Where a joint is to be made, the surface shall be roughened, thoroughly cleaned and all laitance removed. In addition to the foregoing, joints shall be thoroughly wetted and slushed with a coat of neat cement grout immediately before placing of new concrete.

Control joints shall be located as shown on the DRAWINGS. Control joints may be made by sawcutting, placing preformed crack inducing strips, or by hand tooling plastic concrete. Control joints shall be filled with material as indicated on the DRAWINGS.

Isolation joints shall be located as shown on the DRAWINGS. Isolation joints shall be filled with the material indicated on the DRAWINGS. Alternate joint materials must be approved by the COMPANY prior to installation of the joint.

At least two hours must lapse after depositing concrete in columns or walls before depositing in beams, girders or slabs supported thereon. Beams, girders, column capitals, and haunches shall be considered as a part of floor system and shall be placed monolithically there with unless specifically indicated on the DRAWINGS.

6.3.12 CONCRETE FINISHING

Working of the concrete surfaces shall take place while it is sufficiently plastic to achieve the desired shape, planeness and specified surface finish.

A. Initial Finishing

Initial finishing operations shall be performed with a screed, immediately followed by a bull float or darby.

Screeding shall entail striking off the surface of the concrete to the specified grade using a properly designed screed or straight edge. This operation shall be done immediately after the placing, spreading and vibrating of the concrete.

The concrete shall be worked with a bull float or darby to remove high spots and ridges and to fill voids and hollows left in the surface by screeding. A darby shall be used in confined or small areas. This operation shall only slightly embed the coarse aggregate. This operation shall be done before any bleeding or free water is present on the surface of the concrete.

B. Final Finishing

The final finishing operation shall consist of edging and grooving, followed by floating and trowelling. Hand or mechanical equipment may be used for floating and trowelling.

Final finishing shall commence after the bleed water has disappeared and when the concrete has stiffened sufficiently to prevent the working of excess mortar to the surface. No additional water shall be used to facilitate the finishing.

Floating shall be carried out to further remove imperfections, embed large aggregate and prepare the surface for trowelling. When floating removes marks left by the edger or groover, these tools shall be rerun after floating.

The application of cement or other fine materials to dry up excess water on the surface is damaging to the quality of the surface and shall not be done. Excess water on the surface may be removed by allowing the water to evaporate or by using a rubber squeegee. If a squeegee is used, care must be taken not to remove any cement with the water.

Steel trowels shall be used for air entrained concrete. Two or more passes of the trowel shall be made at suitable time intervals to obtain a dense, hard, smooth surface free of blemishes.

After final finishing, curing should commence as soon as practicable in accordance with curing requirements specified herein.

1. Floors and Slabs

All slabs, pads, driveways and ramps shall be edged and finished with a light broom finish. The tops of foundations shall receive a steel trowel finish.

Adequate provisions shall be made to protect the floor from paint, plaster, drippings, dirt, oils, marring by heavy objects or by construction traffic.

If additional floor surface treatment such as painting or sealing is specified, it shall not be done until after 30 days of concrete placement. The floor should be dry and clean and the surface treatment applied in accordance with the manufacturer's recommendations.

2. Sidewalks

The finish on all sidewalks shall be obtained with a light broom finish and then all edges, marks and joints edged.

3. Foundations

All exposed concrete work shall be rubbed finished within 48 hours after removal of forms or as soon as any patching and cleaning operations have been completed. The surface to be treated shall be thoroughly wetted and a stiff mortar (equal parts of cement and sand passing a No. 16 sieve) rubbed into the surface using a No. 20 carborundum stone with considerable pressure so as to fill any voids and to remove objectionable roughness of the surface. The surface shall be allowed to set and shall be moist cured for three days. At the end of this time the finishing treatment shall be made by gentle rubbing with a carborundum stone dipped in water, to prevent gumming, until a smooth uniform textured surface is obtained. After the final surface treatment has set, moist curing shall be continued to the COMPANY'S satisfaction.

4. Rubbed Finishes

All foundations finished with grout shall have a wood float finish. The surface shall be scored and chipped for bonding and thoroughly cleaned before placing grout.

6.3.13 CURING AND PROTECTION

Freshly deposited concrete shall be protected from freezing, rain, abnormally high temperatures, premature drying and moisture loss for a period of time necessary to develop the desired properties of the concrete and in accordance with this section. Curing of concrete shall be in accordance with ACI 308 except where specified otherwise in this section.

Basic curing period for all concrete shall be either three days at a minimum temperature of 50°F or the time required to attain 70% of the specified 28-day compressive strength of concrete.

Additional curing shall often be required for concrete with increased durability, concrete meeting structural safety requirements and mass concrete. The decision

on the amount of additional curing and when it applies will be made solely by the COMPANY.

A. Curing Methods and Materials

Curing of exposed concrete shall commence as soon as the concrete has hardened sufficiently to prevent surface damage.

Curing shall be achieved using one or more of the following:

- Saturated absorptive mat or fabric;
- Ponding or continuous sprinkling;
- Moisture retaining cover or sheeting;
- Curing compound where and as approved by the COMPANY.

Curing compound shall not be used where a bond is required for additional concrete or surface coating. Materials for curing concrete shall meet the requirements of ASTM C171 or ASTM C309. Water used for curing shall be potable water.

B. Curing Under Extreme Temperatures

1. Hot Weather Curing

When air temperature is at or above 80°F curing during the basic curing period shall be accomplished by water spray or by using saturated absorptive mat or fabric in order to achieve cooling by evaporation. Mass concrete shall be cured in a likewise manner for the basic curing period when the air temperature is at or above 70° F in order to minimize the temperature rise of the concrete.

When approved by the COMPANY white pigmented curing compounds may be used in some hot weather applications. Additional information on hot weather curing in ACI Committee Report 305R shall be referred to.

2. Cold Weather Curing

Before concrete is placed, all ice, snow and frost shall be completely removed from surfaces that will be in contact with concrete. These surfaces shall be raised to a temperature above 40° F for a minimum period of 24 hours immediately prior to placing concrete. No concrete shall be placed on a frozen subgrade or one that contains frozen materials.

If the ambient temperature falls below 32° F the concrete and forms shall be adequately enclosed and heated. Concrete heating in excess of 40° F must be maintained for the entire basic curing period.

Enclosures shall be constructed to withstand wind and snow loads and shall be reasonably airtight. The housing shall provide sufficient space between the concrete and the enclosure to permit free circulation of warmed air. Heat shall be supplied to the enclosure by live stream, forced hot air, stationary heaters, or other heaters of various types. At the time of placing and during curing, concrete surfaces shall be protected by formwork or an impermeable membrane from direct exposure to combustion gases or drying from heaters. Heaters shall be vented heaters.

The type of protective cover and the amount of insulation required to cure concrete properly in cold weather shall be determined on the basis of the expected air temperature and wind velocity (wind chill factor), the size and shape of the concrete structure, and the amount of cementing material in the concrete mix.

The recommendations on protective covers and insulation contained in ACI Committee Report 306R shall be referred to.

During freezing weather, water curing of concrete shall be terminated 12 hours before the end of the protection period.

At the end of the protection period, concrete shall be cooled gradually to reduce crack-inducing differential stains between the interior and exterior of its structure. The temperature drop of the concrete surface shall not exceed the following rates during the first 24 hours after the end of the protection period:

Minimum Dimension of Section	Maximum Temperatue Drop
Less than 12"	50°F
12" - 36"	40°F
36" - 72"	30°F
Greater than 72"	20°F

6.3.14 GROUTING

A. Materials

For the pump and motor baseplate the CONTRACTOR shall supply and install a three-component, high-strength, 100% solids, epoxy grouting compound approved by the COMPANY prior to use. Typical approximate cure time of recommended grouts vary from 18 to 54 hours, dependent on temperature. The grout shall be placed strictly in accordance with the Manufacturer's recommendations. Approved grouts include: ITW Philadelphia Resins "Chockfast Red Epoxy Grout" and Carter Waters "CWC 604 Epoxy Grout."

B. Storage and Handling

Grout components shall be kept dry and protected from extreme temperatures. Storage and handling shall be done strictly in accordance with the manufacturer's recommendations and these SPECIFICATIONS.

C. Preparation

The concrete foundations shall cure a minimum of twenty-eight (28) days prior to the application of grout to assure the concrete design strength is achieved and shrinkage of the concrete foundation is negligible.

All concrete surfaces to be grouted shall be roughened to ensure a good bond between concrete and grout. The space to be occupied by the grout shall be thoroughly cleaned, including the underside of the baseplate, removing all dirt, oil, grease, laitance or loose material.

The equipment to be grouted and grouting material shall be at an ambient temperature between 65 and 90 degrees F. twenty-four (24) hours prior to application and remain constant throughout the required curing time. If necessary, the equipment shall be enclosed by a temporary shelter and heated to an acceptable temperature.

Items that must be kept clear of grouting material (i.e., leveling screws, wedges, etc.) shall be protected with caulking, plastic tape or other appropriate means.

Air vent holes shall be provided as required.

All leveling shall be completed and approved by the INSPECTOR prior to placement of grout.

All necessary steps and equipment shall be reviewed by the COMPANY prior to commencing placement of the grout.

D. Forming

Forms may be of regular lumber or other material with sufficient strength to withstand the pressure of the grout.

Forms are to be completely sealed and watertight via pliable caulking or mortar.

The CONTRACTOR shall coat all framework to be in contact with the epoxy grout with an industrial grade paste wax to ensure trouble-free release of forms. Plastic sheet is acceptable, but must be stretched tight to prevent folds and wrinkling.

Both inside and outside right angles (90°) shall be chamfered to a minimum of 1" to prevent stress concentration areas and possible cracking of the epoxy grout.

E. Mixing

The grout shall be mixed as close as practical to the equipment being grouted.

The CONTRACTOR shall strictly follow the manufacturer's mixing procedures to ensure consistent, quality pours.

F. Placement of Grout

Begin filling formwork at one end and maintain level grade as grout progresses to the other end of the form. The grout shall progressively fill voids under the equipment base, sole plate or rail in a one direction flow. Motor and pump pedestals shall also be grouted to reduce vibration.

The CONTRACTOR shall check for voids and fill voids when found as determined by the PROJECT ENGINEER.

Check forms frequently during application for leaks. Any leaks must be sealed immediately with a stiff sand and cement mortar or putty.

Formwork shall be kept in place until the grout has solidified.

During the initial cure, and for at least 30 days thereafter, the grout and grout bed temperature should not be allowed to vary more than 40 degrees F. in a 48-hour period.

G. Cementicious Grout Application

All other areas shall use a cementicious grout in accordance with manufacturing recommendations or as specified on the DRAWINGS. Grout shall be flushed with equipment with chamfered edge to a minimum of 1".

Candice Arnett

From: Thomas Hodge
Sent: Thursday, January 05, 2012 12:48 PM
To: Marc DeVarennes; Claudia Schrull; Candice Arnett
Subject: RE: Final Legal Approved - EIR Draft Line 79 Application LDW20120105.docx

I agree with Marc, can we change to one pump station and we can just remove EN from 4.0 page 57 – they had nothing to do with the preparation of the EIR

No more changes I promise and I would think we could make these without legal's review of the entire doc. Maybe only look at the two suggestions?

TDH

From: Marc DeVarennes
Sent: Thursday, January 05, 2012 12:39 PM
To: Claudia Schrull; Thomas Hodge
Subject: RE: Final Legal Approved - EIR Draft Line 79 Application LDW20120105.docx

Two things.

Page 4 – there is only one new pump station being installed at Stockbridge
Page 56 – 4.0 has a description of Barr and URS but nothing for EN

From: Claudia Schrull
Sent: Thursday, January 05, 2012 10:47 AM
To: Thomas Hodge; Marc DeVarennes
Subject: Final Legal Approved - EIR Draft Line 79 Application LDW20120105.docx

Hi Tom and Marc,

Attached is the final legal approved EIR with redlines. This document has been updated to tweak the right-of-way descriptions.

Please take a quick look.

Thank you ..cs

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 4

ELECTRICAL

March, 2004

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 4

ELECTRICAL

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SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 4

ELECTRICAL

POWER, LIGHTING, HEATING, ALARM AND CONTROL

6.4.1 GENERAL

All electrical materials and equipment shall be new and of the type and quality specified or called out on the DRAWINGS and shall be listed by Underwriters' Laboratories and bear their label where standards have been established. All equipment manuals shall be given to the INSPECTOR. All materials and equipment shall be installed in accordance with the latest edition of the National Electrical Code (NEC) and in accordance with all applicable State and local codes.

The COMPANY will be responsible for submitting the electrical contract drawings to the respective State and local authorities for approval before the start of installation work.

Installation permits and inspection fees shall be the responsibility of the CONTRACTOR.

6.4.2 HAZARDOUS AREAS

Areas are designated either Class I, Division I or Class I, Division II, or non-hazardous, as indicated on the construction set of drawings. Area classification is based upon API RP500 "Classification of Locations for Electrical Installations at Petroleum Facilities".

6.4.3 DRAWINGS AND SPECIFICATIONS

The DRAWINGS may or may not be complete as to details, but are to be considered, in conjunction with these SPECIFICATIONS, as indicative of the Scope of the Work, showing the location and general installation details of all electrical power, lighting, instrumentation, communication, and miscellaneous systems. DRAWINGS include basic layout and typical details, single line diagrams, wiring diagrams, wire, conduit, cable tray and material schedules in sufficient scope that additional engineering in the field will not be required. Electrical system layouts indicated on the DRAWINGS are generally diagrammatic and the location of outlets and equipment are approximate. Exact routing of conduits and cable tray shall conform to the location and position of equipment and structural conditions. Wiring for equipment requiring maintenance or inspection shall be readily accessible.
Before proceeding with any work, the CONTRACTOR shall carefully check and verify all location dimensions, sizes, etc., and shall be responsible for the installed location of materials and equipment particularly as to clearances and points of tie-in

to other equipment and structures. The CONTRACTOR shall maintain a complete set of DRAWINGS which shall have all field changes and deviations marked on them during construction and the exact location of all buried conduit shall be shown. This set of DRAWINGS shall be returned to the COMPANY at the completion of the CONTRACT.

The CONTRACTOR shall not deviate from the DRAWINGS or SPECIFICATIONS without the consent of the COMPANY.

If the CONTRACTOR finds any discrepancy between the DRAWINGS and/or SPECIFICATIONS and the applicable code, he shall notify the COMPANY immediately, as directed in Part 4 of the GENERAL CONDITIONS.

When materials furnished by the CONTRACTOR require shop DRAWINGS, such DRAWINGS will be checked and approved by the COMPANY to comply with construction DRAWINGS and these SPECIFICATIONS.

6.4.4 FOUNDATIONS

Special care shall be exercised to level and trowel the top of concrete foundations for transformers, switchgear, etc., to be as level and smooth as possible to avoid distortion of equipment being placed on them. Sides of all exposed foundations shall be rubbed in accordance with 6.3.12 "Concrete Finishing".

6.4.5 MATERIAL SUPPLIED BY THE CONTRACTOR

All material supplied by the CONTRACTOR shall be new and be suitable for installation in the areas outlined in Clause 6.4.2 of this Section.

6.4.6 CONDUIT

A. Delivery

All conduit shall be new and delivered to the site as received from the Manufacturer.

B. Conduit Above Grade

Shall be hot-dipped galvanized rigid steel, unless otherwise noted on the DRAWINGS. A suitable conduit thread compound shall be used and at least five full threads shall be engaged in fittings and couplings.

C. Conduit Below Grade

1. Coated

Shall be Robroy Industries "Red" or "L2 Bond", Ocal "Blue" or an equal conduit system, pre-approved by the COMPANY, consisting of galvanized rigid steel conduit with 0.040" PVC coating bonded to the conduit, and

assembled with PVC coated fittings and accessories. The conduit system shall be installed strictly in accordance with the Manufacturer's installation instructions, using all special tools specifically designed for use with plastic coated conduit. The use of standard pipe wrenches, threading dies and bending tools, etc., is prohibited since they will damage the PVC coating. Any minor damage to the surface of the conduit shall be repaired by coating the galvanized surface with Carboline Carbo Zinc SP 86 and the PVC coating with Plasti-Bond Touch Up Compound or COMPANY approved equal. If any major damage occurs, the damaged section of conduit shall be replaced. To exclude ground water, the conduit thread compound used shall be General Electric RTV Silicone Rubber Adhesive Sealant, and at least five full threads shall be engaged in fittings and couplings.

2. Wrapped

In very rare cases, where specified conduit systems cannot be acquired in time, the COMPANY may authorize the CONTRACTOR in writing to substitute wrapped galvanized conduit as follows:

This is a substitute system and written approval must first be obtained from the COMPANY to use it.

All buried conduit except conduit which is to be totally encased in concrete shall be cleaned and wrapped with one application of Polyken No. 900 plastic tape, or approved equal.

a. Handling of Materials

All tape shall be stored in a dry warehouse. Rolls shall be placed on end and not more than three tiers high. Where outdoor temperatures at time of tape application are below 32°F, tape shall be stored and conveyed to arrive at the job site at a temperature in excess of 32°F and shall be kept at this temperature until actually applied to the conduit.

b. Cleaning

The conduit shall be cleaned with wire brush or other approved means to remove all dirt, loose rust and loose scale. Tightly adhered rust scale, mill scale, or mill lacquer, may be left on the conduit. Oil or grease shall be removed by solvent washing prior to cleaning. All metal projections such as slivers, burrs, scale, etc. which would conceivably damage the coating material shall be removed by filing, or other approved means, to present a smooth surface.

c. Wrapping

The conduit shall be spirally wrapped by hand or machine with one application of plastic tape. Width of tape shall be in accordance with the Manufacturer's recommendation for the size of conduit concerned and method of application. No primer will be required. Lap of tape shall be a minimum of 1/4" and a maximum of 1/2" unless hand applied, in which case the maximum lap shall be 3/4".

d. Inspection

Visual inspection only will be undertaken to ensure that the proper lap is being maintained and the complete coverage of the conduit is achieved. No holiday detection (or jeeping) will be required on Station conduit installations.

e. Repairs

All defective or damaged wrapping shall be repaired by over-wrapping the damaged area with plastic tape. Such repairs shall be approved by the INSPECTOR before backfilling.

3. Rigid Nonmetallic (PVC) Conduit

In cases where below grade conduits are encased in concrete, PVC conduit may be used in conjunction with the coated galvanized rigid steel conduit system, **when approved by the Project Engineer**. PVC conduit may only be used for conductors 600V and less. All WORK must be done in strict accordance with the National Electric Code, Article 347 and all other applicable articles. The CONTRACTOR shall submit for approval manufacturer's product literature to the COMPANY'S PROJECT ENGINEER.

a. Transitions

All transitions between coated galvanized rigid steel conduit and PVC conduit shall be below grade within the concrete ductbank. Conduit entering or exiting the ductbank shall be coated galvanized rigid steel for a minimum distance of three feet within the ductbank before the transition to PVC. All transition fittings must be approved for such use by the manufacturers of both conduit systems. For bends exceeding 10 degrees, coated galvanized rigid steel conduit shall be used.

b. Grounding

In cases where PVC conduit is utilized, a properly sized grounding conductor shall be installed. The CONTRACTOR shall be responsible for increasing conduit size in cases where

the grounding conductor exceeds the allowed conduit fill. Galvanized rigid steel conduit runs containing PVC sections shall be grounded at both ends.

c. Ductbank Support

Inorganic, nonmetallic conduit supports approved for this specific purpose shall be used to properly support and space the conduits within the ductbank at intervals not exceeding five feet. Additionally, properly sized reinforcement rod shall be used to strengthen and support the ductbank.

D. Reaming of Ends

All conduit shall be properly reamed at the ends to remove burrs.

E. Bending

Conduit bends shall have a minimum radius of curvature of ten conduit diameters, and shall be made without kinking, wrinkling, or excessive flattening, by use of a proper conduit bending tool.

F. Conduit Runs

All exposed conduit shall be installed straight and true with reference to adjacent work. When a number of adjacent conduits run in the same direction, they shall be kept parallel, and when a change in direction is made, the bends shall be concentric.

Expansion joints shall be used in above grade straight runs of rigid steel conduit longer than 100 feet.

G. Conduit Fittings

All rigid conduit couplings, connectors, and fittings, etc., shall be of galvanized steel for mechanical strength, and not of aluminum. All EMT thin wall fittings shall be compression type.

H. Supporting of Conduit

1. In Unexcavated Areas

The conduit shall be supported at ten foot (maximum) intervals on suitable conduit support stands.

2. In Excavated Areas

The trench bottom shall be firm and graded uniformly to support the conduit evenly.

I. Cleaning of Conduit

Conduit shall be installed as a complete system. All buried conduits shall be blown dry and/or swept clean prior to pulling of any wire unless otherwise directed by the INSPECTOR.

J. Pull Wires

Polypropylene pull line with minimum tensile strength of 500 lbs. shall be provided in all unused conduits.

K. Capping of Conduits

All installed conduit shall be kept capped at both ends during construction, to prevent the entrance of dirt and water, etc. All spare conduits shall be terminated with a coupling and a recessed galvanized conduit plug, and below grade the conduit plug shall be protected against corrosion by a coating of Robroy Plasti-Bond Touch-Up Compound or approved equivalent.

L. Conduit Seals

Conduit seals shall be installed as required by the latest edition of the NEC. Seals shall only be poured after final approval by the COMPANY.

M. Conduit Sealing Compound

The sealing compound used in conduit seals shall be CHICO A (or approved equivalent) poured between dams of CHICO X (or approved equivalent) fiber rope.

N. Grounding of Conduit

All conduits terminating at a switchgear cubicle, or a control building, shall be fitted with grounding bushings and bonded to the ground bus of the station.

O. Identification of Conduits

All conduits shall be identified at both ends with stamped brass identification tags attached to the conduit using stainless steel strapping or wire.

P. Flexible Conduit

On outdoor installations, flexible conduit shall be installed horizontally between all field devices and buried conduit such that the buried conduit and the field device will be free to move relative to one another, and thus

accommodate movement due to settling or frost action. Flexible conduit shall never be longer than six feet. Crouse Hinds ECG couplings or equal shall be used in all hazardous locations.

Q. Drilling Holes in Concrete and Masonry

When conduit or cables are to be extended through existing concrete or masonry structures, the holes must be made neatly with a rotary diamond drill, and not with an impact type of drill.

R. Warning Tape

Warning tape shall be installed six inches below grade above all buried conduit.

6.4.7 BACKFILLING

Special care shall be taken in lowering in and backfilling to avoid damage to the PVC coating. Rocks or hard clay lumps shall be removed from the ditch and backfilling shall be accomplished in such a manner as to avoid direct impingement by rocks or hard lumps on the coated conduit. The backfilling shall be completed in compacted layers in accordance with Part 6, Section 1 of the Specifications for Construction, and no backfilling shall be done without approval of the COMPANY. All DRAWINGS showing conduits shall be properly updated (as-built) prior to backfilling.

6.4.8 CONDUIT BOXES

Most conduit boxes are explosion proof, but when sheet metal terminal boxes, pull boxes, gutter or splitter boxes, etc., are specified on the DRAWINGS for outdoor service, they shall be weatherproof construction approved by the COMPANY.

If possible, all conduits shall enter the underside of the box, to reduce the entrance of rain and snow, and all conduit fittings at the box shall be weatherproof.

All unused taps in condulets, fittings, etc. shall be equipped with recessed head galvanized conduit plugs.

6.4.9 LOCATION OF PULL BOXES

The CONTRACTOR shall install sufficient pull boxes to facilitate the pulling of wire and cable or to allow for additional bends in a conduit run per the National Electric Code. Location of pull boxes shall be approved by the COMPANY. In long runs of conduit, the distance between pull boxes shall not exceed 200 feet unless approved by the COMPANY and shall be based on acceptable cable pull tension calculations.

6.4.10 BREATHERS AND DRAINS

Breathers and drain fittings shall be installed in condulets and junction boxes as specified by the COMPANY'S PROJECT ENGINEER.

6.4.11 DUCTBANKS

All ductbanks shall be constructed in accordance with the most recent applicable National Electrical Code requirements.

The conduit in the ductbank shall be equally spaced and supported at intervals of not more than five feet by inorganic non-metallic spacers.

Where concrete is used to encase conduit placed in trenches, forms of polyethylene sheeting must be used to prevent the concrete from contacting the soil until after it has set. The concrete shall have a minimum strength of 2500 PSI and shall be dyed red either prior to its placement or by trowelling on appropriate red die on the top of the concrete ductbank.

6.4.12 CABLE TRAY

A. Cable Tray Design

1. Cable tray systems shall be made of straight sections, fittings and accessories as defined in the latest NEMA standards publication VE-1. Standard cable trays shall be UL classified as equipment grounding conductors. The cable tray system shall be installed in accordance with the National Electric Code Article 318 and all other applicable articles.

2. Cable Tray Fabrication

   Straight section and fitting sidewalls and rungs shall be made from aluminum or steel meeting the minimum mechanical properties of ASTM A570, Grade 33, 14 gauge. Steel tray shall be hot dip galvanized after fabrication in accordance with ASTM A123.

3. Tray Type

   a. Ladder

      Ladder type trays shall consist of two longitudinal members (siderails) with transverse members (rungs) welded to the siderails. Rungs shall be spaced a maximum of 9" on center. Rung spacing in radiused fittings shall be a maximum of 9" on center measured at the center of the tray's width. Rungs shall have a minimum cable bearing surface of 3/4" with radiused edges. No portion of the rungs shall protrude below the bottom plane of the siderails.

4. Tray Size

a. Height

Trays shall have an overall siderail height of 6" with a minimum loading depth of 4".

b. Width

Widths shall be 12", 18", 24", 30", 36" & 42".

c. Length

Straight section siderails shall be of I-Beam design with a rung retaining weld bead. All straight sections shall be supplied in standard lengths of 144" (12 ft.).

d. Fitting Radius

Fitting radius shall be 12". Siderails of straight sections and fittings shall be compatible so that standard splice plates can be used to join straight sections and fittings. Fittings shall have 3" tangents beyond the curved section to accommodate the standard splice plates.

5. Splice Plates, Cover and Accessories

a. Splice plates shall be manufactured from high-strength material, using ribbed neck carriage bolts and serrated flange locknuts. The resistance to fixed splice connections between an adjacent section of tray shall not exceed .00033 ohm. Splice plates shall be furnished with straight sections and fittings and shall be included in unit prices.

b. Covers and other special accessories shall be furnished as required to protect, support and install a cable tray system.

6. Load Capacity

Cable tray load capacity shall be at least 70 lb/ft. (This value includes 30 lbs/ft for cable, 1/2" ice load, 100 mph wind load and 1.5 safety factor.)

7. Manufacture

Cable tray shall be made to manufacturing tolerances as specified by NEMA (see NEMA VE1). Cable trays shall be manufactured by B-Line Systems, Inc. (or equivalent system approved by the COMPANY).

6.4.13 WIRE AND CABLE

A. Delivery

All wire and cable shall be new and delivered to the site as received from the Manufacturer.

B. Size and Type

The type of cable will be as specified below and the size will be as specified in the Cable and Conduit Schedule as found on the Drawings. All wire shall be stranded for flexibility, except as otherwise noted.

1. Cable Specifications

a. 5KV Power Cable

Cable shall be single conductor, UL listed type MV-90, Class B stranded, annealed copper with copper tape shield. Insulation shall be XLPE or EPR with prior COMPANY approval. Overall jacket shall be PVC, rated -10°C installation, -40°C cold bend, -55°C static minimum, 90°C normal. With prior COMPANY approval, unshielded cable may be used if the installation is above ground and in a dry raceway or conduit.

b. 600V, Multiconductor Cable

Shall be Class B, concentric stranded, annealed or soft copper. Insulation shall be XLPE type XHHW, or THHW upon written approval, 90°C dry, 75°C wet locations. Overall jacket shall be PVC, rated -10°C installation, -40°C cold bend, -55°C static minimum, 90°C normal. Color coding shall be solid through to conductor by method 1A with tracing spiraled around conductor.

c. 600V, Single Conductor

Shall be Class B stranded annealed copper. Insulation jacket shall be XLPE type XHHW, or THHW upon written approval, 90°C dry, 75°C wet locations, rated -10°C installation, -40°C cold bend, -55°C static minimum, 90°C normal. Color coding shall be black for phase conductors, white for neutrals and green for ground. Color coding within existing equipment, such as switchgear and control panels, shall match that of the existing wire.

d. Ground Grid Conductors

Shall be single conductor, Class B stranded annealed copper. Insulation shall be 600V, XHHW, or THHW upon written approval. Overall jacket shall be green PVC, rated -10°C installation, -40°C cold bend, -55°C static minimum, 90°C normal. Non-insulated conductors shall be used within the confines of the substation.

e. Instrument Cables

Shall be twisted short lay seven strand copper wire. Insulation shall be 600V, XLPE type XHHW, or THHW upon written approval. Shield shall be aluminum mylar with overall drain wire of seven strand tinned copper. Outer jacket shall be FR-PVC, rated -10°C installation, -40°C cold bend, -55°C static minimum, 90°C normal. Color coding shall be:2C-Black/White 3C-Black/White/Red.

f. Communication Cables

Shall be co-axial, twin axial 600V, tinned solid copper (coaxial) or tinned stranded copper (twin axial). Conductor insulation shall be PVC, polyethylene or polypropylene in accordance with specific application requirement. Shielding for coaxial shall be tinned copper braid, and for twin axial, folded aluminum mylar. Ground drain shall be stranded tinned copper. Jacket shall be gray PVC flame test rated.

g. Multi-Conductor Teck Cable (5KV)

All 5KV multi-conductor cable shall be UL listed 5KV rated three conductor type Teck 90 rated for -40C or MV 90 with PVC jacket under armor, marked CT for cable tray use. Conductors shall be Class B, stranded soft copper. Inner jacket shall be high temperature and moisture resisting PVC. Armor shall be flexible interlocking galvanized steel. Aluminum armor may be used with prior COMPANY approval. Outer jacket shall be PVC, ozone and ultraviolet light resistant, fire retardant and acid gas limited.

Insulation shall be XLPE crosslinked polyethylene, average thickness shall be 90 mils. Minimum thickness at any point shall be not less that 90% of the specified average thickness.

Insulated phase conductors shall be identified and cabled together with a class B concentric or compressed stranded uncoated copper grounding conductor and suitable non-hygroscopic fillers to make round. Length of lay shall not

exceed 35 times the phase conductor diameter. A non-hygroscopic cable tape shall be applied over the assembly.

h. Multi-Conductor Teck Cable (600 Volt & Below)

All 600V multi-conductor cable shall be UL listed Tech 90 rated for -40C or MV90 with PVC jacket under armor marked CT for cable tray use. Conductors shall be class B stranded annealed copper. Cable shall be rated 600V. Inner jacket shall be high temperature and moisture resisting PVC. Armor shall be flexible interlocking aluminum. Outer jacket shall be PVC, ozone and ultraviolet light resistant, fire retardant and acid limited.

Insulation shall be XLPE cross-linked polyethylene, average thickness of insulation shall be 30 mils, minimum thickness at any point shall be not less than 90% of the specified average thickness.

Conductors shall be colored: black/white (2/C); black, red, blue (3/C); black, red, blue, white (4/C). Cable with more than four (4) conductors shall have circuit identification consisting of printed numbers.

Insulated circuit conductors shall be cabled together with a stranded uncoated copper grounding conductor and non-hygroscopic fillers where necessary.

Cables shall be surface ink printed with a legend identifying the manufacturer, number of conductors, size and voltage rating.

i. Cable Terminators

(1) Scope

Cable terminators shall be "per fit" or approved equal explosion proof connectors, UL listed Class I, Division 1, Group A, B, C & D, Class II, Division 2, Groups E, F & G.

(2) Features

Cable terminators shall feature the following:

(a) Built-in sealing chamber
(b) Sealing compound extruder from inside out
(c) No voids in seal
(d) Seal completely encapsulates cable core

(e) Built in coupling for disconnect and reconnect without affecting seal integrity

(f) Use of copper free aluminum and/or nickel-plated brass

(g) Effective ground connection to armor

(h) Substation cable termination kits shall be Raychem CBR-Plugs for blocking and sealing unused legs of breakouts. Catalog Number CBR-6-1-A for phase cables and ground cables. Hy Pres NEMA two-hole lugs, 500 MCM, shall be used to terminate cable on copper pad, with ½" Duran brass bolts. Lugs shall be insulated with heavy wall Type HS-H-PF, flame retardant heat shrink tubing made of cross linked thermally stabilized polyolefin. Shrink ratio to be 3:1, with inside diameter coated with adhesive sealant. Operating temperatures from -55°C to 135°. Shrink temperature of 120°C.

j. Cable Approval

After the contract has been awarded, the CONTRACTOR shall submit for approval samples of each of the cables to be installed along with the cable manufacturer's description, catalogue number and specification.

k. Fiber Optic Cable

Fiber optic cable shall be four fiber count, 67.5/125 with tight bending radius, loose buffer, indoor/outdoor, -30 degree F operating temperature, PVC jacket. Cable to have pull wire within cable jacket. Connectors shall be "ST" type. The CONTRACTOR shall obtain approval of the manufacturer from the PROJECT ENGINEER before ordering.

C. Procurement

The CONTRACTOR shall supply all wire and cable, except for any wire and cable listed in the materials to be supplied by the COMPANY, as specified in Part 5, Clause 5.5 of the SPECIFIC CONDITIONS. The CONTRACTOR shall order all the necessary wire and cable as early as possible, to ensure delivery to meet the Construction Schedule. Copies of purchase orders, requisitions or other verification of material order dates and anticipated delivery dates shall be provided by the CONTRACTOR if requested by the COMPANY.

D. Shielding

Except where specifically stated otherwise for short runs of cable, all power cable operating at circuit voltages above 2,000 Volts phase to phase shall be shielded cable.

E. Stress Cones

All shielded power cables shall be terminated at both ends with stress cones, installed strictly in accordance with the recommendations of the cable manufacturer. The cable shielding shall be grounded at the power source end only of each cable. In general, stress cones shall be preformed type, Elasti-Mold, 3M system, or approved equivalent.

F. Lubricant

No lubricant other than Ideal Yellow 77, or approved equivalent shall be used to facilitate pulling cables into conduit. All conductors shall be kept clean and free of mud, sand and other contamination, at all times. Care shall be taken when pulling in conductors to prevent damage to the insulation.

G. Pulling of Cable

The pulling of cable into conduit, raceways or ducts, etc., shall be accomplished either by hand or by means of a cable-pulling winch, with the tension strictly controlled to suit the particular cable being installed. The use of a vehicle or crane to pull cable is prohibited. Care shall be taken when pulling conductors to avoid stretching the cable or damaging the insulation. On cable runs exceeding 200 feet, pulling tension calculations shall be submitted to the PROJECT ENGINEER for review. Pulling of cable shall not proceed without COMPANY authorization.

H. Terminals

1. Power Cable (4.16 kV, 480 V, 120/240 V & 48 V Circuits)

All terminals shall be good quality clamp type, or compression type connectors as shown on the DRAWINGS or approved by the Project Engineer. All terminations, 2.4kV and above, will be taped by the CONTRACTOR to equal the insulation rating of the associated cable.

2. Control Cable

A conductor terminating at a current transformer or under the head of a machine screw terminal shall be fitted with a compression type eyelet lug. A conductor terminating at a tubular screw, tubular clamp, or strap clamp type terminal, etc. will not require a terminal lug. The use of soldered connections will be confined to No. 19 AWG wire, or

smaller, when connecting to devices specifically designed for soldered connections.

I. Joints and Splices

1. 4.16 kV Cable

No joints or splices of any kind are permitted.

2. Other Wire and Cable

Whenever feasible, all conductors shall be pulled through the conduit system without splicing, but when splices are unavoidable, they shall be made in junction boxes of adequate size. All connections and splices in junction boxes shall be made by means of terminal strips, or by good quality clamp type or compression connectors. If no terminal strip is provided, connections to small field devices with wire leads shall be made with Marr or Marrette type connectors, so that the field device can be disconnected easily for servicing.

In all cases, color coding shall be carried correctly through the splices.

J. Identification Code

Multi-conductor cables shall be ordered with the individual conductors identified by means of a color code or other approved method of marking. In those cases where a dual color is used, the secondary color is to be spiraled the full length of the wire.

K. Markers

All cables and individual conductors shall be identified at both ends with markers bearing the number assigned to both the cable and conductor. Ends of conductors shall be marked with the terminal numbers from both ends, unless they are identical. Markers shall be typewritten, adhesive, wrap-around markers or approved equivalent. Labeling of wiring at terminal blocks shall be the same as the terminal block identification unless otherwise noted on the DRAWINGS.

L. Lacing

All control wiring shall be bundled neatly, and fastened securely with proper cable straps. Particular attention shall be paid to wiring in manholes, cable trays, floor trenches, panels, switchgear, and motor control centers, etc. to keep all wiring neat and tidy. Multiconductor cables shall be stripped back to their entry point into enclosures. A minimum of ten feet of the spare conductors shall be neatly coiled at the bottom of enclosures.

M. Fire Stops

Where fire stops are required in cable runs a seal shall be poured using Dow Corning 3-6548 Silicone RTV Foam or approved equivalent.

N. Shielded Instrumentation Cable

Where shielded cables are not shown with the shield grounded, the shield shall be insulated by taping in order to prevent inadvertent grounding. Shields in terminal boxes shall be maintained and continued on separate terminals.

6.4.14 HEATING CABLE

The pipe shall be thoroughly cleaned to remove all scale, oil, grease, etc. prior to the installation of heating cable and insulation.

Heating cable shall be handled carefully, and not kinked or damaged. Thermostats that are not calibrated must be checked with a thermometer in warm water, to ensure that the thermostat will operate at 50°F before installation. Each installation of heating cable and thermostat must be inspected and approved by the COMPANY both before and after taping. Heating cables shall be secured to the piping every six inches. On horizontal runs, heating cable shall be positioned on the bottom of the pipe.

6.4.15 GROUNDING

To assist cathodic protection at the station, no copper conductors in the grounding system shall be in direct contact with the soil, except within the confines of the substation.

A. Ground Rods

All ground rods shall be of galvanized steel.

B. Conductors

All buried conductors shall be 600 Volt THWN insulated cable, except within the confines of the substation.

C. Connections

All underground connections shall be made by cadwelding. All buried connections shall be insulated with 1/2 lapped plastic tape. Test station connections shall be made by mechanical lugs.

6.4.16 SWITCHGEAR BUILDINGS

Switchgear building must be kept clean and is not to be used by the CONTRACTOR for material storage or as a change room or a lunchroom, etc.

6.4.17 IDENTIFICATION OF EQUIPMENT

All junction boxes, terminal boxes, starters, motors, valve actuators, etc. shall be identified by tagging as called for on the DRAWINGS.

6.4.18 BOOSTER PUMPS AND MAIN LINE PUMPING UNITS

The CONTRACTOR shall install all accessories on the pump unit, such as flood-oil lubricating systems (where used), vibration detectors, etc. and connect the required power and control cables to the unit.

The COMPANY will supply and install all lubricating oils and greases required in the unit.

6.4.19 INSPECTION AND COMMISSIONING

A. Wiring

The CONTRACTOR shall test all wiring for continuity and for short circuits and insulation resistance, using instruments suitable for the particular voltage level of the system concerned. Care must be exercised to use a low voltage ohmmeter on instrument circuits such as resistance temperature detectors (RTD's) to avoid damaging them.

B. Energization

No equipment shall be energized without approval of the COMPANY'S Electrical Maintenance Personnel.

C. Grounding System

The COMPANY will measure the resistance to ground, which shall not be greater than 4 ohms.

D. 4.16 kV Cables

The CONTRACTOR shall conduct high potential D.C. tests on the 4.16 kV power cables under the direct supervision of COMPANY personnel and in accordance with COMPANY test procedures. All test results will be forwarded to the COMPANY'S PROJECT ENGINEER for analysis and distribution.

E. Metal-Clad Switchgear

Will be commissioned by the COMPANY.

F. Motor Control Center

Will be commissioned by the COMPANY.

G. D.C. Power Supply

Will be commissioned by the COMPANY.

H. Instrument Systems

Will be commissioned by the COMPANY.

I. Control, Instrumentation and Alarm System

Will be commissioned by the COMPANY.

J. Computer

Will be commissioned by the COMPANY.

K. Lubricating Oil Unit Systems

The COMPANY will flush out the lubricating oil system, install the lubricating oil, and commission the system.

L. Valve Actuators

Will be commissioned by the COMPANY. **Electric actuators are generally shipped without lubricant and hence must not be operated, even manually**, until COMPANY maintenance personnel have installed special low temperature lubricants.

M. Couplings

The COMPANY will measure the run out of the motor and pump shafts, check the alignment of the coupling, and determine the direction of rotation of the motor before the motor is connected to the pump. The axial position of the motor rotor will also be checked to ensure that there can be no axial thrust on the motor bearing shoulders.

N. Certificate of Approval

Upon completion of the work, the CONTRACTOR shall provide the COMPANY with a Certificate of Approval from the Electrical Inspection Authority having jurisdiction in the area. Final acceptance will not be given until such Certificate has been received.

SPECIFICATIONS FOR CONSTRUCTION

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PIPING AND MECHANICAL

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PIPING AND MECHANICAL

GENERAL

6.5.1 GENERAL

Piping materials, fabrication, installation, inspection and testing shall comply with the U.S. Department of Transportation 49 CFR Part 195 - Transportation of Hazardous Liquids by Pipeline, along with the appropriate reference standards contained within and shall also conform to ASME B31.4, Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids. Any WORK performed that does not conform to the above codes and regulations shall be corrected at the CONTRACTOR'S expense.

The term "piping" as used herein, includes the pipe itself, valves, fittings, flanges, gaskets, bolting, piping components, gauge and other instrument connections, vents, drains and the pipe support system. For instrument connections, piping includes the branch up to and including the first block valve. "Station Piping" applies to all pressure piping, valves, fittings, and auxiliary components used within Station boundaries.

6.5.2 CODES AND STANDARDS

The latest approved edition of the following codes and standards are applicable to all WORK covered by this section of the SPECIFICATIONS:

No.	Description
USDOT 49 CFR Part 195	Transportation of Hazardous Liquids by Pipeline
ASME B31.4	Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids
API 1104	Welding of Pipelines and Related Facilities

In some instances the latest approved edition of a code or standard may not be adopted immediately by the U.S. Department of Transportation. The Specific Conditions of this Specification will identify these codes and, if necessary, provide clarification and direction on the code in which the CONTRACTOR shall comply.

6.5.3 MATERIALS

In general, the COMPANY will supply all piping material in sizes above NPS6; material in sizes NPS6 and below shall be supplied by the CONTRACTOR. Exceptions to this general rule will be highlighted in the DRAWINGS or in the Specific Conditions.

Materials to be supplied by the CONTRACTOR will be specified on the DRAWINGS and/or in the "Specific Conditions" of these SPECIFICATIONS. Where the DRAWINGS do not contain sufficient detail the CONTRACTOR shall make reference to Part 6 - "Piping Classes". All piping materials supplied by the CONTRACTOR shall be new, unused and undamaged and shall conform to requirements of the DRAWINGS and Part 6. Where materials are proposed by the CONTRACTOR as being equal to those specified, prior written approval must be obtained from the COMPANY before they are incorporated into the WORK. The CONTRACTOR shall furnish the COMPANY with copies of certified mill test reports on all CONTRACTOR supplied pipe, fittings, flanges and valves. These shall be forwarded within two weeks of the materials being delivered to the job site and prior to being incorporated into the WORK.

6.5.4 WELDING

A. General Requirements

1. Types and Methods of Welding

Welding processes shall be selected and procedures shall be prepared in accordance with the latest approved edition of API 1104 and these SPECIFICATIONS.

Welding procedures shall be such that the completed welding will satisfy all design requirements. Consideration will be given to welding heat input, consumable selection, preheat and interpass temperatures, and when necessary, to post-weld heat treatments.

Where the wall thickness difference between adjoining pieces of pipe exceeds 3/32", the CONTRACTOR shall install a transition piece as directed by the COMPANY.

2. Welding Equipment

All welding equipment used in connection with the WORK shall be satisfactory to the COMPANY and kept in good mechanical order so as to produce sound welds in a safe manner. Any equipment or supplies not satisfactory to the INSPECTOR shall be replaced to the satisfaction of the INSPECTOR, all at no additional expense to the COMPANY.

Welding machines shall have a minimum NEMA rating of 200 Amps, 30 Volts, 60% duty cycle. Welding machines shall have adequate controls to obtain output adjustments of all SMAW requirements and shall be maintained such that full rated output is achievable at all times. Sufficient portable or permanent meters shall be provided to read voltage and amperage during welding work.

Welding cables shall be of sufficient capacity and condition that voltage drop in full cable length does not exceed 10%. Splices in welding cable shall be made in a skilled manner that assures a secure connection that will not heat up while in service. Electrode holders and electrodes shall not be placed in water for cooling purposes. Ground attachment devices shall be

of such design as to firmly grip the pipe and not arc, having as large a contact area as practical. Arc strikes on pipe as a result of poor grounding shall be considered equal in severity to welding rod arc strikes, and shall be repaired by the CONTRACTOR in a similar manner.

3. Electrode Storage and Handling

When required, the CONTRACTOR shall supply controlled low hydrogen welding electrodes in undamaged, hermetically sealed containers and shall store them so as to avoid moisture contamination. Once the seal has been broken, the materials shall be stored in cabinets or ovens designed for the purpose and shall be continuously maintained at holding temperatures recommended by the manufacturers.

Any electrode that has been out of the original container or the heated oven for more than the time recommended by the manufacturer shall be discarded or reconditioned to the satisfaction of the INSPECTOR. Electrodes shall not be reconditioned more than once. Electrodes that have become noticeably wet shall not be reconditioned and shall be removed from the job.

4. Welding During Inclement Weather

Welding shall not be done when the quality of completed welds would be impaired by prevailing weather conditions including but not limited to: cold, airborne moisture, blowing sand or high winds. The CONTRACTOR shall provide wind breaks of a type that will give adequate protection to the welder and the weld when, in the judgement of the INSPECTOR, such equipment is required due to weather conditions. This equipment shall be provided at no additional expense to the COMPANY.

B. Welding Procedures

The qualification of production and repair welding procedures shall be performed concurrently.

The COMPANY will supply all Welding Procedure Specifications necessary to complete the WORK. Alternative procedures submitted by the CONTRACTOR, which satisfy the design requirements and these Specifications, will be considered for approval by the COMPANY. Alternative procedures must be submitted allowing two weeks time for the COMPANY to review without affecting the project schedule.

C. Qualification of Welders

Each welder employed by the CONTRACTOR shall be required to pass welder qualification tests using the approved qualified welding procedures. The acceptance criteria shall be in accordance with API 1104. The COMPANY may, at its discretion, require some or all of the welders to perform a multiple qualification test per the requirements of API 1104, regardless of the type of production weld to be produced.

The COMPANY will supply the pipe material and an INSPECTOR, and the CONTRACTOR shall provide welders, equipment and consumable materials for the performance of welder qualification tests. All welder qualification costs shall be borne by the CONTRACTOR, including all destructive or third party non-destructive testing.

If a welder fails to produce an acceptable qualification weld, a second qualification test may not be taken unless approval is granted by the COMPANY. A multiple qualification test may not be taken twice, however a welder who fails a multiple qualification test may subsequently take a single qualification test. In the event that a welder passes one portion of the multiple qualification test but fails the other, the passing portion of the test may be used as an acceptable single qualification. The INSPECTOR shall have final determination of the acceptability of a test weld and may disqualify a welder regardless of whether the weld meets the criteria of API 1104.

If the COMPANY questions the competency of a qualified welder, the COMPANY may require that the welder be re-tested at any time, at no additional cost.

D. Standards of Acceptability

The COMPANY shall employ such means as it considers necessary to inspect all welds to ensure pipeline integrity. The standards of acceptability are minimum requirements on welding workmanship, and shall meet the standards of acceptability as set out in API 1104. Unless otherwise stated in the Specific Conditions, the COMPANY will employ a third party nondestructive testing firm to test the welds radiographically or by other appropriate means. The CONTRACTOR shall co-operate fully with the crew(s) carrying out the inspection work. The CONTRACTOR shall also render his co-operation with the radiographic INSPECTOR in regard to informing and educating his welders in their craft. In any code interpretation disputes regarding welding defects, the INSPECTOR shall have final determination of the acceptability of a weld.

If the COMPANY employs the cut-out method of examination of welds, the COMPANY may, in the judgement of its INSPECTOR, cut-out and test any welds designated by him. Should such cut-out welds pass the requirements of API 1104 and these Specifications, the cost of the cutting out and subsequent tie-in will be borne by the COMPANY at the applicable rate set forth in the Bid Form. The cost of cutting out and replacing any welds that fail the tests shall be borne by the CONTRACTOR.

E. Construction Practices

1. General

It shall be the CONTRACTOR'S responsibility to see that all welding debris is collected as the WORK progresses and that it is disposed of at the end of each day.

No tack welds shall be permitted when using external line-up clamps until preheating requirements (if applicable) are met.

The start of all weld passes shall overlap and no pass shall start closer than 2 inches from the start of the preceding pass. No weld passes shall start or stop at the longitudinal seam.

2. Swabbing and Cleaning

Each joint of pipe shall be internally swabbed, by methods approved by the COMPANY, to remove all foreign material from the entire joint length prior to placing the joint in alignment for welding.

Preparatory to aligning pipe for welding, the bevelled ends of each joint shall be thoroughly cleaned of paint, rust, mill scale, dirt or any other foreign material detrimental to the quality of the welds. Any satisfactory method approved by the COMPANY may be used for this cleaning operation.

3. Cleaning of Welds

Each bead shall be thoroughly cleaned of scale, dirt, and slag by grinding or wire brushing prior to the application of succeeding beads. All slag shall be removed from the completed welds.

4. Weld Reinforcement Dressing

When files are used for cleaning up the final or "cap" pass, the metal adjacent to the weld shall not be grooved below the pipe surface. Should this occur, the CONTRACTOR shall cut out the defective weld or make a repair at the option of the COMPANY.

5. Identification of Welds

The work of each welder shall be identified according to a number assigned by the CONTRACTOR. Identification of welds shall be by a non-erasable crayon or paint-type pencil approved by the COMPANY. Should any welder leave the job, the number shall not be duplicated on the job. Steel dies shall not be used for identification purposes.

F. Repair or Removal of Field Joint Defects

1. Repair Welding Procedures

At the option of and under the supervision of the INSPECTOR welds may be repaired by chipping, grinding or gouging to sound metal and re-welding. Such repaired areas shall be re-inspected at the CONTRACTOR'S expense. No further repairs shall be allowed in previously repaired areas.

All costs associated with welding repairs, including inspection costs, shall be borne by the CONTRACTOR.

The accumulated length of weld repairs shall not exceed 25% of the total length of the girth weld.

When welding piping together at places where cut-outs have been made for any reason, one replacement weld will be used if it is practical to pull the piping back into position; otherwise two welds will be made by fitting in a "pup joint" which shall have a minimum length of one pipe diameter or 24" for pipe of 24" and larger nominal pipe diameter. Pups less than four feet in length shall be gathered up and deposited at the COMPANY'S nearest storage area.

2. Mechanical Defects and Arc Strikes

No welding repairs are to be made of gouges, scratches, or other defects in the parent metal of the pipe. Repairs may be made by grinding, provided the finished ground area does not reduce the wall thickness at any point to a thickness less than the minimum thickness required for the design pressure of the pipeline. Areas that are proven to be defective after grinding shall be removed as a cylinder.

6.5.5 FABRICATION AND INSTALLATION

A. General

The fabrication and installation of all piping shall conform to DOT 195 and the reference standards named therein.

Where an item or activity is not covered by DOT 195, it shall be completed in accordance with ASME B31.4.

The CONTRACTOR shall insure that all piping and associated flanges and fittings is fully traceable. The CONTRACTOR shall transfer heat numbers from the inside to the outside of the pipe and to all pipe pieces that have been cut off of the original joint. Any pipe installed in the system without the heat number clearly marked and readily identifiable on the outside of the pipe shall be removed and replaced at the CONTRACTOR'S expense. Heat numbers are to be transferred to CONTRACTOR as-built drawings.

B. Storage and Handling

Pipe and fittings moved mechanically shall be handled using only wide canvas, leather or rubber padded slings. Use of bare cables, chains, hooks, pipe clamps or other similar equipment is not allowed.

The CONTRACTOR shall work closely with the INSPECTOR when receiving material provided by the COMPANY. A detailed list of material received shall be kept by the INSPECTOR and signed by a CONTRACTOR'S Representative whenever a material transfer of possession takes place. The CONTRACTOR shall not take possession of any material supplied by the COMPANY without the INSPECTOR'S prior approval. Material received by the CONTRACTOR, either on

site or from a warehouse, shall be considered in good condition. Any damaged material discovered after the CONTRACTOR has taken possession shall be replaced immediately at the CONTRACTOR'S expense.

All piping shall be kept free of dirt and other foreign matter while storing, handling, fabricating or erecting; while in storage, materials shall be kept off the ground in a neat and orderly fashion on sleepers, on racks or in bins. Flange faces, open ends, and pipe threads shall be protected prior to, during, and after erection. The CONTRACTOR shall replace flanges with damaged faces.

Just prior to installation, a visual inspection of the piping will be made by the COMPANY to ensure that it is clean, dry and free of foreign matter.

C. Pipe Fabrication

Pipe shall be cut squarely followed by reaming, burring and cleaning before installation. Pipe runs shall be straight and true.

When the CONTRACTOR is to pre-fabricate piping, he shall consider the location of field welds. It is the CONTRACTOR'S responsibility to check existing facilities and its own work to verify location, elevations, etc. to ensure that adequate field fit allowance. For all piping, it is the CONTRACTOR'S responsibility to field check all elevations and dimensions to ensure correct fit-up of the piping and equipment.

Bolt holes of all flanges shall be "two-holed" in accordance with good construction and trade practices.

Flanged piping connections to equipment shall be aligned and properly fitted before welding and bolting up. Heating of vessels or nozzles on vessels or equipment will not be permitted. Extreme care shall be taken to avoid damage. Where pipe is connected to rotating equipment, the equipment shall be aligned prior to the connection of piping. The piping shall then be connected and the equipment alignment rechecked. Should the equipment no longer be in alignment, the piping shall be refabricated as required and the equipment alignment and piping connection procedure repeated. When possible, the COMPANY will provide a technician to monitor equipment alignment as the bolting procedure progresses.

"Cold springing" of piping shall only be performed when shown on the DRAWINGS. No "cold springing" shall be done except when the COMPANY has given specific approval prior to the WORK. In general, "cold springing" will not be approved on any line larger than 2" nominal diameter.

For stub-ins, the hole cut for the branch shall have the bore the full size of the branch inner diameter.

Nipples for connections on insulated piping shall have enough length so as to extend beyond insulation by a minimum of 1.5".

D. Pipe Erection

Where the CONTRACTOR is completing piping left by OTHERS, the cutting off of weld caps and removing of blind flanges, etc. (except double faced blinds) shall be the responsibility of the CONTRACTOR at no extra cost to the COMPANY. Before sealing open ends of any shop fabricated piping, the pipe shall be cleaned. All pre-fabricated piping must be delivered to site with ends sealed. Open ends of installed pipe shall be sealed at the end of each day.

The inside diameters of piping components shall be aligned accurately within existing tolerances in accordance with ASME B31.4 with respect to diameters, wall thickness, and out-of-roundness. The COMPANY must be notified within 48 hours of receipt of materials if materials exceed the dimensional tolerances stated in the materials specification.

Longitudinally welded pipe greater than or equal to 16" in diameter shall be aligned so that the seam will be located on the upper surface of the line within one foot of the vertical. Successive joints of pipe shall be rotated to left or right by not less than eight inches to prevent the aligning of weld seams in adjacent pipe sections. Longitudinal seams on pipe bends shall be located approximately 90° from the inside and outside of the bend.

Seal welding of threaded connections is NOT Permitted. *(Rev1)*

For flanged piping, new gaskets shall be used for every assembly operation unless such assembly is intended solely for fit up. Gaskets are to be free of foreign materials. Inside diameter of gaskets shall not protrude inside the piping ID. The COMPANY will provide the required amount of gaskets for final installation and hydrostatic testing. If a gasket becomes damaged after the CONTRACTOR assumes possession, then it shall be the CONTRACTOR'S responsibility to replace the gasket at the CONTRACTOR'S expense. The CONTRACTOR will not be granted extra compensation for lost time due to damaged gaskets.

Where "flat ring" gaskets are specified, they shall be of the type whose outside diameter is contained within the bolt circle. Where "full face" gaskets are specified, they shall be of the type whose outside diameter is the same as the outside diameter of the flange. *(See Gasket Specification – Table 2. pg 6.5 – 19)(Rev 1)*

E. Field Run Piping

When piping is to be field routed, the CONTRACTOR shall, prior to starting any WORK, indicate the proposed routing and installation details to the INSPECTOR and obtain the INSPECTOR'S approval before proceeding with the WORK.

Multiple runs of field run piping shall be grouped in established banks at organized elevations with a change in elevation provided at each change of direction, and with sufficient space allowed between pipe runs so that proper maintenance can be effected. Particular considerations shall be given to insulated piping so that there is no interference between insulation, piping supports and structural steel.

All piping shall be installed in a neat and workmanlike manner along straight lines, both vertically and horizontally, parallel to building walls and partitions and building lines. Field run piping supports shall be supplied and installed by the CONTRACTOR. All piping shall be adequately supported and braced against cross-sway where necessary.

On field run piping, overhead clearance to the underside of the piping shall be seven feet (minimum) in buildings and above walkways and platforms.

Piping shall not be run near the floor, across walkways or working spaces where it will create a hazard. Areas for access shall be free of piping interference.

The piping shall be installed with flanges or unions so that the removal of equipment can take place without the cutting of any pipe.

Lube oil, gland seal and cooling piping at equipment such as pumps, shall be supported independent of the equipment and arranged to permit easy dismantling of the equipment without removal of block valves.

All flange tightening work must be inspected prior to coating.

6.5.6 SHOP FABRICATED PIPING

A. General

At the discretion of the COMPANY piping assemblies may be prefabricated off site. The requirements for such prefabricated piping shall be the same as for field fabricated piping except as outlined in the following subsections.

B. Right-of-Entry

INSPECTORS employed by the COMPANY shall have right of entry to the CONTRACTOR'S shop used for the fabrication of any piping covered by these SPECIFICATIONS. The CONTRACTOR shall afford the INSPECTOR, without charge, any reasonable facilities required to satisfy the INSPECTOR that the material is being furnished in accordance with the SPECIFICATIONS.

C. Time of Inspection

All piping shall be subject to inspection by the INSPECTOR at any time during fabrication. Ample notice of fabrication and non-destructive examination schedules shall be given to the COMPANY so that the INSPECTOR may witness any particular phase of the WORK.

D. Subcontracting of Shop Fabricated Material

Should the CONTRACTOR subcontract any portion of the WORK to another shop, the SUBCONTRACTOR shall be subject to inspection and testing by the INSPECTOR as would be the case if the CONTRACTOR were to perform the fabrication in his own shop.

E. Location of Tests

All inspection and tests shall be made at the CONTRACTOR'S shop unless agreed to by the COMPANY.

All flanged connections must be inspected prior to coating.

F. Defective Material

The COMPANY must be notified within 48 hours of receipt of materials if they have not been supplied in accordance with the requirements of this Specification. Acceptance by the INSPECTOR shall not relieve the CONTRACTOR of responsibility for defective material or workmanship. Adequate precautions shall be taken to prevent damage to spools after prefabrication. Any damage which occurs after receipt of materials shall be repaired by the CONTRACTOR at their expense.

G. Shipping and Handling

The CONTRACTOR is responsible for preparation, loading and shipping to site all fabricated piping.

Before shipment all pipe spools shall be cleaned on the inside and outside, where applicable, by wire brushing, and all loose scale, weld splatter, icicles, etc. shall be removed. Suitable end closures shall be provided and installed to protect piping against the ingress of dirt and moisture during shipping and site storage.

The CONTRACTOR shall ensure that the spools' sizes and configurations are such that they can be safely shipped to site while keeping the number of field welds required to a minimum.

Shipment shall not be made until the COMPANY has accepted the WORK.

H. Documentation

Two weeks prior to the fabrication of piping, the CONTRACTOR shall supply copies of the following documentation for the COMPANY'S review and approval:

- Mill Test Certificates for CONTRACTOR supplied material
- COMPANY'S Weld Procedures
- Weld Procedure Qualification Records

CONTRACTOR shall supply the COMPANY, within one week or prior to shipping, copies of the documentation outlined below:

- Weld Maps
- Weld Inspection and Repair Records
- Hydrostatic test Records
- Hydrostatic test Instrument Calibration Records

6.5.7 UNDERGROUND PIPING

Excavation, bedding, backfill and compaction for underground piping shall be in accordance with Part 6, "Earthwork and Roads".

Coating application for corrosion protection of underground piping shall be in accordance with Part 6, "Painting and Coating".

The CONTRACTOR shall install all piping to the grades, lines and elevations shown on the DRAWINGS. Any deviations to the DRAWINGS shall be approved by the PROJECT ENGINEER in writing prior to the WORK taking place. All deviations from the DRAWINGS shall be recorded and promptly provided to the INSPECTOR for as-builting.

Unless specifically indicated in the DRAWINGS buried flanges shall not be used for joining pipe sections. *The installation of buried flanges is discouraged and should be avoided whenever possible. NOTE: Currently, Regional Technical Supervisors must approve new buried flanges.* *(rev1)*

Under no circumstances shall buried threaded connections be used.

In all cases when pipe transitions from above to below grade, frost heave & pipe flexibility shall be considered when designing and field routing the piping.

Special care shall be taken to avoid damage to coated pipe and/or fittings during handling.

When stringing alongside a pipe trench, pipe shall be supported on timber or sand-filled sacks supported by skids in such a way as to prevent damage to the exterior surface of the pipe. Sacks filled with straw shall not be used as padding.

All dents in the pipe shall be removed by cutting out the dented length of the pipe, rebevelling the cut ends, welding up and recoating. No compensation will be allowed to the CONTRACTOR for such WORK.

Immediately prior to backfilling, the CONTRACTOR shall inspect all pipe and fittings using electrical holiday detection equipment (full circle coil spring). This equipment shall be capable of providing both audible and visual indications when a holiday is detected. The test voltage shall be calibrated using a high resistance and high impedance kilovoltmeter. Said inspection shall be performed as outlined in NACE Standard RP-0274 (latest approved edition) with a certified holiday detector. The entire coated surface shall be inspected for holidays. If the manufacturer does not specify a jeep voltage, the CONTRACTOR shall consult the equipment manufacturer or PROJECT ENGINEER.

After all holidays have been repaired, the above procedure shall be used to re-inspect the repaired areas.

Pipe for underground service shall be checked before being lowered into the trench to ensure that no foreign material, manufacturer's defects, or cracks exist. Pipe and fittings shall be carefully lowered into the trench by means of derricks, ropes, or other approved tools or equipment in a manner that will prevent damage to the pipe and injury of workers.

Precaution shall be taken to ensure that displacement of underground pipe does not occur through soil displacement or flotation due to the presence of trench water. Pipe that has been displaced shall be removed from the trench and relaid after trench is dewatered and reshaped as necessary.

Insulation of underground piping systems shall not be completed until all hydrostatic testing and tracing installation, as applicable, is complete. Temporary support and handling of insulated pipe shall comply with the insulation manufacturer's recommendations. Insulated pipe shall only be primed as per Section 10.

All underground piping shall be inspected and approved by the INSPECTOR prior to backfilling.

6.5.8 TORQUING PROCEDURE

Contractor shall employ the following procedure for joining flanged connections.

A. Equipment

1. Torquing Tools

a. In most cases, use a hand or hydraulic torque wrench for tightening flanges. However, a hydraulic bolt tensioning system provides the most accurate method of applying bolt stress and may be used for tightening critical flanges. (e.g., pumps).

b. If using a hydraulic tensioning tool, the studs must have sufficient length so that the threads extend at least 1.5 times the bolt diameter past the nut face on the side the tensioning tool is mounted. For example, a stud 51 mm (2 in.) in diameter requires at least 76 mm (3 in.) of threads extending past the nut face.

c. An impact wrench may be used to face-up a flange (see Procedure, step 6), but must not be used to tighten the studs (see Procedure, steps 10 to 14). To ensure adequate bolt tension, when the nuts are hand-tight, tighten flange connections using a hand or hydraulic torque wrench that is adequate to measure torque within 5%.

(See Torque requirements for studs in Table 3, pg 5.6 – 20)

B. Requirements

1. Preparation

a. Visually inspect piping to ensure it is free of foreign materials and construction debris
b. Ensure studs are the correct size and material specification, and visually inspect for mechanical damage (e.g., burrs or nicks, or dirt and rust). Replace if necessary.

2. Maximum Allowable Pressure

   a. If torquing a flange assembly while the pipeline is under pressure, see Table 1 for the maximum allowable pressure.

   b. Torquing under pressure is recommended only on non-leaking flanges.

   c. Torquing must be completed the same day it started.

   WARNING: If the pipeline contains NGL, do not torque while the pipeline is under pressure.

   d. Torquing must be completed the same day it started.

4. Gaskets

   a. For acceptable gasket types, see Table 2.

   b. Match the pressure rating and size of the gasket to the flange.

   c. Do not use asbestos and asbestos compounds.

C. Procedure

1. Clean flange faces using a steel scraper or wire brush.

2. Wipe flange faces with a clean rag and visually inspect for surface damage, trueness (i.e., not warped or wavy), and misalignment.

3. Lubricate the threads of studs, faces of nuts, and contact area of flanges with a low friction lubricant (e.g., molybdenum-disulfide-based Moly-Paste C-670).

4. Align flanges using at least two line-up pins sized 2 mm smaller than the diameter of the bolt holes.

CAUTION: Never use chains to pull together misaligned flanges.

CAUTION: To prevent pump nozzle loads, do not use line-up pins on pump flanges. Pipe to pump flange faces must be concentric to within 0.06 in., and parallel to within 0.2 in./ft in the vertical and axial directions.

5. Insert a new gasket, and install studs and nuts, except where the line-up pins prevent this.

NOTE: Never install a used gasket.

NOTE: Studs that are in good condition may be re-used. Replace studs and nuts if both nuts do not easily run up on the stud by hand.

NOTE: If the pipe run is horizontal, install the bottom studs first to retain the gasket.

6. Tighten all nuts hand tight, ensuring the bolts or studs extend completely through the nuts.

   a. Tighten four studs at 90 deg. to each other until there is no visible gap at the gasket.

NOTE: To eliminate the gap, it may be necessary to tighten more than four studs.

NOTE: If the nuts can't be snugged up with a hand torque wrench, the flange is misaligned. If bolt tension is used to overcome the misalignment, there will not be enough clamping stress to seat the gasket.

7. Measure the distance from face-to-face at the flange outside diameter, moving around the flange circumference to ensure there is no more than 2 mm (0.08 in.) variance.

NOTE: The flange is now faced.

8. Number the studs as shown in Figure 1.

9. Tighten the studs in numbered sequence (diametrically opposed) to approximately 30% of the final torque value in Tables 3-7.

NOTE: Skip the line up pins to ensure flange alignment.

NOTE: If tightening pump flanges, some variation in sequences may be necessary to avoid excessive pump shaft deflection.

10. Remove the line-up pins, and install studs and nuts.

11. Tighten studs in numbered sequence (diametrically opposed) to approximately 60% of the final torque value in Tables 3-7.

12. Tighten studs in numbered sequence (diametrically opposed) to 100% of the final torque values in Tables 3-7.

    a. For flanges with studs greater than or equal to 32 mm (1 1/4 in.) in diameter, tighten to 110% of the final torque value.

13. Check the torque of each nut at 100% of the final torque value; moving around the flange in clockwise rotational sequence (i.e., adjacent nuts), using one or more passes to ensure studs are evenly tightened.

14. Slowly pressurize the facility to working pressure and visually inspect for leaks.

    a. If there is a leak, check the stud tension; and, if necessary, tighten all studs to 100% of the final torque value.

    b. If the studs don't retain the applied tension and the flange continues to leak:
       1) Relieve pressure

       2) Remove the studs and the gasket.

       3) Check for flange face defects and gasket defects; repair or replace if necessary.

       4) Repeat the installation procedure

    NOTE: If the flange assembly is in a high pressure or high temperature application, retorquing may be necessary after startup to compensate for any relaxation or creep in the assembly.

D. Documentation

For flanges with studs $\geq$ 32mm (1¼") in diameter, record the installation of flanged/bolted joints using the three part Flange Installation Quality Control Form and give it to the inspector within 4 hours of completion of tightening. A sample form can be found in 6.5.10.

Inspector –

1. White copy onsite
2. Yellow copy in the Engineering project file, if applicable.
3. Pink copy in Facilities Integrity.

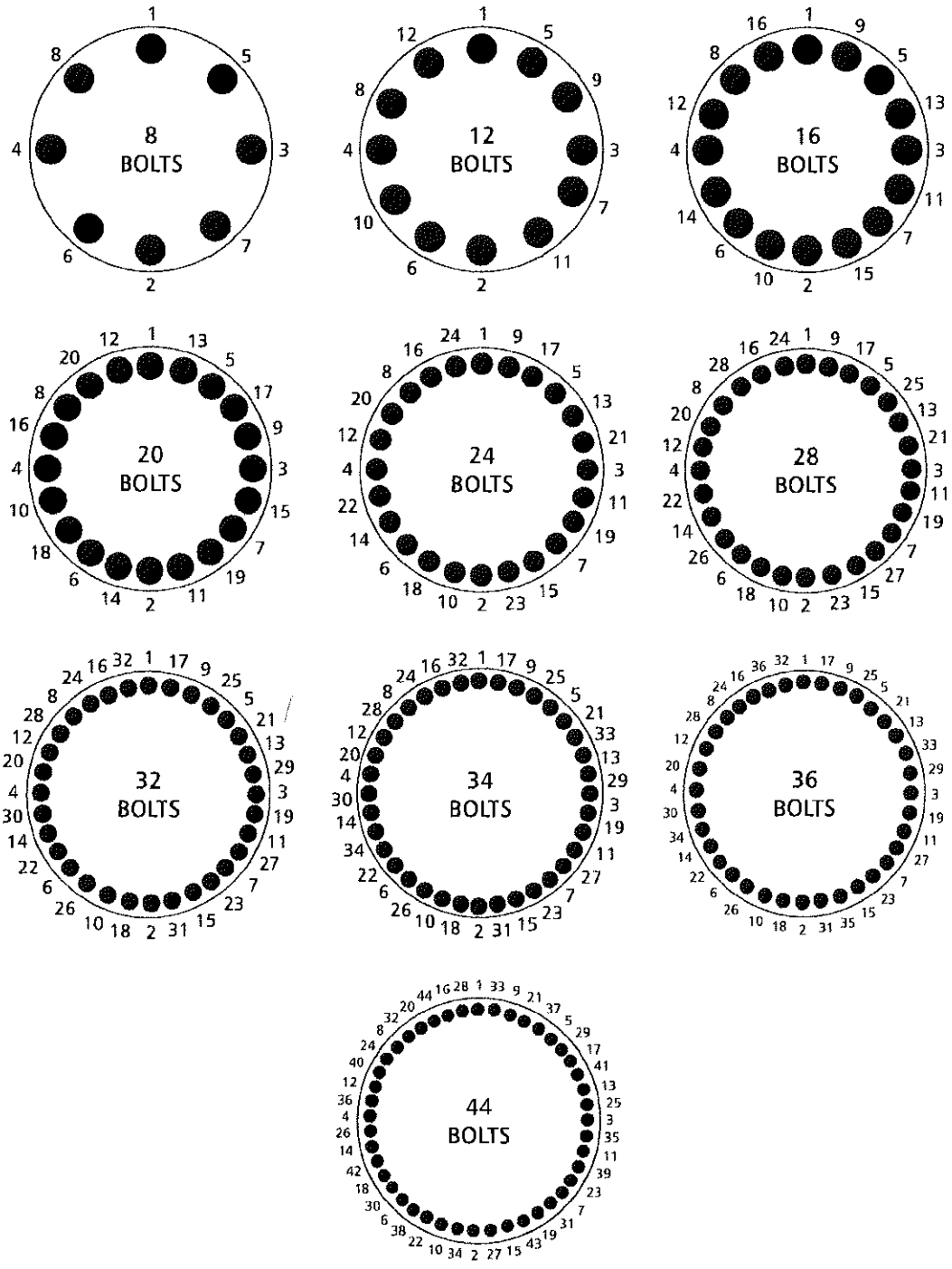

Figure 1
Detailed Numbering and Torquing Sequence

Table 1
Maximum Pressure for Torquing Flanges

ANSI	NPS	Pressure (psig)
150	12 – 26	275
150	30	250
150	34	240
150	36	270
150	42	250
150	48	240
300	12	570
300	14	540
300	16	560
300	18	640
300	20	580
300	24	530
300	26	440
300	30	380
300	34	340
300	36	320
300	48	250
300	IPL 48	250
400	12	790
400	14	690
400	16, 18	700
400	20	640
400	24	530
400	26	440
400	30	380
400	34	340
400	36	320
400	48	250
400	IPL 48	250
600	12	870
600	14	840
600	16	810
600	18	690
600	20	700
600	24	690
600	26	640
600	30	530
600	34	440
600	36	380
600	48	340
900	24	320
900	30	250

NOTES:

Pressures are based on removing no more than 2 studs from the flange assembly at one time.

The Torque Valves in Table 3 are for both ambient and pressure conditions.

Table 2

Gasket Specifications

Application[8]		Gasket Type		
		Corrugated Metal Gasket[1,2,3]	Spiral Wound with an inner ring[4,5,6]	Non Asbestos Fiber Gasket[7]
ANSI 150	NPS <= 24	✓		
	NPS >= 26 or NGL service (any size)		✓	
ANSI 300	NPS <= 24	✓	✓	
	NPS >= 26 or NGL service (any size)		✓	
ANSI 400			✓	
ANSI 600			✓	
ANSI 900			✓	
Tank Manways				✓

Notes:

1. Do not use corrugated metal gaskets for lines in NGL service regardless of the flange rating.
2. Corrugated Metal Gaskets shall be 1/16 in. with flexible graphite sealing element and a 304 SS (or higher grade) metal core.
3. Types of corrugated metal gaskets include the Elastagraph and Graphonic. The Elastagraph brand is preferred for elevated temperature applications (>100°C)
4. Spiral Wound gaskets must be 3.2mm (1/8 in.) thick, with 304 SS (or higher grade) windings, flexible graphite filler and carbon steel (or higher grade) inner and outer rings.
5. The 304 SS gasket is identified by a solid yellow colour around the outside edge of the gasket. The flexible graphite filler is identified by grey stripes placed at equal intervals around the outside edge of the gasket.
6. Spiral Wound gaskets complete with inner rings are commonly referred to as Flexitallic CGI
7. Non Asbestos fiber gaskets must be fire resistant 3.2mm (1/8 in.) material with a nitrile binder (NBR) (e.g. Garlock IFG-5500).
8. For lap-joint and slip-on flanges, use the type of gasket in accordance with the size and rating of the flange.

Table 3

Torque Requirements for Studs

Note: The following torque values are based on well lubricated studs

ANSI 150

NPS	Bolt Size (in)	30% Final Torque	60% Final Torque	100% Final Torque	110% Final Torque
1/2	1/2	10	20	40	N/A
3/4	1/2	20	30	50	N/A
1	1/2	20	40	60	N/A
1 1/4	1/2	20	40	60	N/A
1 1/2	1/2	20	40	60	N/A
2	5/8	30	50	90	N/A
2 1/2	5/8	40	80	130	N/A
3	5/8	40	70	120	N/A
3 1/2	5/8	30	60	100	N/A
4	5/8	30	70	110	N/A
5	3/4	50	100	160	N/A
6	3/4	70	130	220	N/A
8	3/4	70	140	230	N/A
10	7/8	90	180	300	N/A
12	7/8	110	220	360	N/A
14	1	140	270	450	N/A
16	1	120	230	390	N/A
18	1 1/8	230	460	760	N/A
20	1 1/8	210	420	700	N/A
24	1 1/4	300	590	990	1090
26	1 1/4	200	400	670	740
30	1 1/4	200	400	660	730
34	1 1/2	360	720	1200	1320
36	1 1/2	360	720	1200	1320
42	1 1/2	360	720	1200	1320
48	1 1/2	360	720	1200	1320

ANSI 300

NPS	Bolt Size (in)	30% Final Torque	60% Final Torque	100% Final Torque	110% Final Torque
1/2	1/2	10	20	40	N/A
3/4	5/8	20	40	70	N/A
1	5/8	20	40	70	N/A
1 1/4	5/8	20	50	80	N/A
1 1/2	3/4	40	80	130	N/A
2	5/8	20	40	70	N/A
2 1/2	3/4	40	80	130	N/A
3	3/4	50	90	150	N/A
3 1/2	3/4	50	100	160	N/A
4	3/4	70	130	220	N/A
5	3/4	70	130	220	N/A
6	3/4	70	130	220	N/A
8	7/8	110	210	350	N/A
10	1	160	320	530	N/A
12	1 1/8	220	440	730	N/A
14	1 1/8	180	320	540	N/A
16	1 1/4	230	460	760	840
18	1 1/4	240	470	790	870
20	1 1/4	290	570	950	1050
24	1 1/2	450	900	1500	1650
26	1 5/8	510	1020	1700	1870
30	1 3/4	660	1320	2200	2420
34	1 7/8	960	1920	3200	3520
36	2	960	1920	3200	3520
40	1 7/8	1140	2280	3800	4180
IPL 48	2 1/4	1260	2520	4200	4620

ANSI 400

NPS	Bolt Size (in)	30% Final Torque	60% Final Torque	100% Final Torque	110% Final Torque
1/2	1/2	10	20	40	N/A
3/4	5/8	20	40	70	N/A
1	5/8	20	40	70	N/A
1 1/4	5/8	30	50	90	N/A
1 1/2	3/4	40	80	140	N/A
2	5/8	20	50	80	N/A
2 1/2	3/4	40	80	130	N/A
3	3/4	50	110	180	N/A
3 1/2	7/8	100	200	330	N/A
4	7/8	110	220	360	N/A
5	7/8	110	220	360	N/A
6	7/8	110	220	360	N/A
8	1	160	320	540	N/A
10	1 1/8	230	470	780	N/A
12	1 1/4	310	620	1030	1130
14	1 1/4	250	500	830	910
16	1 3/8	330	660	1100	1210
18	1 3/8	380	720	1200	1320
20	1 1/2	420	840	1400	1540
24	1 3/4	600	1200	2000	2200
26	1 3/4	660	1320	2200	2420
30	2	900	1800	3000	3300
34	2	1020	2040	3400	3740
36	2	960	1920	3200	3520
40	2 1/4	1590	3180	5300	5830
IPL 48	2 3/4	2280	4560	7600	8360

ANSI 600

NPS	Bolt Size (in)	30% Final Torque	60% Final Torque	100% Final Torque	110% Final Torque
1/2	1/2	10	20	40	N/A
3/4	5/8	20	40	70	N/A
1	5/8	20	50	80	N/A
1 1/4	5/8	30	50	90	N/A
1 1/2	3/4	50	100	160	N/A
2	5/8	20	50	80	N/A
2 1/2	3/4	40	80	130	N/A
3	3/4	50	110	180	N/A
3 1/2	7/8	100	190	320	N/A
4	7/8	110	210	350	N/A
5	1	160	320	530	N/A
6	1	150	290	490	N/A
8	1 1/8	240	480	800	N/A
10	1 1/4	260	530	880	970
12	1 1/4	260	530	880	970
14	1 3/8	360	710	1190	1310
16	1 1/2	510	1020	1700	1870
18	1 5/8	720	1440	2400	2640
20	1 5/8	660	1320	2200	2420
24	1 7/8	900	1800	3000	3300
26	1 7/8	750	1500	2500	2750
30	2	900	1800	3000	3300
34	2 1/4	1260	2520	4200	4620
36	2 1/2	1770	3540	5900	6490
48	2 3/4	2310	4620	7700	8470

ANSI 900

NPS	Bolt Size (in)	30% Final Torque	60% Final Torque	100% Final Torque	110% Final Torque
1/2	3/4	30	60	100	N/A
3/4	3/4	30	60	100	N/A
1	7/8	50	100	160	N/A
1 1/4	7/8	60	120	200	N/A
1 1/2	1	90	180	300	N/A
2	7/8	60	110	190	N/A
2 1/2	1	80	160	270	N/A
3	7/8	60	170	280	N/A
4	1 1/8	100	310	520	N/A
5	1 1/4	220	440	740	N/A
6	1 1/8	190	370	610	N/A
8	1 3/8	280	560	930	N/A
10	1 3/8	260	520	870	N/A
12	1 3/8	330	660	1100	N/A
14	1 1/2	390	780	1300	N/A
16	1 5/8	480	960	1600	N/A
18	1 7/8	810	1620	2700	N/A
20	2	870	1740	2900	N/A
24	2 1/2	1770	3540	5900	N/A
26	2 3/4	2370	4740	7900	N/A
30	3	3090	6180	10300	N/A
34	3 1/2	4950	9900	16500	N/A
36	3 1/2	4980	9960	16600	N/A

Notes:

- These torque values are applicable for all flange assemblies containing gaskets as specified in the Gasket Specification section.

- These torque values and the gauge reading on the Torque machine itself may vary depending on the particular brand of equipment. Please consult Torque machine operators for conversion chart or further instruction.

6.5.9 HYDROSTATIC TESTING

All new piping shall be hydrostatically tested to the specified hydrostatic test pressure. Pipe that can be visually inspected shall be hydrostatically tested for four hours and fifteen minutes. Pipe that cannot be entirely visually inspected shall be hydrostatically tested for a period of not less than eight hours and fifteen minutes with no leakage. All hydrostatic test data will be recorded and furnished to the COMPANY on a COMPANY supplied Hydrostatic Test Data Form and shall comply with all applicable U.S. DOT 195 regulations.

The COMPANY will supply necessary double faced blinds and blind flanges complete with bolts and gaskets for the hydrostatic testing, unless indicated otherwise. The CONTRACTOR shall supply a certified dead-weight tester, pressure recorder, pressure gauge, and all other equipment necessary for testing. All hydrostatic test equipment shall have calibration data sheets, not more than six months old, made available to the INSPECTOR prior to testing. The CONTRACTOR'S pressure recorder shall have a range that is suitable for the test pressure. The CONTRACTOR'S test pressure gauge and pressure recorder shall be calibrated against a dead-weight tester before and after the test.

The CONTRACTOR shall not test through any rotating equipment or against closed valves. The rotating equipment shall be removed from the system and the piping shall be blinded off. Skillet plates will not be allowed. All valves shall be in the partially open position during the test. The CONTRACTOR shall take care not to damage any pressure sensitive instrumentation or equipment during the hydrostatic test. The instrumentation piping shall be disconnected from the instruments during the test.

Vents for bleeding air and drains to remove the water shall be supplied and installed by the CONTRACTOR as shown on the DRAWINGS. Prior to backfilling, the CONTRACTOR shall install a two foot (minimum) length of PVC pipe, painted safety orange, over all fittings protruding from the top of the pipe.

All hydrostatic test water shall be tested prior to the hydrostatic test by a COMPANY approved laboratory at the CONTRACTOR'S expense. The results of this test shall be immediately forwarded to the COMPANY. The discharge water shall also be tested in the same manner and these results also forwarded immediately to the COMPANY.

The COMPANY will acquire necessary permits for discharge of hydrostatic test water. The CONTRACTOR shall coordinate hydrostatic testing activities with the COMPANY at least 60 days prior to testing due to the long lead time required to obtain permits. Upon successful completion of the hydrostatic testing, the CONTRACTOR shall carefully coordinate with the COMPANY a controlled discharge of the test water in accordance with the provisions of the permit. Approval must be obtained from the COMPANY before any discharge of hydrostatic test water is conducted. No additives to the hydrostatic test water will be allowed unless specifically stated in the permit and prior written approval from the COMPANY is obtained. The CONTRACTOR shall be ultimately responsible for all costs associated with the disposal of all hydrostatic test water, unless otherwise noted in the Specific Conditions.

Hydrostatic testing shall be performed at a time mutually agreeable to the COMPANY and the CONTRACTOR.

The CONTRACTOR shall supply personnel to perform each hydrostatic test. The COMPANY shall witness all hydrostatic tests. Readings shall be taken by the CONTRACTOR every 15 minutes and recorded on forms supplied by the COMPANY. The test pressure shall be maintained throughout the duration of the four or eight hour test without leakage. The PROJECT ENGINEER, prior to COMPANY acceptance, shall approve all completed hydrostatic tests.

All exposed piping shall be visually examined for leaks during testing. If, during testing, leaks develop on piping that has been coated, wrapped, and backfilled, the CONTRACTOR shall uncover and repair such defects and retest as directed by the COMPANY. The cost of any repairs or retesting work shall be borne by the CONTRACTOR. All pressure shall be bled off prior to repairing leaks or tightening flanges.

The CONTRACTOR, upon successful completion of the test, shall supply the COMPANY with the following:

1. Completed Hydrostatic Test Data form, including deadweight log of pressure and temperatures
2. Continuous pressure and temperature recording charts
3. Description of test facility including "test pressure"
4. Description of test equipment used with calibration certificates
5. Date and duration of test
6. Name of the person in charge of the test
7. One marked drawing with tested facilities highlighted

New gaskets shall be used when re-installing flanged piping after the test.

It is particularly brought to the attention of the CONTRACTOR, that immediately after completion of the hydrostatic test, as approved by the INSPECTOR, all piping, valves, and connected equipment must be thoroughly drained and RV type antifreeze added to all low points and valve bodies to prevent subsequent freezing problems. The CONTRACTOR shall ensure that all vent and drain plugs have been removed to allow complete drainage of the system. Before replacing and backwelding the plugs, the CONTRACTOR shall take whatever practical steps are required to assure that all water has been removed from the subject piping.

6.5.10 FORMS AND EXHIBITS

Welder Qualifications (Under separate cover)
Coating and Painting Specifications C-110 and P-210

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 6

PIPING CLASSES

February 2007

PART 6 - SECTION 6

PIPING CLASSES

Attachment: Leak Reduction Initiative "Engineering Best Practices" Issue #1, December 22, 2006

PIPING SPECIFICATION - CLASS A

150# - PETROLEUM LIQUID LINES

Maximum Pressure Temperature Rating 275# at 100°F

150# LUBE OIL, FUEL OIL AND GAS LINES

Maximum Pressure Temperature Rating 240# at 200°F

SERVICE

This SPECIFICATION is for piping material used in lines carrying petroleum liquids, oil, oil vapor or gas within the permissible pressure and temperature limits shown above.

STANDARDS

Standards and Specifications referred to shall be the latest revision thereof.

VALVES

GATE VALVES

Size	Mark No.	Maximum Working Pressure	Description
1/2" to 1-1/2"	VG-3	2000 psi	600#, steel, bolted bonnet, R.S., full port, solid wedge, screwed Crane 3607 XU or equal
2" to 6"	VG-4	275 psi	150#, steel, API Std. 6D, R.S., full port, solid wedge, handwheel operated, flanged, f&d, ANSI B16.5 Crane 47X (47 XU) or equal
2" to 6"	VG-55	275 psi	150#, steel, API Std. 6D, R.S., slab gate, venturi, handwheel operated, enclosed stem flanged, f&d, ANSI B16.5 Grove G-3 or equal

GATE VALVES (continued) **CLASS A**

Size	Mark No.	Maximum Working Pressure	Description
2" to 4"	VG-56	275 psi	150#, steel, API Std. 6D, R.S., slab gate, full opening, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Grove G-3 or equal
4" to 6"	VG-57	275 psi	150#, steel, R.S., slab gate, full opening, handwheel operated, to be installed between companin flanges (f&d, ANSI B16.5 and adapter to meet face to face dimensions of ANSI B16.10. Grove G-5 (with adapter) or equal
4" to 6"	VG-59	275 psi	150#, steel, R.s., slabgate, full opening, handwheel operated, to be installed between companion flanges, f&d, ANSI B16.5 Grove G-5 (without adapter) or equal
1/4" to 1-1/2"	BG-67	2000 psi	600#, steel, bolted bonnet, O.S. & Y., R.S., reduced port, solid wedge, screwed. Crane 3604 XU or Vogt 12111 or equal
6"	VG-68	275 psi	150#, steel, API Std. 6D, R.S., slab gate, venturi, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Grove G-4 or equal

GATE VALVES (continued) **CLASS A**

Size	Mark No.	Maximum Working Pressure	Description
6"	VG-69	275 psi	150#, steel, API Std. 6D, R.S., slab gate, full opening, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Grove G-4 or equal
6"	VG-70	275 psi	150#, steel, API Std. 6D,R.D., double disc, parallel seats, venturi, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Kerrotest 235 or equal
6"	VG-71	275 psi	150#, steel, API Std. 6D,R.S., double disc, parallel seats, full opening, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Kerrotest 319H or equal

GLOBE VALVES **CLASS A**

Size	Mark No.	Maximum Working Pressure	Description
2" to 6"	VO-2	275 psi	150#, steel, ANSI B16.10, R.S., plug type disc, flanged, f&d, ANSI B16.5 Crane 143X or equal
1/4" to 3/4"	VO-3	2000 psi	600#, steel, union bonnet, R.S., plug type disc, screwed Crane 3640 XW or equal
1/2" to 1-1/2"	VO-4	2000 psi	600#, steel, bolted bonnet, R.S., plug type disc, screwed Crane 3644 XW or equal

BALL VALVES **CLASS A**

Size	Mark No.	Maximum Working Pressure	Description
3/8" to 1-1/2"	VB-63	1500 psi	1500#, fire safe, steel,non lubricated, regular port, wrench operated, screwed *WKM Dynaseal 310, (B136-CS-02) or equal*
2" to 4"	VB-64	275 psi	150#, fire safe, steel,API Std. 6D, non lubricated, venturi, wrench operated, flanged, f&d, ANSI B16.5 Grove B-4 or equal
2" to 4"	VB-65	275 psi	150#, fire safe, steel, API Std. 6D, non lubricated, full opening, wrench operated, flanged, f&d, ANSI B16.5 Grove B-4 or equal
6"	VB-66	275 psi	150#, fire safe, steel, API Std. 6D, non lubricated, full opening, wrench operated, flanged, f&d, ANSI B16.5 Grove B-5 or equal

Note: *WKM Dynaseal 2" floating ball valves are not permitted per Leak Reduction Initiative "Engineering Best Practices". (Issue #1, December 22, 2006)* *(Rev1)*

CHECK VALVES **CLASS A**

Size	Mark No.	Maximum Working Pressure	Description
1/2" to 1-1/2"	VC-3	2000 psi	600#, steel, lift type, horizontal, screwed Crane 3674X or equal
2" to 6"	VC-4	275 psi	150#, steel, API Std. 6D, swing type, horizontal or vertical (up flow only), flanged, f&d, ANSI B16.5 Crane 147X or equal
4" to 6"	VC-22	275 psi	150#, steel, API Std. 6D, tilting disc, non slam, horizontal or vertical (up flow only), flanged, f&d, ANSI B16.5 Chapman 123 A or equal
2" to 6"	VC-37	275 psi	150#, steel, split flapper, spring return, horizontal or vertical, installed between flanges, f&d, ANSI B16.5 Mission style B or equal

FITTINGS		**CLASS A**
Size		Description
1/4" to 1-1/2"	Above Grade	3000# F.S., ASTM A105, Grade II
	Below Grade	3000# F.S., socket weld ends, ANSI B16.11 ASTM A105, Grade II
2" to 6"	Above Grade	Butt welded, steel, standard weight, ASTM A234, ANSI B16.9
	Below Grade	Butt welded, steel, extra strong, ASTM A234, ANSI B16.9

For the use of "Sock-o-lets" (Branch connections to pressure piping) see: Enbridge Energy Engineering Standard 3.02-9346.

Note: NO "Thread-o-Lets" of any size or pressure rating are permitted on pressure piping. *(Rev1)*

UNIONS

1/4" to 1-1/2"	Above Grade	3000# F.S., screwed, steel to steel seat, ASTM A105, Grade II
	Below Grade	3000# F.S., socket welding ends, steel to steel seat ASTM 105, Grade II
2" to 6"		Use Flanges

FLANGES

2" to 6"	150# F.S., welding R.F. bored to same I.D. as adjacent pipe, ASTM A105, Grade I, ANSI B16.5
	150# F.S., slip on flanges of similar grade may be used if approved by Company.
	150# F.S., blind, R.F., ASTM A105, Grade I, ANSI B16.5

Note: No Tapped Blind Flanges or Threaded Flanges are Permitted. *(Rev.1)*

CLASS A

GASKETS

Size	Description
2" to 6"	"Elastagraph,Graphonic" (corrugated metal gasket)

See Gasket Specifications

BOLTING

All sizes		Stud bolts with two nuts
	Bolts	Stud bolt, alloy steel, ASTM A193, Grade B7, threaded full length
	Nuts	Hexagon, semi-finished, "Heavy Series", ASTM A194, Grade 2H, Carbon Steel

See Torque Requirements

PIPE

1/4" to 1-1/2"	1st preference	*Stainless Steel w/Swagelok compression fittings (Rev.1)*
	2nd preference	Stainless Steel w/Swagelok compression fittings (Rev.1)
2" to 6"	1st preference	Schedule 80, seamless steel, API-5L, Grade B
	2nd preference	Schedule 80, seamless steel, ASTM A53, Grade B
	Below Grade	Use schedule 80 seamless API 5L, Grade B

CLASS B - ANSI CLASS 300

SERVICE

This SPECIFICATION is for piping material used in lines carrying petroleum liquids within permissible pressure and temperature limits shown below.

PETROLEUM LIQUID LINES

Maximum Pressure Temperature Rating 720 psig at 100°F.

STANDARDS

Standards and Specifications referred to shall be the latest revision thereof.

VALVES

GATE VALVES

Size	Mark No.	Maximum Working Pressure	Description
1/2" to 1-1/2"	VG-3	2000 psi	600#, steel, bolted bonnet, R.S., full port, solid wedge, screwed Crane 3607 XU or equal
2" to 6"	VG-8	720 psi	300#, steel, SPI Std. 6D, R.S., full opening, solid wedge, handwheel operated, flanged, f&d, ANSI B16.5 Crane 33X (33 XU) or equal
1/4" to 1-1/2"	VG-67	2000 psi	600#, steel, bolted bonnet, R.S., reduced port, solid wedge, screwed Crane 3604 XU or Vogt 12111 or equal

GATE VALVES (continued) **CLASS B**

Size	Mark No.	Maximum Working Pressure	Description
6"	VG-72	720 psi	300#, steel, API Std. 6D, R.S., slab gate, venturi, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5
6"	VG-73	720 psi	300#, steel, API Std. 6D, R.S., slab gate, full opening, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Grove G-4 or equal
6"	VG-74	720 psi	300#, steel, API Std. 6D, R.S., double disc, parallel seats, venturi, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Kerrotest 245 H or equal
6"	VG-75	720 PSI	300#, steel, API Std. 6D, R.S., double disc, parallel seats, full opening, hand-wheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Kerrotest 329 H or equal

GLOBE VALVES **CLASS B**

Size	Mark No.	Maximum Working Pressure	Description
1/4" to 3/4"	VO-3	2000 psi	600#, steel, union bonnet, R.S., plug type disc, screwed Crane 3640 XW or equal
1/2" to 1-1/2"	VO-4	2000 psi	600#, steel, bolted bonnet, R.S., plug type disc, screwed Crane 3644 XW or equal
2" to 6"	VO-15	720 psi	300#, steel, ANSI B16.10 R.S., plug type disc, flanged, f&d, ANSI B16.5 Crane 151X or equal

BALL VALVES **CLASS B**

Size	Mark No.	Maximum Working Pressure	Description
3/8" to 1-1/2"	VB-63	1500 psi	1500#, Fire Safe, steel, non-lubricated, regular port, wrench operated *WKM Dynaseal 310, (B136-CS-02) or equal*
2" to 4"	VB-67	720 psi	300#, Fire Safe, steel, API Std. 6D, non-lubricated, venturi, wrench operated, flanged, f&d, ANSI B16.5 Grove B-4 or equal
2" to 4"	VB-68	720 psi	300#, Fire Safe, steel, API Std. 6D, non-lubricated, full opening, wrench operated, flanged, f&d, ANSI B16.5 Grove B-4 or equal
6"	VB-69	720 psi	300#, Fire Safe, steel, API Std., 6D, non-lubricated, full opening, wrench operated, flanged, f&d, ANSI B16.5 Grove B-5 or equal

Note: *WKM Dynaseal 2" floating ball valves are not permitted per Leak Reduction Initiative "Engineering Best Practices". (Issue #1, December 22, 2006)* *(Rev1)*

CHECK VALVES **CLASS B**

Size	Mark No.	Maximum Working Pressure	Description
1/2" to 1-1/2"	VC-3	2000 psi	600#, steel, lift type, horizontal, screwed Crane 3674X or equal
2" to 6"	VC-8	720 psi	300#, steel, API STD. 6D, swing type, horizontal or vertical (up flow only) flanged, f&d, ANSI B16.5 Crane 159X or equal
4" to 6"	VC-24	720 psi	300#, steel, SPI Std. 6D, tilting disc, non slam, horizontal or vertical (up flow only), flanged, f&d, ANSI B16.5 Chapman 323A or equal

FITTINGS		**CLASS B**
Size		Description
1/4" to 1-1/2"	Above Grade	3000# F.S., ASTM A105, Grade II
	Below Grade	3000# F.S., socket weld ends, ANSI B16.11, ASTM A105, Grade II
2" to 6"	Above Grade	Butt welded, steel, standard weight, ASTM A234, ANSI B16.9
	Below Grade	Butt welded, steel, extra strong, ASTM A234, ANSI B16.9

For the use of and "Sock-o-lets" (Branch connections to pressure piping) see: Enbridge Energy Engineering Standard 3.02-9346.

Note: NO "Thread-o-Lets" of any size or pressure rating are permitted on pressure piping. *(Rev1)*

UNIONS		
1/4" to 1-1/2"	Above Grade	3000# F.S., screwed steel to steel seat, ASTM A105, Grade II
	Below Grade	3000# F.S., socket welding ends, steel to steel seat, ASTM A105, Grade II
2" to 6"		Use flanges

FLANGES		
2" to 6"		300# F.S., welding neck, R.F., bored to same I.D. as adjacent pipe, ASTM A105 Grade I, ANSI B16.5
2" to 6"		300# F.S., blind, R.F., ASTM A105, Grade I, ANSI B16.5

Note: No Tapped Blind Flanges or Threaded Flanges are Permitted. *(Rev.1)*

GASKETS

2" to 6"		"Flexitallic" type CG or CGI "Elastograph", "Graphonic"

See Gasket Specifications

BOLTING		**CLASS B**
Size		Description
All sizes		Stud bolts with two nuts
	Bolts	Stud bolt, alloy steel, ASTM A193, Grade B7, threaded full length
	Nuts	Hexagon, semi-finished, "Heavy-Series", ASTM A194, Grade 2H, carbon steel

See Torque Requirements

PIPE

1/4" to 1-1/2"	1st preference	*Stainless steel tubing with Swagelok compression fittings (Rev.1)*
	2nd preference	*Stainless steel tubing with Swagelok compression fittings (Rev.1)*
2" to 6"	1st preference	Schedule 80, seamless steel, Grade B, API 5L
	2nd preference	Schedule 80, seamless steel, ASTM A53, Grade B
	Below grade	Use Schedule 80 seamless API 5L, Grade B

CLASS C - ANSI CLASS 400 (PN 68)

SERVICE

This SPECIFICATION is for piping material used in lines carrying petroleum liquids within permissible pressure and temperature limits shown below.

PETROLEUM LIQUID LINES

Maximum Pressure Temperature Rating 960 psig at 100°F.

STANDARDS

Standards and Specifications referred to shall be the latest revision thereof.

VALVES

GATE VALVES

Size	Mark No.	Maximum Working Pressure	Description
1/2" to 1-1/2"	VG-3	2000 psi	600#, steel, bolted bonnet, R.S., full port, solid wedge, screwed Crane 3607 XU or equal
4" to 6"	VG-49	960 psi	400#, steel, API Std. 6D, bolted bonnet, R.S., full opening, solid wedge, handwheel operated, flanged, f&d, ANSI B16.5 Crane 61X or Kerrotest 31 or equal
6" DN 150	VG-60	960 psi	400#, steel, API Std. 6D, R.S., slab gate, full opening, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Grove G-4 or equal

GATE VALVES (continued) **CLASS C**

Size	Mark No.	Maximum Working Pressure	Description
1/4" to 1-1/2"	VG-67	2000 psi	600#, steel, bolted bonnet, R.S., reduced port, solid wedge, screwed Crane 3604 XU or Vogt 12111 or equal
6"	VG-76	960 psi	400#, steel, API Std. 6D, R.S., slab gate, venturi, handwheel operated, enclosed stem, flanges, f&d, ANSI B16.5 Grove G-4 or equal
6"	VG-77	960 psi	400#, steel, API Std. 6D, R.S., double disc, parallel seats, venturi, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Kerrotest 255 or equal
6"	VG-78	960 psi	400#, steel, API Std. 6D, R.S., double disc, parallel seats, full opening, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Kerrotest 339 H or equal

GLOBE VALVES **CLASS C**

Size	Mark No.	Maximum Working Pressure	Description
1/4" to 3/4"	VO-3	2000 psi	600#, steel, union bonnet, R.S., plug type disc, screwed Crane 3604 XW or equal
1/2" to 1-1/2"	VO-4	2000 psi	600#, steel, bolted bonnet, R.S., plug type disc, screwed Crane 3644 XW or equal
2" to 6"	VO-16	960 psi	400#, steel, ANSI B16.10, O.S. & Y., R.S., plug type disc, flanged, f&d, ANSI ANSI B16.5 Crane 161X or equal

BALL VALVES **CLASS C**

Size	Mark No.	Maximum Working Pressure	Description
3/8" to 1-1/2"	VB-63	1500 psi	1500#, Fire Safe, steel, non-lubricated, regular port, wrench operated, screwed *WKM Dynaseal 310, (B136-CS-02) or equal (Rev.1)*
2" to 4"	VB-70	960 psi	400#, Fire Safe, steel, API Std. 6D, non-lubricated, venturi, wrench operated, flanged, f&d, ANSI B16.5 Grove B-4 or equal
2" to 4"	VB-71	960 psi	400#, Fire Safe, steel, API Std. 6D, non-lubricated, full opening, wrench operated, flanged, f&d, ANSI B16.5 Grove B-4 or equal
6"	VB-72	960 psi	400#, Fire Safe, steel, API Std. 6D, non-lubricated, full opening, gear operated flange, f&d, ANSI B16.5 Grove B-5 or equal

Note: *WKM Dynaseal 2" floating ball valves are not permitted per Leak Reduction Initiative "Engineering Best Practices". (Issue #1, December 22, 2006) (Rev1)*

CHECK VALVES **CLASS C**

Size	Mark No.	Maximum Working Pressure	Description
1/2" to 1-1/2"	VC-3	2000 psi	600#, steel, lift type, horizontal, screwed Crane 3674X or equal
4" to 6"	VC-28	960 psi	400#, steel, API Std. 6D, tilting disc, non slam, horizontal or vertical (up flow only), flanged, f&d ANSI B16.5 Chapman 423A or equal
2" to 6"	VC-38	960 psi	400#, steel, API Std. 6D, swing type, full bore, horizontal or vertical (up flow only), flanged f&d, ANSI B16.5 Crane 169X or equal

FITTINGS		**CLASS C**
Size		Description
1/4" to 1-1/2"	Above Grade	3000# F.S., ASTM A105, Grade II
	Below Grade	3000# F.S., socket weld ends, ANSI B16.11, ASTM A105, Grade II
2" to 6"	Above Grade	Butt welded, steel, Standard weight, ASTM A234, ANSI B16.9
	Below Grade	Butt welded, steel, extra strong, ASTM A234, ANSI B16.9

For the use of and "Sock-o-lets" (Branch connections to pressure piping) see: Enbridge Energy Engineering Standard 3.02-9346.

***Note**: **NO "Thread-o-Lets" of any size or pressure rating are permitted on pressure piping**.* *(Rev1)*

UNIONS		
1/4" to 1-1/2"	Above Grade	3000#, forged steel, screwed, steel to steel seat, ASTM A105, Grade II
	Below Grade	3000#, forged steel, socket welding ends, steel to steel seat, ASTM A105, Grade II
2" to 6"		Use flanges

FLANGES	**CLASS C**
Size	Description
2" to 6"	400#, F.S., welding neck, R.F. bored to same I.D. as adjacent pipe, ASTM A105, Grade I, ANSI B16.5
	400# F.S., blind R.F. ASTM A105, Grade I, ANSI B16.5

Note: No Tapped blind Flanges or Threaded Flanges are Permitted. *(Rev.1)*

GASKETS

2" to 6"	"Flexitallic" Type CG or CGI

See Notes: 1, 2, and 3 of Gasket Specifications

BOLTING

All Sizes	Stud bolts with two nuts
Bolts	Stud bolts, alloy steel, ASTM A193, Grade B7, threaded full length
Nuts	Hexagon, semi-finished, "Heavy Series" ASTM A194, Grade 2H, carbon steel

See Torque Requirements

PIPE

1/4" to 1-1/2"	1st preference	*Stainless steel tubing with Swagelok compression fittings (Rev.1)*
	2nd preference	*Stainless steel tubing with Swagelok compression fittings (Rev.1)*
2" to 6"	1st preference	Schedule 80, seamless steel, Grade B, API 5L
	2nd preference	Schedule 80, seamless steel, ASTM A53, Grade B
	Below Grade	Use Schedule 80 seamless API 5L, Grade B

CLASS D - ANSI CLASS 600 (PN 100)

SERVICE

This SPECIFICATION is for piping material used in lines carrying petroleum liquids within permissible pressure and temperature limits shown below.

PETROLEUM LIQUID LINES

Maximum Pressure Temperature Rating 1,440 psig at 100°F.

STANDARDS

Standards and Specifications referred to shall be the latest revision thereof.

VALVES

GATE VALVES

Size	Mark No.	Maximum Working Pressure	Description
1/2" to 1-1/2"	VG-3	2000 psi	600#, steel, bolted bonnet, R.S., full port, solid wedge, screwed Crane 3607 XU or equal
2" to 6"	VG-9	1440 psi	600#, steel, API Std. 6D, bolted bonnet, R.S., full opening, solid wedge, flanged, f&d, ANSI B16.5 Crane 76X or Kerrotest 41 or equal
1/4" to 1-1/2"	VG-67	2000 psi	600#, steel, bolted bonnet, R.S., reduced port, solid wedge, screwed Crane 3604 XU or Vogt 12111 or equal

GATE VALVES (continued) **CLASS D**

Size	Mark No.	Maximum Working Pressure	Description
6"	VG-79	1440 psi	600#, steel, API Std. 6D, R.S., slab gate, venturi, handwheel operated, enclosed stem, flanged f&d, ANSI B16.5 Grove G-4 or equal
6"	VG-80	1440 psi	600#, steel, API STd. 6D, R.S., slab gate, full opening, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Grove G-4 or equal
6"	VG-81	1440 psi	600#, steel, API Std. 6D, R.S., double disc, parallel seats, venturi, handwheel operated, enclosed stem, flanged, f&d, ANSI B16.5 Kerrotest 265 or equal
6"	VG-82	1440 psi	600#, steel, API Std. 6D, R.S., double disc, parallel seats, full opening, hand-wheel operated, enclosed stem, flanges, f&d, ANSI B16.5 Kerrotest 349H or equal

GLOBE VALVES **CLASS D**

Size	Mark No.	Maximum Working Pressure	Description
1/4" to 3/4"	VO-3	2000 psi	600#, steel, union bonnet, R.S. plug type disc, screwed Crane 3640 XW or equal
1/2" to 1-1/2"	VO-4	2000 psi	600#, steel, bolted bonnet, R.S., plug type disc, screwed Crane 3644 XW or equal
2" to 6"	VO-9	1440 psi	600#, steel, ANSI B16.10, R.S., plug type disc, handwheel operated, flanged, f&d, ANSI B16.5 Crane 171X or equal

BALL VALVES **CLASS D**

Size	Mark No.	Maximum Working Pressure	Description
3/8" to 1-1/2"	VB-63	1500 psi	1500#, Fire Safe, steel,non lubricated, regular pattern, wrench operated, screwed *WKM Dynaseal 310 (B136-CS-02) or equal*
2" to 4	VB-73	1440 psi	600#, Fire Safe, steel, API STd. 6D, non lubricated, venturi, wrench operated, flanged, f&d, ANSI B16.5 Grove B-4 or equal
2" to 4"	VG-74	1440 psi	600#, Fire Safe, steel, API Std. 6D, non lubricated, full opening, wrench operated, flanged, f&d, ANSI B16.5 Grove B-4 or equal
6"	VB-75	1440 psi	600#, Fire Safe, steel, API Std. 6D, non lubricated, full opening, gear operated, flanged, f&d, ANSI B16.5 Grove B-5 or equal

Note: *WKM Dynaseal 2" floating ball valves are not permitted per Leak Reduction Initiative "Engineering Best Practices". (Issue #1, December 22, 2006)* *(Rev1)*

CHECK VALVES **CLASS D**

Size	Mark No.	Maximum Working Pressure	Description
1/2" to 1-1/2"	VC-3	2000 psi	600#, steel, lift type, horizontal, screwed Crane 3674X or equal
2" to 6"	VC-10	1440 psi	600#, steel, API Std. 6D, swing type, full bore, horizontal or vertical (up flow only) flanged, f&d, ANSI B16.5 Crane 175X or equal
3" to 6"	VC-20	1440 psi	600#, steel, API Std. 6D, tilting disc, non slam, horizontal or vertical (up flow only) flanged, f&d, ANSI B16.5 Chapman 623A or equal

FITTINGS		CLASS D
Size		Description
1/4" to 1-1/2"	Above Grade	3000# F.S., ASTM A105, Grade II
	Below Grade	3000# F.S., socket weld ends, ANSI B16.11, ASTM A105, Grade II
2" to 6"	Above Grade	Butt welded, steel, standard weight, ASTM A234, ANSI B16.5

For the use of "Sock-o-lets" (Branch connections to pressure piping) see: Enbridge Energy Engineering Standard 3.02-9346.

Note: NO "Thread-o-Lets" of any size or pressure rating are permitted on pressure piping. *(Rev1)*

UNIONS		
1/4" to 1-1/2"	Above Grade	3000# F.S., screwed, steel to steel seat, ASTM A105, Grade II
	Below Grade	3000#, F.S., socket welding ends, steel to steel seat, ASTM A105, Grade II
2" to 6"		Use flanges

FLANGES		**CLASS D**
Size		Description
2" to 6"		600#, F.S., welding neck, R.F., bored to same I.D. as adjacent pipe, ASTM A105, Grade I, ANSI B16.5
		600#, F.S., blind, R.F., ASTM A105, Grade I, ANSI B16.5

Note: No Tapped blind Flanges or Threaded Flanges are Permitted *(Rev.1)*

GASKETS		
All Sizes		"Flexitallic" Type CGI
≤ 24"		CGI or CG
	See Gasket Specifications	

BOLTING		
All Sizes		Stud bolts with two nuts
	Bolts	Stud bolt, alloy steel, ASTM A193, Grade B7, threaded full length
	Nuts	Hexagon, semi-finished "Heavy Series", ASTM A194, Grade 2H, carbon steel
	See Torque Requirements	

PIPE		
1/4" to 1-1/2"	1st preference	*Stainless steel tubing with Swagelok compression fittings* *(Rev.1)*
	2nd preference	*Stainless steel tubing with Swagelok compression fittings* *(Rev.1)*
2" to 6"	1st preference	Schedule 80, seamless steel, API 5L, Grade B
	2nd preference	Schedule 80, seamless steel, ASTM A53, Grade B
	Below Grade	Use Schedule 80, seamless API 5L, Grade B

CLASS E - HIGH PRESSURE INSTRUMENT LINES

SERVICE

This SPECIFICATION is for piping material used for high pressure instrument lines carrying petroleum liquids within permissible pressure and temperature limits shown below.

HIGH PRESSURE INSTRUMENT LINES FOR PETROLEUM LIQUIDS

Maximum Pressure Temperature Rating 1,440 psig at 100°F.

STANDARDS

Standards and Specifications referred to shall be the latest revision thereof.

VALVES

GATE VALVES

Size	Mark No.	Maximum Working Pressure	Description
1/4" to 1-1/2"	VG-67	2000 psi	600#, steel, bolted bonnet, R.S., reduced port, solid wedge, screwed Crane 3604 XU or Vogt 12111 or equal
GLOBE VALVES			
1/4" to 3/4"	VO-3	2000 psi	600#, steel, union bonnet, R.S., plug type disc, screwed Crane 3640 XW or equal
1/2" to 1-1/2"	VO-4	2000 psi	600#, steel, bolted bonnet, R.S., plug type disc, screwed Crane 3644 XW or equal

NEEDLE VALVES **CLASS E**

Size	Mark No.	Maximum Working Pressure	Description
1/8" to 1"	VN-2	3000 psi	3000#, excelloy, bar stock type, union bonnet, plug type disc, screwed Crane 222X or equal
BALL VALVES			
3/8" to 1-1/2"	VB-63	1500 psi	1500#, Fire Safe, steel, non lubricated, regular port, wrench operated *WKM Dynaseal 310 (B136-CS-02) or equal*

Note: *WKM Dynaseal 2" floating ball valves are not permitted per Leak Reduction Initiative "Engineering Best Practices". (Issue #1, December 22, 2006)* *(Rev1)*

FITTINGS	CLASS E
Size	Description
Steel Tubing	
1/8" to 3/4"	Stainless steel compression fittings Swagelok or equal
UNIONS	
Steel Tubing	
1/8" to 3/4"	Stainless steel compression fittings Swagelok or equal
TUBING	
1/8" to 1/2" (0.035" W.T.) 5/8" to 3/4" (0.049" W.T.)	Stainless Steel O.D., Seamless, soft annealed, pressure tested, S.A.E. 1010 or equal

CLASS F - PETROLEUM LIQUID DRAIN LINES

SERVICE

This SPECIFICATION is for material used in drain lines carrying petroleum liquids from the main pumps to the station pumps.

(For station sump pump piping see Class D.)

PETROLEUM LIQUID DRAIN LINES

Pressure Temperature Rating Atmospheric to 1,440 psig at 100°F.

STANDARDS

Standards and Specifications referred to shall be the latest revision thereof.

VALVES

GATE VALVES

Size	Mark No.	Maximum Working Pressure	Description
1/2" to 2"	VG-67	2000 psi	600#, steel, bolted bonnet, R.S., reduced port, solid wedge, screwed Crane 3604 XU or Vogt 12111 or equal

FITTINGS		**CLASS F**
Size		Description
1/2" to 2"	Above Grade	3000#, F.S., ASTM A105, Grade II
	Below Grade	3000#, F.S., socket weld ends, ANSI B16.11, ASTM A105, Grade II
2" to 6"		Butt, welded, steel, extra strong ASTM A234, ANSI B16.9

For the use of "Sock-o-lets" (Branch connections to pressure piping) see: Enbridge Energy Engineering Standard 3.02-9346

Note: NO "Thread-o-Lets" of any size or pressure rating are permitted on pressure piping. *(Rev1)*

UNIONS		
1/2" to 2"	Above Grade	3000#, F.S., screwed, steel to steel eat, ASTM A105, Grade II
2" to 6"		Use flanges

FLANGES	
2" to 6"	150#, F.S., slip on R.F., ASTM A105, Grade I, ANSI B16.5
	150#, F.S., blind, R.F., ASTM A105, Grade I, ANSI B16.5

No Tapped Blind Flanges or Threaded Flanges are Permitted *(Rev.1)*

GASKETS	
2" to 6"	Flat ring gasket, ANSI B16.21
	1/16" thick Johns Manville #60 or equal

See Gasket Specifications

BOLTING		**CLASS F**
Size		Description
All Sizes		Stud bolts with two nuts
	Bolts	Stud bolt, alloy steel, ASTM A193, Grade B7, threaded full length
	Nuts	Hexagon, semi-finished "Heavy Series" ASTM A194, Grade 2H, carbon steel
	See Torque Requirements	

PIPE		
1/2" to 6"	1st preference	Schedule 80, seamless steel, API 5L, Grade B
	2nd preference	Schedule 80, seamless steel, ASTM A53, Grade B

SUPPLEMENTARY VALVE LIST

WOG - Water, oil or gas service, non-shock at atmospheric temperatures.

RS - Rising stem.

f&d - Faced and drilled (spot facing and back facing included).

NUMERICAL LIST

MARK NO.	PIPING CLASS	MARK NO.	PIPING LIST
GATE VALVES		**GATE VALVES**	
VG-3	A,B,C,D	VG-70	A
VG-4	A	VG-71	A
VG-8	B	VG-72	B
VG-9	D	VG-73	B
VG-49	C	VG-74	B
VG-55	A	VG-75	B
VG-56	A	VG-76	C
VG-57	A	VG-77	C
VG-59	A	VG-78	C
VG-60	C	VG-79	D
VG-67	A,B,C,D,E,F	VG-80	D
VG-68	A	VG-81	D
VG-69	A	VG-82	D

MARK NO.	PIPING CLASS
GLOBE VALVES	
VO-2	A
VO-3	A,B,C,D,E
VO-4	A,B,C,D,E
VO-9	D
VO-15	B
VO-16	C

MARK NO.	PIPING CLASS
BALL VALVES	
VB-63	A,B,C,D,E
VB-64	A
VB-65	A
VB-66	A
VB-67	B
VB-68	B
VB-69	B
VB-70	C
VB-71	C
VB-72	C
VB-73	D
VB-74	D
VB-75	D

NOTE: When order Ball Valves, specify "FIRE SAFE"

MARK NO.	PIPING CLASS

CHECK VALVES

VC-3	A,B,C,D
VC-4	A
VC-8	B
VC-10	D
VC-20	C
VC-22	A
VC-24	B
VC-28	C
VC-37	A
VC-38	C

MARK NO.	PIPING CLASS

NEEDLE VALVES

VH-2	E

RADIOGRAPHY SPECIFICATION

6.7.1 SCOPE

This Specification outlines the requirements and procedures for radiographic nondestructive testing for the Contractor. All procedures, personnel, radiographic, ultrasonic, and radiographic images shall comply with the latest editions of API 1104, Welding of Pipelines and Related Facilities, the ASME Section VIII Boiler and Pressure Vessel Code, the regulations and amendments set forth by US D.O.T. Title 49 CFR Part 195, Transportation of Hazardous Liquids by Pipeline, NRC Title 10 CFR Parts 0-199, and any other applicable regulatory codes.

6.7.2 DEFINITIONS

6.7.2.1 Company – Enbridge Energy Company, Inc. and its subsidiaries and other associated affiliates.

6.7.2.2 Company Representative - the Company's authorized representative in charge of a project's radiographic inspection.

6.7.2.3 Contractor - The organization providing radiographic inspection services to the Company.

6.7.2.4 Contractor Representative - The Contractor's authorized representative in charge of Contractor's work.

6.7.2.5 MREM/HR - Millirem per hour, measurement of absorbed radiation dose in biological matter.

6.7.2.6 NRC - Nuclear Regulatory Commission.

6.7.2.7 Restricted Radiographic Area - This area shall be determined with a survey meter and shall define an area such that outside the boundaries the radiation dose absorbed in one hour shall not exceed 2 millirems (also, called the 2 MREM/HR distance).

6.7.3 CONTRACTOR'S RESPONSIBILITIES

This section outlines the responsibilities of the Contractor and its representatives.

6.7.3.1 Contractor

It is the Company's intention to employ skilled, capable workers for its construction projects and orient them to Company policies and procedures. The Contractor, therefore, shall not replace any personnel working for the Company without the Company's specific written approval. The Company reserves the right to replace, at its discretion, any employee found unsuitable to the Company for any reason.

In addition, the Contractor shall:

- Provide qualified personnel able to perform nondestructive testing in a competent and professional manner.
- Provide personnel able to manage the performance of other Contractor personnel.
- Ensure that Contractor personnel comply with all applicable safety regulations.
- Provide radiographic units and equipment appropriate for performing nondestructive testing.
- Provide storage facilities for radiographic equipment and supplies.
- Maintain radiographic equipment and supplies.

6.7.3.2 Level III Radiographic Technician

The Level III Radiographic Technical shall:

- Coordinate all details of nondestructive testing with the Company.
- Coordinate the activities of all Contractor personnel to comply with the required Contractor performance.
- Establish and record the radiographic procedures to be used.
- Certify that all welds made meet the requirements outlined in this Specification.

6.7.3.3 Level II Radiographic Technician

The Level II Radiographic Technician shall:

- Perform all exposures; however, a certified Level I may perform exposures under the direct supervision of the Level II.
- Perform all equipment set up and calibration
- Manage assistants working with the radiographic unit.

6.7.4 PERSONNEL QUALIFICATIONS

This section outlines the various qualifications and certifications required by the Company for radiographic technicians and assistants.

6.7.4.1 Level III Radiographic Technician

The Radiographic Technician shall meet all qualification standards established by federal, state, and local governments as well as those determined by the Company.

The Level III Radiographic Technician shall be examined and certified in accordance with the ANSI/ASNT recommended practice No. SNT-TC-1A. Prior to commencement of work, the Radiographic Technician shall provide a copy of his/her SNT-TC-1A certification to the Company Representative. Certification shall not exceed one (1) year.

The certification record shall include:

a. Background and experience

b. Results of qualification tests

c. Agency and person granting certification

d. Date of latest qualification test record

e. Expiration date of latest qualification test record

f. Vision examination in accordance with near-vision acuity jaeger number 2 within one (1) year

g. A color contrast differentiation examination within one (1) year.

The Radiographic Technician shall develop and provide a radiographic procedure that is in accordance with the acceptance criteria and shall demonstrate his/her capabilities to produce a quality image in accordance with the procedure. The procedure shall be recorded on the Company's radiographic qualification record form.

The Radiographic Technician's SNT-TC-1A certification shall be attached to the radiographic qualification record form.

6.7.4.2 Level II Radiographic Technician

The Radiographic Technician shall meet all qualification standards established by federal, state, and local governments as well as those determined by the Company.

The Level II Radiographic Technician shall be examined and certified in accordance with the ANSI/ASNT recommended practice No. SNT-TC-1A by a Level III technician. Prior to commencement of work, the Radiographic Technician shall provide a copy of his/her SNT-TC-1A certification to the Company Representative. Certification shall not exceed 1 (1) year.

The certification shall include:

a. Background and experience

b. Results of qualification tests

c. Agency and person granting certification

d. Date of latest qualification test record

e. Expiration date of latest qualification test record

f. Vision examination in accordance with near-vision acuity jaeger number 2 within one (1) year

g. A color contract differentiation examination within one (1) year

6.7.4.3 Level I Radiographic Assistant

The Level I Radiographic Assistant shall meet all qualification standards established by federal, state, and local governments as well as those determined by the Company.

The Level I Radiographic Assistant shall be examined and certified in accordance with ANSI/ASNT recommended practice No. SNT-TC-1A by a Level III Technician.

The Level I Radiographic Assistant shall be fully qualified, certified, and trained under a program that is based on the requirements of ANSI/ANST recommended practice No. SNT-TC-1A.

6.7.5 SAFETY REQUIREMENTS

6.7.5.1 Minimum requirements for safety while working at Company facilities have been established by the Company. Contractor shall enforce Company's minimum requirements for safety and shall monitor all actions and procedures to ensure compliance with all Company safety requirements. Contractor may enforce it's own safety requirements to extent same do not conflict with those of the Company. The Contractor shall, at all times, be responsible for taking every reasonable precaution to protect persons and property in and around the site.

6.7.5.2 If unsafe conditions or practices are discovered, the Contractor shall be responsible for taking immediate corrective action. Any accident resulting in injury or death to persons or property damage shall be promptly reported by the Contractor Representative to the Company Representative. The Contractor shall also provide a written report of each accident to the Company Representative. All Contractor employees involved in the accident may be required to take a drug test.

6.7.5.3 The Radiographic Technician shall be responsible for protecting and monitoring everyone who works with or near radiation sources. The Radiographic Technician shall inform the Company Representative of any case of survey meter or exposure device malfunction.

6.7.5.4 A clean work place shall be maintained at all times. Supplies and waste materials shall be maintained in an orderly manner at a safe distance from water supplies, fire equipment, roads, walkways, and operating facilities where employees require access.

6.7.5.5 Animals or pets shall not be permitted on Company property or the Right-Of-Way at any time.

6.7.5.6 The Company does not allow any alcohol on Company property, nor does the Company allow any person under the influence of alcohol to work on behalf of the Company. Any person suspected of or found to be under the influence of alcohol shall be removed from the Company project.

6.7.5.7 The Company will not, in any way, allow the use of illegal drugs. Any person in possession of any illegal drug or found to use any illegal drug shall be removed from the Company project.

6.7.5.8 There are several areas requiring special consideration when entering a Company facility. All Contractor personnel shall observe the following:

6.7.5.8.1 Carrying smoking materials such as cigarettes, cigars, pipes, matches, and lighters onto plant property is strictly prohibited. These items shall be left in designated "smoking areas".

6.7.5.8.2 Visitors and Contractor personnel are restricted to designated "visitor" parking areas. Additional parking will be provided for large contingents of Contractor personnel that are to be on location for an extended period of time. Vehicle entry into the plant is prohibited unless authorized by the Company representative.

6.7.5.8.3 Contractor personnel shall enter and leave Company facilities via a Contractor entrance designated by the Company Representative.

6.7.6 SAFETY EQUIPMENT

6.7.6.1 Safety equipment shall be provided to all Contractor personnel by the Contractor as specified in Title 10 CFR Part 34 and as specified below. While performing radiography work on Company facilities or on Rights-Of-Way, the Contractor shall provide Contractor's personnel with the following equipment beyond that specified in the attached Safety Guidelines for Contractors and comply with the following practices:

Film Badge (Dosimeter): Film badges shall be worn at all times by all personnel involved in radiographic examination to check for total exposure to radiation.

Pocket Dosimeter: Pocket Dosimeters shall be worn at all times by personnel involved in radiographic examination. The dosimeters shall be calibrated daily, checked for proper operation, and continuously monitored. If a dosimeter reads off the scale without explanation, then an emergency film badge reading shall be taken.

Rate Audible Alarm Meter: A properly functioning rate audible alarm meter shall be carried by the radiographic technician at all times.

Survey Meter: A properly calibrated survey meter shall be used at all times when a radiographic source is in use. A tag shall be attached to each meter indicating the calibration date and the date the meter is to be recelebrated.

a. The survey meter shall be used and passed around the circumference of the exposure device (camera) after each exposure to ensure that the source is properly seated within the device.

b. If the meter seems to be out of calibration or malfunctioning, radiographic operations shall cease until the meter is repaired or replaced.

c. The radiographic technical shall carry the survey meter at all times.

Signs and Barricade Tape: NRX approved "Caution - Radiation Area", "Caution - High Radiation Area", and "Radioactive Material" signs.

6.7.7 POSTING OF RADIATION AREAS

The survey meter shall be used to define the restricted radiographic area and beyond (if required), and the area shall be posted as specified below.

6.7.7..1 Mainline Pipeline

Two "Caution - Radiation Area" signs shall be posted in accordance with NRC, State, or Company requirements, whichever is more stringent.

Signs shall be placed along the Right-Of-Way, one ahead of and one behind the work area. Signs shall be placed at the boundaries of the "Restricted Radiographic area". This boundary is defined as the distance from the source where a radiation dose of 2 millirems could be absorbed in any one hour.

When using external sources, a "Caution - High Radiation" sign shall be placed at the 100 MREM/HR level distance.

When using internal crawler-type devices, two signs shall be placed on top of the pipeline at the 100 MREM/HR level distance, one on each side of the source.

A "Radioactive Material" sign shall be posted on the entrance to the storage area for radioactive material when on Company property such as pump stations, valve settings or pipeline Rights-Of-Way.

All darkrooms shall have "Radioactive" sign posted on all four sides. The radiographic inspection vehicle shall be kept near the work site, so that it is near the restricted area perimeter.

6.7.7.2 Station Fabrication Yards

"Caution - Radiation Area" signs shall be posted in accordance with NRC, State, or Company requirements, whichever is more stringent.

The restricted radiographic area around the source shall be roped off and posted with "Restricted Area" signs on all sides. The boundaries of this area shall be at a distance from the source such that a dose of no more than 2 millirems could be absorbed in any continuous one-hour time span. In addition, a visual watch must be kept on the restricted area at all times when the source is exposed in order to prevent inadvertent trespassing.

6.7.8 EMERGENCIES

6.7.8.1 An emergency situation exists when the source cannot be returned to the device or the source is lost.

6.7.8.2 When an emergency situation exists, the ensuing procedures shall be followed immediately:

6.7.8.3 Follow the policy required by Nuclear Regulatory Commission regulation in the "Contractor's Emergency Guidelines".

6.7.8.4 Immediately notify the Company Representative, the general Contractor's Safety Officer, the Radiographic Contractor's Radiation Field Supervisor, RSO and the required federal, state, and local authorities.

6.7.8.5 Post the area and rope it off at the 2 MREM/HR distance and post "Restricted Area" signs.

6.7.8.6 The radiographic technician or his designate shall keep a visual surveillance over the entire area until the emergency situation is resolved.

6.7.8.7 If the source is lost, secure the entire area and attempt to locate the source by using the survey meter.

6.7.8.8 When the source is located, use the survey meter to determine the boundaries of the restricted radiographic area.

6.7.8.9 Once the emergency situation has been rectified, the malfunctioning exposure device may not be used for radiography until it has been inspected and the problem repaired.

6.7.9 EQUIPMENT

This section defines the equipment required to carry out nondestructive testing operations. The equipment provided by the Contractor shall be in good working condition and available as necessary not to cause any delay to the job progress.

6.7.9.1 Gamma Ray (2 Man Unit) - Tie-Ins, Repairs

Crank-out type exposure devices equipped with collimators of tungsten, lead, or depleted uranium.

Four wheel drive truck

Air-conditioned darkroom (4'x 4'x 7')

Five-gallon chemical tanks (minimum)

Automatic 70 mm field dryer

High-intensity view lights

Necessary darkroom accessories

Four (4) kw electric generator

Densitometers

Ultrasonic thickness gauge with digital display (to check pipe wall thickness at tie-in points to existing pipe)

6.7.9.2 Internal Crawler (Minimum 3 Man Unit) - Main Line

Internal crawler

Four-wheel drive truck

One additional crawler and parts to repair equipment

Air-conditioned darkroom sufficient to develop 100% of the daily production welds and having a viewing room for Contractor inspection
Automatic 70 mm field dryer

High-intensity view lights

Necessary darkroom accessories

Four (4) kw electric generator (minimum)

Digital densitometers

6.7.9.3 Onshore External X-Ray Tube (2 Man Unit) - Tie-Ins, Repairs

External x-ray tube

One additional x-ray tube

Air-conditioned darkroom sufficient to develop 100% of the daily production welds and having a viewing room for inspection

Automatic 70 mm field dryer

High-intensity view lights

Necessary darkroom accessories

Densitometers

Ultrasonic thickness gauge with digital display (to check pipe wall thickness at tie-in points to existing pipe)

6.7.10 EQUIPMENT SPECIFICATIONS

6.7.10.1 All exposure devices shall meet the following criteria. Use of exposure devices which do not meet these criteria shall require the written approval of the Company representative prior to equipment use. Exposure devices with greater strength may be used.

6.7.10.1.1 Gamma Ray Source

2" OD to 6" OD x .432 WT	20 curies minimum
6" OD to 16" OD x .500 WT	25 curies minimum
16" OD and greater	50 curies minimum

6.7.10.1.2 External X-Ray Units

All pipe diameters and wall thicknesses	225KV/3MA minimum

6.7.10.1.3

20" OD and less	150KV/3MA minimum
22" OD to 36" OD	200KV/3MA minimum
36" OD to 48" OD	250KV/3MA minimum

6.7.10.1.4 Exposure devices shall be approved by the Nuclear Regulatory Commission and/or applicable state agency and in good working condition.

6.7.10.1.5 The exposure device shall always be locked, even when it is only being carried from one inspection location to another.

6.7.10.1.6 In case of malfunction, all radiographic activity involving the device shall be stopped until repairs can be made.

6.7.11 INTENSIFICATION SCREENS

6.7.11.1 Lead foil screens shall be used for all radiographs.

6.7.11.2 When using x-ray sources, the front screen shall have a minimum thickness of 0.005" and the back screen shall have a minimum thickness of 0.005".

6.7.11.3 When using gamma ray sources, the front and back screens shall have a minimum thickness of 0.010".

6.7.12 RADIOGRAPHIC FILM SPECIFICATIONS

6.7.12.1 Film shall be free of fog, blemishes, and artifacts.

6.7.12.2 Pre-exposure fog shall not exceed H&D transmitted density of 0.30 for transparent-based film or 0.05 for opaque-based film.

6.7.12.3 Film density shall not be less than 2.0 and not greater than 3.5 (ideally 2.5 to 3.0) through the area of interest (weld) and penetrameter. Density shall not vary more than +30% or -15% through the penetrameter when compared with the area of interest (weld) density.

6.7.12.4 Film shall be stored in a clean, dry environment where the film quality will not be jeopardized.

6.7.12.5 If film quality is questionable, unexposed sheets taken from the front and back of each package, or a length of film equal to the circumference of the original roll, shall be processed in the normal manner.

6.7.12.6 If the film shows fog, discard it or take additional film tests to prove that the remainder is free from pre-exposure fog in accordance with this Specification.

6.7.12.7 A lead letter "B" shall be placed on the back side of the film cassette for monitoring back scatter.

6.7.13 FILM USE

6.7.13.1 The following are the Company requirements for film selection. In all cases, the film used shall produce radiographs with the required Ug sharpness.

6.7.13.1.1 Gamma Ray Radiographs Class I film

6.7.13.1.2 X-Ray Radiographs Class II film

6.7.14 PENETRAMETERS

6.7.14.1 Penetramater selection shall be governed by API 1104, Figure 20, Table 6.

6.7.14.2 The penetrameter selection shall be based on the pipe wall or material thickness. Thickness of the penetrameter shall not exceed 2% of the weld thickness.

6.7.14.3 Shims shall be required as necessary to correspond to the expected weld reinforcement height and backing ring if used.

6.7.14.4 The penetrameter and shim shall be made of material that is radiographically (atomic weight) similar to the material being examined.

6.7.14.5 Lead identification numbers not less than 3/32" in height shall be attached to the penetrameter.

6.7.14.6 Holes shall be round and drilled perpendicular to the surface, with no burrs or chamfers.

6.7.15 WELDS SUBJECT TO INSPECTION

6.7.15.1 All girth welds on piping 2" and larger shall be 100% gamma ray or x-ray inspected.

6.7.15.2 The Company Representative will decide if additional welds require inspection and will identify the welds that are to be radiographed.

6.7.16 QUALIFICATION OF RADIOGRAPHIC PROCEDURES

6.7.16.1 General

The Contractor shall be required to demonstrate that the radiographic procedures to be used consistently produce acceptable radiographs while not presenting delays in the progress of a construction project. Radiographic procedures shall be in accordance with API 1104. Once the Company and the Contractor have agreed on the procedures to be used on the project, the Contractor can then proceed with the assigned work. Qualified procedures will be judged by their capacity to produce x-ray or gamma ray radiographs of sufficient clarity, density, sensitivity, and contrast. Any defects in the weld or in the pipe adjacent to the weld, the outlines of the shim and penetrameter, and the essential holes of the penetrameter shall be clearly visible in the radiograph. The Radiographic Technician shall create and qualify a separate Radiographic Qualification Record for each individual pipe diameter, wall thickness, and technique. This record will be on a form supplied by the Contractor and approved by the Company.

6.7.16.2 Qualification Methods

For mainline projects procedures shall be qualified prior to production radiography. Procedures shall be established as "qualified" if they consistently produce acceptable radiographs under the conditions outlined in this Specification.

6.7.16.3 Recording Qualification

A detail of the procedure, test results, and Company Representative approval shall be recorded on the Radiographic Qualifications Record.

6.7.16.4 Procedures Application

Once a procedure is qualified, it can be used by any other qualified Radiographic Technician employed by the Contractor. The Radiographic Technician shall satisfactorily complete and submit an additional Radiographic Qualification Record to verify his ability to comply with the established procedure. Each new unit shall radiograph one production weld in accordance with the established procedure to qualify his unit.

6.7.16.5 Change in Procedure

A new procedure is required when:

- Pipe diameter or wall thickness change.

- Radiation Source type is changed (ex: gamma ray to x-ray).

- Intensifying screens are added, deleted or otherwise changed.

- Film type or processing is changed.

- Exposure geometry is changed (ex: SWE/SWV to DWE/SWV).

- Penetrameter type, material, identifying number, essential hole or shim material or thickness are changed.

NOTE: The strength of a gamma ray (source) is not an essential variable requiring an additional procedure. The gamma ray (source) deteriorates at a given rate regardless of use.

6.7.17 TESTING TECHNIQUES

6.7.17.1 Single Wall Exposure for Single Wall Viewing (SWE/SWV). See Appendix 1.

6.7.17.1.1 Source Alignment

The source shall be centered in the pipe and positioned so that the projected beam passes through the center of the weld. Maximum deviation from the perpendicular shall not be greater than 5E.

6.7.17.1.2 Source to Object Distance

Eight (8) times the weld thickness minimum.

6.7.17.1.2 Exposures per Weld

One (1)

6.7.17.2 Double Wall Exposure for Single Wall Viewing (DWE/SWV). See Appendix 2.

6.7.17.2.1 Source Alignment

The source shall be positioned on the exterior so that the center of the projected beam passes through the center of the weld portion being examined. The source may be offset to avoid superposition of weld images. Maximum offset shall not be greater than 5°.

6.7.17.2.2 Source to Object Distance

Pipe diameter distance

6.7.17.2.3 Exposures per Weld

Gamma ray sources require a minimum of three (3) exposures per weld. X-ray sources require a minimum of four (4) exposures per weld.

6.7.17.2.4 Film Position

Film shall be in direct contact with the weld and centered to the section of the weld being examined. A minimum overlap of two (2) inches is required at each end of acceptable film length.

6.7.17.3 Penetrameter Placement

6.7.17.3.1 SWE/SWV - Four (4) penetrameters shall be equally spaced around the circumference.

6.7.17.3.2 DWE/SWV - If the film length is five (5) inches or less, one (1) penetrameter shall be placed on the film side, diametrically opposed to the source.

6.7.17.3.3 If the film length is greater than five (5) inches, two (2) penetrameters shall be used. One (1) penetrameter shall be placed within one (1) inch of the end of the film area to be interpreted. The second penetrameter shall be positioned so that it is diametrically opposed to the source.

6.7.18 FILM PROCESSING METHODS

6.7.18.1 The Contractor has the option to use either automatic or manual film processing. Processing shall be done in such a way that radiographs can be stored without risk of discoloration for up to three (3) years after the line has been placed in service

6.7.18.1.1 Automatic Film Processing

6.7.18.1.1.1 Operate film processors in accordance with recommendations established by the equipment and processing chemical manufacturers.

6.7.18.1.1.2 The Contractor shall have standby manual film processing capability.

6.7.18.1.2 Manual Film Processing

6.7.18.1.2.1 Follow manufacturer's recommendations on chemical mixing, replenishment, and replacement.

6.7.18.1.2.2 Processing solutions, including wash water, shall be at a temperature of 68°F.

6.7.18.1.2.3 Change wash water at least once a day.

6.7.19 INTERPRETATION OF RADIOGRAPHS

6.7.19.1 The procedures used by the Contractor shall produce images that meet the acceptance criteria as defined in API 1104 and this Specification. All requirements that refer to the quality of the resulting images shall apply equally to x-rays and gamma rays. The following criteria shall be used to evaluate images.

6.7.19.1.1 Radiographs shall have an acceptable image quality that is free from fog, film artifacts (crimps, chemicals, scratches, etc.), and processing irregularities that could mask the image of actual discontinuities.

6.7.19.1.2 Artifacts on the film in the area of interest that interfere with the interpretation of the film shall be cause for rejection of the radiograph and the weld shall be re-radiographed.

6.7.19.1.3 Radiographs shall have the density, clarity, and contrast required by API 1104, Welding of Pipelines and Related Facilities, Section 6.0 - Acceptance Standards for Nondestructive Testing.

6.7.19.1.4 Images produced shall have the requisite sensitivity to define clearly the essential hole of the proper penetrameter.

6.7.19.1.5 Radiographs shall be identified correctly using the identification system outlined in this Specification.

6.7.19.1.6 The Contractor shall use an acceptable technique, set-up and procedure to produce all radiographs.

6.7.19.1.7 Radiographs shall be evaluated with high-intensity view light. Radiographs shall be evaluated when dry, unless otherwise instructed by Company Representative.

6.7.19.1.8 The Contractor Radiographic Technician (Level II or higher) shall provide a preliminary film interpretation. **The Company shall provide final film interpretation.**

6.7.19.1.9 The acceptance criteria for defects and discontinuities is contained in API 1104.

6.7.20 UNACCEPTABLE WELDS

6.7.20.1 A weld is classified as "unacceptable" if it does not meet the acceptance criteria outlines in this Specification.

6.7.20.2 The weld shall be recorded as specified in this Specification.

6.7.20.3 All welds that are repaired or replaced shall be re-radiographed.

6.7.20.4 More than two repairs to a given weld is not an approved practice. Before radiographic examination of a weld that has been repaired more than twice, the Radiographic Representative shall obtain approval form the Company Representative.

6.7.21 RADIOGRAPH IDENTIFICATION

6.7.21.1 Radiograph Numbering System

All radiographic films shall be identified by their weld ID number, number belts, pipeline number, and work order number unless otherwise stated in this Specification. Number belts, mark the zero and an arrow showing the orientation of the belt on welds with paint stick. The radiograph numbering system shall provide a ready means of cross-referencing the actual location of a weld to its assigned radiographic number entered on the X-Ray Inspection Report of Field Girth Welds, Appendix 1 and Appendix 2.

6.7.21.1.1 Stations

All Station piping constructed on Enbridge's Southern Access Station Projects shall have 100% non-destructive examination (NDE) of the girth welds. NDE shall be either by radiographic or ultrasonic inspection. The following system is devised to provide a simple and unique identification on each girth weld in the completed pipeline:

- **First;** Location of weld will consist of the station number (130) Superior, (502) Minong, (510) Sheldon, (522) Vesper, (527) Rio, (534) Delevan.

- **Second;** Weld Numbers: Consecutive number shall be used starting with the number 1, for each new corresponding girth weld, regardless of the location of the weld in relation to the previous weld.

- **Third;** Type of weld (SW) station weld no specific type, this includes small diameter piping, (TI) tie-in weld, (FB) fabrication shop weld and (MT) for magnetic particle examination.

- **Modifiers;** The original NDE weld number shall be reused when repairs or cut-outs are required **followed by** one of the following modifiers (as applicable):
  For a repair weld, add "R"
  For a cut out weld, add "N"
  For a weld requiring a second cutout, add "NN"
  For a replacement weld requiring repair, add "NR"

NDE numbers including all the above information shall be written on the top of the pipe adjacent to each weld using a permanent type marker or paint stick.

A weld map using the station piping drawings shall provide the location of each weld to correspond the weld schedule.

Film boxes and Reader Sheets for x-ray or ultrasonic NDE shall be referenced back to station location.

EXAMPLES:

1. Superior Station 1st weld = **130-001-SW**
2. Minong Station 15th fab shop weld = **502-015-FB**
3. Sheldon Station 20th Tie-in weld = **510-020-TI**
4. Sheldon Station new NDE on a repair of a tie-in weld = **510-020-TI-R**
5. Delevan Station 5th weld with a cut out = **534-005-SW-N**
6. Rio Station 1st TDW = **527-001-MT**
7. Vesper Station 15th weld drain line = **522-015-SW**

6.7.22 RADIOGRAPH FILING

6.7.22.1 Film shall be submitted to the Company after film is placed in box with separate spacing for each weld.

6.7.22.2 Write the weld or radiograph number on appropriate space on each slot in box of film.

6.7.23 REFERENCES

6.7.23.1 Code of Federal Regulations Title 49, Part 195, issued by the Department of Transportation (D.O.T.).

6.7.23.2 ANSI/ASNT Recommended Practice No. SNT-TC-1A, Supplement A, "Radiograph Testing Method".

6.7.23.3 API Standard 1104, Welding of Pipelines and Related Facilities

6.7.23.4 Code of Federal Regulations Title 10, Parts 0-199, issued by the Nuclear Regulatory Commission.

6.7.23.5 ASME - B31.3, "Chemical Plant and Petroleum Refinery Piping", Section V, "Nondestructive Testing".

6.7.23.6 ASME Boiler and Pressure Vessel Code, Section V Nondestructive Examination - Subsection A, Articles 1, 2, 3 and Subsection B, Article 22.

SPECIFICATIONS FOR CONSTRUCTION

PART 6 - SECTION 8

BLASTING NEAR BUILDINGS AND PIPELINES

April, 2000

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BLASTING NEAR BUILDINGS AND PIPELINES

6.8.1 EXCAVATION ADJACENT TO EXISTING BUILDINGS

A. General

Material to be excavated should be classified and the quantities estimated on the basis of the data available from the contour plan and the geotechnical report.

Excavation materials shall be classified as rock or earth excavations. The PROJECT ENGINEER shall provide direction regarding the removal of materials from the site or borrow areas and the transportation of the materials to designated areas of use or disposal.

B. Rock Excavation

Rock excavation shall be defined as the excavation of materials from solid masses of igneous, sedimentary, or metamorphic rock that, prior to its removal, is part of a solid or continuous mass, as well as boulders or rock fragments having an individual volume in excess of five cubic yards.

1. Solid Rock Excavation

Rock materials requiring drilling and blasting along with barring and wedging for its removal.

2. Rippable Rock Excavation

Rock materials that can be dislodged by the ripping method without the use of blasting.

When rock is encountered, consideration shall be given to the use of rock saw type equipment to eliminate the hazards produced by blasting.

When blasting is necessary, mats and other safeguards shall be used to prevent scattering of loose rock over the right-of-way and adjacent fields and to prevent damage to existing facilities.

The CONTRACTOR shall comply with the requirements of the blast permit, local and state regulations and United States Department of Transportation 29 CFR 1926.900 to .914.

6.8.2 BLASTING (EXPLOSIVES)

Blasting by the CONTRACTOR will not be permitted without prior authorization from the Manager of Engineering and District Manager. When authorization to blast has been received, a detailed blasting and safety procedure will be submitted to the COMPANY for approval prior to the commencement of blasting. The PROJECT ENGINEER and the COMPANY Senior Safety Coordinator shall review and approve these procedures.

Prior to detonation of explosives, the CONTRACTOR shall provide a minimum of 48 hours notice to the COMPANY. The COMPANY will take the necessary measures to reduce operating pressure in the adjacent pipeline(s). In addition, the CONTRACTOR must also notify local law enforcement and nearby residents, sufficiently in advance, to enable them to protect persons, property and livestock. The CONTRACTOR will place signage and/or personnel to warn and safeguard the public if, in the opinion of the COMPANY INSPECTOR, this is necessary. Blasting shall not be performed unless the COMPANY INSPECTOR is present.

The CONTRACTOR shall employ personnel qualified and skilled in blasting operations and will exercise care to prevent damage to pipe that has been strung, nearby structures, overhead telephone, telegraph and/or power lines or underground structures such as cables, conduits and pipelines, as well as to springs and underground watercourses. Explosive agents must in all instances be acceptable to the COMPANY. All necessary permits for blasting shall be obtained by the CONTRACTOR.

Controlled blasting will be required when blasting is performed in the vicinity of overhead facilities or structures. Blast mats shall be used, as directed by the COMPANY to preclude damage due to fly-rock.

Where the pipeline route parallels or crosses an electrical transmission corridor, a potential hazard exists whereby a premature initiation of blasting could be triggered by the stray current from an electrical field that may exist at these locations. The CONTRACTOR shall assess the hazard and may have to restrict the use of electrical detonation caps to a safe distance from such corridors.

To avoid premature detonation of any blast circuit due to static electricity, blasting operations shall be suspended under high wind, dust, snow and dry conditions. Similarly, all moving equipment, including trucks used in the vicinity of electrical blasting operations shall be grounded via a ground strap or other approved method.

All blasting operations shall be suspended and all persons and equipment withdrawn immediately at the first indication of an approaching electrical storm.

Mobile radio transmitters and pagers shall be kept well away from areas of electrical blasting operations and signs shall be posted indicating that all transmitters near the site should be turned off. Drill holes shall not be left loaded overnight unless approved by the COMPANY. When approved, the following restrictions shall apply as a minimum and are subject to review by the COMPANY'S blasting consultant.

- No electrical detonation caps, leg-wires or connecting wires shall be left in place overnight.

- No trunk or surface line primacord connecting individual pigtails shall be left in place overnight. Tying in and relaying of the shot must be delayed until the start of the following day's activities.

All mobile equipment used in clearing fly-rock after a blast shall be equipped with a blast shield in front of the operator's position to protect the operator from fly-rock should a non-detonated charge be encountered.

A controlled area shall be established in all directions from the blast site prior to any blast. No person or vehicles, except the blaster, shall be within this controlled area at the time of blast detonation. All access roads to the blasting sites shall be blocked off and signed while blasting operations are taking place.

An audible blast warning system shall be employed for all blasting. The siren used for a blast signal shall be a distinct sounding siren used on the construction site. Use of vehicle horns as blast signals shall not be permitted in an emergency.

6.8.3 PRECONDITION SURVEY

Due to the potential for damage, the CONTRACTOR shall conduct a precondition survey of all structures within 150 feet of the blasting area. The survey shall be conducted under the responsibility of a professional engineer registered in the state where the WORK is being performed and all reports shall be certified by this engineer.

The minimum required survey for all buildings within the described zone shall document the existing exterior condition of the properties. The survey shall include a documentation of the roof and visible exterior as viewed from grade level with special attention to any visible foundation walls. It shall be detailed by engineering sketches, notes and photographs any existing structural, cosmetic, plumbing or electrical damage visible from the exterior. This level of documentation will be identified as "type A" on the plans.

A more in depth condition survey may be required on specific buildings due to special circumstances, location or condition of the structure as determined by the PROJECT ENGINEER. Those requiring the more in depth documentation will be noted on the drawings as Documentation "Type B". For "Type B" documentation, the building condition survey shall document the existing exterior and interior condition of the property. The survey shall include documentation of the interior subgrade and above grade accessible walls, ceiling, floors, roof and visible exterior as viewed from grade level. It shall be detailed by engineering sketches, notes, and photographs any existing structural, cosmetic, plumbing and electrical damage.

A. Crack Measurement

The CONTRACTOR shall measure and record each significant crack found in the structure (for Type A and B). The measurements shall be recorded on the condition survey forms.

B. Method of Recording

The survey shall consist of taking notes by hand on the condition survey forms and taking black and white photographs in 35mm format, both describing existing structural and cosmetic defects in the buildings. Each roll of film used shall be developed and printed on 8" x 10" contact proof sheets. Each proof sheet shall contain pictures from one roll of film. Each photograph shall be identified immediately upon development.

Field notes and photo proof sheets will be reviewed for completeness, accuracy and neatness by the CONTRACTOR'S professional engineer who shall certify the field notes and ensure proper correlation between the notes and photos. Appropriate corrections or modifications shall be made if necessary.

The original field notes, photo contact sheets and negatives shall be retained in the custody of the CONTRACTOR on behalf of the COMPANY for a period identified by the COMPANY.

C. Reports

One copy of the field notes and one set of photo contact sheets shall be indexed and bound into report format, with a brief typed introduction describing the building condition survey and major findings. The report shall be submitted to the COMPANY prior to any blasting activities.

Each owner shall be supplied with a copy of the documentation and a paper copy of the photographs relevant to his property.

Any requests for copies of the precondition survey notes and/or photographs, other than from the COMPANY, shall be referred to the COMPANY for disposition.

Any requests by the COMPANY for copies of survey and photographic data developed by the CONTRACTOR for the report, except those included in the report specified above shall be supplied by the CONTRACTOR on a time and material basis.

D. Time Schedule

The CONTRACTOR shall not start blasting work on the project until the precondition survey has been completed, submitted and written authorization has been received from the PROJECT ENGINEER.

6.8.4 VIBRATION MONITORING AND CONTROL

A. Instrumentation

The CONTRACTOR shall furnish and maintain at least one vibration monitor (amplitude and frequency sensitive) before beginning any operations that could, in the judgement of the PROJECT ENGINEER, produce ground vibrations or air blast(s). Monitors shall be placed on the ground on the blast side of structures most likely to be damaged by the particular blast or as directed by the PROJECT ENGINEER. In the event that the CONTRACTOR chooses to have concurrent vibration producing activities at more than one location on the construction site, the CONTRACTOR shall notify the PROJECT ENGINEER in writing at least two days prior to the commencement of such activities. The PROJECT ENGINEER may require additional vibration monitoring instruments depending on site parameters. No additional vibration producing activities may be started until the appropriate instrumentation are provided by the CONTRACTOR and approved by the PROJECT ENGINEER.

All vibration monitoring instruments shall be powered with rechargeable batteries, and the CONTRACTOR shall supply extension geophone and microphone cables so that the instruments can be placed within the structure if outside temperatures drop below 0°C (32°F). All vibration instruments shall be supplied with current calibration documents and shall be recalibrated every six months. At a minimum, instrument specific calibration curves shall be provided over the specified frequency ranges at both 0.5 inch and one inch per second for each instrument.

The CONTRACTOR shall be responsible for instrument maintenance. If no operational instruments are available at any given time, the PROJECT ENGINEER may direct that all vibration producing activities cease until necessary instrumentation is working. Recording tape shall be supplied by the CONTRACTOR and at least a two-week supply maintained. The CONTRACTOR shall name one individual in his organization who will be responsible for instrument coordination.

B. Vibration Monitors

The vibration monitoring instruments shall be capable of measuring, recording, producing a hard copy of the frequency and peak particle velocities on three mutually perpendicular axes, along with recording air blast pressure. "Vector Sum": instruments are not acceptable. The instruments shall also have the following features:

1. Self Triggering

2. Permanent record of the time history of the vibration event readable in the field, and the ability to process the data to determine the frequency of all three-peak vibration levels. The

permanent field record shall be of a quality that will permit ready interpretation of frequency content up to 150Hz.

3. A digital display or printout which will yield immediate results of the three components of vibration frequency and air blast.

4. Sensitivity angles adequate to resolve peak particle velocities from 0.01 inch to 4 inches per second.

5. Frequency range from 5-200 Hz+/- 3 dB.

C. Definitions

The following definitions apply to the vibrations and air blast controls:

- Peak particle displacement - The peak displacement is the maximum movement induced by the vibration.

- Frequency - The frequency of vibration is the number of oscillations that occur in one second. The frequency units given are in Hertz (Hz); one Hz equals one cycle per second.

- Air Blast - The air blast is the peak overpressure above or below atmospheric pressure resulting from a blast. The air blast is given in units of pounds per square inch (psi), dB or kilopascals (kPa), which is referenced to sound pressure of 20 micropascals.

D. Ground Vibration and Air Blast Control

The following vibration and air blast control limits are applicable for all blasting on the project, but the ground vibration control is also applicable to all other construction work, including but not limited to pile driving, compaction and hauling activities. The CONTRACTOR is advised that vibration attenuation is affected by the presence of groundwater.

The CONTRACTOR is also advised that the ground vibration and air blast control limits defined herein restrict his blasting practice. To meet the specified limits, the CONTRACTOR shall make whatever modifications are necessary, including but not limited to the use of more delays, smaller rounds, more blast holes, shallower lifts and smaller charges. The CONTRACTOR shall consider these limitations in preparing his bid.

The ground vibration and air blast controls are applicable to external locations and adjacent to all structures.

If the CONTRACTOR'S operations result in values which exceed 80 percent of the ground vibration limit, or 2 dB less (80 percent of pressure value) than the air blast limit for any single blast, he shall suspend that activity and submit a report. This report shall give the blast data and include the proposed

corrective action to ensure that the specified limit is not exceeded for future blasts. This report shall be submitted to the PROJECT ENGINEER, and his permission must be obtained before continuing blasting or engaging in other significant vibration producing activities.

If the CONTRACTOR exceeds the ground vibration or air blast limit (as given in the following section) for any single blast, the PROJECT ENGINEER will direct that all activities related to those causing vibration or air blast, including drilling operations, be stopped. The CONTRACTOR shall submit to the PROJECT ENGINEER a report giving the blast data and shall include the proposed corrective action for future blasts. In order to proceed with any future blast, written permission must be obtained from the PROJECT ENGINEER.

F. Ground Vibration Control Limit

Measurements for this limit will be made at external ground locations adjacent to affected buildings, structures and pipelines. The vibration criteria will be measured in peak particle velocity. No controls have been established for in place utilities, and the CONTRACTOR shall conduct his operations in a way that will prevent damage to them.

In general, expected particle velocity should not exceed 4 in./sec. for a charge detonation and the combined stress on pipe shall not exceed 20% of allowable stress per SMYS.

The maximum single component peak particle velocity resulting from construction activity shall not exceed the values given below:

Frequency of the Peak Particle Velocity (Hz)	**Allowable Peak Particle Velocity** {(inches per second}
40 or less	1.00
50	1.25
60	1.50
70	1.75
80	2.00
90	2.00
100	2.00
110	2.00
120 or greater	2.00

The frequency and peak particle velocity shall be analyzed. The frequency is defined as that associated with peak particle velocity pulse of the ground motion and is calculated as the inverse of twice the time interval between the two zero crossings of that pulse.

G. Air Blast Control Limit

The maximum air blast resulting from blasting shall not exceed the values given in the table below:

Frequency Range of Instrumentation	Maximum Air Blast (dB)	Maximum Air Blast (psi)
0.1-200 Hz, flat response	134	0.015
2.0-200 Hz, flat response	133	0.013
6.0-200 Hz, flat response	129	0.008

6.8.5 MODIFICATIONS TO MEANS, METHODS AND EQUIPMENT

The CONTRACTOR shall modify the means, methods and equipment he uses so damage to property is eliminated. If field experience demonstrates that damage has or may occur, modifications shall be made to previously submitted and approved blasting plans.

The PROJECT ENGINEER shall, at all times, have the authority to prohibit or halt the CONTRACTOR'S blasting operations if, through the methods being employed jeopardizes the safety or convenience of the public.

6.8.6 BLASTING DAMAGE

Blasting will create air and ground vibration that may damage adjacent structures. The CONTRACTOR shall make an assessment of damage potential, based on the blasting work he plans and shall make any adjustments necessary to eliminate damage.

Should the CONTRACTOR'S blasting operations or the accidental detonation of explosives under his control cause damage to any structure, property, well or other facility, he shall immediately undertake emergency action to repair the property, structure, or facility back to a safe and usable condition. Thereafter and without delay, he shall undertake all permanent repairs, reconstruction, and other work necessary to restore the property, structure or facility to at least as good a condition as that preceding the event causing the damage. The CONTRACTOR'S responsibility in this regard is absolute.

6.8.7 SHORING

In Type 1 to 3 (Type A to C) soil conditions, when vertical trench excavations are deeper than four feet, but less than 20 feet, and when the presence of a worker is required or possible, a temporary protective structures shall be provided.

Temporary shoring systems shall be designed and certified by a professional engineer registered in the state in which the work is being done. Shoring systems shall be installed by a competent person(s).

When groundwater or unstable soil, such as muck and peat, are present, recommendations from the geotechnical consultant should be obtained.

6.8.8 BLASTING EXCAVATIONS ADJACENT TO EXISTING PIPELINE

Rock excavation with the use of explosives is not permitted on the site without prior approval from the COMPANY. If and when blasting is permitted the WORK shall be executed in accordance with the COMPANY'S CONSTRUCTION SAFETY MANUAL.

In general the CONTRACTOR shall use methods, techniques and procedures to produce smooth and sound peripheral surfaces of all completed excavation that will minimize over-break and avoid damage to adjacent structure. All rock excavation shall be completed before any structural element is installed in the vicinity of the rock excavation. Loose rock and rock fragments shall be scaled immediately from excavation walls and areas adjacent to the excavation.

If and when blasting is permitted, the CONTRACTOR shall submit a blasting program for review. The proposal shall be prepared by a blasting consultant or a licensed explosives expert as deemed necessary by the COMPANY. In general the proposal shall include the following:

- Types and quantities of explosives to be used
- Loading charts and drill hole patterns
- Type of caps
- Blasting techniques
- Blast protection measures for items such as fly rock, vibration, dust, and noise control
- Details on protection measures; time of blasting and other pertinent details.

In general, expected particle velocity should not exceed 4 in/sec for a charge detonation and the combined stress on pipe shall not exceed 20% of allowable stress per SMYS.

Prior to blasting the CONTRACTOR shall carry out a survey jointly with the INSPECTOR to determine the condition of existing structures and facilities in the vicinity of the proposed blasting Seismographic monitoring, if deemed necessary by

the COMPANY, will be carried out to monitor the effects of the blasting. Cost of this monitoring will be the CONTRACTOR responsibility.

The criteria pertaining to allowable vibrations in general; allowable vibrations and distances for new concrete/grout; and allowable vibrations and distances for adjacent structures shall be as determined by the blasting consultant or licensed explosives expert. Irrespective of the criteria determined, all costs for repairing damages resulting from the blasting operations shall be borne by the CONTRACTOR. The CONTRACTOR shall submit complete and accurate records of all drilling and blasting.

Michigan Public Service Commission
Case No.: U-16937
Exhibit No.: A-4

SPECIFICATION FOR PIPELINE CONSTRUCTION (USA)

PIPELINE CONSTRUCTION

Revision 1

Table of Contents

1 SCOPE

1.1 General

1.1.1 This Specification outlines the minimum requirements for the installation of pipeline systems. The Contractor shall ensure that the pipeline installation requirements set out in this Specification are complied with by the Contractor to the extent they are applicable in the circumstance. Except as otherwise expressly provided herein; the Contractor is responsible for implementing this Specification. The Contractor shall be solely responsible for ensuring that the Work is performed in strict compliance with Environmental, Health, and Safety Laws.

2 ACTS, REGULATIONS, LAWS, CODES, AND STANDARDS

2.1 General

2.1.1 The latest approved edition of the following Acts, Codes, and Standards shall form part of this Specification. It is the Contractor's responsibility to become familiar with the latest approved editions of the Acts, Regulations, Laws, Codes, and Standards that are necessary for the performance of the Work. These and the regulations referenced within shall include but not be limited to the following:

(a) US DOT Title 49, CFR, Part 195, Transportation of Hazardous Liquids by Pipeline,

(b) ASME B31.4, and

(c) All other codes, standards, and plans referenced within this specification, if they exist.

2.1.2 If there is a conflict between the Acts, Regulations, Laws, Codes and Standards the most stringent requirement shall be met by the Contractor without additional cost to the Company.

2.1.3 The Contractor shall comply with the requirements of all applicable Acts, Regulations, Laws, Codes, and Standards in performance of the Work. Environmental plans and permits shall be considered contract specifications and will be enforced as such. If discrepancies between contract specifications and permits exist, the more stringent of the two shall apply. Any doubt as to which is the more stringent shall be resolved by the Company.

2.1.4 Contractors shall be liable for any damages, costs, fines, or penalties imposed by environmental regulatory agencies for violations of any environmental permits, laws, or regulations by the Contractor or its personnel and shall hold the Company harmless and indemnify the Company for any such damages, costs, fines, or penalties.

2.1.5 In addition all work shall be performed in strict compliance with the bid documents, good engineering practice, industry accepted pipeline construction and installation techniques, and all applicable rules and regulations.

3 RELATED TECHNICAL SPECIFICATIONS AND STANDARDS

3.1 General

3.1.1 The following Technical Specifications and Standards shall be read in conjunction with this Specification. The requirements of these documents shall become part of this Specification by reference herein:

(a) USPCS-SPEC-PLW-002 Pipeline Welding;

(b) USPCS-SPEC-NDT-003 Non Destructive Testing;

(c) USPCS-SPEC-PFC-004 Pipeline Field Coating;

(d) USPCS-SPEC-HYDRO-005 Pipeline Hydrostatic Testing;

(e) USPCS-SPEC-HDD-006 Horizontal Directional Drilling; and

(f) USPCS-SPEC-PCCT-007 Post Construction Caliper Tool;

(g) USPCS-SPEC-HDB-008 Horizontal Directional Bore; and

(h) USPCS-SPEC-CCC-009 Continuous Concrete Coating.

4 GENERAL REQUIREMENTS

4.1 General

4.1.1 Pipeline construction shall be performed in accordance with CFR Part 195 and ASME B31.4 unless such requirements are exceeded herein. The Contractor shall also adhere to the requirements of all Governmental Authorities during the performance of the Work.

4.1.2 The Contractor shall have a documented Quality Program in place and a controlled copy of the Quality Program Manual shall be available to the Company at the place of Work. The Company may conduct an audit of the Contractor's implementation of the Contractor's Quality Program.

5 CONSTRUCTION EQUIPMENT

5.1 General

5.1.1 Pipeline construction equipment employed shall be of suitable type and size to construct the pipeline in accordance with this Specification.

5.1.2 Equipment shall be supplied clean, free of leaks, in a safe condition, good working order, properly maintained and serviced and in sufficient quantities to facilitate the installation of the pipeline at a rate meeting the production requirements of the Contract Documents.

5.1.3 Prior to mobilization to the site all equipment shall be free of any vegetation, seed and soil deposits.

5.1.4 The Company, in its sole discretion, reserves the right to prohibit the use of any piece of equipment deemed to be unsuitable for use in the performance of the Work.

6 PIPELINE INSTALLATION MATERIALS

6.1 General

6.1.1 Materials supplied by the Contractor to be incorporated in the Work or consumed during the installation shall be new, in accordance with the Specifications, and when not specified by the Company, fit for the intended service.

6.1.2 The Company reserves the right to prohibit the use of materials it deems unsuitable for proper performance of the Work. All Contractor supplied material will be accompanied by (Material Tracking Records (MTR's) where applicable.

7 RIGHT-OF-WAY AND TEMPORARY WORK SPACE

7.1 Sufficiency of the Right-of-Way and Workspaces

7.1.1 Prior to construction the Company will obtain the Right-of-Way and temporary workspaces shown on the Project Drawings with such minor modifications as may be approved by the Company. The Construction Right-of-Way may include a portion of the existing Right-of-Way, new easements and/or working rights areas where such have been acquired by the Company. In addition, the standard Construction Right-of-Way widths may be reduced substantially in certain areas, as indicated on the Drawings. Unless written approval is obtained from the Company in advance, construction operations shall be strictly confined to these areas.

7.1.2 For the Contractor's construction operations, the Company will provide construction Right-of-Way that, unless specified otherwise in construction permits, Right-of-Way Agreements, Construction Line Lists or on Drawings, will consist of Temporary Work Space as described in the project documents. Working over the existing pipelines shall be strictly prohibited without prior written approval by the Company.

7.1.3 Temporary Work Space as shown on the Drawings will be secured by the Company. The Temporary Work Space limits will be strictly enforced throughout the project.

7.1.4 Temporary Work Space agreements between the Contractor and a third party may only be made with Company approval. All agreements shall be in writing and furnished to the Company prior to authorization.

7.1.5 The Company shall acquire licenses and permits required for the installation of the pipeline that only an owner of a pipeline can obtain, as defined by the Company. The Contractor shall obtain all other permits and licenses and prepare and submit all notices required by Authorities having jurisdiction.

7.1.6 The Construction Line List and Crossing Agreements include information and special requirements for each property and foreign facility crossed by the pipeline. The Contractor shall familiarize itself with, and construct the pipeline in accordance with the conditions of Right-of-Way and Crossing Agreements, licenses, and permits.

7.1.7 Right-of-Way and workspaces including but not limited to, access roads (shoo-flies), staging areas, and storage areas shown on the Project Drawings are considered to be sufficient to construct the pipeline. If conditions change from what could have been anticipated at time of bid, resulting in the need for additional Right-of-Way or workspace in order to construct the pipeline; the Company, if in agreement acting in its sole discretion, shall endeavour to acquire the additional Right-of-Way and or workspace at the Company's expense.

7.1.8 The Company shall be contacted immediately if the Contractor feels it requires additional workspace for access roads (shoo-flies), staging areas, push-outs, deck sites, etc. If the Company agrees with the requirement for additional space it will endeavour to obtain the appropriate permits and approvals at the Contractor's sole cost and expense.

7.1.9 To request Company approval for use of areas such as additional work space, staging areas or access roads not pre-approved by the Company, the Contractor shall provide a written request to the Company that will include, at a minimum, the following:

(a) A map showing the location of the space to be reviewed,

(b) A legal description of the property,

(c) A sketch showing dimensions and layout, and

(d) A brief description of the planned use, including planned changes to the site.

7.1.10 The Contractor shall be responsible for any and all costs, including the Company's costs, resulting from off Right-of-Way activities by the Contractor. Compensation payable by the Contractor to the Landowner for such damages will be negotiated by the Company on behalf of the Contractor.

7.1.11 Should any violations occur, the crew in violation, at the discretion of the Company, will stop work until further assessment by the Company. All costs associated with a work stoppage due to Right-of-Way limit violations shall be borne by the Contractor.

7.1.12 Contractor damages considered negligent as determined by the Company shall be at the Contractor's expense. Damages shall be settled prior to the Contractor leaving the Work areas, and any disputed claims shall be withheld from the Contractor's retainage.

7.1.13 The Company provides no guarantee that additional workspace requested by the Contractor will be acquired or in what period of time. If the additional workspace is not available, the Contractor shall construct the pipeline in the space available using applicable construction methods necessary at no additional cost to the Company.

7.1.14 The Contractor shall positively identify, in advance, the location and required clearance of existing underground and overhead facilities which may be encountered and determine any necessary changes in grade or location.

7.1.15 Where possible, the Company will make available information pertinent to the location of underground facilities. The location of underground structures as shown on the Drawings or given on site by the Company shall be only for the assistance of the Contractor.The ultimate responsibility for locating such underground facilities and structures remains with the Contractor. The Contractor shall avoid damage to and shall be liable for damages to all such structures. The Contractor shall be responsible for all underground utilities whether or not they are located by the Company or referenced on the Drawings.

7.1.16 The Contractor shall be responsible for notifying pipeline, telephone, power, and other companies or agencies that have structures above or below ground either across the construction route or near enough that there could be damage during construction. The Contractor shall notify and comply with the appropriate local utility protection system or the state one-call system, following appropriate notification procedures and permit conditions. In addition, the Contractor shall provide the Company with a record of all notifications.

7.1.17 Utility poles in the path of Construction that require removal or re-location shall be coordinated by the Contractor in advance of construction commencing.

7.2 Conditions of Use of the Right-of-Way and Workspaces

7.2.1 At certain locations the pipeline may be routed adjacent to or across other pipelines, highways, railroads, power and telephone poles and wires, embankments, cliffs, rivers, trees or other obstacles which may physically restrict or limit the use of the Right-of-Way. In some cases such physical confinement may necessitate special methods of construction of the pipeline. Such methods must be pre-authorized by the Company.

7.2.2 When acquiring Right-of-Way along the route of the line, it may be necessary at various locations for the Company to agree to certain special requirements by landowners and tenants. Special requirements shall be noted on the Project Documents. The Contractor shall comply with these special requirements at no additional costs to the Company. If Line Lists are incomplete at the time of bid, items requiring special attention will be negotiated with the Contractor at the time that such items are identified.

7.2.3 The Contractor shall endeavour to reduce surface disturbance where possible if the reduction does not hinder safety, environmental stewardship, and sound construction practices. This may be accomplished by reducing the disturbance within workspaces if the total allotted workspace is not required to perform the Work.

7.2.4 Use of materials found on the Right-of-Way such as sand, gravel, clay, borrow or rip rap is prohibited except with prior approval of the Company. Such materials shall only be sourced off-site from active commercial sites where usage is not confirmed by the Company in writing. Any materials moved along the Right-of-Way must be returned to their original location unless approved by the Company.

7.2.5 Immediately following final reclamation of Right-of-Way and workspaces the Contractor shall assist the Company in obtaining releases from Landowners.

7.2.6 Use of the Right-of-Way shall be conducted with the utmost consideration of the interests of Landowners. Private access shall be maintained and access for farm equipment will be maintained by the Contractor utilizing gaps in stripping and plugs in the ditch.

7.2.7 Gaps shall be maintained by use of windrowed materials on the Right-of-Way at trails used by livestock, wildlife and other intersections. Windrowed materials include snow, topsoil, subsoil, and trench materials.

7.2.8 The Contractor shall not move or store equipment or spoil on or across the Company's existing pipeline(s) except upon a showing of absolute necessity and only with the Company's prior consent given in each individual instance and only in accordance with the approved Company policy.

8 SURVEYS

8.1 Pipeline Construction Survey

8.1.1 All pre-construction, construction, and as-built survey shall be the responsibility of the Company and jointly coordinated between the Contractor and the Company. Contractor is responsible for coordinating the survey needs via the designated Company representative so it does not impact work.

8.1.2 Colored survey ribbon or painted stakes used to perform the Pipeline Construction Survey will be in accordance with the Color Coding convention specified below, unless specific conditions warrant using a different color code.

The flagging color system shall include, but not be limited to the following:

- Existing pipelines – Red
- Survey control points – Pink and white
- Existing Utilities – Use APWA/One Call Color Code Designation as follows: (http://ecommerce.billsblue.com/APWA.pdf)
    - Electric – Red
    - Gas- Oil – Yellow
    - Water – Blue
    - Sewer – Green
    - Communication/CATV – Orange
    - Proposed Excavation – White
    - Reclaimed Water – Purple
    - Temporary Survey Marking – Pink
- Proposed new pipeline – Orange
- P.I. (proposed new pipeline) – Orange and white
- P.I. (existing pipeline) – Red and white
- Wetlands – Pink with wetland boundary text on flagging.
- Foreign pipeline crossing – Orange and red
- Coating or wall thickness change – Green and white
- Temporary workspace or extra workspace – Blue and white
- Exclusion Zones and Cultural Resource Boundaries – Blue and pink
- Proposed facility installations – White
- Topsoil segregation areas – Black

8.1.3 Unless stated otherwise elsewhere, the Company will provide pipeline construction related survey information in the following manner:

(a) Legal Survey Markers will be identified with survey lathe and ribbon;

(b) Tree clearing limits of the Right-of-Way and workspaces will be marked by survey ribbon with at least two survey ribbons visible from any single point along the marked boundaries of the clearing limits;

(c) Limits of the Right-of-Way and workspaces will be marked with survey stakes at intervals not to exceed 200 feet;

(d) At known locations of intersections with foreign Right-of-Way the foreign Right-of-Way will be staked on each Right-of-Way boundary, and the foreign facilities' approximate location will the also be marked. Known locations of intersections will be those shown on the drawings;

(e) The position of any adjacent parallel lines and required Safety buffers will be located at the intervals stated in the Company's Contractor Safety Program (CSP) and/or the Project Ground Disturbance Procedure;

(f) Test points, buoyancy control, Points of Intersect (PI's), valve assemblies and any item shown on the drawings with a corresponding chainage will be staked on the Right-of-Way with survey lath and ribbon;

(g) Surveyed chainage will be marked on at least one set of boundary stakes;

(h) The method used to identify Benchmarks will be communicated from the Survey Contractor to the Pipeline Contractor; and

(i) One set of ditch centerline stakes will be provided as hubs and may vary to suit the location of existing parallel facilities.

8.2 Surveyed Marker Preservation

8.2.1 Surveyed marking preservation will be performed by the Contractor in accordance with the following:

(a) The Contractor shall not disturb, deface, alter, destroy or remove any legal survey markers. The Contractor shall make itself aware of legal survey markers in the field before proceeding with the Work;

(b) The Contractor shall maintain stakes placed by the Company defining safety buffers along existing parallel adjacent pipelines during the timeframe where stripping, grading or excavating will occur. The stakes defining safety zones will be placed in accordance with the CSP;

(c) Since survey information provided by the Company includes the locations of adjacent lines and lines to be crossed, missing or damaged survey information shall be considered to be a safety risk and shall be replaced by Contractor as soon as possible at Contractor's expense;

(d) When it becomes necessary to move boundary or centerline stakes they shall be moved in a line approximately perpendicular to the centerline of the pipeline and opposite the original location of the stake with the offset noted on the stake. Stakes indicating the location of a foreign facility or a facility being protected shall only be moved if the requirements for marking in accordance with the requirements of the CSP are met;

(e) The location of known underground facilities staked in the field by the Company or shown on the Drawings shall be only for the assistance of the Contractor. The Contractor shall be responsible for the identification and marking of all underground

facilities in accordance with the CSP, or the appropriate local safety laws and utility protection system;

(f) All field books used for proper grading of the Right-of-Way, bending of pipe, for locating existing underground facilities, and for other pipeline installations will be available for review by the Company and will be turned over to the Company following construction;

(g) Centerline stakes disturbed by construction activity ahead of the trenching operation shall be replaced in their original location by the Contractor. The Company may check and adjust the location of these stakes as necessary; and

(h) If there is a conflict between the drawings and survey information provided by the Company, the Contractor shall report the conflict prior to the Work being performed. If the Work proceeds without notification, the Contractor shall be solely accountable for all consequences and costs to correct any installation found not to be in its required location.

8.3 As-built Surveys

8.3.1 As-built surveys performed by the Company shall be conducted with the cooperation of the Contractor. The Contractor will cooperate with the Company survey contractor in acquisition of As-built data by providing space and time to safely and efficiently perform the Work.

(a) Pipe Tally to gather all pipe specification data physically identified on the pipe such as but not limited to; heat numbers, joint numbers, wall thickness and lengths. And to assign project specific joint numbers as directed by Company.

(b) Weld Mapping to record above ground as-built of all information collected in Pipe Tally along with all x-ray numbers, side bends, sags and any other pipe information available.

(c) Lowering in survey will include measuring and recording x, y, z coordinates for pipe information such as but not limited to; welds, material changes, bends, set on buoyancy control weights, valve settings and all other appurtenances in accordance with the project coordinate systems as directed by the Company. Depth of cover will be verified at this time to assure compliance with project drawings and specifications.

(d) Tie-ins and bores will be surveyed in the same manner as Lowering-in to assure that all pipe information is measured and recorded with x, y, z coordinates and proper depth of cover is gained.

(e) Post Construction survey to measure and record the x, y, z locations of but not limited to; aerial markers, CP test stations and others as directed by Company.

9 FENCES AND TEMPORARY GATES

9.1 Farm Fences and Gates

9.1.1 Farm fences and gates shall be constructed in accordance with the typical drawings provided by the Company.

9.1.2 After consultation with the Company, the required notification of the landowner has been completed, and prior to opening existing fences that cross the Construction Right-of-Way adjacent posts shall be adequately braced to prevent slackening of the wire.

9.1.3 The Contractor shall be diligent in maintaining the gates and fences along and crossing the Construction Right-of-Way and at access roads until such time as the gates are removed and fences rebuilt to the satisfaction of the Company as confirmed by the Company in writing. The Contractor shall furnish all such gate and fence material as outlined in the Project Documents. The Contractor shall be responsible for loss of any livestock or other third party damages related to open or damaged fences.

9.1.4 Where page wire, wooden, or other special types of fences are indicated on the Construction Line List or encountered, the Contractor shall construct the temporary gates of the same materials as the original fence unless otherwise approved by the Company.

9.1.5 The gates shall be the same height as the adjacent fencing and be wide enough to allow the passage of construction equipment and material. Gates must be entirely within the boundaries of the Construction Right-of-Way and Temporary Work Space.

9.1.6 Gates installed during frozen conditions shall be checked during post construction thawing conditions for unstable posts or any slackening of the wire. The Contractor shall immediately correct loose posts and wire.

9.1.7 Gates shall be constructed in a manner that will keep livestock within the fenced area and shall be capable of being securely closed. Gates, temporary or permanent, shall be kept closed where required by the Line List or where livestock are present. If necessary, watchmen shall be posted at gates to prevent livestock from leaving the fenced area while gates are opened for the passage of vehicles and equipment. The Contractor shall ensure that no loss or inconvenience shall accrue to the owner or tenant by opening fences, installing gates, or failing to properly construct or close gates.

9.2 Fencing at Stations

9.2.1 Where temporary panel type fencing is approved for use it shall provide the same level of security as that provided by the permanent fence.

9.2.2 Fencing at Stations shall be dismantled and erected by competent personnel.

9.2.3 Installed fencing shall be free of loose fabric and gates shall be fully operable.

9.2.4 Where required by the Construction Line List the Contractor shall notify the owner or tenant prior to opening fences.

10 ACCESS, GRADE, AND CLEANUP PLAN

10.1 Purpose of the Access, Grade, and Clean-Up Plan

10.1.1 The Contractor is advised that preparation of an Access, Grade, and Clean-Up Plan (AGC Plan) will be required and will be used as a working tool to minimize disturbance, environmental impacts and to ensure that the integrity of existing operating pipelines are not jeopardized. The AGC Plan shall be submitted in an electronic format acceptable to the Company. The plan will include requirements of all Company Environmental Plans including but not limited to the Environmental Mitigation Plan (EMP), Agricultural Mitigation Plan (AMP), and any other project-specific permit requirements.

10.1.2 One month prior to accessing or grading any portion of the Construction Right-of-Way the Contractor shall provide the Company with an AGC Plan satisfactory to the Company for that portion of the Construction Right-of-Way. This AGC Plan will be developed collaboratively with the Company, the Contractor's Grade Foreman and Superintendent or assistant. No Work will be started on the Construction Right-of-Way until the Company provides written approval of the AGC Plan. In developing the AGC Plan, the Contractor shall make all efforts to:

(a) Become familiar with project requirements;

(b) Minimize the use of the Company's available Temporary Work Space (TWS) to the extent practicable;

(c) Optimize grading of the Right-of-Way varying trench depth and utilizing bending where practical;

(d) Minimize topsoil stripping width to the extent practical;

(e) Contain Work within the staked boundaries of the agreed working areas;

(f) Use only approved access roads (shoo-flies); and

(g) Implement traffic control as necessary.

10.1.3 The AGC Plan shall fully address the following:

(a) Identification of locations where crossing of overhead and underground utilities, conflicts with poles and towers and existing pipeline(s) is required;

(b) Identification of all required access from existing improved roads;

(c) Identification of all required access from existing private and or lease roads;

(d) Identification of chainage and degree of cold bends planned;

(e) Identification of pipe sections, weights or other materials on the Right-of-Way;

(f) Plans showing the method of developing wet or winter access to, and along the Right-of-Way, including proposed method of matting, rip rap or frost packing;

(g) Identification of the method of traffic control;

(h) Explanation of topsoil segregation procedures including plans and justification for stripping in excess of the width shown in the Contract Documents;

(i) Plans showing the need and justification for the use of the Company acquired available Temporary Working Spaces;

(j) The need and justification for the use of additional Temporary Working Spaces required by the Contractor;

(k) Clearing and grade constraints at watercourse crossings;

(l) Preparation of a sediment control plan for all water bodies and any erosion prone areas;

(m) Plans showing the method of crossing each watercourse with construction traffic;

(n) Pipeline installation procedure and method of installing crossings for each watercourse crossing (e.g., open cut, track bore, or HDD);

(o) Turning locations for stringing trucks;

(p) Grade requirements and temporary storage location of surplus spoil;

(q) Identification of restricted workspace on the Construction Right-of-Way;

(r) Preparation of the Urban Construction Plan, if deemed applicable by the Company;

(s) Identification of the method of installing pipe under shelterbelts and in proximity to above ground features;

(t) Identification of the procedure for installing pipe under buried facilities;

(u) Identification of temporary erosion control devices required;

(v) Identification of signage requirements;

(w) Identification and details of equipment cleaning stations;

(x) Identification of locations requiring overhead power markers;

(y) Identification of temporary fencing and gate requirements; and

(z) Landholder concerns as identified in the Construction Line List.

10.2 Maintenance of the Access, Grade, and Clean-Up Plan

10.2.1 The AGC Plan shall be revised to document changes made to the plan so the Right-of-Way can be returned to its original condition if conditions change.

11 ACCESS

11.1 Access to the Right-of-Way

11.1.1 Access to the Construction Right-of-Way shall be along existing public roads, established trails, and Company approved private access roads. Development of new access or upgrading existing access shall only occur following approval of each by the Company through the AGC Plan.

11.1.2 Access for vehicles and equipment to roads from the Right-of-Way shall be constructed in accordance with the EMP and applicable permits/licenses. Topsoil and subsoil may not be used for ramps, unless otherwise approved by Company. Steel culverts may be required in some areas, and if deemed applicable by the Company and permit conditions. These shall be installed at the Contractor's expense. Plastic culverts shall not be used.

11.1.3 Suitable measures shall be used to prevent damage to the road surface when moving equipment across roads.

11.1.4 Access for vehicles and equipment across water bodies shall be in accordance with the EMP and applicable permits/licenses.

11.1.5 Temporary bridges, roads, and the like used for construction shall be designed and constructed using accepted engineering practices to minimize soil erosion, to provide for proper drainage and for safe passage of Construction vehicles and equipment as outlined in the EMP.

11.2 Access Along the Right-Of-Way

11.2.1 The Contractor shall use the travel lane portions of the construction Right-of-Way for vehicle and equipment travel, whenever and to the extent practical.

11.2.2 Natural drainage across the Right-of-Way shall be maintained in accordance with the EMP, AMP, and applicable permits/licences to prevent damage to adjacent properties.

11.2.3 Damage to bridges, private roads, fences, buildings, or other property shall be repaired immediately.

11.2.4 Standing crops shall be mowed and/or harvested prior to topsoil stripping.

12 LOGGING AND CLEARING

12.1 General

12.1.1 The Contractor shall clear and grade the Construction Right-of-Way as shown on the Drawings and as approved by the Company to facilitate the safe movement of rubber tired vehicles. In clearing the Right-of-Way and in the performance of the Construction Work hereunder, the Contractor shall comply with the terms of the Construction Line List, all environmental permits, environmental avoidance plans, EMP and the AMP, and shall carry out and perform its work in a manner which shall cause a minimum of inconvenience, injury or damage to persons or property. Where the Contractor fails to observe restrictions and limitations and causes damages to property beyond the servitudes, Right-of-Way, permits or grants secured by the Company, such damages shall be the Contractor's liability.

12.1.2 Prior to clearing and grading operations, all foreign utility line crossings, drain tile, underground facilities, aboveground facilities, and environmentally sensitive areas shall be located and marked. The Contractor will expose the adjacent Company pipeline, if applicable, at intervals identified in the Company’s Contractor Safety Program (CSP), at no additional expense to the Company.

12.1.3 The Contractor shall take reasonable precautions to protect, in place, public land survey monuments and private property corners or boundary markers. If any land markers or monuments, including existing Company G.P.S. monuments, are destroyed, the Contractor shall re-establish at his expense such markers or monuments in accordance with the specifications of a registered land surveyor.

12.1.4 The Contractor shall restore all damaged property, including but not limited to buildings, fences, hedges, roads, railroads, bridges, culverts, drainage ditches, terraces, drainage tile, creeks, levees and rivers occupied or crossed by construction. Any property damaged during the execution of the work shall be restored to its original condition at the Contractor's expense.

12.1.5 Logging and Clearing on Public land shall be performed in accordance with the Project Timber Salvage Plan, the EMP, and applicable permits/licences. If the Project does not have a Project Timber Salvage Plan or an EMP, logging and clearing will be performed in accordance with the these Specifications and the requirements of the Authorities having jurisdiction.

12.1.6 Logging and Clearing requirements on private land will be defined and performed in accordance with instructions from the landowner as identified in the Construction Line List.

12.1.7 Contractor shall provide a Project specific Logging, Clearing, and Access Plan that will address both Public and Private lands.

12.1.8 The Contractor shall not clear or log the Company defined area of the watercourse bank until immediately prior to commencement of actual crossing construction in accordance with the Project Timber Salvage Plan, if one exists for the Project, and the EMP. Trees shall be felled away from drainages and watercourses to reduce damage to aquatic habitat. No grubbing or soil disturbance will occur within the confines of the buffer zone unless otherwise stated in the aforementioned plans.

12.1.9 Trees, debris, or soil inadvertently deposited within the high water mark of any drainage or watercourse shall be immediately removed. Trees shall not be skidded across a drainage or watercourse.

12.1.10 Specimen trees or shrubs to be protected, as indicated in the Construction Line List, shall be flagged by the Company prior to construction. Snow fencing or other suitable fencing shall then be erected by the Contractor around the trees or shrubs to protect them from damage during construction.

12.2 Timber Salvage

12.2.1 The Contractor shall process all merchantable timber in accordance with the Project Timber Salvage Plan, if one exists for the Project, or as otherwise directed by the Company.

12.2.2 Merchantable timber will be felled with a feller-buncher, forwarded with a grapple skidder and processed with mechanical de-limber or similar equipment in accordance with the Contractor Logging, Clearing, and Access Plan.

12.2.3 The Contractor shall hand fall timber in areas designated as inoperable by conventional harvesting equipment in accordance with the Project Timber Salvage Plan, if one exists for the Project, or where directed by the Company. The Contractor will manually saw this timber into 8 foot lengths and stack the timber in areas adjacent to the Right-of-Way.

12.2.4 Where the Construction Line List requires the preservation of merchantable timber on private land, it shall be as a minimum be limbed, topped, and cut into lengths specified by the Company and neatly stacked along the edge of and within the limits of the cleared Construction Right-of-Way on the respective property. Such merchantable timber shall then become property of the Contractor, Company, or Landowner and shall not be used for construction purposes.

12.2.5 The use of timber for rip-rap and corduroy will not be allowed.

12.3 Felling and Bunching

12.3.1 The Contractor shall fall all merchantable timber identified in the Project Timber Salvage Plan, if one exists for the Project, within the Right-of-Way.

12.3.2 The Contractor shall ensure that all stumps in trench line are removed. Within the work space all stumps shall be ground no less than 4 inches below grade/working surface or removed. In wetlands, vegetation outside the ditch line shall be flush cut, leaving the root systems intact.

12.3.3 The Contractor shall ensure proper operational practices are implemented to prevent reducing timber product quality and merchantable timber volume during felling operations.

12.3.4 All merchantable timber within the confines of the Company defined riparian buffer zone will be felled and carried completely out with a feller buncher unless otherwise specified by the Company. This area shall be flagged-off to ensure the buffer zone is maintained.

12.3.5 All operations within the riparian buffer zone of watercourses shall be conducted perpendicular to the watercourse. Turning of equipment in this zone is to be minimized to the extent possible to prevent soil disturbance.

12.4 Skidding

12.4.1 The Contractor shall skid merchantable timber identified in the Timber Salvage Plan, if one exists for the Project, into the approved Log Deck Sites along the Right-of-Way. The Contractor shall build decks in a manner that will maximize processing efficiency and not inhibit processing or loading operations by skidding timber too close to the edge of an access point.

12.4.2 Coniferous and deciduous timber shall be stacked separately. Logs shall not be skidded through a watercourse, mud, or gravelled areas in order to reach deck sites.

12.4.3 No skidding is to take place within the Company defined buffer zone of a watercourse.

12.4.4 The Contractor shall ensure that proper operational practices are used during skidding operations to prevent degrading timber to a lower grade product and wasting merchantable timber volume through breakage.

12.4.5 Only timber meeting specified product merchantability standards shall be salvaged and skidded to decking sites. Undersized, oversized, rotten material and debris entering the piles will be removed and disposed of on the Right-of-Way at the expense of the Contractor.

12.4.6 All skidding and decking shall be conducted within the confines of the approved Right-of-Way unless otherwise approved by the Company.

12.5 Processing

12.5.1 The Contractor shall limb and process all timber identified as merchantable in the Timber Salvage Plan, if one exists for the Project, or as per the direction of the Company.

12.5.2 The Contractor shall ensure that processed timber meets the product specifications outlined by the receiving mill or as per direction of the Company.

12.5.3 It is the responsibility of the Contractor to monitor timber product quality and implement corrective measures to ensure operations are producing on-spec products.

12.5.4 Merchantable timber shall be limbed and topped on the Right-of-Way. Company authorized burning or chipping shall be used to dispose of debris resulting from limbing and topping operations and must in accordance with the EMP. Merchantable timber shall be processed on the Right-of-Way and piled so as to not prevent debris from being disposed of during clearing operations.

12.6 Decking

12.6.1 All Merchantable timber shall be decked in approved locations as per the Timber Salvage Plan, if one exists for the Project, or in accordance with the direction of the Company.

12.6.2 Deck sites for storage of timber will normally be located off the working side of the Right-of-Way in natural openings wherever possible or in cleared deck sites at locations approved by the local Authorities having jurisdiction. Deck sites will normally be a half mile apart in generally accessible areas and well back of watercourses or areas requiring grading. Timber is not to be decked within 100 feet of a watercourse or any other overhead or underground utility or any crossing unless specified by the Company.

12.6.3 Prior to the commencement of salvage operations the Company will review the log deck sites shown on the Project Drawings with the Contractor. Unless written approval is obtained from the Company in advance, log decks shall be confined to these areas.

12.6.4 Decked timber shall be placed at right angles to access roads with all butts within 10 feet of the access road. Logs decked parallel to access roads within the Right-of-Way shall be placed no further than 20 feet from the existing access road with butts facing towards the direction of travel of the log trucks to the mill site. It is the responsibility of the Contractor to ensure that all timber is within reach by self-loading log trucks at developed access roads.

12.6.5 Coniferous and deciduous logs shall be decked separately. The Contractor shall ensure that log decks are free of debris in a manner that will minimize loading time and maximize efficiency.

12.7 Hauling

12.7.1 If the Company accepts ownership of the salvaged timber the following procedures shall be followed.

12.7.2 All merchantable timber processed on the Right-of-Way will be hauled to a destination approved by the Company.

12.7.3 The Contractor shall supply the Company with a delivery schedule prior to the commencement of Work.

12.7.4 The Contractor shall be responsible for getting their fleet and drivers signed up to haul logs to the receiving mills prior to the commencement of the Work.

12.7.5 The Contractor shall conduct all activities associated with loading. This will include loading, trimming the load and securing the load.

12.7.6 The Contractor shall on a daily basis furnish to the Company a log of hauling activities including but not limited to truck number, driver name, time of loading, time of delivery, and scale information.

12.7.7 The Contractor shall be responsible to ensure that all loads have documentation that is filled out correctly and corresponds with the correct dispositions or other permit information. The Contractor shall be solely and financially responsible for any rejected loads or fines associated with required documents.

12.7.8 The Contractor shall follow the receiving mills Log Haul Safety Program and Procedures as it pertains to overloads and other infractions. The Contractor will be solely and financially responsible for all fines levied by a receiving mill.

12.7.9 The Contractor will be responsible for ensuring that loads do not exceed the height, length, width and weight Specifications set by Authorities having Jurisdiction over the Work.

12.7.10 Where salvaged timber is to be removed from the Right-of-Way and hauled by others contracted to the Company, the Contractor shall provide and maintain Right-of-Way access and shall cooperate with the trucking firm in removal of timber prior to thawing conditions.

12.8 Clearing

12.8.1 Clearing shall include the cutting by approved means and removal of trees and brush vegetation and un-merchantable trees within the boundaries of the Right-of-Way. The Contractor shall ensure that all stumps in trench line are removed. Within the work space all stumps shall be ground no less than 4 inches below grade/working surface or removed. In wetlands, vegetation outside the ditch line shall be flush cut, leaving the root systems intact.

12.8.2 The Right-of-Way and only the needed portions of workspaces shall be cleared. Clearing shall be minimized where possible and specifically in temporary work spaces if the entire workspace is not required for construction.

12.8.3 Trees and vegetative matter shall be knocked down in the direction of the area to be cleared. Trees that become hung up at the edge of, or fall off the Right-of-Way regardless of source shall be removed by the Contractor, upon Company approval. Edge clean up shall be an ongoing operation with debris added to burning or chipping operations.

12.8.4 Non-merchantable timber and lesser vegetation shall not be removed within the Company defined buffer zone of the watercourse unless otherwise specified in the Timber Salvage Plan and the EMP.

12.8.5 Grass and muskeg ground vegetation species shall not be cleared nor have their root mats disturbed in accordance with the EMP.

12.8.6 Material removed from banks of streams shall not be placed in the stream beds, but shall be stockpiled on the Right-of-Way or on adjacent temporary extra work space from where it can be recovered and used by the Contractor to restore the banks to their original state or as directed by the Company and/or the permit requirements. Spoil shall be stored in accordance with the EMP or as indicated within the site specific crossing plan and permits.

12.9 Debris Disposal

12.9.1 The method of disposal of stumps, clearing debris, rock or boulders shall be agreed to by the Company, landowner and/or tenant, and the Authorities having Jurisdiction.

12.9.2 The stumps, rock or boulders may be placed in neat piles to the side of the Right-of-Way at locations agreed to in writing by the landowner. Stump burial is not allowed.

12.9.3 All debris shall be completely disposed of in a timely manner preceding the grading operation. In no event shall debris, stumps, tops, etc. be placed on top of the existing pipeline at any time during the project.

12.9.4 Stumps of trees on said Right-Of-Way shall not come in contact with the pipe. All loose stumps, brush, boulders and other debris shall be removed so that the spoil bank from ditching operations will not fall on any such debris.

12.9.5 If the landowner requests that the stumps, clearing debris, rock or boulders be removed from his property, the Contractor shall haul the material to a Company approved dumpsite. The Contractor shall provide the Company with written approval of all Authorities having Jurisdiction over the area where dumping will occur. All environmental and safety concerns as outlined in the Contract Documents shall apply to such off-site Work.

12.9.6 The Contractor shall pile and burn all woody debris within the Right-of-Way, and temporary workspace boundaries in accordance with the EMP unless instructed by the Company to use different debris disposal techniques. Non-merchantable timber, roots, stumps, branches and all cut material shall be piled for burning.

12.9.7 Piles containing woody debris for burning shall be kept free of snow, duff and soil.

12.9.8 The Contractor shall obtain the necessary burning permits from the Authorities having Jurisdiction and shall not commence burning operations until approval is granted by the Company. A copy of all such consents and permits shall be provided to the Company.

12.9.9 Piles shall not be located near sensitive sites, within 100 feet of any watercourse, lake, or wetland and shall be a minimum safe distance of 25 feet from the existing bush line to avoid damage to the surrounding timber. It is the responsibility of the Contractor to determine the locations of burn piles unless otherwise specified by the Company in the EMP. No foreign debris or non-organic materials are allowed to be burned.

12.9.10 The Contractor shall attend set fires at all times. The Contractor shall maintain responsible personnel and adequate firefighting equipment on site to control burning and prevent fire spreading to adjacent timber, brush, grass or crops. This shall include maintaining a water truck on site during operations when a fire hazard exists for the spread of fire or as per the direction of the Company Inspectors. The Contractor shall have sufficient numbers of crew and equipment to monitor fires over a 24 hour period. The Contractor shall extinguish all fires prior to leaving site if 24 hour coverage is not available.

12.9.11 The Contractor shall ignite piles using only propane torches or petro-gel.

12.9.12 The Contractor shall ensure that all woody debris is fully disposed of during burning. Ignited piles shall be actively re-piled during burning to ensure complete consumption within a 24 hour period. Excavators with thumbs or brush rakes should be used to continuously feed burn piles to promote quick and efficient combustion.

12.9.13 The Contractor shall be responsible for the piling and burning of debris left in the log deck sites as hauling operations progress

12.9.14 The Contractor shall ensure that during winter operations, burn piles are extinguished by mixing with snow if available.

12.9.15 The Contractor shall not leave piles smouldering. Spreading unburned debris on the Right-of-Way shall be minimized to the greatest extent possible.

12.9.16 The Contractor shall be responsible for any fire damage originating from its activities on the Right-of-Way for a period of twelve (12) months from the completion date of the contract or the actual completion date if it exceeds the contract completion date. The Contractor shall at its sole expense, extinguish any hold-over fires or hotspots determined by the Company to impose a risk of spreading to adjacent lands.

12.9.17 The Contractor may be required to mulch or chip woody debris instead of burning in areas predetermined by the Company. If chipping or mulching is used, the Contractor shall ensure that wood chips (less than 1.5 inches in diameter and/or 12 inches in length) are distributed in an even layer not to exceed 1 inch thick to prevent the formation of a woody mat which restricts re-vegetation of the Right-of-Way.

12.10 Grubbing

12.10.1 Grubbing means the removal and proper disposition of all stumps, roots and partially embedded stones, rocks or boulders. Grubbing shall be conducted with the use of brush rakes or a Company approved alternative. This activity will be performed per the applicable permits, Contract Documents, and the EMP.

12.10.2 Root systems should remain intact wherever possible if the Right-of-Way is going to be returned to its natural state. Where removal of willow cover is necessary, the Contractor shall make all reasonable efforts to minimize grubbing and shear off the willows above the root structure. Grubbing shall be minimized where possible. Grubbing shall not be conducted within 6.5 feet of the edge of the Right-of-Way so as to prevent damage to root systems of trees adjacent to the construction. Root systems of grasses on muskegs shall remain intact. Snow fills shall be used for smoothing access during winter clearing operations whenever practical.

12.10.3 The entire Right-of-Way (except the area required to maintain root systems of adjacent trees) shall be completely grubbed on private land and in areas that will support future agricultural production. Grubbed materials remaining after initial burning or chipping shall be removed from the Right-of-Way and transported to a Company approved disposal site or be re-burnt if necessary.

12.10.4 The ditch-line and working areas for movement of rubber tired vehicles shall be grubbed in addition to areas requiring grading. Brush and debris shall be removed to prevent excavated material from the pipeline trench becoming mixed with roots, branches and other debris remaining after clearing operations.

12.10.5 The Contractor shall backfill and compact the depressions from the grubbing operation to prevent water from collecting.

12.10.6 The Contractor can remove trees but shall only grub the trench line within the Company defined buffer zone of a watercourse bank until immediately prior to commencement of actual crossing construction. Refer to the EMP for additional details.

12.11 Rollback

12.11.1 Where specified by the Company cleared trees shall be preserved for rollback for erosion control.

12.12 Prevention of Ditch-line Freezing

12.12.1 When clearing is performed during winter conditions and pipeline installation occurs during the same season a berm over the ditch line shall be constructed using snow immediately following clearing. The snow berm shall be 2 feet high by 10 to 12 feet wide and fully cover the proposed ditch-line. Openings shall be left in the berm to permit the passage of wildlife or livestock.

12.12.2 Travel on the proposed ditch-line with vehicles and equipment during clearing operations shall be minimized as much as possible.

13 TOPSOIL STRIPPING

13.1 General

13.1.1 Prior to ground disturbance on the Construction Right-of-Way the Contractor shall implement the Company's Ground Disturbance Procedure.

13.1.2 The Contractor shall notify, maintain, and comply with the appropriate local utility protection system or the state one-call system requirements. The Contractor shall provide the Company with a record of all notifications (e.g. One-calls, foreign line representatives, local emergency, etc.).

13.1.3 Prior to grading of the Construction Right-of-Way, topsoil shall be stripped and conserved in accordance with the Contract Documents, Construction Line List, EMP, AMP, and to the satisfaction of the Company.

13.1.4 The depth of topsoil stripping shall be in accordance with the Contract Documents, the EMP, AMP, or as directed by the Company.

13.1.5 Wherever grading of the Construction Right-of-Way is required (side hills, slopes, watercourse crossings, road crossings, etc.), the topsoil shall be stripped and stockpiled separately from graded or excavated subsoil. Extra Working Rights to be used by the Contractor shall be stripped of topsoil to the satisfaction of the Company prior to placement of any subsoil material in that area.

13.1.6 Topsoil depths if indicated on the drawings should be considered as average depths and actual depths may actually vary from that shown.

13.1.7 No stripping, stockpiling, or Work of any kind, will be allowed over existing operating pipelines unless authorized by the Company.

13.1.8 Topsoil shall not be used to ramp culverts, road ditches, foreign facility crossings, or drains, unless otherwise approved by the Company.

13.1.9 Topsoil shall not be piled in areas that will result in blocking the movement of water in a watercourse or ditches. Piling of topsoil shall be performed in a manner that will prevent the possibility of increasing the moisture content of soils.

13.1.10 Equipment and methods used for topsoil stripping shall be suitable for the conditions encountered at the time of construction and prevent mixing with subsoil, loss or degradation and shall be subject to Company's approval. Contractor shall pay particular attention to the width of topsoil stripped where poor or wet soil conditions exist to ensure that sloughing trench conditions do not cause loss of topsoil.

13.1.11 Whether single or multiphase stripping, different types of soil stripped shall be stored separately from each other and on material of the same composition unless stripping ditch line on good quality sod. All stripped topsoil shall be stockpiled separately from any subsoil, with a minimum of 2 feet buffer zone separation or as approved by the Company. Graders shall be utilized for the final pass of stripping if more than the ditch-line is stripped.

13.1.12 No stripping or ground disturbance should take place within the Right-of-Way limits of a road, highway, or railroad crossing unless otherwise approved by the crossing permit and the Company.

13.1.13 At each road, highway and railroad crossing, topsoil stripped from within the limits of these crossings shall be stored within the crossing limits as space allows. Equipment used to strip topsoil at these locations shall be cleaned prior to leaving the crossing or as required by the EMP and the AMP.

13.1.14 The Contractor shall loosen the area to be stripped on hay and pasture land by methods approved by the Company unless specifically stated in the Contract Documents. This operation may be waived by the Company on sandy soils or on land with poor sod development.

13.1.15 Where excavating through soils prone to sloughing, areas adjacent to excavations that may fail shall be stripped of topsoil. Topsoil shall be stripped from all areas to be graded and it shall be spread evenly across the Right-of-Way upon replacement.

13.1.16 When adverse weather conditions affect the condition of the Right-of-Way, the Company may require the Contractor to change procedures or suspend construction activities if those activities are causing topsoil loss or damage through erosion, mixing, rutting and any other cause. The Contractor shall at its discretion and expense, reduce vehicle movements where possible, change vehicle traffic patterns, perform additional topsoil stripping, use tracked equipment or move to other areas less sensitive to the adverse weather in order to work continuously. If construction operations cannot be altered to reduce topsoil degradation to acceptable limits the Contractor shall cease its activities until such time as the weather conditions change. Suspension of construction activities will occur without additional compensation to the Contractor.

13.1.17 All handling of topsoil shall take place only when, it is dry enough to avoid soil structure damage and soil intermixing due to excessive rutting, as determined by the Company in accordance with the EMP and the AMP.

13.1.18 The Company may require the application of mulch, tackifiers, water or straw to topsoil storage piles to mitigate the effects of wind erosion during construction. If these methods are deemed by the Company to not be effective then the Contractor shall implement specialized environmental protection techniques to minimize topsoil loss. In the event that wind erosion continues after the application of tackifiers, the Company may direct the Contractor to suspend topsoil handling until, in the opinion of the Company, the conditions improve. Temporary berms and/or silt fences, straw application and cross Right-of-Way drainage may be employed to mitigate the effects of water erosion during construction. All mitigative measures implemented shall be unless stated otherwise, at the expense of the Contractor, performed to the satisfaction of the Company, Authorities having Jurisdiction and Landowners.

13.1.19 Stripped topsoil shall be replaced in a sequence opposite to that removed. The salvaged material shall be spread uniformly over the graded area that the material was salvaged from.

13.1.20 The EMP, Project Noxious Weeds and Invasive Species Control Plan, and the AMP may include requirements for cleaning of equipment between parcels of land in the event weeds or other issues have been identified. The requirements of these plans will be strictly adhered to including steaming, washing, or chemical treating.

14 GRADING

14.1 General

14.1.1 The Contractor shall perform all grading in accordance with the Access, Grade and Clean-Up Plan (AGC), EMP, AMP, and permits/approvals submitted and approved by the Company so as not to interfere with the flow of water. Care shall be taken to prevent the damming or blocking of any drainage course. Public ditches or drains shall have bridges or culverts installed for passage of equipment and vehicles. The Contractor shall confirm with the Company that approval of the Authority having Jurisdiction over same has been secured prior to installation of any crossing.

14.1.2 Where required the Construction Right-of-Way shall be graded to facilitate the safe movement of pipe handling equipment and other rubber-tired pipeline vehicles.

14.1.3 The Contractor is herein obligated to minimize grading of the Right-of-Way and workspaces. Only those areas required to support access requirements and for the safe performance of the Work shall be graded. At its discretion, the Company may limit grading in certain areas. The Contractor shall use alternate methods of construction in these areas if necessary at no additional cost to the Company.

14.1.4 Grading may require that the Contractor drill, blast, and excavate rock in order to build an adequate work surface along the pipeline route. The Contractor shall not excavate any section of the pipeline by the use of explosives without a minimum of 60 days advanced written notice and the written approval of the Company. The Contractor shall submit a Blast Plan for the Company's approval that meets all Federal, State, and Local regulations as well as the CSP. The Contractor shall not receive any additional compensation for the ripping, blasting and/or grading of rock required for Right-of-Way construction.

14.1.5 No graded material shall be permitted to spread into treed areas or placed off of the Construction Right-of-Way.

14.1.6 At locations where topsoil stripping occurs to accommodate grading requirements, the Contractor shall identify the topsoil piles from the graded materials with a suitably marked survey stake or sign to minimize the risk of confusion at time of restoration.

14.1.7 The ditch-line portion of the Right-of-Way shall be generally graded to allow the pipe to be bent and laid within the minimum radius of field bends and shall facilitate the placement of pipe on undisturbed soil in the trench to the minimum cover specified.

14.1.8 Natural drainage or watercourses are not to be disrupted by grading. Grading shall be performed away from watercourses to prevent dirt and debris from entering the watercourse. Where dirt and debris could enter a watercourse due to erosion during construction the Contractor shall install and maintain erosion control structures and devices at no additional expense to the Company. Erosion controls shall be installed in accordance with the EMP.

14.1.9 When the Contractor cuts existing terraces or diversion berms they shall be restored to their original condition within the minimum time practicable. Temporary erosion control devices, per the EMP, will be required during construction to minimize siltation entering watercourses or private property. All grading shall be completed to maintain the original drainage or water flow conditions as nearly as practicable and shall conform to the regulations of the Authority having Jurisdiction over same.

14.1.10 Areas requiring significant cuts during grading or that may lose their stability during the course of construction shall be back-sloped.

14.1.11 Graded areas subjected to rutting shall be bladed daily to remove ruts that could contribute to pooling of water.

14.1.12 Unless stated otherwise, survey markers or pins disturbed during grading shall be re-established by the Company at the Contractor's expense.

15 LOADING, HAULING, STRINGING, STOCKPILING, AND STORING OF PIPE AND OTHER MATERIALS

15.1 General

15.1.1 The Contractor shall ensure that workers of the Contractor and Subcontractor are trained to safely handle and secure pipe and materials.

15.1.2 Loading, hauling, and stringing, together with any intermediate stockpiling required, shall be performed in a manner that will not damage the pipe or coating.

15.1.3 Unless stated elsewhere, the Company shall provide all storage facilities for mainline pipe, valve assemblies, and other Company obtained materials.

15.1.4 In addition to receiving, handling, transporting, unloading and storage of Company supplied materials, the Contractor shall be responsible for and pay for all transportation permits required by Authorities having Jurisdiction.

15.1.5 The Contractor shall satisfy itself as to the condition of the Company supplied items and upon its acceptance of delivery shall be in the care, custody, and control of the Contractor. Damage to items incurred or their loss while in the care of the Contractor shall be repaired or rectified to the satisfaction of the Company at the Contractor's expense.

15.1.6 The Company supplied items which could be affected by exposure to the elements shall be stored in a facility that will eliminate the means of exposure.

15.1.7 The Contractor shall notify the Company three (3) business days in advance of picking up any Company supplied materials at the designated consignment locations.

15.1.8 The Contractor shall pick-up Company supplied materials within a specified time when instructed to do so by the Company. Failure to do so may cause the Company to incur storage or demurrage charges, which will then be recovered from the Contractor.

15.1.9 Upon completion of the Work, all surplus pipe and materials shall be delivered by the Contractor, at no additional expense to the Company, to a location designated by the Company.

15.2 Pipe Handling

15.2.1 Care shall be exercised in handling or storing coated pipe in order to avoid bevel damage, flattening, denting, scratching, gouging, coating flaws, or any other type of damage.

15.2.2 Pipe shall be handled as individual joints with vac-u-lifts, belt slings, or shaped hooks surfaced with a non-contaminating material, as approved by the Company. Hooks shall have sufficient bearing surface to prevent damage to the pipe.

15.2.3 For special coatings or where damage may occur to pipe or coatings, slings providing sufficient weight distribution shall be used for pipe handling.

15.2.4 All pipe shall be loaded and unloaded by means of Company approved lifting devices.

15.2.5 Pipe shall be picked up and not dragged, prevented from striking adjacent pipe, trucks or equipment.

15.2.6 Dunnage supplied by the Contractor shall remain the property of the Contractor whereas that supplied by others at vendor locations, material storage sites, or for transportation shall remain the property of others and shall be returned by the Contractor to the rightful owner at no additional cost to the Company.

15.2.7 Rope separators used for pipe storage or transportation shall be returned or disposed of in a manner found acceptable by and at no additional cost to the Company. End caps supplied with the pipe shall be collected and secured to pallets for transporting to recycle facilities.

15.2.8 If a vac-u-lift device is used to handle pipe, care shall be taken to ensure lifting is from the center of the joint to prevent damage.

15.2.9 If a spreader bar is used, a minimum allowable angle of 45° between the pipe and load lines shall be maintained during pipe handling operations (i.e. loading or unloading trucks from stockpile sites and/or stringing).

15.3 Pipe Transportation

15.3.1 Transportation services shall be performed in strict compliance with all applicable Federal, State, and Local statutes and regulations.

15.3.2 Pipe with a diameter of 12 inches or greater and over 52 feet in length shall only be transported using pole trailers. Pipe bunks shall be adequately cushioned and spaced to prevent damage to the pipe.

15.3.3 Any pipe bearing surface shall be free of rocks and debris. Flatbed trailers shall be equipped with no less than 4 - 3.5 inches high x 3.5 inches wide bearing strips and solidly fastened across the width of the deck, with a maximum spacing of 10 feet.

15.3.4 Maximum overhang for pipe on trailers is 13 feet unless required otherwise by Federal, State, or local regulations.

15.3.5 Shorter pipe shall be placed on top of the load.

15.3.6 To secure pipe on flatbed trailers, non-metallic tie-downs of suitable load bearing capacity shall be used and spaced at approximately 8 ft intervals, not to exceed 10 ft, for each row. Tie-downs on the pipe rows shall be staggered to ensure adequate binding. Tie-downs and any side pins shall have adequate rubber padding to prevent contact with the pipe.

15.3.7 To secure pipe to pole trailers, non-metallic tie-downs of suitable load bearing capacity shall be used for each row and placed at each end of the load. Tie-downs on the pipe rows shall be staggered to ensure adequate binding. Tie-downs and any side pins shall have adequate rubber padding to prevent contact with the pipe.

15.3.8 Both the truck and trailer shall be equipped with mud guards to prevent stones or rocks from impacting the pipe. All trucks, trailers, and other rubber tired vehicles transporting pipe must be equipped with a grounding strap attached to the chassis.

15.3.9 The Contractor is responsible for ensuring pipe and coating are not damaged during transportation. When required by the Company, trucking pre-coated pipe during summer construction, pipe loads shall be completely tarped if hauling will occur on 1 mile or more of road with loose gravel or other loose road material.

15.3.10 When required by the Company, during winter construction when trucking pre-coated pipe, pipe loads shall be completely tarped.

15.3.11 When required by the Company nets shall be used when transporting pipe in areas of severe terrain.

15.4 Pipe Storage

15.4.1 Pipe stored in stockpiles shall be nested on graded stockpile sites capable of supporting the loads imposed by the pipe, loading operations and trucking without failure.

15.4.2 Pipe storage facilities shall be constructed in accordance with the Company supplied Site Specific or Typical Drawings. Bottom tiers of pipe shall be well supported by timber, earthen supports, or sandbag supports of sufficient height to prevent pipe from touching the ground between supports.

15.5 Stringing

15.5.1 Pipe shall be strung with gaps across the Construction Right-of-Way left between adjacent lengths of pipe at suitable intervals to correspond with any required gaps in the topsoil pile, or in accordance with the Construction Line List at well-defined trails to permit the movement of livestock, wildlife, farm equipment, irrigation pivots, and vehicles. Pipe shall be strung to permit the insertion and removal of internal radiography equipment after welding. The radiography contractor shall dictate the intervals required. The Contractor shall complete the tie-ins at these locations at no additional cost to the Company.

15.5.2 Pipe shall be strung onto wooden skids at both ends, lapped not butted and chocked at each end to prevent movement. The skids shall be located so that the pipe will not touch the ground between skids. Skids shall be sufficiently wide and placed in a manner that will prevent damage to the pipe or coating.

15.5.3 Pipe shall not be strung in steep terrain where pipe will be unstable or in areas requiring blasting, or where blasting is probable, until such time as it is completed.

15.5.4 Pups 10 feet and over in length shall be moved ahead daily as tie-ins are being completed. A full joint of pipe shall separate pups moved ahead. On short pipelines where there is less spare pipe, the Contractor may have to utilize pups to complete stringing of the pipe. This Work, if necessary, shall be performed at no additional expense to the Company.

15.5.5 The Contractor shall be responsible for ensuring that all pipe stringing by size, wall thickness, and grade is in accordance with the drawings.

16 BENDING

16.1 General

16.1.1 The Contractor shall make the necessary field bends required in the construction of the pipeline. The Contractor shall bend and lay pipe such that it conforms to the trench bottom. The center of over-bends shall clear the high point of the trench. Sag bends shall fit the bottom of the trench and be firmly supported through the bend. Side bends shall have the neck against the outside curve of the ditch.

16.1.2 No bending shall be permitted when either pipe or ambient temperatures are lower than -20°F. When bending coated pipe, the method of preheating used must not damage the coating, and must be approved in advance by the Company. Under no circumstances shall heating of the pipe above +100ºF be permitted.

16.2 Bending Equipment

16.2.1 Bending shall be performed using a cold stretch process employing the type of machine approved by the Company. Internal mandrels shall be used when bending pipe 16 inch OD and larger. All field bends shall be made by the cold-stretch smooth bending method using a bending machine with a full solid-wall retaining shoe and an internal mandrel. The drive rollers, pin-up shoe and die shall be padded with urethane or neoprene.

16.2.2 Bending shoes are to be of the flexible type with a padded surface extension at least 2 inches beyond the metal edges.

16.3 Bending Requirements

16.3.1 All field bends shall be made to as long a radius as practical. The maximum amount of bending shall be 1.5 degrees in any length along the pipe axis equal to the diameter of the pipe. Further restrictions may be imposed as a result of Bend test results.

16.3.2 No bend shall be made closer than 6 feet from the pipe end. In the case of double-jointed pipe, the bend shall not be closer than 3 feet to the girth weld creating a double or triple joint.

16.3.3 Pipe shall be lifted and carried and not dragged along the ground. All pre-coated pipe shall be handled using non-metallic chokers or slings.

16.3.4 In all bends of longitudinally welded pipe, the longitudinal seams shall be on the neutral axis, with the neutral axis being defined as within thirty degrees (30°) of the 12 o'clock position for side bends and within thirty degrees (30°) of either the 3 o'clock and 9 o'clock positions for sag and over-bends. In the event a compound bend (single section of pipe containing two bends) is required, the longitudinal welded seam shall be on the neutral axis for the larger of the two bends and either the neutral axis or within the 180 degree compressed section of pipe of the other bend.

16.3.5 No bending shall be accepted if it induces buckles, wrinkles, flat spots in the pipe, or is in any way associated with mechanical damage.

16.3.6 Bends with ripples are acceptable providing the ripple is smoothly contoured throughout and there is no coating damage evident, peak-to-trough measurement of any wave height does not exceed 75% of the pipe wall thickness and the distance from the center of a ripple to the center of the closest ripple is no closer than 15 times the height of the ripple.

16.3.7 The maximum diameter reduction in a pipe bend shall not exceed 2.5% of the nominal pipe diameter. (for example: On a 16 inch outside diameter pipe the diametral reduction as measured cannot be greater than 0.4 inches.)

16.3.8 Any bend that is deemed by the Company to be unacceptable shall be replaced. The Contractor shall be solely responsible for the costs associated with rejected bends including but not limited to salvaging pipe to weld in the line at a suitable location.

16.3.9 Completed bends shall be handled with nylon slings and set on properly constructed skid sets.

16.4 Bend Test

16.4.1 Prior to bending any pipe for use in the Work, the Contractor shall conduct a test bend on project pipe to confirm the maximum degree of bending and the distortional limitations to be permitted in the pipe and coating. This requirement applies to each season of work if the Work spans more than one season.

16.4.2 At temperatures of 0ºF or below, additional test bends shall be required. Pipe shall be bent to the required curvature, or to a less severe limit should buckling, wrinkling or flattening occur. A restriction on bending shall be set by the Company which shall be subject to a re-test should the ambient temperature drop a further 10ºF.

17 TRENCHING

17.1 General

17.1.1 The Contractor shall notify and comply with the appropriate local utility protection system or the state one-call system requirements. The Contractor shall provide the Company with a record of all notifications (e.g. One-calls, foreign line representatives, local emergency, and etc.).

17.1.2 The Contractor shall be responsible for positively locating all above and below ground utilities and/or other encumbrances within the granted Right-of-Way, and shall take all precautions necessary in order to fully avoid damage to said facilities. In addition, the contractor shall be fully aware of all public transportation structures located in and around the granted Right-of-Way, and shall abide by any and all restrictions and/or permits that may be applicable.

17.1.3 The Contractor shall excavate the pipeline trench in accordance with the permits and Contract Documents.

17.1.4 Trench shall also mean ditch or any other form of excavation for the purposes of installing the pipeline.

17.1.5 The Contractor shall ensure trench-line staking is maintained.

17.1.6 The trench, if it is to be accessed by personnel, must meet OSHA and the CSP requirements for safe working conditions in the trench.

17.1.7 Dewatering of trenches shall be performed in a manner consistent with good erosion prevention measures and the EMP or other governing requirements. Stable vegetated run-off areas shall be selected, and dispersion sheeting employed at points of discharge.

17.1.8 Where indicated in the EMP and landowner line lists, additional topsoil conservation activities may be required during trenching by excavating and storing different types of soils. Topsoil, trench spoil and grubbing piles shall all be stored separately with at least 2 feet between piles. Spoil shall be stored at least 2 feet from the edge of the trench, unless otherwise directed by the Company.

17.1.9 Open trench shall be minimized where possible. Unless otherwise approved by the Company the trench may remain open for no longer than 3 days.

17.1.10 The Contractor shall trench in such a manner so as to leave a plug across the trench to correspond with any required gaps in the topsoil pile in accordance with the Construction Line List to facilitate the passage of farm equipment, livestock, wildlife, or irrigation pivots.

17.1.11 Safe bridging or backfilling of the trench shall be provided in accordance with reasonable wishes of landowner/occupant or Authorities having Jurisdiction for access of animals or equipment. Trenching in winter shall progress in a manner that will minimize the possibility of freezing the spoil pile and/or filling of the trench with snow.

17.1.12 A Registered Professional Engineer is to be utilized for all shoring, trench box installations, or depth of cut that exceeds 20 feet.

17.2 Normal Depth and Width of Trench

17.2.1 The bottom of the trench shall always be in native materials unless otherwise approved by the Company.

17.2.2 The Company desires to reduce to a minimum the number of bends required to lay the pipe to conform to the contour of the ground and maintain the minimum specified depths of cover. The Contractor shall eliminate unnecessary bending by varying trench depths and by not grading the Construction Right-of-Way. This can be accomplished by cutting the trench slightly deeper at the crest of ridges and by gradually deepening the trench at approaches to crossings of roads, railroads, highways, ditches, ravines and watercourses.

17.2.3 Unless stated otherwise the minimum depth of cover for the pipe, weights, or other appurtenances shall be in accordance with the Contract Documents.

17.2.4 The minimum trench dimensions, as specified in the Construction Specifications, shall be adhered to by the Contractor throughout the full length of the Work including areas of wetlands. The minimum depth of cover is measured from the graded surface of the Right-of-Way adjacent to the trench at the time of trench excavation. At locations where concrete river weights, swamp weights, sack weights, or other below grade appurtenances are to be installed, the Contractor shall provide a trench wide and deep enough to permit installation with the minimum specified depth of cover.

17.2.5 The Company Authorized Engineering and/or Construction Representative may adjust the buoyancy control requirements after the trench is open if site specific conditions warrant such a change.

17.2.6 Trench excavation shall accommodate the installation of the Company's pipeline under a foreign underground facility with a minimum of 1 foot of separation or as specified in Crossing Agreements, when applicable.

17.3 Excavated Crossings

17.3.1 When the pipe is to be laid across railroad ditches, highway or road ditches, irrigation or drainage ditches, rivers, creeks, canals, ravines and other drainage or watercourses, the trench shall be excavated to provide the minimum specified depth of cover over the pipe as specified in the Contract Documents, Permits, and/or Crossing Agreements. In addition, spoil banks from trenching operations shall be placed in such a manner to ensure that all drainages and watercourses are kept open, functional, and contained. Such material will be contained in accordance with the Company's EMP and Environmental Permits.

17.4 Finishing the Trench

17.4.1 The completed trench must be ready for placement of the pipe. It shall be excavated to a smooth finish, uniformly graded, free of water, ice, and rocks on the bottoms or sides and free of other projections that may be injurious to the pipe or coating. The excavation shall be sufficiently deep to allow for the bedding and to achieve the required minimum depth of cover over the pipeline.

17.4.2 The trench bottom shall conform to pre-bent pipe. Pipe not supported by the trench floor must be cut and fit to the floor, or where approved by the Company, sandbags, Company approved foam pillows or Company approved field applied foam must be installed for support provided that minimum cover is maintained.

17.5 Trenching During Winter Construction

17.5.1 The Contractor shall make all efforts to schedule trenching operations such that freezing of the excavated materials is minimized. Frozen lumps from ripping shall be separated from the trench spoil to facilitate backfilling. All ice, snow, and frozen lumps shall be removed to provide a smooth flat ditch bottom free of loose rocks greater than 2 inches.

17.5.2 In the event that the ditch bottom or backfill materials become frozen and could damage the pipe, the Contractor shall install bedding and pillows to support the pipe and padding to protect the pipe from backfill damage.

18 LOWERING-IN

18.1 General

18.1.1 The Contractor shall submit a lowering-in plan to the Company prior to the start of construction. The plan shall detail the equipment being used and the spacing of equipment during lowering-in. Separate plans shall be provided for each diameter of pipe and for concrete coated pipe or pipe with weights. The stresses shall be limited to the specified minimum yield strength (SMYS) of the pipe, or as directed by the Company. The plan will be reviewed by the Company to confirm no detrimental stresses during lowering-in.

18.1.2 All brush, skids, pipe, metal of any kind, rocks, large clods, sticks, projecting rocks, and other hard objects shall be removed from the trench into which the pipeline is to be lowered so that the protective coating shall not be damaged.

18.1.3 In rock trench, and wherever the bottom of the trench contains projecting rocks or other hard objects which might damage the pipe or coating in the opinion of the Company, with exception to wetlands (unless approved by the Company), the bottom of the trench shall be bedded with a minimum of 6 inches of earth (free of stones, clods, or other foreign objects) or sand, in accordance with the clause on bedding of this Specification.

18.1.4 The center of over-bends shall clear the high point of the trench. Sag bends shall fit the bottom of the trench.

18.1.5 Earth, sand, or foam pillows may be used for intermediate support above the bottom of the trench and their maximum spacing shall be 10 feet on center, or as otherwise directed by the Company. If foam pillows are used as a support option the Company may request earth/sand supports be interspersed with the foam pillows to minimize the risk of pillows collapsing at the pressure points. Topsoil shall not be used as support material.

18.1.6 Water shall be pumped from the trench prior to the pipe being lowered-in per the EMP. Water shall not be pumped off the Construction Right-of-Way or into wetlands/water bodies without written permission from the Company. Care shall be taken to prevent erosion and flooding of crops.

18.1.7 Set-on buoyancy control measures shall be installed as required after lowering in.

18.1.8 All coated pipe shall be subject to a visual inspection and checked with a holiday detector immediately prior to lowering-in to ensure that the coating is undamaged. All holidays shall be repaired in accordance with the coating Specifications.

18.1.9 Pre-coated pipe shall be lowered-in using wide belts, round endless slings, or rubber-tired/neoprene-lined cradles. These shall be kept free of sand, mud, stones or any foreign objects.

18.1.10 The coated pipe shall be lifted and not dragged off the support skids.

18.1.11 The Contractor shall lower the pipe into the trench in such a manner as to provide sufficient slack to the satisfaction of the Company. The Contractor shall ensure the strains induced in the pipe are minimized.

18.1.12 The pipe shall not be dropped or subjected to jarring or impact. Should a section of the pipeline fall off the skids, the Contractor shall immediately report this fact to the Company. The Company shall be allowed reasonable time to inspect the pipe section involved, at no expense to the Company, and the Contractor shall cut out and replace any defects and damaged pipe at the expense of the Contractor.

18.1.13 No worker shall be between the sideboom tractors and the pipe, between the pipe and the trench, or in the trench during raising, lowering, or moving of the pipe.

19 BACKFILLING

19.1 General

19.1.1 The Contractor shall provide sufficient time between lowering-in and backfill operations to allow company survey crews to conduct an as-built survey of the lowered-in pipe. No backfilling will be allowed where as-built survey data has not been obtained.

19.1.2 Extreme care shall be taken in backfilling the trench to prevent damage to the pipe or pipe coating.

19.1.3 The trench shall not be backfilled until the Company confirms through survey and inspection that the pipe has the required minimum depth of cover and the pipe fits the trench. If a section of trench is backfilled without the required approval, the Contractor, at its own expense, shall uncover the pipe to allow the Company to conduct necessary surveys and or inspections. If cover over the pipe is not in accordance with the Contract Documents the Contractor, at its expense, shall remove the pipe and re-excavate the trench as directed by the Company until the desired depth of cover is obtained.

19.1.4 To prevent erosion of the backfill in sloping terrain the Company may require trench breakers and/or sub-drains to be installed in conjunction with shallow ditches or diversion berms. The Company will determine the locations and type of breakers to be installed. Breakers and diversion berms shall be installed in accordance with the EMP.

(a) If sand bags are used to construct a breaker the bags shall be tightly fitted to reduce voids. All breakers shall be keyed into the ditch banks.

(b) Polyethylene sheeting when installed above the bags shall be free of wrinkles and holes.

(c) Geotextile separators used in the construction of trench breakers or diversion berms shall be staked into position so it remains in place during backfill with native materials.

(d) Berms shall have uniform dimensions along their entire length.

(e) When constructing berms in winter, care shall be taken to minimize the amount of snow in the berm.

19.1.5 After lowering-in, the trench shall be backfilled as soon as possible following confirmation from survey that as-built information has been obtained. The initial backfill operation shall consist of shading the pipe. This shading operation shall be performed by backhoes or an alternate method approved by the Company. The Contractor shall make all reasonable efforts to sort shading material from the trench spoil. Backfill material within 6 inches of the pipe shall have a maximum size of 1.5 inches measured in any direction. This material shall be placed using a procedure that does not allow backfill to fall directly on the pipe resulting in damage to the pipe or coating. The Contractor shall also comply with any requirements contained in the Construction Line List concerning the order in which respective materials are backfilled.

19.1.6 When the Company determines that the Contractor is unable to practically sort acceptable shading material from the trench spoil, pipe protection shall be provided in accordance with this Specification and as approved by the Company.

19.1.7 No rock in excess of 9 inches in diameter shall be introduced into the backfill material. All materials unsuitable as backfill material shall be treated as waste and disposed of in a manner approved by the Company.

19.1.8 In uplands, the trench shall be filled with soil to a height of no more than 6 inches above the level of the surrounding ground or as stated in the permits or the Construction Line List. To minimize the risk of trench line settlement compaction of the trench line with Company approved Low Ground Pressure (LGP) equipment is required except in rocky or swampy areas.

19.1.9 The Contractor shall restore wetlands as near as practicable to pre-construction conditions and must make a reasonable attempt to return the subsoil to its pre-construction density. During backfilling of wetland areas, subsoil material removed from the trench during construction shall be replaced so that the material is not mounded above the adjacent ground surface (undisturbed trench wall). Subsoil that exceeds the elevation of the ground adjacent to the trench shall be removed from the wetland and disposed of in an upland area on the Right-of-Way or a Company-approved disposal site. After the trench has been backfilled with subsoil, previously segregated topsoil shall be spread over the trench area and mounded as specified in the applicable permits/licenses.

19.1.10 Backfill compaction at road crossings, pipeline crossings, stream and river crossings, irrigated lands, valve sites and station sites will require a greater level of compaction as required in the Contract Documents.

19.1.11 Under no circumstances will topsoil be used for backfill material and extreme caution shall be exercised by the Contractor to ensure that mixing of topsoil and subsoil does not occur. Topsoil shall be replaced subsequently in a separate operation once the stripped portion of the Construction Right-of-Way has been prepared in accordance with the Contract Documents, and to the satisfaction of the Company.

19.1.12 After backfilling and compacting of the trench excess spoil remaining after the trench has been backfilled shall be feathered to the existing grade within the existing stripped area such that it will not interfere with drainage patterns or farming operations. The backfill crown will be in accordance with the Project Contract Documents. Spoil which cannot be dispersed in this manner to the satisfaction of the Company shall be considered as surplus and shall be properly disposed of in accordance with these Specifications, the EMP, or AMP.

19.1.13 Watercourses and/or seasonal drains disturbed by construction of the pipeline shall be opened across the construction Right-of-Way to allow the proper flow of water.

19.1.14 Slope breakers, furrows, and terraces shall be constructed across the construction Right-of-Way as necessary to divert the flow of water away from the backfilled trench and into natural drainage courses to prevent excess erosion along the pipeline prior to clean-up. Terraces and levees shall be restored to their former condition to function as originally intended.

19.2 Backfill of Buried Foreign Facilities

19.2.1 The Contractor shall ensure that all requirements for the type of materials/soils, placement, and compaction of backfill are in accordance with the requirements of the Construction Line List.

19.2.2 In the absence of specific requirements, backfill material within 6 feet of either side of any buried facility shall be deposited in layers not exceeding 6 inches. The backfill shall be compacted to 85% Standard Proctor Density to minimize settlement and provide adequate support. Random tests may be performed by the Company at the Company's discretion. Backfill which fails to achieve the required density shall be removed and re-compacted.

19.2.3 The Contractor shall take all appropriate measures to ensure facilities are not damaged during backfilling operations and shall report any damage to buried facilities to the Company.

19.2.4 All Work must be completed in accordance with the requirements of the Company's Health & Safety Management System (where applicable), the Company's Construction Safety Manual (where applicable), EMP, AMP, and Project Ground Disturbance Procedure.

19.3 Backfilling in Areas of Irrigation

19.3.1 Backfilling through areas of active irrigation shall occur immediately after lowering-in operations to ensure the minimum amount of disturbance occurs to landowners.

19.3.2 Where backfilling of the pipeline trench is done through areas of flood irrigation and areas of mobile irrigation (wheel line or pivot type systems) the Contractor shall ensure that all the backfill is compacted and consolidated. The trench shall be backfilled to 12 inches over the pipe and the fill wetted and compacted using mechanical hand-tamping devices. The balance of the fill shall be wetted and compacted in 6 inch layers. All layers of this backfill shall be compacted to match the subsoil compaction adjacent to the construction Right-of-Way and, in any event, compacted to 98% of Standard Proctor Density.

19.3.3 No tractors or other heavy equipment shall be used for tamping. Upon completion of the backfilling and tamping, the Contractor shall restore the original grade. All excess soil shall be removed and disposed of as directed by the Company

19.3.4 Through flood irrigation areas the Contractor shall backfill in a manner resulting in the finished grade being restored to precisely the original surface contour.

19.3.5 The replacement or repair of all irrigation dikes that are disturbed or destroyed during the Work shall occur as soon as practical after backfill. This shall include compaction of the dikes to a standard matching the adjacent undisturbed dike compaction.

20 PIPE PROTECTION

20.1 General

20.1.1 Pipe Protection requirements will be determined by the Company during the trenching operation.

20.1.2 Where the Company requires that material be imported from external sources for pipe protection the Contractor shall be responsible for acquiring all approvals and associated permits for the use of these sources from all Authorities having Jurisdiction. The Contractor shall comply with all applicable permit conditions and provide the Company with a copy of all permits.

20.2 Pillows

20.2.1 The Contractor may elect to use foam pillows or other intermediate supports, as approved by the Company, to support the pipe above the bottom of the trench prior to bedding material being placed. Pillows shall not be allowed in areas not requiring bedding, as determined by the Company.

20.2.2 Foam pillow supports shall have a 2 lbs/ft^3 minimum density and a 30 lbs/in^2 minimum compressive strength.

20.2.3 Support pillows shall provide even support across the lower quadrant of the pipe, and shall provide a finished clearance of 6 inches between the trench bottom and the pipe.

20.2.4 The maximum center to center spacing between such supports shall be 10 feet, or as otherwise directed by the Company. The Company may require additional supports (such as sand bedding) between the foam pillows to adequately support the pipe.

20.2.5 The Company may require changes to the spacing of these supports contingent on a trial section of pipe being lowered in and clearances between trench bottom and bottom of pipe being checked to ensure that the minimum clearance of 6 inches is maintained.

20.3 Bedding

20.3.1 Where requested by the Company the bottom of the trench shall be bedded.

20.3.2 Bedding material shall consist of well-graded non-angular mineral material with a maximum particle size of 1.5 inches.

20.3.3 Bedding shall be performed to achieve a smooth and even finish with a minimum compacted thickness of 6 inches between the bottom of the pipe and the closest point to the trench bottom.

20.3.4 Under no circumstances will topsoil be used to bed the pipe.

20.4 Padding

20.4.1 Where requested by the Company, the Contractor shall pad the top and sides of the pipe such that only padding materials are within 6 inches of the pipe.

20.4.2 The material to be used for padding shall be well-graded non-angular mineral material with a maximum particle size of 1.5 inches.

20.4.3 This material shall be placed on the pipe using a procedure that does not damage the coating.

20.4.4 When suitable material cannot be obtained in sufficient quantities from the ditch spoil, and when approved by the Company, select material can be obtained using a mechanical padder. Screens on the mechanical padder shall be of a size to provide material that does not damage the coating on the pipe upon impact and, as a minimum, shall not allow particles that exceed 1.5 inches in size to pass through the screens. If these criteria are not maintained the Contractor will be required to change screens and/or revise the process to ensure screened material dropping on the pipe does not damage the coating.

20.5 Rock Shield

20.5.1 At certain locations, to protect the coated pipe, the Company may request that the coated pipe be wrapped with full circumference PVC rock shield

20.5.2 Tuff-N-Nuff or an approved equivalent (6mm minimum thickness) shall be used as rock shield products.

20.5.3 Prior to installation of the rock shield the coating shall be holiday tested and repaired as required in accordance with the Coating Specifications.

20.5.4 Rock shield shall be fastened to the pipe so that it will not become dislodged, bunch up, or become discontinuous during the lowering-in process. At a minimum it shall be installed with a 4 inches lap at all joints and be secured with fibreglass reinforced tape spaced at 2 feet. Weld location and pipe information required for survey shall be transferred to the outside of the rock shield prior to lowering-in.

20.6 Wood Lagging

20.6.1 At certain locations, to protect the coated pipe, the Company may request that the coated pipe be wrapped with full circumference wood lagging.

20.6.2 Prior to installation of the wood lagging the coating shall be holiday tested and repaired as required in accordance with the Coating Specifications.

20.6.3 PVC rock shield shall also be installed between the pipe and wood lagging.

21 CROSSINGS – GENERAL REQUIREMENTS

21.1 General

21.1.1 The method for constructing each crossing shall be in accordance with the Crossing Agreement, Crossing Drawings, EMP, requirements of any Authority having Jurisdiction, or as requested by the Company.

21.1.2 The Crossing Agreement, EMP, and other permits shall be onsite at all times.

21.1.3 Vehicle crossings over foreign facilities shall be constructed in accordance with the requirements of the crossing agreements or in the absence thereof in accordance with the CSP. It is the Contractor's responsibility to become familiar with all requirements of the Crossing Agreement, construction permit, or Environmental Plans including notices that must be provided to Authorities having Jurisdiction prior to commencing Work on a crossing. The Contractor shall anticipate such requirements and provide the required notice within the time period specified in the permits. The Contractor shall obtain the specific approval from the Company prior to commencing excavation at any crossing.

21.1.4 Crossings requiring heavy wall pipe, as defined on the Drawings, shall have the minimum amount installed as indicated on the Drawings or otherwise authorized as the minimum practical by the Company.

21.1.5 All Work performed at each crossing shall be performed in such a manner as to prevent undue obstruction, delay, or interference with traffic at the crossing.

21.1.6 It shall be the Contractor's responsibility to furnish and install at all crossings adequate and proper traffic aids, warning signs, barricades, flares and other safeguards necessary, in accordance with the CSP and the Authorities having Jurisdiction for the public safety and to maintain them throughout the duration of the Work at no incremental cost to the Company.

21.1.7 Suitable measures shall be used to prevent damage to road surfaces when crossing with construction equipment. Roads shall be kept clean and free of debris.

21.1.8 Prior to installing the pipe it shall be holiday tested and repaired as required in accordance with the Pipeline Field Coating Specification.

21.1.9 Trenchless methods for crossing railroads, highways, and road crossings shall be approved by the Company and shall be in accordance with the project drawings, meet the requirements of the crossing permit, and be approved by the Authorities having Jurisdiction. Permanent casing will not be installed unless shown on the drawings, or as directed by specific permitting requirements provided to the Contractor by the Company. The Contractor shall notify the Governmental Authorities in writing, the specified amount of time before, but no less than 48 hours in advance of starting the Work. The Contractor shall provide the Company with a copy of the notice.

21.1.10 Where open cutting a roadway is approved by the Company, the crossing shall be completed in one day. The Contractor shall provide temporary roads, barricades, signs, flares and flag persons as required to divert traffic and warn the public. The pipe shall be shaded with sand to approximately 8 inches above the pipe and the remainder of the excavation filled with gravel unless otherwise stated. Upon Company approval, flowable fill may be used.

21.1.11 When specifically requested by the Company, the Contractor shall install concrete pipe protection.

21.1.12 Casing where required shall be thoroughly cleaned inside. The pipeline shall be installed immediately or the casing must be fitted with welded waterproof caps. The ends of the casing may be required to be vented and end seals installed. Insulators shall be installed on the carrier pipe or pipe with concrete coating may be used. Casing and carrier pipe shall be checked to determine that they are electrically isolated prior to and upon completion of backfilling.

21.1.13 The bored or augered hole for crossings shall be made accurately to the line and elevation indicated on the drawing or as required by the crossing agreement. The bored or augered hole diameter shall be no larger than the pipe outside diameter plus 2 inches.

21.1.14 The same size pilot pipe shall precede the carrier pipe on slick bores. Soil shall only be removed through the pilot pipe.

21.1.15 Where casing or product pipe is not supported on the ditch bottom or undisturbed soil, the Contractor shall support the pipe by installing sandbags, foam pillows, field applied foam or compacted backfill as authorized by the Company.

21.1.16 If the Company authorizes foam pillows or field applied foam their maximum spacing shall be 10 feet on center or as otherwise directed by the Company. The Contractor shall backfill and compact between the foam structures with earth/sand to eliminate voids. Topsoil shall not be used as support material.

21.1.17 If the Company authorizes compacted backfill, it will be installed in 6 inch lifts and compacted to minimize settlement and provide adequate support.

21.1.18 The Contractor shall correct any deficiency detected in trenchless and open cut crossings within the warranty period including, but not limited to, subsidence.

21.2 Railroads

21.2.1 Bell holes shall not be made closer than 20 feet from the edge of shoulder or nearest rail. If so warranted by soil conditions, the Permit, the Crossing Agreement, or Authorities having Jurisdiction these distances may be increased and/or the Contractor may be required to reinforce the trench walls by means of shoring or sheet piling to prevent sloughing and the possibility of undermining the structure being crossed.

21.3 Private Road

21.3.1 Private roads shall be open cut unless noted otherwise on the drawings, crossing agreement, or Construction Line List. The Contractor shall ensure that warning signs are erected prior to open cutting a road or trail.

21.4 Public Roads and Highways

21.4.1 Crossings of Public Roads and Highways shall be in accordance with the Road and Highway Crossing Permits. Bell holes shall not be made within the road/highway Right-of-Way, unless otherwise approved by the Company and the applicable permit. If so warranted by soil conditions or the EMP, the Permit, the Crossing Agreement, or Authorities having Jurisdiction, the Contractor may be required to reinforce the trench walls by means of shoring or sheet piling, to prevent sloughing and the possibility of undermining the crossing.

21.5 Watercourses

21.5.1 All watercourse crossings will be isolated, if flowing, during construction unless otherwise approved by the Company.

21.5.2 Watercourse crossings include the crossing of any surface feature where flowing water, standing water or the potential thereof exists on the Right-of-Way and as further defined in the EMP included herein and this Specification.

21.5.3 Crossings of a watercourse including but not limited to a river, stream, creek, channel, irrigation trench, canal or flume shall be performed in accordance with the terms of crossing agreements, standard or typical drawings, permits, licences, and regulations of Authorities having Jurisdiction. Design drawings will be provided for significant crossings, as determined by the Company. If specific design drawings have not been provided, crossings shall be performed in accordance with the EMP.

21.5.4 When open trench methods are used, the Company must be made aware of proposed installation procedures prior to commencement of the Work. Crossing activities shall be well planned and where possible, performed in one day. The Contractor shall adhere to the requirements for fluming or by-pass pumping where cross flowing water exists, or as required by the Company.

21.5.5 Concrete coated pipe or weights shall be installed in accordance with the Project Drawings or as directed by the Company.

21.5.6 Where a drag section with bolt-on weights will be pulled across a watercourse, metal or nylon banded wood lagging, 1 inch thick supplemented by four 1.5 inch X 3.5 inch slats placed at 90^0 to each other shall be supplied and installed by the Contractor. The number of pieces of lagging will be increased to prevent the metal banding from touching the pipe. The lagging shall be installed around the entire pipe between river weights to maintain the weight spacing.

21.5.7 If permitted by Authorities having Jurisdiction, excavation materials may be stored in water body crossings. Silt fences shall be installed by the Contractor, as directed by the Company, and without additional compensation. Immediately prior to installing the crossing section in the trench, any ice shall be broken and sharp edges remaining on the trench edges shall be removed to prevent damage to the pipe coating.

21.5.8 The minimum cover for all water crossings shall be as stated on the Construction Documents and Permits.

21.5.9 At the discretion of the Company, pre and post-installation hydrostatic test may be required.

21.5.10 Vehicle crossings of watercourses shall be in accordance with the EMP, or as approved by the Company. All such structures shall be removed as soon as practical after construction.

21.6 Facility Crossings

21.6.1 All foreign lines shall be crossed in accordance with the terms of crossing agreements and/or letters of agreement and regulations of Authorities having jurisdiction.

21.6.2 Overhead power line crossings shall be marked and signs erected in accordance with the Company's CSP. Ground disturbance without a representative of the permittee or licensee of the pipeline or cable being present is not permitted. No ground disturbance shall take place within 10 feet of the pipeline or cable until the foreign utility has been positively identified. The method of positively identifying foreign lines shall be by hand digging, hydrovac or other daylighting procedure approved by the owner of the foreign line or cable. No mechanical excavation shall be permitted within 1 foot of a foreign utility at any time. Refer to the CSP for additional direction.

21.6.3 The minimum clearance between foreign lines and Company's pipeline shall be 1 foot or as otherwise specified in Crossing Agreements. The depth at the point of crossing shall be maintained for the total width of the foreign line's Right-of-Way. The Company's pipeline shall be installed under the foreign line unless otherwise shown on the Project Drawings and specified in the Crossing Agreements.

21.6.4 The Contractor shall provide a written procedure to be followed for each crossing. The procedure shall include but not be limited to the proposed method of crossing, clearances, monitoring methods, supporting methods to be utilized, and other relevant details.

21.6.5 The Contractor shall pay particular attention to 3rd Party and the Company's existing valve and pump station sites to determine the exact location of all power and communication cables and conduit. It shall be the responsibility of the Contractor to notify the owners of all such underground and above ground structures 72 hours or in accordance with the Crossing Agreement, or the appropriate local utility protection system in advance of any such intended crossing. A copy of such notification shall be forwarded to the Company at the same time. Excavation shall not commence until the authorized representative of the foreign facility and the Company is present.

21.6.6 The Contractor shall make contacts required for crossings in writing where possible and maintain a contact log. The contact log shall, as a minimum, record name of the Company, person contacted, time and date of call and brief summary of discussion. Confirmation of these notifications shall be provided to the Company.

21.6.7 When telephone, power and utility lines, poles, or other structures interfere with the Contractor's vehicles or construction equipment during construction or installation of the pipeline, the Contractor shall make the necessary arrangements to preserve the continuous use of the utility during construction. Utilities located along the centerline, requiring relocation for construction shall be brought to the attention of the Company to facilitate timely relocation with the owner of the facility.

21.6.8 Cables shall be supported in such a manner so as to prevent damage. Any damage to foreign utilities will be at the sole expense of the Contractor.

21.6.9 The Contractor shall obtain the permission of the Company prior to requesting that an owner of a pipeline or utility relocate or cut their lines or cables to facilitate a crossing. The Contractor shall be responsible for all costs and damages to perform the cut or relocate.

21.6.10 Where foreign lines, utilities or cables are located within a crossing to be bored or augered, 2 ft of separation shall be maintained between the Company's pipeline and the foreign facility.

22 CROSSINGS – METHODS

22.1 Slick/Slip Bored Crossings

22.1.1 Bores shall be made maintaining the minimum depth of cover requirements as specified in the Permits, Drawings, or Contract Documents.

22.1.2 The Contractor shall accomplish the boring or auguring through a pilot section of uncoated pipe (i.e. auger casing). The Contractor shall furnish the pipe to be used for this purpose unless otherwise stated in the Contract Documents. No boring or auguring shall take place through the carrier pipe that will be part of the permanent pipeline.

22.1.3 The bored or augered hole for crossings shall be made accurately to the line and elevation indicated on the drawing or as required by the crossing agreement. The bored or augered hole diameter shall be no larger than the pipe outside diameter plus 2 inches.

22.1.4 After the carrier pipe has been installed the Company shall conduct a visual inspection and may also choose to conduct a coating continuity test (in accordance with Pipeline Research Council International PR-262-9738, Appendix F) on the installed pipeline section. The Contractor shall cooperate with this requirement and ensure that each end of the section is clean, dry and not in contact with the ground while the visual inspection and the coating continuity measurement is taken. If the inspection indicates the coating has been damaged during installation and exceeds acceptable tolerances, as determined by site specific conditions, the section will require removal and the coating damage repaired. The Contractor shall take preventative measures to ensure no further damage occurs during re-installation of the carrier pipe. It will then be re-inspected in accordance with the above.

22.1.5 To prevent subsequent settling of the crossing, excessive voids around the carrier pipe resulting from installation by the boring or augering methods shall be filled with grout at the sole expense of the Contractor. Excessive voids shall be determined by the Company. The type of grout and the method of installation shall be approved by the Company, adhere to applicable permits, and the Authorities having Jurisdiction over the crossing.

22.1.6 After the bored section has been tied-in the Contractor shall ensure the pipe is adequately supported prior to completing backfilling. Compaction of native material and/or sandbag supports, each a minimum length of 3 feet along the pipe, shall be utilized or until undisturbed ground is reached.

22.2 Horizontal Drilled (HD) Bore Crossing

22.2.1 The HD Bore is defined as the use of a small to medium size horizontal drilling rig to steer and drill a bore under a crossing which can be a small watercourse, foreign pipeline, highway, railway or other foreign utilities.

22.2.2 The depth of the pipeline installation will be limited to 20 feet to the center of the pilot hole unless otherwise approved by the Company.

22.2.3 The typical HD Bore has a straight alignment and a horizontal or level profile. However the Company may authorize a curve in the drill profile.

22.2.4 HD Bores with a radius of curvature in the drill profile shall meet the same Specifications for the drill path and directional tolerances as a Horizontal Direction Drill (HDD) or per the Contract Documents. The design radius of curvature is to be no less than for a comparable Horizontal Directional Drill or in accordance with the Contract Documents.

22.2.5 The pilot hole shall be completed by equipment that is steerable and trackable.

22.2.6 The wall thickness of the carrier pipe shall be as designated by the Company.

22.2.7 Product pipe that is installed by HD Bore technique shall have a sacrificial abrasion coating over the corrosion protection coating in accordance with the Coating Specifications.

22.2.8 The Contractor will evaluate all proposed HD Bore locations to ensure that the soil conditions are compatible with the HD Bore construction methodology and that the risk of washout is minimized within the bore path.

22.2.9 HD Bores may employ predrilled pressure relief holes to allow the release of slurry in controlled locations during pipe pullback. The Contractor shall present a plan showing the proposed location of relief holes for approval by the Company prior to commencement of each bored location, if applicable.

22.2.10 Prior to commencement of any work, the Contractor shall provide a detailed plan for the steering and guidance of the pilot hole for approval by the Company. For steering/tracking the Contractor may utilize a typical walkover steering system for shallow HD Bores (depth less than 20 ft). Where the drill path has a designed curvature the accuracy of the steering equipment must provide and read to one decimal place accuracy (0.1% or 0.1 degrees of inclination and 0.1 feet of depth).

22.2.11 Only qualified and competent personnel are to be employed on an HD Bore installation. The résumés of the Contractor's personnel must be submitted to the Company for approval prior to start of construction.

22.2.12 The Contractor must maintain a current copy of the steering system's operating manual with the steering equipment. Operation of the tracking receiver and transmitter shall be as per the Manufacturer's Operating Specifications at all times (calibration requirements, cold weather operations etc.).

22.2.13 Where the HD Bore crosses under foreign pipelines or other critical utilities the Contractor is to provide recommendations for the minimum clear distance between the pipelines or other critical utilities for Company approval. Under no circumstances shall the minimum clearance between the pipeline and existing facility be less than 2 feet.

22.2.14 Final ream size for bores with curvature in the drill profile shall be the industry standard of 1.5 times the product pipe diameter for sizes up to NPS 24 and for pipe sizes greater than NPS 24 the final ream size shall be pipe diameter plus 12 inches.

22.2.15 For HD Bores with no design curvature the final ream size shall be that as specified for a slip/slick bore.

22.2.16 Pull back of the product pipe shall be at a rate that minimizes the potential for drilling slurry release to surface. Pull back operations shall not commence unless a Company Authorized Representative is present.

22.2.17 The Contractor shall be responsible for containment and clean-up of any drilling slurry or other material used to facilitate advancement of the pilot hole, reaming, and pull back of the product pipe.

22.2.18 The Contractor shall have spill and containment materials and equipment, and personnel trained in spill handling on site before starting any Work and for the duration of the Work.

22.2.19 After the bored section has been tied-in the Contractor shall ensure the pipe is adequately supported prior to completing backfilling. Compaction of native material or imported material, sandbags, foam pillows or spray in foam supports shall be utilized in accordance with this specification.

22.2.20 Upon completion of the pilot hole an as-built vertical and horizontal profile is to be supplied to the Company in the form acceptable to the Company.

22.3 Open Cut Road Crossings

22.3.1 When open cutting a road the Contractor shall refer to the Construction Line List to determine if that road must remain open to traffic. If such a requirement exists, the Contractor shall ensure that a detour exists, an access road (shoo-fly) suitable for automobile traffic is provided, or temporary bridgework of adequate strength and width to ensure the safe passage of traffic is installed. Prior to the commencing the open cut process these measures shall have the approval of the Company and the Authority having Jurisdiction.

22.3.2 The Contractor shall arrange to complete the trenching, laying and backfilling of road crossings and removal of temporary bridging before the end of the workday so as to avoid hazards to night traffic. The Contractor may have to complete the open cut crossing in sections to facilitate the continuous flow of traffic.

22.3.3 In the absence of any specific requirements attached to a crossing agreement for an open-cut crossing through driveways, streets, roads or highways the initial backfill material shall be wetted sand placed evenly and carefully around and over the pipe in 6 inch layers. Each layer shall be carefully compacted by further wetting as required and by tamping until 12 inches of cover exists over the pipe. The balance of backfill material shall be placed in 6 inches layers and shall be compacted by the use of mechanical tampers so that each layer has a density equal to or greater than that of the adjacent original material. For highways or well-travelled roads this shall be 95% of Standard Proctor Density. Upon Company approval, flowable fill may be used. The upper 1 foot of the travel surface shall be replaced with material that is equivalent to, or better than, the original surface material of the road. Surfaces previously paved shall be repaved by the Contractor.

22.3.4 In the absence of any specific requirements attached to a crossing agreement, when performing an open-cut crossing through unimproved trails or private access in the winter months, the initial backfill material shall be unfrozen material when practical. If unfrozen material is not readily available, backfill may be performed with frozen material with a maximum particle size of 6 inches. These crossings will be re-visited the following construction season.

22.4 Open Cut Watercourse Crossings

22.4.1 The Contractor shall provide notification of in-stream activities in accordance with the conditions of the EMP, crossing approvals, or permits.

22.4.2 Grading, excavation and backfilling shall be performed in a manner and method satisfactory to the Company and the Authorities having Jurisdiction. The Contractor shall comply with all special precautionary measures required by Federal, State, and Local authorities and shall work closely with such authorities to prevent or minimize obstructions to navigation on the watercourses.

22.4.3 Hard plugs should be left in both banks until channel excavation begins in order to minimize the duration of watercourse sediment loading.

22.4.4 Crossings shall proceed only with when environmental conditions that will cause high volumes of water flow are not anticipated. The Contractor shall have contingency plans and capabilities to ensure environmental compliance.

22.4.5 In-watercourse activity shall be completed in accordance with the EMP.

22.4.6 Sag bends shall be set well back into the watercourse banks in accordance with the Drawings and as approved by the Company.

22.4.7 The Contractor shall exercise care during construction to ensure that normal watercourse flow and direction is not impeded.

22.4.8 The trench shall be excavated to the depth required to provide the minimum depth of cover as shown on the Drawings or as authorized by the Company. If buoyancy control devices are used the depth of cover will be from the top of the buoyancy controlled device unless otherwise directed.

22.4.9 Trench spoil material shall not be stockpiled in the watercourse channel, unless otherwise approved by applicable Permits. Mitigative measures, as approved by the Company or in the EMP, shall be implemented to restrict the migration of spoil materials back into the watercourse.

22.4.10 The Contractor shall schedule his Work such that the watercourse crossing pipe section is ready to install prior to commencing in-watercourse stream trenching operations.

22.4.11 The Contractor shall take depth measurements of the bottom of the pipeline trench at intervals along the crossing immediately prior to installation of the pipe to ensure adequate trench depth has been excavated to achieve the design depth of cover. Depth measurements shall be taken from the top of the pipe after installation to confirm the depth of cover meets the minimum design depth of cover and fits the trench as excavated. If buoyancy control devices are used the depth or measurements shall be taken from the top of the buoyancy control device after installation to confirm the depth of cover meets the minimum design depth of cover and fits the trench as excavated.

22.4.12 The Company may employ a diver or use any other suitable method to inspect the bottom of the trench prior to pipe installation and prior to the backfilling of the trench. The Contractor shall facilitate the work of the diver and shall furnish helpers and the necessary equipment other than the actual diving equipment for the diver to perform his work.

22.4.13 The Contractor shall assist the Company in establishing a final top of pipe profile of each crossing.

22.4.14 After the depth of cover over the pipe and the pipe alignment have been inspected and approved by the Company, the pipe trench shall be backfilled to its original contours with excavated material to the satisfaction of the Authority having Jurisdiction and the Company unless otherwise shown on the Drawings.

22.4.15 To prevent soil and bank erosion watercourse banks and levees shall be backfilled, re-contoured, and fully compacted to the satisfaction of the Authority having Jurisdiction and the Company. The watercourse banks, approaches, and levees shall be re-vegetated in accordance with these Specifications and the EMP.

22.4.16 Where special materials are required, as per the Drawings, the Contractor shall provide and place such materials for bank and levee backfill.

22.4.17 Unless stated otherwise in the EMP, banks shall be restored and stabilized as follows:

(a) Bank material shall be sloped (maximum: 1 vertical: 2 horizontal) to a point 3 feet above normal high water level or as specified by the Company. A step shall be installed above the back-slope (minimum of 5 feet wide), extended across the Right-of-Way, and shaded into natural profiles at its edge. Above the step, slopes shall be restored to natural contours. Streambed materials shall never be used as bank construction materials;

(b) The Contractor shall, at no extra cost to Company, install and dismantle during clean-up operations any special silt fences, settling ponds or bypass flumes used in performing the crossing;

(c) Final clean up shall include the removal of temporary bridges, excess construction materials and debris, both within the banks and downstream of the crossing;

(d) Post construction erosion control measures shall be installed by the Contractor where specified by the Company;

(e) The Contractor shall be responsible for any bank slope stability armouring, re-vegetation or problems on graded banks during the warranty period.

23 BUOYANCY CONTROL

23.1 General

23.1.1 Locations requiring Buoyancy control and the type to be used will be shown on the Project drawings. Buoyancy control may consist of concrete bolt on weights, concrete set on weights, bag weights, concrete coated pipe, or screw anchors.

23.1.2 Buoyancy control types and quantities that are shown on the drawings are to be considered a guide only. The Company may increase or decrease quantities or change the type of buoyancy control shown after the pipe trench has been excavated.

23.1.3 Trench walls shall be excavated in accordance with the Company's CSP or approved Contractor's Safety Program. This may require the ditch walls to be tapered or cut back to provide safe installation or re-positioning of buoyancy control.

23.1.4 The trench depth and width requirements will change for each type of buoyancy control. The Contractor shall perform the additional excavation required for the installation of buoyancy control at no additional cost to the Company.

23.1.5 The Contractor shall refer to equipment load charts to ensure equipment with the proper lifting capacities and reach is utilized during placement of buoyancy controls.

23.1.6 Buoyancy control shall not be used when, in the opinion of the Company, the trench can be dewatered and the backfill material is stable enough to hold the pipeline in place after the trench has been backfilled.

23.1.7 Extreme care shall be taken in handling and installing of buoyancy control devices to prevent damage to the pipe, coating, and weights.

23.1.8 The required design depth of cover shall be maintained and will be measured from the top of the buoyancy control device. The minimum depth of cover is measured from the graded surface of the Right-of-Way adjacent to the trench at the time of trench excavation.

23.1.9 The Company Engineering Representative may adjust the buoyancy control requirements after the trench is open if site specific conditions warrant such a change.

23.2 Continuous Concrete

23.2.1 Continuous concrete coating includes concrete coated pipe complete with shop applied concrete and pipe hauled to site with concrete applied on site. Pre-coated or shop applied concrete coating will require field coating of the joints. Field joints shall be coated with a material approved by the Company.

23.2.2 The Contractor will provide to the Company for approval, prior to commencing concrete Work, a detailed procedure for the forming and pouring of the concrete.

23.2.3 Submitted procedures for concrete coating pipe shall include mix designs for the concrete and reinforcing to be used if other than welded wire mesh in addition to other details including formwork design. Refer to USPCS-SPEC-CCC-007.

23.2.4 The thickness of continuous concrete coating shall be specified on the drawings.

23.2.5 Concrete coating shall be continuous for the entire length of pipe and may require additional subsequent applications of concrete at support locations.

23.2.6 If the temperature is less than 40°F heating and hoarding shall be utilized for casting and curing concrete coating.

23.3 Screw Anchors

23.3.1 General requirements for screw anchor installation equipment are as follows:

(a) Installation equipment shall be capable of supplying installation torque up to 8,000 ft-lb. If the installation equipment is capable of supplying a torque in excess of this, the installation equipment shall be controlled in such a way as to prevent a torque greater than 8,000 ft- lbs being applied to a screw anchor or extension shaft. Shafts may start to twist at 6,000 ft-lbs of torque;

(b) The torque indicator shall be able to operate in cold weather conditions and shall be easily read by the operator without entering the ditch; and

(c) Anchors can be installed either with single or twin drive installation units. Anchor shafts shall be placed correctly to ensure the saddle can be properly installed.

23.3.2 Screw anchors shall be installed in accordance with the following:

(a) Screw anchor assemblies shall be installed at the spacing shown on the project drawings. If the specified location lies within 20 inches of a girth weld, the assembly shall be moved to beyond this distance from the weld;

(b) Screw anchors shall be placed in any location where the depth to competent soil is 2 feet or greater;

(c) While installing the screw anchor and extension shafts, excess downward or upward pressure shall not be applied to enhance or impede the progress of the anchors into the ground. Screw anchors shall be allowed to progress into the ground naturally, without undue force;

(d) Screw anchors and extensions shall be installed as close as practical to vertical;

(e) Each screw anchor shall be installed to the minimum installation torque of 1000 ft-lbs;

(f) If the minimum installation torque is not achieved after the installation of the screw anchor and one 6 foot long extension shaft, the Contractor shall add extension shafts as necessary until the minimum installation torque is achieved;

(g) If the minimum installation torque is achieved before the extension shaft is added, the Company shall be notified prior to commencement of any further Work. Screw anchor assemblies less than 12 feet in length (one 6 foot screw anchor plus a 6 foot extension shaft) shall be pull-tested to verify their holding capacity. Screw anchors less than 9 feet in length will not be accepted;

(h) A polyester saddle and fastening system, designed to withstand the loading, shall be used. The saddle shall be installed square and level on the pipeline. Polyester saddles shall be installed with a maximum allowable slack between the strap and the pipeline crown of 2 inch;

(i) All bolts in the assembly shall be hand tight with all threads engaged;

(j) If the Contractor is unable to install screw anchor extension shafts to full depth, pipe sleeves may be used to complete the termination. In no case shall the terminator atop the shaft be allowed to protrude more than 2 inches above the top of the pipe; and

(k) Trenches shall be de-watered for the installation of anchors. Where considered to be impractical to de-water the entire trench, the Contractor shall install earth plugs between proposed anchor locations after lowering in and thereafter de-water the area in the vicinity of the anchor.

23.3.3 Pull testing shall be performed in accordance with the following:

(a) A pull-test to a minimum of 3,000 lb. shall be performed on both screw anchors every tenth (10th) screw anchor. The load shall be held a minimum of 30 seconds; and

(b) If, after allowing an initial movement or ‘set’, movement greater than 1 inch continuous ‘creep’ movement is observed, the screw anchor shall be deemed to have failed the pull-test. In this case additional extension shafts shall be added to the screw anchor and installed to the new depth, and the subsequent installation shall be re-tested. Equal maximum spacing of the anchors as specified on the Project Drawings must be adhered to.

23.4 Attached Weights

23.4.1 Bolt-on concrete weights or strap-on bag weights shall be installed prior to lowering-in operations.

23.4.2 Pipe coating shall be checked and repaired if necessary, prior to the installation of weights.

23.4.3 Where bolt-on concrete weights are called for on the Drawings or requested by the Company the pipe under the weight shall be wrapped with wood lagging or other suitable material approved by the Company.

23.4.4 Weights shall be handled and installed in such a manner as to prevent damage to the pipe, coating or the weight. Rock shield shall be installed beneath weights with damaged felt padding.

23.4.5 Weights shall be securely fitted to the pipe and all bolts or straps shall be securely tightened

23.4.6 On long sections of pipe with weights, care shall be taken to prevent buckling of the pipe while lowering the pipe into the trench.

23.5 Concrete Set-on Weights

23.5.1 Weights shall be handled and installed in such a manner as to prevent damage to the pipe, coating or the weight.

23.5.2 The Contractor shall do all Work necessary to fabricate, load, haul, string and install weights. The Contractor shall own any excess set-on weights that the Contractor fabricated. The Company reserves the right to supply any or all weights.

23.5.3 The Contractor shall take samples to ensure the compressive strength and density of the concrete meets the requirements specified in the Typical Drawings and USPCS-SPEC-CCC-007 Appendix A.

23.5.4 Forms may be removed from the weights as long as no slumpage occurs. If slumping occurs, the weights shall be replaced at the Contractor's expense.

23.5.5 A calcium chloride accelerator will be allowed for concrete weights only (not on structural or continuous concrete coating). The maximum allowable calcium chloride concentration shall be two (2) percent.

23.5.6 Concrete set-on weights shall be backfilled with backhoes. Backfill shall progress evenly on both sides of the weight until it is covered. Care shall be taken to ensure that the weights stay vertical without tipping in either direction while back filling.

23.6 Saddle Bag Weights

23.6.1 General

(a) The Contractor shall furnish all labor, equipment and material required for the filling and use of the saddle bag weights. The Contractor shall own any excess set-on weights that the Contractor fabricated. The Company reserves the right to supply any or all weights.

(b) Any identification markings or stencilling on the external pipe surface shall be documented by survey and/or inspection prior to the placement of any saddle bag weight.

(c) The Contractor will own any surplus filled saddle bag weights.

23.6.2 Delivery, Storage, and Handling

(a) The Contractor shall exercise due caution in handling, storing and transporting the saddle bag weights, whether full or empty.

(b) A protective cover is to remain on the empty bag weights until they are filled to ensure proper protection from the elements.

(c) Weights shall be stored in the upright position and shall not be stacked.

(d) Weights that are to be stockpiled during freezing conditions or for more than 30 days shall be covered to prevent snow from melting and re-freezing between the stockpiled weights, and UV degradation of the materials.

(e) During freezing conditions, to ensure filled bags do not freeze to the ground, a layer of straw should be spread on the ground prior to storing filled bags.

23.6.3 Materials

(a) The body fabric of the bag weight shall be of a woven polypropylene material. All webbing and lifting straps shall be polypropylene or polyester.

(b) The design of the weight shall require no more than ½ the pipes diameter on each side in extra trench width.

(c) Body fabric shall be rated for geotextile use with UV inhibitors.

(d) Body fabric shall not exceed an elongation rating of 15%.

(e) All materials shall be stable within a pH range of 2 to 12.

(f) Body fabric shall be of a material that does not result in cathodic protection shielding, and must possess a minimum permeability rating of 10 gal/min/ft^2.

(g) All webbing must be rated to provide a combined safety factor of four times the capacity.

(h) The fill material shall be a road crush or screened stone of a consistent size (.25 inch – .75 inch diameter), and be free of silt and clay. The fill material must also be kept dry to prevent freezing. Sand is not acceptable.

(i) The dry bulk density of the fill material must be a minimum of 100 lbs/ft^3.

23.6.4 Application

(a) To minimize pipe coating damage during installation, the exterior of the bags are to be inspected and cleaned of any stones or other material that may have become frozen or implanted on the exterior of the bag prior to placement.

(b) The saddle bag shall be lifted by the use of all lifting loops provided.

(c) Chains with suitable clevises or polyester bag slings shall be used when lifting to ensure no damage occurs to the lifting loops.

23.6.5 Inspection

(a) All weights found to have torn or worn straps or body fabric shall not be hauled to right of way and be set aside unless otherwise directed by company. The on-site inspector shall be made aware of any instance.

(b) The filled weight of the saddle bags shall be confirmed to meet the Company specified requirements by sampling the first filled weight during any filling activity, change in filling location, or any change in fill material. A sample shall also be taken once every 100 bags filled.

23.7 Buoyancy Control by Additional Depth

23.7.1 Buoyancy control may be accomplished by installing the pipeline at greater depth thereby ensuring sufficient competent material is backfilled over the pipe providing negative buoyancy. This method shall only be used where requested by the Company.

24 TIE-INS

24.1 General

24.1.1 The pipe shall be cut to permit proper line-up with sufficient slack to ensure a stress free line-up.

24.1.2 When possible, tie-ins shall not be made at transition welds.

24.1.3 Bell holes shall be adequately sized to enable the welder(s) to exercise normal welding skill and ability and to ensure the safety of personnel working in the trench.

24.1.4 The Contractor shall permit the Company time necessary to perform NDT on tie-in welds prior to coating application at no additional costs to the Company.

24.1.5 The Contractor shall support pipe in bellholes and pipe adjacent to bellholes by installing sandbags, foam pillows, field applied foam or compacted backfill as authorized by the Company.

24.1.6 If the Company authorizes foam pillows or field applied foam, their maximum spacing shall be 10 feet on center, or as otherwise directed by the Company. The Contractor will backfill and compact between the foam structures with earth/sand to fill the voids. Topsoil shall not be used as support material.

24.1.7 If the Company authorizes compacted backfill is used, it will be installed in 6 inch lifts and compacted to minimize settlement and provide adequate support.

24.1.8 Open trench shall be minimized where possible. Unless otherwise approved by the Company excavations for tie-ins of crossings, bends, valves or other appurtenances may remain open for no longer than 5 days.

24.1.9 Pipe pups 10 feet and over in length shall be moved ahead daily and welded into the line. Pipe pups less than 16 feet in length shall not be welded in sequence; they shall be separated by a full joint of pipe.

25 CATHODIC PROTECTION RELATED INSTALLATIONS

25.1 Cathodic Protection Test Leads

25.1.1 Prior to backfill operations, test leads shall be installed by the cad weld method in accordance with crossing agreements, Project Drawings or as directed by the Company. Brazing shall not be permitted. The security of the Thermite weld will be checked by tapping with a weld hammer. Thermite welding to foreign owned pipelines shall not be performed unless an authorized representative of the pipeline owner is present. The cad weld will be coated in accordance with the Project Drawings or as directed by the Company.

25.1.2 The Contractor shall install test lead assemblies on the Company's pipeline in accordance with the Drawings and Specifications. The Contractor shall cooperate with and support foreign line owners who will install the test leads on their pipelines. Test lead stations shall be attached to Company warning signs where applicable.

25.1.3 Where internal pressures are too high, wall thickness too thin or where requested by the owner of a foreign pipeline, mechanical clamps shall be used to connect leads to the pipe. Some foreign line owners may specify clamp attachments for leads and will supply their Specifications with such requests.

25.1.4 When installing clamps the coating shall be totally removed from the circumference of the pipe except when the pipe is coated with FBE. The cable lug connection point shall be filed to clean bright metal. The Contractor shall install a crimp or screwed type lug connector on each lead. The clamp shall consist of a 0.5 inch wide Band-it brand or approved equivalent 316 SS band. The band shall be tightened with the manufacturers tensioning equipment. The entire connection, including the banding shall be coated with a compatible and comparable coating as a minimum. A Petrolatum coating is to be liberally applied and where soil stress or mechanical damage may be a concern the Petrolatum is to be protected with a suitable fiberglass mesh coating.

25.1.5 Test lead assemblies shall be supplied with an adequate length of wire to allow two wraps around the new pipeline and to accommodate the design depth of cover.

25.1.6 The test lead wire will terminate in test posts as per the Project Drawings. On tree covered land test posts shall be located at the nearest boundary of the Right-of-Way. Test lead wires shall be laid in a 30 inches deep trench to the boundary unless otherwise specified.

25.1.7 The test wire is to be laid in the ditch and carefully protected against breaks, bruises or damage. Where foreign pipeline crossings occur in cultivated fields, and where instructed to do so by the Company, the Company supplied wire is to be run from the foreign pipeline to the nearest fence line. Cad welds to the Company's pipeline(s) are to be made at the fence line. Test lead electrical continuity will be checked following backfill, and will be repaired immediately if necessary.

25.2 Insulating Gaskets

25.2.1 The Contractor shall install insulating gasket kits where shown on the project drawings. Bolts, nuts, washers and studs shall not touch any part of the flange through which their insulating washer/sleeve is installed.

25.2.2 No incomplete insulating kits shall be installed. Any new tie-ins to previously insulated flanged joints shall be made using new insulating kits.

25.2.3 Insulating kits shall be installed on the mainline side of a block valve or as indicated on the Project Drawings.

25.2.4 The Contractor shall electrically test the insulation following installation of insulating kits using a 500 V Megger meter to check for electrical short circuits. In the event of short circuits, The Contractor shall complete repairs to the satisfaction of the Company, and at no additional cost to the Company.

26 DRAIN TILE REPAIR

26.1 General

26.1.1 Where drain tile has been removed or damaged in constructing the pipeline the Contractor shall replace and repair it with a Company approved equivalent material in accordance with the, the EMP, the AMP, and the Contract Documents.

26.1.2 Tile damaged during trench excavation shall be marked by the Contractor by survey station on a lath adjacent to the damaged tile and surveyors will record the location. The Company shall be immediately notified.

26.1.3 Broken tile shall be removed in such a manner as to ensure the functional integrity of the remaining tile.

26.1.4 A single continuous supporting member shall be placed across the trench as a trough in which to lay replacement tile. The supporting member shall span the trench and have a minimum of 2 feet of solid bearing under each end.

26.1.5 Where the original tile line parallels the pipeline the tile shall be re-laid for some distance on both sides of the trench such that it crosses the pipeline at an angle approved by the Company.

26.1.6 Before completing permanent tile replacements the Contractor shall examine the adjacent tile lying beneath the Working Side of the Right-of-Way to ensure that tile has not been crushed, plugged, misaligned, or otherwise disturbed.

26.1.7 A minimum of 12 inches of clearance between the top of the pipeline and the bottom of the continuous supporting member shall be maintained unless otherwise approved by the Company.

26.1.8 The trench shall be backfilled and compacted to the elevation of the bottom of the drain tile. After installation of the repaired drain tile the trench shall be backfilled and the backfill compacted in such a manner as to thoroughly protect the repaired crossing.

27 INTERNAL CLEANING PIG

27.1 General

27.1.1 The complete pipeline shall be delivered to the Company free from water, dirt and other foreign objects.

27.1.2 After lowering-in and backfilling, a cleaning-type pipeline pig consisting of four rubber discs and fitted with wire brushes, furnished and maintained by the Contractor, shall be run through the entire line in sections not to exceed the maximum hydrostatic test section length.

27.1.3 The Company will determine if cleaning pigs will be run through the pipeline prior to the installation of the mainline valves.

27.1.4 If all foreign material has not been removed to the satisfaction of the Company by one running of the cleaning pig additional runs shall be made by the Contractor until the Company accepts that the pipeline is free of all foreign material.

27.1.5 The rubber discs and wire brushes shall be measured prior to each run of the construction pig to ensure they are adequate to apply sufficient pressure on the pipe walls to provide effective cleaning of the pipe walls.

27.1.6 When the pig becomes damaged and, at the discretion of the Company, the rubber discs or wire brushes have become excessively worn or distorted, they shall be replaced with new discs or wire brushes furnished by the Contractor.

27.1.7 Each pig shall be driven by compressed air furnished by the Contractor. Each pig shall be run with sufficient head pressure to maintain an average pig speed of three to five miles per hour. The Contractor is responsible to furnish adequate compressors to ensure this pressure can be maintained at the downstream end of the section.

27.1.8 Company personnel shall be present for the insertion and removal of any/all pig(s).

27.1.9 The Contractor shall contain and collect dirt and debris produced as a result of the pigging operations.

27.1.10 After a section of pipeline has been cleaned, and tie-in welding at such a time is impractical, the cleaned section shall have a nightcap installed in the presence of the Company Inspector.

27.1.11 The nightcap shall be constructed of steel and shall be attached to the pipe in such a manner as to provide a watertight seal, regardless of groundwater or weather risks.

27.2 Gauging Pig

27.2.1 It is the sole responsibility of Contractor to deliver to the Company a completed pipeline free from defects in workmanship. Any defects so discovered shall be cut out, and replacement pipe installed by the Contractor at the Contractor's expense.

27.2.2 Suitable precautions shall be taken to ensure that pigs are trapped on completion of run without damage to persons, wildlife or property.

27.2.3 The Contractor shall supply all tools, equipment (including pigs) and labor necessary for necessary for execution of gauging pigging operations of the pipeline. The Company shall witness all pigging.

27.2.4 All pipe sections shall be pigged with gauging pigs following backfill and cleaning pig runs. The intent of the gauging pig run is to ensure the proper passage of the inline inspection geometry tool.

27.2.5 The Contractor shall confirm that all valves, fittings, and appurtenances are full opening and piggable in advance of running engaging pigs.

27.2.6 Gauging pigs shall be driven by compressed air. The lengths of the sections shall be limited to the length of the hydrotest sections.

27.2.7 Mild steel or aluminum gauge plates fitted to a cleaning-type pipeline pig consisting of four rubber discs and fitted with wire brushes shall be supplied by the Contractor and shall conform to the following dimensions:

Pipe OD (inches)	Plate Thickness (inches)	Plate Diameter
2 to 5	0.25	90 % of Pipe I.D.
6 to 10.75	0.5	90 % of Pipe I.D.
12.75 and above	0.625	90 % of Pipe I.D.

27.2.8 Gauge plate edges must be machined or ground to the required diameter. The outer edge of plate may be of brazed infill material to a radial thickness not exceeding 3% of the plate diameter.

27.2.9 Sizing scrapers shall be run through the same section of pipe more than once if in the opinion of the Company the pipe is insufficiently cleaned or the plate is deformed, gouged or unduly scarred. The location of segments of the pipeline which cause plate deformation, the rectification of same, and the re-running of the pig shall all be at the Contractor's expense.

27.2.10 Open ends of pipeline shall be covered when pigging operations have been completed and temporary launchers and receivers have been removed.

28 IN-LINE INSPECTION FOR GEOMETRY DEFORMATION

28.1 General

28.1.1 A geometry or caliper pig shall be run through newly installed pipe after thorough cleaning and hydrotesting to demonstrate to the Company’s satisfaction that the pipeline is free of any irregularities.

28.1.2 The Contractor shall provide a clean and dry line prior to electronic inspection operations.

28.1.3 Inspection runs shall be made under the technical guidance and supervision of the Company or may be directly controlled by the Company and in such cases the Contractor shall fully support and cooperate at no incremental cost to the Company.

28.1.4 The electronic inspection tools require careful handling at all times and shall be done in the presence of the Company or the Company’s designate. The Contractor shall be liable for any damage to these devices that are caused by negligence or rough handling on its part.

28.1.5 The Contractor shall develop a survey pigging plan and present it to the Company for acceptance at least 5 working days before the scheduled survey. A pre-job meeting will be held with representatives of the Company and of the Contractor to discuss the Work 2 to 5 working days prior to the first scheduled survey.

28.2 Field Services and Equipment

28.2.1 Unless specified otherwise in the Contract documents, the Contractor shall supply the following:

(a) Company approved, multi-purpose launchers/receivers;

(b) Compressed air source and associated hardware necessary to perform the inspection work. Sufficient air compression capacity shall be provided to maintain manufacturer's recommended speed of travel for both the cleaning, gauging pigs and electronic inspection tools;

(c) Labor and lifting facilities necessary to transfer tool between launchers/receivers and delivery truck and to install and remove tool from the line unless Company specifies otherwise;

(d) One fully equipped and qualified crew to be available as needed during the project;

(e) Transportation in a manner compatible with project schedule;

(f) Assistance for Company during tool propulsion in the pipeline if so requested; and

(g) Rerunning any faulty survey as necessary until error free, unambiguous, complete and otherwise reliable data is obtained.

28.2.2 The crew for the project shall be equipped (at a minimum) with the following items:

(a) Sufficient inventory of spare parts and consumables to maintain equipment in peak operating condition and to repair any reasonably foreseeable or possible damages for the duration of the project;

(b) Trays or skids (if necessary) for loading, unloading and transporting tools;

(c) Vehicle(s) suitable for transporting equipment and personnel to and from loading and unloading points; and

(d) Cellular telephone or 2-way radio.

28.2.3 The Contractor shall remove any unacceptable anomalies or defects that the geometry pig detects. The Contractor's cost for labor and equipment to remove and repair irregularities will be borne by the Contractor.

28.2.4 The Contractor certifies that the people provided for the duration of this inspection will be qualified to perform their stated duties.

28.3 Company Supplied Field Services and Equipment

28.3.1 In-line geometry caliper inspection tool from Company approved tool vendor that will perform an automated inspection for deformation and anomalies;

28.3.2 Comprehensive tool maintenance and repair in a manner compatible with manufacturer's recommendations;

28.3.3 Setting up and operating tool while it is in the pipeline;

28.3.4 Analyzing survey data and producing a preliminary report (to include location information and identification of pipeline anomalies);

28.3.5 Final report indicating dig locations.

28.3.6 Land survey services for referencing transmitters, receivers, marker coils or other type of reference point for any indication will be supplied by Company.

28.4 Faulty Surveys

28.4.1 In the event of a faulty survey the run will be rejected by the Company and the tool shall be rerun until a survey acceptable to Company is achieved. If the faulty survey is a result of conditions within the control of the Contractor, in the opinion of the Company, additional runs shall be at the Contractor's expense.

28.5 Site Responsibilities

28.5.1 The Contractor will supervise operations of the control manifold to maintain a suitable air feed and back pressure to operate the tool (pig) within the speeds recommended by the tool vendor.

28.5.2 The Contractor shall ensure that the pipe is overlapped, at the launching and receiving ends, in such a manner that working room is available for inserting and retrieving the inspection tools.

28.5.3 In addition to providing a means of safe trench ingress and egress, the Contractor shall supply and install suitable safe scaffolding and a means of keeping the trench free of water at the test head sites.

28.5.4 When it is necessary to work after daylight hours, the Contractor shall obtain prior Company approval to work by artificial light. The Contractor shall supply equipment which will provide an intensity of illumination that will permit Work to be done in a safe manner without risk of personal injury or unsatisfactory Work. Furthermore, such lighting shall be mounted well above the line of vision of the workers so that hand signals to equipment operators and others can be clearly seen.

28.6 Acceptance Criteria

28.6.1 The Company supplied geometry/caliper tool will be of such design and resolution to be able to detect the presence of and the o'clock orientation of dents and ovality of a magnitude of 0.5%.

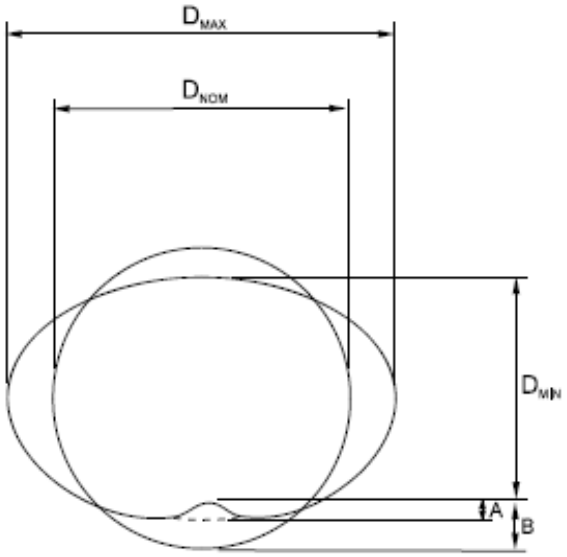
28.6.2 For purposes of evaluation, a dent shall normally be defined as a depression that produces a gross disturbance in the curvature of the pipe wall away from its normal contour and where the measured deflection is equal to or greater than 1% of pipe outside diameter per lineal length of pipe equivalent to one pipe diameter.

28.6.3 Ovality means any deflection that is not a dent greater than 1% of pipe diameter.

28.6.4 The formula for calculating the percentage depth of a dent or ovality or a combination thereof is:

$$\% \text{ Dent/Ovality} = \frac{(D_{max} - D_{min}) - (B\text{-}A)}{D_{NOM}} \times 100\%$$

Where:



28.6.5 Upon completion of Calliper pigging, an onsite analysis of the data will be made for gross determinations of quality. Upon request by the Company, any locations where anomalies are indicated to be greater than 1.5% will be excavated at the expense of the Contractor and visually examined by the Company.

28.6.6 The following defects shall be removed and replaced by the Contractor at no additional cost to the Company:

(a) Any anomalies that the Company deems injurious or that present an unacceptable level of risk for long term pipeline operations;

(b) Any Dent or stress concentrator, such as a gouge, of any size located on a girth weld or seam weld;

(c) Any Dent of any size that contains any type of stress riser;

(d) Any Dent of any size that shows signs of metal loss;

(e) All Dents greater than 2% of the nominal pipe diameter for NPS 12 and larger, all Dents greater than 0.25 inches for pipe diameters less than NPS 12;

(f) All Dents of 1% or greater magnitude for NPS 12 and larger and all Dents greater than 0.125 inches for pipe diameters less than NPS 12 that occur above the 4:00 and 8:00 position (upper two-thirds), with 12:00 being top dead center;

(g) All ovality of 5% or greater;

(h) Combination Dent/Ovality greater than 5% of the nominal pipe diameter; and

(i) Wrinkles.

28.7 Ovality Remediation

28.7.1 As soon as pipe is uncovered measurements of pipe outside diameter will be taken with callipers across at least 4 axes in an attempt to determine the greatest and the smallest diameters. In order to calculate the percent ovality the smallest measured diameter (D_{min}) will be subtracted from the greatest measured diameter (D_{max}) and that difference divided by the nominal outside diameter (OD) as follows:

$$(D_{max} - D_{min})/OD \times 100 = \text{Percent Ovality}$$

28.7.2 If Percent Ovality is 5% or greater, excavation will continue with measurements taken at appropriate intervals to determine if ovality has been relieved.

28.7.3 If it is determined that ovality has been relieved the ditch line will be inspected and any voids in backfill or improperly compacted backfill will be remedied. Backfill will then be carefully placed in the excavated trench and sidewalls will be tamped in 1 foot lifts.

28.7.4 If ovality cannot be relieved by removing the overburden of backfill the section containing the ovality will be cut out and replaced by the Contractor at no additional cost to the Company.

29 CLEAN-UP

29.1 General

29.1.1 The Contractor shall collect all waste materials and construction debris daily. Each working crew shall have at the work site, adequate garbage receptacles. Paper and other light-weight items shall not be permitted to be scattered around by the wind. The objective is to maintain a clean and neat work site at all times.

29.1.2 Burying of waste shall not be permitted on the Construction Right-of-Way, Temporary Work Space, Extra Work Space, in the Contractor Yards, or Pipe Yards.

29.1.3 The Contractor shall commence clean-up operations as soon as practical after backfill but in no case later than seven 7 days after backfill, unless otherwise approved by the Company.

29.1.4 Clean-up or any other construction activities commencing after caliper pigging of a section of pipeline shall be performed only when approved by the Company. Equipment used for these activities will be limited to low ground pressure (LGP) equipment as approved by the Company.

29.1.5 The Company shall provide a procedure to work over top of adjacent operating and/or unpressurized lines (if applicable).

29.1.6 The shoulders, ditches, banks and slopes of all crossings shall be restored to their former condition and shall be properly stabilized in accordance with the EMP. Such restoration shall be performed to meet the requirements of the Authorities having Jurisdiction, the Contract Documents and the Company.

29.1.7 All crossings are to be continuously maintained until the completion of the Work and until the termination of the specified warranty period.

29.1.8 The Construction Right-of-Way and temporary workspace shall be restored to a condition consistent with the condition of the ground prior to the construction of the pipeline including the re-sloping of grade cuts from previous pipeline construction not restored but encountered by the Contractor along the Construction Right-of-Way.

29.1.9 All cleanup Work shall be performed to the complete satisfaction of the Company, in accordance with the EMP, the AMP, the AGC, the Construction Line List, the Contract Documents, and any Authority having Jurisdiction.

29.1.10 Where the pipeline has crossed lawns, yards, or driveways, the lawns shall be prepared for sod and yards and driveways shall be returned to their preconstruction condition and finished to the complete satisfaction of the Company.

29.1.11 Where the pipeline has crossed environmentally sensitive areas they shall be restored to the satisfaction of the Company and the Authority having Jurisdiction.

29.1.12 Immediately following installation and backfilling of the pipeline the Contractor shall collect all rocks, stumps and remaining construction materials and dispose of same. Skids and timber mats shall be removed, stockpiled and transported by the Contractor.

29.1.13 The Contractor shall fill and level holes, ruts, and depressions to the satisfaction of the Company.

29.1.14 The subsoil shall be loosened to a minimum of 12 inches, or as specified by the EMP or the AMP to the depth required to break up all compaction. This operation shall be conducted in a criss-cross pattern and then disked or otherwise cultivated to prepare a reasonably smooth surface to the satisfaction of the Company before replacing the topsoil.

29.1.15 Any rocks greater than 4 inches or other debris brought to the surface as a result of ripping shall be collected and properly disposed of prior to replacement of topsoil or as specified by the EMP, or the AMP. Efforts will cease when the size and density of rocks on the Right-of-Way are similar to undisturbed areas adjacent to the Right-of-Way.

29.1.16 The method of disposal of stumps, clearing debris, rock or boulders shall be agreed to by the Company and the Authorities having Jurisdiction, and will generally consist of one of the following methods:

(a) The stumps, rock, or boulders may be placed in neat piles to the side of the Construction Right-of-Way at locations agreed to as indicated on the Construction Line List.

(b) The Contractor shall obtain and supply the Company with a copy of written permission from the landowner or occupant outlining the conditions for disposal of rock on their property if permission has not been provided in the Construction Line List.

(c) If the Construction Line List stipulates that surplus stumps, clearing debris, rock or boulders are to be removed from the Right-of-Way the Contractor shall haul the surplus material to an approved dumpsite. The Contractor shall provide the Company with the written approval of all Authorities having Jurisdiction over the area where dumping will

occur. All environmental and safety concerns as outlined in the Contract Documents, EMP, AMP, or Permits shall apply to all such off-site Work.

29.1.17 In the event that clean-up is not completed before freeze-up the Contractor shall, as a minimum, implement the following, to the satisfaction of the Company:

(a) Install erosion control devices as required to minimize the potential for erosion in areas where final clean-up is not completed.

(b) Ensure that access roads and trails are graded and left in a condition acceptable to the Company and the Authorities having Jurisdiction.

(c) Ensure that all installed watercourse crossings are cleaned up, reclaimed, and protected from erosion concerns in the spring in accordance with the Contract conditions, the EMP, or the AMP, and Permits.

(d) Ensure that all temporary fencing is adequately braced and supported and left in a condition acceptable to the Company.

29.1.18 Any clean-up not completed before freeze-up shall be finalized the following season, once ground conditions permit, at times acceptable to the Company, as specified in the Construction Line List, and in compliance with environmental timing restrictions. The Contractor is advised that various environmental timing restrictions along the Right-of-Way will be in place during the spring and early summer.

29.1.19 If clean-up activities occur during the following season the Contractor will be responsible for dedicating a work crew to address landowner concerns in a timely and competent manner such as weed control, erosion control, accessibility to fields and flooding.

29.2 Topsoil Replacement and Stabilization Procedure

29.2.1 Any topsoil removed from the Construction Right-of-Way during any construction operation shall be returned and restored to a condition as close to the original as practicable, and in accordance with the Drawings.

29.2.2 Topsoil shall be returned to those areas from which it was originally removed.

29.2.3 All handling and replacement of topsoil shall take place only when the topsoil is not excessively wet, as determined by the Company. Topsoil handling and replacement shall be suspended if dry topsoil is drifting in the presence of strong winds, as determined by the Company, to avoid soil loss or structure damage.

29.2.4 The following procedures shall be followed during the replacement of topsoil:

(a) In uplands, any surplus trench spoil remaining following the compaction of the ditch line, and any excess material required to leave a crown height over the trench line in accordance with the Contract Documents and acceptable to the Company, may be feathered out over the stripped portion of the Construction Right-of-Way. In wetlands, subsoil material removed from the trench during construction shall be replaced so that the material is not mounded above the adjacent ground surface (undisturbed trench wall). Subsoil that exceeds the elevation of the ground adjacent to the trench will be removed from the wetland and disposed of in an upland area with the Right-of-Way or a

Company-approved disposal site. After the trench has been backfilled with subsoil, previously segregated topsoil shall be spread over the trench area and mounded no more than 12 inches above the adjacent, undisturbed soil;

(b) Where acceptable to the Company, the Company will allow a wider area to be stripped to facilitate the feathering of surplus ditch material where blade width stripping was previously conducted;

(c) Surplus spoil which cannot be dispersed in accordance with these Specifications shall be considered as surplus and will be properly disposed of by loading, hauling and disposal in a manner and at suitable locations that will be satisfactory to the Company; and

(d) Following the replacement, compaction, and feathering of the ditch spoil material, and in preparation of the subsoil in accordance with these Specifications, the topsoil shall be replaced over the stripped portion of the Construction Right-of-Way.

29.2.5 Where the topsoil material is stored on native or improved pasture or hay land care shall be taken to ensure that the unprotected sod material is left in an undisturbed state.

29.2.6 Where straw has been used as a protective barrier between un-stripped topsoil and trench spoil the Contractor shall make all reasonable efforts to remove all trench spoil from the straw layer.

29.2.7 Upon written agreement with the landowner, as indicated in the Construction Line List, any straw remaining from this operation will not need to be picked up.

29.2.8 Rocks shall be removed from the topsoil to a condition consistent with the adjacent land. All rocks 4 inches in diameter or larger shall be removed from the upper 1 foot of soil.

29.2.9 Clean-up shall include cultivating, compaction relief, disking, harrowing and rock picking of the Construction Right-of-Way after topsoil replacement is completed.

29.2.10 Re-vegetation shall be completed using a Company supplied seed mix or with a mix approved in writing by the Company. Re-vegetation will comply with the requirements of the EMP, AMP, and/or Construction Line List.

29.2.11 When roll back is required in accordance with the EMP it shall be walked in with a dozer.

29.3 Fences

29.3.1 Upon completion of all clean-up and re-vegetation of the Construction Right-of-Way and areas adjacent thereto, the Contractor shall make permanent repairs to fences and/or other enclosures.

29.3.2 The Contractor shall make all reasonable efforts to coordinate final fencing Work with the Company to allow re-vegetation activities to be completed prior to final fencing where required.

29.3.3 Fences shall be replaced in a condition as good as, or better than, at the beginning of the Construction.

29.3.4 New materials shall be used in making these repairs. As a minimum the Contractor shall install new pressure treated posts of equal or greater diameter than the posts that were previously removed or damaged. The Contractor shall furnish and install steel, concrete or specially constructed posts wherever necessary to match the fence construction of the landowner.

29.3.5 All fence repairs shall be in accordance with the Drawings, Construction Line List and to the satisfaction of the Company.

29.3.6 After fence installation the Contractor shall paint all new posts and any posts damaged or not previously painted, within the limits of the Right-of-Way, to the Company's color and paint Specifications.

29.4 Clean-up Releases

29.4.1 The Contractor shall notify the Company when clean-up has been completed on each landowner tract.

29.4.2 The Company will obtain clean-up releases upon completion of final restoration. In the event a landowner and/or tenant refuse to sign a clean-up release, the Company will inform the Contractor of any noted deficiencies. The remediation of any deficiencies will be at the sole expense of the Contractor.

30 APPURTENANCES

30.1 General

30.1.1 Appurtenances included under this Specification are: fabricated assemblies (mainline valves, check valves, station connections, crossovers and scraper traps) and pipeline markers.

30.1.2 All above-grade surfaces of all appurtenances shall be thoroughly sand blasted and painted in accordance with the Coating Specification.

30.1.3 During hauling and storage the Contractor shall ensure that ends of pipe, valve stem extensions, grease lines and vents are protected and maintained free of all moisture, dirt and other foreign materials.

30.1.4 The inside of all valves, pipe and fittings shall be thoroughly cleaned of any dust, dirt and other foreign material immediately prior to installation.

30.1.5 The Contractor shall pay particular attention to the elevation and location of fabricated assemblies to ensure that they are installed level, at the proper height and free from excessive stresses.

30.2 Fabricated Assemblies

30.2.1 The trench for underground appurtenances shall be cut to a grade that will provide uniform support and provide the minimum required depth of cover.

30.2.2 Excavations for foundations, piers and support pads shall be made to permit the structures to be placed on undisturbed soil.

30.2.3 All over excavation underneath fabricated assemblies shall be brought back to proper elevation through the use of Fill-crete or select fill compacted to 98% Standard Proctor Density in 6 inch lifts.

30.2.4 Bell holes for tie-ins shall be filled and compacted as necessary to ensure the product pipe and assembly are adequately supported prior to installation or backfilling.

30.2.5 Concrete Work shall be performed in accordance with the Company's concrete specifications and in accordance with the applicable codes. Refer to Appendix A of USPCS-SPEC-CCC-007.

30.2.6 At flanged connections the flange face and gasket shall be cleaned immediately prior to fit-up and bolts shall be tightened using a torque wrench so that gasket-seating pressure is uniform. Torque procedures and values shall be in accordance with the manufacturer's recommendation and/or the Company Specifications. Torque values and sequence shall be recorded on Company provided forms. In bolting up flanges an approved thread lubricant shall be used on all bolt threads. Ordinary greases shall not be used for this purpose.

30.2.7 All flanges shall be installed so that the bolt holes straddle the vertical centerline of the pipe and the flange face is perpendicular to the longitudinal centerline.

30.2.8 At mainline valve installations the area within the fenced enclosures shall be graded level, ensuring proper drainage. All valves shall be set in accordance with the Contract Documents. Prior to hydrostatic testing operations the Contractor shall lubricate where necessary and check and test all valves for proper operation.

30.2.9 All valve actuators/operators shall be installed by the Contractor under the direction of the Company or the vendor. The Contractor shall not operate, adjust, or install any electrical works associated with the valve actuator without direct oversight by the Company. Valve-operator mounting flanges, on valves supplied without the operator pre-mounted, shall be kept covered and water tight. Valve stem extensions must be maintained free of all moisture, dirt and other foreign objects. These extensions shall be filled with a minimum of 1 gallon of Company approved anti-freeze.

30.3 Pipeline Warning Signs

30.3.1 Pipeline warning signs shall be installed on both sides of all road, highway and railroad crossings at the easement boundaries and, at any other location so required by the Company. Warning signs shall also be installed at the top of each bank at major stream crossings as directed by the Company. Marker posts shall be installed in accordance with the Contract Documents and as directed by the Company.

Michigan Public Service Commission
Case No. U-16937
Exhibit A-5

Enbridge Pipelines (Toledo) Inc.

Environmental Impact Report

Line 79 Pipeline System Project

Prepared by:

and

December 2011

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ACRONYMS AND ABBREVIATIONS

API	American Petroleum Institute
BMPs	best management practices
bpd	barrels per day
CAA	Clean Air Act
CFR	Code of Federal Regulations
EIA	U.S. Energy Information Administration
EIR	Environmental Impact Report
EI	Environmental Inspector
EMP	Environmental Mitigation Plan
Enbridge Toledo	Enbridge Pipelines (Toledo) Inc.
ESA	Endangered Species Act of 1973
FAA	Federal Aviation Administration
ft amsl	feet above mean sea
GIS	Geographic Information Systems
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDD	Horizontal Directional Drilling
HVTL	High Voltage Transmission Line
IMP	Integrity Management Program
MAOP	Maximum Allowable Operating Pressure
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MLV	Mainline Valve
MPSC	Michigan Public Service Commission
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
OPS	Office of Pipeline Safety
OSA	Michigan Office of State Archaeology
OSHA	Occupational Safety and Health Administration
PHMSA	Pipeline and Hazardous Materials Safety Administration
PLM	Pipe Line Maintenance
Project	Line 17B Twinning Project
SCADA	Supervisory Control and Data Acquisition
SESC	Soil Erosion and Sedimentation Control
SHPO	State Historic Preservation Office
Spill Plan	Spill Prevention, Containment, and Control
SRHS	State Register of Historic Sites
SSURGO	Soil Survey Geographic Database
UHF	Ultra High Frequency

URS	URS Corporation
USCOE	U.S. Army Corps of Engineers
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	Volatile Organic Compounds

EXECUTIVE SUMMARY

This Environmental Impact Report ("EIR") was prepared in support of Enbridge Pipelines (Toledo) Inc.'s ("Enbridge Toledo") Application to the Michigan Public Service Commission ("MPSC") in Case No. 16937 for authority to install a new crude oil and petroleum pipeline ("Line 79") and install certain new station facilities, pursuant to 1929 PA 16; MCL 483.1 et seq. and Rule 601 of the MPSC's Rules of Practice and Procedure, R 460.17601.

Enbridge Toledo seeks authorization to construct, install, operate, repair, and maintain the Line 79 pipeline in Michigan. The Line 79 Pipeline System Project ("Line 79 Project" or "Project") consists of the installation of approximately 35 miles of new 20-inch-diameter pipeline between Stockbridge and Freedom Junction, Michigan, a new meter station near Romulus, Michigan, and upgrades at the existing Stockbridge Pump Station and Terminal Facility ("Stockbridge Station) and Freedom Junction Station. Line 79 will be co-located parallel to Enbridge Toledo's existing 16-inch pipeline known as Line 17[1] from the Stockbridge Station in Ingham County, Michigan to Freedom Junction Station in Washtenaw County, Michigan. As proposed, Line 79 will be adjacent to Line 17's existing right-of-way, much of which is in a utility corridor. See Part b.8 of the Application and the testimony of Mr. Doug Aller for more detailed information on the right-of-way requirements for this Project.

The Project is needed to increase transportation capacity for crude oil. Refiners connected to the existing Line 17 (i.e., BP-Husky in Toledo and Marathon in Detroit) are upgrading their refinery equipment in order to accommodate the processing of increased supplies of heavy crude oil from western Canada. Michigan does not produce sufficient supplies of crude oil to meet the refinery's feedstock needs and Michigan's sole refinery in Detroit is only capable of satisfying a portion of the State's petroleum needs; therefore, Michigan residents are dependent on receipt of refined products produced by refineries throughout the region. The Project will help Enbridge Toledo to meet the region's energy needs by ensuring reliable, safe, and economical delivery of crude oil. Similar to Line 17, Enbridge Toledo will own the Line 79 pipeline system, but such pipeline and its associated facilities will be operated through operating agreements by Enbridge Energy Company, Inc., ("Enbridge").

Construction of the Project will result in minor short term impacts on the environment. This EIR describes the potential impacts of the Project on geology and mineral resources, soils, water resources, vegetation, wildlife, fisheries, special status species, land use, visual resources, socioeconomics, cultural resources, air quality, and noise. This EIR also discusses the methods Enbridge Toledo will implement to mitigate potential environmental impacts.

[1] Enbridge Toledo owns, or leases, certain 16-inch diameter pipeline segments, which comprise the pipeline system known as Line 17. This 88-mile long pipeline system originates at Stockbridge, Michigan, and terminates at Toledo, Ohio. Enbridge Toledo owns the first 35 miles of 16-inch diameter pipeline originating at the Stockbridge Station in Ingham County, Michigan, and terminating at the existing Freedom Junction Station in Washtenaw County, Michigan. At Freedom Junction, the Applicant leases from Wolverine the remaining 53 miles of 16-inch- diameter pipeline, extending from Freedom Junction south to the existing Oregon Station in Toledo, Ohio. Under an operating agreement, Enbridge Energy Company, Inc. operates and maintains the leased portion of Line 17 between Freedom Junction and Toledo. Line 17 currently delivers crude oil to the BP-Husky Toledo refinery, with some capacity for delivery to the Marathon Detroit refinery through an interconnecting pipeline at Samaria, Michigan, as shown on the Project Overview Map attached to the Application as Exhibit A-1.

Enbridge Toledo evaluated several alternatives to the Project including: no action, system alternatives, route variations, and alternative energy and conservation alternatives. After analyzing each project alternative and route variation, Enbridge Toledo determined that the proposed Project is the preferred option to meet the demand for additional supply of crude oil along this portion of its system while minimizing potential impacts on the environment.

Impacts on natural resources are anticipated to be minimal and short term. The entirety of Line 79 is planned to be adjacent and parallel to similar existing pipeline and utility right-of-way. Generally, Enbridge Toledo will install the new Line 79 pipeline adjacent to and abutting existing electrical transmission power line easements or adjacent to Enbridge Toledo's existing Line 17. In rare instances, final alignment may require minor deviations from the existing right-of-way.

Additionally, Enbridge Toledo selected a typical 400-foot wide environmental survey corridor, and in limited areas, a slightly wider corridor was chosen in order to address unique features that were specific to that particular location. The environmental corridor is typically centered based footage measured from the alignment of the proposed pipeline. Enbridge Toledo took this approach in routing its planned new pipeline so that it could effectively make necessary minor deviations within an established corridor that was environmentally surveyed and where landowners were notified. Generally, minor deviations are needed as a result of encroachments, landowner requests and the need to avoid certain environmentally sensitive areas identified by environmental surveys or the permitting agencies. All such potential landowners within the survey corridor have been notified and are included on Enbridge Toledo's landowner mailing list for the purpose of this Application.

Approximately 431.1 acres of land, including permanent easement acreage, will be temporarily disturbed during construction. Additional permanent easement beyond the easement for Line 17 is required to maintain a safe working distance from the existing active pipeline during construction. Maintenance and operations of the permanent easement and aboveground facilities will affect approximately 98.1 acres. Enbridge Toledo will cross waterbodies, railroads, roads, and sensitive features by a combination of horizontal directional drill, bore, and open cut methods. These crossings will be fully restored in accordance with state and local permit requirements and applicable landowner agreements.

Anticipated land use impacts from construction activities will be short term. During pipeline construction, crop production within the construction corridor will be suspended. In active croplands, pastures, and hayfields, at minimum, topsoil will be stripped from the ditch and subsoil storage areas, typically to a depth of up to 12 inches. Stripped topsoil will be segregated from the subsoil excavated from the pipeline trench. Following pipeline installation, the subsoil will be returned to the trench. Topsoil will be evenly distributed on the previously stripped area. Approximately 82.7 acres of forestland will be cleared during construction activities, the majority of which will be allowed to revert to forestland after construction. Construction in residential and commercial areas will be completed as expeditiously as practical. Enbridge Toledo will coordinate the development of its construction plan and negotiate pipeline easements with land and business owners. Enbridge Toledo does not anticipate any significant effect on public traffic patterns because the pipeline will be installed by boring underneath all major roadways. If public traffic may be affected, Enbridge Toledo will coordinate its activities with local authorities.

Approximately 50 percent of the route has been surveyed for environmental and cultural resources. In the spring of 2012, all remaining surveys will be completed for wetlands,

waterbodies, sensitive species, and cultural resources. Enbridge Toledo has and will continue to consult with state and federal agencies to ensure that impacts on these resources are minimal and land is restored to preconstruction conditions in accordance with environmental permits. Enbridge Toledo has incorporated industry-approved and agency-accepted construction procedures into its construction planning and Environmental Mitigation Plan ("EMP") to minimize impacts on the environment (see Appendix A).

The main visual impacts from construction of the pipeline will be the clearing of the additional permanent easement and temporary workspaces. Generally, visual impacts along and within the pipeline right-of-way will diminish after construction and restoration as vegetation, crops, and trees re-establish. Temporary visual and recreational impacts will occur during construction; however, Enbridge Toledo anticipates no long-term impacts.

The pipeline corridor was assessed for cultural and historic resources. At this time, approximately 50 percent of the Project route and temporary workspace has been surveyed. The field survey identified 14 archaeological sites, and 99 historic standing structures located within 0.5 miles of the Project, none of which are listed on the National Register of Historic Places. A summary of preliminary findings is provided in this EIR, and detailed findings of the archaeological investigations will be included in a separate Phase I Archaeological Survey Report presented to the Michigan Office of State Archeology for review prior to the initiation of pipeline construction. Enbridge Toledo also has an Unanticipated Discovery Plan, which will be implemented during construction if required. An assessment of minority, Native American, and low income populations in the vicinity of the Project did not identify any disproportionately high or adverse human health or environmental impacts related to the Project.

Enbridge Toledo's construction, operation, and maintenance of the Project will comply with all applicable local, state, and federal permit and regulatory requirements. Enbridge Toledo developed a Spill Prevention, Containment, and Control Plan ("Spill Plan") and EMP that outlines construction procedures that will minimize Project impacts during construction and restoration of the Project. These plans will be updated as necessary to incorporate all regulatory permit requirements.

The Project will be collocated with an existing pipeline and/or electrical transmission right-of-way with the potential for only minor deviations, which will significantly reduce even short-term impacts. This will also restrict environmental and land use impacts to an existing disturbed area of a similar land use, thus minimizing impacts on new undisturbed areas. Specific construction mitigation measures to minimize adverse impacts of the Project will be employed, including both general construction best management practices ("BMPs") and resource-specific measures. In summary, Enbridge Toledo believes the construction and operation of the Project will result in minor short term impacts on the environment.

1.0 INTRODUCTION

Enbridge Pipelines (Toledo) Inc. ("Enbridge Toledo" or "Applicant) seeks authorization to construct, own, operate and maintain approximately 35 miles of new 20-inch diameter pipeline and associated station facilities for the transportation of crude oil and petroleum in the counties of Ingham, Jackson, Washtenaw and Wayne, Michigan. The Line 79 Pipeline System Project ("Line 79 Project" or "Project") involves the location of the new Line 79 generally adjacent to and parallel with Enbridge Toledo's existing crude oil pipeline known as Line 17[2], and a new meter station near the city of Romulus, Michigan. Line 79 will originate at the Stockbridge Station in Ingham County and then extend to the southeast for approximately 35 miles before terminating at the Freedom Junction Station in Washtenaw County. From Freedom Junction, Enbridge Toledo has leased approximately 29 miles of an existing 16-inch diameter pipeline owned by Wolverine Pipe Line Company[3] ("Wolverine"). This leased pipeline will be used to transport crude oil volumes from Freedom Junction to the new Romulus meter station located in Wayne County, Michigan. Enbridge Toledo plans to operate the leased pipeline as an integral part of its Line 79 pipeline system and installation of a new custody meter facility near the city of Romulus will provide for the delivery of crude oil volumes to the existing interconnecting Wolverine pipeline leased by Marathon Petroleum Corporation, LLC ("Marathon"). Marathon will then transport such volumes to its refinery in Detroit, Michigan ("Marathon Detroit Refinery"). As previously stated, Enbridge Toledo will own the Line 79 pipeline system, but such pipeline and its associated facilities will be operated through operating agreements by Enbridge Energy Company, Inc., ("Enbridge").

Enbridge Toledo plans to install new station facilities at the existing Stockbridge and Freedom Junction Stations in Ingham and Washtenaw Counties respectively, and at the new meter station site near the city of Romulus, in Wayne County, Michigan, as discussed in more detail in this EIR, and Exhibit A-2 of the Application docketed as U-16937.

This EIR has been prepared in support of an application for approval from the Michigan Public Service Commission ("MPSC") in Case No. U-16937, consistent with the Michigan Crude Oil and Petroleum Act 16 of 1929 (1929 PA 16; MCL 483.1 et seq., as amended) and Rule 601 of the MPSC's Rules of Practice and Procedure (R 460.17601). This EIR describes the anticipated environmental impacts that may result from the construction and operation of the Project.

1.1 LOCATION, PURPOSE, AND NEED

The Project will be located in Ingham, Jackson, and Washtenaw Counties, Michigan (see overview Figure 1.1 below), with a meter station (Romulus Meter Station) located in Wayne County, Michigan. A project overview location map is provided as Exhibit A-1 and USGS topographical maps are provided as Exhibit A-3 of the Application. Table 1.1-1 provides public lands survey system information for the proposed installation route within Ingham, Jackson, and

[2] Line 17 was original constructed in 1998 as approved by this Commission on May 18, 1998 in Case. No. 11600.

[3] The 16-inch pipeline which Applicant leased from Wolverine Pipe Line Company was approved by this Commission on April 16, 1953 in Case No. D-3910 to transport up to 95,000 bpd of crude oil or petroleum from Hammond, Indiana to Detroit, Michigan and Toledo, Ohio.

Washtenaw Counties, Michigan and the location of the new meter station in Wayne County, Michigan.

Enbridge Toledo selected a typical 400-foot wide environmental survey corridor, and in limited areas, a slightly wider corridor was chosen in order to address unique features that were specific to that particular location. The environmental corridor is typically centered based footage measured from the alignment of the proposed pipeline. Enbridge Toledo took this approach in routing its planned new pipeline so that it could effectively make necessary minor deviations within an established corridor that was environmentally surveyed and where landowners were notified. Generally, minor deviations are needed as a result of encroachments, landowner requests and the need to avoid certain environmentally sensitive areas identified by environmental surveys or the permitting agencies.

TABLE 1.1-1

LOCATION OF THE LINE 79 PIPELINE SYSTEM PROJECT

County	Township	Range	Section
Ingham	01N	02E	5, 6, 8, 16, 17, 21, 28, 33
Jackson	01S	02E	1, 2, 3, 4
Washtenaw	01S	03E	2, 3, 6, 7, 8, 9, 10, 11, 14, 23, 24
		04E	19, 20, 21, 27, 28, 34
	02S	04E	3, 10, 15, 22, 27, 34
	03S	04E	3, 10, 15, 16
Wayne	03S	08E	24

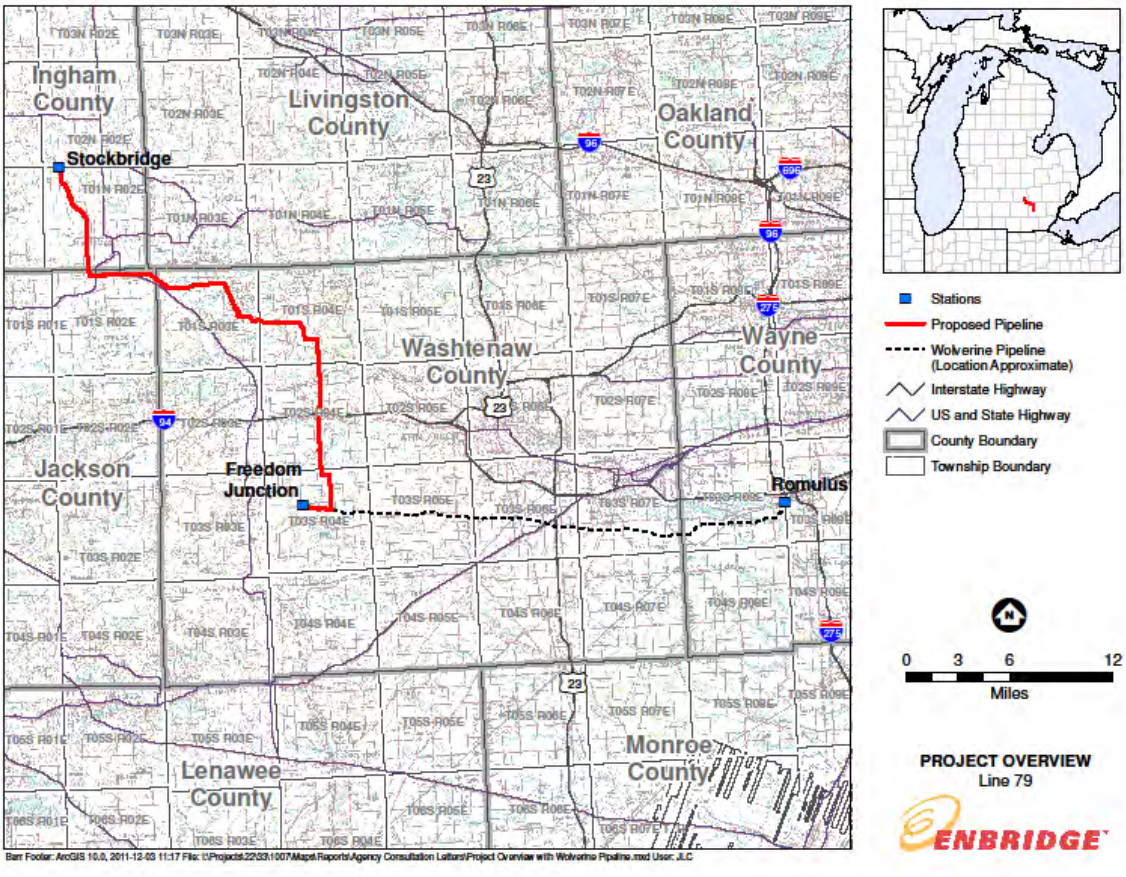

Figure 1.1 – Project Overview Map

1.2 CONSTRUCTION METHODS

General construction methods for the Project are described in this section. Enbridge Toledo developed an EMP, provided as Appendix A that outlines construction-related environmental policies, procedures, and mitigation measures that Enbridge Toledo will implement during construction of the Project. The EMP was developed based on Enbridge Toledo's experience implementing best management practices during recent construction of a number of unrelated pipeline expansion projects in the Midwest. The EMP is intended to meet or exceed applicable federal, state, tribal, and local environmental protection and erosion control specifications and practices. The EMP is designed to address typical circumstances that may be encountered during a pipeline project. Project-specific permit conditions and/or landowner agreements may supersede general practices described in the EMP document.

Enbridge Toledo will construct the Project by following several typical sequential pipeline construction techniques, including: survey and staking; clearing and site preparation; pipe stringing, bending, welding; trenching; lowering-in and backfilling; hydrostatic testing; and cleanup and restoration. In open areas, these construction techniques would proceed in an assembly line fashion with construction crews moving down the construction right-of-way as work proceeds. Concurrently, smaller construction crews will complete road, waterway, and railroad crossings that require boring or other site-specific crossing methods.

Survey and Staking

The first step of construction involves survey crews staking the limits of the construction right-of-way, the centerline of the proposed trench, any temporary extra workspaces, and other approved work areas. No unauthorized disturbance is allowed beyond the workspace limits. Enbridge Toledo will clearly mark access roads using temporary signs or flagging. Enbridge Toledo will mark wetlands and other environmentally sensitive areas where appropriate. In cooperation with affected landowners, Enbridge Toledo will brace and cut fences and will install temporary gates and fences to contain livestock in active grazing or livestock areas.

Clearing and Site Preparation

Trees, brush, and shrubs within the construction workspace will be cut at or near ground level. Select tree clearing may occur based on discussions with state and federal agencies. All brush and other materials cleared from upland areas within the construction corridor will be placed as a windrow along the construction corridor and disposed of as agreed to with the landowner. Brush and other materials cleared from wetland areas will be removed from the wetland and placed in upland areas and burned or disposed of as agreed to with the landowner. Erosion control measures will be installed at the commencement of ground disturbing activities in accordance with federal, state, and local agency requirements, as applicable.

The construction corridor will be graded as needed to provide safe and efficient operation of construction equipment in upland areas and to preserve topsoil. Topsoil will be segregated from subsoil as described in section 3.2.2. The topsoil will be stockpiled for later replacement. Grading will not occur within wetlands. The terrain along the pipeline route varies from relatively flat to moderate slopes. Significant cutting of steep terrain will not be performed unless required and topsoiling will occur to the extent practicable in steep terrain. Erosion control measures will be installed prior to the commencement of ground disturbing activities in accordance with federal, state, and local agency requirements as applicable.

Pipe Stringing, Bending, and Welding

After clearing and site preparation, sections of pipe between 40 and 80 feet long (also referred to as “joints”) will be transported to the construction right-of-way by truck. Each segment of pipe will be unloaded by cranes or tractors equipped with side booms and slings and strung beside the future location of the trench in a continuous line.

After the segments of pipe are strung along the workspace, but before the joints are welded together, workers will use a track-mounted, hydraulic pipe-bending machine to bend the pipe to accommodate horizontal and vertical changes in direction. Where multiple or complex bends are required, the pipe will be bent at a pipe fabrication factory and shipped to the Project. After the pipe is bent, the pipe segments will be aligned end-to-end and clamped into position.

Qualified welders will weld the aligned and clamped pipe joints.[4] Welds will be visually inspected by a qualified inspector and will be non-destructively inspected.[5] Any defects in the welding will be repaired or removed as required by the specified regulations and standards. Every pipeline weld will be non-destructively tested.

The welded pipeline joints will be coated with an Enbridge-approved protective layer of coating to prevent corrosion. The pipeline will be visually and mechanically inspected and will be repaired, if needed, before it is lowered into the trench.

Trenching

Pipeline trench excavation follows stringing, bending, and welding. The majority of the excavation will be accomplished using track hoes. The trench will be excavated to a sufficient depth to provide the required minimum depth of cover.[6] Finally, silt fence or an alternative physical barrier may be used to contain and segregate soil piles, as necessary.

Any crossing of foreign utilities, roads, railroads, and waterbodies will generally require the pipeline to be buried at greater depths. Where practicable, 12 inches of clearance will be maintained when crossing foreign utilities, cables, or other similar structures.

Lowering-In and Backfilling

Once the coating operation and trenching is complete, the trench is inspected to ensure it is clear of rocks or other debris that may damage the pipe or its protective coating. Trench dewatering may be necessary to inspect the bottom of the trench in areas where water has accumulated. Trench water discharges will be directed to well-vegetated upland areas through sediment filtration devices to minimize the potential for runoff and sedimentation. The pipe is then carefully lowered to the bottom of the trench by a series of side-boom tractors.

Trench breakers (stacked sand bags or polyurethane foam) will be installed in the trench on slopes at specified intervals to prevent subsurface water movement along the pipeline. The trench will be backfilled using the excavated material. Subsoil is returned to the trench first,

[4] 49 CFR Part 195 and API 1104 "Standard for Welding Pipelines and Related Facilities" (latest edition)
[5] 49 CFR Part 195
[6] 49 CFR Part 195

followed by topsoil. An earth crown will be left over the trench line to allow for future settling of the backfill material. Crowns will be no more than 6 to 12 inches in height in upland areas. The contractor will restore contours as near as practicable to pre-construction conditions.

Drain tile locations cut during trenching will be flagged by the contractor. Prior to backfilling, drain tiles crossed by the trench will be probed with a sewer rod or pipe snake to determine if tiles were damaged during construction. Drain tiles damaged during construction will be repaired to their preconstruction condition.

Hydrostatic Testing

Hydrostatic testing will be conducted to verify the integrity of the new pipeline in accordance with federal pipeline safety regulations. Pipe integrity is tested by capping the welded pipeline with test manifolds and filling the capped pipeline with water. The water is then pressurized and held for a prescribed time period.[7] Any significant loss of pressure indicates that a leak may exist. The pipe will then be inspected, repaired, and re-tested as necessary per regulations.

After testing is complete, the test water will be discharged to an upland area within and/or immediately adjacent to the construction workspace using energy dissipation and filtration devices to reduce the velocity of the discharged water to minimize potential soil erosion. Water may also be discharged directly to waterbodies using approved methods to prevent stream scour and bank erosion. Enbridge Toledo will secure and comply with all necessary permits from the Michigan Department of Environmental Quality ("MDEQ") for discharging hydrostatic test water to groundwater or surface waters.

Pipeline Tie-in

Following hydrostatic testing, the newly installed pipeline will be tied-in to the existing Wolverine line (NPS16).

Cleanup and Restoration

After the completion of backfilling, all disturbed areas will be final graded. Any remaining trash or debris will be properly disposed. After construction is complete, the entire construction corridor will be protected by the implementation of appropriate erosion control measures. The erosion control measures used will be in accordance with federal, state, and local agency requirements as applicable. Cleanup and restoration procedures will be initiated as soon as practical after backfilling.

The construction right-of-way will be restored to its pre-construction condition as near as practicable and in accordance with applicable federal, state, and local regulations and permits. Generally, after the contours are restored, the corridor will be final-graded and reseeded as soon as possible to minimize erosion. If seasonal or weather conditions are not favorable, revegetation will be delayed until favorable conditions exist. Revegetation will be accomplished in a manner compatible with pre-construction and adjacent vegetation patterns.

[7] 49 CFR Part 195

Specialized Construction Techniques

Special construction techniques are typically required when constructing across wetlands, waterbodies, roads, railroads, foreign utilities, and adjacent to residences. Temporary extra workspaces adjacent to the construction right-of-way would be utilized at most of these areas for staging construction, storing materials, maneuvering equipment, fabricating pipe, and stockpiling spoil. Enbridge Toledo's EMP details construction in these areas.

Environmental Inspection Program

Enbridge Toledo will incorporate an environmental inspection program as part of this Project. Environmental Inspectors ("EIs") will be responsible for implementing the various environmental requirements, and project-specific plans and permit conditions during and after construction. Their specific duties include:

- supporting Enbridge Toledo's project and environmental interests during construction;
- participating in the initial management and supervision of personnel environmental training;
- attending daily construction meetings to discuss compliance issues with the contractor and the construction management team;
- serving as the point of contact for environmental agency representatives visiting the project site;
- providing environmental training to newly arrived contractor personnel and other visitors after construction begins;
- inspecting and assisting in achieving compliance with the requirements of Enbridge Toledo's project plans, the conditions of environmental regulatory authorizations, the mitigation measures proposed by Enbridge Toledo, other environmental permits and approvals, and environmental requirements in landowner easement agreements;
- identifying, documenting, and overseeing corrective actions, if necessary, to ensure compliance;
- stopping construction activities that are not in compliance with Enbridge Toledo's environmental requirements, if necessary;
- testing subsoil and topsoil, as deemed necessary, in agricultural and residential areas to measure compaction and determine the need for corrective action;
- advising construction management when conditions (such as wet weather) make it advisable to restrict construction activities to avoid excessive rutting;
- determining the need for and documenting that erosion controls are properly installed as necessary to prevent sediment flow into wetlands, waterbodies, sensitive areas, and onto roads;
- inspecting temporary erosion control measures throughout construction and within 24 hours of each 0.5-inch rainfall event;

- identifying ineffective erosion controls and documenting the repair of ineffective temporary erosion control measures within 24 hours of identification;
- keeping records of compliance with the environmental conditions of environmental regulatory permits and approvals, and the mitigation measures proposed by Enbridge Toledo in the permit applications submitted to agencies during active construction and restoration; and
- identifying areas that would require special attention to ensure stabilization and restoration after the construction phase.

1.3 LAND REQUIREMENTS

Construction of the pipeline will typically require a 105-foot-wide construction corridor, or construction right-of-way, in upland areas and an 80-foot-wide construction right-of-way in wetlands. In addition to the construction corridor, Enbridge Toledo will utilize small areas of temporary additional workspaces during construction of the pipeline. Additional workspaces will be needed at select road and waterbody crossings, for truck turn-around areas, foreign utility crossings, pipeline valve and launcher locations, pipe laydown areas, and tie-in locations to the existing Wolverine pipeline.

Enbridge Toledo plans to install mainline valves ("MLVs") as part of the Project. These facilities will be determined prior to construction and will be located within Enbridge Toledo's permanent easement.

Enbridge Toledo will access the pipeline construction right-of-way at locations where the right-of-way intersects with existing public and private roads. Currently, twenty temporary access roads averaging ½ mile in length and 75 feet in width are proposed for the Project. Existing roads requiring modification and all temporary access roads will be surveyed for wetland, waterbodies and cultural resources, and any necessary consultation or approvals will be obtained prior to their use.

The Project will result in the construction of a new Romulus Meter Station (metering skid, including all valves and appurtenances, and other above-ground facilities) located at such point where the leased 16-inch pipeline ends near Romulus, Michigan to delivery such crude oil volumes to the Marathon Pipeline. Enbridge Toledo is considering two sites in Wayne County, Michigan for its new Romulus Meter Station referenced as: Option No. 1, which is located in Section 24, Township 3 South Range 8 East, Van Buren Township; and Option No. 2, which is located in Section 25, Township 3 South Range 8 East, Van Buren Township. Enbridge Toledo Toledo plans to acquire only one of these sites and is preparing to work with the underlying landowners to secure an Option Agreement to purchase the land in Fee. The area required for the Romulus Meter Station is approximately 150 feet by 150 feet. This area is primarily upland forest, and any necessary consultation or approvals will be obtained prior to construction.

Enbridge Toledo's construction contractor will need pipe and equipment storage areas for construction of the Project. Enbridge Toledo is currently permitting and plans to construct a storage yard in the spring of 2012 for proposed maintenance projects. The storage yard is located at 6400 Preston Road, near Howell, Michigan, and will be used to provide temporary storage of newly delivered pipe joints and other construction materials, parking of equipment, and office space. No permanent impacts will occur. Erosion control measures, such as silt

fence and straw bales, will be installed as needed prior to soil disturbance in accordance with Enbridge Toledo's Environmental Mitigation Plan.

Construction of the Project will affect approximately 431.1 acres of land in Michigan, not including additional workspaces. After construction, Enbridge will typically operate and maintain a 50-foot-wide permanent easement adjacent to and typically abutting or co-located with the existing easement of Line 17, much of which is in a utility corridor. The 50-foot permanent right-of-way easement will enable Enbridge to maintain a typical 25-foot offset or buffer between the new 20-inch diameter pipeline and the existing Line 17 pipeline and another 25-foot offset or buffer from the new 20-inch diameter pipeline to the edge of the new right-of-way easement boundary. The 50-foot-wide permanent easement will prevent the encroachment of physical structures near the pipeline, protect the pipeline from third-party excavation damage, ensure a safe working distance from the existing operating high voltage transmission line ("HVTL") during construction, and allow Enbridge to inspect and maintain the pipeline. The permanent easement and aboveground facilities will occupy approximately 98.1 acres of land. Table 1.3-1 includes a summary of land requirements that will be affected by construction and operation of the Project.

TABLE 1.3-1

SUMMARY OF LAND REQUIREMENTS FOR THE LINE 79 PROJECT

Facility	Land Affected During Construction[a] (acres)	Land Affected During Operation[b] (acres)
Pipeline	430.9	97.9
Romulus Meter Station	0.2	0.2
Contractor/Pipe Yards		
Contractor/Pipe Yards	40.0	0.0

[a] Acres of land within the construction corridor, not including additional workspaces.
[b] Acres of land within the new 50-foot-wide permanent easement to be acquired along the new pipeline route.

1.4 OPERATION AND INTEGRITY MANAGEMENT

Enbridge addresses pipeline safety and integrity by various means including initial system design, materials, construction practices, and operation, maintenance, and inspection procedures Enbridge is committed to operating and maintaining the pipeline system in a manner that protects the environment and protects the safety of the public, contractors, and employees. The main elements of pipeline safety and integrity are discussed below.

1.4.1 Release Prevention

Release prevention starts with the design and construction of new facilities and carries through the operational life of all Enbridge facilities. Aspects of system design and operations are discussed below.

Route Selection

Enbridge Toledo conducts extensive surveys and research to identify the optimal route for new pipeline and aboveground facilities. Typically, the safest and least environmentally damaging route is within and/or adjacent to an existing pipeline corridor. In some cases, such as in sensitive environmental areas or areas of intensive human activity, it may be advantageous to deviate from an existing corridor.

Pipeline Materials

The manufacture of various components of a pipeline system (e.g., pipe, valves, and gaskets) is guided by federal pipeline safety regulations and specific standards, which account for margins of safety. Mainline pipe is subject to the American Petroleum Institute ("API") Standard Specification 5L, which includes stringent requirements for non-destructive and destructive testing, hydrostatic testing, welding, and material tolerances. New fusion bonded epoxy coatings have been developed, which bond much better than field-applied hot and cold wraps. These coatings are now typically applied at the pipe fabrication mill in a controlled environment, which enhances the overall quality of the coating system. Technology and quality control in the areas of the pipe milling, coating, component manufacturing, and shipment have improved significantly over the years, reducing the number of repairs and maintenance required to ensure safe and reliable pipeline operation.

Compliance with Federal Pipeline Safety Regulations and National Standards

The U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration's Office of Pipeline Safety ("OPS") regulates and inspects liquid petroleum pipelines to ensure compliance with the applicable pipeline regulations included in 49 CFR Parts 194, 195, and other parts applicable to liquid petroleum pipelines. Regulatory requirements and inspections include design, construction, and testing requirements during the installation of the Project. Enbridge's construction specifications and operating and maintenance procedures meet or exceed the federal regulatory requirements and standards published by various consensus standards organizations in the United States.

Coating

Pipe coating will be applied in the factory and inspected upon delivery and installation. In addition, Enbridge has precise specifications for the field coating of welds. Qualified inspectors thoroughly inspect field coating and the entire fusion bonded epoxy system. Coating is the primary line of defense against external corrosion; therefore, ensuring correct field coating is a key factor in release prevention.

Post-Construction Testing

Once pipeline installation is complete, two tests are performed to verify the integrity of the pipeline. First, an electronic inspection tool called an "instrument or intelligent pig" is run through the pipeline to assure that no dents or buckling occurred during construction. If deformities are discovered beyond acceptable tolerances, the affected pipe section is replaced or repaired.

Upon completion of a successful caliper pig run, water is placed into the line and is pressurized to between 90 percent and 100 percent of the specified minimum yield strength of the pipeline.

This pressurization is considerably higher than the maximum 72 percent of yield at which the pipeline may operate. Hydrostatic testing is guided by rigorous specifications found within 49 CFR Part 195. The Maximum Allowable Operating Pressure ("MAOP") for the newly installed pipeline will be established according to federal code at 80 percent of the hydrostatic test pressure or 72 percent of specified minimum yield strength of pipe (whichever is less).

Operation, Maintenance, and Inspection

Many of Enbridge's ongoing operation and maintenance procedures focus on petroleum release prevention. Enbridge procedures, guided by over 200 national consensus organization standards (including API, National Association for Corrosion Engineers, Association Society of Mechanical Engineers), meet and/or exceed federal regulatory requirements. Many of the national consensus standards have been incorporated by reference into federal pipeline safety regulations. Operating and Maintenance Procedures are included in written procedures subject to OPS inspection and include preventative maintenance, inspections, tests, pipeline control, and leak detection and record keeping. Enbridge provides comprehensive training for employees and contractors, specifically complying with the Operator Qualification requirements included in 49 CFR Part 195. Enbridge is subject to periodic audits and inspections by OPS.

Enbridge has a formal integrity management program described in Section VI of its Application for this Project. This program includes assessment techniques using periodic state-of-the-art in-line inspections to identify early signs or features caused by corrosion, cracks, dents or other features. These features are investigated through excavations and mitigated through rehabilitation, repair and/or replacement. The integrity management program and assessment plan is modified based on the operating and inspection experience of a pipeline and is overseen by OPS.

Pipeline Operation and Control

Qualified pipeline operators and their supervisors staff Enbridge's Pipeline Control Center, located in Edmonton, Alberta, Canada 24-hours per day. The computerized pipeline control system allows operators to monitor and remotely control the pipelines and related facilities. When the pipeline is in operational mode and flowing, pipeline pumps may be automatically shutdown if pre-determined pressure limits are exceeded. Landlines and satellite communications are used to exchange computerized data for pipeline monitoring and control. Enbridge maintains an ultra-high frequency ("UHF") radio system, supplemented by cellular phones as needed, to facilitate personnel communications during operation, maintenance, and emergency activities. Pipeline Control Center operations are subject to OPS regulations as the center operates pipelines within the United States.

Enbridge pipelines are typically buried three or more feet below grade to prevent damage from normal human activities. Enbridge has an aggressive program to inform excavators and the public along the pipeline system about the location of the pipelines and requirements to call MISS DIG System in Michigan as well as the new, federally-mandated national "Call Before You Dig" 811 number prior to excavation. Enbridge conducts a public awareness program that meets or exceeds the requirements in 49 CFR Part 195. The public awareness program includes mailings to the affected public, such as those who live and work along the pipeline, emergency officials, excavators in counties crossed by the pipeline and local public officials. Enbridge periodically joins other pipeline operators and hosts group events or outreach to raise the awareness of safe digging practices to avoid damage to pipelines and other underground

utilities. The pipeline right-of-way is well marked by signs at strategic locations and Enbridge's periodic aerial patrol seeks to identify unsafe excavation or encroachments along the right-of-way.

Protection of the Pipeline from Corrosion

In addition to protective coatings, Enbridge's pipelines are protected against corrosion by a well-maintained cathodic protection system. Cathodic protection systems are regularly monitored. The cathodic protection systems are adjusted on an ongoing basis. Enbridge conducts a program for monitoring for internal corrosion and, as necessary, initiates measures to protect the pipeline from internal corrosion.

Maintenance

Each year, Enbridge invests substantial resources towards ongoing maintenance of its pipeline system. The Company conducts on-site inspections as specified by pre-established preventive maintenance requirements. Examples of components inspected on-site include isolating valves, overpressure safety devices, pipe coatings for aboveground portions of the system, vapor monitoring equipment, pump maintenance, etc. Inspection records are available for review by OPS field inspection personnel during scheduled and unscheduled inspections.

Patrol

The pipeline route is patrolled by air at least 26 times per year (weather permitting) to inspect the surface conditions of land on, or adjacent to, the pipeline right-of-way, and in accordance with frequencies prescribed in 49 CFR Part 195. Enbridge contracts the services of a pilot to look for unusual excavation activity or conditions that could indicate inadvertent petroleum releases. If abnormal conditions are observed, ground crews are immediately dispatched for further investigation. In the event of a suspected release, the pilot will notify the Pipeline Control Center by radio and the affected pipeline segment may be shut down pending on-site investigation. As a supplement to the aerial patrol, Enbridge employees visually inspect the right-of-way from the ground in selected locations on a periodic basis.

1.4.2 Release Detection

In the unlikely event of a release from the pipeline, Enbridge has several provisions to enable early detection. The pipeline is monitored round the clock using a Supervisory Control and Data Acquisition ("SCADA") system, which includes various pipeline sensing devices (i.e., pressure, temperature, density, and flow sensors), a remote computer at each Enbridge station, a real-time communication network, a centralized data processing system, and a complete data display available to the pipeline control operator. The SCADA system includes automated alarms to warn operators of abnormal conditions when measurements depart from pre-determined maximum and minimum limits. The automated alarms can be triggered when the pipeline is operating and pressures exceed or drop below pre-determined safety limits. In addition to the SCADA system, Enbridge will employ its leak detection subsystem on Line 79, which supplements the ability of the control system and pipeline control operators to identify abnormal conditions on the flowing pipeline to prompt a pipeline segment shutdown, isolation and on-site investigation. Aerial patrols, foot patrols, and internal inspections are described in the previous section and are used for visual and electronic inspection of early signs of damage or abnormal conditions. Enbridge's public awareness program includes information to the

affected public along the pipeline route on how to recognize, respond and report abnormal conditions or suspected pipeline releases.

1.4.3 Release Response

While Enbridge's goal is to prevent emergencies on its system, it is imperative that its personnel are prepared to respond to an emergency should one occur. Enbridge's emergency response program includes pre-planning, equipment staging, notifications, and emergency and release containment procedures. Key components of Enbridge's release response program are discussed below.

Emergency Response Plan

Enbridge's emergency response plan has been submitted to and approved by OPS and the plan will be amended as necessary upon the completion of Line 79. Enbridge periodically meets with emergency responders along the pipeline route to review and sometimes exercise emergency response plans and resources. The plan demonstrates Enbridge's response capabilities in accordance with the regulations set forth in 49 CFR Part 194 as well as requirements by the Occupational Safety and Health Administration ("OSHA") final rules on Hazardous Waste Operations and Emergency Response ("HAZWOPER"). Enbridge's plan addresses compliance with public and employee safety issues including implementation of the Incident Command System, training of response personnel, protection requirements, site control procedures, and decontamination.

Enbridge maintains detailed mapping of its system using both publicly available map resources and electronic geographic information system ("GIS") platforms, filed with the National Pipeline Mapping System maintained by PHMSA. Enbridge can evaluate potential impacts on unusually sensitive environmental areas as defined by 49 CFR Part 195 as well as navigable water crossings and populated areas, and develop site-specific plans as needed to respond to emergencies.

The emergency response plan is maintained at major facilities and offices along the Enbridge System. Enbridge employees are provided a copy of an Emergency Response Directory that provides checklists, summaries from the plan, internal and external contacts, and notification/reporting procedures.

Staffing

Enbridge technicians based at pump stations and terminals are trained in first-response to react to potential emergencies. Enbridge also has Pipeline Maintenance ("PLM") facilities spaced at regular intervals along the pipeline route. The Griffith, Indiana and Marshall and Bay City, Michigan PLMs are nearest to Line 79. Each PLM employee is trained and equipped to respond to an emergency. Each maintenance facility has available mobile response units (equipped for both land- and water-based releases) and heavy equipment. In addition, pre-staged containment and recovery equipment is maintained and available at several other locations along the Enbridge system.

Enbridge has pre-defined response contractors to supplement Enbridge resources, if necessary. Further, Enbridge is active in several industry and government cooperatives and mutual aid groups to facilitate emergency response.

Training

Enbridge personnel receive classroom and practical training in safety and emergency response procedures. Employees must demonstrate knowledge and proficiency in these areas as appropriate to their responsibilities. All PLM, electrical, and mechanical staff are trained to a "Hazardous Materials Technician" designation in OSHA rules (HAZWOPER (1910.120(q)). In addition, Enbridge employees receive job-specific training as dictated by the federal OPS Operator's Qualification program. Enbridge's resources and response capabilities are subject to periodic inspection by PHMSA as well. Enbridge participates with regional and local emergency response agencies to conduct training, awareness, and/or exercises.

1.5 GOVERNMENT AGENCY PERMITS, AUTHORIZATIONS, AND REVIEWS

The Project must comply with various federal, state, and local regulations, permits, authorizations, and reviews in order to proceed. The government agencies and applicable regulations are listed in Table 1.5-1.

TABLE 1.5-1

PERMIT TABLE FOR THE LINE 79 PROJECT

FEDERAL APPROVALS	
USCOE Detroit District – Section 401/404 Permit	Michigan received authorization from the U.S. Army Corps of Engineers (USCOE) to administer Section 401/404 of the Clean Water Act for most inland lakes, streams, and wetlands consistent with the requirements of the federal Clean Water Act and associated regulations set forth in the Section 401/404 guidelines. USCOE approval is not anticipated for the Project; however, the Michigan MDEQ may notify the USCOE as deemed necessary. See MDEQ Inland Lakes and Streams Part 301/303 Permit.
USFWS – Endangered Species Act Section 9 Compliance	Enbridge will comply with Section 9 of the Endangered Species Act, as there is no federal nexus for this Project. Six endangered, threatened, candidate, or proposed as endangered species are known to occur within the counties crossed by the Project. See Section 3.7 for a further discussion regarding consultation with the USFWS.
STATE APPROVALS	
Michigan Public Service Commission – Act 16 Approval	Enbridge Toledo will submit an application pursuant to the Michigan Crude Oil and Petroleum Act 16 of 1929 (1929 PA 16; MCL 483.1 et seq., as amended) and Rule 601 of the MPSC's Rules of Practice and Procedure (R 460.17601). This EIR is submitted in support of the MPSC application.
Michigan Department of Environmental Quality (MDEQ) – Inland Lakes and Streams Part 301/303 Permit (Joint Permit with USCOE)	A Pre-Application meeting will be held with the MDEQ. The Project may be eligible for the MDEQ's General Permit (GP) for the Repair of Oil and Gas Pipelines, thereby streamlining the permitting process. Coverage under the GP requires submittal of the Joint Application to MDEQ for review and regulatory determination. If sensitive or significant wetlands would be impacted by the Project, an Individual Permit may be required.
MDEQ – Hydrostatic test water discharge to surface waters	Under Parts 31 and 41, of the NREPA, 1994, Part 451, as amended, hydrostatic test water is authorized to be discharged to surface waterbodies from facilities as specified in individual certificates of coverage and in accordance with the General Permit for Hydrostatic Test Water Discharge (MIG679000). It is currently unknown if hydrostatic test water will be discharged to surface waters.
MDEQ – Hydrostatic test water discharge to groundwater	The MDEQ administers Groundwater Discharge General Permit 2215-10-8. This permit sets conditions and limitations for hydrostatic test water discharges to the ground for new pipelines and tanks. It is currently unknown if hydrostatic test water will be discharged to surface waters.
MDEQ – NPDES Storm Water Coverage	Enbridge Toledo will submit a Notice of Coverage (NOC) to obtain coverage under Permit-by-Rule after first obtaining a Soil Erosion and Sediment Control (SESC) permit from each local SESC permitting agency pursuant to Part 91 (see discussion of individual SESC requirements by county under the "Local Permits/Approvals" section of this permit table).
Michigan DNR – State Special Status Species Review and Compliance	An initial review concluded that numerous state-protected species and natural communities have been identified in each of the counties crossed by the Project.
Michigan State Historic Preservation Office (SHPO) – Adherence to the National Historic Preservation Act.	Surveys have been completed for 50 percent of the Project area. A final report is being produced that will be submitted to SHPO. Enbridge Toledo will seek concurrence with the findings and recommendations within the final report.
LOCAL APPROVALS	
Ingham County Drain Commissioner – SESC Permit	Project activities in this county occur within 500 feet of a lake, river, stream, pond, drain, wetland, and/or are greater than one acre in size. Enbridge Toledo will submit a SESC permit application to the county.
Ingham County Drain Commissioner – Drain Permit	Enbridge Toledo will consult with Drain Commissioner's Office to determine if drains are affected. Field surveys and GIS data indicate that drains may be affected.
Jackson County Health Department – SESC Permit	Project activities in this county occur within 500 feet of a lake, river, stream, pond, drain, wetland, and/or are greater than one acre in size. Enbridge Toledo will submit a SESC permit application to the county.
Jackson County Drain Commissioner – Drain Permit	Enbridge Toledo will consult with Drain Commissioner's Office to determine if drains are affected. Field surveys and GIS data indicate that drains may be affected.
Washtenaw County Water Resources Commissioner – SESC Permit	Project activities in this county occur within 500 feet of a lake, river, stream, pond, drain, wetland, and/or are greater than one acre in size. Enbridge Toledo will submit a SESC permit application to the county.
Washtenaw County Water Resources Commissioner – Drain Permit	Enbridge Toledo will consult with Drain Commissioner's Office to determine if drains are affected. Field surveys and GIS data indicate that drains may be affected.

1.6 METHODOLOGY

The assessments described in this EIR were completed by a team of qualified experts in their respective fields, including wetland and wildlife scientists, archaeologists, and environmental specialists (see Section 4.0). The assessment approach involved the mobilization of multiple field teams for concurrent assessments to conduct civil, wildlife habitat, wetland, and cultural resource surveys. Wetlands were field delineated by URS Corporation ("URS") of Minneapolis, MN. URS also completed habitat and sensitive species surveys for the Project. FirstSearch Technology Corporation ("FirstSearch") of Norwood, Massachusetts completed a search of local, state, and federal databases to identify environmental and historical risk information within the Project area.

Archaeological, historic, and cultural resources were also assessed by URS. These resources were also identified by various methods, including gathering background information from the State Historic Preservation Office ("SHPO"), the State Library in Lansing, Michigan, and archaeological field investigations. A summary of the findings is provided in Section 3.10 of this EIR, while detailed findings of the archaeological investigations will be included in a separate Cultural Resources Survey Report, submitted to the Michigan Office of State Archaeology ("OSA") for review prior to construction.

2.0 ALTERNATIVES TO THE PROPOSED ACTION

Enbridge Toledo evaluated several alternatives to the Project to determine if a more reasonable and environmentally preferable option exists. Enbridge Toledo's analysis of alternatives includes the no-action alternative; system alternatives; route variations; alternative energy sources; and energy conservation.

The criteria used to evaluate potential alternatives included: whether an alternative offers a significant environmental advantage over the Project; whether an alternative is technically and/or economically feasible and practical; and whether an alternative meets Enbridge Toledo's stated Project objectives. Enbridge Toledo utilized actual land and workspace requirements, survey data for wetland, habitat, and cultural resource, desktop sources of information, and information from the FirstSearch database search to standardize the comparison between the Project and the alternatives.

2.1 NO-ACTION ALTERNATIVE

Enbridge Toledo would not install the Line 79 pipeline and related facilities if the no-action alternative was implemented. This is not a viable alternative to the Project. Refiners along the existing Line 17 (i.e., BP-Husky in Toledo and Marathon in Detroit) have undertaken upgrades to accommodate additional supplies of crude oil and Line 17 is operating at full capacity. The Project is necessary to increase transportation capacity for heavy crude oil and will help Enbridge Toledo to meet the region's energy needs by ensuring reliable, safe, and economical delivery of crude oil.

2.2 SYSTEM ALTERNATIVES

System alternatives are alternatives to the Project that would make use of existing, modified, or other newly proposed crude oil transmission systems to supply the volumes of crude oil that would be transported by the proposed Line 79 pipeline. If the Line 79 pipeline and related facilities are not installed, modifications or additions to another pipeline system may be required, or an entirely new greenfield pipeline system may be needed. Such modifications or additions would result in environmental impacts that could be less than, similar to, or greater than the impacts associated with construction of the Project.

In order to be a viable system alternative to the proposed Line 79 pipeline and meet Enbridge Toledo's customers' needs, potential system alternatives would have to provide transportation of up to 80,000 barrels per day (bpd) of crude petroleum to refineries served by Line 79 (see Parts A and E of Section VI of the Application). Supply of heavy crude oil from western Canada drove the business decision to upgrade refineries to enable processing of increased amounts of heavy crude oil. No other pipelines exist that are able to transport this additional volume from western Canada to the Michigan and Ohio refineries, who have requested increased transportation of this heavy oil supply. As a result, a system alternative is not a viable option at this time.

2.3 ROUTE VARIATIONS

Route variations are typically short deviations from the proposed route and are identified to resolve or reduce construction impacts on localized, specific resources such as cultural resource sites, wetlands, recreational lands, residences, landowner requests, and terrain conditions. Enbridge Toledo considered a variety of factors in evaluating route variations, including length, land requirements, the number of landowners affected, and potential for reducing or minimizing resource impacts. As additional information is collected and additional landowner and agency discussions evolve, there will likely be several additional route variations identified and assessed.

In areas where work is proposed within close proximities to structures, Enbridge Toledo will work with the affected landowner to develop a site-specific crossing to minimize construction impacts.

Variation 1

Route Variation 1 begins approximately 7 miles south of the Stockbridge Station, at which point the pipeline would be located adjacent and parallel with Enbridge Toledo's existing Line 17 pipeline on the opposite side of Line 17 from the Consumers Energy HVTL.

List additional construction constraints, limited workspace issues, or other difficulties with Variation 1 here. Table 2.3-1 presents a comparison of the prominent environmental features of this variation to the proposed route.

TABLE 2.3-1

COMPARISON OF VARIATION 1 TO PROPOSED ROUTE

Environmental Factor	Variation 1	Proposed Route
Length of Route (miles)	35.1	35.0
Amount of Workspace (acres)	370.8	430.9
Parallel to Existing Rights-of-Way	100%	100%
Waterbodies Crossed (number)	19	20
Wetland affected (acres)	41.9	47.4
Forest or woodland (acres)	76.5	82.7

Variation 1 and the proposed route have relatively similar impacts on natural resources, such as cultural and historic resources, wetlands, waterways, forested areas, drains, agricultural land, and prime farmland.

2.4 ALTERNATIVE ENERGY SOURCES, TRANSPORT MODES, AND ENERGY CONSERVATION

The Project involves the installation of a new pipeline, parallel and adjacent to the existing Line 17 pipeline, much of which is co-located within an existing utility corridor. The use of alternative energy sources is an option to reduce the need for crude oil. Potential alternative energy sources to crude oil include coal, natural gas, nuclear energy, and electricity, as well as more innovative sources including solar, wind, geothermal energy, and biofuels. All of these alternate energy sources, depending on the location of the source, will require additional energy gathering facilities and the construction or expansion of transmission/distribution facilities to be a viable alternative to the Project. In addition, if the refineries served by the proposed Line 79 would not be able to receive this supply of crude oil, the refineries could reduce their capacity, or shut down. It is not known the extent to which these actions would increase the price of local petroleum products.

Energy conservation reduces the need for crude oil, its refined petroleum products, and other energy sources, and has been effective in slowing the growth in U.S. demand for petroleum products. Therefore, energy conservation could potentially be a future partial alternative to crude oil transportation and refining. Energy conservation methods have long been advocated by federal and state governmental agencies; however, conservation programs and individual efforts are not capable of alleviating the current need for crude oil and operation of the Line 79 pipeline. For energy conservation to become viable, it will require widespread industry research and development efforts (e.g. – to produce more energy efficient vehicles, engines, machinery, etc.), and increased support and conservation practices by consumers, as well as political support. U.S. Energy Information Administration ("EIA") has projected that there will be an increase in energy conservation through 2035; however, growth projections suggest that the demand for energy, including crude oil, will exceed cost-effective programs designed to stimulate energy conservation (EIA, 2011). Therefore, the regional demand for new sources of energy, while maintaining current sources, including crude oil, will continue into the future.

While energy conservation may provide an alternative to crude oil use in the future, energy conservation, by itself, is not viable to meet the current energy demand and supply that will be provided by Enbridge Toledo's Line 79 pipeline.

Alternative modes of transporting up to 80,000 bpd of crude oil that can be transported on Line 79 are limited. It is technically feasible to deliver crude oil into this region by waterborne transit, rail or truck; however, these options are not as economical or reliable year-round modes of transit in order to efficiently deliver large volumes over long distances. In the lower 48 states, crude oil is almost exclusively transported by pipeline (EIA, 2010). A modest-sized pipeline, which might transport 150,000 bpd, would require 750 tanker truck loads per day, a load delivered every 2 minutes around the clock. Replacing the same pipeline with railroad cars would require a 225-car train to arrive, unload and depart every day (Association of Oil Pipelines, 2011). Even if these alternative modes were pursued as an alternative, additional rail, port, and roadways would be needed. The National Transportation Safety Board and OPS have stated that pipelines are the safest, most environmentally-friendly, and reliable mode of transporting large volumes of hazardous liquids over long distance (OPS 2011).

2.5 BASIS FOR PROJECT

Enbridge Toledo determined the Project to be superior to the alternatives described above. The pipeline route minimizes unavoidable environmental impacts by constructing, to the extent feasible, immediately adjacent to Enbridge Toledo's existing and previously disturbed right-of-way in addition to existing utility corridors, which will result in fewer impacts on natural resources, such as cultural and historic resources, wetlands, waterways, forested areas, drains, agricultural land, and prime farmland.

Enbridge Toledo believes that the Project is the most environmentally acceptable alternative and the most practical route from an engineering, construction, and operational aspect. The Project also takes into consideration the minimization of impacts and disruptions to landowners while having a higher level of acceptability to the general public.

3.0 SITE CHARACTERISTICS

Site characteristics of the Project are presented in this section and provide a framework on which potential environmental impacts have been evaluated.

3.1 GEOLOGIC AND PHYSIOGRAPHIC CHARACTERISTICS

3.1.1 Geology of Michigan

The Project area is located in the Eastern Lake section of the Central Lowland physiographic province of the Interior Plains (Fenneman, 1916). In general, this region is hilly to gently rolling terrain coupled with considerably flat topography. This area is further defined by hilly moraine glacial features, which dominate much of the bottom one-half of the Lower Peninsula. These features are identified as low-lying ridges (end moraines) separated by relatively flat areas (outwash or till plains). Narrow low-profile glacial ridges (eskers) of sand and gravel are also common near the Project area (Farrand, 1982).

The ground surface elevation of the proposed pipeline ranges from approximately 875 to 1,300 feet above mean sea level ("feet amsl") for the Project route extent. In general, the northwest 45 percent of the Project route ranges from 930 to 950 feet amsl. Surficial sediments in this area range from post-glacial alluvium, glacial outwash and till deposits. Approximately 10 percent of the Project near the route mid-point is a topographic feature ranging from 1,000 to 1,300 feet amsl. This feature corresponds to mapped sand and gravel outwash deposits. The southeast 45 percent of the Project route ranges from 875 to 900 feet amsl. Surface sediments in this area are typically described as clay, sand, and gravel-rich glacial till deposits (Farrand, 1982 and MDEQ, 2011).

Surficial sediments are expected to range in thickness from 45 to greater than 100 feet across the Project area. Shallow bedrock is not anticipated within 20 feet of the ground surface in the Project area (MDEQ, 2011).

The Michigan Basin is a bowl-shaped structural basin that encompasses all of Michigan's Southern Peninsula and part of the Northern Peninsula, which covers approximately 122,000 square miles. Sedimentary rocks deposited in the basin and restricted to the Project area spanned from the Late Cambrian to Pennsylvanian Period (544 to 286 million years ago). During this time, much of North America was covered by water and deposited a maximum of 15,800 feet of sediment in the basin (Milstein, 1989). This variety of sedimentary rocks were deposited in the basin where the midpoint of the Southern Peninsula hosts the youngest rocks with approximately 2.5 miles of sequentially older layers advance to Precambrian sedimentary or crystalline basement bedrock.

The Saginaw Formation, Bayport Limestone (Grand Rapids group), Michigan Formation, Coldwater Shale, and Marshall Sandstone consist of the uppermost bedrock units identified within the Project area, identified from northwest to southeast (youngest to oldest), which are summarized below (MDEQ, 1987 and USGS, 2011):

Pennsylvanian Period

The Saginaw Formation (Pennsylvanian) is the uppermost bedrock unit identified along the northwest part of the Project area. The Saginaw is up to 400 feet in thickness with lithogy ranging from sandstone, shale, coal, and limestone, which were likely deposited in fresh, brackish, and marine waters.

Mississippian Period

Bayport limestone underlies unconsolidated sediments, which ranges in thickness from 20 to 50 feet. Limestone and sandstone are primary lithologies with minor amounts of shale, dolomite, bedded chert, and evaporites.

Michigan Formation conformably underlies the Bayport limestone. This formation ranges in thickness from 250 to 450 feet thick and primarily consists of lithologically variable shale with discontinuous layers of sandstone, limestone, dolostone, gypsum, and anhydrite.

Marshall Sandstone conformably underlies the Michigan Formation. This unit ranges in thickness from 120 to 350 feet and primarily consists of fossiliferous to non-fossiliferous sandstone with variable sedimentary depositional features.

Coldwater shale conformably underlies the Marshall Sandstone, which ranges in thickness from 500 to 1,000 feet. The lithology generally consists of silty and sandy shale, siltstone and fine-grained sandstone, fossiliferous limestone and dolostone.

3.1.2 Mineral Resources

The Michigan Basin is an important source of nonfuel raw mineral production which accounts for nearly 3% of the U.S. total. Concentration of mineral operations related to construction sand and gravel mining is located in Washtenaw County and east of the southeastern portion of the Project area. Additional mineral resources have been identified near the Project area which includes peat, steal, and dimension sandstone. These non-metallic mineral resources are commonly mined from quarries or from peat farms (MDEQ, 2010).

The Department of Natural Resources (DNR) owns several undifferentiated parcels of land in several quarter by quarter sections along the Project route, which are concentrated in the east-west (middle) trending part of the proposed pipeline. Land ownership is classified as mixed ownership (combination of several parcels with mineral and surface ownership), mineral, or mineral and surface ownership. Additional parcels leased by the DNR also occupy parcels within the same quarter section along the Project route.

3.1.3 Paleontological Resources

The potential for finding fossilized remains or impressions of prehistoric plants and animals in is unlikely due to the absence of shallow bedrock anticipated along the Project route. Therefore, the chance of impacting paleontological resources is low. Enbridge Toledo developed an Unanticipated Discovery Plan that outlines procedures to be followed in the event of an unanticipated discovery of archaeological or paleontological resources, or human remains, during the construction activities for the Project (see Appendix B).

3.1.4 Geologic Hazards

Enbridge Toledo considered any geologic hazards, such as seismic activity, landslides, and ground failure for the project areas. Because the Project activities will not involve significant subsurface disturbance or significant stress to the landform, this application will address only general consideration of potential geological hazards, and preliminary findings for the potential for such occurrences.

According to the 2008 National Seismic Hazard Map (Petersen et al., 2008), the potential for earthquakes, ground shaking, surface rupture, and related seismic activity is low for the Project area. The assigned rating of 4-8 percent g (acceleration due to gravity) with a two percent chance of being exceeded in 50 years is the second lowest hazard rating assigned in North America. Seismic hazard ratings are assigned to seven possible categories (the highest being the seventh category, which has a 64+ percent g (acceleration due to gravity) with a two percent chance of being exceeded in 50 years. The last earthquake with a magnitude greater than 3.0 occurred in Lansing in 1994; it had a depth of 5 kilometers and a magnitude of 3.5 on the Richter scale. The largest earthquake recorded in Michigan occurred in 1947 near Kalamazoo; it had a magnitude of 4.6 on the Richter scale (USGS, 2011a).

The potential for landslides and associated ground movements such as rock falls and debris flows for the Project location was also examined. The *National Landslide Overview Map of the*

Conterminous United States (USGS; Godt) indicates that the entire pipeline route is located in an area with low landslide incidence (<1.5 percent of area involved).

Ground subsidence (the dropping or fissuring of the ground surface) can be caused by natural and manmade underground features. Karst collapse (the formation of sinkholes) is naturally occurring and develops most commonly in areas with carbonate bedrock. GIS data from the USGS indicates that there are no known karst formations in the Project area. In summary, the Project is not within known areas of karst formations, or other geological formations that would threaten ground stability.

3.2 SOILS

Soils traversed by the Project route were evaluated using the Soil Survey Geographic ("SSURGO") Database developed by the Natural Resources Conservation Service ("NRCS"). The Project route in Ingham County mainly traverses through the Oshtemo soil series. Oshtemo is well-drained soil formed in stratified loamy and sandy deposits that is not classified as prime farmland or as a hydric soil. In Jackson County, the majority of the project route traverses through the Hillsdale and Riddles soil series. These soils are characterized as well-drained soils. They are classified as prime farmland and farmland of local importance, respectively, and are not classified as hydric soils. Washtenaw County, traverses through the Miami soil series. This series is characterized as moderately well-drained with loam or silt loam texture. They are not classified as prime farmland or as hydric soils. In Wayne County, the meter station site consists primarily of Oakville fine sand, which is well drained and not classified as prime farmland.

3.2.1 Soil Characteristics and Limitations

Several soil characteristics have the potential to affect, or to be affected by, construction and operation of the Project including erosion potential (wind), prime farmland designations, compaction potential, potential for shallow bedrock, and hydric soils. These soil characteristics and limitations are discussed individually below. Table 3.2-1 identifies the amount of soils characteristics and limitations that could potentially be impacted by the Project.

TABLE 3.2-1

SOIL CHARACTERISTICS AND LIMITATIONS CROSSED BY THE LINE 79 PROJECT

County	Total acreage in County	Highly Wind Erodible[b]	Prime Farmland[c]	Hydric Soils[d]
Igham	81.1	76.0	20.7	19.1
Jackson	51.7	51.3	22.6	10.4
Washtenaw	298.1	182.6	71.9	26.2
Wayne	0.2	0.2	0.04	0.0
Total Acres [a]	431.1	310.1	115.3	55.7
Total Percentage		71.9%	26.7%	12.9%

TABLE 3.2-1

SOIL CHARACTERISTICS AND LIMITATIONS CROSSED BY THE LINE 79 PROJECT

County	Total acreage in County	Highly Wind Erodible[b]	Prime Farmland[c]	Hydric Soils[d]

[a] Acreage calculated includes the entire 105-foot-wide construction right-of-way but not additional workspaces.
[b] Includes soils in wind erodibility groups 1, 2, and 3 (potential erosion rates of 86 to 310 tons per acre per year).
[c] Includes soils designated as prime farmland by the NRCS
[d] Includes soils that are classified as hydric.
Note: An area may have more than one soil limitation.

Erosion Hazard

Erosion is a natural process where surface soils are worn away, typically by wind or water. Factors that influence the erosion potential of soil include gradation (distribution of soil particles), vegetation cover, length and percent of slope, rainfall, and wind intensity. Soils on steep, long slopes are much more susceptible to water erosion than those on short slopes because the steeper slopes accelerate the flow of surface runoff. According to SSURGO data, approximately 72 percent of the Project crosses highly wind erodible soils.

Prime Farmland

The NRCS defines prime farmland as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. Soils classified as prime farmland have few or no rocks, a dependable water supply, favorable growing season, not saturated for long periods of time, not flooded during the growing season, and are permeable to air and water. Prime farmland generally provides the highest crop yield per unit of energy expended. Potential impacts on agricultural uses and prime farmland soils from pipeline construction include soil erosion, interference with and damage to agricultural surface and sub-surface drainage systems and irrigation systems, the mixing of topsoil and subsoil, the potential loss of fertile topsoil, and topsoil compaction. Prime farmland is represented by many soil associations and series crossed by the Project. Table C-1 in Appendix C identifies which soils series crossed by the Project are considered prime farmland. Table 3.2-1 identifies the amount of prime farmland crossed by the pipeline.

Compaction Potential

Construction equipment repeatedly traveling over wet or saturated soils could compact the soil. Compaction modifies soil structure and decreases pore space and water-retention capacity, which restricts the transport of air and water to plant roots. As a result, soil productivity and plant growth rates may be reduced, soils may become more susceptible to erosion, and natural drainage patterns may be altered. Consequently, soil compaction is of particular concern in agricultural areas where crops yields may be adversely affected. Poorly-drained and fine-grained silt and clay soils are the most likely soils to experience compaction.

Table C-1 in Appendix C identifies the compaction rating for each of the soils traversed by the Project. A compaction rating of high was given to clay loam or finer grain soils with a drainage

class of either somewhat poor, poor, or very poor. Three percent of the Project route traverses high potential, compaction prone soils.

Shallow Bedrock or Rocky Soils

Stony soils are identified as soils having more than 5 percent by weight of particles larger than 3 inches. The presence of stony-rocky soils could interfere with agricultural practices and inhibit revegetation efforts. Shallow bedrock is defined by the NRCS as bedrock within 60 inches of the land surface. Areas with shallow bedrock would require specialized trench excavating techniques such as rock saws or blasting. The Project route does not traverse any stony or shallow bedrock areas (Farrand, 1082, MDEQ, 2011).

Hydric Soils

The NRCS defines hydric soils as those that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper soil horizon. Soils that form under hydric conditions in their unaltered state are still considered hydric when artificially drained or altered for such purposes as agricultural use. Hydric soils are typically poorly drained, and the presence of hydric soils is one of the criteria used for defining wetlands. Hydric soils may also be prone to compaction and rutting. Approximately 13 percent of the Project route crosses hydric soils.

3.2.2 Soil Mitigation Measures

Pipeline construction activities such as clearing, grading, trench excavation, backfilling, heavy equipment traffic, and restoration could result in adverse impacts on soil resources along the construction right-of-way, in temporary work areas (including contractor and pipe yards), and potential new or modified access roads. Clearing will remove protective vegetation cover and will expose soil to the effects of wind, sun, and precipitation, which could potentially increase soil erosion and the transport of sediment to sensitive areas such as wetlands or waterbodies. Grading and equipment traffic could compact soil, reducing porosity and percolation rates, which could result in increased runoff potential. In addition, grading could result in the mixing of topsoil with subsoil, which could result in long-term reduction of agricultural productivity and could introduce subsurface rocks to the soil surface. Trench excavation and backfilling on the construction right-of-way could also lead to the mixing of topsoil and subsoil; the introduction of excavated rocks; and excavation of rock and/or gravel into the soil surface, which could result in a future increase in operation labor, decrease in agricultural productivity, and potential damage to agricultural field equipment. Soil contamination from equipment spills and/or leakage of fuels, lubricants, and coolants could also impact soils.

Certain construction and restoration practices will help minimize impacts on soils. The principal temporary impacts on soils resulting from construction of the Project may include soil erosion. To minimize or avoid potential soil erosion and sedimentation, Enbridge Toledo will utilize erosion and sedimentation control devices at locations identified in its EMP and according to erosion control plans that will be submitted pursuant to county-specific Soil Erosion and Sedimentation Control (“SESC”) Permit(s) and National Pollutant Discharge Elimination System (“NPDES”) Construction Storm Water Discharge Permit(s).

Topsoil generally has physical and chemical properties that are conducive to good plant growth. Topsoil will be segregated in upland cropland, hay fields, pasture, residential areas, and other

areas as requested by the landowner or as specified in the Project plans, commitments, and/or permits. When constructing in wetland areas without standing water, up to one foot of topsoil (organic layer) will be stripped from the trench line and stockpiled separate from trench spoil to preserve the native seed stock. In standing water wetlands, organic soil segregation is not typically practical; however, the construction contractor will attempt to segregate as much of the organic layer as possible based on site/saturation conditions. If normally unsaturated wetlands are saturated at the time of construction, topsoil segregation will be attempted according to the EMP and based on recommendations from the on-site EI and appropriate regulatory agencies. According to Section 483.2a of the Michigan Crude Oil and Petroleum Act 16 of 1929, Enbridge Toledo will provide written assurance to agricultural landowners that topsoil will be properly separated and replaced. Additional details regarding topsoil segregation are identified in the EMP (see Appendix A).

At the end of construction, Enbridge Toledo will minimize the potential for further erosion by reseeding the disturbed areas, where applicable, with NRCS or property owner recommended seeding mixtures. Enbridge Toledo will monitor the disturbed areas, maintain erosion control structures, and repair areas that may have eroded during construction according to the EMP and/or permit conditions. Once re-vegetation is established, temporary erosion control structures will be removed.

Cultivated fields and compacted or rutted areas will be tilled with a deep tillage device or chisel plowed to loosen compacted soils, if present. If subsequent construction and cleanup activities result in further compaction, additional measures will be undertaken to alleviate the soil compaction.

3.3 GROUNDWATER RESOURCES

3.3.1 Drinking Water Resources and Supplies

Groundwater is the principal source of drinking water for communities in the vicinity of the Project route. Public and private wells near the Project route withdraw water from one of three aquifer sources: the surficial aquifer system, the Pennsylvanian aquifer, and the Mississippian aquifer. Surficial and bedrock aquifers are organized by mileposts in Table 3.3-1 for the Project route below:

TABLE 3.3-1

AQUIFERS CROSSED BY THE LINE 79 PIPELINE SYSTEM PROJECT

Surficial Aquifer	Uppermost Bedrock Aquifer	Start Milepost	End Milepost
Glacial	Pennsylvanian	0	8.5
Glacial	Not reported	8.5	12
Glacial	Mississippian	12	20.6
Glacial	Not reported	20.6	21.9
Glacial	Mississippian	21.9	22.4
Glacial	Not reported	22.4	23.5
Glacial	Mississippian	23.5	28
	Silurian-Devonian	Romulus Meter Station	

The surficial aquifer system is comprised of complex glacial till deposits. Glacier advancement southward through northern Michigan encountered large areas of sandstone and crystalline rock, transporting and depositing highly permeable sand and gravel in the form of outwash, lake sand, eskers and kames. Due to the highly permeable nature of these deposits found near the surface in the Lower Peninsula, the surficial aquifer system acts as a storage reservoir for precipitation and is the primary source of groundwater in the state. Underlying Pennsylvanian and Mississippian aquifers are generally less productive and less aerially extensive. The highly permeable glacial deposits also periodically act as a as a conduit for recharging underlying aquifers (USGS, 2011b).

Silurian-Devonian limestone, sandstone and dolomite units are present throughout Michigan, but they form an unconfined aquifer only in the southeastern part of the Upper Peninsula and the northeastern and southeastern parts of the Lower Peninsula. In these areas, Silurian and Devonian geologic units are immediately overlain by surficial deposits or, in small cases, crop out at the surface. The aquifer is susceptible to contamination due to primary water movement occurring through joints, fractures and bedding-plane openings formed through dissolution. Similar to aquifers detailed below, groundwater from the Devonian-Silurian aquifer in the interior of the Michigan Basin is too saline for use since fresh water circulation decreases away from peripheral recharge zones.

The Silurian carbonate Niagara and Bass Island Groups underlie surficial deposits in the very southeastern part of the Lower Peninsula and are able to provide enough water for domestic use. The dolomitic Niagara Group in particular is known to produce up to 50 gallons per minute. The Ordovician Richmond Group acts as a confining unit below the Silurian units. Of the Devonian units, the Sylvania Sandstone is an important aquifer unit in the southeastern Lower Peninsula, and is also known to produce up to 50 gallons per minute. When overlying and underlying carbonate Devonian units crop out or are found immediately below surficial deposits, the unconfined aquifer is susceptible to surface contamination due to karst features near or at the surface. Where the aquifer is confined, the Devonian Ellsworth and Antrim Shale's act as upper confining units (USGS, 2011e). The Pennsylvanian aquifer, also known as the Grand River-Saginaw aquifer in Michigan, corresponds to the Grand River and Saginaw geologic formations and is a major source of municipal, industrial, and domestic water supply in the area. This aquifer is concentrated in the central portion of Michigan, which underlies nearly half of the Project route. Both geologic formations are hydraulically connected to form the Pennsylvanian aquifer. Recharge occurs predominantly through surficial deposits where the Grand River and Saginaw formations directly underlie and are hydraulically connected to the highly permeable surficial aquifer system. Less significant recharge occurs where water percolates through Jurassic Age shale-rich sandstone that acts as a confining unit in the central part of the aquifer. Transmissivity values for the aquifer range from 3,000 to 37,000 ft^2/day and wells screened in this aquifer yield from 900 to 1,000 gpm and wells yield 50 to 900 gallons per minute. Groundwater drawn from the Pennsylvanian aquifer overlain by the Jurassic Age confining unit is generally salty; however, anticipated dissolved-solids concentrations of this aquifer in the Project area are less than 500 mg/L (USGS, 2011d).

The Mississippian aquifer in Michigan is found in the Marshall Sandstone. The aquifer is overlain by the Mississippian Bayport-Michigan confining unit, Pennsylvanian geologic units and surficial unconsolidated deposits in the majority of the Project area. The Mississippian aquifer (Marshall Sandstone) also immediately underlies and is hydraulically connected to the surficial aquifer system in the southern and eastern parts of the Project area. The Coldwater Shale,

stratigraphically below the Marshall sandstone, acts as a confining unit for the Mississippian aquifer. The Mississippian aquifer has higher transmissivity values in these peripheral areas underlying surficial deposits due to larger and more numerous fractures.

Transmissivity values for the Mississippian aquifer range from 2,700 to 67,000 ft^2/day and wells screened in this aquifer yield from 900 to 1,000 gpm and wells yield 900 to 1,000 gallons per minute. Aquifer recharge predominantly takes place in these areas. Similar to the overlying Pennsylvanian aquifer units, groundwater in deeper parts of the Mississippian aquifer in the center of the Lower Peninsula are too saline for use. The anticipated dissolved-solids concentrations of this aquifer in the Project area range from 1,000 to 100,000 mg/L. As a result, the Mississippian aquifer is only used in the southern part of the state and around the Saginaw Bay area where shallower aquifer units are not available (USGS, 2011c).

Enbridge Toledo reviewed the MDEQ's Statewide Groundwater Database to determine the number and location of wells that may be within 200 feet of the Project. According to MDEQ data, there are 10 wells within 200 feet of the Project, all of which are private wells (MDEQ, 2011a). The locations of the wells are provided below in Table 3.3-2. The MDEQ states that there are spatial inaccuracies with the GIS data; however, the MDEQ's database is the best means to identify potential locations of public and private wells at this time. Enbridge Toledo will conduct a civil survey of the Project area and consult with landowners to determine the location of wells prior to construction. If wells are identified within the Project workspace, Enbridge Toledo will slightly re-route the pipeline, modify the workspace, or possibly move and re-drill the well to avoid direct impacts to the well users.

TABLE 3.3-2

WATER WELLS WITHIN 200 FEET OF THE LINE 79 PIPELINE SYSTEM PROJECT WORKSPACE

County	Milepost	Well Identification	Distance from Centerline (feet) [a]	Well Depth (feet)	Well Type
Ingham	2	33000008330	148	176	Household
Ingham	2	33000008333	163	231	Household
Ingham	4.5	33000001296	112	234	Household
Ingham	4.5	33000012672	180	220	Household
Jackson	8.7	38000004558	235	200	Household
Washtenaw	18	81000000225	108	135	Household
Washtenaw	18	81000015167	81	153	Household
Washtenaw	19	81000009969	50	140	Household
Washtenaw	19.8	81000011946	240	140	Household
Washtenaw	28.5	81000003495	193	72	Household
Washtenaw	28.5	81000003496	187	97	Household
Washtenaw	34	81000005859	45	54	Household

[a] Distances provided are measured from the centerline of the pipeline, but are within 200 feet of the construction workspace.

The U.S. Environmental Protection Agency ("USEPA") defines a sole or principal source aquifer as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. There are no sole source aquifers in the state of Michigan (USEPA, 2011a). Additionally, no state-designated wellhead protection areas were identified within 200 feet of the Project (MDEQ, 2011b).

3.3.2 Groundwater Impacts and Mitigation

Excavation of the pipeline trench could potentially expose only the uppermost water level in aquifers occurring at shallow depths (6 to 8 feet in most upland and wetland areas). Bore and HDD pits may extend to greater depths. Although these excavations will likely encounter the shallow groundwater table, the limit of excavation is not expected to impact the upper-most bedrock aquifers that are typically more than 50 feet below the ground surface. Construction activities, such as trenching, dewatering, and backfilling, may produce minor fluctuations in shallow groundwater levels, but these effects will be short-lived and will produce negligible impacts.

Localized, minor, and temporary disturbance of shallow aquifers could result from changes in overland water flow and recharge caused by clearing and grading of construction right-of-way. Soil compaction caused by construction equipment could also reduce the soil's ability to absorb water. These impacts would be temporary and would not significantly affect groundwater resources or ground water quality. Should Project activities disrupt or adversely affect a ground water supply, Enbridge Toledo will provide a temporary water source to affected well owners and will assume responsibility for restoring the supply well or water source.

HDDs may impact groundwater locally through contact with drilling fluids. However, this potential impact is considered temporary and minor because much of the drilling fluid would be absorbed by the formation. In addition, bentonite is a naturally occurring, non-toxic, inert drilling fluid additive; if an inadvertent release of drilling fluid were to occur to a surface waterbody, there would be no adverse environmental impacts other than a temporary increase in local turbidity. At this time, Enbridge Toledo may cross Interstate 94 at approximate MP 27.2 using the HDD method, and other HDD crossings may be identified during the construction planning and permitting process.

Enbridge Toledo does not anticipate the need for blasting during construction of the Project. As a result, no blasting-related impacts on wetlands, springs, water wells, or other groundwater resources are expected. Should the need for blasting arise, Enbridge Toledo will follow local and/or state requirements and use accepted safe construction blasting techniques and safeguards.

Septic systems may also be located within the construction right-of-way. Enbridge Toledo will work with the affected landowner and either slightly alter the pipeline location or move the septic system to minimize impact to the landowner. Enbridge Toledo will also work with the affected landowners to identify any other potential underground features prior to construction and design a mitigation plan, if necessary.

Accidental spills or leaks of hazardous materials associated with vehicle fueling, vehicle maintenance, and material storage would present the greatest potential contamination threat to groundwater resources during construction of the pipeline. Soil contamination resulting from these spills or leaks could introduce pollutants to the groundwater. Implementation of proper

storage, containment, and handling procedures will minimize the chance of such releases. Enbridge's Spill Plan addresses preventative and mitigative measures that will be used to avoid or minimize the potential impacts of hazardous material spills during construction (see Appendix D). Measures outlined in the Spill Plan include, but are not limited to:

- spill prevention and response training for construction personnel;
- regular inspection of construction equipment for leaks;
- prohibition of fueling and lubricating activities and hazardous material storage in or adjacent to sensitive areas;
- secondary containment for storage of fuels, oils, hazardous materials, and equipment;
- collection and disposal procedures for wastes generated during equipment maintenance;
- emergency response procedures; and
- standard procedures for excavation and off-site disposal of any soils contaminated by spillage.

3.4 SURFACE WATER RESOURCES

The Project crosses 20 waterbodies including drains, streams, creeks, and ponds (some of which are considered perennial). The name of the drains, streams and creeks crossed by the Project, the nearest milepost, flow regime, and Michigan Hydrologic Unit Code (HUC) Basin ID number are provided in Table 3.4-1. The nearest milepost and HUC Basin ID number for the three unnamed ponds crossed by the Project are provided in Table 3.4-2.

TABLE 3.4-1

DRAINS, STREAMS AND RIVERS CROSSED BY THE LINE 79 PIPELINE SYSTEM PROJECT

Nearest Milepost	Waterbody Name	Flow Regime	Michigan Hydrologic Unit Code (HUC) Basin ID
0	Tributary of Doan Creek	Canal/Ditch	04050004000988
1.1	Tributary of Doan Creek	Canal/Ditch	04050004002686
2.7	Jacobs Drain	Canal/Ditch	04050004003981
3.2	Jacobs Drain	Canal/Ditch	04050004000785
3.5	Rose Drain	Canal/Ditch	04050004002736
4.2	Polliwog Drain	Canal/Ditch	04050004000100
6	Bronnell Drain	Canal/Ditch	04090005004741
12.8	Tributary of Portage Creek	Perennial Stream	04090005004934
14	Stream between Joslin Lake and South Lake	Perennial Stream	04090005000768
15.5	Stream north of Sullivan Lakes	Perennial Stream	04090005000211
21	Tributary Drain of Huron River	Canal/Ditch	04090005000297
21.3	Tributary Drain of Huron River	Canal/Ditch	04090005000297
22	Tributary Drain of Huron River	Canal/Ditch	04090005000297
24.5	Tributary of North Fork Mill Creek	Canal/Ditch	04090005000295

TABLE 3.4-1

DRAINS, STREAMS AND RIVERS CROSSED BY THE LINE 79 PIPELINE SYSTEM PROJECT

Nearest Milepost	Waterbody Name	Flow Regime	Michigan Hydrologic Unit Code (HUC) Basin ID
27.8	North Fork Mill Creek	Perennial Stream	04090005000086
28	Tributary of North Fork Mill Creek	Canal/Ditch	04090005000258
29.6	Mill Creek	Perennial Stream	04090005000092
Source: National Hydrology Dataset (NHD)			

TABLE 3.4-2

LAKES AND PONDS CROSSED BY THE LINE 79 PIPELINE SYSTEM PROJECT

Nearest Milepost	Waterbody Name	Michigan Hydrologic Unit Code (HUC) Basin ID	Michigan Hydrologic Unit Code (HUC) Basin Name
15.9	Unnamed Pond	040900050306	Lower Portage Creek
16.8	Unnamed Pond	040900050307	Portage Lake – Huron River
20.8	Unnamed Pond	040900050309	Barton Pond-Huron River
Source: Michigan DNR, Fisheries Division			

The MDEQ 2010 Water Quality Integrated Report (MDEQ, 2010; USEPA, 2011b) lists impaired streams and waterbodies with contamination issues or impairments. The drains, streams and creeks crossed by the Project were not listed as impaired. The three unnamed ponds crossed by the project are located within basins that are listed as impaired; however, the Project does not cross these waterbodies in areas where impairment is cited.

Impacts on surface water resources resulting from the construction, operation, and maintenance of the pipeline and mitigative measures to minimize or avoid these impacts are presented in this section. Impacts on surface water resources from pipeline activities are expected to be minimal.

To ensure integrity, any new pipe will be hydrostatically pressure tested upon completion of construction. Water will be required for the hydrostatic testing and will be obtained from groundwater or surface water sources. After testing is complete, the test water will be discharged to an upland area within and/or immediately adjacent to the construction workspace using energy dissipation and filtration devices to reduce the velocity of the discharged water and thereby reduce erosion potential. Water may also be discharged directly to waterbodies using approved methods to prevent stream scour and bank erosion. Enbridge Toledo will secure and comply with all necessary permits from the MDEQ for discharging hydrostatic test water to groundwater or surface waters.

The principal impacts of construction to surface waters will be a very short-term, temporary increase in the suspended sediment loads, potentially decreased dissolved oxygen and potential mobilization of chemical contaminants. The degree to which suspended solids will increase depends on the velocity of water and grain size of the substrate. Increased sediment

loads can also decrease light penetration in the water column, thus decreasing the primary productivity of the waterbody. It is unlikely that the temporary increase in turbidity will have an adverse impact on aquatic biota of the area, especially because these waterbodies remain turbid during certain times of the year.

In areas where contaminated materials are thought to be present in the substrate of a waterway crossing, mobilization could occur as a result of the soil disturbance associated with pipeline installation. The introduction or re-suspension of sediment in waterways may result from in-stream and streamside construction, trench dewatering operations, and soil erosion along the construction right-of-way; however, because of the relatively short period of time involved for construction activities on or across waterbodies and the small area of impact, the overall effect on local water quality will be minor and short-term.

Disturbance of stream banks results in short-term alteration of streamside vegetation. Impacts of vegetation clearing will be minimized as the pipeline will be constructed adjacent to an existing maintained pipeline corridor.

Enbridge Toledo will minimize impacts on waterbodies during construction by implementing Enbridge Toledo's EMP. Standards and procedures within the EMP include, but are not limited to:

- locating temporary additional workspaces at least 50 feet from surface waters except where adjacent upland is actively farmed or developed or where approved by the appropriate agencies;
- limiting clearing of vegetation between temporary extra workspaces and the edge of the waterbody to preserve riparian vegetation;
- constructing the crossing as close to perpendicular to the waterbody as site conditions allow;
- maintaining adequate flow rates throughout construction to protect aquatic life and prevent the interruption of existing downstream uses;
- locating equipment parking areas, equipment refueling areas, concrete coating activities, and hazardous material storage at least 100 feet from surface waters, unless unfeasible;
- requiring construction across waterbodies to be completed as quickly as possible or within timelines required by applicable permits;
- requiring maintenance of temporary erosion and sediment control measures throughout construction until stream banks and adjacent upland areas are stabilized;
- requiring bank stabilization and reestablishment of bed and bank contours and riparian vegetation after construction;
- preventing the invasion or spread of undesirable exotic and invasive vegetation; and
- implementing the Spill Plan (Appendix D) if a spill or leak occurs during construction.

In addition to the measures identified above, Enbridge Toledo will comply with the following applicable parts of the Michigan Natural Resources and Environmental Protection Act, 1994, P.A. 451 regarding the protection of the state waters:

- Part 31, Water Resources Protection
- Part 91, Soil Erosion and Sedimentation Control
- Part 301, Inland Lakes and Streams
- Part 303, Wetlands Protection

Enbridge Toledo will employ impact minimization and restoration methods to mitigate impacts on riparian areas and promote re-vegetation success. During the construction phase, efforts will be made to minimize clearing to the extent practical, while ensuring safe construction conditions. Based on evaluation by the EIs, selected trees at the edges of the temporary work space may be retained to help minimize impacts. Trees and brush that have to be removed will be cut at ground level to the extent practical, leaving stumps and root systems in place, thus potentially promoting sprouting. Stumps over the trench line and in the area of the equipment crossing will be removed.

Following installation of the pipeline, stream banks will be stabilized with a NRCS or landowner-approved stream bank herbaceous seed mixture or erosion control fabric, such as jute netting. Enbridge Toledo will employ a similar strategy for vegetation monitoring and assessment of re-establishment of woody riparian vegetation. The general design philosophy to be implemented by Enbridge Toledo will be to minimize erosion, to intercept sediment, and to promote re-vegetation.

3.5 WETLANDS

In general, the regulation of wetlands falls under the jurisdiction of the EPA, U.S. Army Corps of Engineers (“USCOE”), Michigan Department of Environmental Quality (“MDEQ”) and, in some cases, local units of government. These agencies make the final determination as to what constitutes a wetland and the extent of regulatory authority the agency has over the wetland. Their determination can vary from time to time depending upon many factors including, but not limited to, the agency representative conducting the determination, wetland policy, and the time of year the site is examined. In addition, the extent and boundaries of wetlands on the site can change from time to time depending upon numerous factors including, but not limited to, changes in vegetation, drainage, weather patterns, and activities on adjacent properties that may alter the pattern of wetlands on the subject property.

In Michigan, the USCOE delegated its Section 404 Wetland Regulation authority to the MDEQ. Under the provisions of the Natural Resources and Environmental Protection Act, P.A. 451 of 1994, Part 303, Wetland Protection, and its administrative rules, a wetland is defined as land characterized by the presence of water at a frequency and duration sufficient to support and that, under normal circumstances, does support wetland vegetation or aquatic life. A wetland area is regulated by the State of Michigan if it is greater than 5 acres in size and is within 500 feet of an inland lake, stream or pond, or is within 1,000 feet of the Great Lakes. The MDEQ may also assert jurisdiction over a wetland less than 5 acres in size if it determines protection of the wetland is essential to the preservation of the natural resources of the state and the other

criteria above are met. Enbridge Toledo proposes to submit a Part 301/303 application to the MDEQ in spring 2012.

Enbridge Toledo initiated pedestrian wetland surveys for the Project. A portion of the Project area was surveyed in the fall of 2011 by URS. Approximately 40 percent of the proposed route has not been surveyed for wetlands due to primarily seasonal restrictions. Enbridge Toledo utilized National Wetlands Inventory ("NWI") data to determine potential wetland locations and impacts for this EIR. Wetland delineations are being completed using the methodologies outlined in the USCOE's Wetlands Delineation Manual (1987) and the USCOE's Northcentral and Northeast Interim Regional Supplement to the 1987 Manual (USCOE, 2009).

In general, a 400-foot-wide corridor was surveyed for wetlands to account for areas where larger workspaces would be required, such as HDD staging areas.

The proposed pipeline route, including the additional temporary workspace, would cross 82 NWI wetlands for a total of 47.4 acres of temporary impacts, or less than 11 percent of the total Project construction area. Table 3.5-1 provides a summary of wetland types crossed by the Project.

TABLE 3.5-1

SUMMARY OF WETLANDS AFFECTED BY THE LINE 79 PIPELINE SYSTEM PROJECT (NWI DATA)

County/Facility	Wetland Classification [a]	Wetland Area Affected During Construction (acres) [b]	Wetland Area Affected During Operation (acres) [c]
Ingham County			
	PEM	3.0	0.9
	PFO	2.4	0.8
	PSS	2.1	0.7
	Subtotal	7.5	2.4
Jackson County			
	PEM	6.3	1.9
	PFO	1.3	0.4
	PSS	3.6	1.1
	PAB	0.4	0.1
	Subtotal	11.9	3.5
Washtenaw County			
	PEM	13.0	4.1
	PFO	6.6	2.1
	POW	0.8	0.3
	PSS	7.6	2.4
	Subtotal	28.0	8.9
Wayne County			
	-	0.0	0.0
	TOTAL	**47.4**	**14.8**

TABLE 3.5-1

SUMMARY OF WETLANDS AFFECTED BY THE LINE 79 PIPELINE SYSTEM PROJECT (NWI DATA)

County/Facility	Wetland Classification [a]	Wetland Area Affected During Construction (acres) [b]	Wetland Area Affected During Operation (acres) [c]

[a] Wetland Types
- PEM Palustrine Emergent Wetland
- PSS Palustrine Scrub-Shrub
- PFO Palustrine Forested
- POW Palustrine Open Water
- PAB Palustrine Aquatic Bed
- PUB Palustrine Unconsolidated Bottom

[b] Assumes an 80-foot-wide construction right-of-way.

[c] Assumes a 50-foot-wide operational right-of-way.

Wetland construction will be performed in accordance with MDEQ's Part 303, Wetland Protection, Natural Resources and Environmental Protection Act of 1994 (1994 P.A. 451, as amended) and Enbridge Toledo's EMP. These regulations and plans contain wetland mitigation measures that are designed to minimize the overall area and duration of wetland disturbance, reduce the amount of wetland soil disturbance, and enhance wetland restoration following construction. Construction and restoration procedures include in these regulations and plans include, but are not limited to:

- limiting the operation of construction equipment within wetlands to equipment essential for clearing, excavation, pipe installation, backfilling, and restoration;
- limiting grading to directly over the trench line, except where necessary to ensure safety;
- limiting grading by using low ground weight construction equipment, or by operating equipment from prefabricated timber mats in saturated or standing-water wetlands;
- segregating topsoil from the trench line in non-saturated wetlands;
- minimizing the time the trench is open in wetlands;
- using the push-pull crossing method in wetlands, where possible;
- installing trench breakers at the boundaries of wetlands as needed to prevent draining of a wetland and to maintain original wetland hydrology;
- prohibiting storage of hazardous materials, chemicals, fuels, and lubricating oils within 100 feet of a wetland boundary unless infeasible;
- prohibiting the refueling of equipment within 100 feet of wetlands unless the EI finds no reasonable alternative; and
- consulting with the appropriate land managing or state agencies to develop plans to revegetate wetlands, and, where necessary, preventing the invasion or spread of undesirable exotic and invasive vegetation.

In general, the width of the construction right-of-way in wetlands will be limited to 80 feet (typically 105 feet in uplands) and to the extent practicable, all temporary extra workspaces will be located a minimum of 50 feet from wetlands. Enbridge Toledo will restore wetlands to preconstruction conditions and will leave existing root systems intact where possible to encourage re-growth and re-vegetation along the equipment passage and soil storage areas. Enbridge Toledo will salvage topsoil in areas to be excavated, unless saturated soil conditions are present. The replaced topsoil will be a source of native seeds and propagules.

Throughout construction, operation, and maintenance of the Project, Enbridge Toledo will comply with Part 91, Soil Erosion and Sedimentation Control of the Michigan Natural Resources and Environmental Protection Act, 1994, P.A. 451 regarding the protection of the state waters and wetlands.

3.6 LAND USE AND TERRESTRIAL RESOURCES

Areas surrounding Enbridge Toledo's pipeline route are dominated by existing pipeline easements and bordered by forested lands, agricultural and herbaceous land, and developed land. These observations were based on review of aerial photography and field verification. The construction and operation of the Project will result in the widening of the existing corridor or permanent easement. Impacts on many of the land uses crossed by the pipeline will be temporary in nature and will occur during construction. Typical construction activities will be contained within the designated 105-foot-wide construction right-of-way and where necessary, may be decreased.

Land uses crossed by the pipeline route are discussed below and summarized in Table 3.6-1.

TABLE 3.6-1

ACRES OF LAND AFFECTED BY CONSTRUCTION AND OPERATION OF THE LINE 79 PIPELINE SYSTEM PROJECT

Wetland		Pasture		Forest Land[a]		Agricultural [b]		Developed		Total	
Con[c]	**Op[d]**	Con [c]	Op [d]	Con [c]	Op [d]	Con [c]	Op [d]	Con [c]	Op [d]	Con [c]	Op [d]
53.6	15.1	40.0	9.3	82.9	19.3	239.7	52.0	10.7	2.0	**427.1[d]**	**98.1**

[a] Agricultural land includes cultivated row crop fields.
[b] Assumes a 105-foot-wide construction workspace centered over the pipeline centerline.
[c] Assumes a 50-foot-wide new permanent, operational right-of-way.
[d] Total acres based on Michigan DNR, Forest, Mineral and Fire Management Division, IFMAP/GAP Lower Peninsula Land Cover, 2001
Note: This dataset is designed for use at a 30 meter spatial resolution. In order to only report what the dataset actually shows, land use acreages shown were calculated at the resolution of the data and may not add up to total corridor area.

3.6.1 Agricultural

The Project will cross approximately 239.7 acres of agricultural land. Most of the active agricultural land is cropland. The pipeline will be constructed in a manner that will minimize the impacts on these agricultural areas. In active croplands, pastures, and hayfields, topsoil will be stripped to a typical depth of 12 inches over the entire construction right-of-way. Topsoil will be segregated from the subsoil excavated from the trench to ensure preservation of topsoil.

Following pipeline installation, the subsoil will be returned to the ditch and the topsoil then replaced in the area from where it was stripped to promote rapid growth.

Prime farmland is soils that have been determined by the NRCS to possess the best combination of physical and chemical characteristics for producing crops and are available for such use. Not all prime farmland soils are used for agricultural purposes. Approximately 102.8 acres of the pipeline route is considered prime farmland soils. Topsoil in prime farmland acreage will be segregated as described above. See Section 3.2.1 for a full description of prime farmland crossed by the pipeline.

During construction, increased observation will occur in order to locate field drain tiles and special efforts will be made to avoid impacts on drain tiles where practicable. Enbridge will work with property owners to identify locations of drain tiles prior to construction. Drain tiles that are encountered during construction will be probed for damage beyond the limits of the trench line. Drain tiles that are damaged during construction will be repaired and/or replaced to pre-construction conditions.

Short-term impacts on agricultural land could include the loss of standing crops within the construction right-of-way and disruption of farming operations, but will be limited to the growing season during the year of construction. Agricultural lands and prime farmland soils located along the Project route and the ultimate 50-foot-wide additional permanent easement that are being used as active croplands, are expected to return to agricultural use after completion of construction. Agreements will be made with individual property owners of agricultural land to provide fair compensation for crop damages or losses.

3.6.2 Forest Land

During construction, the Project will disturb approximately 82.9 acres of forest consisting mainly of deciduous trees. Disturbance to forest land is minimized since the pipeline will be collocated with Enbridge Toledo's existing right-of-way. As a result, only 19 percent of the total land area disturbed by the Project is forest land. Construction will require the removal of trees to prepare the construction workspace. However, trees cleared within the temporary and additional workspace areas will be allowed to regenerate to preconstruction conditions following construction. Permanent impacts will be greatest over the maintained permanent easement portion of the additional right-of-way. Enbridge Toledo will maintain the new additional 50-foot-wide permanent easement to prevent mature overstory vegetation for pipeline inspection purposes. The new permanent easement will impact approximately 19.3 acres of forest land.

3.6.3 Residential

Although the Project will cross individual homesteads or residences located primarily within agricultural areas, the Project route will not cross areas zoned as residential. As commencement of construction nears, if a new residence or occupied structure is identified, appropriate coordination and modification of construction methods and procedures will be implemented to avoid or minimize impacts.

Construction activities near residences will be completed as quickly as practicable in order to minimize disturbances to the nearby residences. If construction is too close to an occupied residential structure, Enbridge Toledo will work with the landowner to determine appropriate

impact minimization or avoidance measures. Effects on these residences will be minor and short-term and may include dust and noise during construction.

Maintained residential lawns will be returned to pre-construction conditions including soils, grasses, and landscaping as identified in agreements with the landowner.

3.6.4 Commercial and Commerce

Although the Project will cross minimal commercial and industrial property located primarily within agricultural areas, the Project route will not cross areas zoned as commercial or industrial. Construction activities in commercial and industrial areas will be completed as expediently as practical in order to minimize disturbance on business operations. Effects on business operations will be minor and short-term and may include dust and noise during the construction period. No commercial or industrial operations are anticipated to require relocation as a result of the construction of the pipeline.

Efforts to mitigate potential construction impacts on actively-operating industrial or commercial facilities include providing alternate access to businesses and flagmen for traffic. After construction is completed, and except where negotiated with the business/property owner, these areas will be allowed to revert to pre-existing conditions and use.

3.6.5 Sensitive Receptors and Other Land Uses

The Project will be situated within 0.5 mile of multiple high consequence areas. Most of the high consequence areas are Other Population Areas; two are Environmentally Sensitive Areas.

Categories of sensitive receptors include schools, churches, cemeteries, and daycare facilities. The number of sensitive receptors within 0.5 mile of the Project will be identified prior to construction. Impacts will likely be minor and short-term and may include dust and noise during construction. Generally there will likely be no construction on Sundays.

Other land use categories include quarries, gravel pits, transitional areas of land, and urban recreational grasses. These areas will be identified prior to construction.

The Project route will cross the Pinckney State Recreation Area at MP-13.8-14.8, 15.1-15.3, and 16.1-17.2, which provides over 11,000 acres of activities for park visitors including fishing, swimming, hiking, and biking (MDNR 2011a).

Road crossings such as highways, interstates, and railroads are identified on the location maps (see Exhibit A-3 of the Application). Roads crossed by the pipeline will not be significantly disturbed; see Section 4.0 of the EMP (Appendix A) for detailed information on road crossing method techniques.

3.7 THREATENED AND ENDANGERED SPECIES

U.S. Fish and Wildlife Service (USFWS)

The USFWS administers enforcement of federally listed threatened and endangered species under the Endangered Species Act of 1973 (“ESA”). The purpose of the ESA is to protect and recover imperiled species and the ecosystems on which they depend.

Enbridge Toledo reviewed the USFWS website for listed species and critical habitat that may be present within the Project area. Six threatened, endangered, or candidate plant and animal species are known to occur within the counties crossed by the proposed pipeline route (see Table 3.7-1).

TABLE 3.7-1

KNOWN FEDERALLY LISTED SPECIES

Species	Common Name	Status	County
MAMMALS			
Myotis sodalist	Indiana Bat	Endangered	Ingham, Jackson, and Washtenaw
REPTILES			
Sistrurus catenatus catenatus	Eastern Massasauga	Candidate	Ingham, Jackson, Washtenaw
PLANTS			
Plantathera leucophaea	Eastern Prairie Fringed Orchid	Threatened	Washtenaw
INVERTEBRATES			
Neonympha mitchellii mitchellii	Mitchell's Satyr Butterfly	Endangered	Jackson and Washtenaw
Oarisma Poweshiek	Poweshiek Skipperling	Candidate	Jackson and Washtnaw
MUSSELS			
Epioblasma triguetra	Snuffbox	Proposed as Endangered	Washtenaw

Enbridge Toledo initiated informal consultation with the USFWS East Lansing Field Office with a letter dated November 22, 2011. Enbridge Toledo conducted onsite evaluations for approximately sixty percent of the Project route within forested areas to determine whether suitable roosting habitat (e.g., dead or dying trees with peeling bark) for the Indiana bat (*Myotis sodalis*) exist within the Project boundaries. In an email dated December 8, 2011, the USFWS indicated habitat assessments must be completed for the federally listed species. The Endangered Species Act ("ESA") does not extend to candidate species; however, the USFWS encourages their consideration in resource planning. Section 7 of the ESA does not apply because this Project is not federally funded, nor will it be authorized or carried out by a federal agency. However, Section 9 does apply and states that it is unlawful to take (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such contact) endangered fish and wildlife. Enbridge Toledo will complete the remained of their habitat surveys along the Project route, in order to ensure that there is no take of any federally-listed species.

State of Michigan – Department of Natural Resources ("MDNR")

In the State of Michigan, the MDNR administers enforcement of Part 365 Endangered Species Protection of the Natural Resources and Environmental Protection Act, Act 451 of the Public Acts of 1994. The presence of endangered or threatened species does not necessarily preclude development, but may require alterations in the development plans. A Threatened/Endangered Species Permit is required from the MDNR if any endangered or threatened species will be taken or harmed by a project.

The Michigan Natural Features Inventory database maintains a record of threatened, endangered, or special concern species which the MDNR relies on for their environmental project reviews. The following describes the definition for each state status listing.

- An endangered species is a species of fish, plant life, or wildlife that is in danger of extinction throughout all or a significant part of its range.
- A threatened species is a species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
- A special concern species is a species that while not listed as endangered or threatened or afforded legal protection, is extremely uncommon in Michigan and deserves further study and monitoring.

Enbridge Toledo requested the MDNR complete an environmental review of the Project with a letter dated November 22, 2011, and at this time, a response has not been received.

Impact Mitigation Measures

Enbridge Toledo completed habitat surveys for approximately sixty percent of the Project route. The remainder of the surveys will be completed in the spring of 2012. Potential roosting habitat for the Indiana bat has been identified along the pipeline route. To avoid impacts on the Indiana bat, Enbridge Toledo will either conduct tree clearing between November 1 and April 1, or will work with the USFWS to identify specific suitable habitat locations where Enbridge Toledo may conduct mist net surveys for Indiana bat. If Indiana bats are captured during a mist net survey, Enbridge Toledo will modify its construction plan to avoid the bat habitat or will clear trees during the approved timing window. If bats are not identified during surveys, Enbridge Toledo will obtain clearance from the USFWS that Indiana bats will not be adversely impacted by construction activities.

The results of the habitat assessment survey will be submitted to the MDNR for review. Enbridge Toledo will seek recommendations to avoid and minimize potential impacts on these species, which may include seasonal construction restrictions and/or conducting additional surveys. Enbridge Toledo will continue to coordinate with the MDNR regarding the above-listed species to ensure no adverse impacts on sensitive species will occur.

Wildlife species and their habitat(s) will be impacted by construction and operation of the Project to differing extents and durations, depending on the species present in each land cover type and their individual life history. Impacts on wildlife along the pipeline route should be relatively short, and species and their habitats should recover quickly. Forested communities, both upland and wetland, will be affected to a greater extent because of the long term conversion of these wooded habitats to earlier succession stages in the construction areas and the permanent removal or maintenance to woody species in the permanently maintained pipeline easement. With the exception of the permanent easement, the Project's impacts on scrub/shrub and wetland habitats should be relatively short-term. In the upland areas along the pipeline easement, vegetation maintenance will generally occur every three years.

3.8 AIR AND NOISE

3.8.1 Air Quality

As a common carrier pipeline, Line 79 will transport the types of crude oil that meet its tariff conditions of service posted with and approved by the Federal Energy Regulatory Commission. The pipeline being installed will be buried underground and will not generate direct air emissions as part of its physical and operational design. The Project will result in the construction of a pump station at the Stockbridge Station and custody transfer metering equipment (metering skid, prover) near Romulus, which is located at the end of the Wolverine Pipeline lease. Air emissions from the pump and metering stations will be insignificant. In addition, the project will result in increased withdrawal losses from the storage tanks Enbridge operates at the Stockbridge Station. The potential increase in storage tank withdrawal loss emissions resulting from the project will be minimal.

At the Stockbridge Station, crude oil will be injected from storage tanks into Line 79. The terminal operates under a minor source air quality permit (Permit number 190-98B) issued by the MDEQ. The air quality permit specifies a material usage or throughput limit for crude oil per 12-month rolling time period. The potential increase in terminal throughput and resulting storage tank withdrawal loss emissions resulting from the project will be subject to MDEQ's air quality permit-to-install approval process.

Federal and State Air Quality Regulatory Requirements

The Clean Air Act ("CAA") and its implementing regulations (42 USC 7401 et seq., as amended in 1977 and 1990) are the basic federal statutes and regulations governing air pollution in the United States. The following federal requirements have been reviewed for applicability to the proposed Project:

- New Source Review (NSR) / Prevention of Significant Deterioration (PSD);
- Air Quality Control Regions (AQCRs);
- New Source Performance Standards (NSPS);
- National Emission Standards for Hazardous Air Pollutants (NESHAPs)/Maximum Achievable Control Technology (MACT);
- Chemical Accident Prevention Provisions;
- Title V Operating Permits; and
- General Conformity Rule.

The Project will result in minimal increase in emissions and the increases will primarily occur at the Stockbridge Station. Stockbridge Station is located in an attainment area and is a minor source for PSD and Title V permitting programs; therefore, the Project is not subject to nor triggers any of the requirements listed above.

Michigan Air Pollution Control Rules

The MDEQ has established air pollution control rules which have been adopted pursuant to Part 55 of the Natural Resources and Environmental Protection Act of 1994, which generally mirror federal air pollution control requirements. These rules establish emission limitations and prohibitions for numerous air pollutants emitted from stationary sources. The Project will comply with current applicable emission standards.

Potential Project Air Quality Impacts and Mitigation

Two types of impacts on air quality were considered for this analysis: temporary impacts from construction-related emissions and long-term impacts associated with emissions generated from continued operation of a stationary source (e.g., pump and metering stations and a storage terminal).

Construction Impacts

Air quality impacts associated with construction of the Project would include emissions from fugitive dust, and emissions from fossil-fueled construction equipment and temporary fuel transfer systems and associated storage tanks. These types of emissions are not subject to review on state or federal construction permit approval.

Fugitive Dust

Fugitive dust is a source of respirable airborne particulate matter, including PM_{10} and $PM_{2.5}$ (particulate matter less than 10 and 2.5 microns in diameter, respectively), that could result from vehicle traffic on paved and unpaved roads. The amount of dust generated is a function of construction activities, silt, moisture-content of the soil, wind speed, frequency of precipitation, vehicle traffic, vehicle types, and roadway characteristics. Emissions would be greater during drier months, and in fine-textured soils.

Emissions of particulate matter arising from fugitive dust are regulated by state and local agencies. Michigan regulates fugitive dust under Michigan Rule R 336.1372. The regulations include typical control measures to prevent fugitive dust from becoming airborne and leaving the property boundary. Enbridge Toledo proposes to apply water to the right-of-way as necessary for dust suppression. The majority of pipeline construction activity would be short-term impacts at any one location during construction.

Fossil-Fueled Construction Equipment

Large earth-moving equipment, skip loaders, trucks, and other mobile sources may be powered by diesel or gasoline and are sources of combustion emissions, including NO_x, CO, VOCs, SO_2, PM_{10}, $PM_{2.5}$, and small amounts of HAPs. Construction equipment also emits greenhouse gases. Gasoline and diesel engines must comply with the EPA mobile source regulations in 40 CFR Part 86 for on-road engines and 40 CFR Part 89 for non-road engines. These regulations are designed to minimize emissions. Enbridge Toledo contractors will maintain all fossil-fueled construction equipment in accordance with manufacturer's recommendations to minimize construction-related emissions.

Temporary Fuel Transfer Systems and Associated Storage Tanks

Temporary fuel transfer systems and tanks have the potential to release VOC emissions. Because most construction equipment would use diesel fuel with a low vapor pressure (<0.01 psi); releases of VOCs would be minimal.

Continued Operation of a Stationary Source

The Project includes the construction of a new pump station and metering station. Continued operation of this equipment will result in VOC emissions generated from pumps seals and piping components (valves, flanges, connectors, instrumentation). Enbridge Toledo will operate the equipment to minimize emissions and will follow strict inspection and repair procedures.

Construction of Line 79 will result in an increase in Stockbridge Station throughput and associated withdrawal loss emissions from terminal storage tanks. The storage tanks are equipped with internal floating roofs which meet best available control technology standards. The project related withdrawal losses and additional emissions resulting from the construction of the pump station at the Stockbridge Station will be subject to the MDEQ's permit-to-install permitting process.

Greenhouse Gases (GHG)

The Project will result in minimal direct GHG emissions primarily associated with continued pipeline operation (e.g., vehicle operation and fugitive emissions) and indirect GHG emissions associated with continued electrical generation for the existing pump stations. Since the Project includes the installation of new pipeline, it will result in increased operational GHG emissions as a result of the increased crude oil transfer capacity.

The Project will also result in GHG emissions from construction activities, specifically from the combustion of fossil fuels in construction equipment and support vehicles and from soil/sediment disturbances during construction activities. Carbon emissions from habitat disturbance are dependent on the type of habit disturbed; habitats such as wetlands and forested areas would result in higher GHG emissions due to the carbon sequestration in these habitats. Following construction, the disturbed wetlands would continue to function as wetlands, the permanent right-of-way would be reseeded to initiate re-vegetation, and the forested areas in the construction right-of-way would slowly regenerate as forest. Due to the limited and temporal nature of the construction activities, there will only be limited GHG emissions from construction activities.

Air Quality Conclusions

Because pipeline construction moves through an area relatively quickly, air emissions typically will be localized, intermittent, and short term. Emissions from fugitive dust, construction equipment combustion and temporary fuel transfer systems and associated tanks will be controlled to the extent required by state and local agencies. Emissions from the new pump station and increased throughput at the Stockbridge Station will have negligible impact. Emissions from the new metering station will also have a negligible impact.

3.8.2 Noise Levels

Construction related activities will also create a temporary increase in noise levels attributable to the construction equipment. The increase in noise levels resulting from construction will be temporary, localized, and generally considered negligible. The proposed facility upgrades will not result in an increase of noise levels when in service.

Residences in close proximity to the locations where horizontal directional drilling equipment is utilized will be impacted by the continuous, elevated noise levels that result from drilling operations. To mitigate this impact, Enbridge Toledo will construct noise barriers around drilling activities, if required due to proximity or special circumstances, will work with adjacent residents, and/or offer to temporarily relocate residents affected by drilling operation noise.

3.9 AREAS OF ENVIRONMENTAL CONCERN

Enbridge Toledo contracted FirstSearch to complete a database review to identify areas of environmental concern that are within 1-mile of the Project. A 1-mile search buffer was used so that all route variations analyzed in section 2.4 will be included in the database search. Enbridge Toledo reviewed the results of FirstSearch's report to identify environmental concern areas that are within 500 feet of the of the construction right-of-way. Enbridge Toledo believes areas of concern that are generally greater than 500 feet from the Project will not be encountered or affected by the Project, and any environmental hazards associated with the areas of concern will not affect construction activities. Prior to construction, Enbridge Toledo will investigate potential areas of environmental concern at the Romulus metering station.

The following is a list of the databases that were reviewed by FirstSearch and which Enbridge Toledo believes should be considered when designing and constructing a pipeline Project.

- NPL — National Priority List (Superfund Sites)
- Delisted NPL — National Priority List Deletions
- CERCLIS — Potentially hazardous waste sites reported to the EPA
- NFRAP — CERCLIS sites with no further remedial action required
- Federal Brownfields — Federal Brownfields Sites
- ERNS — Emergency Response Notification System
- Tribal Lands — Indian lands of the United States
- State/Tribal Sites — List of contaminated sites
- State/Tribal SWL — Solid Waste Landfills and Disposal Sites
- State/Tribal LUST — Leaking Underground Storage Tanks
- State/Tribal Brownfields — Available brownfield property listings
- HMIRS — Hazardous Materials Incident Response System
- Coal Gasification — Sites involved in coal gasification

Enbridge Toledo reviewed the FirstSearch Report and determined one environmental concern area was within 500 feet of the Project (see Table 3.9-1). To determine if any of these sites are actual environmental concerns or could impact the Project in any manner, additional research of relevant federal and state agencies' records, consultation with relevant agencies, as well as visual inspections, will be conducted by Enbridge Toledo. Furthermore, prior to construction, Enbridge Toledo will prepare a soil management plan for any potential unanticipated encounters with contaminated soils during construction.

TABLE 3.9-1

ENVIROMENTAL CONCERN AREAS WITHIN 500 FEET OF THE LINE 79 PIPELINE SYSTEM PROJECT

Environmental Concern	Nearest Milepost
LUST Site of gasoline/diesel release. Leak Number C-0602-00 FirstSearch Report, Focus Map 11, Site #36.	9.1

Thirty-six non-geocoded (orphan) sites were identified in the FirstSearch Report. Through a review of mapping websites and sources, the location of 27 of the 36 non-geocoded listings could be estimated. The nine un-locatable orphan sites are tribal lands, with unknown addresses or locations. Listings in the Tribal Land regulatory database, when they are not combined with another, more significant database listing, do not represent documentation of a release.

3.10 ARCHAEOLOGICAL, HISTORIC, AND CULTURAL RESOURCES

As part of its environmental review and examination of impacts on cultural resources, Enbridge Toledo conducted Phase I investigations to identify any significant cultural sites that may be affected by the Project. Enbridge Toledo defined the Project area as generally a 400-foot-wide survey corridor, (wider or narrower at select locations), and the cultural resources study area as one-half mile radius from the Project centerline. The Phase I investigation of the Romulus metering station will occur in the spring of 2012. Significant cultural resources are more than 50 years old and can be above ground historic structures, below ground archaeological sites, underwater archaeological sites, cultural landscapes, traditional cultural properties or historic districts. Enbridge Toledo searched the files of the SHPO and the OSA in order to identify cultural resources recorded within the one-half mile study area in Michigan. The basic file search also identified cultural resources inventory surveys that had been conducted in the study area.

The SHPO maintains a database of over 3,500 above ground historic properties. These properties are public and private buildings, historic locations, and other properties that are listed on the National Register of Historic Places (“NRHP”), awarded National Landmark status, or listed on the Michigan State Register of Historic Sites (“SRHS”). Enbridge Toledo’s consultant, URS, searched SHPO files for listed properties located in the study area.

The OSA maintains a database of below ground and underwater archaeological properties in their Lansing, Michigan office. URS searched the OSA files for archaeological sites recorded within the study area, and for archeological field inventory survey reports on file for the study area. Table 3.10-1 lists the previous cultural resource surveys that have been conducted within 0.5 mile of the Project corridor.

TABLE 3.10-1
PREVIOUS CULTURAL RESOURCE AND INVENTORY SURVEYS WITHIN 0.5 MILE OF THE PROJECT CORRIDOR

Report Number	Title	Authors (Date)[a]	Survey Type	Client Type	Sites
	A Preliminary Inventory of Archaeological and Historic Sites in Michigan State Parks and Recreational Areas.	Jackson et al. (1996)	Phase I	Parks/Recreation	600
ER98-30	*Cultural Resources Survey, IPL Toledo Pipeline (USA), Inc. Project, Ingham, Jackson, Washtenaw, and Monroe Counties, Michigan.*	Robertson et al. (1998)	Phase I	Pipeline	13
ER98-30	*IPL Toledo Pipeline (USA), Inc. Project.*	Robertson (1998)	Desktop	Pipeline	NA
ER98-30	*Phase I Survey, Access Rd #13, IPL Toledo Pipeline, Washtenaw County Letter Report.*	Robertson (1998)	Phase I	Pipeline	NA
ER98-30	*Assessment of Archaeological Historic Site Potential for a Proposed Utility Corridor in Ingham, Jackson, and Washtenaw Counties, Michigan.*	Robertson et al. (1997)	Desktop	Pipeline	NA
ER00-220	*Phase I Survey of the Proposed Wolverine Pipeline Spartan System Project, Clinton, Ingham, and Jackson Counties, Michigan.*	Dunham and Taylor (2000)	Phase I	Pipeline	5
ER98-30	*Phase I Survey, Cultural Resources Survey of the Proposed Vector Pipeline in Berrien, Cass, St. Joseph, Kalamazoo, Calhoun, Jackson, Ingham, Livingston, Oakland, and St. Clair Counties, Michigan.*	Robertson et al. (2000)	Phase I	Pipeline	55
ER00-7.06.050672	*Archaeological Field Reconnaissance of a Proposed Cellular Phone Tower (Project #050672) in Stockbridge, Jackson County, Michigan.*	Stillwell (2005)	Phase I	Tele-communications	0
ER02-261.11	Archaeological Reconnaissance of the Proposed Telecommunications Facility in Washtenaw County, Michigan.	Walz (2011)	Phase I	Tele-communications	0

[a] Full bibliography available in the reference section

Table 3.10-2 lists the fourteen archaeological sites have been identified within the buffer zone. Six (6) of the sites are associated with the prehistoric period (Paleo-Indian to early/Mid Archaic), four (4) are nineteenth to twentieth century historic farmsteads/barns, and three do not provide any information concerning site types and/or cultural associations. A single twentieth century railroad depot was also identified. With regard to NRHP significance, eight (8) of the sites were not assessed and the remaining six (6) were considered not eligible.

TABLE 3.10-2

RECORDED ARCHAEOLOGICAL SITES WITHIN 0.5 MILE OF THE PROJECT CORRIDOR

Site Number	USGS Quad	County	Township	Site Type	NRHP Status
20IN105	Stockbridge	Ingham	Stockbridge	Railroad depot; 20th century	Not Assessed
20IN107	Stockbridge	Ingham	Stockbridge	Findspot (single chert flake)	Not Assessed
20IN114	Millville	Ingham	White Oak	Prehistoric; Paleo-Indian	Not Eligible
20IN192	Stockbridge	Ingham	Stockbridge	Prehistoric; Paleo-Indian	Not Assessed
20IN79	Stockbridge	Ingham	Stockbridge	Farmstead; 19th Century	Not Eligible
20JA261	Jackson	Jackson	Waterloo	Historic Foundation	Not Eligible
20JA262	Jackson	Jackson	Waterloo	Prehistoric Isolate; Paleo-Indian	Not Eligible
20WA143	Bridgewater	Washtenaw	Freedom	Prehistoric Camp; Early/Mid-Archaic	Not Assessed
20WA144	Bridgewater	Washtenaw	Freedom	Prehistoric Camp; Early/Mid-Archaic	Not Assessed
20WA288	Dexter	Washtenaw	Dexter	Prehistoric Isolate; Paleo-Indian	Not Assessed
20WA308	Gregory	Washtenaw	Lyndon	Turn-of-the Century Farmstead	Not Assessed
20WA309	Gregory	Washtenaw	Lyndon	Historic Barn/Farmstead; 19th – 2oth century	Not Assessed
20WA323		Washtenaw	Lyndon	Findspot (single chert flake)	Not Eligible
20WA324		Washtenaw	Lyndon	Findspot (two chert flakes)	Not Eligible

Table 3.10-3 lists nine cemeteries that were identified within approximately 0.5 mile of the Project corridor. Seven of the cemeteries lie outside of the Project corridor; however, two cemeteries in Lima Township are positioned significantly closer to the corridor (between 0.02 and 0.04 mile).

TABLE 3.10-3

RECORDED CEMETERIES WITHIN 0.5 MILE OF THE PROJECT CORRIDOR

Township	Cemetery Name	Nearest MP	Offline/Online	Location (to corridor)
Stockbridge	Derby	5.2	Offline	0.43 miles west
Waterloo	North Waterloo	10.4	Offline	0.21 miles south
Dexter	North Lake	19.2	Offline	0.32 miles north
Lima	Unnamed	25.6	Offline	0.04 miles west
Lima	Lima	27.4	Offline	0.02 miles east
Freedom	Unnamed	31.95	Offline	0.34 miles west
Freedom	Unnamed	34.3	Offline	0.39 miles north
Freedom	Mt. Hope	34.8	Offline	0.28 miles north
Freedom	Unnamed	35.2	Offline	0.14 miles west

As listed in Table 3.10-4, a total of 99 historic standing structures were identified within 0.5 mile of the Project corridor. All of these structures are situated within Washtenaw County and none were located within the Project corridor. The vast majority of these structures were residential in nature (91), with commercial, agricultural, education, and outbuildings contributing the remainder of the inventory. With regard to National Register of Historic Places (NRHP) eligibility, 80 of these structures do not appear to have been assessed for their eligibility, while five were considered not eligible for NRHP listing. Fourteen were described as eligible for listing in the NRHP; however, no listed NRHP properties were identified within 0.5 mile of the Project corridor.

TABLE 3.10-4

RECORDED HISTORIC STANDING STRUCTURES WITHIN 0.5 MILE OF THE PROJECT CORRIDOR*

Parcel Number	Structure Name	Context	Construction Date	Style	Foundation	NRHP Status	Condition
LYNDON TOWNSHIP							
E-05-03-400-007	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Fair
E-05-04-300-007	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Poor
E-05-04-300-012	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Fair
E-05-06-200-005	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Good

TABLE 3.10-4

RECORDED HISTORIC STANDING STRUCTURES WITHIN 0.5 MILE OF THE PROJECT CORRIDOR*

Parcel Number	Structure Name	Context	Construction Date	Style	Foundation	NRHP Status	Condition
E-05-06-400-002	n/a	Residence	Pre-1930	No detailing	Not visible	Unknown	Excellent
E-05-08-400-007	n/a	Residence	Pre-1930	No detailing	Field stone	Eligible	Unstated
E-05-09-200-016	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Fair
E-05-09-200-021	n/a	Residence	Pre-1930	Greek Revival	Not visible	Unknown	Unstated
E-05-10-100-006	**n/a**	**Residence**	**1879**	**No detailing**	**Not visible**	**Eligible**	**Good**
E-05-11-100-006	n/a	Residence	Pre-1930	No detailing	Not visible	Unknown	Unstated
E-05-11-300-006	n/a	Residence	Pre-1930	No detailing	Cement	Unknown	Good
E-05-11-400-007	n/a	Residence	Pre-1930	Greek Revival	Field stone	Unknown	Excellent
DEXTER TOWNSHIP							
D-04-18-385-014	n/a	Residence	Pre-1930	Italianate	Field stone	Unknown	Excellent
D-04-19-100-009	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Good
D-04-20-100-023	n/a	Residence	Pre-1930	No detailing	Poured concrete	Unknown	Poor
D-04-20-200-004	n/a	Residence	Pre-1930	Greek Revival	Poured concrete	Unknown	Excellent
D-04-21-300-009	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Good
D-04-27-300-006	n/a	Residence	Pre-1930	No detailing	Concrete block	Unknown	Good
D-04-27-300-008	n/a	Residence	Pre-1930	Greek Revival	Not visible	Unknown	Good
D-04-28-100-001	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Excellent
D-04-28-300-004	n/a	Residence	Pre-1930	No detailing	Not visible	Unknown	Good
D-04-28-400-014	n/a	Residence	Pre-1930	Greek Revival	Field stone	Unknown	Fair
D-04-34-100-005	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Good
D-04-34-100-019	n/a	Residence	Pre-1930	Colonial Revival	Not visible	Unknown	Good
D-04-34-100-024	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Fair
LIMA TOWNSHIP							
N-14-02-300-001	**Stierle House**	**Residence**	**Unstated**	**Greek Revival**	**Field stone**	**Eligible**	**Unstated**
N-14-03-400-003	n/a	Residence	Unstated	Unstated	Unstated	Unknown	Unstated
N-14-08-400-001	n/a	Residence	Unstated	Unstated	Unstated	Unknown	Unstated
N-14-08-400-002	n/a	Residence	Unstated	Greek Revival	Field stone	Unknown	Fair
N-14-09-200-005	n/a	Residence	Unstated	Unstated	Unstated	Unknown	Unstated
N-14-09-300-003	n/a	Residence	Unstated	Colonial Revival	Concrete block	Unknown	Fair
N-14-09-300-004	n/a	Residence	Unstated	No detailing	Concrete block	Unknown	Good
N-14-09-300-006	*n/a*	*Residence*	*Unstated*	*Unstated*	*Unstated*	*Unknown*	*Unstated*
N-14-09-400-005	n/a	Outbuilding	Unstated	Unstated	Unstated	Unknown	Unstated
N-14-10-100-002	n/a	Residence	Unstated	Queen Anne	Field stone	Unknown	Fair
N-14-10-100-004	n/a	Residence	Unstated	Greek Revival	Field stone	Unknown	Unstated
N-14-10-300-004	n/a	Residence	Unstated	Greek Revival	Unstated	Unknown	Unstated
N-14-10-300-006	n/a	Residence	Unstated	No detailing	Unstated	Unknown	Unstated
N-14-10-400-001	n/a	Residence	Unstated	No detailing	Unstated	Unknown	Unstated
N-14-11-200-003	n/a	Residence	Unstated	No detailing	Unstated	Unknown	Unstated
N-14-11-200-008	*n/a*	*Residence*	*Unstated*	*Unstated*	*Unstated*	*Unknown*	*Unstated*
N-14-14-200-003	n/a	Residence	Unstated	Unstated	Unstated	Unknown	Unstated
N-14-14-200-004	n/a	Agricultural	Unstated	Barns	Unstated	Unknown	Unstated
N-14-15-100-003	n/a	Residence	Unstated	Greek Revival	Unstated	Unknown	Unstated
N-14-15-200-001	n/a	Residence	Unstated	Greek Revival	Unstated	Unknown	Unstated
N-14-15-200-006	n/a	Residence	Unstated	Colonial Revival	Not visible	Unknown	Good
N-14-15-200-009	n/a	Residence	Unstated	Unstated	Unstated	Unknown	Unstated
N-14-16-100-001	n/a	Residence	Unstated	Greek Revival	Unstated	Unknown	Unstated
N-14-16-100-007	n/a	Residence	Unstated	Unstated	Field stone	Unknown	Unstated
N-14-16-200-001	n/a	Residence	Unstated	No detailing	Unstated	Unknown	Unstated
N-14-16-300-001	n/a	Residence	Pre-1930	No detailing	Field stone	Unknown	Good
N-14-17-100-001	**n/a**	**Residence**	**Unstated**	**Unstated**	**Unstated**	**Eligible**	**Unstated**
N-14-17-100-004	n/a	Agricultural	Unstated	Barn	Field stone	Unknown	Unstated

TABLE 3.10-4

RECORDED HISTORIC STANDING STRUCTURES WITHIN 0.5 MILE OF THE PROJECT CORRIDOR*

Parcel Number	Structure Name	Context	Construction Date	Style	Foundation	NRHP Status	Condition
N-14-17-4100-001	n/a	Residence	Pre-1930	No detailing	Field stone/ concrete blocks	Unknown	Excellent
			FREEDOM TOWNSHIP				
G-07-10-100-014	n/a	Residence	Pre-1930	No detailing	Field stone	Eligible	Good
G-07-10-200-016	n/a	Residence	Pre-1930	No detailing	Not visible	Not eligible	Good
G-07-15-360-003	n/a	Residence	Unstated	No detailing	Concrete block	Unknown	Unstated
G-07-15-360-004	(Former) Lima Center School	Education	Unstated	No detailing	Unstated	Unknown	Unstated
G-07-15-361-001	**Beach Farm**	**Residence**	**Post 1853**	**Italianate**	**Unstated**	**Eligible**	**Unstated**
G-07-15-400-013	Williams-Finkbeiner Farm	Residence	Unstated	No detailing	Unstated	Unknown	Unstated
G-07-16-400-010	Hammond Farm	Residence	Unstated	No detailing	Field stone	Unknown	Unstated
G-07-16-400-011	Service Station	Commercial	Unstated	No detailing	Cement	Unknown	Unstated
G-07-16-400-012	Lima Center Station	Commercial	ca. 1901	Unstated	Unstated	Eligible	Excellent
G-07-16-400-013	n/a	Residence	Unstated	No detailing	Concrete block	Unknown	Unstated
G-07-16-400-014	n/a	Residence	Unstated	No detailing	Concrete block	Unknown	Unstated
G-07-16-400-015	n/a	Residence	Unstated	No detailing	Poured concrete	Unknown	Unstated
G-07-16-400-016	n/a	Residence	ca. 1948-1949	No detailing	Poured concrete	Unknown	Unstated
G-07-21-100-001	n/a	Commercial	Unstated	No detailing	Concrete block	Unknown	Unstated
G-07-21-100-002	n/a	Residence	Unstated	No detailing	Field stone	Unknown	Good
G-07-21-400-001	n/a	Residence	19th Century	No detailing	Unstated	Eligible	Unstated
G-07-21-400-004	n/a	Residence	1920	No detailing	Concrete	Eligible	Good
G-07-22-100-001	Luick Farm	Residence	Unstated	Greek Revival	Unstated	Unknown	Good
G-07-22-100-012	n/a	Residence	Unstated	Queen Anne	Unstated	Unknown	Good
G-07-22-228-003	n/a	Commercial	Unstated	No detailing	Unstated	Unknown	Good
G-07-22-228-004	Storms Farm	Residence	Unstated	Greek Revival	Unstated	Unknown	Unstated
G-07-22-300-003	n/a	Residence	Unstated	Unstated	Unstated	Eligible	Unstated
G-07-22-400-003	n/a	Residence	Unstated	No detailing	Not visible	Not eligible	Unstated
G-07-27-100-002	Jewett-Allen Farm	Residence	Unstated	Italianate	Unstated	Eligible	Unstated
G-07-27-200-001	n/a	Residence	Unstated	Unstated	Unstated	Not eligible	Unstated
G-07-27-200-003	n/a	Residence	Unstated	No detailing	Not visible	Unknown	Good
G-07-27-200-004	Earl Bauer Farm	Residence	Unstated	No detailing	Unstated	Unknown	Unstated
G-07-27-200-010	n/a	Residence	Unstated	Unstated	Unstated	Unknown	Unstated
G-07-27-200-016	n/a	Residence	Unstated	Greek Revival	Unstated	Unknown	Unstated
G-07-27-200-021	Earl Bauer Farm	Residence	Unstated	Unstated	Unstated	Unknown	Unstated
G-07-28-100-002	n/a	Residence	1960	No detailing	Concrete	Unknown	Unstated
G-07-28-100-004	n/a	Residence	Unstated	No detailing	Not visible	Unknown	Good
G-07-28-100-005	Mitchell-Barth Farm	Residence	Late 19th Century	Greek Revival	Unstated	Unknown	Unstated
G-07-28-400-007	Gustav Laier Farm	Residence	Unstated	Unstated	Unstated	Unknown	Unstated
G-07-28-400-008	Gustav Laier Farm	Residence	1960	Ranch	Concrete	Unknown	Good
G-07-34-100-003	n/a	Residence	Unstated	Ranch	Concrete	Not eligible	Good

TABLE 3.10-4

RECORDED HISTORIC STANDING STRUCTURES WITHIN 0.5 MILE OF THE PROJECT CORRIDOR*

Parcel Number	Structure Name	Context	Construction Date	Style	Foundation	NRHP Status	Condition
G-07-34-100-008	n/a	Residence	Unstated	Cape Cod Revival	Not visible	Eligible	Good
G-07-34-200-001	n/a	Residence	Unstated	No detailing	Not visible	Unknown	Good
G-07-34-200-002	E. H. Keyes (Heller) Farm	Residence	Unstated	Unstated	Unstated	Eligible	Unstated
G-07-34-300-011	n/a	Residence	Unstated	No detailing	Unstated	Unknown	Unstated
G-07-34-300-015	n/a	Residence	1850	Greek Revival	Field stone	Eligible	Good
G-07-34-400-009	n/a	Residence	Unstated	No detailing	Not visible	Not eligible	Good
G-07-34-400-010	n/a	Residence	Unstated	No detailing	Not visible	Unknown	Good
G-07-34-400-022	n/a	Residence	Unstated	Unstated	Unstated	Unknown	Good
G-07-34-410-007	Yager Farm	Residence	1834	Greek Revival	Unstated	Unknown	Unstated

*Structures in bold are certified Centennial Farms and Italicized structures were recorded, but determined to be non-contributing.

URS reviewed available digital historic maps to identify the potential locations for historic structures, roads, railroad grades, and churches/cemeteries within or immediately adjacent to, the Project corridor. As listed in Table 3.10-5, twenty-seven (27) road crossings, six potential structures, and two railroad grades were identified.

TABLE 3.10-5

IDENTIFIED HISTORIC RESOURCES – MAP RESEARCH WITHIN OR IMMEDIATELY

Township	MP	Location	Feature Type
Stockbridge (ND)	0.65	Dexter Trail Road	Road Crossing
Stockbridge (ND)	2.25	Catholic Road	Road Crossing
Stockbridge (1859; 1895)	4.65	Morton Road	Building
Stockbridge (ND)	4.7 to 5.2	Heeney Road	Road Crossing
Stockbridge (1895)	6.7	Railroad Crossing	Railroad Grade
Waterloo (1874)			None
Waterloo (ND)	7.35	Michigan 106	Road Crossing
Waterloo (ND)	8.85	Michigan 52	Road Crossing
Waterloo (ND)	9.85	Hill Road	Road Crossing
Waterloo (ND)	10.65	Leeke Road	Road Crossing
Waterloo (ND)	10.95	Farnsworth Road	Road Crossing
Lyndon (ND)	12.6	Farnsworth Road	Road Crossing
Lyndon (ND)	13.6	Roepke Road	Road Crossing
Lyndon (ND)	14.85	Joslin Drive	Road Crossing
Lyndon (1874)	14.95	Joslin Drive	Building
Lyndon (ND)	17.0	Joslin Drive	Road Crossing
Lyndon (ND)	18.2	North Territorial Road	Road Crossing
Lyndon (ND)	18.75	Stofer Road	Road Crossing
Dexter (1874)			None
Dexter (ND)	20.2	Riker Road	Road Crossing
Dexter (ND)	20.7	Madden Road	Road Crossing
Dexter (ND)	21.65	Colby Road	Road Crossing
Dexter (ND)	23.5	Island Lake Road	Road Crossing
Lima (ND)	24.75	Beach Road	Road Crossing
Lima (1874)	25.3	Railroad Crossing	Railroad Grade
Lima (ND)	25.55	Dexter Chelsea Road	Road Crossing
Lima (ND)	26.55	Trinkle Road	Road Crossing

TABLE 3.10-5

IDENTIFIED HISTORIC RESOURCES – MAP RESEARCH WITHIN OR IMMEDIATELY

Township	MP	Location	Feature Type
Lima (1874)	27.45	Old US Highway 12	Church/Cemetery
Lima (ND)	27.6	Old US Highway 12	Road Crossing
Lima (ND)	28.75	Jerusalem Road	Road Crossing
Lima (ND)	30.4	Scio Church Road	Road Crossing
Freedom (ND)	31.95	Waters Road	Road Crossing
Freedom (ND)	32.95	West Ellsworth Road	Road Crossing
Freedom (1874)	32.95	West Ellsworth Road	Building
Freedom (ND)	34.3	Lima Center Road	Road Crossing
Freedom (1874)	34.3	Lima Center Road	Building
Freedom (1874)	34.3	Lima Center Road	Building

In summary, Enbridge Toledo conducted a Phase I cultural resource survey of approximately 50 percent of the right-of-way corridor, and will complete the remaining surveys along the route and at the Romulus metering station in the spring of 2012 when seasonal conditions warrant. Enbridge Toledo will submit a report documenting their survey findings and will request SHPO concurrence.

3.11 VISUAL RESOURCES AND AESTHETICS

The overall visual character of the Project area varies little. The majority of the Project traverses plots of agricultural and scattered wooded land. As described in Section 3.6.1, approximately 52 percent of the route crosses agricultural land. Agricultural plots range in size from less than one acre to 13 acres. Woodland and shelterbelts are common throughout the Project area. Wooded areas are generally a few acres in size and residential plots are generally less than one acre to 2.3 acres in size and are surrounded by agricultural land and wooded areas.

Visual impacts may occur in areas where woodland will be cleared to create the permanent easement. However, the pipeline will be located adjacent to existing pipeline and other utility rights-of-way that are currently maintained as open land. Therefore, the addition of the proposed pipeline will have minimal affect on visual resources.

During construction, temporary visual impacts will occur as a result of construction equipment and disturbed soil. Areas affected during construction will be replanted, where applicable, in accordance with agreements with property owners and/or NRCS recommendations.

Visual impacts resulting from aboveground facilities will be negligible. The MLVs for the Project will require minimal ground space. The placement of these minor aboveground facilities will present minimal visual and aesthetic effects on the surroundings.

Based on the Project's location adjacent to existing rights-of-way and location in undeveloped areas, the Project and associated aboveground facilities will not be visually or aesthetically obtrusive.

3.12 PUBLIC COMMUNICATIONS

Enbridge Toledo is committed to timely and meaningful dialogue with community stakeholders that have an interest in the Project. Enbridge Toledo will follow an established public consultation and notification process for this Project that reflects the following principles:

Enbridge Toledo project team members:

- Have identified parties that may be impacted by the Project;
- Provided affected stakeholders with comprehensive and updated information regarding the Project;
- Will continue to identify affected stakeholders' issues of interest, provide the means for comment and input and, where possible, resolve concerns raised;
- Will employ various outreach methods to provide ample opportunity for affected stakeholders to learn about the Project; and,
- Will seek to gain support or non-objections from potentially affected stakeholders.

3.12.1 Stakeholder Groups Notified and Consulted

Early in the planning process for this outreach program, potentially interested groups and individuals were identified and appropriate levels of consultation and notification were established and will be implemented for each (see Table 3.12-1).

TABLE 3.12-1

PUBLIC COMMUNICATIONS FOR THE LINE 79 PIPELINE SYSTEM PROJECT

Stakeholders Identified	Action
Landowners (including businesses) Current Landowners	Project announcement and update letters and face-to-face contact with agents
Elected/Appointed Officials Local (City/Township/Village) County State Federal	Project announcement and update letters. Supplementary telephone, mail and e-mail contacts to selected officials at all levels most directly impacted.
Federal Agencies OPS USFWS USCOE	Face-to-face and/or phone preliminary consultations held.
State/County/Agencies Michigan PSC Michigan DNR Michigan DEQ Michigan SHPO/State Archaeologist County SESC and Drain Commissions	Comprehensive briefing held for MPSC staff State agencies and counties will be contacted once proposed routing is finalized

3.12.2 Notification and Consultation Activities

Enbridge Toledo's project team, including Land and Right-of-Way and Public Affairs groups, has been actively engaged in the planning process for the Project and has developed plans and deliverables for ongoing consultation purposes. Additional materials will be developed as needed during the coming months. Below is a summary of key activities to date.

An agency consultation letter was submitted to the U.S. Fish and Wildlife Service in November 2011. The correspondence requested a formal review of the Project for potential Federally-listed Species. An additional agency consultation letter was submitted to the Michigan Natural Features Inventory in November 2011. This correspondence requested a formal review of the Project for endangered or threatened species and other natural features. See Appendix E of this EIR for copies of the agency correspondence.

Two Public Officials' mailing lists have been developed so that affected officials can receive Project updates in a timely fashion. The lists will be updated as necessary. One broader list is for general communications; a second more concise list will receive copies of the Michigan MPSC filing, in keeping with regulatory requirements.

Public officials were sent a letter explaining the Project, its purpose and providing contact information to address questions or concerns. The letter included a Project map, and summary information. Additional letters will be sent as the Project develops.

Collateral materials have been, or are being, developed. These materials include a general Project handout for public officials, landowners or media and descriptive maps showing the locations of the replacement segments for use in meetings with officials and other affected stakeholders. Assuming regulatory approval, additional construction process-related materials and web site information will be produced and made available to public officials, landowners and other interested parties.

A detailed public consultation plan has been developed and included in the overall Project planning regime that guides external communications with affected public. A Land and Right-of-Way plan has also been developed that guides the plan to negotiate permanent and temporary right-of-way rights with landowners.

4.0 PREPARER'S QUALIFICATIONS

The Project team organized for conducting the environmental impact review and preparing this EIR consisted of qualified and experienced environmental scientists and professional personnel. This team included environmental scientists, wetland scientists, geologists, archaeologists, archaeological principal investigators, geoarchaeologists, archaeological field technicians, and Project management personnel.

The consulting firms participating in the review and report preparation effort included Barr Engineering Company ("Barr"), URS, and EN Engineering.

Barr is a private consulting firm responsible for providing project management, research, and environmental assessment for the EIR. Barr's team included project managers and environmental resource scientists whom specialize in the analysis of environmental impacts related to utility and energy projects.

URS is a fully integrated engineering, construction, and technical services organization that provides services including site assessments and inventories, wetland delineations and mapping, habitat and migratory species studies and impact assessments. URS conducted wetland delineations, biological surveys, cultural resource investigations, and provided the archaeological and historic evaluation of the construction corridor for the Project.

5.0 CONCLUSION

The Project will be co-located and parallel to the existing Line 17 pipeline right-of-way, much of which is within an existing HVTL right-of-way, resulting in the potential for only minor deviations with limited short-term impacts. This will also restrict environmental and land use impacts to an existing disturbed area of a similar land use, thus minimizing impacts on new undisturbed areas. As discussed throughout this document, specific construction mitigation measures to minimize adverse impacts of the Project will be employed, including both general construction best management practices and resource-specific measures. In summary, Enbridge Toledo believes the construction and operation of the Project will result in minor short term impacts on the environment.

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Michigan Public Service Commission
Case No.: U-16937
Exhibit No.: A-4

SPECIFICATION FOR PIPELINE CONSTRUCTION (USA)

PIPELINE CONSTRUCTION

Revision 1

Table of Contents

1 SCOPE

1.1 General

1.1.1 This Specification outlines the minimum requirements for the installation of pipeline systems. The Contractor shall ensure that the pipeline installation requirements set out in this Specification are complied with by the Contractor to the extent they are applicable in the circumstance. Except as otherwise expressly provided herein; the Contractor is responsible for implementing this Specification. The Contractor shall be solely responsible for ensuring that the Work is performed in strict compliance with Environmental, Health, and Safety Laws.

2 ACTS, REGULATIONS, LAWS, CODES, AND STANDARDS

2.1 General

2.1.1 The latest approved edition of the following Acts, Codes, and Standards shall form part of this Specification. It is the Contractor's responsibility to become familiar with the latest approved editions of the Acts, Regulations, Laws, Codes, and Standards that are necessary for the performance of the Work. These and the regulations referenced within shall include but not be limited to the following:

(a) US DOT Title 49, CFR, Part 195, Transportation of Hazardous Liquids by Pipeline,

(b) ASME B31.4, and

(c) All other codes, standards, and plans referenced within this specification, if they exist.

2.1.2 If there is a conflict between the Acts, Regulations, Laws, Codes and Standards the most stringent requirement shall be met by the Contractor without additional cost to the Company.

2.1.3 The Contractor shall comply with the requirements of all applicable Acts, Regulations, Laws, Codes, and Standards in performance of the Work. Environmental plans and permits shall be considered contract specifications and will be enforced as such. If discrepancies between contract specifications and permits exist, the more stringent of the two shall apply. Any doubt as to which is the more stringent shall be resolved by the Company.

2.1.4 Contractors shall be liable for any damages, costs, fines, or penalties imposed by environmental regulatory agencies for violations of any environmental permits, laws, or regulations by the Contractor or its personnel and shall hold the Company harmless and indemnify the Company for any such damages, costs, fines, or penalties.

2.1.5 In addition all work shall be performed in strict compliance with the bid documents, good engineering practice, industry accepted pipeline construction and installation techniques, and all applicable rules and regulations.

3 RELATED TECHNICAL SPECIFICATIONS AND STANDARDS

3.1 General

3.1.1 The following Technical Specifications and Standards shall be read in conjunction with this Specification. The requirements of these documents shall become part of this Specification by reference herein:

(a) USPCS-SPEC-PLW-002 Pipeline Welding;

(b) USPCS-SPEC-NDT-003 Non Destructive Testing;

(c) USPCS-SPEC-PFC-004 Pipeline Field Coating;

(d) USPCS-SPEC-HYDRO-005 Pipeline Hydrostatic Testing;

(e) USPCS-SPEC-HDD-006 Horizontal Directional Drilling; and

(f) USPCS-SPEC-PCCT-007 Post Construction Caliper Tool;

(g) USPCS-SPEC-HDB-008 Horizontal Directional Bore; and

(h) USPCS-SPEC-CCC-009 Continuous Concrete Coating.

4 GENERAL REQUIREMENTS

4.1 General

4.1.1 Pipeline construction shall be performed in accordance with CFR Part 195 and ASME B31.4 unless such requirements are exceeded herein. The Contractor shall also adhere to the requirements of all Governmental Authorities during the performance of the Work.

4.1.2 The Contractor shall have a documented Quality Program in place and a controlled copy of the Quality Program Manual shall be available to the Company at the place of Work. The Company may conduct an audit of the Contractor's implementation of the Contractor's Quality Program.

5 CONSTRUCTION EQUIPMENT

5.1 General

5.1.1 Pipeline construction equipment employed shall be of suitable type and size to construct the pipeline in accordance with this Specification.

5.1.2 Equipment shall be supplied clean, free of leaks, in a safe condition, good working order, properly maintained and serviced and in sufficient quantities to facilitate the installation of the pipeline at a rate meeting the production requirements of the Contract Documents.

5.1.3 Prior to mobilization to the site all equipment shall be free of any vegetation, seed and soil deposits.

5.1.4 The Company, in its sole discretion, reserves the right to prohibit the use of any piece of equipment deemed to be unsuitable for use in the performance of the Work.

6 PIPELINE INSTALLATION MATERIALS

6.1 General

6.1.1 Materials supplied by the Contractor to be incorporated in the Work or consumed during the installation shall be new, in accordance with the Specifications, and when not specified by the Company, fit for the intended service.

6.1.2 The Company reserves the right to prohibit the use of materials it deems unsuitable for proper performance of the Work. All Contractor supplied material will be accompanied by (Material Tracking Records (MTR's) where applicable.

7 RIGHT-OF-WAY AND TEMPORARY WORK SPACE

7.1 Sufficiency of the Right-of-Way and Workspaces

7.1.1 Prior to construction the Company will obtain the Right-of-Way and temporary workspaces shown on the Project Drawings with such minor modifications as may be approved by the Company. The Construction Right-of-Way may include a portion of the existing Right-of-Way, new easements and/or working rights areas where such have been acquired by the Company. In addition, the standard Construction Right-of-Way widths may be reduced substantially in certain areas, as indicated on the Drawings. Unless written approval is obtained from the Company in advance, construction operations shall be strictly confined to these areas.

7.1.2 For the Contractor's construction operations, the Company will provide construction Right-of-Way that, unless specified otherwise in construction permits, Right-of-Way Agreements, Construction Line Lists or on Drawings, will consist of Temporary Work Space as described in the project documents. Working over the existing pipelines shall be strictly prohibited without prior written approval by the Company.

7.1.3 Temporary Work Space as shown on the Drawings will be secured by the Company. The Temporary Work Space limits will be strictly enforced throughout the project.

7.1.4 Temporary Work Space agreements between the Contractor and a third party may only be made with Company approval. All agreements shall be in writing and furnished to the Company prior to authorization.

7.1.5 The Company shall acquire licenses and permits required for the installation of the pipeline that only an owner of a pipeline can obtain, as defined by the Company. The Contractor shall obtain all other permits and licenses and prepare and submit all notices required by Authorities having jurisdiction.

7.1.6 The Construction Line List and Crossing Agreements include information and special requirements for each property and foreign facility crossed by the pipeline. The Contractor shall familiarize itself with, and construct the pipeline in accordance with the conditions of Right-of-Way and Crossing Agreements, licenses, and permits.

7.1.7 Right-of-Way and workspaces including but not limited to, access roads (shoo-flies), staging areas, and storage areas shown on the Project Drawings are considered to be sufficient to construct the pipeline. If conditions change from what could have been anticipated at time of bid, resulting in the need for additional Right-of-Way or workspace in order to construct the pipeline; the Company, if in agreement acting in its sole discretion, shall endeavour to acquire the additional Right-of-Way and or workspace at the Company's expense.

7.1.8 The Company shall be contacted immediately if the Contractor feels it requires additional workspace for access roads (shoo-flies), staging areas, push-outs, deck sites, etc. If the Company agrees with the requirement for additional space it will endeavour to obtain the appropriate permits and approvals at the Contractor's sole cost and expense.

7.1.9 To request Company approval for use of areas such as additional work space, staging areas or access roads not pre-approved by the Company, the Contractor shall provide a written request to the Company that will include, at a minimum, the following:

(a) A map showing the location of the space to be reviewed,

(b) A legal description of the property,

(c) A sketch showing dimensions and layout, and

(d) A brief description of the planned use, including planned changes to the site.

7.1.10 The Contractor shall be responsible for any and all costs, including the Company's costs, resulting from off Right-of-Way activities by the Contractor. Compensation payable by the Contractor to the Landowner for such damages will be negotiated by the Company on behalf of the Contractor.

7.1.11 Should any violations occur, the crew in violation, at the discretion of the Company, will stop work until further assessment by the Company. All costs associated with a work stoppage due to Right-of-Way limit violations shall be borne by the Contractor.

7.1.12 Contractor damages considered negligent as determined by the Company shall be at the Contractor's expense. Damages shall be settled prior to the Contractor leaving the Work areas, and any disputed claims shall be withheld from the Contractor's retainage.

7.1.13 The Company provides no guarantee that additional workspace requested by the Contractor will be acquired or in what period of time. If the additional workspace is not available, the Contractor shall construct the pipeline in the space available using applicable construction methods necessary at no additional cost to the Company.

7.1.14 The Contractor shall positively identify, in advance, the location and required clearance of existing underground and overhead facilities which may be encountered and determine any necessary changes in grade or location.

7.1.15 Where possible, the Company will make available information pertinent to the location of underground facilities. The location of underground structures as shown on the Drawings or given on site by the Company shall be only for the assistance of the Contractor.The ultimate responsibility for locating such underground facilities and structures remains with the Contractor. The Contractor shall avoid damage to and shall be liable for damages to all such structures. The Contractor shall be responsible for all underground utilities whether or not they are located by the Company or referenced on the Drawings.

7.1.16 The Contractor shall be responsible for notifying pipeline, telephone, power, and other companies or agencies that have structures above or below ground either across the construction route or near enough that there could be damage during construction. The Contractor shall notify and comply with the appropriate local utility protection system or the state one-call system, following appropriate notification procedures and permit conditions. In addition, the Contractor shall provide the Company with a record of all notifications.

7.1.17 Utility poles in the path of Construction that require removal or re-location shall be coordinated by the Contractor in advance of construction commencing.

7.2 Conditions of Use of the Right-of-Way and Workspaces

7.2.1 At certain locations the pipeline may be routed adjacent to or across other pipelines, highways, railroads, power and telephone poles and wires, embankments, cliffs, rivers, trees or other obstacles which may physically restrict or limit the use of the Right-of-Way. In some cases such physical confinement may necessitate special methods of construction of the pipeline. Such methods must be pre-authorized by the Company.

7.2.2 When acquiring Right-of-Way along the route of the line, it may be necessary at various locations for the Company to agree to certain special requirements by landowners and tenants. Special requirements shall be noted on the Project Documents. The Contractor shall comply with these special requirements at no additional costs to the Company. If Line Lists are incomplete at the time of bid, items requiring special attention will be negotiated with the Contractor at the time that such items are identified.

7.2.3 The Contractor shall endeavour to reduce surface disturbance where possible if the reduction does not hinder safety, environmental stewardship, and sound construction practices. This may be accomplished by reducing the disturbance within workspaces if the total allotted workspace is not required to perform the Work.

7.2.4 Use of materials found on the Right-of-Way such as sand, gravel, clay, borrow or rip rap is prohibited except with prior approval of the Company. Such materials shall only be sourced off-site from active commercial sites where usage is not confirmed by the Company in writing. Any materials moved along the Right-of-Way must be returned to their original location unless approved by the Company.

7.2.5 Immediately following final reclamation of Right-of-Way and workspaces the Contractor shall assist the Company in obtaining releases from Landowners.

7.2.6 Use of the Right-of-Way shall be conducted with the utmost consideration of the interests of Landowners. Private access shall be maintained and access for farm equipment will be maintained by the Contractor utilizing gaps in stripping and plugs in the ditch.

7.2.7 Gaps shall be maintained by use of windrowed materials on the Right-of-Way at trails used by livestock, wildlife and other intersections. Windrowed materials include snow, topsoil, subsoil, and trench materials.

7.2.8 The Contractor shall not move or store equipment or spoil on or across the Company's existing pipeline(s) except upon a showing of absolute necessity and only with the Company's prior consent given in each individual instance and only in accordance with the approved Company policy.

8 SURVEYS

8.1 Pipeline Construction Survey

8.1.1 All pre-construction, construction, and as-built survey shall be the responsibility of the Company and jointly coordinated between the Contractor and the Company. Contractor is responsible for coordinating the survey needs via the designated Company representative so it does not impact work.

8.1.2 Colored survey ribbon or painted stakes used to perform the Pipeline Construction Survey will be in accordance with the Color Coding convention specified below, unless specific conditions warrant using a different color code.

The flagging color system shall include, but not be limited to the following:

- Existing pipelines – Red
- Survey control points – Pink and white
- Existing Utilities – Use APWA/One Call Color Code Designation as follows: (http://ecommerce.billsblue.com/APWA.pdf)
    - Electric – Red
    - Gas- Oil – Yellow
    - Water – Blue
    - Sewer – Green
    - Communication/CATV – Orange
    - Proposed Excavation – White
    - Reclaimed Water – Purple
    - Temporary Survey Marking – Pink
- Proposed new pipeline – Orange
- P.I. (proposed new pipeline) – Orange and white
- P.I. (existing pipeline) – Red and white
- Wetlands – Pink with wetland boundary text on flagging.
- Foreign pipeline crossing – Orange and red
- Coating or wall thickness change – Green and white
- Temporary workspace or extra workspace – Blue and white
- Exclusion Zones and Cultural Resource Boundaries – Blue and pink
- Proposed facility installations – White
- Topsoil segregation areas – Black

8.1.3 Unless stated otherwise elsewhere, the Company will provide pipeline construction related survey information in the following manner:

(a) Legal Survey Markers will be identified with survey lathe and ribbon;

(b) Tree clearing limits of the Right-of-Way and workspaces will be marked by survey ribbon with at least two survey ribbons visible from any single point along the marked boundaries of the clearing limits;

(c) Limits of the Right-of-Way and workspaces will be marked with survey stakes at intervals not to exceed 200 feet;

(d) At known locations of intersections with foreign Right-of-Way the foreign Right-of-Way will be staked on each Right-of-Way boundary, and the foreign facilities' approximate location will the also be marked. Known locations of intersections will be those shown on the drawings;

(e) The position of any adjacent parallel lines and required Safety buffers will be located at the intervals stated in the Company's Contractor Safety Program (CSP) and/or the Project Ground Disturbance Procedure;

(f) Test points, buoyancy control, Points of Intersect (PI's), valve assemblies and any item shown on the drawings with a corresponding chainage will be staked on the Right-of-Way with survey lath and ribbon;

(g) Surveyed chainage will be marked on at least one set of boundary stakes;

(h) The method used to identify Benchmarks will be communicated from the Survey Contractor to the Pipeline Contractor; and

(i) One set of ditch centerline stakes will be provided as hubs and may vary to suit the location of existing parallel facilities.

8.2 Surveyed Marker Preservation

8.2.1 Surveyed marking preservation will be performed by the Contractor in accordance with the following:

(a) The Contractor shall not disturb, deface, alter, destroy or remove any legal survey markers. The Contractor shall make itself aware of legal survey markers in the field before proceeding with the Work;

(b) The Contractor shall maintain stakes placed by the Company defining safety buffers along existing parallel adjacent pipelines during the timeframe where stripping, grading or excavating will occur. The stakes defining safety zones will be placed in accordance with the CSP;

(c) Since survey information provided by the Company includes the locations of adjacent lines and lines to be crossed, missing or damaged survey information shall be considered to be a safety risk and shall be replaced by Contractor as soon as possible at Contractor's expense;

(d) When it becomes necessary to move boundary or centerline stakes they shall be moved in a line approximately perpendicular to the centerline of the pipeline and opposite the original location of the stake with the offset noted on the stake. Stakes indicating the location of a foreign facility or a facility being protected shall only be moved if the requirements for marking in accordance with the requirements of the CSP are met;

(e) The location of known underground facilities staked in the field by the Company or shown on the Drawings shall be only for the assistance of the Contractor. The Contractor shall be responsible for the identification and marking of all underground

facilities in accordance with the CSP, or the appropriate local safety laws and utility protection system;

(f) All field books used for proper grading of the Right-of-Way, bending of pipe, for locating existing underground facilities, and for other pipeline installations will be available for review by the Company and will be turned over to the Company following construction;

(g) Centerline stakes disturbed by construction activity ahead of the trenching operation shall be replaced in their original location by the Contractor. The Company may check and adjust the location of these stakes as necessary; and

(h) If there is a conflict between the drawings and survey information provided by the Company, the Contractor shall report the conflict prior to the Work being performed. If the Work proceeds without notification, the Contractor shall be solely accountable for all consequences and costs to correct any installation found not to be in its required location.

8.3 As-built Surveys

8.3.1 As-built surveys performed by the Company shall be conducted with the cooperation of the Contractor. The Contractor will cooperate with the Company survey contractor in acquisition of As-built data by providing space and time to safely and efficiently perform the Work.

(a) Pipe Tally to gather all pipe specification data physically identified on the pipe such as but not limited to; heat numbers, joint numbers, wall thickness and lengths. And to assign project specific joint numbers as directed by Company.

(b) Weld Mapping to record above ground as-built of all information collected in Pipe Tally along with all x-ray numbers, side bends, sags and any other pipe information available.

(c) Lowering in survey will include measuring and recording x, y, z coordinates for pipe information such as but not limited to; welds, material changes, bends, set on buoyancy control weights, valve settings and all other appurtenances in accordance with the project coordinate systems as directed by the Company. Depth of cover will be verified at this time to assure compliance with project drawings and specifications.

(d) Tie-ins and bores will be surveyed in the same manner as Lowering-in to assure that all pipe information is measured and recorded with x, y, z coordinates and proper depth of cover is gained.

(e) Post Construction survey to measure and record the x, y, z locations of but not limited to; aerial markers, CP test stations and others as directed by Company.

9 FENCES AND TEMPORARY GATES

9.1 Farm Fences and Gates

9.1.1 Farm fences and gates shall be constructed in accordance with the typical drawings provided by the Company.

9.1.2 After consultation with the Company, the required notification of the landowner has been completed, and prior to opening existing fences that cross the Construction Right-of-Way adjacent posts shall be adequately braced to prevent slackening of the wire.

9.1.3 The Contractor shall be diligent in maintaining the gates and fences along and crossing the Construction Right-of-Way and at access roads until such time as the gates are removed and fences rebuilt to the satisfaction of the Company as confirmed by the Company in writing. The Contractor shall furnish all such gate and fence material as outlined in the Project Documents. The Contractor shall be responsible for loss of any livestock or other third party damages related to open or damaged fences.

9.1.4 Where page wire, wooden, or other special types of fences are indicated on the Construction Line List or encountered, the Contractor shall construct the temporary gates of the same materials as the original fence unless otherwise approved by the Company.

9.1.5 The gates shall be the same height as the adjacent fencing and be wide enough to allow the passage of construction equipment and material. Gates must be entirely within the boundaries of the Construction Right-of-Way and Temporary Work Space.

9.1.6 Gates installed during frozen conditions shall be checked during post construction thawing conditions for unstable posts or any slackening of the wire. The Contractor shall immediately correct loose posts and wire.

9.1.7 Gates shall be constructed in a manner that will keep livestock within the fenced area and shall be capable of being securely closed. Gates, temporary or permanent, shall be kept closed where required by the Line List or where livestock are present. If necessary, watchmen shall be posted at gates to prevent livestock from leaving the fenced area while gates are opened for the passage of vehicles and equipment. The Contractor shall ensure that no loss or inconvenience shall accrue to the owner or tenant by opening fences, installing gates, or failing to properly construct or close gates.

9.2 Fencing at Stations

9.2.1 Where temporary panel type fencing is approved for use it shall provide the same level of security as that provided by the permanent fence.

9.2.2 Fencing at Stations shall be dismantled and erected by competent personnel.

9.2.3 Installed fencing shall be free of loose fabric and gates shall be fully operable.

9.2.4 Where required by the Construction Line List the Contractor shall notify the owner or tenant prior to opening fences.

10 ACCESS, GRADE, AND CLEANUP PLAN

10.1 Purpose of the Access, Grade, and Clean-Up Plan

10.1.1 The Contractor is advised that preparation of an Access, Grade, and Clean-Up Plan (AGC Plan) will be required and will be used as a working tool to minimize disturbance, environmental impacts and to ensure that the integrity of existing operating pipelines are not jeopardized. The AGC Plan shall be submitted in an electronic format acceptable to the Company. The plan will include requirements of all Company Environmental Plans including but not limited to the Environmental Mitigation Plan (EMP), Agricultural Mitigation Plan (AMP), and any other project-specific permit requirements.

10.1.2 One month prior to accessing or grading any portion of the Construction Right-of-Way the Contractor shall provide the Company with an AGC Plan satisfactory to the Company for that portion of the Construction Right-of-Way. This AGC Plan will be developed collaboratively with the Company, the Contractor's Grade Foreman and Superintendent or assistant. No Work will be started on the Construction Right-of-Way until the Company provides written approval of the AGC Plan. In developing the AGC Plan, the Contractor shall make all efforts to:

(a) Become familiar with project requirements;

(b) Minimize the use of the Company's available Temporary Work Space (TWS) to the extent practicable;

(c) Optimize grading of the Right-of-Way varying trench depth and utilizing bending where practical;

(d) Minimize topsoil stripping width to the extent practical;

(e) Contain Work within the staked boundaries of the agreed working areas;

(f) Use only approved access roads (shoo-flies); and

(g) Implement traffic control as necessary.

10.1.3 The AGC Plan shall fully address the following:

(a) Identification of locations where crossing of overhead and underground utilities, conflicts with poles and towers and existing pipeline(s) is required;

(b) Identification of all required access from existing improved roads;

(c) Identification of all required access from existing private and or lease roads;

(d) Identification of chainage and degree of cold bends planned;

(e) Identification of pipe sections, weights or other materials on the Right-of-Way;

(f) Plans showing the method of developing wet or winter access to, and along the Right-of-Way, including proposed method of matting, rip rap or frost packing;

(g) Identification of the method of traffic control;

(h) Explanation of topsoil segregation procedures including plans and justification for stripping in excess of the width shown in the Contract Documents;

(i) Plans showing the need and justification for the use of the Company acquired available Temporary Working Spaces;

(j) The need and justification for the use of additional Temporary Working Spaces required by the Contractor;

(k) Clearing and grade constraints at watercourse crossings;

(l) Preparation of a sediment control plan for all water bodies and any erosion prone areas;

(m) Plans showing the method of crossing each watercourse with construction traffic;

(n) Pipeline installation procedure and method of installing crossings for each watercourse crossing (e.g., open cut, track bore, or HDD);

(o) Turning locations for stringing trucks;

(p) Grade requirements and temporary storage location of surplus spoil;

(q) Identification of restricted workspace on the Construction Right-of-Way;

(r) Preparation of the Urban Construction Plan, if deemed applicable by the Company;

(s) Identification of the method of installing pipe under shelterbelts and in proximity to above ground features;

(t) Identification of the procedure for installing pipe under buried facilities;

(u) Identification of temporary erosion control devices required;

(v) Identification of signage requirements;

(w) Identification and details of equipment cleaning stations;

(x) Identification of locations requiring overhead power markers;

(y) Identification of temporary fencing and gate requirements; and

(z) Landholder concerns as identified in the Construction Line List.

10.2 Maintenance of the Access, Grade, and Clean-Up Plan

10.2.1 The AGC Plan shall be revised to document changes made to the plan so the Right-of-Way can be returned to its original condition if conditions change.

11 ACCESS

11.1 Access to the Right-of-Way

11.1.1 Access to the Construction Right-of-Way shall be along existing public roads, established trails, and Company approved private access roads. Development of new access or upgrading existing access shall only occur following approval of each by the Company through the AGC Plan.

11.1.2 Access for vehicles and equipment to roads from the Right-of-Way shall be constructed in accordance with the EMP and applicable permits/licenses. Topsoil and subsoil may not be used for ramps, unless otherwise approved by Company. Steel culverts may be required in some areas, and if deemed applicable by the Company and permit conditions. These shall be installed at the Contractor's expense. Plastic culverts shall not be used.

11.1.3 Suitable measures shall be used to prevent damage to the road surface when moving equipment across roads.

11.1.4 Access for vehicles and equipment across water bodies shall be in accordance with the EMP and applicable permits/licenses.

11.1.5 Temporary bridges, roads, and the like used for construction shall be designed and constructed using accepted engineering practices to minimize soil erosion, to provide for proper drainage and for safe passage of Construction vehicles and equipment as outlined in the EMP.

11.2 Access Along the Right-Of-Way

11.2.1 The Contractor shall use the travel lane portions of the construction Right-of-Way for vehicle and equipment travel, whenever and to the extent practical.

11.2.2 Natural drainage across the Right-of-Way shall be maintained in accordance with the EMP, AMP, and applicable permits/licences to prevent damage to adjacent properties.

11.2.3 Damage to bridges, private roads, fences, buildings, or other property shall be repaired immediately.

11.2.4 Standing crops shall be mowed and/or harvested prior to topsoil stripping.

12 LOGGING AND CLEARING

12.1 General

12.1.1 The Contractor shall clear and grade the Construction Right-of-Way as shown on the Drawings and as approved by the Company to facilitate the safe movement of rubber tired vehicles. In clearing the Right-of-Way and in the performance of the Construction Work hereunder, the Contractor shall comply with the terms of the Construction Line List, all environmental permits, environmental avoidance plans, EMP and the AMP, and shall carry out and perform its work in a manner which shall cause a minimum of inconvenience, injury or damage to persons or property. Where the Contractor fails to observe restrictions and limitations and causes damages to property beyond the servitudes, Right-of-Way, permits or grants secured by the Company, such damages shall be the Contractor's liability.

12.1.2 Prior to clearing and grading operations, all foreign utility line crossings, drain tile, underground facilities, aboveground facilities, and environmentally sensitive areas shall be located and marked. The Contractor will expose the adjacent Company pipeline, if applicable, at intervals identified in the Company’s Contractor Safety Program (CSP), at no additional expense to the Company.

12.1.3 The Contractor shall take reasonable precautions to protect, in place, public land survey monuments and private property corners or boundary markers. If any land markers or monuments, including existing Company G.P.S. monuments, are destroyed, the Contractor shall re-establish at his expense such markers or monuments in accordance with the specifications of a registered land surveyor.

12.1.4 The Contractor shall restore all damaged property, including but not limited to buildings, fences, hedges, roads, railroads, bridges, culverts, drainage ditches, terraces, drainage tile, creeks, levees and rivers occupied or crossed by construction. Any property damaged during the execution of the work shall be restored to its original condition at the Contractor's expense.

12.1.5 Logging and Clearing on Public land shall be performed in accordance with the Project Timber Salvage Plan, the EMP, and applicable permits/licences. If the Project does not have a Project Timber Salvage Plan or an EMP, logging and clearing will be performed in accordance with the these Specifications and the requirements of the Authorities having jurisdiction.

12.1.6 Logging and Clearing requirements on private land will be defined and performed in accordance with instructions from the landowner as identified in the Construction Line List.

12.1.7 Contractor shall provide a Project specific Logging, Clearing, and Access Plan that will address both Public and Private lands.

12.1.8 The Contractor shall not clear or log the Company defined area of the watercourse bank until immediately prior to commencement of actual crossing construction in accordance with the Project Timber Salvage Plan, if one exists for the Project, and the EMP. Trees shall be felled away from drainages and watercourses to reduce damage to aquatic habitat. No grubbing or soil disturbance will occur within the confines of the buffer zone unless otherwise stated in the aforementioned plans.

12.1.9 Trees, debris, or soil inadvertently deposited within the high water mark of any drainage or watercourse shall be immediately removed. Trees shall not be skidded across a drainage or watercourse.

12.1.10 Specimen trees or shrubs to be protected, as indicated in the Construction Line List, shall be flagged by the Company prior to construction. Snow fencing or other suitable fencing shall then be erected by the Contractor around the trees or shrubs to protect them from damage during construction.

12.2 Timber Salvage

12.2.1 The Contractor shall process all merchantable timber in accordance with the Project Timber Salvage Plan, if one exists for the Project, or as otherwise directed by the Company.

12.2.2 Merchantable timber will be felled with a feller-buncher, forwarded with a grapple skidder and processed with mechanical de-limber or similar equipment in accordance with the Contractor Logging, Clearing, and Access Plan.

12.2.3 The Contractor shall hand fall timber in areas designated as inoperable by conventional harvesting equipment in accordance with the Project Timber Salvage Plan, if one exists for the Project, or where directed by the Company. The Contractor will manually saw this timber into 8 foot lengths and stack the timber in areas adjacent to the Right-of-Way.

12.2.4 Where the Construction Line List requires the preservation of merchantable timber on private land, it shall be as a minimum be limbed, topped, and cut into lengths specified by the Company and neatly stacked along the edge of and within the limits of the cleared Construction Right-of-Way on the respective property. Such merchantable timber shall then become property of the Contractor, Company, or Landowner and shall not be used for construction purposes.

12.2.5 The use of timber for rip-rap and corduroy will not be allowed.

12.3 Felling and Bunching

12.3.1 The Contractor shall fall all merchantable timber identified in the Project Timber Salvage Plan, if one exists for the Project, within the Right-of-Way.

12.3.2 The Contractor shall ensure that all stumps in trench line are removed. Within the work space all stumps shall be ground no less than 4 inches below grade/working surface or removed. In wetlands, vegetation outside the ditch line shall be flush cut, leaving the root systems intact.

12.3.3 The Contractor shall ensure proper operational practices are implemented to prevent reducing timber product quality and merchantable timber volume during felling operations.

12.3.4 All merchantable timber within the confines of the Company defined riparian buffer zone will be felled and carried completely out with a feller buncher unless otherwise specified by the Company. This area shall be flagged-off to ensure the buffer zone is maintained.

12.3.5 All operations within the riparian buffer zone of watercourses shall be conducted perpendicular to the watercourse. Turning of equipment in this zone is to be minimized to the extent possible to prevent soil disturbance.

12.4 Skidding

12.4.1 The Contractor shall skid merchantable timber identified in the Timber Salvage Plan, if one exists for the Project, into the approved Log Deck Sites along the Right-of-Way. The Contractor shall build decks in a manner that will maximize processing efficiency and not inhibit processing or loading operations by skidding timber too close to the edge of an access point.

12.4.2 Coniferous and deciduous timber shall be stacked separately. Logs shall not be skidded through a watercourse, mud, or gravelled areas in order to reach deck sites.

12.4.3 No skidding is to take place within the Company defined buffer zone of a watercourse.

12.4.4 The Contractor shall ensure that proper operational practices are used during skidding operations to prevent degrading timber to a lower grade product and wasting merchantable timber volume through breakage.

12.4.5 Only timber meeting specified product merchantability standards shall be salvaged and skidded to decking sites. Undersized, oversized, rotten material and debris entering the piles will be removed and disposed of on the Right-of-Way at the expense of the Contractor.

12.4.6 All skidding and decking shall be conducted within the confines of the approved Right-of-Way unless otherwise approved by the Company.

12.5 Processing

12.5.1 The Contractor shall limb and process all timber identified as merchantable in the Timber Salvage Plan, if one exists for the Project, or as per the direction of the Company.

12.5.2 The Contractor shall ensure that processed timber meets the product specifications outlined by the receiving mill or as per direction of the Company.

12.5.3 It is the responsibility of the Contractor to monitor timber product quality and implement corrective measures to ensure operations are producing on-spec products.

12.5.4 Merchantable timber shall be limbed and topped on the Right-of-Way. Company authorized burning or chipping shall be used to dispose of debris resulting from limbing and topping operations and must in accordance with the EMP. Merchantable timber shall be processed on the Right-of-Way and piled so as to not prevent debris from being disposed of during clearing operations.

12.6 Decking

12.6.1 All Merchantable timber shall be decked in approved locations as per the Timber Salvage Plan, if one exists for the Project, or in accordance with the direction of the Company.

12.6.2 Deck sites for storage of timber will normally be located off the working side of the Right-of-Way in natural openings wherever possible or in cleared deck sites at locations approved by the local Authorities having jurisdiction. Deck sites will normally be a half mile apart in generally accessible areas and well back of watercourses or areas requiring grading. Timber is not to be decked within 100 feet of a watercourse or any other overhead or underground utility or any crossing unless specified by the Company.

12.6.3 Prior to the commencement of salvage operations the Company will review the log deck sites shown on the Project Drawings with the Contractor. Unless written approval is obtained from the Company in advance, log decks shall be confined to these areas.

12.6.4 Decked timber shall be placed at right angles to access roads with all butts within 10 feet of the access road. Logs decked parallel to access roads within the Right-of-Way shall be placed no further than 20 feet from the existing access road with butts facing towards the direction of travel of the log trucks to the mill site. It is the responsibility of the Contractor to ensure that all timber is within reach by self-loading log trucks at developed access roads.

12.6.5 Coniferous and deciduous logs shall be decked separately. The Contractor shall ensure that log decks are free of debris in a manner that will minimize loading time and maximize efficiency.

12.7 Hauling

12.7.1 If the Company accepts ownership of the salvaged timber the following procedures shall be followed.

12.7.2 All merchantable timber processed on the Right-of-Way will be hauled to a destination approved by the Company.

12.7.3 The Contractor shall supply the Company with a delivery schedule prior to the commencement of Work.

12.7.4 The Contractor shall be responsible for getting their fleet and drivers signed up to haul logs to the receiving mills prior to the commencement of the Work.

12.7.5 The Contractor shall conduct all activities associated with loading. This will include loading, trimming the load and securing the load.

12.7.6 The Contractor shall on a daily basis furnish to the Company a log of hauling activities including but not limited to truck number, driver name, time of loading, time of delivery, and scale information.

12.7.7 The Contractor shall be responsible to ensure that all loads have documentation that is filled out correctly and corresponds with the correct dispositions or other permit information. The Contractor shall be solely and financially responsible for any rejected loads or fines associated with required documents.

12.7.8 The Contractor shall follow the receiving mills Log Haul Safety Program and Procedures as it pertains to overloads and other infractions. The Contractor will be solely and financially responsible for all fines levied by a receiving mill.

12.7.9 The Contractor will be responsible for ensuring that loads do not exceed the height, length, width and weight Specifications set by Authorities having Jurisdiction over the Work.

12.7.10 Where salvaged timber is to be removed from the Right-of-Way and hauled by others contracted to the Company, the Contractor shall provide and maintain Right-of-Way access and shall cooperate with the trucking firm in removal of timber prior to thawing conditions.

12.8 Clearing

12.8.1 Clearing shall include the cutting by approved means and removal of trees and brush vegetation and un-merchantable trees within the boundaries of the Right-of-Way. The Contractor shall ensure that all stumps in trench line are removed. Within the work space all stumps shall be ground no less than 4 inches below grade/working surface or removed. In wetlands, vegetation outside the ditch line shall be flush cut, leaving the root systems intact.

12.8.2 The Right-of-Way and only the needed portions of workspaces shall be cleared. Clearing shall be minimized where possible and specifically in temporary work spaces if the entire workspace is not required for construction.

12.8.3 Trees and vegetative matter shall be knocked down in the direction of the area to be cleared. Trees that become hung up at the edge of, or fall off the Right-of-Way regardless of source shall be removed by the Contractor, upon Company approval. Edge clean up shall be an ongoing operation with debris added to burning or chipping operations.

12.8.4 Non-merchantable timber and lesser vegetation shall not be removed within the Company defined buffer zone of the watercourse unless otherwise specified in the Timber Salvage Plan and the EMP.

12.8.5 Grass and muskeg ground vegetation species shall not be cleared nor have their root mats disturbed in accordance with the EMP.

12.8.6 Material removed from banks of streams shall not be placed in the stream beds, but shall be stockpiled on the Right-of-Way or on adjacent temporary extra work space from where it can be recovered and used by the Contractor to restore the banks to their original state or as directed by the Company and/or the permit requirements. Spoil shall be stored in accordance with the EMP or as indicated within the site specific crossing plan and permits.

12.9 Debris Disposal

12.9.1 The method of disposal of stumps, clearing debris, rock or boulders shall be agreed to by the Company, landowner and/or tenant, and the Authorities having Jurisdiction.

12.9.2 The stumps, rock or boulders may be placed in neat piles to the side of the Right-of-Way at locations agreed to in writing by the landowner. Stump burial is not allowed.

12.9.3 All debris shall be completely disposed of in a timely manner preceding the grading operation. In no event shall debris, stumps, tops, etc. be placed on top of the existing pipeline at any time during the project.

12.9.4 Stumps of trees on said Right-Of-Way shall not come in contact with the pipe. All loose stumps, brush, boulders and other debris shall be removed so that the spoil bank from ditching operations will not fall on any such debris.

12.9.5 If the landowner requests that the stumps, clearing debris, rock or boulders be removed from his property, the Contractor shall haul the material to a Company approved dumpsite. The Contractor shall provide the Company with written approval of all Authorities having Jurisdiction over the area where dumping will occur. All environmental and safety concerns as outlined in the Contract Documents shall apply to such off-site Work.

12.9.6 The Contractor shall pile and burn all woody debris within the Right-of-Way, and temporary workspace boundaries in accordance with the EMP unless instructed by the Company to use different debris disposal techniques. Non-merchantable timber, roots, stumps, branches and all cut material shall be piled for burning.

12.9.7 Piles containing woody debris for burning shall be kept free of snow, duff and soil.

12.9.8 The Contractor shall obtain the necessary burning permits from the Authorities having Jurisdiction and shall not commence burning operations until approval is granted by the Company. A copy of all such consents and permits shall be provided to the Company.

12.9.9 Piles shall not be located near sensitive sites, within 100 feet of any watercourse, lake, or wetland and shall be a minimum safe distance of 25 feet from the existing bush line to avoid damage to the surrounding timber. It is the responsibility of the Contractor to determine the locations of burn piles unless otherwise specified by the Company in the EMP. No foreign debris or non-organic materials are allowed to be burned.

12.9.10 The Contractor shall attend set fires at all times. The Contractor shall maintain responsible personnel and adequate firefighting equipment on site to control burning and prevent fire spreading to adjacent timber, brush, grass or crops. This shall include maintaining a water truck on site during operations when a fire hazard exists for the spread of fire or as per the direction of the Company Inspectors. The Contractor shall have sufficient numbers of crew and equipment to monitor fires over a 24 hour period. The Contractor shall extinguish all fires prior to leaving site if 24 hour coverage is not available.

12.9.11 The Contractor shall ignite piles using only propane torches or petro-gel.

12.9.12 The Contractor shall ensure that all woody debris is fully disposed of during burning. Ignited piles shall be actively re-piled during burning to ensure complete consumption within a 24 hour period. Excavators with thumbs or brush rakes should be used to continuously feed burn piles to promote quick and efficient combustion.

12.9.13 The Contractor shall be responsible for the piling and burning of debris left in the log deck sites as hauling operations progress

12.9.14 The Contractor shall ensure that during winter operations, burn piles are extinguished by mixing with snow if available.

12.9.15 The Contractor shall not leave piles smouldering. Spreading unburned debris on the Right-of-Way shall be minimized to the greatest extent possible.

12.9.16 The Contractor shall be responsible for any fire damage originating from its activities on the Right-of-Way for a period of twelve (12) months from the completion date of the contract or the actual completion date if it exceeds the contract completion date. The Contractor shall at its sole expense, extinguish any hold-over fires or hotspots determined by the Company to impose a risk of spreading to adjacent lands.

12.9.17 The Contractor may be required to mulch or chip woody debris instead of burning in areas predetermined by the Company. If chipping or mulching is used, the Contractor shall ensure that wood chips (less than 1.5 inches in diameter and/or 12 inches in length) are distributed in an even layer not to exceed 1 inch thick to prevent the formation of a woody mat which restricts re-vegetation of the Right-of-Way.

12.10 Grubbing

12.10.1 Grubbing means the removal and proper disposition of all stumps, roots and partially embedded stones, rocks or boulders. Grubbing shall be conducted with the use of brush rakes or a Company approved alternative. This activity will be performed per the applicable permits, Contract Documents, and the EMP.

12.10.2 Root systems should remain intact wherever possible if the Right-of-Way is going to be returned to its natural state. Where removal of willow cover is necessary, the Contractor shall make all reasonable efforts to minimize grubbing and shear off the willows above the root structure. Grubbing shall be minimized where possible. Grubbing shall not be conducted within 6.5 feet of the edge of the Right-of-Way so as to prevent damage to root systems of trees adjacent to the construction. Root systems of grasses on muskegs shall remain intact. Snow fills shall be used for smoothing access during winter clearing operations whenever practical.

12.10.3 The entire Right-of-Way (except the area required to maintain root systems of adjacent trees) shall be completely grubbed on private land and in areas that will support future agricultural production. Grubbed materials remaining after initial burning or chipping shall be removed from the Right-of-Way and transported to a Company approved disposal site or be re-burnt if necessary.

12.10.4 The ditch-line and working areas for movement of rubber tired vehicles shall be grubbed in addition to areas requiring grading. Brush and debris shall be removed to prevent excavated material from the pipeline trench becoming mixed with roots, branches and other debris remaining after clearing operations.

12.10.5 The Contractor shall backfill and compact the depressions from the grubbing operation to prevent water from collecting.

12.10.6 The Contractor can remove trees but shall only grub the trench line within the Company defined buffer zone of a watercourse bank until immediately prior to commencement of actual crossing construction. Refer to the EMP for additional details.

12.11 Rollback

12.11.1 Where specified by the Company cleared trees shall be preserved for rollback for erosion control.

12.12 Prevention of Ditch-line Freezing

12.12.1 When clearing is performed during winter conditions and pipeline installation occurs during the same season a berm over the ditch line shall be constructed using snow immediately following clearing. The snow berm shall be 2 feet high by 10 to 12 feet wide and fully cover the proposed ditch-line. Openings shall be left in the berm to permit the passage of wildlife or livestock.

12.12.2 Travel on the proposed ditch-line with vehicles and equipment during clearing operations shall be minimized as much as possible.

13 TOPSOIL STRIPPING

13.1 General

13.1.1 Prior to ground disturbance on the Construction Right-of-Way the Contractor shall implement the Company's Ground Disturbance Procedure.

13.1.2 The Contractor shall notify, maintain, and comply with the appropriate local utility protection system or the state one-call system requirements. The Contractor shall provide the Company with a record of all notifications (e.g. One-calls, foreign line representatives, local emergency, etc.).

13.1.3 Prior to grading of the Construction Right-of-Way, topsoil shall be stripped and conserved in accordance with the Contract Documents, Construction Line List, EMP, AMP, and to the satisfaction of the Company.

13.1.4 The depth of topsoil stripping shall be in accordance with the Contract Documents, the EMP, AMP, or as directed by the Company.

13.1.5 Wherever grading of the Construction Right-of-Way is required (side hills, slopes, watercourse crossings, road crossings, etc.), the topsoil shall be stripped and stockpiled separately from graded or excavated subsoil. Extra Working Rights to be used by the Contractor shall be stripped of topsoil to the satisfaction of the Company prior to placement of any subsoil material in that area.

13.1.6 Topsoil depths if indicated on the drawings should be considered as average depths and actual depths may actually vary from that shown.

13.1.7 No stripping, stockpiling, or Work of any kind, will be allowed over existing operating pipelines unless authorized by the Company.

13.1.8 Topsoil shall not be used to ramp culverts, road ditches, foreign facility crossings, or drains, unless otherwise approved by the Company.

13.1.9 Topsoil shall not be piled in areas that will result in blocking the movement of water in a watercourse or ditches. Piling of topsoil shall be performed in a manner that will prevent the possibility of increasing the moisture content of soils.

13.1.10 Equipment and methods used for topsoil stripping shall be suitable for the conditions encountered at the time of construction and prevent mixing with subsoil, loss or degradation and shall be subject to Company's approval. Contractor shall pay particular attention to the width of topsoil stripped where poor or wet soil conditions exist to ensure that sloughing trench conditions do not cause loss of topsoil.

13.1.11 Whether single or multiphase stripping, different types of soil stripped shall be stored separately from each other and on material of the same composition unless stripping ditch line on good quality sod. All stripped topsoil shall be stockpiled separately from any subsoil, with a minimum of 2 feet buffer zone separation or as approved by the Company. Graders shall be utilized for the final pass of stripping if more than the ditch-line is stripped.

13.1.12 No stripping or ground disturbance should take place within the Right-of-Way limits of a road, highway, or railroad crossing unless otherwise approved by the crossing permit and the Company.

13.1.13 At each road, highway and railroad crossing, topsoil stripped from within the limits of these crossings shall be stored within the crossing limits as space allows. Equipment used to strip topsoil at these locations shall be cleaned prior to leaving the crossing or as required by the EMP and the AMP.

13.1.14 The Contractor shall loosen the area to be stripped on hay and pasture land by methods approved by the Company unless specifically stated in the Contract Documents. This operation may be waived by the Company on sandy soils or on land with poor sod development.

13.1.15 Where excavating through soils prone to sloughing, areas adjacent to excavations that may fail shall be stripped of topsoil. Topsoil shall be stripped from all areas to be graded and it shall be spread evenly across the Right-of-Way upon replacement.

13.1.16 When adverse weather conditions affect the condition of the Right-of-Way, the Company may require the Contractor to change procedures or suspend construction activities if those activities are causing topsoil loss or damage through erosion, mixing, rutting and any other cause. The Contractor shall at its discretion and expense, reduce vehicle movements where possible, change vehicle traffic patterns, perform additional topsoil stripping, use tracked equipment or move to other areas less sensitive to the adverse weather in order to work continuously. If construction operations cannot be altered to reduce topsoil degradation to acceptable limits the Contractor shall cease its activities until such time as the weather conditions change. Suspension of construction activities will occur without additional compensation to the Contractor.

13.1.17 All handling of topsoil shall take place only when, it is dry enough to avoid soil structure damage and soil intermixing due to excessive rutting, as determined by the Company in accordance with the EMP and the AMP.

13.1.18 The Company may require the application of mulch, tackifiers, water or straw to topsoil storage piles to mitigate the effects of wind erosion during construction. If these methods are deemed by the Company to not be effective then the Contractor shall implement specialized environmental protection techniques to minimize topsoil loss. In the event that wind erosion continues after the application of tackifiers, the Company may direct the Contractor to suspend topsoil handling until, in the opinion of the Company, the conditions improve. Temporary berms and/or silt fences, straw application and cross Right-of-Way drainage may be employed to mitigate the effects of water erosion during construction. All mitigative measures implemented shall be unless stated otherwise, at the expense of the Contractor, performed to the satisfaction of the Company, Authorities having Jurisdiction and Landowners.

13.1.19 Stripped topsoil shall be replaced in a sequence opposite to that removed. The salvaged material shall be spread uniformly over the graded area that the material was salvaged from.

13.1.20 The EMP, Project Noxious Weeds and Invasive Species Control Plan, and the AMP may include requirements for cleaning of equipment between parcels of land in the event weeds or other issues have been identified. The requirements of these plans will be strictly adhered to including steaming, washing, or chemical treating.

14 GRADING

14.1 General

14.1.1 The Contractor shall perform all grading in accordance with the Access, Grade and Clean-Up Plan (AGC), EMP, AMP, and permits/approvals submitted and approved by the Company so as not to interfere with the flow of water. Care shall be taken to prevent the damming or blocking of any drainage course. Public ditches or drains shall have bridges or culverts installed for passage of equipment and vehicles. The Contractor shall confirm with the Company that approval of the Authority having Jurisdiction over same has been secured prior to installation of any crossing.

14.1.2 Where required the Construction Right-of-Way shall be graded to facilitate the safe movement of pipe handling equipment and other rubber-tired pipeline vehicles.

14.1.3 The Contractor is herein obligated to minimize grading of the Right-of-Way and workspaces. Only those areas required to support access requirements and for the safe performance of the Work shall be graded. At its discretion, the Company may limit grading in certain areas. The Contractor shall use alternate methods of construction in these areas if necessary at no additional cost to the Company.

14.1.4 Grading may require that the Contractor drill, blast, and excavate rock in order to build an adequate work surface along the pipeline route. The Contractor shall not excavate any section of the pipeline by the use of explosives without a minimum of 60 days advanced written notice and the written approval of the Company. The Contractor shall submit a Blast Plan for the Company's approval that meets all Federal, State, and Local regulations as well as the CSP. The Contractor shall not receive any additional compensation for the ripping, blasting and/or grading of rock required for Right-of-Way construction.

14.1.5 No graded material shall be permitted to spread into treed areas or placed off of the Construction Right-of-Way.

14.1.6 At locations where topsoil stripping occurs to accommodate grading requirements, the Contractor shall identify the topsoil piles from the graded materials with a suitably marked survey stake or sign to minimize the risk of confusion at time of restoration.

14.1.7 The ditch-line portion of the Right-of-Way shall be generally graded to allow the pipe to be bent and laid within the minimum radius of field bends and shall facilitate the placement of pipe on undisturbed soil in the trench to the minimum cover specified.

14.1.8 Natural drainage or watercourses are not to be disrupted by grading. Grading shall be performed away from watercourses to prevent dirt and debris from entering the watercourse. Where dirt and debris could enter a watercourse due to erosion during construction the Contractor shall install and maintain erosion control structures and devices at no additional expense to the Company. Erosion controls shall be installed in accordance with the EMP.

14.1.9 When the Contractor cuts existing terraces or diversion berms they shall be restored to their original condition within the minimum time practicable. Temporary erosion control devices, per the EMP, will be required during construction to minimize siltation entering watercourses or private property. All grading shall be completed to maintain the original drainage or water flow conditions as nearly as practicable and shall conform to the regulations of the Authority having Jurisdiction over same.

14.1.10 Areas requiring significant cuts during grading or that may lose their stability during the course of construction shall be back-sloped.

14.1.11 Graded areas subjected to rutting shall be bladed daily to remove ruts that could contribute to pooling of water.

14.1.12 Unless stated otherwise, survey markers or pins disturbed during grading shall be re-established by the Company at the Contractor's expense.

15 LOADING, HAULING, STRINGING, STOCKPILING, AND STORING OF PIPE AND OTHER MATERIALS

15.1 General

15.1.1 The Contractor shall ensure that workers of the Contractor and Subcontractor are trained to safely handle and secure pipe and materials.

15.1.2 Loading, hauling, and stringing, together with any intermediate stockpiling required, shall be performed in a manner that will not damage the pipe or coating.

15.1.3 Unless stated elsewhere, the Company shall provide all storage facilities for mainline pipe, valve assemblies, and other Company obtained materials.

15.1.4 In addition to receiving, handling, transporting, unloading and storage of Company supplied materials, the Contractor shall be responsible for and pay for all transportation permits required by Authorities having Jurisdiction.

15.1.5 The Contractor shall satisfy itself as to the condition of the Company supplied items and upon its acceptance of delivery shall be in the care, custody, and control of the Contractor. Damage to items incurred or their loss while in the care of the Contractor shall be repaired or rectified to the satisfaction of the Company at the Contractor's expense.

15.1.6 The Company supplied items which could be affected by exposure to the elements shall be stored in a facility that will eliminate the means of exposure.

15.1.7 The Contractor shall notify the Company three (3) business days in advance of picking up any Company supplied materials at the designated consignment locations.

15.1.8 The Contractor shall pick-up Company supplied materials within a specified time when instructed to do so by the Company. Failure to do so may cause the Company to incur storage or demurrage charges, which will then be recovered from the Contractor.

15.1.9 Upon completion of the Work, all surplus pipe and materials shall be delivered by the Contractor, at no additional expense to the Company, to a location designated by the Company.

15.2 Pipe Handling

15.2.1 Care shall be exercised in handling or storing coated pipe in order to avoid bevel damage, flattening, denting, scratching, gouging, coating flaws, or any other type of damage.

15.2.2 Pipe shall be handled as individual joints with vac-u-lifts, belt slings, or shaped hooks surfaced with a non-contaminating material, as approved by the Company. Hooks shall have sufficient bearing surface to prevent damage to the pipe.

15.2.3 For special coatings or where damage may occur to pipe or coatings, slings providing sufficient weight distribution shall be used for pipe handling.

15.2.4 All pipe shall be loaded and unloaded by means of Company approved lifting devices.

15.2.5 Pipe shall be picked up and not dragged, prevented from striking adjacent pipe, trucks or equipment.

15.2.6 Dunnage supplied by the Contractor shall remain the property of the Contractor whereas that supplied by others at vendor locations, material storage sites, or for transportation shall remain the property of others and shall be returned by the Contractor to the rightful owner at no additional cost to the Company.

15.2.7 Rope separators used for pipe storage or transportation shall be returned or disposed of in a manner found acceptable by and at no additional cost to the Company. End caps supplied with the pipe shall be collected and secured to pallets for transporting to recycle facilities.

15.2.8 If a vac-u-lift device is used to handle pipe, care shall be taken to ensure lifting is from the center of the joint to prevent damage.

15.2.9 If a spreader bar is used, a minimum allowable angle of 45° between the pipe and load lines shall be maintained during pipe handling operations (i.e. loading or unloading trucks from stockpile sites and/or stringing).

15.3 Pipe Transportation

15.3.1 Transportation services shall be performed in strict compliance with all applicable Federal, State, and Local statutes and regulations.

15.3.2 Pipe with a diameter of 12 inches or greater and over 52 feet in length shall only be transported using pole trailers. Pipe bunks shall be adequately cushioned and spaced to prevent damage to the pipe.

15.3.3 Any pipe bearing surface shall be free of rocks and debris. Flatbed trailers shall be equipped with no less than 4 - 3.5 inches high x 3.5 inches wide bearing strips and solidly fastened across the width of the deck, with a maximum spacing of 10 feet.

15.3.4 Maximum overhang for pipe on trailers is 13 feet unless required otherwise by Federal, State, or local regulations.

15.3.5 Shorter pipe shall be placed on top of the load.

15.3.6 To secure pipe on flatbed trailers, non-metallic tie-downs of suitable load bearing capacity shall be used and spaced at approximately 8 ft intervals, not to exceed 10 ft, for each row. Tie-downs on the pipe rows shall be staggered to ensure adequate binding. Tie-downs and any side pins shall have adequate rubber padding to prevent contact with the pipe.

15.3.7 To secure pipe to pole trailers, non-metallic tie-downs of suitable load bearing capacity shall be used for each row and placed at each end of the load. Tie-downs on the pipe rows shall be staggered to ensure adequate binding. Tie-downs and any side pins shall have adequate rubber padding to prevent contact with the pipe.

15.3.8 Both the truck and trailer shall be equipped with mud guards to prevent stones or rocks from impacting the pipe. All trucks, trailers, and other rubber tired vehicles transporting pipe must be equipped with a grounding strap attached to the chassis.

15.3.9 The Contractor is responsible for ensuring pipe and coating are not damaged during transportation. When required by the Company, trucking pre-coated pipe during summer construction, pipe loads shall be completely tarped if hauling will occur on 1 mile or more of road with loose gravel or other loose road material.

15.3.10 When required by the Company, during winter construction when trucking pre-coated pipe, pipe loads shall be completely tarped.

15.3.11 When required by the Company nets shall be used when transporting pipe in areas of severe terrain.

15.4 Pipe Storage

15.4.1 Pipe stored in stockpiles shall be nested on graded stockpile sites capable of supporting the loads imposed by the pipe, loading operations and trucking without failure.

15.4.2 Pipe storage facilities shall be constructed in accordance with the Company supplied Site Specific or Typical Drawings. Bottom tiers of pipe shall be well supported by timber, earthen supports, or sandbag supports of sufficient height to prevent pipe from touching the ground between supports.

15.5 Stringing

15.5.1 Pipe shall be strung with gaps across the Construction Right-of-Way left between adjacent lengths of pipe at suitable intervals to correspond with any required gaps in the topsoil pile, or in accordance with the Construction Line List at well-defined trails to permit the movement of livestock, wildlife, farm equipment, irrigation pivots, and vehicles. Pipe shall be strung to permit the insertion and removal of internal radiography equipment after welding. The radiography contractor shall dictate the intervals required. The Contractor shall complete the tie-ins at these locations at no additional cost to the Company.

15.5.2 Pipe shall be strung onto wooden skids at both ends, lapped not butted and chocked at each end to prevent movement. The skids shall be located so that the pipe will not touch the ground between skids. Skids shall be sufficiently wide and placed in a manner that will prevent damage to the pipe or coating.

15.5.3 Pipe shall not be strung in steep terrain where pipe will be unstable or in areas requiring blasting, or where blasting is probable, until such time as it is completed.

15.5.4 Pups 10 feet and over in length shall be moved ahead daily as tie-ins are being completed. A full joint of pipe shall separate pups moved ahead. On short pipelines where there is less spare pipe, the Contractor may have to utilize pups to complete stringing of the pipe. This Work, if necessary, shall be performed at no additional expense to the Company.

15.5.5 The Contractor shall be responsible for ensuring that all pipe stringing by size, wall thickness, and grade is in accordance with the drawings.

16 BENDING

16.1 General

16.1.1 The Contractor shall make the necessary field bends required in the construction of the pipeline. The Contractor shall bend and lay pipe such that it conforms to the trench bottom. The center of over-bends shall clear the high point of the trench. Sag bends shall fit the bottom of the trench and be firmly supported through the bend. Side bends shall have the neck against the outside curve of the ditch.

16.1.2 No bending shall be permitted when either pipe or ambient temperatures are lower than -20°F. When bending coated pipe, the method of preheating used must not damage the coating, and must be approved in advance by the Company. Under no circumstances shall heating of the pipe above +100ºF be permitted.

16.2 Bending Equipment

16.2.1 Bending shall be performed using a cold stretch process employing the type of machine approved by the Company. Internal mandrels shall be used when bending pipe 16 inch OD and larger. All field bends shall be made by the cold-stretch smooth bending method using a bending machine with a full solid-wall retaining shoe and an internal mandrel. The drive rollers, pin-up shoe and die shall be padded with urethane or neoprene.

16.2.2 Bending shoes are to be of the flexible type with a padded surface extension at least 2 inches beyond the metal edges.

16.3 Bending Requirements

16.3.1 All field bends shall be made to as long a radius as practical. The maximum amount of bending shall be 1.5 degrees in any length along the pipe axis equal to the diameter of the pipe. Further restrictions may be imposed as a result of Bend test results.

16.3.2 No bend shall be made closer than 6 feet from the pipe end. In the case of double-jointed pipe, the bend shall not be closer than 3 feet to the girth weld creating a double or triple joint.

16.3.3 Pipe shall be lifted and carried and not dragged along the ground. All pre-coated pipe shall be handled using non-metallic chokers or slings.

16.3.4 In all bends of longitudinally welded pipe, the longitudinal seams shall be on the neutral axis, with the neutral axis being defined as within thirty degrees (30°) of the 12 o'clock position for side bends and within thirty degrees (30°) of either the 3 o'clock and 9 o'clock positions for sag and over-bends. In the event a compound bend (single section of pipe containing two bends) is required, the longitudinal welded seam shall be on the neutral axis for the larger of the two bends and either the neutral axis or within the 180 degree compressed section of pipe of the other bend.

16.3.5 No bending shall be accepted if it induces buckles, wrinkles, flat spots in the pipe, or is in any way associated with mechanical damage.

16.3.6 Bends with ripples are acceptable providing the ripple is smoothly contoured throughout and there is no coating damage evident, peak-to-trough measurement of any wave height does not exceed 75% of the pipe wall thickness and the distance from the center of a ripple to the center of the closest ripple is no closer than 15 times the height of the ripple.

16.3.7 The maximum diameter reduction in a pipe bend shall not exceed 2.5% of the nominal pipe diameter. (for example: On a 16 inch outside diameter pipe the diametral reduction as measured cannot be greater than 0.4 inches.)

16.3.8 Any bend that is deemed by the Company to be unacceptable shall be replaced. The Contractor shall be solely responsible for the costs associated with rejected bends including but not limited to salvaging pipe to weld in the line at a suitable location.

16.3.9 Completed bends shall be handled with nylon slings and set on properly constructed skid sets.

16.4 Bend Test

16.4.1 Prior to bending any pipe for use in the Work, the Contractor shall conduct a test bend on project pipe to confirm the maximum degree of bending and the distortional limitations to be permitted in the pipe and coating. This requirement applies to each season of work if the Work spans more than one season.

16.4.2 At temperatures of 0ºF or below, additional test bends shall be required. Pipe shall be bent to the required curvature, or to a less severe limit should buckling, wrinkling or flattening occur. A restriction on bending shall be set by the Company which shall be subject to a re-test should the ambient temperature drop a further 10ºF.

17 TRENCHING

17.1 General

17.1.1 The Contractor shall notify and comply with the appropriate local utility protection system or the state one-call system requirements. The Contractor shall provide the Company with a record of all notifications (e.g. One-calls, foreign line representatives, local emergency, and etc.).

17.1.2 The Contractor shall be responsible for positively locating all above and below ground utilities and/or other encumbrances within the granted Right-of-Way, and shall take all precautions necessary in order to fully avoid damage to said facilities. In addition, the contractor shall be fully aware of all public transportation structures located in and around the granted Right-of-Way, and shall abide by any and all restrictions and/or permits that may be applicable.

17.1.3 The Contractor shall excavate the pipeline trench in accordance with the permits and Contract Documents.

17.1.4 Trench shall also mean ditch or any other form of excavation for the purposes of installing the pipeline.

17.1.5 The Contractor shall ensure trench-line staking is maintained.

17.1.6 The trench, if it is to be accessed by personnel, must meet OSHA and the CSP requirements for safe working conditions in the trench.

17.1.7 Dewatering of trenches shall be performed in a manner consistent with good erosion prevention measures and the EMP or other governing requirements. Stable vegetated run-off areas shall be selected, and dispersion sheeting employed at points of discharge.

17.1.8 Where indicated in the EMP and landowner line lists, additional topsoil conservation activities may be required during trenching by excavating and storing different types of soils. Topsoil, trench spoil and grubbing piles shall all be stored separately with at least 2 feet between piles. Spoil shall be stored at least 2 feet from the edge of the trench, unless otherwise directed by the Company.

17.1.9 Open trench shall be minimized where possible. Unless otherwise approved by the Company the trench may remain open for no longer than 3 days.

17.1.10 The Contractor shall trench in such a manner so as to leave a plug across the trench to correspond with any required gaps in the topsoil pile in accordance with the Construction Line List to facilitate the passage of farm equipment, livestock, wildlife, or irrigation pivots.

17.1.11 Safe bridging or backfilling of the trench shall be provided in accordance with reasonable wishes of landowner/occupant or Authorities having Jurisdiction for access of animals or equipment. Trenching in winter shall progress in a manner that will minimize the possibility of freezing the spoil pile and/or filling of the trench with snow.

17.1.12 A Registered Professional Engineer is to be utilized for all shoring, trench box installations, or depth of cut that exceeds 20 feet.

17.2 Normal Depth and Width of Trench

17.2.1 The bottom of the trench shall always be in native materials unless otherwise approved by the Company.

17.2.2 The Company desires to reduce to a minimum the number of bends required to lay the pipe to conform to the contour of the ground and maintain the minimum specified depths of cover. The Contractor shall eliminate unnecessary bending by varying trench depths and by not grading the Construction Right-of-Way. This can be accomplished by cutting the trench slightly deeper at the crest of ridges and by gradually deepening the trench at approaches to crossings of roads, railroads, highways, ditches, ravines and watercourses.

17.2.3 Unless stated otherwise the minimum depth of cover for the pipe, weights, or other appurtenances shall be in accordance with the Contract Documents.

17.2.4 The minimum trench dimensions, as specified in the Construction Specifications, shall be adhered to by the Contractor throughout the full length of the Work including areas of wetlands. The minimum depth of cover is measured from the graded surface of the Right-of-Way adjacent to the trench at the time of trench excavation. At locations where concrete river weights, swamp weights, sack weights, or other below grade appurtenances are to be installed, the Contractor shall provide a trench wide and deep enough to permit installation with the minimum specified depth of cover.

17.2.5 The Company Authorized Engineering and/or Construction Representative may adjust the buoyancy control requirements after the trench is open if site specific conditions warrant such a change.

17.2.6 Trench excavation shall accommodate the installation of the Company's pipeline under a foreign underground facility with a minimum of 1 foot of separation or as specified in Crossing Agreements, when applicable.

17.3 Excavated Crossings

17.3.1 When the pipe is to be laid across railroad ditches, highway or road ditches, irrigation or drainage ditches, rivers, creeks, canals, ravines and other drainage or watercourses, the trench shall be excavated to provide the minimum specified depth of cover over the pipe as specified in the Contract Documents, Permits, and/or Crossing Agreements. In addition, spoil banks from trenching operations shall be placed in such a manner to ensure that all drainages and watercourses are kept open, functional, and contained. Such material will be contained in accordance with the Company's EMP and Environmental Permits.

17.4 Finishing the Trench

17.4.1 The completed trench must be ready for placement of the pipe. It shall be excavated to a smooth finish, uniformly graded, free of water, ice, and rocks on the bottoms or sides and free of other projections that may be injurious to the pipe or coating. The excavation shall be sufficiently deep to allow for the bedding and to achieve the required minimum depth of cover over the pipeline.

17.4.2 The trench bottom shall conform to pre-bent pipe. Pipe not supported by the trench floor must be cut and fit to the floor, or where approved by the Company, sandbags, Company approved foam pillows or Company approved field applied foam must be installed for support provided that minimum cover is maintained.

17.5 Trenching During Winter Construction

17.5.1 The Contractor shall make all efforts to schedule trenching operations such that freezing of the excavated materials is minimized. Frozen lumps from ripping shall be separated from the trench spoil to facilitate backfilling. All ice, snow, and frozen lumps shall be removed to provide a smooth flat ditch bottom free of loose rocks greater than 2 inches.

17.5.2 In the event that the ditch bottom or backfill materials become frozen and could damage the pipe, the Contractor shall install bedding and pillows to support the pipe and padding to protect the pipe from backfill damage.

18 LOWERING-IN

18.1 General

18.1.1 The Contractor shall submit a lowering-in plan to the Company prior to the start of construction. The plan shall detail the equipment being used and the spacing of equipment during lowering-in. Separate plans shall be provided for each diameter of pipe and for concrete coated pipe or pipe with weights. The stresses shall be limited to the specified minimum yield strength (SMYS) of the pipe, or as directed by the Company. The plan will be reviewed by the Company to confirm no detrimental stresses during lowering-in.

18.1.2 All brush, skids, pipe, metal of any kind, rocks, large clods, sticks, projecting rocks, and other hard objects shall be removed from the trench into which the pipeline is to be lowered so that the protective coating shall not be damaged.

18.1.3 In rock trench, and wherever the bottom of the trench contains projecting rocks or other hard objects which might damage the pipe or coating in the opinion of the Company, with exception to wetlands (unless approved by the Company), the bottom of the trench shall be bedded with a minimum of 6 inches of earth (free of stones, clods, or other foreign objects) or sand, in accordance with the clause on bedding of this Specification.

18.1.4 The center of over-bends shall clear the high point of the trench. Sag bends shall fit the bottom of the trench.

18.1.5 Earth, sand, or foam pillows may be used for intermediate support above the bottom of the trench and their maximum spacing shall be 10 feet on center, or as otherwise directed by the Company. If foam pillows are used as a support option the Company may request earth/sand supports be interspersed with the foam pillows to minimize the risk of pillows collapsing at the pressure points. Topsoil shall not be used as support material.

18.1.6 Water shall be pumped from the trench prior to the pipe being lowered-in per the EMP. Water shall not be pumped off the Construction Right-of-Way or into wetlands/water bodies without written permission from the Company. Care shall be taken to prevent erosion and flooding of crops.

18.1.7 Set-on buoyancy control measures shall be installed as required after lowering in.

18.1.8 All coated pipe shall be subject to a visual inspection and checked with a holiday detector immediately prior to lowering-in to ensure that the coating is undamaged. All holidays shall be repaired in accordance with the coating Specifications.

18.1.9 Pre-coated pipe shall be lowered-in using wide belts, round endless slings, or rubber-tired/neoprene-lined cradles. These shall be kept free of sand, mud, stones or any foreign objects.

18.1.10 The coated pipe shall be lifted and not dragged off the support skids.

18.1.11 The Contractor shall lower the pipe into the trench in such a manner as to provide sufficient slack to the satisfaction of the Company. The Contractor shall ensure the strains induced in the pipe are minimized.

18.1.12 The pipe shall not be dropped or subjected to jarring or impact. Should a section of the pipeline fall off the skids, the Contractor shall immediately report this fact to the Company. The Company shall be allowed reasonable time to inspect the pipe section involved, at no expense to the Company, and the Contractor shall cut out and replace any defects and damaged pipe at the expense of the Contractor.

18.1.13 No worker shall be between the sideboom tractors and the pipe, between the pipe and the trench, or in the trench during raising, lowering, or moving of the pipe.

19 BACKFILLING

19.1 General

19.1.1 The Contractor shall provide sufficient time between lowering-in and backfill operations to allow company survey crews to conduct an as-built survey of the lowered-in pipe. No backfilling will be allowed where as-built survey data has not been obtained.

19.1.2 Extreme care shall be taken in backfilling the trench to prevent damage to the pipe or pipe coating.

19.1.3 The trench shall not be backfilled until the Company confirms through survey and inspection that the pipe has the required minimum depth of cover and the pipe fits the trench. If a section of trench is backfilled without the required approval, the Contractor, at its own expense, shall uncover the pipe to allow the Company to conduct necessary surveys and or inspections. If cover over the pipe is not in accordance with the Contract Documents the Contractor, at its expense, shall remove the pipe and re-excavate the trench as directed by the Company until the desired depth of cover is obtained.

19.1.4 To prevent erosion of the backfill in sloping terrain the Company may require trench breakers and/or sub-drains to be installed in conjunction with shallow ditches or diversion berms. The Company will determine the locations and type of breakers to be installed. Breakers and diversion berms shall be installed in accordance with the EMP.

(a) If sand bags are used to construct a breaker the bags shall be tightly fitted to reduce voids. All breakers shall be keyed into the ditch banks.

(b) Polyethylene sheeting when installed above the bags shall be free of wrinkles and holes.

(c) Geotextile separators used in the construction of trench breakers or diversion berms shall be staked into position so it remains in place during backfill with native materials.

(d) Berms shall have uniform dimensions along their entire length.

(e) When constructing berms in winter, care shall be taken to minimize the amount of snow in the berm.

19.1.5 After lowering-in, the trench shall be backfilled as soon as possible following confirmation from survey that as-built information has been obtained. The initial backfill operation shall consist of shading the pipe. This shading operation shall be performed by backhoes or an alternate method approved by the Company. The Contractor shall make all reasonable efforts to sort shading material from the trench spoil. Backfill material within 6 inches of the pipe shall have a maximum size of 1.5 inches measured in any direction. This material shall be placed using a procedure that does not allow backfill to fall directly on the pipe resulting in damage to the pipe or coating. The Contractor shall also comply with any requirements contained in the Construction Line List concerning the order in which respective materials are backfilled.

19.1.6 When the Company determines that the Contractor is unable to practically sort acceptable shading material from the trench spoil, pipe protection shall be provided in accordance with this Specification and as approved by the Company.

19.1.7 No rock in excess of 9 inches in diameter shall be introduced into the backfill material. All materials unsuitable as backfill material shall be treated as waste and disposed of in a manner approved by the Company.

19.1.8 In uplands, the trench shall be filled with soil to a height of no more than 6 inches above the level of the surrounding ground or as stated in the permits or the Construction Line List. To minimize the risk of trench line settlement compaction of the trench line with Company approved Low Ground Pressure (LGP) equipment is required except in rocky or swampy areas.

19.1.9 The Contractor shall restore wetlands as near as practicable to pre-construction conditions and must make a reasonable attempt to return the subsoil to its pre-construction density. During backfilling of wetland areas, subsoil material removed from the trench during construction shall be replaced so that the material is not mounded above the adjacent ground surface (undisturbed trench wall). Subsoil that exceeds the elevation of the ground adjacent to the trench shall be removed from the wetland and disposed of in an upland area on the Right-of-Way or a Company-approved disposal site. After the trench has been backfilled with subsoil, previously segregated topsoil shall be spread over the trench area and mounded as specified in the applicable permits/licenses.

19.1.10 Backfill compaction at road crossings, pipeline crossings, stream and river crossings, irrigated lands, valve sites and station sites will require a greater level of compaction as required in the Contract Documents.

19.1.11 Under no circumstances will topsoil be used for backfill material and extreme caution shall be exercised by the Contractor to ensure that mixing of topsoil and subsoil does not occur. Topsoil shall be replaced subsequently in a separate operation once the stripped portion of the Construction Right-of-Way has been prepared in accordance with the Contract Documents, and to the satisfaction of the Company.

19.1.12 After backfilling and compacting of the trench excess spoil remaining after the trench has been backfilled shall be feathered to the existing grade within the existing stripped area such that it will not interfere with drainage patterns or farming operations. The backfill crown will be in accordance with the Project Contract Documents. Spoil which cannot be dispersed in this manner to the satisfaction of the Company shall be considered as surplus and shall be properly disposed of in accordance with these Specifications, the EMP, or AMP.

19.1.13 Watercourses and/or seasonal drains disturbed by construction of the pipeline shall be opened across the construction Right-of-Way to allow the proper flow of water.

19.1.14 Slope breakers, furrows, and terraces shall be constructed across the construction Right-of-Way as necessary to divert the flow of water away from the backfilled trench and into natural drainage courses to prevent excess erosion along the pipeline prior to clean-up. Terraces and levees shall be restored to their former condition to function as originally intended.

19.2 Backfill of Buried Foreign Facilities

19.2.1 The Contractor shall ensure that all requirements for the type of materials/soils, placement, and compaction of backfill are in accordance with the requirements of the Construction Line List.

19.2.2 In the absence of specific requirements, backfill material within 6 feet of either side of any buried facility shall be deposited in layers not exceeding 6 inches. The backfill shall be compacted to 85% Standard Proctor Density to minimize settlement and provide adequate support. Random tests may be performed by the Company at the Company's discretion. Backfill which fails to achieve the required density shall be removed and re-compacted.

19.2.3 The Contractor shall take all appropriate measures to ensure facilities are not damaged during backfilling operations and shall report any damage to buried facilities to the Company.

19.2.4 All Work must be completed in accordance with the requirements of the Company's Health & Safety Management System (where applicable), the Company's Construction Safety Manual (where applicable), EMP, AMP, and Project Ground Disturbance Procedure.

19.3 Backfilling in Areas of Irrigation

19.3.1 Backfilling through areas of active irrigation shall occur immediately after lowering-in operations to ensure the minimum amount of disturbance occurs to landowners.

19.3.2 Where backfilling of the pipeline trench is done through areas of flood irrigation and areas of mobile irrigation (wheel line or pivot type systems) the Contractor shall ensure that all the backfill is compacted and consolidated. The trench shall be backfilled to 12 inches over the pipe and the fill wetted and compacted using mechanical hand-tamping devices. The balance of the fill shall be wetted and compacted in 6 inch layers. All layers of this backfill shall be compacted to match the subsoil compaction adjacent to the construction Right-of-Way and, in any event, compacted to 98% of Standard Proctor Density.

19.3.3 No tractors or other heavy equipment shall be used for tamping. Upon completion of the backfilling and tamping, the Contractor shall restore the original grade. All excess soil shall be removed and disposed of as directed by the Company

19.3.4 Through flood irrigation areas the Contractor shall backfill in a manner resulting in the finished grade being restored to precisely the original surface contour.

19.3.5 The replacement or repair of all irrigation dikes that are disturbed or destroyed during the Work shall occur as soon as practical after backfill. This shall include compaction of the dikes to a standard matching the adjacent undisturbed dike compaction.

20 PIPE PROTECTION

20.1 General

20.1.1 Pipe Protection requirements will be determined by the Company during the trenching operation.

20.1.2 Where the Company requires that material be imported from external sources for pipe protection the Contractor shall be responsible for acquiring all approvals and associated permits for the use of these sources from all Authorities having Jurisdiction. The Contractor shall comply with all applicable permit conditions and provide the Company with a copy of all permits.

20.2 Pillows

20.2.1 The Contractor may elect to use foam pillows or other intermediate supports, as approved by the Company, to support the pipe above the bottom of the trench prior to bedding material being placed. Pillows shall not be allowed in areas not requiring bedding, as determined by the Company.

20.2.2 Foam pillow supports shall have a 2 lbs/ft^3 minimum density and a 30 lbs/in^2 minimum compressive strength.

20.2.3 Support pillows shall provide even support across the lower quadrant of the pipe, and shall provide a finished clearance of 6 inches between the trench bottom and the pipe.

20.2.4 The maximum center to center spacing between such supports shall be 10 feet, or as otherwise directed by the Company. The Company may require additional supports (such as sand bedding) between the foam pillows to adequately support the pipe.

20.2.5 The Company may require changes to the spacing of these supports contingent on a trial section of pipe being lowered in and clearances between trench bottom and bottom of pipe being checked to ensure that the minimum clearance of 6 inches is maintained.

20.3 Bedding

20.3.1 Where requested by the Company the bottom of the trench shall be bedded.

20.3.2 Bedding material shall consist of well-graded non-angular mineral material with a maximum particle size of 1.5 inches.

20.3.3 Bedding shall be performed to achieve a smooth and even finish with a minimum compacted thickness of 6 inches between the bottom of the pipe and the closest point to the trench bottom.

20.3.4 Under no circumstances will topsoil be used to bed the pipe.

20.4 Padding

20.4.1 Where requested by the Company, the Contractor shall pad the top and sides of the pipe such that only padding materials are within 6 inches of the pipe.

20.4.2 The material to be used for padding shall be well-graded non-angular mineral material with a maximum particle size of 1.5 inches.

20.4.3 This material shall be placed on the pipe using a procedure that does not damage the coating.

20.4.4 When suitable material cannot be obtained in sufficient quantities from the ditch spoil, and when approved by the Company, select material can be obtained using a mechanical padder. Screens on the mechanical padder shall be of a size to provide material that does not damage the coating on the pipe upon impact and, as a minimum, shall not allow particles that exceed 1.5 inches in size to pass through the screens. If these criteria are not maintained the Contractor will be required to change screens and/or revise the process to ensure screened material dropping on the pipe does not damage the coating.

20.5 Rock Shield

20.5.1 At certain locations, to protect the coated pipe, the Company may request that the coated pipe be wrapped with full circumference PVC rock shield

20.5.2 Tuff-N-Nuff or an approved equivalent (6mm minimum thickness) shall be used as rock shield products.

20.5.3 Prior to installation of the rock shield the coating shall be holiday tested and repaired as required in accordance with the Coating Specifications.

20.5.4 Rock shield shall be fastened to the pipe so that it will not become dislodged, bunch up, or become discontinuous during the lowering-in process. At a minimum it shall be installed with a 4 inches lap at all joints and be secured with fibreglass reinforced tape spaced at 2 feet. Weld location and pipe information required for survey shall be transferred to the outside of the rock shield prior to lowering-in.

20.6 Wood Lagging

20.6.1 At certain locations, to protect the coated pipe, the Company may request that the coated pipe be wrapped with full circumference wood lagging.

20.6.2 Prior to installation of the wood lagging the coating shall be holiday tested and repaired as required in accordance with the Coating Specifications.

20.6.3 PVC rock shield shall also be installed between the pipe and wood lagging.

21 CROSSINGS – GENERAL REQUIREMENTS

21.1 General

21.1.1 The method for constructing each crossing shall be in accordance with the Crossing Agreement, Crossing Drawings, EMP, requirements of any Authority having Jurisdiction, or as requested by the Company.

21.1.2 The Crossing Agreement, EMP, and other permits shall be onsite at all times.

21.1.3 Vehicle crossings over foreign facilities shall be constructed in accordance with the requirements of the crossing agreements or in the absence thereof in accordance with the CSP. It is the Contractor's responsibility to become familiar with all requirements of the Crossing Agreement, construction permit, or Environmental Plans including notices that must be provided to Authorities having Jurisdiction prior to commencing Work on a crossing. The Contractor shall anticipate such requirements and provide the required notice within the time period specified in the permits. The Contractor shall obtain the specific approval from the Company prior to commencing excavation at any crossing.

21.1.4 Crossings requiring heavy wall pipe, as defined on the Drawings, shall have the minimum amount installed as indicated on the Drawings or otherwise authorized as the minimum practical by the Company.

21.1.5 All Work performed at each crossing shall be performed in such a manner as to prevent undue obstruction, delay, or interference with traffic at the crossing.

21.1.6 It shall be the Contractor's responsibility to furnish and install at all crossings adequate and proper traffic aids, warning signs, barricades, flares and other safeguards necessary, in accordance with the CSP and the Authorities having Jurisdiction for the public safety and to maintain them throughout the duration of the Work at no incremental cost to the Company.

21.1.7 Suitable measures shall be used to prevent damage to road surfaces when crossing with construction equipment. Roads shall be kept clean and free of debris.

21.1.8 Prior to installing the pipe it shall be holiday tested and repaired as required in accordance with the Pipeline Field Coating Specification.

21.1.9 Trenchless methods for crossing railroads, highways, and road crossings shall be approved by the Company and shall be in accordance with the project drawings, meet the requirements of the crossing permit, and be approved by the Authorities having Jurisdiction. Permanent casing will not be installed unless shown on the drawings, or as directed by specific permitting requirements provided to the Contractor by the Company. The Contractor shall notify the Governmental Authorities in writing, the specified amount of time before, but no less than 48 hours in advance of starting the Work. The Contractor shall provide the Company with a copy of the notice.

21.1.10 Where open cutting a roadway is approved by the Company, the crossing shall be completed in one day. The Contractor shall provide temporary roads, barricades, signs, flares and flag persons as required to divert traffic and warn the public. The pipe shall be shaded with sand to approximately 8 inches above the pipe and the remainder of the excavation filled with gravel unless otherwise stated. Upon Company approval, flowable fill may be used.

21.1.11 When specifically requested by the Company, the Contractor shall install concrete pipe protection.

21.1.12 Casing where required shall be thoroughly cleaned inside. The pipeline shall be installed immediately or the casing must be fitted with welded waterproof caps. The ends of the casing may be required to be vented and end seals installed. Insulators shall be installed on the carrier pipe or pipe with concrete coating may be used. Casing and carrier pipe shall be checked to determine that they are electrically isolated prior to and upon completion of backfilling.

21.1.13 The bored or augered hole for crossings shall be made accurately to the line and elevation indicated on the drawing or as required by the crossing agreement. The bored or augered hole diameter shall be no larger than the pipe outside diameter plus 2 inches.

21.1.14 The same size pilot pipe shall precede the carrier pipe on slick bores. Soil shall only be removed through the pilot pipe.

21.1.15 Where casing or product pipe is not supported on the ditch bottom or undisturbed soil, the Contractor shall support the pipe by installing sandbags, foam pillows, field applied foam or compacted backfill as authorized by the Company.

21.1.16 If the Company authorizes foam pillows or field applied foam their maximum spacing shall be 10 feet on center or as otherwise directed by the Company. The Contractor shall backfill and compact between the foam structures with earth/sand to eliminate voids. Topsoil shall not be used as support material.

21.1.17 If the Company authorizes compacted backfill, it will be installed in 6 inch lifts and compacted to minimize settlement and provide adequate support.

21.1.18 The Contractor shall correct any deficiency detected in trenchless and open cut crossings within the warranty period including, but not limited to, subsidence.

21.2 Railroads

21.2.1 Bell holes shall not be made closer than 20 feet from the edge of shoulder or nearest rail. If so warranted by soil conditions, the Permit, the Crossing Agreement, or Authorities having Jurisdiction these distances may be increased and/or the Contractor may be required to reinforce the trench walls by means of shoring or sheet piling to prevent sloughing and the possibility of undermining the structure being crossed.

21.3 Private Road

21.3.1 Private roads shall be open cut unless noted otherwise on the drawings, crossing agreement, or Construction Line List. The Contractor shall ensure that warning signs are erected prior to open cutting a road or trail.

21.4 Public Roads and Highways

21.4.1 Crossings of Public Roads and Highways shall be in accordance with the Road and Highway Crossing Permits. Bell holes shall not be made within the road/highway Right-of-Way, unless otherwise approved by the Company and the applicable permit. If so warranted by soil conditions or the EMP, the Permit, the Crossing Agreement, or Authorities having Jurisdiction, the Contractor may be required to reinforce the trench walls by means of shoring or sheet piling, to prevent sloughing and the possibility of undermining the crossing.

21.5 Watercourses

21.5.1 All watercourse crossings will be isolated, if flowing, during construction unless otherwise approved by the Company.

21.5.2 Watercourse crossings include the crossing of any surface feature where flowing water, standing water or the potential thereof exists on the Right-of-Way and as further defined in the EMP included herein and this Specification.

21.5.3 Crossings of a watercourse including but not limited to a river, stream, creek, channel, irrigation trench, canal or flume shall be performed in accordance with the terms of crossing agreements, standard or typical drawings, permits, licences, and regulations of Authorities having Jurisdiction. Design drawings will be provided for significant crossings, as determined by the Company. If specific design drawings have not been provided, crossings shall be performed in accordance with the EMP.

21.5.4 When open trench methods are used, the Company must be made aware of proposed installation procedures prior to commencement of the Work. Crossing activities shall be well planned and where possible, performed in one day. The Contractor shall adhere to the requirements for fluming or by-pass pumping where cross flowing water exists, or as required by the Company.

21.5.5 Concrete coated pipe or weights shall be installed in accordance with the Project Drawings or as directed by the Company.

21.5.6 Where a drag section with bolt-on weights will be pulled across a watercourse, metal or nylon banded wood lagging, 1 inch thick supplemented by four 1.5 inch X 3.5 inch slats placed at 90^0 to each other shall be supplied and installed by the Contractor. The number of pieces of lagging will be increased to prevent the metal banding from touching the pipe. The lagging shall be installed around the entire pipe between river weights to maintain the weight spacing.

21.5.7 If permitted by Authorities having Jurisdiction, excavation materials may be stored in water body crossings. Silt fences shall be installed by the Contractor, as directed by the Company, and without additional compensation. Immediately prior to installing the crossing section in the trench, any ice shall be broken and sharp edges remaining on the trench edges shall be removed to prevent damage to the pipe coating.

21.5.8 The minimum cover for all water crossings shall be as stated on the Construction Documents and Permits.

21.5.9 At the discretion of the Company, pre and post-installation hydrostatic test may be required.

21.5.10 Vehicle crossings of watercourses shall be in accordance with the EMP, or as approved by the Company. All such structures shall be removed as soon as practical after construction.

21.6 Facility Crossings

21.6.1 All foreign lines shall be crossed in accordance with the terms of crossing agreements and/or letters of agreement and regulations of Authorities having jurisdiction.

21.6.2 Overhead power line crossings shall be marked and signs erected in accordance with the Company's CSP. Ground disturbance without a representative of the permittee or licensee of the pipeline or cable being present is not permitted. No ground disturbance shall take place within 10 feet of the pipeline or cable until the foreign utility has been positively identified. The method of positively identifying foreign lines shall be by hand digging, hydrovac or other daylighting procedure approved by the owner of the foreign line or cable. No mechanical excavation shall be permitted within 1 foot of a foreign utility at any time. Refer to the CSP for additional direction.

21.6.3 The minimum clearance between foreign lines and Company's pipeline shall be 1 foot or as otherwise specified in Crossing Agreements. The depth at the point of crossing shall be maintained for the total width of the foreign line's Right-of-Way. The Company's pipeline shall be installed under the foreign line unless otherwise shown on the Project Drawings and specified in the Crossing Agreements.

21.6.4 The Contractor shall provide a written procedure to be followed for each crossing. The procedure shall include but not be limited to the proposed method of crossing, clearances, monitoring methods, supporting methods to be utilized, and other relevant details.

21.6.5 The Contractor shall pay particular attention to 3rd Party and the Company's existing valve and pump station sites to determine the exact location of all power and communication cables and conduit. It shall be the responsibility of the Contractor to notify the owners of all such underground and above ground structures 72 hours or in accordance with the Crossing Agreement, or the appropriate local utility protection system in advance of any such intended crossing. A copy of such notification shall be forwarded to the Company at the same time. Excavation shall not commence until the authorized representative of the foreign facility and the Company is present.

21.6.6 The Contractor shall make contacts required for crossings in writing where possible and maintain a contact log. The contact log shall, as a minimum, record name of the Company, person contacted, time and date of call and brief summary of discussion. Confirmation of these notifications shall be provided to the Company.

21.6.7 When telephone, power and utility lines, poles, or other structures interfere with the Contractor's vehicles or construction equipment during construction or installation of the pipeline, the Contractor shall make the necessary arrangements to preserve the continuous use of the utility during construction. Utilities located along the centerline, requiring relocation for construction shall be brought to the attention of the Company to facilitate timely relocation with the owner of the facility.

21.6.8 Cables shall be supported in such a manner so as to prevent damage. Any damage to foreign utilities will be at the sole expense of the Contractor.

21.6.9 The Contractor shall obtain the permission of the Company prior to requesting that an owner of a pipeline or utility relocate or cut their lines or cables to facilitate a crossing. The Contractor shall be responsible for all costs and damages to perform the cut or relocate.

21.6.10 Where foreign lines, utilities or cables are located within a crossing to be bored or augered, 2 ft of separation shall be maintained between the Company's pipeline and the foreign facility.

22 CROSSINGS – METHODS

22.1 Slick/Slip Bored Crossings

22.1.1 Bores shall be made maintaining the minimum depth of cover requirements as specified in the Permits, Drawings, or Contract Documents.

22.1.2 The Contractor shall accomplish the boring or auguring through a pilot section of uncoated pipe (i.e. auger casing). The Contractor shall furnish the pipe to be used for this purpose unless otherwise stated in the Contract Documents. No boring or auguring shall take place through the carrier pipe that will be part of the permanent pipeline.

22.1.3 The bored or augered hole for crossings shall be made accurately to the line and elevation indicated on the drawing or as required by the crossing agreement. The bored or augered hole diameter shall be no larger than the pipe outside diameter plus 2 inches.

22.1.4 After the carrier pipe has been installed the Company shall conduct a visual inspection and may also choose to conduct a coating continuity test (in accordance with Pipeline Research Council International PR-262-9738, Appendix F) on the installed pipeline section. The Contractor shall cooperate with this requirement and ensure that each end of the section is clean, dry and not in contact with the ground while the visual inspection and the coating continuity measurement is taken. If the inspection indicates the coating has been damaged during installation and exceeds acceptable tolerances, as determined by site specific conditions, the section will require removal and the coating damage repaired. The Contractor shall take preventative measures to ensure no further damage occurs during re-installation of the carrier pipe. It will then be re-inspected in accordance with the above.

22.1.5 To prevent subsequent settling of the crossing, excessive voids around the carrier pipe resulting from installation by the boring or augering methods shall be filled with grout at the sole expense of the Contractor. Excessive voids shall be determined by the Company. The type of grout and the method of installation shall be approved by the Company, adhere to applicable permits, and the Authorities having Jurisdiction over the crossing.

22.1.6 After the bored section has been tied-in the Contractor shall ensure the pipe is adequately supported prior to completing backfilling. Compaction of native material and/or sandbag supports, each a minimum length of 3 feet along the pipe, shall be utilized or until undisturbed ground is reached.

22.2 Horizontal Drilled (HD) Bore Crossing

22.2.1 The HD Bore is defined as the use of a small to medium size horizontal drilling rig to steer and drill a bore under a crossing which can be a small watercourse, foreign pipeline, highway, railway or other foreign utilities.

22.2.2 The depth of the pipeline installation will be limited to 20 feet to the center of the pilot hole unless otherwise approved by the Company.

22.2.3 The typical HD Bore has a straight alignment and a horizontal or level profile. However the Company may authorize a curve in the drill profile.

22.2.4 HD Bores with a radius of curvature in the drill profile shall meet the same Specifications for the drill path and directional tolerances as a Horizontal Direction Drill (HDD) or per the Contract Documents. The design radius of curvature is to be no less than for a comparable Horizontal Directional Drill or in accordance with the Contract Documents.

22.2.5 The pilot hole shall be completed by equipment that is steerable and trackable.

22.2.6 The wall thickness of the carrier pipe shall be as designated by the Company.

22.2.7 Product pipe that is installed by HD Bore technique shall have a sacrificial abrasion coating over the corrosion protection coating in accordance with the Coating Specifications.

22.2.8 The Contractor will evaluate all proposed HD Bore locations to ensure that the soil conditions are compatible with the HD Bore construction methodology and that the risk of washout is minimized within the bore path.

22.2.9 HD Bores may employ predrilled pressure relief holes to allow the release of slurry in controlled locations during pipe pullback. The Contractor shall present a plan showing the proposed location of relief holes for approval by the Company prior to commencement of each bored location, if applicable.

22.2.10 Prior to commencement of any work, the Contractor shall provide a detailed plan for the steering and guidance of the pilot hole for approval by the Company. For steering/tracking the Contractor may utilize a typical walkover steering system for shallow HD Bores (depth less than 20 ft). Where the drill path has a designed curvature the accuracy of the steering equipment must provide and read to one decimal place accuracy (0.1% or 0.1 degrees of inclination and 0.1 feet of depth).

22.2.11 Only qualified and competent personnel are to be employed on an HD Bore installation. The résumés of the Contractor's personnel must be submitted to the Company for approval prior to start of construction.

22.2.12 The Contractor must maintain a current copy of the steering system's operating manual with the steering equipment. Operation of the tracking receiver and transmitter shall be as per the Manufacturer's Operating Specifications at all times (calibration requirements, cold weather operations etc.).

22.2.13 Where the HD Bore crosses under foreign pipelines or other critical utilities the Contractor is to provide recommendations for the minimum clear distance between the pipelines or other critical utilities for Company approval. Under no circumstances shall the minimum clearance between the pipeline and existing facility be less than 2 feet.

22.2.14 Final ream size for bores with curvature in the drill profile shall be the industry standard of 1.5 times the product pipe diameter for sizes up to NPS 24 and for pipe sizes greater than NPS 24 the final ream size shall be pipe diameter plus 12 inches.

22.2.15 For HD Bores with no design curvature the final ream size shall be that as specified for a slip/slick bore.

22.2.16 Pull back of the product pipe shall be at a rate that minimizes the potential for drilling slurry release to surface. Pull back operations shall not commence unless a Company Authorized Representative is present.

22.2.17 The Contractor shall be responsible for containment and clean-up of any drilling slurry or other material used to facilitate advancement of the pilot hole, reaming, and pull back of the product pipe.

22.2.18 The Contractor shall have spill and containment materials and equipment, and personnel trained in spill handling on site before starting any Work and for the duration of the Work.

22.2.19 After the bored section has been tied-in the Contractor shall ensure the pipe is adequately supported prior to completing backfilling. Compaction of native material or imported material, sandbags, foam pillows or spray in foam supports shall be utilized in accordance with this specification.

22.2.20 Upon completion of the pilot hole an as-built vertical and horizontal profile is to be supplied to the Company in the form acceptable to the Company.

22.3 Open Cut Road Crossings

22.3.1 When open cutting a road the Contractor shall refer to the Construction Line List to determine if that road must remain open to traffic. If such a requirement exists, the Contractor shall ensure that a detour exists, an access road (shoo-fly) suitable for automobile traffic is provided, or temporary bridgework of adequate strength and width to ensure the safe passage of traffic is installed. Prior to the commencing the open cut process these measures shall have the approval of the Company and the Authority having Jurisdiction.

22.3.2 The Contractor shall arrange to complete the trenching, laying and backfilling of road crossings and removal of temporary bridging before the end of the workday so as to avoid hazards to night traffic. The Contractor may have to complete the open cut crossing in sections to facilitate the continuous flow of traffic.

22.3.3 In the absence of any specific requirements attached to a crossing agreement for an open-cut crossing through driveways, streets, roads or highways the initial backfill material shall be wetted sand placed evenly and carefully around and over the pipe in 6 inch layers. Each layer shall be carefully compacted by further wetting as required and by tamping until 12 inches of cover exists over the pipe. The balance of backfill material shall be placed in 6 inches layers and shall be compacted by the use of mechanical tampers so that each layer has a density equal to or greater than that of the adjacent original material. For highways or well-travelled roads this shall be 95% of Standard Proctor Density. Upon Company approval, flowable fill may be used. The upper 1 foot of the travel surface shall be replaced with material that is equivalent to, or better than, the original surface material of the road. Surfaces previously paved shall be repaved by the Contractor.

22.3.4 In the absence of any specific requirements attached to a crossing agreement, when performing an open-cut crossing through unimproved trails or private access in the winter months, the initial backfill material shall be unfrozen material when practical. If unfrozen material is not readily available, backfill may be performed with frozen material with a maximum particle size of 6 inches. These crossings will be re-visited the following construction season.

22.4 Open Cut Watercourse Crossings

22.4.1 The Contractor shall provide notification of in-stream activities in accordance with the conditions of the EMP, crossing approvals, or permits.

22.4.2 Grading, excavation and backfilling shall be performed in a manner and method satisfactory to the Company and the Authorities having Jurisdiction. The Contractor shall comply with all special precautionary measures required by Federal, State, and Local authorities and shall work closely with such authorities to prevent or minimize obstructions to navigation on the watercourses.

22.4.3 Hard plugs should be left in both banks until channel excavation begins in order to minimize the duration of watercourse sediment loading.

22.4.4 Crossings shall proceed only with when environmental conditions that will cause high volumes of water flow are not anticipated. The Contractor shall have contingency plans and capabilities to ensure environmental compliance.

22.4.5 In-watercourse activity shall be completed in accordance with the EMP.

22.4.6 Sag bends shall be set well back into the watercourse banks in accordance with the Drawings and as approved by the Company.

22.4.7 The Contractor shall exercise care during construction to ensure that normal watercourse flow and direction is not impeded.

22.4.8 The trench shall be excavated to the depth required to provide the minimum depth of cover as shown on the Drawings or as authorized by the Company. If buoyancy control devices are used the depth of cover will be from the top of the buoyancy controlled device unless otherwise directed.

22.4.9 Trench spoil material shall not be stockpiled in the watercourse channel, unless otherwise approved by applicable Permits. Mitigative measures, as approved by the Company or in the EMP, shall be implemented to restrict the migration of spoil materials back into the watercourse.

22.4.10 The Contractor shall schedule his Work such that the watercourse crossing pipe section is ready to install prior to commencing in-watercourse stream trenching operations.

22.4.11 The Contractor shall take depth measurements of the bottom of the pipeline trench at intervals along the crossing immediately prior to installation of the pipe to ensure adequate trench depth has been excavated to achieve the design depth of cover. Depth measurements shall be taken from the top of the pipe after installation to confirm the depth of cover meets the minimum design depth of cover and fits the trench as excavated. If buoyancy control devices are used the depth or measurements shall be taken from the top of the buoyancy control device after installation to confirm the depth of cover meets the minimum design depth of cover and fits the trench as excavated.

22.4.12 The Company may employ a diver or use any other suitable method to inspect the bottom of the trench prior to pipe installation and prior to the backfilling of the trench. The Contractor shall facilitate the work of the diver and shall furnish helpers and the necessary equipment other than the actual diving equipment for the diver to perform his work.

22.4.13 The Contractor shall assist the Company in establishing a final top of pipe profile of each crossing.

22.4.14 After the depth of cover over the pipe and the pipe alignment have been inspected and approved by the Company, the pipe trench shall be backfilled to its original contours with excavated material to the satisfaction of the Authority having Jurisdiction and the Company unless otherwise shown on the Drawings.

22.4.15 To prevent soil and bank erosion watercourse banks and levees shall be backfilled, re-contoured, and fully compacted to the satisfaction of the Authority having Jurisdiction and the Company. The watercourse banks, approaches, and levees shall be re-vegetated in accordance with these Specifications and the EMP.

22.4.16 Where special materials are required, as per the Drawings, the Contractor shall provide and place such materials for bank and levee backfill.

22.4.17 Unless stated otherwise in the EMP, banks shall be restored and stabilized as follows:

(a) Bank material shall be sloped (maximum: 1 vertical: 2 horizontal) to a point 3 feet above normal high water level or as specified by the Company. A step shall be installed above the back-slope (minimum of 5 feet wide), extended across the Right-of-Way, and shaded into natural profiles at its edge. Above the step, slopes shall be restored to natural contours. Streambed materials shall never be used as bank construction materials;

(b) The Contractor shall, at no extra cost to Company, install and dismantle during clean-up operations any special silt fences, settling ponds or bypass flumes used in performing the crossing;

(c) Final clean up shall include the removal of temporary bridges, excess construction materials and debris, both within the banks and downstream of the crossing;

(d) Post construction erosion control measures shall be installed by the Contractor where specified by the Company;

(e) The Contractor shall be responsible for any bank slope stability armouring, re-vegetation or problems on graded banks during the warranty period.

23 BUOYANCY CONTROL

23.1 General

23.1.1 Locations requiring Buoyancy control and the type to be used will be shown on the Project drawings. Buoyancy control may consist of concrete bolt on weights, concrete set on weights, bag weights, concrete coated pipe, or screw anchors.

23.1.2 Buoyancy control types and quantities that are shown on the drawings are to be considered a guide only. The Company may increase or decrease quantities or change the type of buoyancy control shown after the pipe trench has been excavated.

23.1.3 Trench walls shall be excavated in accordance with the Company's CSP or approved Contractor's Safety Program. This may require the ditch walls to be tapered or cut back to provide safe installation or re-positioning of buoyancy control.

23.1.4 The trench depth and width requirements will change for each type of buoyancy control. The Contractor shall perform the additional excavation required for the installation of buoyancy control at no additional cost to the Company.

23.1.5 The Contractor shall refer to equipment load charts to ensure equipment with the proper lifting capacities and reach is utilized during placement of buoyancy controls.

23.1.6 Buoyancy control shall not be used when, in the opinion of the Company, the trench can be dewatered and the backfill material is stable enough to hold the pipeline in place after the trench has been backfilled.

23.1.7 Extreme care shall be taken in handling and installing of buoyancy control devices to prevent damage to the pipe, coating, and weights.

23.1.8 The required design depth of cover shall be maintained and will be measured from the top of the buoyancy control device. The minimum depth of cover is measured from the graded surface of the Right-of-Way adjacent to the trench at the time of trench excavation.

23.1.9 The Company Engineering Representative may adjust the buoyancy control requirements after the trench is open if site specific conditions warrant such a change.

23.2 Continuous Concrete

23.2.1 Continuous concrete coating includes concrete coated pipe complete with shop applied concrete and pipe hauled to site with concrete applied on site. Pre-coated or shop applied concrete coating will require field coating of the joints. Field joints shall be coated with a material approved by the Company.

23.2.2 The Contractor will provide to the Company for approval, prior to commencing concrete Work, a detailed procedure for the forming and pouring of the concrete.

23.2.3 Submitted procedures for concrete coating pipe shall include mix designs for the concrete and reinforcing to be used if other than welded wire mesh in addition to other details including formwork design. Refer to USPCS-SPEC-CCC-007.

23.2.4 The thickness of continuous concrete coating shall be specified on the drawings.

23.2.5 Concrete coating shall be continuous for the entire length of pipe and may require additional subsequent applications of concrete at support locations.

23.2.6 If the temperature is less than 40°F heating and hoarding shall be utilized for casting and curing concrete coating.

23.3 Screw Anchors

23.3.1 General requirements for screw anchor installation equipment are as follows:

(a) Installation equipment shall be capable of supplying installation torque up to 8,000 ft-lb. If the installation equipment is capable of supplying a torque in excess of this, the installation equipment shall be controlled in such a way as to prevent a torque greater than 8,000 ft- lbs being applied to a screw anchor or extension shaft. Shafts may start to twist at 6,000 ft-lbs of torque;

(b) The torque indicator shall be able to operate in cold weather conditions and shall be easily read by the operator without entering the ditch; and

(c) Anchors can be installed either with single or twin drive installation units. Anchor shafts shall be placed correctly to ensure the saddle can be properly installed.

23.3.2 Screw anchors shall be installed in accordance with the following:

(a) Screw anchor assemblies shall be installed at the spacing shown on the project drawings. If the specified location lies within 20 inches of a girth weld, the assembly shall be moved to beyond this distance from the weld;

(b) Screw anchors shall be placed in any location where the depth to competent soil is 2 feet or greater;

(c) While installing the screw anchor and extension shafts, excess downward or upward pressure shall not be applied to enhance or impede the progress of the anchors into the ground. Screw anchors shall be allowed to progress into the ground naturally, without undue force;

(d) Screw anchors and extensions shall be installed as close as practical to vertical;

(e) Each screw anchor shall be installed to the minimum installation torque of 1000 ft-lbs;

(f) If the minimum installation torque is not achieved after the installation of the screw anchor and one 6 foot long extension shaft, the Contractor shall add extension shafts as necessary until the minimum installation torque is achieved;

(g) If the minimum installation torque is achieved before the extension shaft is added, the Company shall be notified prior to commencement of any further Work. Screw anchor assemblies less than 12 feet in length (one 6 foot screw anchor plus a 6 foot extension shaft) shall be pull-tested to verify their holding capacity. Screw anchors less than 9 feet in length will not be accepted;

(h) A polyester saddle and fastening system, designed to withstand the loading, shall be used. The saddle shall be installed square and level on the pipeline. Polyester saddles shall be installed with a maximum allowable slack between the strap and the pipeline crown of 2 inch;

(i) All bolts in the assembly shall be hand tight with all threads engaged;

(j) If the Contractor is unable to install screw anchor extension shafts to full depth, pipe sleeves may be used to complete the termination. In no case shall the terminator atop the shaft be allowed to protrude more than 2 inches above the top of the pipe; and

(k) Trenches shall be de-watered for the installation of anchors. Where considered to be impractical to de-water the entire trench, the Contractor shall install earth plugs between proposed anchor locations after lowering in and thereafter de-water the area in the vicinity of the anchor.

23.3.3 Pull testing shall be performed in accordance with the following:

(a) A pull-test to a minimum of 3,000 lb. shall be performed on both screw anchors every tenth (10th) screw anchor. The load shall be held a minimum of 30 seconds; and

(b) If, after allowing an initial movement or ‘set’, movement greater than 1 inch continuous ‘creep’ movement is observed, the screw anchor shall be deemed to have failed the pull-test. In this case additional extension shafts shall be added to the screw anchor and installed to the new depth, and the subsequent installation shall be re-tested. Equal maximum spacing of the anchors as specified on the Project Drawings must be adhered to.

23.4 Attached Weights

23.4.1 Bolt-on concrete weights or strap-on bag weights shall be installed prior to lowering-in operations.

23.4.2 Pipe coating shall be checked and repaired if necessary, prior to the installation of weights.

23.4.3 Where bolt-on concrete weights are called for on the Drawings or requested by the Company the pipe under the weight shall be wrapped with wood lagging or other suitable material approved by the Company.

23.4.4 Weights shall be handled and installed in such a manner as to prevent damage to the pipe, coating or the weight. Rock shield shall be installed beneath weights with damaged felt padding.

23.4.5 Weights shall be securely fitted to the pipe and all bolts or straps shall be securely tightened

23.4.6 On long sections of pipe with weights, care shall be taken to prevent buckling of the pipe while lowering the pipe into the trench.

23.5 Concrete Set-on Weights

23.5.1 Weights shall be handled and installed in such a manner as to prevent damage to the pipe, coating or the weight.

23.5.2 The Contractor shall do all Work necessary to fabricate, load, haul, string and install weights. The Contractor shall own any excess set-on weights that the Contractor fabricated. The Company reserves the right to supply any or all weights.

23.5.3 The Contractor shall take samples to ensure the compressive strength and density of the concrete meets the requirements specified in the Typical Drawings and USPCS-SPEC-CCC-007 Appendix A.

23.5.4 Forms may be removed from the weights as long as no slumpage occurs. If slumping occurs, the weights shall be replaced at the Contractor's expense.

23.5.5 A calcium chloride accelerator will be allowed for concrete weights only (not on structural or continuous concrete coating). The maximum allowable calcium chloride concentration shall be two (2) percent.

23.5.6 Concrete set-on weights shall be backfilled with backhoes. Backfill shall progress evenly on both sides of the weight until it is covered. Care shall be taken to ensure that the weights stay vertical without tipping in either direction while back filling.

23.6 Saddle Bag Weights

23.6.1 General

(a) The Contractor shall furnish all labor, equipment and material required for the filling and use of the saddle bag weights. The Contractor shall own any excess set-on weights that the Contractor fabricated. The Company reserves the right to supply any or all weights.

(b) Any identification markings or stencilling on the external pipe surface shall be documented by survey and/or inspection prior to the placement of any saddle bag weight.

(c) The Contractor will own any surplus filled saddle bag weights.

23.6.2 Delivery, Storage, and Handling

(a) The Contractor shall exercise due caution in handling, storing and transporting the saddle bag weights, whether full or empty.

(b) A protective cover is to remain on the empty bag weights until they are filled to ensure proper protection from the elements.

(c) Weights shall be stored in the upright position and shall not be stacked.

(d) Weights that are to be stockpiled during freezing conditions or for more than 30 days shall be covered to prevent snow from melting and re-freezing between the stockpiled weights, and UV degradation of the materials.

(e) During freezing conditions, to ensure filled bags do not freeze to the ground, a layer of straw should be spread on the ground prior to storing filled bags.

23.6.3 Materials

(a) The body fabric of the bag weight shall be of a woven polypropylene material. All webbing and lifting straps shall be polypropylene or polyester.

(b) The design of the weight shall require no more than ½ the pipes diameter on each side in extra trench width.

(c) Body fabric shall be rated for geotextile use with UV inhibitors.

(d) Body fabric shall not exceed an elongation rating of 15%.

(e) All materials shall be stable within a pH range of 2 to 12.

(f) Body fabric shall be of a material that does not result in cathodic protection shielding, and must possess a minimum permeability rating of 10 gal/min/ft^2.

(g) All webbing must be rated to provide a combined safety factor of four times the capacity.

(h) The fill material shall be a road crush or screened stone of a consistent size (.25 inch – .75 inch diameter), and be free of silt and clay. The fill material must also be kept dry to prevent freezing. Sand is not acceptable.

(i) The dry bulk density of the fill material must be a minimum of 100 lbs/ft^3.

23.6.4 Application

(a) To minimize pipe coating damage during installation, the exterior of the bags are to be inspected and cleaned of any stones or other material that may have become frozen or implanted on the exterior of the bag prior to placement.

(b) The saddle bag shall be lifted by the use of all lifting loops provided.

(c) Chains with suitable clevises or polyester bag slings shall be used when lifting to ensure no damage occurs to the lifting loops.

23.6.5 Inspection

(a) All weights found to have torn or worn straps or body fabric shall not be hauled to right of way and be set aside unless otherwise directed by company. The on-site inspector shall be made aware of any instance.

(b) The filled weight of the saddle bags shall be confirmed to meet the Company specified requirements by sampling the first filled weight during any filling activity, change in filling location, or any change in fill material. A sample shall also be taken once every 100 bags filled.

23.7 Buoyancy Control by Additional Depth

23.7.1 Buoyancy control may be accomplished by installing the pipeline at greater depth thereby ensuring sufficient competent material is backfilled over the pipe providing negative buoyancy. This method shall only be used where requested by the Company.

24 TIE-INS

24.1 General

24.1.1 The pipe shall be cut to permit proper line-up with sufficient slack to ensure a stress free line-up.

24.1.2 When possible, tie-ins shall not be made at transition welds.

24.1.3 Bell holes shall be adequately sized to enable the welder(s) to exercise normal welding skill and ability and to ensure the safety of personnel working in the trench.

24.1.4 The Contractor shall permit the Company time necessary to perform NDT on tie-in welds prior to coating application at no additional costs to the Company.

24.1.5 The Contractor shall support pipe in bellholes and pipe adjacent to bellholes by installing sandbags, foam pillows, field applied foam or compacted backfill as authorized by the Company.

24.1.6 If the Company authorizes foam pillows or field applied foam, their maximum spacing shall be 10 feet on center, or as otherwise directed by the Company. The Contractor will backfill and compact between the foam structures with earth/sand to fill the voids. Topsoil shall not be used as support material.

24.1.7 If the Company authorizes compacted backfill is used, it will be installed in 6 inch lifts and compacted to minimize settlement and provide adequate support.

24.1.8 Open trench shall be minimized where possible. Unless otherwise approved by the Company excavations for tie-ins of crossings, bends, valves or other appurtenances may remain open for no longer than 5 days.

24.1.9 Pipe pups 10 feet and over in length shall be moved ahead daily and welded into the line. Pipe pups less than 16 feet in length shall not be welded in sequence; they shall be separated by a full joint of pipe.

25 CATHODIC PROTECTION RELATED INSTALLATIONS

25.1 Cathodic Protection Test Leads

25.1.1 Prior to backfill operations, test leads shall be installed by the cad weld method in accordance with crossing agreements, Project Drawings or as directed by the Company. Brazing shall not be permitted. The security of the Thermite weld will be checked by tapping with a weld hammer. Thermite welding to foreign owned pipelines shall not be performed unless an authorized representative of the pipeline owner is present. The cad weld will be coated in accordance with the Project Drawings or as directed by the Company.

25.1.2 The Contractor shall install test lead assemblies on the Company's pipeline in accordance with the Drawings and Specifications. The Contractor shall cooperate with and support foreign line owners who will install the test leads on their pipelines. Test lead stations shall be attached to Company warning signs where applicable.

25.1.3 Where internal pressures are too high, wall thickness too thin or where requested by the owner of a foreign pipeline, mechanical clamps shall be used to connect leads to the pipe. Some foreign line owners may specify clamp attachments for leads and will supply their Specifications with such requests.

25.1.4 When installing clamps the coating shall be totally removed from the circumference of the pipe except when the pipe is coated with FBE. The cable lug connection point shall be filed to clean bright metal. The Contractor shall install a crimp or screwed type lug connector on each lead. The clamp shall consist of a 0.5 inch wide Band-it brand or approved equivalent 316 SS band. The band shall be tightened with the manufacturers tensioning equipment. The entire connection, including the banding shall be coated with a compatible and comparable coating as a minimum. A Petrolatum coating is to be liberally applied and where soil stress or mechanical damage may be a concern the Petrolatum is to be protected with a suitable fiberglass mesh coating.

25.1.5 Test lead assemblies shall be supplied with an adequate length of wire to allow two wraps around the new pipeline and to accommodate the design depth of cover.

25.1.6 The test lead wire will terminate in test posts as per the Project Drawings. On tree covered land test posts shall be located at the nearest boundary of the Right-of-Way. Test lead wires shall be laid in a 30 inches deep trench to the boundary unless otherwise specified.

25.1.7 The test wire is to be laid in the ditch and carefully protected against breaks, bruises or damage. Where foreign pipeline crossings occur in cultivated fields, and where instructed to do so by the Company, the Company supplied wire is to be run from the foreign pipeline to the nearest fence line. Cad welds to the Company's pipeline(s) are to be made at the fence line. Test lead electrical continuity will be checked following backfill, and will be repaired immediately if necessary.

25.2 Insulating Gaskets

25.2.1 The Contractor shall install insulating gasket kits where shown on the project drawings. Bolts, nuts, washers and studs shall not touch any part of the flange through which their insulating washer/sleeve is installed.

25.2.2 No incomplete insulating kits shall be installed. Any new tie-ins to previously insulated flanged joints shall be made using new insulating kits.

25.2.3 Insulating kits shall be installed on the mainline side of a block valve or as indicated on the Project Drawings.

25.2.4 The Contractor shall electrically test the insulation following installation of insulating kits using a 500 V Megger meter to check for electrical short circuits. In the event of short circuits, The Contractor shall complete repairs to the satisfaction of the Company, and at no additional cost to the Company.

26 DRAIN TILE REPAIR

26.1 General

26.1.1 Where drain tile has been removed or damaged in constructing the pipeline the Contractor shall replace and repair it with a Company approved equivalent material in accordance with the, the EMP, the AMP, and the Contract Documents.

26.1.2 Tile damaged during trench excavation shall be marked by the Contractor by survey station on a lath adjacent to the damaged tile and surveyors will record the location. The Company shall be immediately notified.

26.1.3 Broken tile shall be removed in such a manner as to ensure the functional integrity of the remaining tile.

26.1.4 A single continuous supporting member shall be placed across the trench as a trough in which to lay replacement tile. The supporting member shall span the trench and have a minimum of 2 feet of solid bearing under each end.

26.1.5 Where the original tile line parallels the pipeline the tile shall be re-laid for some distance on both sides of the trench such that it crosses the pipeline at an angle approved by the Company.

26.1.6 Before completing permanent tile replacements the Contractor shall examine the adjacent tile lying beneath the Working Side of the Right-of-Way to ensure that tile has not been crushed, plugged, misaligned, or otherwise disturbed.

26.1.7 A minimum of 12 inches of clearance between the top of the pipeline and the bottom of the continuous supporting member shall be maintained unless otherwise approved by the Company.

26.1.8 The trench shall be backfilled and compacted to the elevation of the bottom of the drain tile. After installation of the repaired drain tile the trench shall be backfilled and the backfill compacted in such a manner as to thoroughly protect the repaired crossing.

27 INTERNAL CLEANING PIG

27.1 General

27.1.1 The complete pipeline shall be delivered to the Company free from water, dirt and other foreign objects.

27.1.2 After lowering-in and backfilling, a cleaning-type pipeline pig consisting of four rubber discs and fitted with wire brushes, furnished and maintained by the Contractor, shall be run through the entire line in sections not to exceed the maximum hydrostatic test section length.

27.1.3 The Company will determine if cleaning pigs will be run through the pipeline prior to the installation of the mainline valves.

27.1.4 If all foreign material has not been removed to the satisfaction of the Company by one running of the cleaning pig additional runs shall be made by the Contractor until the Company accepts that the pipeline is free of all foreign material.

27.1.5 The rubber discs and wire brushes shall be measured prior to each run of the construction pig to ensure they are adequate to apply sufficient pressure on the pipe walls to provide effective cleaning of the pipe walls.

27.1.6 When the pig becomes damaged and, at the discretion of the Company, the rubber discs or wire brushes have become excessively worn or distorted, they shall be replaced with new discs or wire brushes furnished by the Contractor.

27.1.7 Each pig shall be driven by compressed air furnished by the Contractor. Each pig shall be run with sufficient head pressure to maintain an average pig speed of three to five miles per hour. The Contractor is responsible to furnish adequate compressors to ensure this pressure can be maintained at the downstream end of the section.

27.1.8 Company personnel shall be present for the insertion and removal of any/all pig(s).

27.1.9 The Contractor shall contain and collect dirt and debris produced as a result of the pigging operations.

27.1.10 After a section of pipeline has been cleaned, and tie-in welding at such a time is impractical, the cleaned section shall have a nightcap installed in the presence of the Company Inspector.

27.1.11 The nightcap shall be constructed of steel and shall be attached to the pipe in such a manner as to provide a watertight seal, regardless of groundwater or weather risks.

27.2 Gauging Pig

27.2.1 It is the sole responsibility of Contractor to deliver to the Company a completed pipeline free from defects in workmanship. Any defects so discovered shall be cut out, and replacement pipe installed by the Contractor at the Contractor's expense.

27.2.2 Suitable precautions shall be taken to ensure that pigs are trapped on completion of run without damage to persons, wildlife or property.

27.2.3 The Contractor shall supply all tools, equipment (including pigs) and labor necessary for necessary for execution of gauging pigging operations of the pipeline. The Company shall witness all pigging.

27.2.4 All pipe sections shall be pigged with gauging pigs following backfill and cleaning pig runs. The intent of the gauging pig run is to ensure the proper passage of the inline inspection geometry tool.

27.2.5 The Contractor shall confirm that all valves, fittings, and appurtenances are full opening and piggable in advance of running engaging pigs.

27.2.6 Gauging pigs shall be driven by compressed air. The lengths of the sections shall be limited to the length of the hydrotest sections.

27.2.7 Mild steel or aluminum gauge plates fitted to a cleaning-type pipeline pig consisting of four rubber discs and fitted with wire brushes shall be supplied by the Contractor and shall conform to the following dimensions:

Pipe OD (inches)	Plate Thickness (inches)	Plate Diameter
2 to 5	0.25	90 % of Pipe I.D.
6 to 10.75	0.5	90 % of Pipe I.D.
12.75 and above	0.625	90 % of Pipe I.D.

27.2.8 Gauge plate edges must be machined or ground to the required diameter. The outer edge of plate may be of brazed infill material to a radial thickness not exceeding 3% of the plate diameter.

27.2.9 Sizing scrapers shall be run through the same section of pipe more than once if in the opinion of the Company the pipe is insufficiently cleaned or the plate is deformed, gouged or unduly scarred. The location of segments of the pipeline which cause plate deformation, the rectification of same, and the re-running of the pig shall all be at the Contractor's expense.

27.2.10 Open ends of pipeline shall be covered when pigging operations have been completed and temporary launchers and receivers have been removed.

28 IN-LINE INSPECTION FOR GEOMETRY DEFORMATION

28.1 General

28.1.1 A geometry or caliper pig shall be run through newly installed pipe after thorough cleaning and hydrotesting to demonstrate to the Company’s satisfaction that the pipeline is free of any irregularities.

28.1.2 The Contractor shall provide a clean and dry line prior to electronic inspection operations.

28.1.3 Inspection runs shall be made under the technical guidance and supervision of the Company or may be directly controlled by the Company and in such cases the Contractor shall fully support and cooperate at no incremental cost to the Company.

28.1.4 The electronic inspection tools require careful handling at all times and shall be done in the presence of the Company or the Company’s designate. The Contractor shall be liable for any damage to these devices that are caused by negligence or rough handling on its part.

28.1.5 The Contractor shall develop a survey pigging plan and present it to the Company for acceptance at least 5 working days before the scheduled survey. A pre-job meeting will be held with representatives of the Company and of the Contractor to discuss the Work 2 to 5 working days prior to the first scheduled survey.

28.2 Field Services and Equipment

28.2.1 Unless specified otherwise in the Contract documents, the Contractor shall supply the following:

(a) Company approved, multi-purpose launchers/receivers;

(b) Compressed air source and associated hardware necessary to perform the inspection work. Sufficient air compression capacity shall be provided to maintain manufacturer's recommended speed of travel for both the cleaning, gauging pigs and electronic inspection tools;

(c) Labor and lifting facilities necessary to transfer tool between launchers/receivers and delivery truck and to install and remove tool from the line unless Company specifies otherwise;

(d) One fully equipped and qualified crew to be available as needed during the project;

(e) Transportation in a manner compatible with project schedule;

(f) Assistance for Company during tool propulsion in the pipeline if so requested; and

(g) Rerunning any faulty survey as necessary until error free, unambiguous, complete and otherwise reliable data is obtained.

28.2.2 The crew for the project shall be equipped (at a minimum) with the following items:

(a) Sufficient inventory of spare parts and consumables to maintain equipment in peak operating condition and to repair any reasonably foreseeable or possible damages for the duration of the project;

(b) Trays or skids (if necessary) for loading, unloading and transporting tools;

(c) Vehicle(s) suitable for transporting equipment and personnel to and from loading and unloading points; and

(d) Cellular telephone or 2-way radio.

28.2.3 The Contractor shall remove any unacceptable anomalies or defects that the geometry pig detects. The Contractor's cost for labor and equipment to remove and repair irregularities will be borne by the Contractor.

28.2.4 The Contractor certifies that the people provided for the duration of this inspection will be qualified to perform their stated duties.

28.3 Company Supplied Field Services and Equipment

28.3.1 In-line geometry caliper inspection tool from Company approved tool vendor that will perform an automated inspection for deformation and anomalies;

28.3.2 Comprehensive tool maintenance and repair in a manner compatible with manufacturer's recommendations;

28.3.3 Setting up and operating tool while it is in the pipeline;

28.3.4 Analyzing survey data and producing a preliminary report (to include location information and identification of pipeline anomalies);

28.3.5 Final report indicating dig locations.

28.3.6 Land survey services for referencing transmitters, receivers, marker coils or other type of reference point for any indication will be supplied by Company.

28.4 Faulty Surveys

28.4.1 In the event of a faulty survey the run will be rejected by the Company and the tool shall be rerun until a survey acceptable to Company is achieved. If the faulty survey is a result of conditions within the control of the Contractor, in the opinion of the Company, additional runs shall be at the Contractor's expense.

28.5 Site Responsibilities

28.5.1 The Contractor will supervise operations of the control manifold to maintain a suitable air feed and back pressure to operate the tool (pig) within the speeds recommended by the tool vendor.

28.5.2 The Contractor shall ensure that the pipe is overlapped, at the launching and receiving ends, in such a manner that working room is available for inserting and retrieving the inspection tools.

28.5.3 In addition to providing a means of safe trench ingress and egress, the Contractor shall supply and install suitable safe scaffolding and a means of keeping the trench free of water at the test head sites.

28.5.4 When it is necessary to work after daylight hours, the Contractor shall obtain prior Company approval to work by artificial light. The Contractor shall supply equipment which will provide an intensity of illumination that will permit Work to be done in a safe manner without risk of personal injury or unsatisfactory Work. Furthermore, such lighting shall be mounted well above the line of vision of the workers so that hand signals to equipment operators and others can be clearly seen.

28.6 Acceptance Criteria

28.6.1 The Company supplied geometry/caliper tool will be of such design and resolution to be able to detect the presence of and the o'clock orientation of dents and ovality of a magnitude of 0.5%.

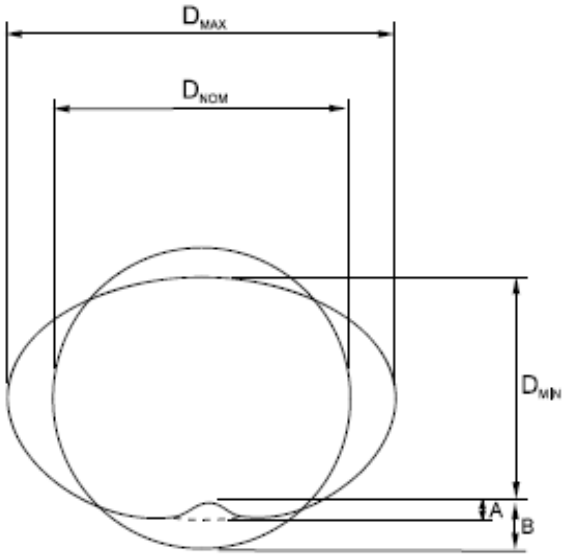
28.6.2 For purposes of evaluation, a dent shall normally be defined as a depression that produces a gross disturbance in the curvature of the pipe wall away from its normal contour and where the measured deflection is equal to or greater than 1% of pipe outside diameter per lineal length of pipe equivalent to one pipe diameter.

28.6.3 Ovality means any deflection that is not a dent greater than 1% of pipe diameter.

28.6.4 The formula for calculating the percentage depth of a dent or ovality or a combination thereof is:

$$\% \text{ Dent/Ovality} = \frac{(D_{max} - D_{min}) - (B\text{-}A)}{D_{NOM}} \times 100\%$$

Where:



28.6.5 Upon completion of Calliper pigging, an onsite analysis of the data will be made for gross determinations of quality. Upon request by the Company, any locations where anomalies are indicated to be greater than 1.5% will be excavated at the expense of the Contractor and visually examined by the Company.

28.6.6 The following defects shall be removed and replaced by the Contractor at no additional cost to the Company:

(a) Any anomalies that the Company deems injurious or that present an unacceptable level of risk for long term pipeline operations;

(b) Any Dent or stress concentrator, such as a gouge, of any size located on a girth weld or seam weld;

(c) Any Dent of any size that contains any type of stress riser;

(d) Any Dent of any size that shows signs of metal loss;

(e) All Dents greater than 2% of the nominal pipe diameter for NPS 12 and larger, all Dents greater than 0.25 inches for pipe diameters less than NPS 12;

(f) All Dents of 1% or greater magnitude for NPS 12 and larger and all Dents greater than 0.125 inches for pipe diameters less than NPS 12 that occur above the 4:00 and 8:00 position (upper two-thirds), with 12:00 being top dead center;

(g) All ovality of 5% or greater;

(h) Combination Dent/Ovality greater than 5% of the nominal pipe diameter; and

(i) Wrinkles.

28.7 Ovality Remediation

28.7.1 As soon as pipe is uncovered measurements of pipe outside diameter will be taken with callipers across at least 4 axes in an attempt to determine the greatest and the smallest diameters. In order to calculate the percent ovality the smallest measured diameter (D_{min}) will be subtracted from the greatest measured diameter (D_{max}) and that difference divided by the nominal outside diameter (OD) as follows:

$$(D_{max} - D_{min})/OD \times 100 = \text{Percent Ovality}$$

28.7.2 If Percent Ovality is 5% or greater, excavation will continue with measurements taken at appropriate intervals to determine if ovality has been relieved.

28.7.3 If it is determined that ovality has been relieved the ditch line will be inspected and any voids in backfill or improperly compacted backfill will be remedied. Backfill will then be carefully placed in the excavated trench and sidewalls will be tamped in 1 foot lifts.

28.7.4 If ovality cannot be relieved by removing the overburden of backfill the section containing the ovality will be cut out and replaced by the Contractor at no additional cost to the Company.

29 CLEAN-UP

29.1 General

29.1.1 The Contractor shall collect all waste materials and construction debris daily. Each working crew shall have at the work site, adequate garbage receptacles. Paper and other light-weight items shall not be permitted to be scattered around by the wind. The objective is to maintain a clean and neat work site at all times.

29.1.2 Burying of waste shall not be permitted on the Construction Right-of-Way, Temporary Work Space, Extra Work Space, in the Contractor Yards, or Pipe Yards.

29.1.3 The Contractor shall commence clean-up operations as soon as practical after backfill but in no case later than seven 7 days after backfill, unless otherwise approved by the Company.

29.1.4 Clean-up or any other construction activities commencing after caliper pigging of a section of pipeline shall be performed only when approved by the Company. Equipment used for these activities will be limited to low ground pressure (LGP) equipment as approved by the Company.

29.1.5 The Company shall provide a procedure to work over top of adjacent operating and/or unpressurized lines (if applicable).

29.1.6 The shoulders, ditches, banks and slopes of all crossings shall be restored to their former condition and shall be properly stabilized in accordance with the EMP. Such restoration shall be performed to meet the requirements of the Authorities having Jurisdiction, the Contract Documents and the Company.

29.1.7 All crossings are to be continuously maintained until the completion of the Work and until the termination of the specified warranty period.

29.1.8 The Construction Right-of-Way and temporary workspace shall be restored to a condition consistent with the condition of the ground prior to the construction of the pipeline including the re-sloping of grade cuts from previous pipeline construction not restored but encountered by the Contractor along the Construction Right-of-Way.

29.1.9 All cleanup Work shall be performed to the complete satisfaction of the Company, in accordance with the EMP, the AMP, the AGC, the Construction Line List, the Contract Documents, and any Authority having Jurisdiction.

29.1.10 Where the pipeline has crossed lawns, yards, or driveways, the lawns shall be prepared for sod and yards and driveways shall be returned to their preconstruction condition and finished to the complete satisfaction of the Company.

29.1.11 Where the pipeline has crossed environmentally sensitive areas they shall be restored to the satisfaction of the Company and the Authority having Jurisdiction.

29.1.12 Immediately following installation and backfilling of the pipeline the Contractor shall collect all rocks, stumps and remaining construction materials and dispose of same. Skids and timber mats shall be removed, stockpiled and transported by the Contractor.

29.1.13 The Contractor shall fill and level holes, ruts, and depressions to the satisfaction of the Company.

29.1.14 The subsoil shall be loosened to a minimum of 12 inches, or as specified by the EMP or the AMP to the depth required to break up all compaction. This operation shall be conducted in a criss-cross pattern and then disked or otherwise cultivated to prepare a reasonably smooth surface to the satisfaction of the Company before replacing the topsoil.

29.1.15 Any rocks greater than 4 inches or other debris brought to the surface as a result of ripping shall be collected and properly disposed of prior to replacement of topsoil or as specified by the EMP, or the AMP. Efforts will cease when the size and density of rocks on the Right-of-Way are similar to undisturbed areas adjacent to the Right-of-Way.

29.1.16 The method of disposal of stumps, clearing debris, rock or boulders shall be agreed to by the Company and the Authorities having Jurisdiction, and will generally consist of one of the following methods:

(a) The stumps, rock, or boulders may be placed in neat piles to the side of the Construction Right-of-Way at locations agreed to as indicated on the Construction Line List.

(b) The Contractor shall obtain and supply the Company with a copy of written permission from the landowner or occupant outlining the conditions for disposal of rock on their property if permission has not been provided in the Construction Line List.

(c) If the Construction Line List stipulates that surplus stumps, clearing debris, rock or boulders are to be removed from the Right-of-Way the Contractor shall haul the surplus material to an approved dumpsite. The Contractor shall provide the Company with the written approval of all Authorities having Jurisdiction over the area where dumping will

occur. All environmental and safety concerns as outlined in the Contract Documents, EMP, AMP, or Permits shall apply to all such off-site Work.

29.1.17 In the event that clean-up is not completed before freeze-up the Contractor shall, as a minimum, implement the following, to the satisfaction of the Company:

(a) Install erosion control devices as required to minimize the potential for erosion in areas where final clean-up is not completed.

(b) Ensure that access roads and trails are graded and left in a condition acceptable to the Company and the Authorities having Jurisdiction.

(c) Ensure that all installed watercourse crossings are cleaned up, reclaimed, and protected from erosion concerns in the spring in accordance with the Contract conditions, the EMP, or the AMP, and Permits.

(d) Ensure that all temporary fencing is adequately braced and supported and left in a condition acceptable to the Company.

29.1.18 Any clean-up not completed before freeze-up shall be finalized the following season, once ground conditions permit, at times acceptable to the Company, as specified in the Construction Line List, and in compliance with environmental timing restrictions. The Contractor is advised that various environmental timing restrictions along the Right-of-Way will be in place during the spring and early summer.

29.1.19 If clean-up activities occur during the following season the Contractor will be responsible for dedicating a work crew to address landowner concerns in a timely and competent manner such as weed control, erosion control, accessibility to fields and flooding.

29.2 Topsoil Replacement and Stabilization Procedure

29.2.1 Any topsoil removed from the Construction Right-of-Way during any construction operation shall be returned and restored to a condition as close to the original as practicable, and in accordance with the Drawings.

29.2.2 Topsoil shall be returned to those areas from which it was originally removed.

29.2.3 All handling and replacement of topsoil shall take place only when the topsoil is not excessively wet, as determined by the Company. Topsoil handling and replacement shall be suspended if dry topsoil is drifting in the presence of strong winds, as determined by the Company, to avoid soil loss or structure damage.

29.2.4 The following procedures shall be followed during the replacement of topsoil:

(a) In uplands, any surplus trench spoil remaining following the compaction of the ditch line, and any excess material required to leave a crown height over the trench line in accordance with the Contract Documents and acceptable to the Company, may be feathered out over the stripped portion of the Construction Right-of-Way. In wetlands, subsoil material removed from the trench during construction shall be replaced so that the material is not mounded above the adjacent ground surface (undisturbed trench wall). Subsoil that exceeds the elevation of the ground adjacent to the trench will be removed from the wetland and disposed of in an upland area with the Right-of-Way or a

Company-approved disposal site. After the trench has been backfilled with subsoil, previously segregated topsoil shall be spread over the trench area and mounded no more than 12 inches above the adjacent, undisturbed soil;

(b) Where acceptable to the Company, the Company will allow a wider area to be stripped to facilitate the feathering of surplus ditch material where blade width stripping was previously conducted;

(c) Surplus spoil which cannot be dispersed in accordance with these Specifications shall be considered as surplus and will be properly disposed of by loading, hauling and disposal in a manner and at suitable locations that will be satisfactory to the Company; and

(d) Following the replacement, compaction, and feathering of the ditch spoil material, and in preparation of the subsoil in accordance with these Specifications, the topsoil shall be replaced over the stripped portion of the Construction Right-of-Way.

29.2.5 Where the topsoil material is stored on native or improved pasture or hay land care shall be taken to ensure that the unprotected sod material is left in an undisturbed state.

29.2.6 Where straw has been used as a protective barrier between un-stripped topsoil and trench spoil the Contractor shall make all reasonable efforts to remove all trench spoil from the straw layer.

29.2.7 Upon written agreement with the landowner, as indicated in the Construction Line List, any straw remaining from this operation will not need to be picked up.

29.2.8 Rocks shall be removed from the topsoil to a condition consistent with the adjacent land. All rocks 4 inches in diameter or larger shall be removed from the upper 1 foot of soil.

29.2.9 Clean-up shall include cultivating, compaction relief, disking, harrowing and rock picking of the Construction Right-of-Way after topsoil replacement is completed.

29.2.10 Re-vegetation shall be completed using a Company supplied seed mix or with a mix approved in writing by the Company. Re-vegetation will comply with the requirements of the EMP, AMP, and/or Construction Line List.

29.2.11 When roll back is required in accordance with the EMP it shall be walked in with a dozer.

29.3 Fences

29.3.1 Upon completion of all clean-up and re-vegetation of the Construction Right-of-Way and areas adjacent thereto, the Contractor shall make permanent repairs to fences and/or other enclosures.

29.3.2 The Contractor shall make all reasonable efforts to coordinate final fencing Work with the Company to allow re-vegetation activities to be completed prior to final fencing where required.

29.3.3 Fences shall be replaced in a condition as good as, or better than, at the beginning of the Construction.

29.3.4 New materials shall be used in making these repairs. As a minimum the Contractor shall install new pressure treated posts of equal or greater diameter than the posts that were previously removed or damaged. The Contractor shall furnish and install steel, concrete or specially constructed posts wherever necessary to match the fence construction of the landowner.

29.3.5 All fence repairs shall be in accordance with the Drawings, Construction Line List and to the satisfaction of the Company.

29.3.6 After fence installation the Contractor shall paint all new posts and any posts damaged or not previously painted, within the limits of the Right-of-Way, to the Company's color and paint Specifications.

29.4 Clean-up Releases

29.4.1 The Contractor shall notify the Company when clean-up has been completed on each landowner tract.

29.4.2 The Company will obtain clean-up releases upon completion of final restoration. In the event a landowner and/or tenant refuse to sign a clean-up release, the Company will inform the Contractor of any noted deficiencies. The remediation of any deficiencies will be at the sole expense of the Contractor.

30 APPURTENANCES

30.1 General

30.1.1 Appurtenances included under this Specification are: fabricated assemblies (mainline valves, check valves, station connections, crossovers and scraper traps) and pipeline markers.

30.1.2 All above-grade surfaces of all appurtenances shall be thoroughly sand blasted and painted in accordance with the Coating Specification.

30.1.3 During hauling and storage the Contractor shall ensure that ends of pipe, valve stem extensions, grease lines and vents are protected and maintained free of all moisture, dirt and other foreign materials.

30.1.4 The inside of all valves, pipe and fittings shall be thoroughly cleaned of any dust, dirt and other foreign material immediately prior to installation.

30.1.5 The Contractor shall pay particular attention to the elevation and location of fabricated assemblies to ensure that they are installed level, at the proper height and free from excessive stresses.

30.2 Fabricated Assemblies

30.2.1 The trench for underground appurtenances shall be cut to a grade that will provide uniform support and provide the minimum required depth of cover.

30.2.2 Excavations for foundations, piers and support pads shall be made to permit the structures to be placed on undisturbed soil.

30.2.3 All over excavation underneath fabricated assemblies shall be brought back to proper elevation through the use of Fill-crete or select fill compacted to 98% Standard Proctor Density in 6 inch lifts.

30.2.4 Bell holes for tie-ins shall be filled and compacted as necessary to ensure the product pipe and assembly are adequately supported prior to installation or backfilling.

30.2.5 Concrete Work shall be performed in accordance with the Company's concrete specifications and in accordance with the applicable codes. Refer to Appendix A of USPCS-SPEC-CCC-007.

30.2.6 At flanged connections the flange face and gasket shall be cleaned immediately prior to fit-up and bolts shall be tightened using a torque wrench so that gasket-seating pressure is uniform. Torque procedures and values shall be in accordance with the manufacturer's recommendation and/or the Company Specifications. Torque values and sequence shall be recorded on Company provided forms. In bolting up flanges an approved thread lubricant shall be used on all bolt threads. Ordinary greases shall not be used for this purpose.

30.2.7 All flanges shall be installed so that the bolt holes straddle the vertical centerline of the pipe and the flange face is perpendicular to the longitudinal centerline.

30.2.8 At mainline valve installations the area within the fenced enclosures shall be graded level, ensuring proper drainage. All valves shall be set in accordance with the Contract Documents. Prior to hydrostatic testing operations the Contractor shall lubricate where necessary and check and test all valves for proper operation.

30.2.9 All valve actuators/operators shall be installed by the Contractor under the direction of the Company or the vendor. The Contractor shall not operate, adjust, or install any electrical works associated with the valve actuator without direct oversight by the Company. Valve-operator mounting flanges, on valves supplied without the operator pre-mounted, shall be kept covered and water tight. Valve stem extensions must be maintained free of all moisture, dirt and other foreign objects. These extensions shall be filled with a minimum of 1 gallon of Company approved anti-freeze.

30.3 Pipeline Warning Signs

30.3.1 Pipeline warning signs shall be installed on both sides of all road, highway and railroad crossings at the easement boundaries and, at any other location so required by the Company. Warning signs shall also be installed at the top of each bank at major stream crossings as directed by the Company. Marker posts shall be installed in accordance with the Contract Documents and as directed by the Company.