I-69 SECTION 5 PROJECT

PUBLIC-PRIVATE AGREEMENT

TECHNICAL PROVISIONS

ATTACHMENT 8-1
CONSULTING PARTIES

ction 5 — Consulting Parties — 1-30-13

Company	Address	E-Mail	Phone Number	Fax Number	Corridor Wide CP	Consulting Party In Other Sections	Did Not Respond to Invitation	Did Not Wish To Be a Consulting Party	Returned Original Response Card
ington Restorations, Inc.	2920 E. 10th St. Bloomington, IN 47408	bri@bloomingtonrestorations	812-336-0909	812-323-2089					06/21/04
(Citizens for Appropriate Rural s)	PO Box 54 Stanford, IN 47463	carr@bluemarble.net	812-825-9555	812-825-9555	X				06/07/04
f Mitchell	407 S. 6th Street Mitchell, IN 47446-1710	mayor@mitchell-in.gov	812-849-5161	812-849-0721					06/01/04
are Nation	PO Box 825 Anadarko, OK 73005	tfrancis@delawarenation.com	405-247-2448 ext. 130	405-247-9393	X				06/01/04
er Environmental Council	3951 N. Meridian Suite 100 Indiana	jkharbanda@hecweb.org	317-685-8800 x103	317-686-4754	X				07/07/04
Division of Historic Preservation haeology/SHPO	Division of Historical Preservation 402 W. Washington St., Room W274 Indianapolis, IN 46204	cslider@dnr.in.gov	317-234-5366	317-232-0693	X				X
a Landmarks	1201 Central Avenue, Indianpolis, IN 46202	mdollase@indianalandmarks.org	317-639-4534	317-639-6734	X				06/24/04
a Landmarks	PO Box 297 Evansville, IN 47702	ssebree@indianalandmarks.org	812-423-3173		X				06/07/04
a Landmarks	669 Ohio Street Terre Haute, IN 47807	tkleckner@indianalandmarks.org	812-232-4534	812-234-0156					05/25/04
Tribe of Oklahoma	PO Box 1326 Miami, OK 74355	jlolds@miamination.com	918-542-1445	918-542-7260	X				07/26/04
e County Historic Preservation of Review	501 N. Morton St. Ste 224, Bloomington, IN 47404		none						
e County Planner	501 N. Morton St. Ste 224, Bloomington	jscanlan@co.monroe.in.us	812-349-2968						06/01/04
an County Commissioner	1620 Cramertown Loop Martinsville, IN 46151	nvoyles@morgancounty.in.gc	765-342-4513						05/24/04
an County Historian	759 E Washington St., Martinsville, IN 46151-1646	jstuttgen@comcast.net	765-349-1537						
an County Historic Preservation ty	P.O. Box 1377, Martinsville IN 46151	jstuttgen@comcast.net	765-349-1537						06/01/04
County CARR/ County Preservations	1816 Concord Rd. Gosport, IN 47433	esarra@indiana.edu	812-829-0451		X				06/14/04
County Preservations, Inc.	8000 West Sand College Gosport, IN 47433	ppal@bluemarble.net	812-876-6017						06/21/04
County Preservations, Inc.	8000 West Sand College	albontinsley@smithville.net	812-876-6017	albontinsley@att.net, OR lesndeb@wildblue.net					06/21/04
a Tribe of Indians of Oklahoma	PO Box 1527 Miami, OK 74355	jfroman@peoriatribe.com	918-540-2535	918-540-2538	X				06/01/04
e Band Potawatomi Nation	Government Center 16281 Q Road Mayetta, KS 66509-8970	steveo@pbpnation.org	785-966-4007	785-966-4009	X				06/07/04
nee Tribe	PO Box 189 Miami, OK 74355	Shawneetribe@neok.com	918-542-2441	918-542-2922	X				06/01/04

Company	Address	E-Mail	Phone Number	Fax Number	Corridor Wide CP	Consulting Party In Other Sections	Did Not Respond to Invitation	Did Not Wish To Be a Consulting Party	Returned Original Response Card
ional Arts Indiana	504 N. Fess Ave., Bloomington, IN 47408	tradarts@indiana.edu	812-855-0418	812-855-4008	X				
sh & Ohio Chapter of Industrial ology	4311 Broadway St., Indianapolis, IN 46205-1811	nmcniece@indy.rr.com	317-925-5766						
	4410 North Pennsylvania St., Indianapc	pspiegel@indiana.edu	317-926-6617		x				X
	4495 N. Benton Ct. Bloomington, IN 47408	bhb@bernacki.com	812-339-0149 cell 812-339-0652 home						
am Manager Historic rvation ng and Neighborhood opment	P.O. Box 100 Bloomington, IN 47402	hiestann@bloomington.in.gov	812-349-3507	812-349-3582					
	629 E. Seminary Street Greencastle, IN 46135	ilcooper@ccrtc.com	765-653-8855						
ic Spans Taskforce	5868 Croton Circle Indianapolis, IN 46254	indianabridges@sbcglobal.net	317-347-1004						
e County Commissioner	100 W Kirkwood Ave., Bloomington, IN 47404-5140	pstoffer@alumni.indiana.edu	812-349-2550						
er Environmental Council	3951 N. Meridian Suite 100 Indiana	maloneyt@hecweb.org	317-685-8800 ext. 115	317-686-4754	X				07/07/04
	6707 W. Rockeast Rd., Bloomington, IN 47403		812-325-3407						
Quarries, Inc.	P.O. Box 64, Bloomington, IN 47402	reedquarries@sbcglobal.net	812-332-2771						
a Department of Transportation	100 N. Senate Ave., IGCN, Room N642, Indianapolis, IN 46204	pacarpenter@indot.in.gov	317-232-5161						
A	E76, 1200 New Jersey Ave. SE, Washington, D.C. 20590	maryann.naber@dot.gov	202-366-2060						
A	Room 254, Federal Office Bldg 575 N. Pennsylvania St. Indianapolis, IN 46204	Michelle.Allen@dot.gov	317 226-7344						
ory Council on Historic rvation	1100 Pennsylvania Ave. NW Ste. 803 Washington, D.C. 20004	clegard@achp.gov	202-606-8522	202-606-8647					
Added 3-23-12									
l Stout House (105-055-2503)	6037 Sandhurst Lane, Unit C, Dallas TX 75206-4723		214-691-1532						

Company	Address	E-Mail	Phone Number	Fax Number	Corridor Wide CP	Consulting Party In Other Sections	Did Not Respond to Invitation	Did Not Wish To Be a Consulting Party	Returned Original Response Card
e Grove Road Rural Historic ct	Maple Grove Rd Neighborhood Assn., PO Box 547, Ellettsville, IN 47429								
Bender Farmstead (105-115-5)	5804 W State Road 46, Bloomington, IN 47404-9359								
ce Head House (MB18)	PO Box 2175, Bloomington, IN 47402								
Clear Creek Historic Landscape ct	525 S. Landmark Ave., Bloomington, IN 47403-3329								
Clear Creek Historic Landscape ct	PO Box 250, Bloomington, IN 47402		800-742-4064						
Clear Creek Historic Landscape ct	PO Box 147, Clear Creek, IN 47426		812-336-2560						
Clear Creek Historic cape District (including 105-115-0)	2300 W. Tapp Rd., Bloomington IN 47403								
r Valley Historic Landscape ct	301 Main St., PO Box 27, Oolitic, IN 47451		812-275-3341	812-275-3344					
r Valley Historic Landscape ct	PO Box 1224, Bloomington, IN 47402-1224		812-332-1447	812-332-6085					
r Valley Historic Landscape ct	PO Box 26, Washburn, WI 54891								
r Valley Historic Landscape ct	1900 S. Liberty Dr., Bloomington, IN 47403-5136								
r Valley Historic Landscape Distric	1555 S. Pine Ridge Dr., Martinsville, IN 46151-6387								
r Valley Historic Landscape ct	3939 N. Kinser Pike, Bloomington, IN 47404-1870		812-339-1323						
r Valley Historic Landscape ct	2001 Hunter Valley Rd., Bloomington, IN 47404-1577		812-323-8540						
Historic Landscape District	PO Box 64, Bloomington, IN 47402		812-332-2771						

I-69 SECTION 5 PROJECT

PUBLIC-PRIVATE AGREEMENT

TECHNICAL PROVISIONS

ATTACHMENT 9-1A
H&V Control Book

I-69
Evansville to Indianapolis Tier 1

Horizontal and Vertical Control Field Book

Prepared By:
Bernardin · Lochmueller & Associates

Job Numbers:

INDOT
DM-IN10(001)
DM-IN48(048)
Des. No. 9906000

BLA
199-0001-4SV/SV02

Contents:

*Control Monument References
*Set Benchmark References
*Aerial Panel Coordinate List
*Additional Photo-Identifiable Point Coordinate List

COORDINATE SYSTEMS AND DATUMS

The I-69 East and West Zones are Transverse Mercator map projections based upon the Geodetic Reference System of 1980 (GRS 80) ellipsoid and were designed in an effort to minimize the differences between grid coordinate inverses and ground-measured distances for the design stage of the "Evansville to Indianapolis" I-69 corridor. The North American Datum of 1983, per the 1997 High Accuracy Reference Network (HARN) adjustment (NAD 83(1997)), was the controlling horizontal datum employed for the GPS observations and least squares adjustment to derive the geodetic positions and subsequent grid coordinates for the primary control network of said corridor.

The projection parameters for the I-69 East and West Zones are as follows:

Projection Name	I-69 West Zone	I-69 East Zone
Projection Type	Transverse Mercator	Transverse Mercator
Horizontal Datum	NAD 83(1997)	NAD 83(1997)
Reference Ellipsoid	GRS 80	GRS 80
West Longitude of Central Meridian	87-12-18 (87.205)	86-25-12 (86.420)
North Latitude of Grid Origin	38-09-36 (38.160)	38-09-36 (38.160)
False Northing (Lat Origin)	50,000 meters	50,000 meters
False Easting (Central Meridian)	200,000 meters	400,000 meters
Central Meridian Scale Factor	1.0000154	1.0000260

Within the limits of said corridor, there are distinguishing characteristics of the numerical values of grid coordinates of the following map projections that users should become familiar with so as to easily differentiate the I-69 East and West Zone from one another as well as from the Indiana State Plane East (1301) or West (1302) Zone or the Universal Transverse Mercator Zone 16. These values, in U.S. Survey Feet, are as follows:

The northing (Y) coordinates:

I-69 West and East Zones:	Positive, under 1,000,000
Indiana State Plane West (1302) and East (1301) Zones:	Between 1-2,000,000
UTM Zone 16:	Between 13-15,000,000

The easting (X) coordinates:

I-69 West Zone:	Positive, under 1,000,000
I-69 East Zone:	Between 1-2,000,000

It should also be noted that within the limits of said corridor, the northing and easting values of any coordinate pair in either the I-69 East or West Zone are separated enough so that the northing (Y) value will be less than the easting value (X).

No “exact” line is designated for the division/separation of the I-69 East and West Zones. Instead, an overlap of zones coverage for equating horizontal alignments, surveys, photogrammetry, design, construction staging, etc. is planned to occur in the vicinity of the intersections of the I-69 corridor with State Roads 45 and 54.

VERTICAL DATUM

The North American Vertical Datum of 1988 (NAVD88) was the controlling vertical datum employed for the differential leveling observations and least squares adjustment to derive the orthometric heights for the primary control network of said corridor. Orthometric heights are not effected by converting from one map projection to another.

LINEAR UNITS

Although the above listed “False Northings” and “False Eastings” are defined in meters, U.S. Survey Feet (3,937 feet=1,200 meters) is the recognized definition to be utilized in the I-69 East and West Zones.

Control Monument References

(NOTE: All Northing, Easting and Elevation Values are Listed in U.S. Feet.)

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Clear Creek Quad County: Monroe

Sec. 29, T 8N, R 1W

Control Point: 64

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1405220.74

Easting: 3103836.80

Vertical Datum: NAVD88

Elevation: 716.08'

Horizontal Datum: WGS 1984

Latitude: 39°06'18.79599"

Longitude: 86°33'03.30862"

Ellipsoidal Height: 607.65'

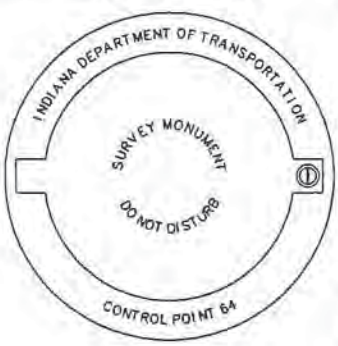
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14201248.40

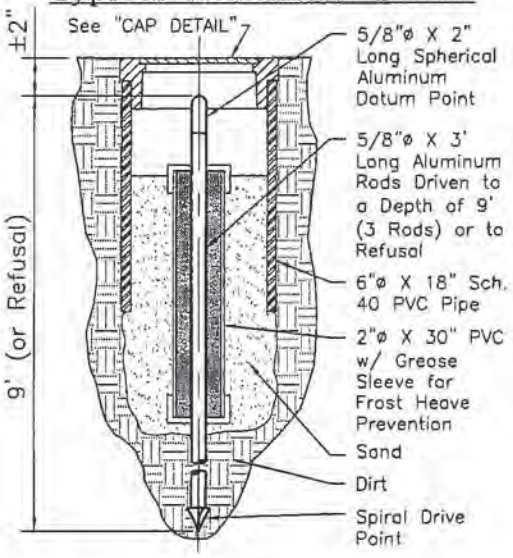
Easting: 1767808.56

Comments: .21' from top of access cover to datum point.

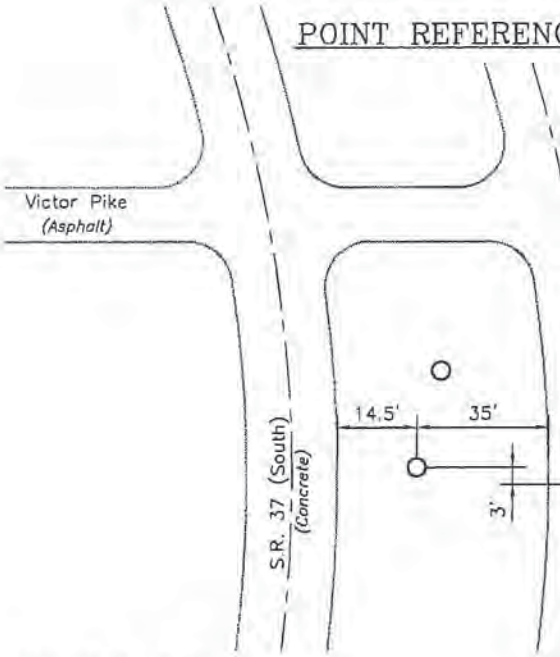
Cap Detail:



Typical Monument Detail:



POINT REFERENC



REFERENCE 1:

*DISTANCE: 14.5'

DESCRIPTION: West to east edge of concrete

REFERENCE 2:

*DISTANCE: 35'

DESCRIPTION: East to west edge of concrete

REFERENCE 3:

*DISTANCE:

DESCRIPTION:

*NOTE: ALL DISTANCES ARE APPROXIMATE A
ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Clear Creek Quad County: Monroe

Sec. 19, T 8N, R 1W

Control Point: 65 Horizontal Datum: WGS 1984

Horizontal Datum: NAD83 (1997) Latitude: 39°06'53.05758"

Indiana State Plane West Longitude: 86°33'24.10348"

Northing: 1408677.52 Ellipsoidal Height: 589.35'

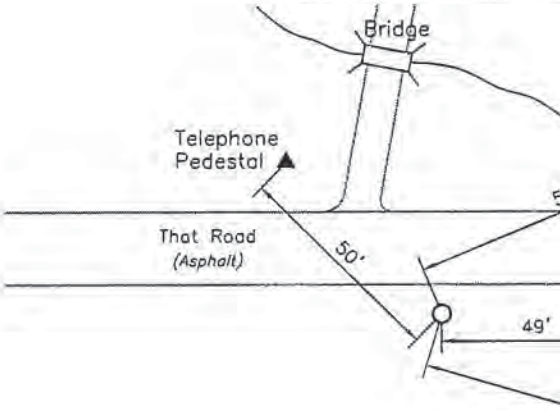
Easting: 3102177.49 Horizontal Datum: UTM 16 NAD83 (Ft.)

Vertical Datum: NAVD88 Northing: 14204705.41

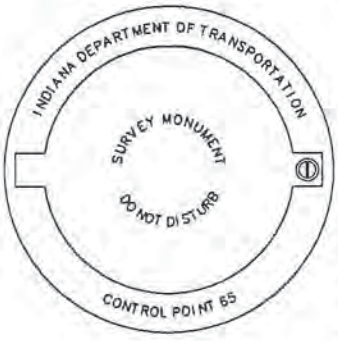
Elevation: 697.76' Easting: 1766153.05

Comments: .25' from top of access cover to datum point.

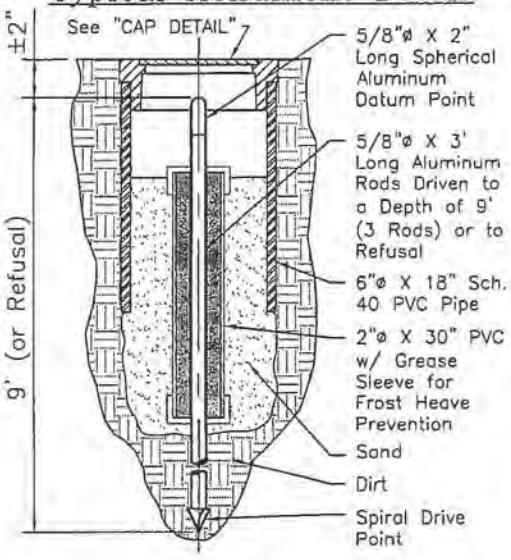
POINT REFERENC



Cap Detail:



Typical Monument Detail:



REFERENCE 1:

*DISTANCE: 48'

DESCRIPTION: East to approximate centerline

REFERENCE 2:

*DISTANCE: 50'

DESCRIPTION: Northwest to telephone pedest

REFERENCE 3:

*DISTANCE: 50'

DESCRIPTION: Northeast to north end of 36

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Bloomington Quad

Sec. 31, T 9N, R 1W

Control Point: 66

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1426808.88

Easting: 3100083.29

Vertical Datum: NAVD88

Elevation: 860.59'

County: Monroe

Horizontal Datum: WGS 1984

Latitude: 39°09'52.38231"

Longitude: 86°33'49.35621"

Ellipsoidal Height: 752.24'

Horizontal Datum: UTM 16 NAD83 (Ft.)

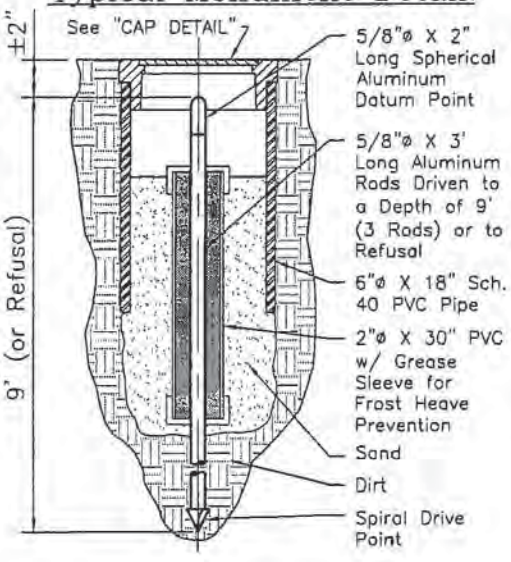
Northing: 14222831.90

Easting: 1764076.28

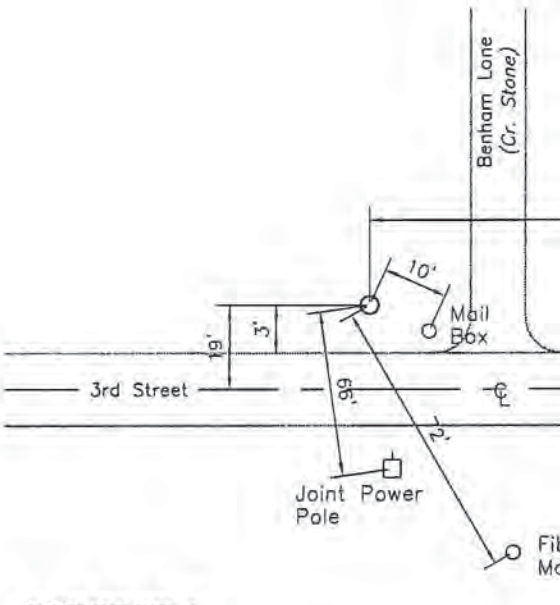
Comments: –

Cap Detail:

Typical Monument Detail:



POINT REFERENC



REFERENCE 1:

*DISTANCE: 10'

DESCRIPTION: Southeast to mail box.

REFERENCE 2:

*DISTANCE: 66'

DESCRIPTION: South to joint power pole.

REFERENCE 3:

*DISTANCE: 72'

DESCRIPTION: Southeast to fiber optic marke

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Bloomington Quad County: Monroe

Sec. 1, T 8N, R 2W

Control Point: 67

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1426738.22

Easting: 3095742.31

Vertical Datum: NAVD88

Elevation: 854.03'

Horizontal Datum: WGS 1984

Latitude: 39°09'51.92601"

Longitude: 86°34'44.47526"

Ellipsoidal Height: 745.71'

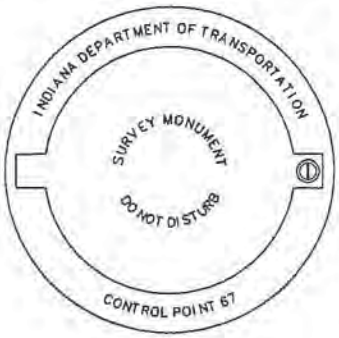
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14222765.25

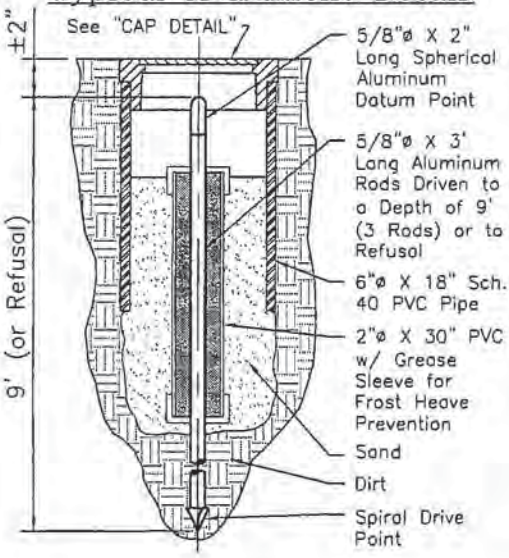
Easting: 1759736.85

Comments: .32' from top of access cover to datum point.

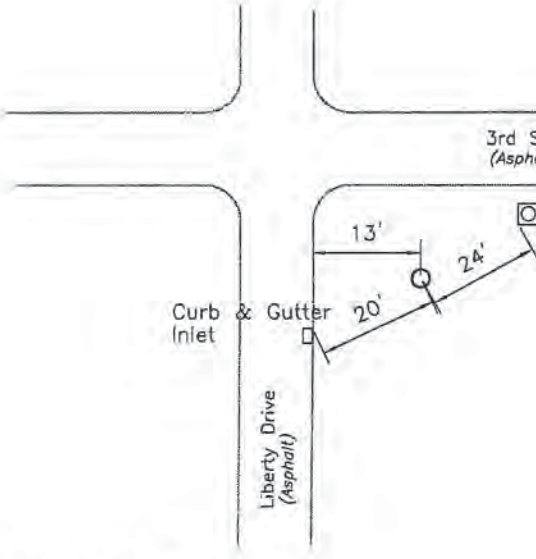
Cap Detail:



Typical Monument Detail:



POINT REFEREN



REFERENCE 1:

*DISTANCE: 13'

DESCRIPTION: West to east back of curb on

REFERENCE 2:

*DISTANCE: 20'

DESCRIPTION: Southwest to the northeast co inlet.

REFERENCE 3:

*DISTANCE: 24'

DESCRIPTION: Northeast to the south ancho pole.

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Bloomington Quad County: Monroe

Sec. 29, T 9N, R 1W

Control Point: 68

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1434910.42

Easting: 3104777.70

Vertical Datum: NAVD88

Elevation: 803.45'

Horizontal Datum: WGS 1984

Latitude: 39°11'12.18504"

Longitude: 86°32'49.14696"

Ellipsoidal Height: 695.07'

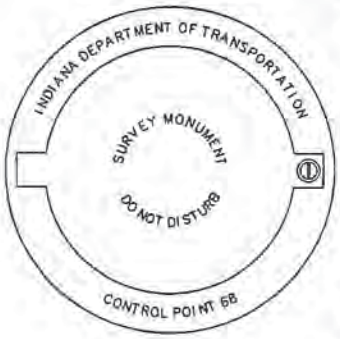
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14230926.10

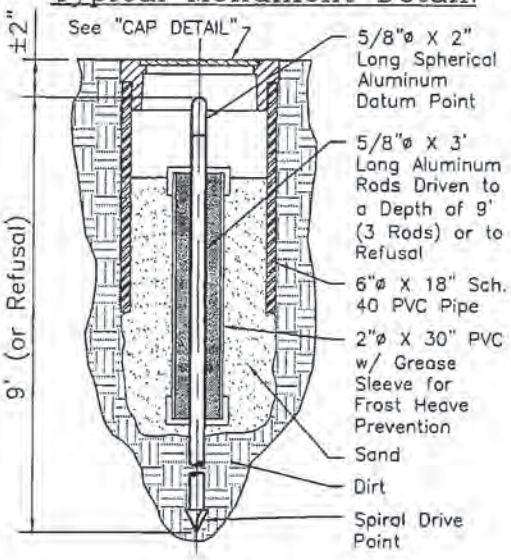
Easting: 1768776.37

Comments: .15' from top of access cover to datum point.

Cap Detail:



Typical Monument Detail:



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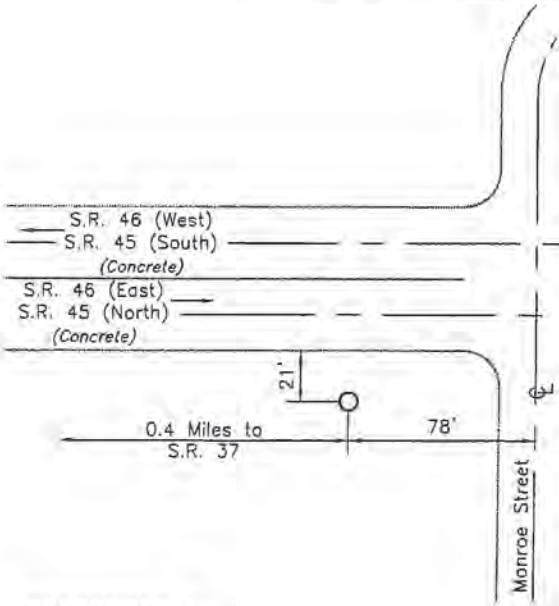


REFERENCE 1:

*DISTANCE: 21'

DESCRIPTION: North to the south edge of co

REFERENCE 2:

*DISTANCE: 78'

DESCRIPTION: East to approximate centerline

REFERENCE 3:

*DISTANCE:

DESCRIPTION:

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Bloomington Quad County: Monroe

Sec. 30, T 9N, R 1W

Control Point: 69

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1435097.57

Easting: 3100909.18

Vertical Datum: NAVD88

Elevation: 773.68'

Horizontal Datum: WGS 1984

Latitude: 39°11'14.25800"

Longitude: 86°33'38.26413"

Ellipsoidal Height: 665.33'

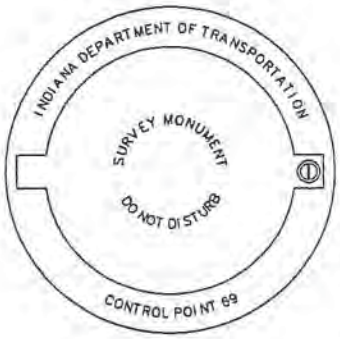
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14231116.73

Easting: 1764909.46

Comments: .33' from top of access cover to datum point.

Cap Detail:



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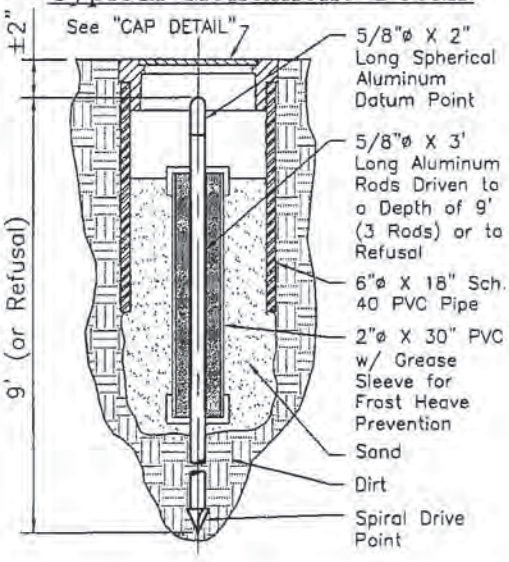

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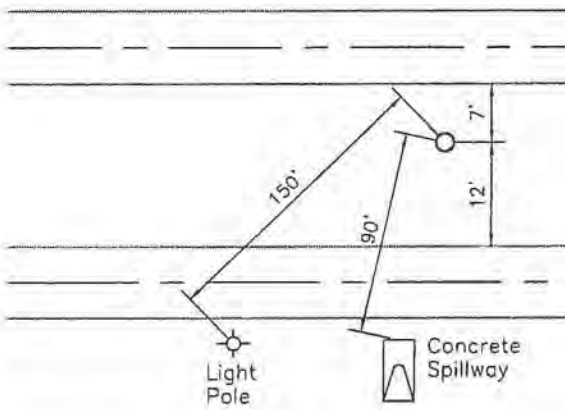


REFERENCE 1:

*DISTANCE: 7'

DESCRIPTION: North to south edge of aspha

REFERENCE 2:

*DISTANCE: 12'

DESCRIPTION: South to north edge of aspha

REFERENCE 3:

*DISTANCE: 90'

DESCRIPTION: South to approximate center o

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Bloomington Quad County: Monroe

Sec. 8, T 9N, R 1W

Control Point: 70

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1448286.29

Easting: 3106817.71

Vertical Datum: NAVD88

Elevation: 587.98'

Horizontal Datum: WGS 1984

Latitude: 39°13'24.26648"

Longitude: 86°32'22.21933"

Ellipsoidal Height: 479.59'

Horizontal Datum: UTM 16 NAD83 (Ft.)

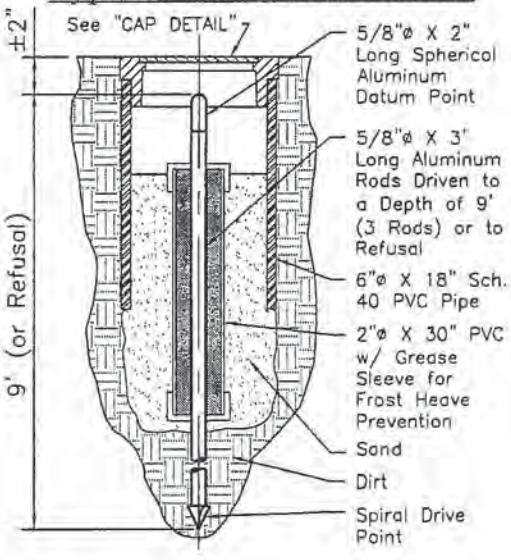
Northing: 14244295.08

Easting: 1770827.91

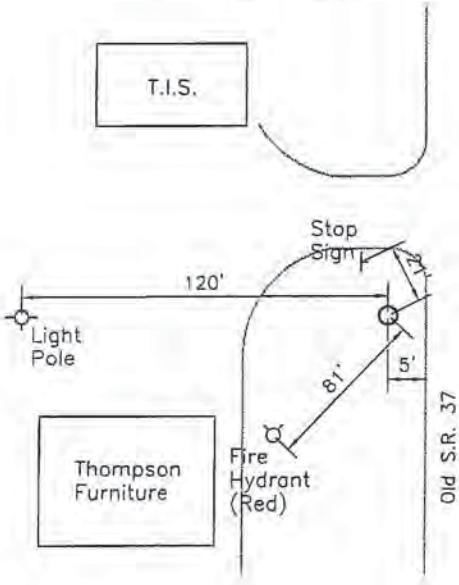
Comments: –

Cap Detail:

Typical Monument Detail:



POINT REFERENC



REFERENCE 1:

*DISTANCE: 21'

DESCRIPTION: North to stop sign.

REFERENCE 2:

*DISTANCE: 81'

DESCRIPTION: Southwest to a red fire hydra

REFERENCE 3:

*DISTANCE: 120'

DESCRIPTION: West to power pole.

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Bloomington Quad County: Monroe

Sec. 5, T 9N, R 1W

Control Point: 71

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1453669.55

Easting: 3105765.90

Vertical Datum: NAVD88

Elevation: 579.15'

Horizontal Datum: WGS 1984

Latitude: 39°14'17.53429"

Longitude: 86°32'35.17648"

Ellipsoidal Height: 470.78'

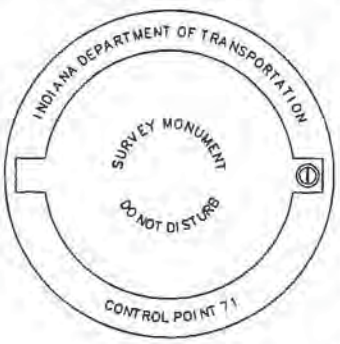
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14249677.28

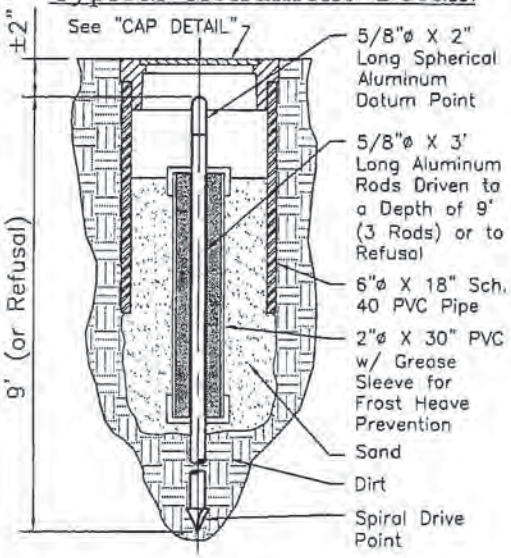
Easting: 1769781.44

Comments: .22' from top of access cover to datum point.

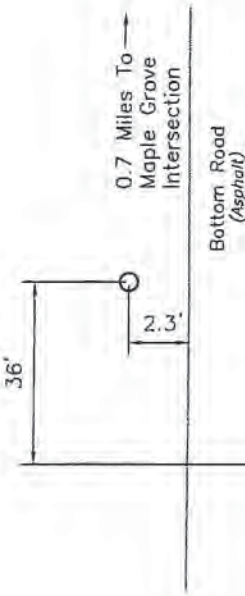
Cap Detail:



Typical Monument Detail:



POINT REFEREN



REFERENCE 1:

*DISTANCE: 2.3'

DESCRIPTION: East to the west edge of Bot

REFERENCE 2:

*DISTANCE: 36'

DESCRIPTION: South to the centerline of a

REFERENCE 3:

*DISTANCE: 0.7 Miles

DESCRIPTION: North to the intersection of B Grove Road.

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Modesto Quad County: Monroe

Sec. 34, T10N, R1W

Control Point: 72

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1463408.78

Easting: 3112817.83

Vertical Datum: NAVD88

Elevation: 785.66'

Horizontal Datum: WGS 1984

Latitude: 39°15'53.36639"

Longitude: 86°31'04.77811"

Ellipsoidal Height: 677.30'

Horizontal Datum: UTM 16 NAD83 (Ft.)

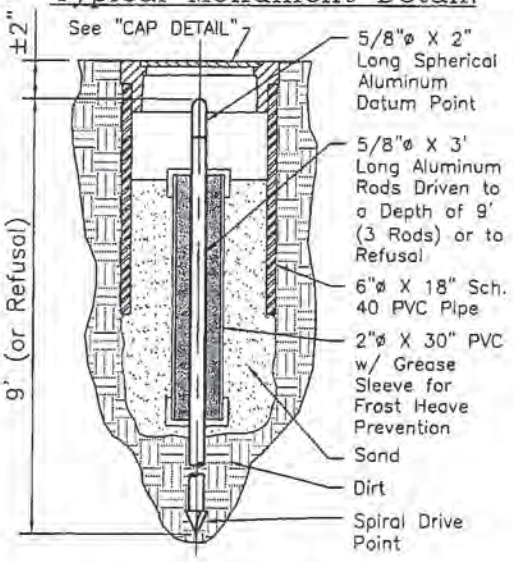
Northing: 14259406.38

Easting: 1776839.68

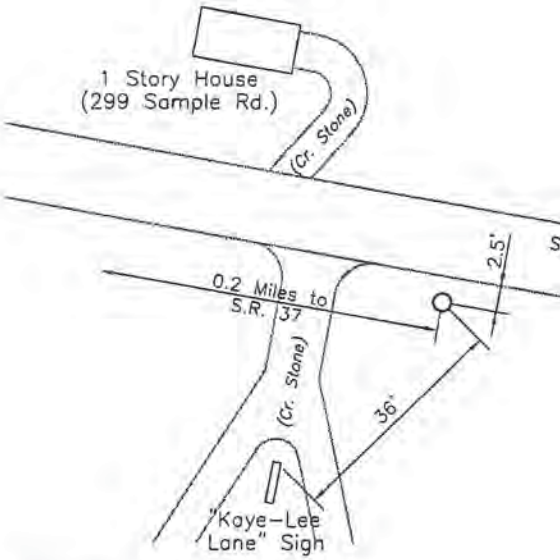
Comments: –

Cap Detail:

Typical Monument Detail:



POINT REFEREN



REFERENCE 1:

*DISTANCE: 2.5'

DESCRIPTION: Northeast (perpendicular) to th

REFERENCE 2:

*DISTANCE: 36'

DESCRIPTION: Southwest to north end of "Ka

REFERENCE 3:

*DISTANCE:

DESCRIPTION:

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Modesto Quad County: Monroe

Sec. 28, T10N, R1W

Control Point: 73

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1463849.45

Easting: 3110125.14

Vertical Datum: NAVD88

Elevation: 763.18'

Comments: –

Horizontal Datum: WGS 1984

Latitude: 39°15'57.88652"

Longitude: 86°31'38.97906"

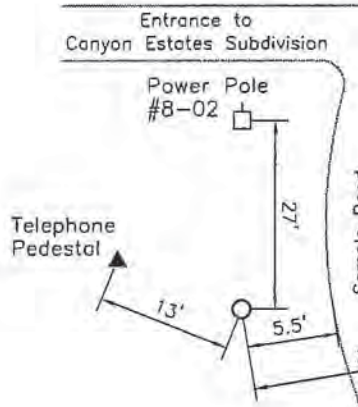
Ellipsoidal Height: 654.83'

Horizontal Datum: UTM 16 NAD83 (Ft.)

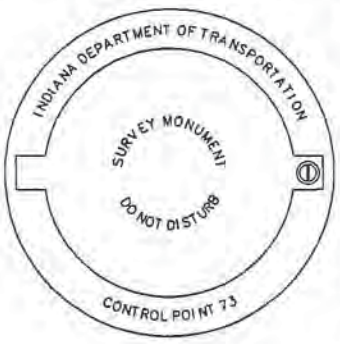
Northing: 14259849.36

Easting: 1774148.41

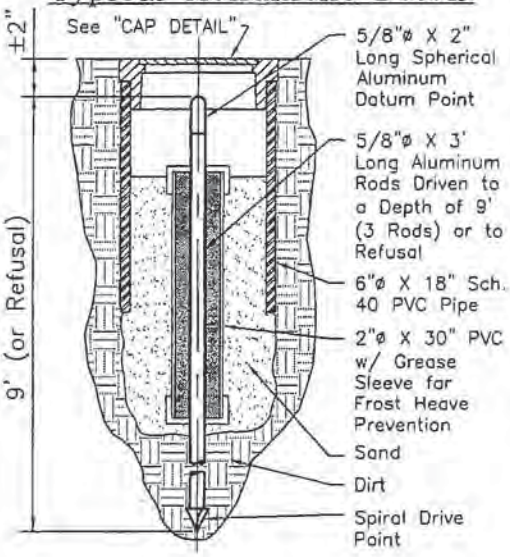
POINT REFEREN



Cap Detail:



Typical Monument Detail:



REFERENCE 1:

*DISTANCE: 5.5'

DESCRIPTION: East to the edge of asphalt

REFERENCE 2:

*DISTANCE: 13'

DESCRIPTION: Northwest to a telephone pede

REFERENCE 3:

*DISTANCE: 27'

DESCRIPTION: North to power pole #8-02.

*NOTE: ALL DISTANCES ARE APPROXIMATE A
ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Modesto Quad County: Morgan

Sec. 10, T10N, R1W

Control Point: 74

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1479778.48

Easting: 3117007.05

Vertical Datum: NAVD88

Elevation: 862.04'

Horizontal Datum: WGS 1984

Latitude: 39°18'34.89239"

Longitude: 86°30'10.18046'

Ellipsoidal Height: 753.75'

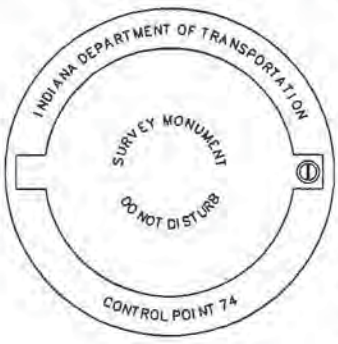
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14275766.08

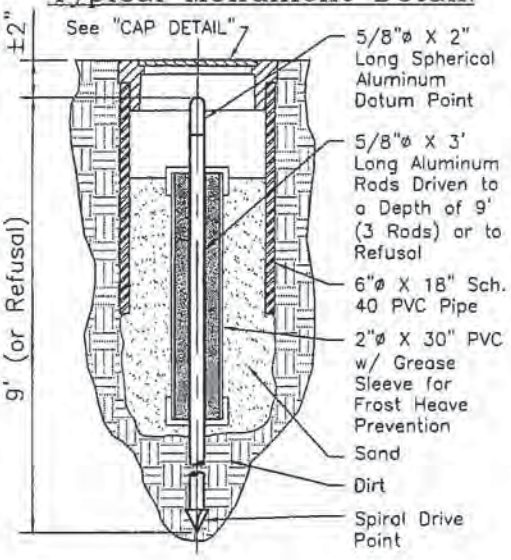
Easting: 1781042.40

Comments: .45' from top of access cover to datum point.

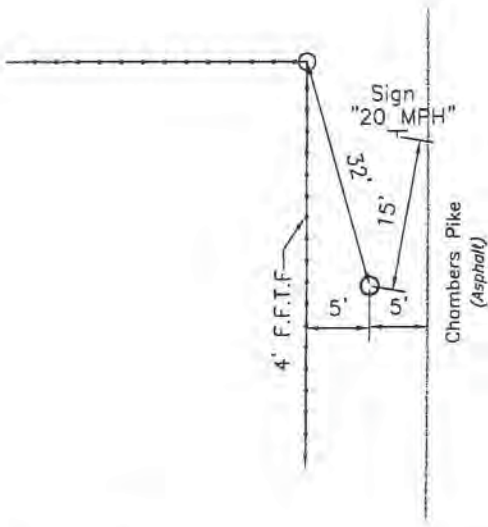
Cap Detail:



Typical Monument Detail:



POINT REFERENC



REFERENCE 1:

*DISTANCE: 5'

DESCRIPTION: East to the west edge of Cha

REFERENCE 2:

*DISTANCE: 5'

DESCRIPTION: West to the fifth fence post f

REFERENCE 3:

*DISTANCE: 15'

DESCRIPTION: North to the "20 M.P.H." Sign.

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Modesto Quad County: Morgan

Sec. 16, T10N, R1W

Control Point: 75

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1476906.62

Easting: 3111372.18

Vertical Datum: NAVD88

Elevation: 782.78'

Horizontal Datum: WGS 1984

Latitude: 39°18'06.86005"

Longitude: 86°31'22.09533"

Ellipsoidal Height: 674.49'

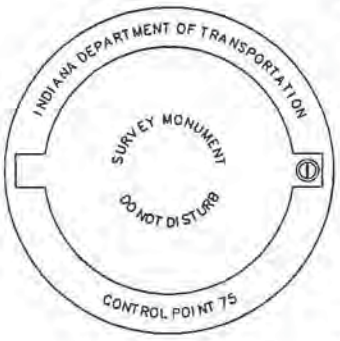
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14272900.49

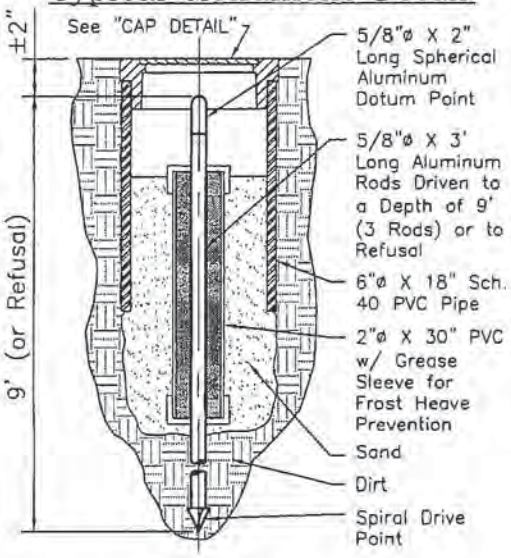
Easting: 1775407.00

Comments: .33' from top of access cover to datum point.

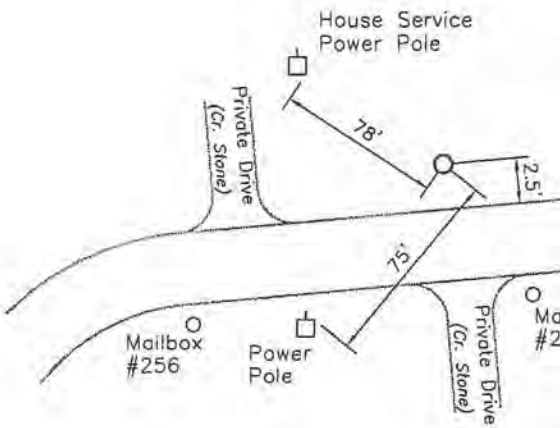
Cap Detail:



Typical Monument Detail:



POINT REFERENC



REFERENCE 1:

*DISTANCE: 2.5'

DESCRIPTION: South to north edge of paven

REFERENCE 2:

*DISTANCE: 75'

DESCRIPTION: Southwest to power pole.

REFERENCE 3:

*DISTANCE: 78'

DESCRIPTION: Northwest to house service po

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Hindustan Quad County: Morgan

Sec. 26, T11N, R1W

Control Point: 76

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1496256.54

Easting: 3117407.43

Vertical Datum: NAVD88

Elevation: 783.99'

Horizontal Datum: WGS 1984

Latitude: 39°21'17.72455"

Longitude: 86°30'03.73634"

Ellipsoidal Height: 675.77'

Horizontal Datum: UTM 16 NAD83 (Ft.)

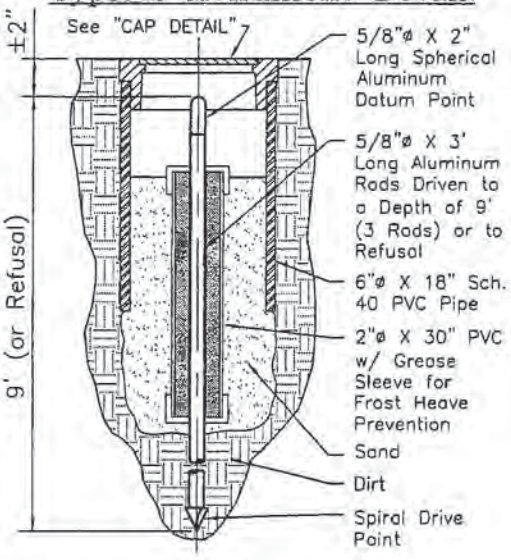
Northing: 14292237.58

Easting: 1781457.81

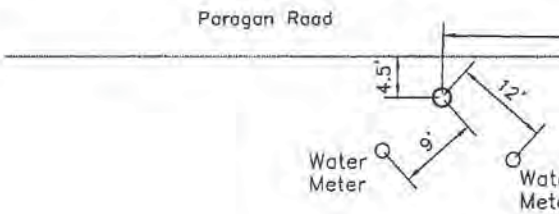
Comments: –

Cap Detail:

Typical Monument Detail:



POINT REFEREN



REFERENCE 1:

*DISTANCE: 9'

DESCRIPTION: Southwest to water meter.

REFERENCE 2:

*DISTANCE: 12'

DESCRIPTION: Southeast to water meter.

REFERENCE 3:

*DISTANCE: 51'

DESCRIPTION: East to telephone pole.

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Hindustan Quad County: Morgan

Sec. 35, T11N, R1W

Control Point: 77

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1494605.67

Easting: 3119825.37

Vertical Datum: NAVD88

Elevation: 799.68'

Horizontal Datum: WGS 1984

Latitude: 39°21'01.25343"

Longitude: 86°29'33.09229"

Ellipsoidal Height: 691.44'

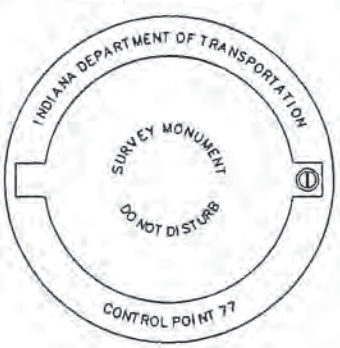
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14290585.10

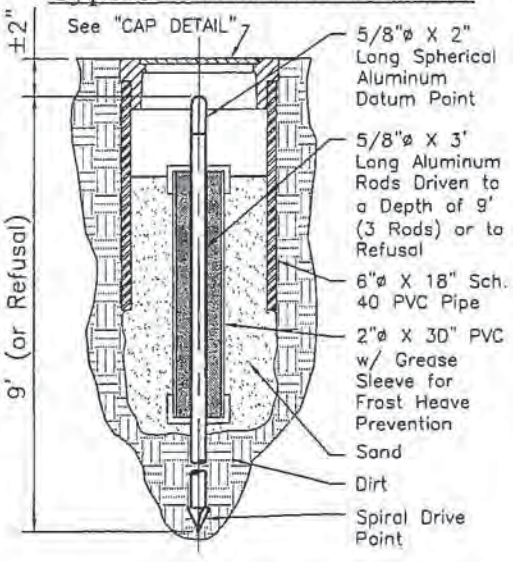
Easting: 1783873.33

Comments: .25' from top of access cover to datum point.

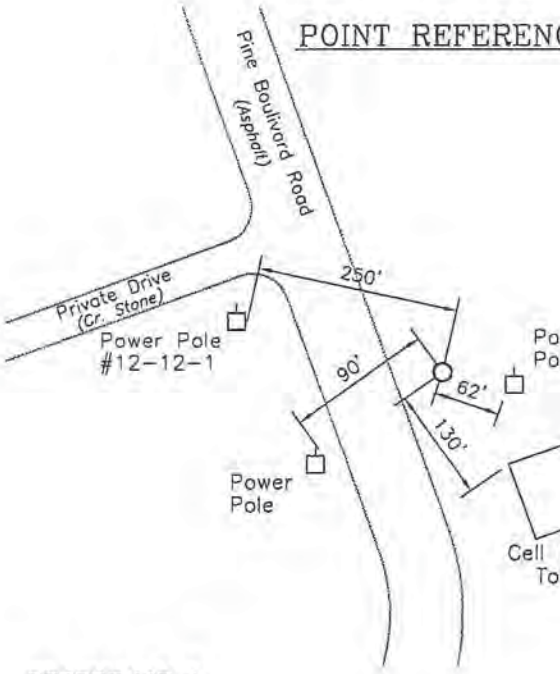
Cap Detail:



Typical Monument Detail:



POINT REFERENC



REFERENCE 1:

*DISTANCE: 82'

DESCRIPTION: East to power pole.

REFERENCE 2:

*DISTANCE: 90'

DESCRIPTION: Southwest to power pole.

REFERENCE 3:

*DISTANCE: 130'

DESCRIPTION: Southeast to cell phone tower

*NOTE: ALL DISTANCES ARE APPROXIMATE A
ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Martinsville Quad County: Morgan

Sec. 18, T11N, R 1E

Control Point: 78

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1509667.65

Easting: 3130066.13

Vertical Datum: NAVD88

Elevation: 593.43'

Horizontal Datum: WGS 1984

Latitude: 39°23'29.43127"

Longitude: 86°27'21.40039"

Ellipsoidal Height: 485.24'

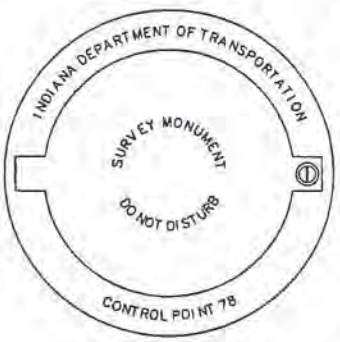
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14305631.98

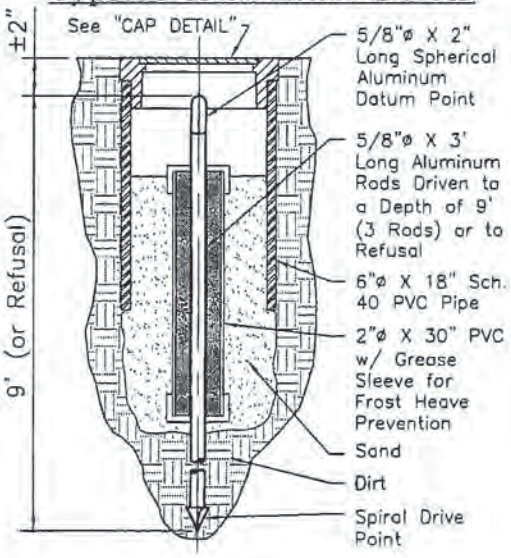
Easting: 1794124.13

Comments: .17' from top of access cover to datum point.

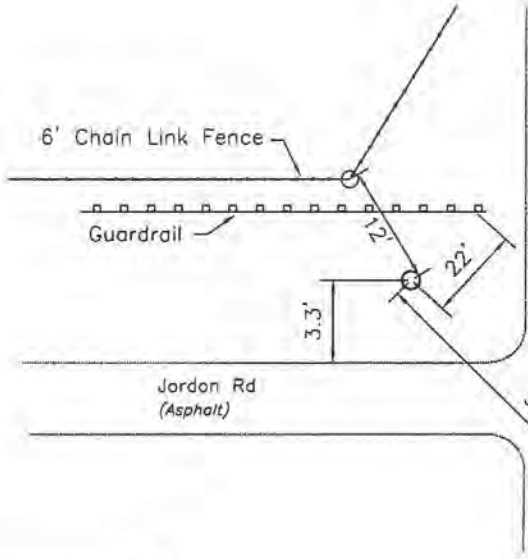
Cap Detail:



Typical Monument Detail:



POINT REFEREN



REFERENCE 1:

*DISTANCE: 3.3'

DESCRIPTION: South to the north edge of J

REFERENCE 2:

*DISTANCE: 12'

DESCRIPTION: Northwest to the corner post

REFERENCE 3:

*DISTANCE: 22'

DESCRIPTION: Northeast to the first post on

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

HORIZONTAL/VERTICAL CONTROL MONUMENT REFERENCE

Location:

Martinsville Quad County: Morgan

Sec. 8, T11N, R1E

Control Point: 79

Horizontal Datum: NAD83 (1997)

Indiana State Plane West

Northing: 1514433.60

Easting: 3131073.85

Vertical Datum: NAVD88

Elevation: 591.25'

Horizontal Datum: WGS 1984

Latitude: 39°24'16.46420"

Longitude: 86°27'08.14070"

Ellipsoidal Height: 483.09'

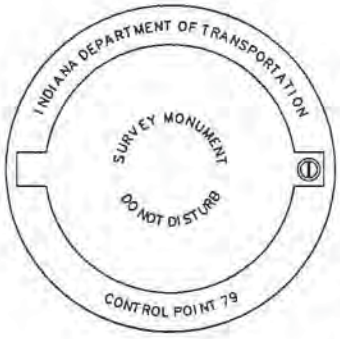
Horizontal Datum: UTM 16 NAD83 (Ft.)

Northing: 14310395.21

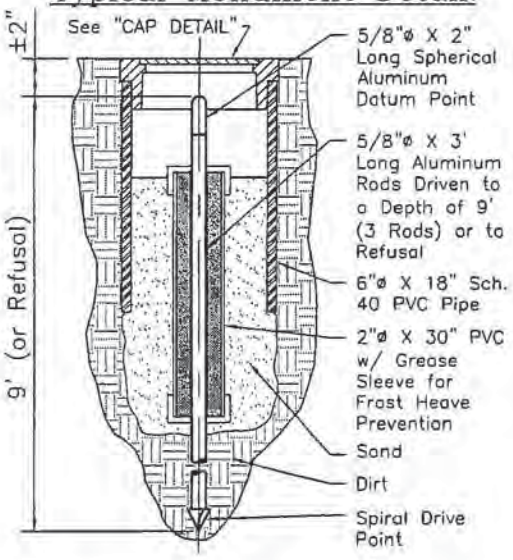
Easting: 1795135.87

Comments: 17' from top of access cover to datum point.

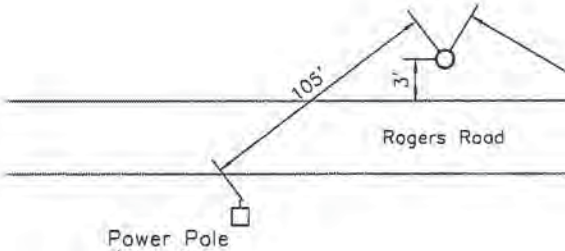
Cap Detail:



Typical Monument Detail:



POINT REFERENC



REFERENCE 1:

*DISTANCE: 3'

DESCRIPTION: South to north edge of Roger

REFERENCE 2:

*DISTANCE: 105'

DESCRIPTION: Southwest to power pole #235

REFERENCE 3:

*DISTANCE: 120'

DESCRIPTION: Southeast to power pole.

*NOTE: ALL DISTANCES ARE APPROXIMATE A ROUGH LOCATION ONLY.

Set Benchmark References

(NOTE: All Elevation Values are Listed in U.S. Feet.)

I-69 Set Benchmark Location Reference Spreadsheet

Benchmark Number	*Elevation (NAVD88)*	*Latitude*	*Longitude*	*County*	*Quad*	*Section, Township & Range*	*Section of Construction*
BM1 (VV)	454.86	38°10'10" N	87°28'13" W	Gibson	Elberfeld	Sec. 13, T4S, R10W	1
BM2 (WW)	406.55	38°13'24" N	87°27'49" W	Gibson	Elberfeld	Sec. 30, T3S, R9W	2
BM3 (K)	421.95	38°15'09" N	87°25'41" W	Gibson	Francisco	Sec. 17, T3S, R9W	2
BM4 (KK)	426.30	38°15'09" N	87°26'29" W	Gibson	Francisco	Sec. 17, T3S, R9W	2
BM5 (L)	455.05	38°16'59" N	87°24'19" W	Gibson	Francisco	Sec. 3, T3S, R9W	2
BM6 (A)	429.79	38°19'36" N	87°23'59" W	Gibson	Francisco	Sec. 22, T2S, R9W	2
BM7 (C)	428.78	38°24'11" N	87°18'54" W	Pike	Petersburg	Sec. 28, T1S, R8W	2
BM8 (E)	447.54	38°28'29" N	87°16'05" W	Pike	Petersburg	Sec. 35. T1N, R8W	2
BM9 (F)	432.15	38°31'02" N	87°14'25" W	Pike	Sandy Hook	Sec. 18, T1N, R7W	2
BM10 (H)	Not Used/Checked Due to CP26 Removal						
BM11 (I)	474.94	38°39'19" N	87°07'35" W	Daviess	Washington	Sec. 30, T3N, R6W	3
BM12 (UU)	453.81	38°42'22" N	87°06'54" W	Daviess	Montgomery	Sec. 7, T3N, R6W	3
BM13 (MT)	458.47	38°43'15" N	87°04'58" W	Daviess	Montgomery	Sec. 4, T3N, R6W	3
BM14 (N)	457.38	38°45'41" N	87°05'00" W	Daviess	Epsom	Sec. 21, T4N, R6W	3
BM15 (O)	490.50	38°48'03" N	87°04'12" W	Daviess	Epsom	Sec. 10, T4N, R6W	3
BM16 (SS)	480.03	38°49'49" N	87°03'37" W	Daviess	Epsom	Sec. 34, T5N, R6W	3
BM17 (Q)	509.41	38°53'43" N	87°02'09" W	Daviess	Lyons	Sec. 1, T5N, R6W	4
BM18 (R)	509.65	38°54'47" N	86°58'41" W	Greene	Scotland	Sec. 33, T6N, R5W	4
BM19 (S)	524.44	38°55'07" N	86°55'19" W	Daviess	Scotland	Sec. 36, T6N, R5W	4
BM20 (U)	528.96	38°57'18" N	86°50'09" W	Greene	Koleen	Sec. 15, T6N, R4W	4
BM21 (V)	615.96	38°57'55" N	86°46'05" W	Greene	Koleen	Sec. 8, T6N, R3W	4
BM22 (W)	722.69	38°59'37" N	86°42'37" W	Greene	Owensburg	Sec. 35, T7N, R3W	4
BM23 (Y)	699.48	39°04'08" N	86°40'22" W	Greene	Koleen	Sec. 15, T6N, R4W	4
BM24 (Z)	648.09	39°04'16" N	86°36'04" W	Monroe	Clear Creek	Sec. 2, T7N, R2W	4
BM25 (AA)	659.88	39°06'42" N	86°32'54" W	Monroe	Clear Creek	Sec. 20, T8N, R1W	5
BM26 (BB)	880.60	39°09'53" N	86°34'25" W	Monroe	Bloomington	Sec. 31, T9N, R1W	5
BM27 (CC)	829.11	39°11'14" N	86°33'21" W	Monroe	Bloomington	Sec. 29, T9N, R1W	5
BM28 (DD)	589.15	39°13'55" N	86°32'26" W	Monroe	Bloomington	Sec. 8, T9N, R1W	5
BM29 (HH)	596.68	39°23'36" N	86°27'23" W	Morgan	Martinsville	Sec. 18, T11N, R1E	5
BM30 (JJ)	625.45	39°28'32" N	86°22'21" W	Morgan	Cope	Sec. 13, T12N, R1E	6
BM31 (PP)	683.32	39°41'32" N	86°12'09" W	Marion	Maywood	Sec. 8, T14N, R3E	6
BM32 (LL)	640.99	39°30'58" N	86°18'09" W	Morgan	Mooresville East	Sec. 34, T13N, R2E	6

Note: Latitude and Longitude on all benchmarks were obtained with handheld GPS units and have an accuracy of ±30'

Miscellaneous Spreadsheets

Contents:

*Monument Location Reference Spreadsheet
*Monument Numbering order Spreadsheet
*Panels, Control Points and Benchmarks
Applicable to Each Tier 2 Study Section

(NOTE: All Northing, Easting and Elevation Values are Listed in U.S. Feet.)

Control Point Number	*Reference Number*	*County*	*Quad*	*Section, Township & Range*	*Section of Construction*
34	TT1	Daviess	Montgomery	Sec. 33, T4N, R6W	3
35	TT2	Daviess	Montgomery	Sec. 34, T4N, R6W	3
36	N1	Daviess	Epsom	Sec. 21, T4N, R6W	3
37	N2	Daviess	Epsom	Sec. 22, T4N, R6W	3
38	O1	Daviess	Epsom	Sec. 9, T4N, R6W	3
39	O2	Daviess	Epsom	Sec. 2, T4N, R6W	3
40	SS1	Daviess	Epsom	Sec. 33, T5N, R6W	3
41	SS2	Daviess	Epsom	Sec. 34, T5N, R6W	3
42	P1	Daviess	Epsom	Sec. 16, T5N, R6W	4
43	P2	Daviess	Epsom	Sec. 15, T5N, R6W	4
44	Q1	Greene	Lyons	Sec. 36, T6N, R6W	4
45	Q2	Daviess	Lyons	Sec.1, T5N, R6W	4
46	R1	Daviess	Scotland	Sec. 5, T5N, R5W	4
47	R2	Greene	Scotland	Sec. 32, T6N, R5W	4
48	S1	Greene	Scotland	Sec. 26, T6N, R5W	4
49	S2	Greene	Scotland	Sec. 36, T6N R5W	4
50	T1	Greene	Scotland	Sec. 29, T6N, R4W	4
51	T2	Greene	Koleen	Sec. 28, T6N, R4W	4
52	U1	Greene	Koleen	Sec. 15, T6N, R4W	4
53	U2	Greene	Koleen	Sec. 11, T6N, R4W	4
54	V1	Greene	Koleen	Sec. 17, T6N, R3W	4
55	V2	Greene	Koleen	Sec. 8, T6N, R3W	4
56	W1	Greene	Owensburg	Sec. 35, T7N, R3W	4
57	W2	Greene	Owensburg	Sec. 2, T6N, R3W	4
58	X1	Greene	Stanford	Sec. 24, T7N, R3W	4
59	X2	Monroe	Stanford	Sec. 19, T7N, R2W	4
60	Y1	Monroe	Stanford	Sec. 6, T7N, R2W	4
61	Y2	Monroe	Stanford	Sec. 6, T7N, R2W	4
62	Z1	Monroe	Clear Creek	Sec. 1, T7N, R2W	4
63	Z2	Monroe	Clear Creek	Sec. 1, T7N, R2W	4
64	AA1	Monroe	Clear Creek	Sec. 29, T8N, R1W	5
65	AA2	Monroe	Clear Creek	Sec. 19, T8N, R1W	5
66	BB1	Monroe	Bloomington	Sec. 31, T9N, R1W	5
67	BB2	Monroe	Bloomington	Sec. 1, T8N, R2W	5
68	CC1	Monroe	Bloomington	Sec. 29, T9N, R1W	5

Control Point Number	*Reference Number*	*County*	*Quad*	*Section, Township & Range*	*Section of Construction*
69	CC2	Monroe	Bloomington	Sec. 30, T9N, R1W	5
70	DD1	Monroe	Bloomington	Sec. 8, T9N, R1W	5
71	DD2	Monroe	Bloomington	Sec. 5, T9N, R1W	5
72	EE1	Monroe	Modesto	Sec. 34, T10N, R1W	5
73	EE2	Monroe	Modesto	Sec. 28, T10N, R1W	5
74	FF1	Morgan	Modesto	Sec. 10, T10N, R1W	5
75	FF2	Morgan	Modesto	Sec. 16, T10N, R1W	5
76	GG1	Morgan	Hindustan	Sec. 26, T11N, R1W	5
77	GG2	Morgan	Hindustan	Sec. 35, T11N, R1W	5
78	HH1	Morgan	Martinsville	Sec. 18, T11N, R1E	5
79	HH2	Morgan	Martinsville	Sec. 8, T11N, R1E	5
80	RR1	Morgan	Martinsville	Sec. 9, T11N, R1E	6
81	II1	Morgan	Martinsville	Sec. 2, T11N, R1E	6
82	II2	Morgan	Martinsville	Sec. 34, T12N, R1E	6
83	JJ1	Morgan	Cope	Sec. 18, T12N, R2E	6
84	JJ2	Morgan	Cope	Sec. 13, T12N, R1E	6
85	KK1	Morgan	Cope	Sec. 7, T12N, R2E	6
86	KK2	Morgan	Mooresville East	Sec. 4, T12N, R2E	6
87	LL1	Morgan	Mooresville East	Sec. 35, T13N, R2E	6
88	LL2	Morgan	Mooresville East	Sec. 27, T13N, R2E	6
89	MM1	Morgan	Mooresville East	Sec. 13, T13N, R2E	6
90	MM2	Morgan	Bargersville	Sec. 18, T13N, R3E	6
91	NN1	Morgan	Bargersville	Sec. 33, T14N, R3E	6
92	NN2	Morgan	Bargersville	Sec. 32, T14N, R3E	6
93	OO1	Marion	Maywood	Sec. 21, T14N, R3E	6
94	OO2	Marion	Maywood	Sec. 22, T14N, R3E	6
95	QQ1	Marion	Maywood	Sec. 9, T14N, R3E	6
96	QQ2	Marion	Maywood	Sec. 10, T14N, R3E	6
97	PP1	Marion	Maywood	Sec. 3, T14N, R3E	6
98	PP2	Marion	Maywood	Sec. 33, T15N, R3E	6

I-69 SECTION 5 PROJECT

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

ATTACHMENT 9-1B

HORIZONTAL & VERTICAL
CONTROL MONUMENTS

I-69 EAST ZONE COORDINATES (U.S. feet)

POINT #	NORTHING	EASTING	ELEV.	DESC.
64	508327.24	1275179.45	0	I-69 MON
65	511796.17	1273545.38	0	I-69 MON
66	529943.01	1271583.66	0	I-69 MON
67	529904.08	1267242.12	0	I-69 MON
68	538010.28	1276337.36	0	I-69 MON
69	538225.73	1272470.18	0	I-69 MON
70	551371.32	1278475.28	0	I-69 MON
71	556762.31	1277462.88	0	I-69 MON
72	566449.94	1284586.19	0	I-69 MON
73	566910.34	1281896.71	0	I-69 MON
74	582788.98	1288895.43	0	I-69 MON
75	579958.44	1283239.48	0	I-69 MON
76	599264.13	1289416.73	0	I-69 MON
77	597595.51	1291822.56	0	I-69 MON
78	612582.26	1302173.92	0	I-69 MON
79	617340.79	1303216.66	0	I-69 MON

UTM COORDINATES (U.S. feet)

POINT #	NORTHING	EASTING	ELEV.	DESC.
164	14201248.40	1767808.56	0	mon-UTM
165	14204705.41	1766153.05	0	mon-UTM
166	14222831.90	1764076.28	0	mon-UTM
167	14222765.25	1759736.85	0	mon-UTM
168	14230926.10	1768776.37	0	mon-UTM
169	14231116.73	1764909.46	0	mon-UTM
170	14244295.08	1770827.91	0	mon-UTM
171	14248677.28	1769781.44	0	mon-UTM
172	14259406.38	1776839.68	0	mon-UTM
173	14259849.36	1774148.41	0	mon-UTM
174	14275766.08	1781042.40	0	mon-UTM
175	14272900.49	1775407.00	0	mon-UTM
176	14292237.58	1781457.81	0	mon-UTM
177	14290585.10	1783873.33	0	mon-UTM
178	14305631.98	1794124.13	0	mon-UTM
179	14310395.21	1795135.87	0	mon-UTM

I-69 SECTION 5

PUBLIC-PRIVATE

AGREEMENT BOOK 2

TECHNICAL PROVISIONS

ATTACHMENT 12-1
QUEUE LENGTH RESTRICTIONS DURING CONSTRUCTION

Attachment 12-1 Queue Length Restrictions During Construction

1 Queue Length Restrictions

The following restrictions shall apply to queue lengths on SR 37 or I-69 where Developer implements single lane closures during the daytime period (6 a.m. to 9 p.m.) on SR 37 or Mainline north of Sample Road.

- No queues of any length shall exceed two continuous hours duration
- Queues greater than 0.5 miles in length shall not exceed one hour.

For the purpose of this Attachment, a queue is defined as the length of the pavement occupied by a line or lines of vehicles travelling below the posted speed limit and shall be measured from the point of the restriction as per Figure 1 -- Queue Length Measurement.

2 Advance Warning Signs

Developer shall provide additional advanced work zone warning signage at the distances noted in the IMUTCD ahead of the queue whenever a queue develops on SR 37 or I-69 within or outside the Project Limits in connection with a single lane closure within the Projects Limits, whether or not such queue was predicted by traffic analysis.

3 Queue Measurement and Monitoring

Developer shall implement queue length and delay measurements whenever a single lane closure north of Sample Road that is included in an approved TTCP is expected to be in place for a period greater than seven days.

For the purposes of taking measurements, the seven days of restriction do not need to be consecutive, and any portion of a day shall be counted as a whole day.

Measurements shall be initiated three days after any of the following:

- An initial traffic maintenance setup
- A change in traffic maintenance phase
- A shift of traffic maintenance from one highway segment to another
- A change in traffic maintenance setup in response to excessive queue lengths
- A significant change in the traffic maintenance setup

Developer shall report measurements at least twice per week during the highest traffic volume period when restrictions are in place.

If a restriction is in place for at least seven consecutive days, Developer shall measure at least once during the highest volume period on a weekend day.

4 Reporting

Developer shall complete a Work Zone Queue and Delay Report in the format shown below each time a set of measurements is taken for submittal to IFA.

INDOT
WORK ZONE QUEUE & DELAY REPORT FORM

Co**ntract No:**

Route & Project Limits/Location:

County:
District:

Occasion:
(see note 1)

Date: / /

Measurement 1:
Direction of Travel: Time: : am/pm
Location of Queue *(see note 2):*
Queue Length: miles Delay: minutes

Measurement 2:
Direction of Travel: Time: : am/pm
Location of Queue *(see note 2):*
Queue Length: miles Delay: minutes

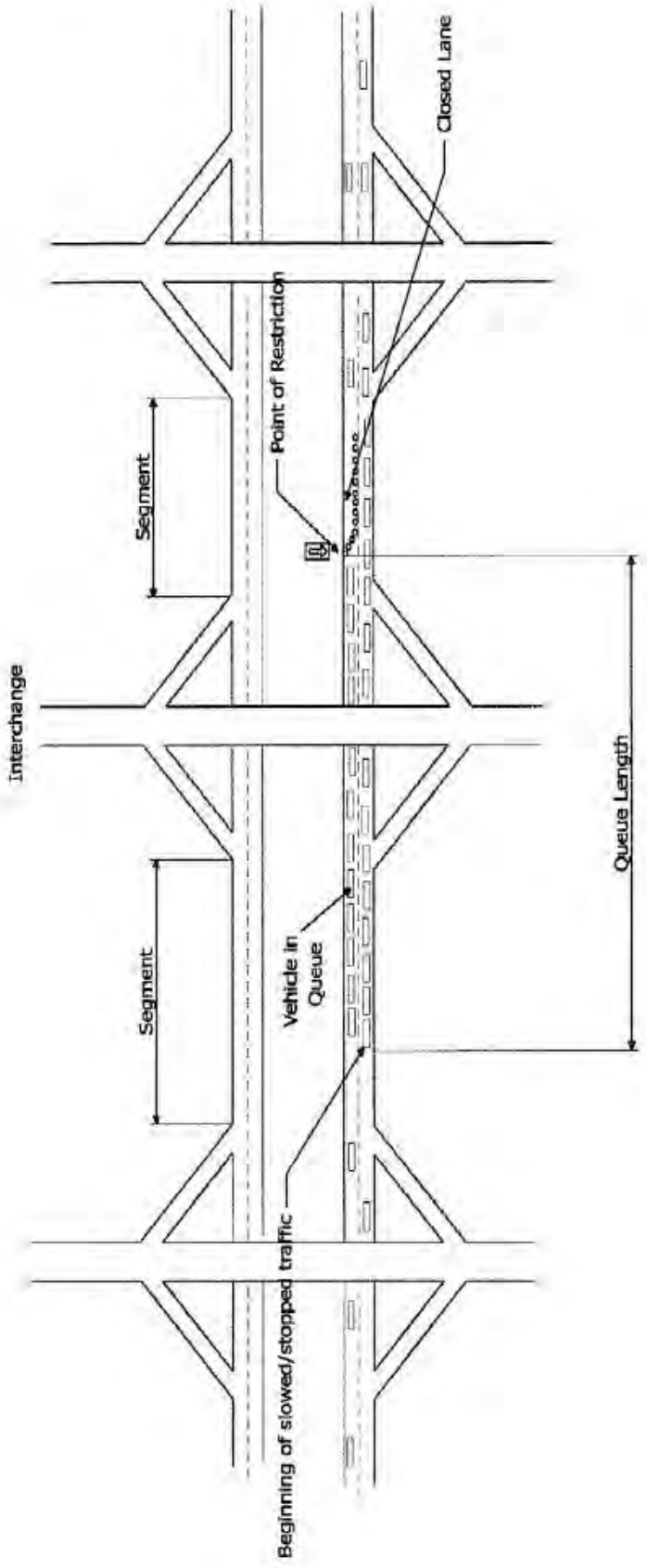
Comments:

Signed,

Project Engineer/Supervisor Report Date

NOTES:
1. Occasion refers to the event (e.g., start of construction, phase change, location change) that is prompting the measurements.

Figure 1 – Queue Length Measurement



I-69 SECTION 5

PUBLIC-PRIVATE

AGREEMENT BOOK 2
TECHNICAL PROVISIONS

ATTACHMENT 13-1
BLASTING OPERATIONS

BLASTING OPERATIONS

Description

This work shall consist of blasting for rock excavation in accordance with 105.03, 203.15 and the requirements herein.

General

All blasting shall be performed in accordance with 675 IAC 26.

Blasting shall only be done between 2 hours after sunrise and 1 hour before sunset. Sunrise and sunset for each day shall be as defined by the US Naval Observatory for the closest available city or town to the project location.

No blasting shall be done on holidays.

Blasting operations may be necessary in rock that contains voids and soft seams.

Developer shall identify existing structures and wells within a 0.5 mi radius of the limits of blasting operations. Pre-blast surveys shall be conducted to document the condition of structures and wells prior to the start of blasting. A copy of the documentation shall be provided to IFA and to the property owner of the structure or well.

Monitoring

Developer shall provide for the services of a specialty subcontractor to perform vibration, airblast and flyrock monitoring. The specialty subcontractor shall also perform pre-blast surveys and documentation and provide shot records as defined herein.

Vibration and airblast overpressure shall be monitored for each shot.

For structures and other property, monitoring locations shall include, but are not limited to the following:

1. At the right-of-way limit closest to the center of the shot, but not to exceed 250 ft from the closest position of explosives for the shot.
2. At the nearest cast-in-place concrete placed on the project within seven days prior to the shot and having a scaled distance of less than 100 $ft/lb^{1/2}$.
3. At a structure for which any of the following conditions apply:
    a. The scaled distance is less than 50 $ft/lb^{1/2}$, or
    b. the estimated particle velocity is greater than 75% of the maximum allowable particle velocity, or
    c. a damage complaint was received on the immediately preceding shot, or
    d. the actual particle velocity on the immediately preceding shot exceeded the estimated particle velocity for that shot by more than 25%.

For commercial building stone and other rock formations, monitoring locations shall include, but are not limited to the following:

1. At the limit of the purchased mineral rights closest to the shot.

2. At the closest rock formation outside of the right-of-way.

Developer shall obtain a written right-of-entry to any private property as necessary to perform pre-blast survey and monitoring activities. If a right-of-entry is not granted by the property owner, Developer shall submit proposed alternate monitoring locations within the right-of-way or on other public lands to IFA for approval.

Each instrument used for vibration monitoring shall have a calibration certificate within an 11-month period prior to the date of use on the project.

A given monitoring location may satisfy more than 1 of the required locations.

Flyrock observations shall be performed as required by 675 IAC 26.

Blasting Plan

A blasting plan shall be submitted to IFA for review and comment. The blasting plan shall be submitted in both hard copy and an electronic format acceptable to IFA. The blasting plan shall include a quality control plan in accordance with the general requirements of ITM 803 and shall include the following:

1. The name of the licensed regulated explosive use-operator that will be in responsible charge of blasting operations and a copy of that person's license issued by the Indiana State Fire Marshall under 675 IAC 26.
2. The name of each licensed regulated explosive use-blaster that will be directing or performing blasting operations and a copy of each person's license issued by the Indiana State Fire Marshall under 675 IAC 26.
3. The name of the specialty subcontractor and the name and qualifications of each of the subcontractor's employees that will be performing pre-blast survey and monitoring activities.
4. A detailed description of the proposed plan for blasting operations, including the following:
    a. A description of the proposed drilling methods that will be used and the proposed methods to identify and record voids and soft seams within each shot-hole. The plan shall include an example of a shot-hole drill log to be used. The drill log shall at a minimum indicate a general rock description, drilling penetration rate and the means to convey the depth range of voids and soft seams that are encountered.
    b. A description of the proposed blasting methods that will be used and the planned sequence of blasting operations through the project, including what methods will be used to prevent damage to structures, rock formations, commercial building stone formations and other property outside the right-of-way and new construction within the right-of-way.
    c. A description of specific safety practices that will be used.
    d. Full size, 24″ x 36″ plan sheets showing all proposed blasting areas indicating the station and offset limits of each area.
    e. Full size, 24″ x 36″ profile sheets showing the existing and proposed profile grades and the station limits and elevations of each blasting area.

f. Examples of the forms and format to be used for submittal of shot plans.

5. A detailed description of the proposed methods for monitoring vibrations, airblast and flyrock, including the following:
   a. The proposed maximum particle velocity and airblast overpressure criteria for monitoring structures, rock formations, commercial building stone formations and other property outside the right-of-way and new construction within the right-of-way.
   b. Examples of the forms and format to be used for submittal of shot records.
6. A detailed description of the plan for pre-blast surveys, including how locations will be determined, how contact will be made with property owners, and what information will be gathered as part of the surveys.
7. A detailed description of how alleged damage claims will be resolved.

The blasting plan shall be maintained and revised as necessary during the Project. Revisions shall be submitted to IFA for review and comment a minimum of five Business Days prior to any changes being implemented.

Pre-Construction Meeting and Coordination

Developer shall schedule a pre-construction meeting with IFA to be held a minimum of 14 days prior to the start of blasting operations. Developer shall provide a review of the blasting plan and the plan of operations for blasting including methods for blasting rock that contains voids and soft seams. Any outstanding issues from the blasting plan shall also be discussed.

If a building stone company has limestone deposits within 1 mile of any point along the right-of-way, Developer shall invite representatives of the company to attend the meeting and shall discuss the methods that will be used to prevent damage to any building stone formations. Developer shall notify a representative of each building stone company a minimum of seven days prior to the start of blasting operations and shall allow for representatives of the company to be present on-site during blasting and monitoring activities.

Shot Plans

Developer shall prepare a shot plan for each blast. No less than 1 hour prior to each shot, a hard copy of the shot plan shall be delivered to IFA and an electronic copy sent via email to a distribution list provided by IFA. A concluding shot plan shall be delivered to IFA and an electronic copy sent via email to the distribution list provided by IFA within five Business Days following the last shot. The concluding shot plan shall report on the last shot’s damages and impediments, and provide any remaining reporting for all prior shots that have an unresolved issue concerning damage from such prior shots.

Each shot plan shall be signed by the licensed explosive use-blaster and shall include the following:

1. The date and order number of the shot.
2. The shot-hole drill log that indicates the known voids and soft seams encountered during drilling. The licensed regulated explosive use-operator shall review the drill log and shall acknowledge review by initialing the first page of each drill log.
3. Details, including tables, maps and plan sheets showing the actual shot-hole positions and charge placement.

4. The GPS horizontal location of the outermost shot-holes and the lift elevations.
5. The total weight of explosives placed.
6. The total number of holes to be shot.
7. Whether decking or delays within a single hole will be used.
8. A table of the shot-hole data by the ascending time order of delays for the shot. Each shot-hole shall be a row in the table with columns providing the number of the hole, its depth, depth in rock, depth of stemming, charge weight within the hole and total delay time for the hole.
9. Maximum charge weight per delay for the shot.
10. Powder factors, both in charge weight per cubic yard of material shot and in charge weight per foot of total shot-hole depth.
11. A table of monitoring locations. Each location shall be a row in the table with columns providing the monitoring location's or nearest structure's name or number, the closest approach to the blast, scaled distance for monitoring location or structure, the estimated particle velocities and airblast overpressures calculated for the monitoring location or nearest structure and the procedure for controlling flyrock.
12. The location of the blast pattern on a plan map of the project.
13. A large-scale plan map depicting the shot pattern, firing order and delays to be employed.
14. A generalized elevation sketch of a typical hole depicting sub-drilling, decking charges, locations of explosives and stemming, and the locations of primers and boosters.
15. A section on prior shots that includes, but is not limited to, the following events:
    a. An injury or a complaint of damage due to blasting.
    b. A flyrock projectile thrown a sizable distance or endangering either personnel or property.
    c. A shot that either exceeded maximum particle velocity or airblast overpressure limits, or recorded maximum particle velocity or airblast overpressure 25% greater than that estimated for the shot.
    d. A misfire, including any portion of the pattern not firing or a delay being skipped.
16. The section on prior shots shall reference:
    a. The date and order number of the shot.
    b. Any alleged damage due to an earlier shot.
    c. Any impediments or problems with the shot.
    d. If the shot was an aborted or delayed shot.
    e. Vibration and airblast data that exceeded contract limits or that were 25% greater than the prior shot plan's estimate, including the monitoring location, the estimated and recorded peak values of particle velocity and airblast overpressure, the monitoring equipment's manufacturer, model, serial number and last calibration date, and the closest approach to the blast. A brief narrative shall describe the cause of each difficulty, and the means to avoid its future occurrence.
    f. Methods or procedural changes to correct blasting problems in future shots.

Shot Records

Developer shall submit a shot record for each blast to IFA. No more than one Business Day after each shot and no less than 1 hour prior to a subsequent shot, whichever occurs first, a paper copy of the shot record shall be delivered to IFA and an electronic copy sent via email to a distribution list provided by IFA.

Each shot record shall be signed by the person in responsible charge for the specialty subcontractor and shall include the following:

1. The date and order number of the shot.
2. A narrative description of monitoring performed for the shot.
3. Details, including tables, maps and plan sheets that compare the blast's charge placement and parameters and its estimates of the vibration and airblast values to the recorded particle velocity and airblast overpressure.
4. The GPS horizontal location and approximate elevation for all the monitoring locations and nearby structures.
5. The monitoring equipments' manufacturer, model, serial number, and the last calibration date by location.
6. The total weight of explosives shot, reduced by the charge weight of any explosives that did not detonate.
7. The total number of holes shot.
8. The actual maximum charge weight per delay for the shot, recomputed if necessary.
9. The powder factors, both in charge weight per cubic yard of material shot and in charge weight per foot of total shot-hole depth, recomputed if necessary.
10. A table of monitoring locations. Each location shall be a row in the table with columns providing the monitoring location's or nearest structure's name or number, the closest approach to the blast, scaled distance for monitoring location or structure, the estimated particle velocities and airblast overpressures reported in the shot plan for the monitoring location or nearest structure, the actual recorded peak particle velocities and airblast overpressures for the monitoring location or nearest structure and the percentage of the actual values in relation to the estimated values.
11. The recorded values for the three vector components of particle velocity and airblast overpressure.
12. A narrative of flyrock observations and measurements, if an observation was made.
13. The location of the blast pattern on a plan map of the project with the monitoring locations and nearest structures of interest shown.
14. A graph, in logarithmic scales on both axis, of particle velocity versus scaled distance from all prior shots in the same geologic formation.

I-69 SECTION 5

PUBLIC-PRIVATE

AGREEMENT

BOOK 2
TECHNICAL PROVISIONS

ATTACHMENT 13-2
SITE-SPECIFIC DESIGN REQUIREMENTS FOR ROCK CUT SLOPES

Attachment 13-2
Site-Specific Design Requirements for Rock Cut Slopes

Developer's design for rock cuts shall:
(i) Be based on a site-specific geotechnical exploration taking into consideration safety and future maintenance requirements extending beyond the Term of the Agreement.
(ii) Use all appropriate information regarding the site geology and the condition of cut slopes in similar geology within proximity to the Project to determine the appropriate slope configuration.
(iii) Take into consideration lithology, rock properties, and bedrock structure.
(iv) Use properties such as intact rock strength, rock durability, fracture frequency, regional joint characteristics, and other common rock properties.
(v) Address causes of degradation and failure of rock cuts arising from differences in durability of rock units and intersecting discontinuities.
(vi) Where interlayered units exhibit significant stratigraphic variations, take into account these variations in cut slope design recommendations.

Developer's design for benches shall:
(i) Consider specific widths of benches to be adopted for incompetent design units of differing thickness.
(ii) Consider bench design where permeable formations overlie impermeable ones (including areas of fractured flow), which may indicate potential aquifer zones.
(iii) Include requirements for benches along the contact between competent-incompetent rock units where groundwater is encountered or anticipated to collect seeping water

Developer's design for rockfall catchment shall:
(i) Take into consideration that rock slopes that have been determined to be globally stable will not necessarily be safe with regard to rockfall.
(ii) Be based on the principle that although some component of rockfall may result from triggering events, such as rainfall, another component of rockfall occurs in the absence of any obvious triggering mechanisms.
(iii) Be based on an understanding of local situations where rock discontinuities form blocks in competent units, which are underlain by easily erodible incompetent units.
(iv) Include a rockfall catchment design criterion that will ensure a specified percentage of rockfall catchment at the edge of pavement (typically edge of paved shoulder).
(v) Consider the appropriate sizing of a catchment area as the primary method of control, with other rockfall control and protection methods beyond catchment ditches that may include walls, barriers, wire mesh fences, and mesh slope drapes.

I-69 SECTION 5

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

ATTACHMENT 14-1
FIBER WRAP CONCRETE CASING SYSTEM PROVISIONS

FIBER WRAP CONCRETE CASING SYSTEM

Description

This Work shall consist of providing reinforced concrete strengthening using fiber reinforced (FRP) composite systems. The fiber reinforced composite system shall be field applied to the existing concrete pier caps and columns to obtain the required additional flexural capacity, as shown in the Design Documents.

Materials

The materials and installation direction for this Work shall be supplied by:

1. Fyfe Co. LLC
   Nancy Ridge Technology Center,
   6310 Nancy Ridge Drive, Suite 103,
   San Diego, CA 92121.
   Tel: 858.642.0694,
   Fax: 858.6420.0947, or

2. QuakeWrap, Inc.
   237 N. Vine Ave.,
   Tuscon, AZ 85719-5552.
   Tel.: 520.791.7000,
   Fax: 520.791.0600, or

3. Vector Corrosion Technologies
   103 Warlington Circle,
   McMurray, PA 15317.
   Tel.: 724.941.2096,
   Fax: 724.942.4456.

4. Or approved equal

Materials shall be delivered to the Project site in factory-sealed containers with the manufacturer’s labels intact and legible with verification of date of manufacture and shelf life. Products shall be stored according the manufacturer’s requirements and shall avoid contact with moisture. All materials supplied shall have a Type B certification in accordance with 916 of the Standard Specifications.

(a) Submittals

The following items shall be submitted by Developer prior to beginning this Work:

1. ASTM E84 (flame and smoke) test results. Provide the minimum of a Class 1 rating for the system.

2. Independent test report showing system environmental durability on the proposed composite to be used; including a minimum of 10,000 hour resistance to salt water, alkali soil, and 100 percent humidity. Material shall maintain design properties as described herein.

3. Freeze-thaw resistance tests (minimum 20 cycles). Material shall maintain design properties as described herein.

4. Certification from the manufacturer of the system's material properties including previously completed ASTM D3039 test results of the proposed system.

5. Complete shop drawings containing details of the number and thickness of layers, joint and end details and locations to satisfy project requirements.

6. Design calculations for the composite system submitted for approval by IFA, stamped by a registered civil engineer.

7. Applicator project references from at least 10 previously completed projects using the proposed FRP system in the last two years.

8. Supply the names of at least 3 individuals who have been certified and trained by the FRP system manufacturer and who will be on site during all phases of the project.

9. Written certification from the composite system manufacturer showing the names of at least 3 trained personnel who will be on the jobsite during all phases of the installation.

10. A list of at least 2 different qualified testing laboratories that can perform the required ASTM D3039 tests as per this specification.

Design the composite system, per ACI 440.2R-02 and/or ICC ES AC125 design criteria, to achieve the structural performance shown on the Design Documents. Design calculations for the composite system shall be submitted for approval by IFA, and shall be stamped by an Indiana registered professional engineer.

Developer shall require approval in writing prior to beginning Work.

(b) Composite Strengthening System.

The composite strengthening system shall be TYFO FiberWrap by Fyfe Co., QuakeWrap products by QuakeWrap, Inc., X-Mesh Gold by Vector Corrosion Technologies, or approved equal.

Construction Requirements

This Work shall be performed by an applicator with proven past experience applying the approved composite system for a minimum of 10 projects in the past 2 years with over 100 elements strengthened. The applicator shall supply the names of at least 3 individuals who have been certified and trained by the FRP system manufacturer and who will be on site during all phases of the project. IFA shall have the right to approve or reject the personnel qualifications as submitted. IFA may suspend the work if Developer substitutes unauthorized personnel for authorized personnel during construction.

The composite system applicator shall submit a written description of the proposed epoxy, including VOC levels, and a complete written description of the application procedures for review and comment by IFA. The applicator must be certified by the manufacturer/supplier and provide a quality control procedure in accordance with this specification.

The supply and installation of the composite system shall meet the performance criteria of this specification and as stated on the Design Documents. Calculations to determine the installed composite thickness are to be supplied for approval by IFA.

This Work shall be completed per manufacturer/supplier requirements.

Field Quality Control Procedures

The application and testing of this Work shall be done in accordance with the following field quality control procedures:

(a) Installers

Installers shall record batch numbers for fabric and epoxy used each day, and note locations of installation. Measure square footage of fabric and volume of epoxy used each day. Complete report and submit to IFA and the system manufacturer.

(b) Inspection

A certified Special Inspector, approved by IFA, shall periodically observe all aspects of preparation, mixing, and application of materials, including the following:

1. Material container labels
2. Surface Preparation
3. Mixing of epoxy
4. Application of epoxy to the fiber
5. Application of composite system
6. Curing of composite material
7. Preparation and labeling of test samples.
8. Supervise all adhesion (ASTM D4541) testing (if required)
9. Visual inspections and sounding of the installed composite.

The composite casing shall be completely inspected by the Special Inspector during and immediately following application of the composite. Developer shall monitor the mixing of all epoxy components for proper ratio and adherence to manufacturer’s recommendations.

(c) Visual Inspection and Sounding of Installed Concrete

All installed areas shall be visually inspected by the Special Inspector. The installed composite should appear to be completely adhered to the concrete substrate with no bubbles or voids. Any suspect areas should be sounded with a ball peen hammer. A light tapping will indicate the presence of any voids behind the installed composite. All defects shall be reported to IFA and repaired as described below in this specification.

(d) Laboratory Testing

Record lot number of fabric and resin used and location of installation. A “sample batch” shall consist of two 12in. by 12in. samples of cured composite. A minimum of 2 sample batches shall be made daily. The 2 sample batches shall be taken at appropriate times during the day so as to ensure the maximum material deviance in the components of the composite. Testing laboratory shall pre-condition samples at 140º F for 48 hours before testing. Samples shall be tested, at random, at IFA’s discretion.

Tested samples shall be tested per ASTM D3039. The 12in. x 12in. panel shall have 5 coupons, ¾in. x 9in., removed and tested for their material properties in the longitudinal (primary fiber) direction. Tests shall conform to ASTM procedures and manufacturer's published testing methods. Only pre-qualified testing laboratories shall be used.

Testing results shall be made available within 3 weeks of sample submission. The testing shall provide average values of the following:

1. Ultimate tensile strength
2. Tensile Modulus
3. Percent elongation

15 percent of all sample batches shall be tested. If one 12 in. by 12 in. sample fails (on average), specimens from the same sample shall be tested. If these specimens also fail (on average), the other 12 in. by 12 in. from the same sample batch shall be tested. In the extreme case that this sample also fails, the remaining sample batch for that day shall be tested and appropriate remedial measures will be taken, as described below in this specification, to ensure integrity of the system from the failed sample batch. In addition, 25 percent of the remaining sample batches will then be tested by the same criteria.

(e) Substrate Adhesion Testing

Direct tension adhesion testing of cored samples shall be conducted using the method described by ASTM D4541. A minimum of 3 tests shall be performed for each day of production or for each 500 square feet of FRP application, whichever is less.

Pull-off tests shall be performed on a representative adjacent area to the area being strengthened. Tests shall be performed on each type of substrate or for each surface preparation technique used.

The prepared surface with 1 layer of the bonded FRP system shall be allowed to cure a minimum of 48 hours before execution of the direct tension pull-off test. The locations of the pull-off tests shall be representative and on flat surfaces. If no adjacent areas exist, the tests shall be conducted on areas of the FRP system subjected to relatively low stress during service. The minimum acceptable value for any single tension test is 175 psi. The average of the 3 tests at each location shall not be less than 200 psi. Additional tests may be performed to qualify the work. The tension adhesion tests shall exhibit failure of the substrate indicated by a layer of concrete or masonry on the underside of the test puck following the test.

(f) Repairs

All defects, including bubbles, delaminations, and fabric tears, spanning more than 5 percent of the surface area, or as specified by IFA, shall be repaired. Two types of repairs shall be performed:

1. Small defects (on the order of 3 in. diameter) shall be injected or back filled with epoxy.

2. Large defects shall be repaired as required by this specification and by the manufacturer’s specifications.

Small entrapped air pockets and voids naturally occur in mixed resin systems and do not require repair or treatment. Defect repair shall be provided by the manufacturer and be submitted to IFA for approval.

(g) Remedial Measures

In the event that material testing determines a sample batch to possess insufficient material properties, remedial measures shall be taken. If the tested composite system has material properties determined to be below the minimum specified values, additional layers shall be installed until the final composite thickness is increased by the same percentage as the deficiency of the material’s elastic modulus.

I-69 SECTION 5

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

ATTACHMENT 14-2
STRUCTURAL MASS POUR CONCRETE PROVISIONS

STRUCTURAL MASS POUR CONCRETE

Description

The purpose of this Work is to produce a concrete structural element, of large cross section, that is free of cracks resulting from thermal gradients created by the heat of hydration during the curing process. This is to be accomplished through appropriate mix design and management of the concrete temperature and temperature differential. Structural mass pour concrete is defined as any concrete placements with a least dimension greater than 5.0 feet and as indicated on the Design Documents. This specification does not apply to concrete placed in drilled shafts.

Materials

The mass pour concrete structural element shall utilize Class A concrete in accordance with 702.02 and 702.03, except as follows:

1. The coarse aggregate shall be size No. 5 or No. 8. An AASHTO M 43 size coarse aggregate meeting the gradation requirements of #467, #4 or #357 may be used if approved by IFA. In addition, the minimum clearance between steel reinforcement shall be at least 1.5 times the nominal maximum size of the coarse aggregate.
2. Cooling of materials prior to addition to the mixer will be allowed to reduce the temperature of the concrete in its plastic state. The normal practices as identified in ACI 207.4R – 05 are considered acceptable for pre-cooling materials prior to and at the time of concrete batching.
3. Other acceptable methods that are developed by Developer and approved by IFA in writing may be used.
4. Concrete designated as sulfate resistant on the Design Documents shall incorporate one of the following options for materials and proportioning.
    a. Use a Type V portland cement meeting the requirements of AASHTO M 85, from a source on the Department’s list of approved cement sources. Proportioning of the Class A mix shall be in accordance with 702.02 and 702.05 except that cement reduction and replacement with a pozzolan is not allowed.
    b. Use a Type II portland cement. Proportioning of the Class A mix shall be in accordance with 702.02 and 702.05 except that the water/cementitious ratio shall not exceed 0.450.
    c. If approved by IFA, a Type I Portland cement and a fly ash may be used. Proportioning of the Class A mix shall be in accordance with 702.02 and 702.05 except that the water/cementitious ratio shall not exceed 0.440. In addition, the cement shall be tested in combination with the fly ash to establish sulfate resistance according to Procedure A, in Table 4 of AASHTO M 295. The tested material shall meet the requirements for moderate sulfate resistance. Approval will be based on a Type A Certification in accordance with 916.02, except that the samples of cement and fly ash do not have to be from material shipped to the contract. The cement and fly ash used to evaluate sulfate resistance shall be tested for compliance with AASHTO M 85 and M 295, respectively; and the results reported with the Type A certification.

Cement used in the job concrete shall have a C_3A content that does not exceed the amount determined for the cement sample tested for sulfate resistance or 10.0%, whichever is lower.

Thermal Control

The maximum concrete temperature at time of placement shall not exceed 70°F and shall not be less than 40°F. The maximum concrete temperature during the period of heat dissipation shall not exceed 150°F. The temperature differential between the interior of the section and the outside surface of the section shall not exceed the limits specified in the following table:

Hours After Placement Hours	Maximum Temperature Differential °F
0-24	20
24-48	30
48-72	40
>72	50

Thermal control of each placement shall be maintained until the temperature of the interior is within 50°F of the average outside air temperature. The average outside air temperature shall be determined by averaging the daily high and low temperature of the preceding seven calendar days.

Thermal Control Plan

A thermal control plan shall be written to describe the procedures used during the period of heat dissipation following concrete placement. The thermal control plan shall describe the procedures used to ensure that the maximum temperature and temperature differential between the interior of the section and the outside surface of the section do not exceed the restrictions specified. The thermal control plan shall be submitted to IFA for approval at least 30 days before the first intended structural mass pour concrete placement. Compliance with this specification may result in long cooling times. Therefore, consideration shall be given to options that control heat of hydration that are compatible with the desired construction schedule and erection procedures.

Mass pour concrete shall not be placed until the thermal control plan has been approved by IFA, and the equipment and materials necessary to facilitate the plan are on site and ready for use.

For mass pour concrete placements, the thermal control plan shall be developed by an Indiana licensed Professional Engineer who is competent in the modeling, design, and temperature control of mass pour concrete in structural elements. The Professional Engineer shall be known as the Thermal Control Engineer (TCE). The TCE shall be knowledgeable of Section 207.02R-95 of the ACI Manual of Concrete Practice entitled “Effect of Restraint, Volume Change and Reinforcement on Cracking of Mass Concrete“. The TCE shall follow the guidelines outlined in Section 207.4R-05 of the ACI Manual of Concrete Practice entitled “Cooling and Insulating Systems for Mass Concrete” to formulate, implement, administer, and monitor a thermal control plan.

The TCE shall have administered at least three mass pour concrete projects of similar dimension and thermal control requirements to those shown on the Design Documents and the projects must have been completed within the past three years. The TCE shall be responsible for making adjustments as necessary to ensure compliance with these specifications.

The thermal control plan shall include, but is not limited to the following:

1. The mix design for the mass pour concrete.
2. The adiabatic heat generation for the mix design being used. This shall be determined by laboratory testing in accordance with ASTM C 186.
3. Identification of any modeling software used to predict maximum temperature and temperature differential resulting from the heat of hydration generated in mass pour concrete.
4. Methods to monitor and control the maximum temperature and the temperature differential temperature within the concrete to prevent thermal cracking. Method(s) of curing and a remedial action plan shall be defined.
5. List at least three mass pour concrete projects of similar dimension and thermal control requirements to those shown on the Design Documents. The projects must have been administered by the TCE and must have been completed within the past three years. The list of projects shall include the names and phone numbers of the owner’s representative who can verify the TCE’s participation on those projects.
6. Qualifications of all technicians employed to inspect or monitor mass pour concrete placements.
7. If necessary, design of a post-cooling system consisting of non-corrosive piping to be embedded in the structural mass. Details of the grouting operations shall be provided. The grout shall be a pre-packaged material and shall be identified in the plan.
8. Provide information on the temperature sensing and recording equipment to be used and the details of the installation and location of the temperature probes for each planned mass pour concrete placement.
9. Details of mass pour concrete placement to ensure prevention of cold joints during placement.

Temperature Sensing and Recording

For each placement of structural mass pour concrete, two temperature sensors shall be installed at each of the following five locations (for a total of ten temperature sensors). Additional sensors may be installed at other locations within the concrete placement, as required and detailed in the thermal control plan.

- Center of the placement.
- Midpoint of the side which is the shortest distance from the center, having 2-3 inches of cover.
- Midpoint of the top surface, having 2-3 inches of cover.
- Corner of the placement which is furthest distance from the center, having 2-3 inches of cover.
- Air temperature.

The purpose of the two sensors at each location is to provide a primary sensor and secondary back up sensor. A back-up readout device for the sensors shall also be provided. The back-up system is intended to be used to complete the monitoring of a placement should the primary system fail.

Temperatures shall be electronically recorded automatically by an approved recorder furnished by Developer. The equipment shall be capable of continuously recording at least one reading every 30 minutes for the duration of the mass concrete temperature monitoring period. The sensors and recorder shall be accurate to within ± 2°F in the temperature range of the 32°F to 212°F.

Production

The TCE, or qualified technician employed by the TCE, shall personally inspect and approve the installation of monitoring devices and verify that the process for recording temperature data is effective for the first placement of each size and type of mass pour concrete component. Recording of temperature data shall begin when the mass pour concrete placement is complete and shall continue past the maximum temperature differential (not maximum temperature) and a decreasing temperature differential is confirmed for compliance with these specifications. For placements other than the first, a qualified technician may inspect and monitor the temperature sensing and recording system for the purpose of:

1. Reviewing temperature data.
2. Being in contact with the TCE should adjustments be made as a result of the temperature differential being exceeded.
3. Implement adjustments to temperature control measure as directed by the TCE.
4. If conditions change, such as a drop in the ambient temperature or a change in insulation resulting in an increase in the temperature differential, the recording of the temperature data shall be resumed. A copy of all recorded temperature data shall be furnished to IFA as they are determined.

The TCE or qualified technician shall report temperature data at intervals not exceeding four hours. The TCE shall furnish IFA a final report within three days of completion of monitoring of each structural element. The report shall include all recorded temperature data and pertinent information and actions taken to implement the thermal control plan.

If the maximum concrete temperature or differential temperature within the structural mass pour concrete placement exceeds the specified limits, immediate corrective action as directed by Developer or the TCE shall be taken. Future placement of structural mass pour concrete will be suspended and a revised thermal control plan shall be submitted to IFA for approval. Further placement of mass pour concrete shall not occur without written approval from IFA.

Acceptance

Application of loads and acceptance of concrete shall be in accordance with 702.24, except that sulfate resistant concrete will be tested for compliance based on flexural strength of beam specimens. ITM 402 may be used as an alternate method to determine flexural strength.

If the maximum temperature of the mass pour concrete after placement exceeds 150°F, but is less than 160°F, the concrete will be accepted if no cracking or other unacceptable defects are identified. If cracking or unacceptable defects are identified, the mass pour concrete will be adjudicated as a failed material in accordance with normal Department practice as stated in 105.03. If the maximum concrete temperature equals or exceeds 160°F, the mass pour concrete will be adjudicated as a failed material in accordance with normal Department practice as stated in 105.03.

If a temperature differential between the internal center of concrete placement and the concrete 2–3 inches from the exposed surface exceeds the specified amount, the concrete will be accepted if no cracking or other unacceptable defects are identified. If cracking or unacceptable defects are identified, the mass pour concrete will be adjudicated as a failed material in accordance with normal Department practice as stated in 105.03.

IFA will inspect the concrete for cracks after the temperature monitoring is discontinued. Developer shall provide access for IFA to conduct the inspection. A crack may require repair by Developer as determined by IFA. Developer shall be responsible for repair of cracks as identified by IFA. An INDOT clear concrete sealer shall be applied in accordance with 709 to a crack that is less than 0.007 inches in width. A crack that is 0.007 inch or greater in width shall be repaired by epoxy injection in accordance with 727.

I-69 SECTION 5

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

ATTACHMENT 14-3
EXISTING OVERLAY REMOVAL, HYDRODEMOLITION AND LATEX MODIFIED CONCRETE REPLACEMENT OVERLAY FOR BRIDGE DECK PROVISIONS

EXISTING OVERLAY REMOVAL, HYDRODEMOLITION AND LATEX MODIFIED CONCRETE REPLACEMENT OVERLAY FOR BRIDGE DECK

Description

This Work shall consist of the removal of an existing bridge deck overlay followed by preparation of the exposed bridge deck surface in accordance with 722, and shall involve milling and the use of hydrodemolition. Subsequent to the deck preparation, the Work shall consist of constructing a latex modified portland cement concrete overlay.

Materials

Materials shall be in accordance with 722.02.

Storage and Handling of Materials

Storage and handling of materials shall be in accordance with 722.03.

Construction Requirements

Removal of Existing Concrete Overlay and Deck Scarification

The entire bridge deck overlay shall be removed in accordance with 722.05. After the overlay removal, an additional 1/2 inch scarification of the bridge deck surface shall be conducted. The overlay removal and deck scarification operation shall be limited to that portion of the bridge deck that is closed to traffic at any one time.

Removal of the existing overlay and additional 1/2 inch of bridge deck scarification shall be performed with a power operated mechanical milling machine capable of scarifying existing overlay and bridge deck concrete to the required depth. The equipment shall be self-propelled with sufficient power, traction and stability to maintain accurate depth of cut and slope. The equipment shall be capable of accurately and automatically establishing profile grades along each edge of the machine by referencing the existing bridge deck by means of a ski or matching shoe.

If the use of mechanical scarifying equipment results in the snagging of the top mat of steel reinforcement, the milling operation shall be stopped and depth of removal adjusted. Any damaged reinforcing bars shall be repaired by the Developer.

Concrete Bridge Deck Removal by Hydrodemolition

The purpose of this operation is to remove all unsound concrete and prepare the bridge deck surface, using hydrodemolition in accordance with 722.05 (a) 2., for new overlay placement. The hydrodemolition equipment shall be a self-propelled computerized robot that utilizes a high pressure water jet stream capable of removing concrete as specified herein, as well as removing rust and concrete particles from exposed reinforcing steel.

After removal of the existing concrete overlay and deck scarification, the Contractor shall clean the milled deck surface in accordance with 722.05.

Prior to the commencement of the removal operation with hydrodemolition, the equipment shall be calibrated on an area of sound original deck concrete. The Developer shall verify the following settings:

1. Water pressure gauge (13,000 psi minimum).
2. Water usage (55 gallons per minute, minimum)
3. Machine staging control (step)
4. Nozzle size

5. Nozzle speed (travel)

The equipment shall then be moved to a known delaminated area to verify that initial settings will remove all unsound concrete within the designated area. The initial settings may need to be adjusted, within the limits established above, in order to achieve total removal of unsound concrete. IFA shall be notified of the final equipment settings resulting from the calibration process.

After calibration of the equipment, concrete removal by hydrodemolition shall be conducted on the bridge deck. The removal shall be verified every 30 ft along the cutting path. The equipment settings shall be documented. Calibration of the hydrodemolition equipment shall be conducted for every day of operation and, if necessary, re-calibrated to ensure removal of known areas of delaminated concrete as well as to guard against removal of sound concrete. Handchipping shall be used in areas that are inaccessible to the self-propelled hydrodemolition equipment. Handchipping tools may be hand or mechanically driven and operated.

The Developer shall submit a plan for approval for control and filtering of all water discharged during hydrodemolition operations to produce visibly clear water prior to release to the surrounding environment. The Developer shall block all drains on the deck and install dams to strain the runoff every 150 ft or less, along the drainage path. The dams shall be constructed from aggregate or straw having minimum dimensions of 6 in. in height, by 1 ft in width. The exposed bridge deck shall be used as a settlement basin for runoff. An additional settlement basin outside the limits of the bridge deck may be required if further straining is necessary.

The Developer shall provide shielding to ensure containment of all dislodged concrete during hydrodemolition operations to prevent damage to surrounding property and from flying debris both on and under the work site.

Cleaning of the hydrodemolition debris and slurry shall be performed with a vacuum system equipped with fugitive dust control devices and capable of removing wet debris and water in the same pass. The vacuum equipment shall be capable of washing the deck with pressurized water during the vacuum operation to dislodge all debris and slurry from the bridge deck surface. Cleaning shall be done before any debris or slurry is allowed to dry on the bridge deck surface.

Additional Removal

After concrete bridge deck removal by hydrodemolition has been completed for the construction phase, the deck shall undergo final sounding to assure that all unsound concrete has been removed. The prepared deck surface shall be completely dry prior to final sounding and shall consist of as many successive soundings as required to ensure that all delaminated concrete has been removed. Additional concrete removal shall be performed by handchipping or hydrodemolition. Only handchipping tools shall be used when removing concrete within 1 inch of reinforcing steel.

Where the bond between the existing concrete and the reinforcing steel has been destroyed by handchipping, the concrete adjacent to the steel shall be removed to a minimum clearance of 1 in. around the periphery of the exposed steel.

Full Depth Repair of Bridge Floor

Where the deck is sound for less than half of its original depth, the concrete shall be removed full depth except for limited areas as determined by IFA. Forms for areas of up to 4 ft^2 may be suspended from wires attached to the reinforcing steel. For areas greater than 4 ft^2, the forms shall be supported from the structural members of the superstructure or by shoring from below. Exposed reinforcing steel shall not be damaged by the full depth removal operation. Any damaged reinforcing steel shall be repaired. The removal area shall be thoroughly cleaned of all dirt, foreign materials and loose concrete to the extent necessary to produce a firm solid surface for adherence of the new concrete. A minimum 1 in. vertical surface shall remain, or be cut, 1 in. outside and around the entire periphery of each full depth removal area after removal of all loose and unsound concrete. Full depth patching of the bridge floor shall be conducted in accordance with 722.06 (a).

Preparation of Bridge Floor Prior to Overlay Placement

After completion of hydrodemolition and full depth repair of the bridge floor, but not more than 24 h prior to placement of the overly, the entire deck shall be cleaned in accordance with 722.05 (c).

Proportioning and Mixing

Proportioning and mixing of the latex modified concrete shall be in accordance with 722.04 and 722.08, respectively.

Placing and Finishing

Placement and finishing of the latex modified concrete overly shall be in accordance with 722.09.

Texturing and Curing

Texturing and curing shall be in accordance with 722.10 and 722.11, respectively.

Calibration of Continuous Mixers

Calibration of continuous mixers shall be in accordance with 722.12.

I-69 SECTION 5

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

ATTACHMENT 15-1
DUKE ENERGY ELECTRICAL TRANSMISSION RIGHTS-OF-WAY GUIDELINES/RESTRICTIONS

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DUKE ENERGY
ELECTRIC TRANSMISSION RIGHTS-OF-WAY GUIDELINES/RESTRICTIONS
VALID FOR OHIO, INDIANA, AND KENTUCKY
(R 10/1/13)

This list of rights-of-way restrictions has been developed to answer the most frequently asked questions about property owner use of Duke Energy's electric transmission rights of way. This list does not cover all restrictions or all possible situations. You should contact the Asset Protection Right-of-Way Specialist if you have additional concerns about the rights of way. This list of restrictions is subject to change at any time and without notice. Duke Energy reserves all rights conveyed to it by the right-of-way agreement applicable to the subject property. All activity within the rights of way shall be reviewed by an Asset Protection Right-of-Way Specialist. It is strongly suggested that you contact Duke Energy and submit plans for approval prior to construction of any improvements within the rights of way.

1. Structures, buildings, manufactured homes, mobile homes and trailers, satellite signal receiver systems, swimming pools (and any associated equipment and decking), graves, billboards, dumpsters, signs, wells, septic systems or storage tanks and systems (whether above or below ground), refuse of any type, flammable material, building material, wrecked or disabled vehicles and all other objects (whether above or below ground) which may, in Duke Energy's opinion, interfere with the electric transmission right of way in any way, are not allowed within the rights- of-way limits. Transformers, telephone/cable pedestals (and associated equipment), and fire hydrants are not allowed. Manholes, water valves, water meters and backflow preventors are not permitted.

2. Fences shall not be attached to poles or towers. Fences shall not exceed 10 feet in height and shall be installed greater than 25 feet from poles, towers and guy anchors. Fences shall not parallel the centerline within the rights of way but may cross from one side to the other at any angle not less than 30 degrees with the centerline. If a fence crosses the rights of way, a gate (16 foot wide at each crossing) shall be installed by the property owner, per Duke Energy's specifications, to allow free access required by Duke Energy equipment.

3. Contact Duke Energy and obtain written approval before grading or filling on the rights of way. Grading (cuts or fill) shall be no closer than 25 feet from a pole or tower leg and the slope shall not exceed 4:1 on the rights of way. Grading or filling within the rights of way or near a structure, which will prevent free equipment/vehicle access, or creates ground to conductor clearance violations, will not be permitted. Sedimentation control, including re-vegetation, is required per state regulations.

4. Streets, roads, driveways, sewer lines, water lines, and other utility lines, or any underground facilities shall not parallel the centerline within the rights of way, but may cross, from one side to the other, at any angle not less than 30 degrees with the centerline. No portion of such facility shall be located within 25 feet of Duke Energy's supporting structures. Intersections of roads, driveways, or alleyways are not permitted within the rights of way.

5. Any drainage feature that allows water to pond, causes erosion, directs storm water toward the rights of way, or limits access to or around a structure is prohibited.

6. Contact Duke Energy prior to the construction of lakes, ponds or retention facilities, etc., within the rights-of-way limits.

7. Duke Energy does not object to parking within the rights of way, provided that:

    a. A barrier, sufficient to withstand a 15 mph vehicular impact, shall be erected by the party constructing the parking area to protect the pole, tower or guy anchor. The barrier shall be located in such a manner as to restrict parking to at least 5 feet from the structure.
    b. Any access areas, entrances, or exits shall cross (from one side to the other) the rights of way at or near right angles to the centerline, and shall not pass within 25 feet of any structure. Parking lot entrances/exits cannot create an intersection within the right of way.
    c. Lighting structures within the rights-of-way limits must be approved by Duke Energy before installing. Approval will be subject to the same rules as vegetation plantings outlined in paragraph eight (8).
    d. Signs and other attachments to Duke Energy structures are prohibited.

DUKE ENERGY
ELECTRIC TRANSMISSION PROJECT SPECIFIC GUIDELINES/RESTRICTIONS
(R 10/1/13)

The following project specific guidelines/restrictions have been developed for that portion of the INDOT I-69 Section 5 between south of Fullerton Road to SR 48. This list does not cover all Duke Energy guidelines/restrictions applicable to this specific INDOT project. To the extent they are inconsistent with the attached "Duke Energy Electric Transmission Rights-of-Way Guidelines/Restrictions," these project specific guidelines/restrictions shall control. You should contact Duke Energy Transmission Line Engineering/Project Management if you have additional questions or concerns. This list of guidelines/restrictions is subject to change at any time and without notice. Duke Energy reserves all rights conveyed to it by the easement grant applicable to the subject property. All activity within any easement grant area should be reviewed and approved by Duke Energy Transmission Line Engineering/Project Management. You should also contact Duke Energy Transmission Line Engineering/Project Management and submit plans for their review and approval prior to construction of any improvements within any easement grant area.

1. All work around Duke Energy facilities shall conform to National Electric Safety Code (NESC) and Occupation Safety and Health Administration (OSHA) Cranes & Derricks in Construction Power Line Safety Standards 1926.1408 and 1926.1409.

2. There are overhead 138,000 Volt and 69,000 Volt electric transmission lines in this section of I-69 containing bare wires which are insulated by isolation only and not by any insulating covering. Any contact with these bare wires could cause serious injury including death and serious damage to property.

3. Outages on transmission lines:

    a. Outages typically cannot occur between May 15 and September 15. Additionally, there may be other times during the year that outages cannot take place due to loading, other work being performed on the system, etc.
    b. Once a work schedule for the transmission lines is determined, outages will be scheduled and coordinated with an independent transmission operator. Outages are not guaranteed, as the transmission system is controlled by the independent transmission operator.
    c. Outages will not be taken for work by third parties.

4. Vehicles and/or equipment working around or under Duke Energy facilities shall not exceed 14 feet in height.

5. Access to all Duke Energy facilities is required at all times.

6. Retaining walls and sound barriers are not permitted within Duke Energy rights-of-way.

7. Grading and filling requirements:

    a. Grading or filling in the existing rights-of-way shall be reviewed by Duke Energy.
    b. Grading or filling around existing structures will likely require the replacement and/or relocation of that structure.
    c. Fill placed within 25 feet of existing or proposed structures shall meet the following specifications:
        1) Fill material shall be placed in 12 inch maximum loose lifts.
        2) Fill shall be compacted to 95% of maximum density (Maximum Density based on the Standard Proctor Test ASTM D698).
        3) A 'sheepsfoot roller' or equivalent machine shall be used.

4) Material used in this area shall be clean clay classified as CL and/or CL-ML based on the Unified Soil Classification System. Material used to fill shall be from an on-site source unless approved by Duke Energy. The material used shall be non-organic earthen material, free of deleterious foreign matter (eg., vegetation, ash, wood, building rubble, frozen material, organic soils, refuse, etc.) and capable of being compacted as specified. 3 inches of topsoil may be added to support grass growth after all construction activities have completed.

d. Fill placed in the rights-of-way but more than 25 feet from existing or proposed structures shall be constructed in a reasonable manner as to accommodate heavy equipment travel and stationary earth pressures necessary to facilitate power line construction.
e. Duke Energy at its discretion may utilized a third party geotechnical firm to perform field density tests to confirm the density of compacted fill prior to and during construction of power line facilities.

8. The relocation or replacement of an existing structure may require the replacement and/or relocation of adjacent structures.

9. Filling at Fullerton Pike and Tapp Road will require a minimum of two structures at each location to be relocated and/or replaced.

10. The height of street lights and traffic signals at Fullerton Pike and Tapp Road will be limited to 30’ above final grade.

11. At S.R. 45, it is suggested that this area be designed so that the existing Duke Energy facilities are not impacted in order to avoid the high cost to replace them.

12. Lead-time for transmission material is currently 6 months following the approval of the design, signing of the reimbursement agreement and receipt of payment.

13. In locations where drainage ditches are located across rights-of-way, a 16 foot culvert shall be installed to accommodate AASHTO HS-20 3-axle truck loads to maintain access along the rights-of-way. The location of the culvert will be reviewed by Duke Energy.

I-69 SECTION 5

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

ATTACHMENT 15-2
CONSTRUCTION SPECIFICATIONS FOR CITY OF BLOOMINGTON UTILITIES

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CONSTRUCTION SPECIFICATIONS

For...

CITY OF BLOOMINGTON UTILITIES

Wastewater, Water, and Storm Projects

Update Issue April 20, 2012

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4.4.3.2.1.1. Locator Wire and Signs.
4.4.3.2.2. Ductile Iron.
4.4.3.2.2.1. Pipe Joints.
4.4.3.2.2.2. Pipe Fittings.
4.4.3.2.2.3. Polyethylene Encasement
4.4.3.2.3. High Density Polyethylene (HDPE) Pipe.
4.4.3.2.3.1. HDPE Fittings.
4.4.3.2.3.2. Joining of HDPE.
4.4.3.2.3.3. Locator Wire and Signs.
4.4.3.2.4. (Intentionally Left Open)
4.4.3.2.5. Valves.
4.4.3.2.5.1. Gate Valves.
4.4.3.2.5.2. Plug Valves.
4.4.3.2.5.3. Check Valves.
4.4.3.2.5.4. Air/Vacuum Valves.
4.4.3.3. Pump Station Specifications (separate packet).
4.4.4. **Materials for Water Mains.**
4.4.4.1. Water Pipes.
4.4.4.1.1. Ductile Iron.
4.4.4.1.1.1. D.I.P Joints.
4.4.4.1.1.2. D.I.P Fittings.
4.4.4.1.1.3. Polyethylene Encasement
4.4.4.1.2. Polyvinyl Chloride (PVC).
4.4.4.1.2.1. Locator Wire and Signs.
4.4.4.1.3. Prestressed Concrete Cylinder Pipe.
4.4.4.1.4. Copper.
4.4.4.1.4.1. Fittings for Service Lines.
4.4.4.2. Valves.
4.4.4.2.1. Gate Valves.
4.4.4.2.2. Butterfly Valves.
4.4.4.2.3. Air Release Valves.
4.4.4.2.4. Tapping Valves.
4.4.4.2.5. Tapping Sleeves or Saddles.
4.4.4.3. Valve Markers.
4.4.4.4. Fire Hydrants.
4.4.4.5. Flush Hydrants.
4.4.5. **Materials for Storm Sewers.**
4.4.5.1. Pipe for Storm Sewers.
4.4.5.1.1. Ductile Iron Pipe (DIP).
4.4.5.1.1.1. Coatings and Linings.
4.4.5.1.1.2. Joints.
4.4.5.1.1.2.1. Push-on Joints.
4.4.5.1.1.2.2. Mechanical Joints.
4.4.5.1.1.3. Fittings.

4. CONSTRUCTION SPECIFICATIONS FOR SANITARY, WATER, AND STORM PROJECTS.

4.1. SCOPE.

4.1.1. DESCRIPTION. These specifications are based on the Indiana Water Pollution Control Board Article 327 IAC and the Ten States Standards for sewer and water. They describe the procedures, methods and materials for installing gravity sewers, pressure sewers, water mains, and storm sewers, together with all necessary appurtenances and surface restoration. They are intended in specific for all sewer, storm or water projects of the City of Bloomington Utilities Department, and shall supercede all other specifications for any sanitary, water, or storm construction taking place within the jurisdictional area of the City of Bloomington Utilities Department.

4.1.2. ORDER OF PRECEDENCE. These specifications are to be considered an integral part of the Construction Contract and shall be deemed to be inserted therein. The Construction Contract shall be read and enforced as though these specifications were included verbatim. Wherein conflicts of language are encountered between these Specifications and the other parts of the Contract Documents, the component part first enumerated shall govern over any other component part which follows it in this Order of Precedence:

1. Construction Contract
2. Addenda
3. Special Conditions
4. Supplementary Conditions
5. Construction Specifications
6. Contract Drawings
7. General Conditions
8. Standard Drawings
9. Instruction to Bidders
10. Advertisement for Bids
11. Contractor's Proposal (Bid Form)

4.1.3. LIMITS OF WORK. The Work shall be prosecuted entirely within the limits of right-of-way of the various roads, highways, and easements, as indicated on the drawings and on file in the office of the County Recorder. If soil conditions or other conditions should make it necessary to provide sheeting, shoring, or special excavation procedures, in order to confine the Work within the prescribed limits, the Contractor will be required to provide such protective measures at his own expense.

4.1.3.1. ON PRIVATE PROPERTY. Unless otherwise stated in the Contract Documents, easements across private property have been obtained when necessary by the Owner and are indicated on the drawings. The Contractor shall be responsible for determining the easements in the field and for setting stakes as he considers necessary to mark the boundaries.

The Contractor shall not enter, for any purpose, any private property outside the designated construction easement boundaries without written permission from the owner and the tenant of the property. This shall include, but not be limited to, delivery of pipe and materials, storage of equipment and materials, and storage of materials excavated from the trench.

4.1.3.2. WORK WITHIN HIGHWAY AND RAILROAD RIGHT-OF-WAY. Unless otherwise stated in the Contract Documents, permits shall be obtained by Owner. All Work performed, and all operations of Contractor, his employees or Subcontractors, within the limits of railroad and highway rights-of-way, shall be in conformity with the requirements and be under the control (through the Owner) of the railroad or highway authority owning, or having jurisdiction over and control of, the right-of-way in each case.

4.1.3.3. ROAD CUT PERMITS. Unless otherwise stated in the Contract Documents, the Owner shall obtain permission for construction within the rights-of-way of the City, County, and State roads; however, the Contractor shall be responsible for obtaining necessary permits from the City and County to cut any of their streets or curbs. The Contractor should be aware that some streets are designated "no-cut" streets,

and should consult with the City or County Engineer concerning these. Street replacement and site restoration shall be approved by the appropriate agency before final acceptance of the job.

4.2. **PROJECT REQUIREMENTS.**

4.2.1. NOTIFICATION PROCEDURES. The Indiana Underground Utility Facilities Damage Prevention Act has been in effect since January 1, 1991. This law requires the Contractor, at least two working days before start of construction, to call the Indiana Underground Plant Protection Service (I.U.P.P.S.), commonly referred to as Holey Moley, 1-800-382-5544 or 811, and request location and marking of underground facilities in the construction area. Contractor shall also give at least forty-eight (48) hours notice to the agencies and persons indicated in the section of this Contract titled "Notification."

4.2.1.1. UTILITIES. The Owner shall notify all utilities of the extent of the project and shall indicate approximate locations of these utilities on the drawings. However, it is the responsibility of the Contractor to request field-marking of all utilities, as directed in Paragraph 4.2.1., well in advance of the start of construction, and compare field markings with utility locations indicated on the plan drawings. Contractor shall notify design engineers of any discrepancies and request correction of the plan drawings. Contractor shall give all utilities at least two (2) working days advance notice of the date of the start of construction to insure that all concerned utilities have the necessary time and access to locate and protect their facilities and to provide inspection during construction. Some utilities which must be notified are: Indiana University, gas, telephone, electric, cable TV, data fiber, traffic lights, water, sanitary sewer, and storm sewer.

4.2.1.2. PROTECTION OF UNDERGROUND FACILITIES. Contractor shall observe Indiana Code 8-1 Chapter 26 (Damage to Underground Facilities) both prior to and during all excavation. Contractor shall be aware that IC 8-1-26-20 Section 2 states: *"If the clearance is less than two (2) feet, exposure of the underground facility may be accomplished only by the use of hand excavation, air cutting, or vacuum excavation."* The "hand digging" zone is two (2) feet each side of the mark or line indicated by marks or flags, if the size of the underground facility is not indicated. Otherwise, the "hand digging" zone is two (2) feet on each side of the structure.

4.2.2. PRE-CONSTRUCTION MEETING. Projects that have utilities to be inspected by CBU will require a pre-construction meeting with the developer or the contractor to go over the scope of the project. Contact Tom Axsom at (812)349-3633 to set up the pre-construction meeting.

4.2.2.1. UTILITIES INSPECTION. Contractor shall notify the City of Bloomington, Utilities Engineering Department one (1) working day prior to construction of any water, storm, or sanitary sewer utility work. A CBU inspector must have notice so work can be inspected, documented, and a proper as-built made. When a contractor works on weekends or beyond normal CBU work hours or on holidays of CBU the contractor will pay for the inspector's overtime. For CBU work hours and holiday information call the City of Bloomington, Utilities Engineering Department at (812)349-3660.

4.2.3. CONSTRUCTION SCHEDULE. Before construction begins, a construction schedule shall be submitted estimating completion dates for the various portions and items of Work and number of crews or manpower on the job at various periods. This schedule must be posted and kept up to date. The Contractor shall submit a tentative Work schedule with his bid.

4.2.4. UNFAVORABLE CONSTRUCTION CONDITIONS. During unfavorable weather, or when unsuitable construction conditions are encountered, the Contractor shall confine his operations to Work which will not be affected adversely by such conditions. No portion of the Work shall be performed under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by the Contractor to perform the Work in a proper and satisfactory manner.

4.2.5. CLEAN-UP OPERATIONS. The entire project site shall be thoroughly cleaned by the Contractor at the completion of the Work or portions thereof. Clean-up operations at a minimum shall consist of the removal and disposal of all broken concrete, wood scraps, wire, packaging materials, forms, scaffolds, and other objectionable rubble created during construction operations. Clean-up shall also consist of

washing and scrubbing areas which are dirtied by mud, sewage, oil, grease and dust, in order to return such areas to a clean and finished appearance.

4.2.5.1. DAILY CLEAN - UP. During construction the Contractor shall clean up all construction areas at the end of each working day. This clean-up operation shall include, but not be limited to, the collection and disposition of all material to be discarded, the removal of excavated material from any roadway, walk, or driveway, the disposal of all flammable materials, and the storage of construction tools, equipment, and unused construction materials in their proper storage place.

4.3. **TEMPORARY FACILITIES.**

4.3.1. WATER. All water required for and in connection with the Work to be performed and for any specified tests of piping, equipment, devices, etc., for inundation or settling of backfill material or for any other use as may be required for proper completion of the Work shall be provided by, and at the expense of, the Contractor. The only exception shall be the filling and flushing of water mains in accordance with 4.5.3.5.1. No separate payment for water used or required will be made and all costs in connection therewith shall be included in the other items.

4.3.2. POWER. Contractor shall provide all power for heating, lighting, operation of Contractor's plant or equipment, or for any other use by Contractor.

4.3.3. MAINTENANCE OF TRAFFIC. Contractor shall conduct his Work to minimize interference with public travel, whether vehicular or pedestrian. Contractor shall provide a Traffic Maintenance Plan in accordance with the Manual of Uniform Traffic Control Devices (MUTCD) which must be approved by the agency having jurisdiction. Whenever it is necessary to cross, obstruct, or close roads and driveways, whether public or private, Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at the designated point.

In making open-cut road crossings, Contractor shall not block more than one-half of the road at a time. The Contractor shall furnish all flagmen, barricades, flashing lights, signs, and other protective devices to insure the safety of all vehicular and pedestrian traffic. Whenever possible, Contractor shall widen the shoulder on the opposite side to facilitate traffic flow. Temporary surfacing shall be provided as necessary on shoulders.

4.3.4. BARRICADES AND LIGHTS. All roads, highways, and other public thoroughfares which are closed to traffic shall be protected by effective barricades on which shall be placed acceptable warning signs. Barricades shall be located at the nearest intersecting public highway or road on each side of the blocked section.

All open trenches and other excavations shall have suitable barricades, signs, and lights to provide adequate protection to the public. Obstructions such as material piles and equipment shall be provided with similar warning signs and lights.

All barricades and obstructions shall be illuminated with warning lights from sunset to sunrise. Material storage and conduct of Work on or alongside public roads and highways shall cause minimal obstruction and inconvenience to the traveling public.

All barricades, signs, lights and other protective devices shall be installed and maintained in conformity with the requirements of the appropriate jurisdictional agency. All Work within the rights-of-way of any primary or secondary streets within the City shall be protected with flagmen, barricades, flashing lights, signs and other devices as required by the Indiana Department of Transportation. Work within the rights-of-way of all other streets shall be protected by flagmen, barricades, flashing lights, signs and other devices as required by the Utilities Engineer, City Engineer, County Engineer or their agents.

4.3.5. PROTECTION OF PUBLIC AND PRIVATE PROPERTY. Contractor shall observe Indiana Code 8-1 Chapter 26 (Damage to Underground Facilities) both prior to and during all excavation. Contractor shall protect, shore, brace, support and maintain all underground pipes, conduits, drains, and other underground construction uncovered or otherwise affected by his construction operations. All pavement, surfacing, driveways, utility poles, guy wires, fences, walls and other surface structures affected by construction operations, shall be restored to their original condition. All replacements shall be made with new materials and under the supervision of the authority having jurisdiction.

Contractor shall be responsible for all damage to streets, roads, highways, shoulders, ditches, embankments, culverts, bridges, and other public or private property, regardless of location or character, which may be caused by transporting equipment, materials, or men from the Work or any part of the site thereof, whether by him or his Subcontractors. Contractor shall make satisfactory and acceptable arrangements with the owners of, or the agency of authority having jurisdiction over, the damaged property concerning its repair or replacement or payment of costs incurred in connection with the damage.

4.3.6. TREE PROTECTION. Trees and vegetation which must be removed to perform the Work shall be moved and disposed of properly by the Contractor; however, all other trees and vegetation shall be protected against injury from construction operations.

Contractor shall take extra measures to protect trees, such as erecting barricades, trimming to prevent damage from construction equipment, and installing pipe or other Work by means of hand excavation or tunneling methods. Such trees shall not be endangered by stockpiling excavated material within the dripline or storing equipment against the trunk.

4.3.7. DUST CONTROL. Contractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water or by application of an approved chemical dust inhibitor. Dusty materials in piles or in transit shall be covered when practical to prevent blowing.

Buildings or operating facilities which may be affected adversely by dust shall be adequately protected from dust. Machinery, motors, instrument panels, and similar equipment shall be included with dust screens.

4.3.8. TEMPORARY DRAINAGE PROVISIONS. Contractor shall provide for the drainage of stormwater and such water as may be applied or discharged on the site in the performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the site, and adjacent property.

Existing drainage channels and conduits shall be cleaned, enlarged, or supplemented as necessary to carry all increased run-off attributable to Contractor's operations. Dikes shall be constructed as necessary to divert increased run-off from entering adjacent property (except in natural channels) to protect the Work, and to direct water to drainage channels or conduits.

Ponding shall be provided as necessary to prevent downstream flooding.

4.3.9. EROSION CONTROL. Contractor shall prevent erosion of soil on site and adjacent property resulting from his construction activities. Contractor's Erosion Control Plan must be approved by either the City or County Engineer, depending on jurisdiction. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection.

Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, so as to minimize erosion. Temporary fast-growing vegetation or other suitable ground cover shall be provided as necessary to control run-off.

4.3.10. POLLUTION CONTROL. Contractor shall prevent the pollution of drains and water courses by sanitary wastes, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers.

No sediment, debris, or other substance will be permitted to enter sanitary sewers and reasonable measures will be taken to prevent such materials from entering any drain or watercourse.

4.4. **MATERIALS FOR SANITARY, WATER, AND STORM PROJECTS.**

4.4.1. GENERAL.

4.4.1.1. CONCRETE. Portland cement concrete shall be composed of Portland cement, fine and coarse aggregates, and water, proportioned and mixed as required to produce a smooth, workable mixture, and shall be designated by classes according to compressive strength. It shall have a minimum ultimate compressive strength for each class as determined by testing 6" X 12" cylinder samples of concrete in accordance with the requirements of the latest revision of ASTM C39, Standard Method of Test for Compressive Strength of Molded Concrete Cylinders. The aggregate shall be well-graded with a maximum size such that 100% passes a two-inch (2") mesh screen, unless otherwise specified.

4.4.1.1.1. CLASS A CONCRETE. Class A concrete shall have a 28-day compressive strength of 4,000 psi, and is intended for reinforced structures designed for strength and non-permeability. Unless otherwise specified, all reinforced concrete shall be Class A.

4.4.1.1.1.1. REINFORCING STEEL. Reinforcing steel shall conform to the latest revision of ASTM A615. Unless otherwise specified, bars for concrete reinforcement shall be deformed billet steel, grade 40 or 60.

4.4.1.1.2. CLASS B CONCRETE. Class B concrete shall have a 28-day compressive strength of 2,000 psi, and is intended principally for pipe cradles or encasements, for backfill of unauthorized excavation, and for locations where lower-strength concrete is indicated.

4.4.1.2. FORMS. Forms shall be used, whenever necessary, to confine the concrete and shape it to the required lines. All exposed concrete surfaces having slopes steeper than two (horizontal) to one (vertical) shall be formed. The forms shall have sufficient strength and rigidity to hold the concrete and withstand the necessary pressure, tamping, and vibration without deflecting from prescribed lines.

Surfaces of all forms in contact with the concrete shall be clean, rigid, tight, and smooth. Forms treated to prevent bond shall be coated with an approved compound which is not harmful to the concrete and which will nor discolor the finished surface.

Unless otherwise specified, forms for concrete surfaces that will be exposed to view shall be waterproof plywood, press board, or metal. Exposed edges and corners of concrete on the outside or inside of structures shall be chamfered at 45 degrees, such level being one inch (1") on a side unless otherwise specified.

4.4.2. **MATERIALS FOR GRAVITY SANITARY SEWERS.** This section describes the materials to be used in construction of gravity sewers, including sewer pipe, manholes, castings, and other fittings and appurtenances. Large diameter interceptor mains (30” – 72”) are evaluated on a case by case basis.

4.4.2.1. PIPE AND FITTINGS FOR GRAVITY SEWERS. Shall be made in the U.S.A.

4.4.2.1.1. PLASTIC PIPE. This subsection specifies the materials for gravity sewer pipe made of polyvinyl chloride or polyethylene plastic.

4.4.2.1.1.1. POLYVINYL CHLORIDE (PVC) PIPE. PVC gravity sewers 4"-15" in diameter shall conform to the latest revision of ASTM D-3034 SDR 35. The pipe shall be made of PVC having a minimum cell classification of 12454-B, 12454-C, or 12364-C. Fittings for these diameters of PVC pipe shall be injection molded whenever commercially available and conform to the latest revision of ASTM D-3034 SDR 35 with a minimum cell classification of 12454-B, 12454-C, or 12364-C (SDR-26 wyes required for pipe deeper than 6’ of cover). Pipe shall have a minimum tensile strength of 34.50 Mpa as defined in ASTM D-1784. Tees and wyes for service connections on pipe 18" in diameter or larger shall be factory-made in-line fittings.

PVC gravity sewer pipe 18"and larger in diameter shall conform to the latest revision of ASTM F-679. The pipe shall be made of PVC having a minimum cell classification of 12454-C or 12364-C. Fittings for F-679 PVC pipe shall also conform to the latest revision of ASTM D-3034 SDR 35 with a minimum cell classification of 12454-C or 12364-C. Pipe shall have a minimum tensile strength of 34.50 Mpa as defined in ASTM D-1784. Tees and wyes for pipe greater than 15" in diameter shall be factory-made in-line fittings. Romac Industries "CB" sewer saddle or Inserta-tees may be used if Utilities Engineer permits.

All joints shall be of the elastomeric gasket type meeting ASTM F-477 and installed per the manufacturer's recommendations. Solvent cement joints shall not be used.

All pipe shall be provided with home marks to insure proper gasket seating. The home mark shall be situated so that, on a seated pipe, it is within one-half inch of the bell end of the previous pipe.

All pipe sections and fittings shall be clearly marked to indicate their conformity with the ASTM specifications.

4.4.2.1.1.1.2. WATER-GRADE PVC PIPE. In certain conditions, use of water-grade PVC pipe meeting AWWA Standard C900 may be required for gravity sewers with diameters of 8" to 12". For diameters of 14" to 24", pipe meeting AWWA Standard C905 may be required. Wyes for pipe diameters 8″ through 12″ shall be HARCO (www.harcofittings.com) or preapproved equal, sized for C900 on the run and SDR-35 on the branch. Larger diameter pipe shall use C900 tees; the lateral may transition to SDR-35 PVC pipe by using a properly sized HARCO C900 to SDR-35 Adapter.

4.4.2.1.1.2. POLYETHYLENE (PE) PIPE. PE pipe may be used (when preapproved by the Utilities Engineer) for gravity sewers with diameters 18" and larger. The type and brand will be reviewed on a case by case basis.

4.4.2.1.2. VITRIFIED CLAY PIPE (VCP). VCP is NOT an approved material for construction of sanitary sewers within the City of Bloomington jurisdictional area without the express written approval of the Utilities Engineer. VCP shall be manufactured of surface clay, fire clay, shale, or a combination of these materials as specified in the ASTM Specifications. Unless otherwise specified in the Special Conditions or the Drawings, double-strength clay pipe as described in ASTM C-700 shall be used. Pipe shall be free from fracture, large or deep cracks, and surface roughness. The planes at the ends of the pipe shall be perpendicular to the longitudinal axis.

All pipe joints must meet the requirements of ASTM C-425. A PVC or Fiberglas collar instead of a clay bell may be used, but must also conform to ASTM D-1784, Class 12454-B. The type of joint to be used (plain mortar, cement hump, plastic, hot-poured, or any other) shall be submitted to the Engineer for his approval.

All pipe sections and fittings shall be marked as required by the ASTM Specifications.

4.4.2.1.3. DUCTILE IRON PIPE (DIP). Where it is impossible to maintain minimum cover over pipe, Ductile Iron Pipe with an especially resistant lining may be required. DIP shall be manufactured by American, Griffin, or U.S. Pipe in accordance with the latest revision of ANSI A21.51 and AWWA C151. For sanitary sewer application, DIP shall have ceramic epoxy lining, minimum thickness 40 mils, and shall be **Protecto 401**, as manufactured by Induron Protective Coatings. When field cutting or to repair damage to the lining you must use the repair kit for Protecto 401 as directed by the manufacturer.

4.4.2.1.4. REINFORCED CONCRETE PIPE. All reinforced concrete pipe shall be Class III, IV, or V in accordance with the latest edition of ASTM C 76, wall thickness "B" or "C" as per site conditions. Pipe shall be manufactured from Portland Cement and aggregate as specified herein.

4.4.2.1.4.1. PORTLAND CEMENT. Portland Cement for manufacture of concrete pipe and fittings shall be Type I or Type III and shall conform to ASTM C 150. Upon request, the Contractor shall furnish manufacturer's certificate stating the type of cement used in the manufacture of the pipe furnished.

4.4.2.1.4.2. AGGREGATE. Aggregate for manufacture of concrete pipe and fittings shall conform to ASTM C 33 except that the requirement for gradation shall not apply. Upon request, the Contractor shall furnish manufacturer's certificate stating the type of aggregate used in the manufacture of the pipe furnished.

4.4.2.1.4.3. STEEL REINFORCEMENT. Steel reinforcement shall be in accordance with requirements of the applicable table in ASTM C 76. Reinforcement shall extend full into bell and spigot ends for pipes 36 inch and larger, and shall extend full into the bell of rubber gasket pipes 12 inch and larger. Elliptical reinforcement shall not be permitted. Longitudinal reinforcement shall be continuous, and all reinforcement shall have a minimum concrete cover of 1 inch.

4.4.2.1.4.4. LIFT HOLES. Lift holes shall not be permitted for concrete sanitary sewer pipe.

4.4.2.1.4.5. JOINTS. Concrete pipe shall be furnished with joints using either concrete bell and spigot or zinc coated steel bell and spigot rings, or rubber seal and rings (Anderson Seal or approved equal). All types of joints shall have a groove on the spigot for a rubber "O" ring gasket. Pipe joints using concrete bell and spigot or zinc coated steel bell and spigot rings shall conform to ASTM C 361 except that the gaskets shall be as specified hereinafter. Pipe joints using rubber gaskets shall conform to ASTM C 443 so that the joint will remain watertight for all soil types and groundwater conditions. The steel bell shall be welded to the longitudinal reinforcing, and a steel skirt (minimum 5.75 inches in length and fabricated from 16 gauge metal) shall be continuously welded to the inside face of the steel spigot ring and to the longitudinal reinforcement.

Profile gasket type joints using a self-lubricated gasket (Forsheda Style 138 or approved equal) on a single offset spigot and formed bell are acceptable. Joints shall be sealed with a profile rubber gasket conforming to ASTM C 443 so that the joint will remain watertight under all conditions of service. On request, the joint shall demonstrate the ability to pass a 2 psi pressure test without leakage.

Only one style of joint system will be permitted from structure to structure in a single run of pipe.

Mastic sealer shall not be used to seal reinforced concrete pipe joints.

4.4.2.1.4.6. ABSORPTION LIMIT. Absorption by the reinforced concrete pipe shall not exceed 6% of its dry weight.

4.4.2.1.4.7. MARKINGS. The date of manufacture, class of pipe, and specification designation, size of pipe, name or trademark of the manufacturer, and identification of plant shall be legibly marked on each section of pipe per the ASTM requirement.

4.4.2.1.5. NON-SHEAR PIPE COUPLINGS**.** When connecting one cut section of pipe to another and the gasketed bell-and-spigot system cannot be used, For PVC pipes of identical size and material, Contractor shall use a sleeve type repair coupling, as manufactured by HARCO (The Harrington Corporation) (www.harcofittings.com), or prior-approved equal. If dissimilar material or size, Contractor shall make this connection by utilizing an approved non-shear coupling or non-shear adapter coupling correctly sized for this purpose. Acceptable non-shear couplings are Mission ARC coupling (www.missionrubber.com), Fernco 5000 RC coupling (www.fernco.com), and Indiana Seal Shear Ring and Shear Guard couplings (www.indiana-seal.com), or prior-approved equal.

4.4.2.2. MANHOLES. Manholes shall be constructed of pre-cast concrete meeting the requirements of ASTM C-478. All manhole sections, including the cone or flat-top, shall be wet-cast; dry-cast sections are not acceptable. The following chart indicates minimum manhole diameters for sanitary sewers entering/exiting a manhole at various ranges of angles:

	MANHOLE DIAMETERS	
PIPE SIZE	Pipes Entering/ Leaving at 0-45 Degree Bend	Pipes entering/ Leaving at 45-90 Degree Bend
8"-21"	48"	48"
24"	48"	60"
27"-30"	60"	60"
33"-36"	60"	72"

Minimum manhole diameter shall also be determined by the number of pipes entering and exiting the structure, as well as pipe diameters and angles. To preserve structural integrity, there shall in no case be less than a span of six inches (6″), measured at the narrowest interval, between any two pipes connecting to a manhole. This measurement shall exclude gasket or boot width. Anything smaller than a six inch span will require written acceptance of responsibility from the manhole manufacturer, as well as written permission form the Utilities Engineer.

4.4.2.2.1. GENERAL. The Contractor shall construct all manholes at the locations and of the materials indicated on the drawings and as specified. Manholes shall be designed and constructed to have no more than one foot of fall from invert in to invert out. Greater than one foot of fall will require construction of an outside drop. During sewer design, the Design Engineer shall determine if there will be adequate vertical space to construct the outside drop of the proper diameter pipe in accordance with CBU Standard Detail #2. If he determines that there is not adequate vertical space, the Design Engineer shall adjust the slope of the incoming pipe to leave maximum one foot of fall through the manhole so that an outside drop is not required.

The Design Engineer shall also be aware that, for manholes having more than one inlet pipe, there shall be no more than 0.3 foot difference between invert elevations of the inlet pipes. This will preserve flow characteristics through the manhole and facilitate construction of table and troughs.

4.4.2.2.2. MANHOLE BASES. The manhole base and first riser section shall be one complete pre-cast unit. The invert of all pipe openings shall be at least three inches above the base slab to provide for installation of table and trough. Sewers shall enter and exit the manhole walls as indicated in the Standard Drawings. Openings for these sewers shall either be formed in the casting process, or core-drilled. Openings shall be equipped with an elastomeric gasket or boot as specified in 4.4.2.2.5.

Openings shall be provided in manholes at locations shown on the plans for future connections. All such openings shall have an approved gasket, and shall be temporarily closed by installing a plug or a short section of appropriately sized pipe and a cap .

For manholes on a completely new reach of sanitary sewer, the table and trough may be cast as a part of the base unit, or constructed of masonry brick and non-shrink mortar in accordance with 4.5.2.1.7.2. with written permission of the Utilities Engineer. For replacement manholes to which one or more existing pipes must be connected, openings in the base unit shall be core-drilled on site after removing the old structure and shooting elevations of existing pipe(s) to assure accuracy; table and trough shall be installed on site and constructed of masonry brick and non-shrink mortar in accordance with 4.5.2.1.7.2. In both cases the invert channels shall be smooth with a semi-circular bottom and vertical sides extending upward to the height of the pipe crown. In the latter case, both table and invert channel shall receive two coats of Drycon (IPA Systems, Inc.) (www.ipasystems.com). Changes of flow direction within manholes shall be made by a smooth curve having as large a radius as possible. The manhole table shall be smooth and slope towards the channel not less than one inch (1") per foot.

4.4.2.2.3. MANHOLE TOPS. Manholes six feet or more in depth shall have eccentric cone tops. Flattops shall be used if indicated on the drawings or when manhole is less than six feet deep. No brick or block shall be used to adjust the elevation of the frame and cover without permission of the Engineer. Cones or flattops shall be set so that no more than 12" of reinforced concrete rings will be required to adjust the top of the manhole casting to grade. All pre-cast tops and riser rings shall meet the requirements in the latest edition of ASTM C-478.

4.4.2.2.4. MANHOLE BARRELS. Pre-cast manhole barrels shall be reinforced concrete conforming to ASTM C-478. Joints between the barrels, between the barrels and the base unit, and between the barrels and the cone or flattop shall be sealed by using an approved rubber gasket in accordance with ASTM C-443, latest edition.

4.4.2.2.5. MANHOLE GASKETS AND BOOTS. To connect a sanitary sewer to a manhole, either a flexible boot KOR-N-SEAL flexible connector (www. trelleborg.com/npc), "A"-Lock or “Z”-Lok gaskets (www.a-lok.com) or an approved equal shall be used. Connections to an existing manhole shall be a flexible boot KOR-N-SEAL, Press-Seal PSX Positive Seal(www.press-seal.com) or approved equal.

All flexible connectors shall conform to ASTM C-923, and shall be resistant to ozone, weather elements, chemicals including acids and alkalis, animal and vegetable fats, oils and petroleum products.

The stainless steel elements of the connector shall be totally non-magnetic Series 305 stainless steel. The stainless steel clamp shall be capable of sustaining applied torque in excess of eighty (80) inch-pounds.

It shall be the responsibility of the Contractor to submit details of the proposed connection to the Engineer for approval. Connections not approved by the Engineer shall be subject to removal and replacement with an approved connector.

4.4.2.2.6. MANHOLE SEALANTS. There are two acceptable methods of assuring water-tight manhole construction. Method #1 is strongly preferred; Method #2 may be used only with written permission of the Utilities Engineer. Regardless of which waterproofing method is used, Contractor shall plug all lift holes and seal all pipes both internally and externally with a non-shrink grout or an expanding Portland Cement mixture such as OCTOCRETE (IPA Systems, Inc.) (www.ipasystems.com) in accordance with manufacturer's application instructions. The section joints shall be sealed outside with trowelable EZ-STIK all weather Butyl Rubber Sealant as manufactured by Press-Seal Gasket Corporation (www.press-seal.com) or pre-approved equivalent

> Method #1: The manhole manufacturer shall give written conformation that all reinforced precast concrete manhole sections contain the inorganic copolymer waterproofing admixture IPANEX, manufactured by IPA Systems, Inc. (www.ipasystems.com), in compliance with manufacturer's dosage and mixing instructions.
>
> Method #2: (Only with written permission of the Utilities Engineer) Before assembly, the entire outer surface of the manhole, including the underside of the manhole base, shall receive a minimum of two coats of FARBERTITE (IPA Systems, Inc.) (www.ipasystems.com) in accordance with manufacturer's application instructions. After assembly (sealing all joints between manhole sections and plugging all lift holes as indicated above), Contractor shall apply a minimum of two coats of DRYCON (IPA Systems, Inc.) (www.ipasystems.com) to the entire manhole interior in accordance with manufacturer's mixing and application instructions.

4.4.2.2.7. CASTINGS. Manhole frames and covers shall be East Jordan Iron Works castings, catalogue number 1020 or 1022 or approved equivalent. Catalog numbers 1037, 1050, or 2995 or equivalent may be used with the permission of the Engineer. Lids shall be Gasket Seal Cover catalog number 1020A, heavy duty, or approved equivalent. The words "SANITARY SEWER" shall be cast in each manhole cover. All castings and lids shall be coated. No type of casting or cover other than East Jordan will be used unless written approval is granted by the Engineer. Castings shall be set in a nominal 1" bed (approximately 0.75"× 1.05") of sealant made of butyl rubber material in flexible rope form. Sealant shall

meet all requirements of ASTM C-990 and AASHTO M-198. Sealant shall be PRO-STIK, as manufactured by Press-Seal Gasket Corporation (www.press-seal.com), or pre-approved equivalent.

4.4.2.2.8. STEPS. Manhole steps shall be polypropylene, polypropylene coated steel reinforcing, or an approved non-corrosive fiberglass material. The copolymer polypropylene shall meet the requirements of ASTM D 4101, reinforced with deformed 3/8 of an inch minimum diameter reinforcing steel conforming to ASTM A 615, Grade 60. Cast iron steps are not acceptable.

4.4.3. **MATERIAL FOR PRESSURE SANITARY SEWERS.**

4.4.3.1. GENERAL. The following section governs the materials for force main pipe and fittings. Any deviation from these specifications must be approved in writing by the Utilities Engineer. All materials for sewage force mains and appurtenances shall conform to these specifications. Where particular brands or manufacturers are mentioned, the materials must be furnished as so named. If a brand is listed and followed by "or approved equal," the Contractor may substitute materials of similar quality, if approved in writing by the Utilities Engineer.

4.4.3.2. FORCE MAIN PIPE AND FITTINGS. Shall be made in the U.S.A.

4.4.3.2.1. POLYVINYL CHLORIDE (PVC). PVC pressure pipe may be used in construction of force mains. Pipe shall be SDR-21 (PR200) or C900 (DR-18) or ULTRA BLUE C909.

ULTRA BLUE shall conform to ASTM F 1483, and ASTM D 2241, and shall have a cell classification of 12454-B in conformance with ASTM D 1784. The gasketed joint system shall conform to ASTM D3139. Both SDR-21 and C900 shall have a cell classification of 12454-A or 12454-B according to ASTM D1784. The minimum allowable material shall be PVC 1120. SDR-21 shall be PR200 and conform to ASTM D2241 and D3139. C900 shall have DR=18, 150 psi. All types shall have push-on joints. Elastomeric gaskets shall be manufactured to conform to ASTM F477. Solvent cement joints will not be allowed.

All fittings shall be ductile iron in conformance with AWWA C110, ANSI A21.10 or AWWA C-153, ANSI A21.53, cement-lined and coated in accordance with the latest revision of AWWA C104, ANSI A21.4. Valves shall be as listed in 4.4.3.2.5. and following, and must be for wastewater application.

4.4.3.2.1.1. LOCATOR WIRE AND SIGNS. A #10 insulated solid copper wire or #12 AWG HS-CCS high strength copper clad steel insulated locate wire shall be wrapped around all nonmetallic pipe so that one revolution is made at least every pipe joint. Splices are to be made with an approved connector, and are to be suitably protected against corrosion.

Where the main is laid off the road, the wire is to be brought to the surface approximately every 500 feet to a valve box or air/vacuum valve vault, and a sign post. Where the main is laid in the street, the wire is to be brought into a valve box approximately every 500 feet. Sign post shall be furnished by the Utilities Department; valve boxes to be furnished by Contractor.

4.4.3.2.2. DUCTILE IRON PIPE (DIP). Ductile iron pipe shall be manufactured by American, Griffin, or U.S. Pipe in accordance with the latest revision of ANSI A21.51 and AWWA C151. For 4-inch through 12-inch diameter DIP, Pressure Class shall be 350. For DIP with a diameter larger than 12 inches, Pressure Class shall be determined by the Utilities Engineer on a case by case basis.

For sanitary sewer application, DIP shall have a ceramic epoxy lining, minimum thickness 40 mils, and shall be **Protecto 401**, as manufactured by Induron Protective Coatings. When field cutting or to repair damage to the lining you must use the repair kit for Protecto 401 as directed by the manufacturer.

4.4.3.2.2.1. PIPE JOINTS. Mechanical joints, push-on or flanged joints shall be provided. Mechanical joints and accessories shall conform to AWWA C111, ANSI A21.11. Bolts and nuts shall be corrosive resistant high-strength alloy steel. Push-on joints with rubber O-ring gaskets shall comply with AWWA C111, ANSI A21.11. Flanged joints shall be manufactured with laying dimensions, facing and flanges detailed in accordance with AWWA C115, ANSI A21.15.

4.4.3.2.2.2. PIPE FITTINGS. Fittings with mechanical joints, bell and spigot joints, and flange joints, shall conform to the dimensions and weights in accordance with the latest revisions of AWWA C-110, ANSI A 21.10, or AWWA C-153, ANSI A 21.53. Fittings shall be cement-lined and coated in accordance with the latest revision of AWWA C104, ANSI A21.4.

4.4.3.2.2.3. POLYETHYLENE ENCASEMENT. Ductile iron pipe when requiring poly wrap shall be installed with an 8 mil high-density cross-linked polyethylene encasement material, inclusive of valves and fittings. The material shall be furnished and installed in accordance with AWWA C-105, ANSI A21.5 to provide the pipe with a protective enclosure.

4.4.3.2.3. HIGH DENSITY POLYETHYLENE (HDPE) PIPE. HDPE pipe for force main use shall be 4-inch and larger and shall have a nominal IPS (Iron Pipe Size) O.D. HDPE pipe used in open-cut installations shall have a minimum DR of 11. The pipe shall be produced from a HDPE pipe grade resin meeting the specifications of ASTM D 3350 with a minimum cell classification of 345464C. Pipe shall be made to the dimensions and tolerances specified in the latest version of ASTM F 714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-21) Based on Outside Diameter.

4.4.3.2.3.1. HDPE FITTINGS. HDPE fittings shall be in accordance with ASTM D 3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabrication from HDPE pipe conforming to this specification; they shall be manufactured from the same resin type and cell classification as the pipe itself. The fittings shall be fully pressure rated and provide a working pressure equal to that of the pipe with an included 2:1 safety factor.

4.4.3.2.3.2. JOINING OF HDPE. Sections of HDPE pipe shall be joined by the butt fusion process into a continuous length of pipe at the job site. The joining process shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations, including pipe temperature, alignment, and fusion pressure. The heat fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer. Extrusion welding or hot gas welding of HDPE shall not be used. Mechanical joint adapters or flanges may be used to mechanically connect HDPE pipe to transition points. This joining method shall also be performed in strict accordance with the pipe manufacturer's recommendations.

4.4.3.2.3.3. LOCATOR WIRE AND SIGNS. A #10 insulated solid copper wire or #12 AWG HS-CCS high strength copper clad steel insulated locate wire shall be wrapped around all nonmetal pipe so that one revolution is made at least every 10 feet. Splices are to be made with an approved connector, and are to be suitably protected against corrosion.

Where the force main is laid off the road, the wire is to be brought to the surface approximately every 500 feet to a valve box or air/vacuum valve vault, and a sign post. Where the force main is laid in the street, the wire is to be brought into a valve box approximately every 500 feet. Sign post shall be furnished by the Utilities Department; valve boxes to be furnished by Contractor.

4.4.3.2.4. (INTENTIONALLY LEFT OPEN)

4.4.3.2.5. VALVES. All valves other than air/vacuum shall be manufactured by M & H Valve Company (www.mh-valve.com), American Flow Control (www.acipco.com), Kennedy Valve Company (www.kennedyvalve.com), Mueller Company (www.muellercompany.com), or U.S. Pipe and Foundry Company (www.uspipe.com).

Valves shall be approved for sanitary sewer, direct burial service. Valves shall be for vertical setting with two inch (2") square operating nut, shall open counter-clockwise, and shall have "O" ring-type packing. All valves not requiring a vault shall have two-piece cast iron valve box, Models 562-S or 662-S, as manufactured by Tyler Pipe, or approved equivalent. Valve box shall be equipped with a cast iron lid imprinted "SEWER". A centering device such as Boxlok or an approved equal shall be used to keep the valve box centered.

Vendor shall furnish to the Owner an affidavit of compliance with all provisions of the standard, including testing.

4.4.3.2.5.1. GATE VALVES. Gate valves shall be cast iron body; fully bronze mounted, double-disk type with non-rising stem in accordance with the latest revision of AWWA C509, and shall be designed for use in wastewater applications. All valves shall be open left with a 2-inch square cast iron operating nut.

4.4.3.2.5.2. PLUG VALVES. Plug valves shall be cast iron body, eccentric type with flanged ends and designed for use in wastewater applications. Hydrostatic shell test rating shall be 350 psi and seal test rating shall be 175 psi for valves 3" through 12". Hydrostatic shell test rating shall be 300 psi and seal test rating shall be 150 psi for valves 14" and larger.

4.4.3.2.5.3. CHECK VALVES. Check valves shall be cast iron body, bronze mounted, external weight and lever arm, with flanged ends, and designed for use in wastewater applications. Hydrostatic test pressure rating shall be 350 psi and working pressure rating shall be 175 psi for check valves 2.5" through 12". Hydrostatic test pressure rating shall be 300 psi and working pressure rating shall be 150 psi for check valves 14" or larger.

4.4.3.2.5.4. AIR/VACUUM VALVES. Air/vacuum valves for force mains shall be constructed for sanitary sewer use. A Combination valve shall be installed to exhaust large quantities of air during the filling of a main and allow air to re-enter during draining or when a negative pressure occurs. An air release valve shall be installed at high points to permit small quantities of air to escape from the pipe. The inlet and outlet of the valves shall have the same cross-sectional area. The floats shall be guided by a stainless steel guide shaft and seat against a synthetic seat. Valves sized 1/2" through 3" shall have N.P.T. inlets and outlets. Valves sized 4" and larger shall be flanged inlets with plain outlets and protective hoods to prevent debris and foreign matter from entering the valves. All air/vacuum valves shall be constructed of cast iron with stainless steel trim and Buna-N seating. Valves shall be as manufactured by Val-Matic Valve and Mfg. Corp (www.val-matic.com) or approved equal.

Air/vacuum valves must be sized by the design engineer according to volume of main and maximum operating pressure. Valve size must be approved by Utilities Engineer.

Air/vacuum valves are to be installed in an air/vacuum valve vault as detailed in Standard Detail #3.

4.4.3.3. PUMP STATION SPECIFICATIONS. Specifications for pump stations, pumps, wet wells, valve pits, etc. are available in a separate packet in the office of the Utilities Engineer, at 600 East Miller Drive.

4.4.4. **MATERIALS FOR WATER MAINS.** This section describes the materials to be used in construction of water mains, including water pipe, valves, and other fittings and appurtenances. Any deviation from these specifications must be approved in writing by the Utilities Engineer.

4.4.4.1. WATER PIPES AND FITTINGS. Shall be made in the U.S.A.

4.4.4.1.1. DUCTILE IRON PIPE (DIP). Ductile iron pipe shall be manufactured by American, Griffin, or U.S. Pipe in accordance with the latest revision of ANSI A21.51 and AWWA C151. For 3-inch through 12-inch diameter DIP, Pressure Class shall be 350. For DIP with a diameter larger than 12 inches, Pressure Class shall be determined by the Design Engineer and approved by the Utilities Engineer on a case by case basis.

The pipe shall be lined with an approved thin Portland Cement spun lining and a bituminous seal in accordance with the latest revision of ANSI/AWWA C104/A21.

4.4.4.1.1.1. D.I.P. JOINTS. Mechanical joints, push-on or flanged joints shall be provided. Mechanical joints and accessories shall conform to the latest revision of AWWA C111, ANSI A21.11. Bolts and nuts shall be corrosive-resistant, high-strength, low alloy steel. Push-on joints with rubber O-ring gaskets shall comply with AWWA C111, ANSI A21.11. Flanged joints shall be manufactured with laying dimensions, facing and flanges detailed in accordance with AWWA C115, ANSI A21.15.

4.4.4.1.1.2. D.I.P. FITTINGS. The material and construction of fittings shall be similar to those of the pipes. Fittings with mechanical joints, bell and spigot joints, and flange joints, shall conform to the dimensions and weights in accordance with the latest revisions of AWWA C-110, ANSI A21.10, or AWWA C-153, ANSI A21.53. Fittings shall be cement-lined and coated as stated in 4.4.4.1.1., or may be coated with a 6 to 8 mil nominal thickness fusion-bonded epoxy coating conforming to ANSI/AWWA C550 and C116/A21.16.

4.4.4.1.1.3. POLYETHYLENE ENCASEMENT. Ductile iron pipe when requiring poly wrap shall be installed with an 8 mil high-density cross-linked polyethylene encasement material, inclusive of valves and fittings. The material shall be furnished and installed in accordance with AWWA C-105, ANSI A21.5 to provide the pipe with a protective enclosure.

4.4.4.1.2. POLYVINYL CHLORIDE (PVC). PVC pipe is NOT an approved material for construction of 6" and larger water mains within the City of Bloomington water jurisdiction. In special instances the Utilities Engineer may give written permission to utilize PVC pipe in construction of water mains after a master meter which are to remain private. This will be done on a case by case basis.

PVC pressure pipe may be used in construction of 2-inch or 4-inch water mains to be taken over and maintained by City of Bloomington Utilities. In such case the 2-inch pipe shall be SDR-21 (PR200), and the 4-inch pipe may be either SDR-21 (PR200) or C900 (DR-14). All service lines connecting to 2-inch PVC mains shall be 1-inch type K copper and shall connect by means of a self-tapping unit with compression connector outlet. Self-tapping unit shall be **FastTap**, as manufactured by **Continental Industries, Inc.** (www.conind.com) or pre-approved equal. Meter setup shall be in conformance with City of Bloomington Utilities Standard Detail Number 15.

Both SDR-21 and C900 shall have a cell classification of 12454-A or 12454-B according to ASTM D1784. The minimum allowable material shall be PVC 1120. SDR-21 shall be PR200 and conform to ASTM D2241 and D3139. C900 shall have DR=14, 200 psi. Both types shall have push-on joints. Solvent cement joints will not be allowed. All fittings shall be of the type and material recommended by the manufacturer. Elastomeric gaskets shall be manufactured to conform with ASTM F477.

4.4.4.1.2.1. LOCATOR WIRE AND SIGNS. A #10 insulated solid copper wire or #12 AWG HS-CCS high strength copper clad steel insulated locate wire shall be wrapped around all nonmetallic pipe so that one revolution is made at least every pipe joint. Splices are to be made with an approved connector, and are to be suitably protected against corrosion.

Where the main is laid off the road, the wire is to be brought to the surface approximately every 500 feet to a valve box or air valve vault, and sign post. Where the main is laid in the street, the wire is to be brought into a valve box approximately every 500 feet. Sign post shall be furnished by the Utilities Department; valve boxes to be furnished by Contractor.

4.4.4.1.3. PRESTRESSED CONCRETE CYLINDER PIPE. Prestressed Concrete Cylinder Pipe with I.D. 24" and larger may be used for water transmission mains requiring relatively few taps. Pipe and fittings shall be furnished in accordance with AWWA C301. Exact pipe and fitting materials and design pressures must be preapproved by the Utilities Engineer.

4.4.4.1.4. COPPER. All 2-inch or less service lines from the main to the meter shall be Type K copper with flared ends in conformance with ASTM B88. Compression or solder joints will not be allowed on any service line between the main and the meter.

4.4.4.1.4.1. FITTINGS FOR SERVICE LINES. All fittings shall be in conformance with ANSI/AWWA C800. Both corporation stops and curb stops shall be ball valve type, brass-bodied, full-port, with a Teflon coated ball. The corp stop shall have a single O-ring and the curb stop double O-rings. Only flared fittings will be permitted on Type K copper. The curb stop however shall be fitted with a flare by female iron pipe thread for later attachment to yoke. Fittings shall be Ford, McDonald, or Mueller or an approved equivalent, made in the U.S.A.

4.4.4.2. VALVES. All valves other than air release valves and tapping valves shall be manufactured by M&H Valve Company (www.mh-valve.com), American Flow Control (www.acipco.com), Kennedy Valve Company (www.kennedyvalve.com), Mueller Company (www.muellercompany.com), or U.S. Pipe and Foundry Company (www.uspipe.com). No other valves will be considered.

Valves shall be for direct burial service. Valves shall be for vertical setting with two inch (2") square operating nut, shall open left (counter-clockwise), and shall have "O" ring-type packing. All valves not requiring a vault shall have two-piece cast iron valve box, Models 562-S or 662-S, as manufactured by Tyler Pipe, or approved equivalent. Valve box shall be equipped with a cast iron lid imprinted “WATER”. A centering device such as Boxlok or an approved equal shall be used to keep the valve box centered.

Vendor shall furnish an affidavit to the Owner assuring compliance with all provisions of the standard, including testing.

4.4.4.2.1. GATE VALVES. All gate valves four inch (4″) through fourteen inch (14″) shall be resilient wedge type with either a cast or ductile iron body and a non-rising stem. The wedge shall be either cast or ductile iron encapsulated with rubber, shall be symmetrical, and seal equally well with the flow in either direction. Gate valves shall be in compliance with the latest version of either AWWA C509 or AWWA C515. Bolting materials shall be stainless steel with the bolting strength required by ASTM A307 and may have either square or hexagonal heads with dimensions conforming to ANSI B18.2.1. All valves shall be open left (counter clockwise) and shall be furnished with a 2-inch square cast iron operating nut.

4.4.4.2.2. BUTTERFLY VALVES. All water mains of 16 inches or larger diameter shall require the use of resilient seat butterfly valves in accordance with ANSI/AWWA C504. All valves shall be open left (counter clockwise) and shall be furnished with a 2-inch square cast iron operating nut.
All butterfly valves shall be installed in a precast concrete manhole having a minimum interior diameter of five feet, and in accordance with 4.5.3.4.4. The dimensions of larger valves may require 6-foot I.D. manholes. Manhole casting shall be East Jordan 1020 series with a self-sealing, non-rocking lid imprinted with the word "WATER".

4.4.4.2.3. AIR RELEASE VALVES. Air release valves shall be Val-Matic, model numbers 15, 22, 25 or 38 or approved equal (www.val-matic.com), and shall incorporate the optional vacuum-check feature. All air release valves must be sized by the design engineer according to system capacity and operating pressure, and size must be approved by the Utilities Engineer. Air release valves are to be installed in an air valve vault as detailed in the Standard Detail #3.

4.4.4.2.4. TAPPING VALVES. A tapping valve is a special gate valve designed with end connections and an unobstructed waterway to provide proper alignment and positioning when assembling a tapping sleeve, valve, and machine for tapping pipe dry or under pressure. The connecting flange of the tapping valve mating with the tapping machine must be parallel and concentric with the waterway to provide proper alignment for the tapping operation. The size of the valve waterway shall include appropriate clearance for the diameter of the tapping machine cutter recommended by the valve manufacturer. All tapping valves shall be cast iron body, fully bronze mounted, with a resilient seat and a non-rising stem in accordance with the latest revision of AWWA C509. All tapping valves shall be open left, and shall be furnished with a 2-inch square cast iron operating nut. Tapping valves shall have mechanical joint ends, with one end flanged with raised face to match the groove in the tapping machine outlet. All tapping valves shall be manufactured by American Flow Control (www.acipco.com), Kennedy Valve Company (www.kennedyvalve.com), Mueller Company (www.muellercompany.com), or U.S. Pipe (www.uspipe.com).

4.4.4.2.5. TAPPING SLEEVES OR SADDLES. Mechanical joint tapping sleeves shall be used to connect a tapping valve to an existing pressurized main to make a tap where conditions make it impractical to interrupt service to the existing main. The tapping sleeve body consists of two main parts, a back section and a throat section. These are coupled around the existing main by bolts and nuts and sealed to the main by a gasket. The tapping sleeve body shall be fabricated of carbon steel, stainless steel, cast iron, or ductile iron. The body shall be provided with a test plug for pressurization of the sleeve, valve, and tapping machine assembly just before the cut is made. Bolts and nuts shall be either corrosion resistant, high-strength, low alloy steel, in accordance with AWWA C111, or 18-8 stainless steel. Gaskets shall be Buna-N (Nitrile) in accordance with ASTM D2000 BA508, or pre-approved equal.

For all instances where the tap is at least one pipe size smaller than the pipe to be tapped, contractor shall use one of the following sleeves: Ford Style FTS, FTSC, or FTSS; Smith-Blair 622; Romac SST; JCM 412-ESS. For size-on-size taps (where the tap is the same size as the pipe to be tapped) where pipe diameter is 12-inches or less, contractor shall use one of the following: Tyler/Union Ductile Iron MJ Tapping Sleeve; Mueller H-615 MJ Tapping Sleeve. Size-on-size taps for pipe diameters larger than 12-inches will be reviewed by the Utilities Engineer on a case-by-case basis.

4.4.4.3. VALVE MARKERS. A valve marker is to be set near each sectionalizing valve and air release valve. No extra payment will be made for valve markers; the price of each valve marker is to be included in that of the valve it locates.

4.4.4.4. FIRE HYDRANTS. Fire hydrants shall conform to the latest revision of ANSI/AWWA C502 and shall be mechanical joint, with two hose nozzles and one pumper nozzle, with a 1½" pentagon operating nut that opens left (counter-clockwise), and have a valve opening of 5¼". All hydrants shall be Kennedy Guardian (www.kennedyvalve.com), Mueller Super Centurion 250 (www.muellercompany.com), or Waterous Pacer Classic (www.acipco.com). No other hydrants will be considered. Hydrants shall be painted and coated per the manufacturers specification in colors for the following owners, hydrants to be taken over and maintained by CBU shall receive a thorough coat of silver metallic paint; hydrants to be taken over and maintained by Indiana University shall receive a thorough coat of red paint; hydrants to be privately owned and maintained shall receive a thorough coat of yellow paint.

4.4.4.5. FLUSH HYDRANTS. All flush hydrants, whether installed in grassy areas or in pavement, shall be **Gil, 2-inch Slim Line Flush Hydrant**, (www.gilindustries.com) or **Kupferle Model TF500 Flush Hydrant** (www.hydrants.com). All flush hydrants shall be installed in a traffic-rated six-inch valve box with lid. A 2-inch, brass-bodied, double O-ring, full-port valve with a Teflon coated ball shall be installed immediately before either type of flush hydrant. Valve shall be equipped with road type valve box.

4.4.5. **MATERIALS FOR STORM SEWERS.** This section describes materials to be used in design and construction of storm sewers, including pipes, manholes, inlets, catch basins, castings, frames, and covers. Inlets, catch basins, concrete curbs and gutters along all streets, and storm sewers, shall be designed to accommodate peak discharge produced by the ten (10) year design interval storm. All structures shall be protected from the one-hundred (100) year design interval storm, and shall be consistent with the capacity of downstream storm sewer facilities. Storm sewer systems shall be designed using the Rainfall Intensity-Duration-Frequency Curves (IDF Curves) for Bloomington, Indiana. The IDF Curves are developed by CBU utilizing the latest information from the National Weather Service, and are shown on CBU Standard Detail Number 16. Rainfall duration shall be equal to time of concentration. Hydraulic calculations for each run of pipe shall accompany all storm sewer plans submitted to CBU for review. Hydraulic calculations must be prepared by a licensed professional engineer registered in the State of Indiana and engaged in storm drainage design.

4.4.5.1. PIPE AND FITTINGS FOR STORM SEWERS. Shall be made in the U.S.A.

4.4.5.1.1. DUCTILE IRON PIPE (DIP). Ductile Iron Pipe shall be manufactured by American, Griffin or U.S. Pipe and shall conform to ANSI A21.51 and AWWA C-151, latest revision. Ductile Iron Pipe shall be Pressure Class 350, 300, 250, 200 or 150. Old pressure classes 50 through 56 will also be allowed when required due to deep burial or high loading. Pressure class shall be determined by the Utilities Engineer on a case-by-case basis.

4.4.5.1.1.1. COATINGS AND LININGS. DIP shall be standard cement lined with an approved bituminous seal coat in accordance with AWWA C-104, ANSI A21.4. Pipe when requiring poly wrap shall be installed with an 8 mil high-density cross-linked polyethylene encasement material, inclusive of fittings. The material shall be furnished and installed in accordance with AWWA C-105, ANSI A21.5 to provide the pipe with a protective enclosure.

4.4.5.1.1.2. JOINTS. Joints may be either push-on or mechanical joints.

4.4.5.1.1.2.1. PUSH-ON JOINTS. The O-ring gaskets sealing the push-on joint shall be made of rubber of special composition having a texture to assure a soil-tight, permanent seal, and shall be the product of

a manufacturer having at least five (5) years experience in the manufacture of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture resistant to common ingredients of sewage, industrial wastes, and surface runoff, and which will be very highly resistant to conditions likely to be imposed by this service. The gasket shall conform to AWWA C-111, ANSI A 21.11.

4.4.5.1.1.2.2. MECHANICAL JOINTS. Mechanical joints are also acceptable and may be required by the Utilities Engineer in certain circumstances. Mechanical joints and accessories shall conform to AWWA C-110. The nuts and bolts shall be corrosion resistant high-strength low alloy steel.

4.4.5.1.1.3. FITTINGS. Fittings shall be standardized for the type of pipe and joint specified, and shall comply with AWWA C-110, ANSI A 21.10, and AWWA C-153, ANSI A 21.53. Fittings shall be cement lined and seal coated in accordance with 4.5.1.1.1.

4.4.5.1.1.4. MARKINGS. The class designations for the various classes of pipes and fittings shall be cast into fittings in raised letters and numerals, and cast or stamped on the outside of each joint of pipe.

4.4.5.1.2. HIGH DENSITY POLYETHYLENE (HDPE) PIPE. HDPE pipe shall be bell and spigot type with smooth interior walls. The pipe and fittings shall be made from virgin PE compounds which conform to the current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350. All HDPE pipe shall meet requirements of the current issue of AASHTO M252 and M294 (4″- 60″ diameters).

Manufactured wyes, tees, bends or adapters will only be allowed in place of precast storm sewer manholes, inlets, or catch basins when written permission has been given by the Utilities Engineer

4.4.5.1.2.1. JOINTS. Flexible gasket joints shall be compression type so that, when assembled, the gasket on the pipe end shall be compressed radially in the pipe bell to form a soil-tight seal for all soil types and groundwater conditions.

4.4.5.1.2.2. GASKETS. Gaskets for HDPE shall be of an elastomeric o-ring composition having a texture to assure a soil-tight and permanent seal. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture to restrain common ingredients of sewage, industrial waste, and surface runoff, and which will be highly resistant to conditions likely to be imposed by this service. Gaskets shall conform to all requirements of ASTM F477.

4.4.5.1.2.3. NOMINAL PIPE STIFFNESS. Minimum parallel plate stiffness values for HDPE storm sewer pipe, when tested in accordance with ASTM D2412, shall be as follows: 4″ through 12″ = 49 pii, 15″ = 42 pii, 18″ = 40 pii, 24″ = 34 pii, 30″ = 28 pii, 36″ = 22 pii, 42″ = 20 pii, 48″ = 18 pii, 60″ = 14 pii.

4.4.5.1.2.4. MARKINGS. Each length of HDPE storm sewer pipe shall be clearly marked with the manufacturer's name, trademark, nominal pipe size, production or extrusion code, material cell classification, and ASTM or AASHTO number.

4.4.5.1.3. POLYVINYL CHLORIDE (PVC) PIPE. PVC pipe may only be used for storm sewer construction with written permission of the Utilities Engineer. When approved, it shall conform to the following: PVC storm pipe shall be the integral wall bell and spigot type with elastomeric seal joints and smooth inner walls. Pipe shall meet one of the following standards and related cell classifications:

ASTM D 3034	12454B or C, 13364B
ASTM F 789	12164B
ASTM F 679	12364C, 12454C
ASTM F 794	12364A
ASTM F 949	12454B or C
AASHTO M304	12454C, 12364C

All PVC storm sewer pipe shall have a minimum pipe stiffness of 46 psi when measured at 5% vertical ring deflection and tested in accordance with ASTM D 2412.

4.4.5.1.3.1. JOINTS. Flexible gasket joints shall be compression type so that, when assembled, the gasket inside the machined groove on the pipe spigot shall be compressed radially in the pipe bell to form

a soiltight seal for all soil types and groundwater conditions. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations and ASTM D 3212.

4.4.5.1.3.2. GASKETS. Gaskets for PVC shall be made of rubber of special composition having a texture to assure a watertight, permanent seal, and shall be the product of a manufacturer having at least five (5) years experience in the manufacture of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture resistant to common ingredients of sewage, industrial wastes, and surface runoff, and which will be very highly resistant to conditions likely to be imposed by this service. Gaskets shall conform to all requirements of ASTM F 477.

4.4.5.1.3.3. MARKINGS. The date of manufacture, class of pipe, and specification designation, size of pipe, name or trademark of the manufacturer, and identification of plant shall be legibly marked on each section of pipe per the ASTM requirement.

4.4.5.1.4. REINFORCED CONCRETE PIPE. All reinforced concrete pipe shall be Class III, IV, or V in accordance with the latest edition of ASTM C 76, wall thickness "B" or "C" as per site conditions. Pipe shall be manufactured from Portland Cement and aggregate as specified herein.

4.4.5.1.4.1. PORTLAND CEMENT. Portland Cement for manufacture of concrete pipe and fittings shall be Type I or Type III and shall conform to ASTM C 150. Upon request, the Contractor shall furnish manufacturer's certificate stating the type of cement used in the manufacture of the pipe furnished.

4.4.5.1.4.2. AGGREGATE. Aggregate for manufacture of concrete pipe and fittings shall conform to ASTM C 33 except that the requirement for gradation shall not apply. Upon request, the Contractor shall furnish manufacturer's certificate stating the type of aggregate used in the manufacture of the pipe furnished.

4.4.5.1.4.3. STEEL REINFORCEMENT. Steel reinforcement shall be in accordance with requirements of the applicable table in ASTM C 76. Reinforcement shall extend full into bell and spigot ends for pipes 36 inch and larger, and shall extend full into the bell of rubber gasket pipes 12 inch and larger. Elliptical reinforcement shall not be permitted. Longitudinal reinforcement shall be continuous, and all reinforcement shall have a minimum concrete cover of 1 inch.

4.4.5.1.4.4. LIFT HOLES. Lift holes shall not be permitted for concrete pipe.

4.4.5.1.4.5. JOINTS. Concrete pipe shall be furnished with joints using either concrete bell and spigot or zinc coated steel bell and spigot rings, or rubber seal and rings (Anderson Seal or approved equal). All types of joints shall have a groove on the spigot for a rubber "O" ring gasket. Pipe joints using concrete bell and spigot or zinc coated steel bell and spigot rings shall conform to ASTM C 361 except that the gaskets shall be as specified hereinafter. Pipe joints using rubber gaskets shall conform to ASTM C 443 so that the joint will remain soiltight for all soil types and groundwater conditions. The steel bell shall be welded to the longitudinal reinforcing, and a steel skirt (minimum 5.75 inches in length and fabricated from 16 gauge metal) shall be continuously welded to the inside face of the steel spigot ring and to the longitudinal reinforcement.

Profile gasket type joints using a self-lubricated gasket (Forsheda Style 138 or approved equal) on a single offset spigot and formed bell are acceptable. Joints shall be sealed with a profile rubber gasket conforming to ASTM C 443 so that the joint will remain soiltight under all conditions of service.

Only one style of joint system will be permitted from structure to structure in a single run of pipe.

Mastic sealer shall not be used to seal reinforced concrete pipe joints.

4.4.5.1.4.6. ABSORPTION LIMIT. Absorption by the reinforced concrete pipe shall not exceed 6% of its dry weight.

4.4.5.1.4.7. MARKINGS. The date of manufacture, class of pipe, and specification designation, size of pipe, name or trademark of the manufacturer, and identification of plant shall be legibly marked on each section of pipe per the ASTM requirement.

4.4.5.1.5. SPIRAL RIB (TYPE I.R.) METAL PIPE (SRP). Spiral Rib Pipe may be used on a case-by-case basis with written approval of the Utilities Engineer after review of hydraulic calculations. All Spiral Rib (Type I.R.) metal pipe fabricated under this specification shall be formed from aluminum coated Type 2 sheet conforming to AASHTO M274 (ASTM A 929).
The manufacture of Spiral Rib (Type I.R.) pipe shall be in accordance with the applicable section of AASHTO M36, ASTM A 760. In addition, a 1/8″ diameter rubber cord shall be placed in the lockseam during the manufacturing process.

4.4.5.1.5.1. NOMINAL PIPE WALL THICKNESS. All Spiral Rib pipe provided under this specification shall have wall sectional properties that meet the design requirements of AASHTO Standard Specification for Highway Bridges - Section 12 (ASTM A 796).

4.4.5.1.5.2. JOINTS. External coupling bands will be accepted for use with Spiral Rib pipe. All coupling bands shall be fabricated of the same material type as the pipe and shall be fabricated to overlap an equal amount of each adjoining pipe section. Each pipe end shall be formed to have a minimum of two annular corrugations. Each joint shall utilize closed-cell expanded rubber gaskets. The coupling bands shall be fully corrugated 5-C annular bands with a double-bolted bar-and-strap connector and a nominal 12 inch wide gasket.

4.4.5.1.5.3. GASKETS. The closed-cell expanded rubber gaskets shall be approximately 12 inches wide and approximately 3/8″ thick. The gaskets shall conform to ASTM D 1056, Grade SCE-43-L.

4.4.5.1.5.4. INSTALLATION. Installation of Spiral Rib pipe shall be in conformance with ASTM A 798 - Standard Practice for Installing Factory-made Corrugated Pipe for Sewers.

4.4.5.1.5.5. MARKINGS. The date of manufacture, trademark of the manufacturer, and identification of plant location shall be legibly marked on the outside of each pipe section in accordance with the required Standards.

4.4.5.2. PRECAST AND CAST-IN-PLACE BOX CULVERTS: For both precast and cast-in-place structures, shop drawings showing at a minimum the concrete mix, wall thickness, steel reinforcement details, pipe connections, and structure dimensions, shall be submitted for approval of each structure to be built. The shop drawings must be reviewed and certified by a registered Professional Engineer prior to submittal. Such shop drawings will be reviewed by CBU on a case-by-case basis.

4.4.5.3. OPEN CHANNELS: All open channel design shall conform to the standards set forth in the latest issue of the Monroe County Storm Water Design Ordinance. CBU reserves the right to modify said standards on a case-by-case basis as deemed necessary by the Utilities Engineer. Plans for repair and replacement of existing open channel structures within the CBU jurisdictional area must be reviewed and certified by a registered Professional Engineer prior to submittal. Such plans will then be reviewed by CBU on a case-by-case basis.

4.4.5.4. DETENTION PONDS AND DAMS. Design of detention ponds and dams shall be in accordance with the standards set forth in the latest issue of the Monroe County Storm Water Design Ordinance. CBU reserves the right to modify said standards on a case-by-case basis as deemed necessary by the Utilities Engineer. Plans for detention ponds and dams within the CBU jurisdictional area must be reviewed and certified by a registered Professional Engineer prior to submittal. Such plans will then be reviewed by CBU on a case-by-case basis.

4.4.5.5. STORM SEWER MANHOLES, INLETS, AND CATCH BASINS. Storm sewer manholes, inlets, and catch basins shall be installed at the locations and elevations shown on the plans. Manholes or inlets are required at the following locations: at the end of each line segment; at all changes in alignment, grade, size, and pipe material; and at all pipe intersections. Catch basins may be constructed using manholes or inlets having the outlet pipe installed minimum 30 inches above the structure base so that sediment and debris may be trapped before entering the storm sewer pipe system.

4.4.5.5.1. STORM SEWER STRUCTURES. Structures for storm sewers may be cast-in-place or precast.

4.4.5.5.1.1. CAST-IN-PLACE STORM SEWER STRUCTURES. For cast-in-place structures, shop drawings showing at a minimum the concrete mix, wall thickness, steel reinforcement details, pipe connections, and structure dimensions, shall be submitted for approval of each structure to be built. The shop drawings must be reviewed and certified by a registered Professional Engineer prior to submittal.
4.4.5.5.1.2. PRECAST STORM SEWER MANHOLES. See Sanitary Sewer Manholes, Sections 4.4.2.2.2. through 4.4.2.2.4. and Sections 4.5.2.1.7.1. through 4.5.2.1.7.4. Storm manholes will not be restricted to one foot of fall through the structure, nor will outside drops be required. Sealing or waterproofing of storm manholes will not be required, but they must be soil tight.

4.4.5.5.1.3. PRECAST CONCRETE INLETS AND CATCH BASINS. Precast concrete box inlets and catch basins shall be constructed in accordance with Indiana Department of Transportation (INDOT) Standard Specifications. Only inlet Type “A”, Type “A” Modified, Type “C”, Type “E”, and Type “J”, and catch basin Type “A”, Type “J”, and Type “W” may be used.

Alternative precast or monolithic box inlets will be accepted provided all standard specifications of INDOT are met or exceeded.

The structural design of precast concrete box inlets and catch basins shall be in full conformance with the requirements of ASTM C 890.

A maximum depth of four feet from the bottom of the casting to outlet pipe invert will be allowed for Type “A” or Type “A” (modified) box inlet structures.

4.4.5.5.1.4. CONCRETE BASES, INVERTS, AND FLOW CHANNELS. Monolithic or precast bases shall be minimum 6 inches thick for 4 foot diameter and minimum 8 inches thick for larger diameter manholes, and shall be constructed of Class A Concrete having a minimum compressive strength of 4,000 psi.

The wall and base thickness of precast box inlet and catch basin structures shall be as specified by the INDOT Standard Specifications and shall be constructed of Class A Concrete having a minimum compressive strength of 4,000 psi.

Manhole table and trough shall be in accordance with Section 4.5.2.1.7.2.

When Contractor is connecting a new pipe to an existing storm structure, the table and trough of the existing structure shall be rebuilt to conform to the standards of a new structure.

4.4.5.5.1.5. ADJUSTMENT OF FRAMES AND COVERS.

4.4.5.5.1.5.1. PRECAST MANHOLE ADJUSTING RINGS. Final adjustments to the elevation of the frame and cover shall be made only by the use of precast concrete adjusting rings conforming to ASTM C 478. Rings shall be of a nominal thickness of not less than two (2) inches. No more than twelve (12) inches total of adjusting rings shall be used to adjust the elevation of a frame and cover.

A soiltight seal shall be provided between the cone or flattop and riser ring, and between adjoining riser rings, by use of PRO-STIK Butyl Rubber Rope as manufactured by Press-Seal Gasket Corporation (www.press-seal.com), or pre-approved equivalent.

4.4.5.5.1.5.2. PRECAST CONCRETE BOX INLETS AND SPACERS. For precast concrete box inlets, the adjustment of casting and grate shall be accomplished using precast concrete spacers of a minimal nominal thickness of six (6) inches. The maximum number of spacers allowed will be four (4). A soiltight seal shall be provided between each component of the precast box inlet and precast concrete spacers by use of non-shrink waterproof mortar or non-asphaltic mastic material.
Adjustment of casting elevation for precast box inlets may be accomplished by using solid concrete brick and mortar to a maximum height of six (6) inches. This type of casting adjustment shall be accomplished in conformance with the following:

1. Solid pre-cast Class A concrete bricks of a nominal thickness of two (2) inches in conformance with ASTM C 139 shall be used.

2. No joint shall exceed 3/8 of an inch in width, and as nearly as practicable, adjoining courses shall break joints at one-half unit intervals.

3. Minimum constructed wall thickness shall be six (6) inches.

4. Mortar for laying bricks shall be composed of one (1) part masonry cement and two (2) parts mortar sand.

5. Both the inside and the outside of the adjustment area shall be plastered to at least ½ of an inch thickness using the mortar mix as in Item 4 above, or a mixture composed of one (1) part of a combination of Portland Cement and hydrated lime and two (2) parts sand. The lime portion of this mix shall not exceed ten percent (10%) of the sand. Plaster coats shall be smooth, clean, and watertight.

4.4.5.5.1.6. CASTINGS, FRAMES, AND COVERS. The plans shall show the use and placement of each casting type. Type of casting shall consider the required square footage of open area needed to convey the estimated stormwater flow. “Bicycle safe” and “pedestrian safe” grates shall be used where deemed necessary by the Utilities Engineer.

Manhole frames and covers shall be East Jordan Iron Works castings, catalogue number 1020 or 1022 or approved equivalent. Catalogue numbers 1037 or 1050 or approved equivalents may be used with the permission of the Utilities Engineer. Lids shall be Gasket Seal Cover catalogue number 1020A, heavy duty, or approved equivalent. The words “STORM SEWER” shall be cast in each manhole cover.

All castings, frames, grates, and lids shall be coated. All inlet and catch basin frames shall be imprinted with the words: “DUMP NO WASTE – DRAINS TO RIVER”. No type of casting, frame, grate, or cover other than East Jordan shall be used unless written approval is granted by the Utilities Engineer.

All castings shall conform to the requirements of ASTM and following:

1. Castings shall be of uniform quality, free from blow holes, porosity, hard spots, shrinkage, distortion, or other defects. Castings shall be smooth and well-cleaned by shot blasting or other approved method.

2. All castings shall be manufactured true to pattern; component parts shall fit together in a satisfactory manner. Round frames and covers shall be of non-rocking design or shall have machined horizontal bearing services to prevent rocking and rattling under traffic. All castings used for the same application shall be fully interchangeable.

3. All weights shall not deviate from the tolerances permitted by ASTM Standards (i.e., ASTM A 48-83 “Standard Specifications for Gray Iron Castings”).

4. All castings shall be manufactured in accordance with ASTM A 48-83 Class 35B, and shall have a minimum tensile strength of 35,000 psi.

4.4.5.5.1.7. MANHOLE AND INLET DIMENSIONS. The following are minimum manhole diameters for storm sewers entering or exiting a manhole at the following range of angles:

	MANHOLE DIAMETERS	
PIPE SIZE	Pipes Entering/ Leaving at 0-45 Degree Bend	Pipes entering/ Leaving at 45-90 Degree Bend
12"-21"	48"	48"
24"	48"	60"
27"-30"	60"	60"
33"-36"	60"	72"

Manholes for pipe sizes greater than 36 inches shall be reviewed by the Utilities Engineer on a case-by-case basis.

The following are maximum pipe inside diameters for precast inlets and catch basins:

MAXIMUM INSIDE DIAMETERS FOR INLETS AND CATCH BASINS

Structure Type	Straight Connection (See Note 1 below)		Skew / Corner Connection (See Note 2 below)	
A	15″		12”	
A Modified	18″		15″	
	Long Wall / Short Wall		**Long Wall / Short Wall**	
B	36″	24″	24″	15″
C	36″	24″	24″	15″
E	24″	24″	15″	15″
J	27″	18″	18″	15″

Note 1: Straight-out connections should not be made to either precast inlet wall touched by a skew / corner connection unless sufficient box inlet wall area remains on each side of the connecting pipe to assure structural integrity of the precast unit.

Note 2: A maximum of two (2) skew / corner connections will be permitted for each precast inlet.

The number and entrance angle of pipe connections, with consideration given to outside pipe diameter(s), shall be as stated above to ensure maintenance of structural integrity of the manhole or inlet structure. If the structural integrity of the manhole or inlet cannot be maintained, a cast-in-place structure will be required. Shop drawings for cast-in-place structures showing at a minimum the concrete mix, steel reinforcement details, pipe connections, and structure dimensions, shall be submitted for approval of each structure to be built. The shop drawings must be reviewed and certified by a registered Professional Engineer prior to submittal.

With written permission of the Utilities Engineer, a standard manhole structure, fit with a standard inlet casting, may be used in place of a cast-in-place structure to overcome skew problems with interconnecting pipes. Such use of standard manhole structures will be reviewed on a case-by-case basis.

4.4.5.6. STEPS. Manhole steps shall be provided in all storm sewer structures 48 inches in diameter and larger as required to allow access for inspection, cleaning, and repairs. Steps shall only be required above the maximum flow line in each sewer, and essentially only in the risers and cone sections above large box structures.

Manhole steps shall be polypropylene, polypropylene coated steel reinforcing, or an approved non-corrosive fiberglass material. The copolymer polypropylene shall meet the requirements of ASTM D 4101, reinforced with deformed 3/8 of an inch minimum diameter reinforcing steel conforming to ASTM A 615, Grade 60. Cast iron steps are not acceptable.

4.4.5.7. SEWER PIPE TO STORM STRUCTURE CONNECTIONS. Inlet and outlet pipes shall extend through the inlet or outlet walls a sufficient distance to allow placement of grouting material around the pipe diameter both inside and outside the structure wall, preventing leakage around the pipe's outer surface. Inlet and outlet pipes shall not extend through the structure wall to the point that flow is obstructed.

Holes for connection of storm sewer pipes shall be pre-formed by the manufacturer, or by core-drilling the structure. At no time shall the pipe hole exceed pipe outer diameter plus six (6) inches (O.D. + 6″), to ensure proper connection is achieved. Structures with pre-formed thin-wall "knock-outs" will not be permitted unless approved by the Utilities Engineer.

For Reinforced Concrete Pipe, the annular space between the pipe and the precast structure wall shall be filled inside and out with a waterproof, non-shrink mortar such as OCTOCRETE (IPA Systems, Inc.) (www.ipasystems.com), or approved equal, in accordance with the manufacturer's instructions.

PVC pipe, HDPE pipe, DIP, and SRP pipe may also be connected to a structure by use of a flexible boot KOR-N-SEAL flexible connector (www. trelleborg.com/npc), Press-Seal PSX Positive Seal (www.press-seal.com), "A"-Lok or "Z"-Lok gasket (www.a-lok.com), Fernco Waterstop gasket or approved equals.

4.4.5.8. REJECTION OF PRECAST STORM STRUCTURE SECTIONS. Precast reinforced concrete manholes, risers, inlets, catch basins, and tops shall be subject to rejection for failure to conform to any of the following specification requirements:

1. Fractures or cracks passing through the shell, except for a single crack that does not exceed the depth of the joint.
2. Defects that indicate imperfect proportioning, mixing, and molding.
3. Surface defects indicating honeycombed or open texture.
4. Damaged ends, where such damage would prevent making a satisfactory joint.
5. The internal diameter of the manhole section shall not vary more than one percent (1%) from the nominal diameter.
6. Structure having visible reinforcing steel along the inside or outside surface, except for reinforcement stirrups or spacers used to position the cage or form during manufacture.

4.5. INSTALLATION OF SANITARY, WATER, AND STORM MAINS.

4.5.1. **GENERAL.** This section covers excavation work and pipe installation which include the following: clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching; handling, storage, transportation, and disposal of all excavated material; sheeting, shoring, and protection; preparation of subgrades; pumping and dewatering; protection of adjacent property; pipe embedment; laying of pipe; excavation for structures; bedding; backfilling; construction of fills and embankments; surface restoration and regrading; other appurtenant work.

Before commencement of any on-site activity, the Contractor shall verify that a copy of the State Construction Permit is on file in the Office of the Utilities Engineer.

The Contractor shall indicate to the Utilities Inspector, during his initial visit to the site, the nature and storage place of any and all hazardous substances. This shall be updated as necessary.

The Contractor is responsible for ensuring that safe working conditions exist and safety procedures are being followed at the Work site, and shall maintain a trench safety system in compliance with OSHA Part 1926 of the Code of Federal Regulations. The Utilities Department's inspector is **NOT** responsible for policing the Contractor's safety program. If, in the course of routine inspection, an unsafe condition is noted, the inspector will notify the Contractor of this condition and report it to the Engineer. If the condition continues to exist, the inspector shall again notify the Engineer, document the unsafe condition in writing and through a photograph, and leave the job site. The Engineer will contact IOSHA and request that they dispatch an inspector immediately.

Bedding, backfilling, construction fills, and embankments shall not be done during freezing weather except by permission of the Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment. All rough grading, fill and compaction shall be complete before construction of any sanitary, storm, or water main.

4.5.1.1. PROTECTION OF THE SITE. Before any excavation is started, adequate protection shall be provided for all lawns, trees, shrubs, landscape work, fences, hydrants, wells, sidewalks and curbs, and other objects that are to remain in place. Such protection shall be maintained as long as necessary to prevent damage from the Contractor's operations. Any damage that may occur shall be repaired to original condition or replaced by the Contractor at no expense to the Owner.

4.5.1.2. TRENCH EXCAVATION. Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of 48" except as otherwise ordered or approved by the Utilities Engineer.

When unstable soil conditions are encountered and the trench bottom is not firm, all soft and compressible material shall be excavated and replaced with #1 or #2 crushed stone before placement of the bedding material. As an alternative, with written permission of the Utilities Engineer, an acceptable geo-fabric may be used beneath the bedding material to stabilize the trench bottom.

Trenches shall be excavated to a width which will provide adequate working space for proper pipe installation, jointing, and embedment. However, the minimum trench width between the installed pipe and either trench wall shall be seven inches (7"). The stipulated minimum clearances are not minimum average clearances, but the minimum clear distances which will be permitted between any part of the pipe as laid, and any part, projection, or point of rock, stone, or boulder.

Where necessary to reduce the earth load on trench banks to prevent sliding and caving, the banks may be cut back on slopes which shall not extend lower than one foot (1') above the top of the pipe.

4.5.1.2.1. CLASSIFICATION OF EXCAVATED MATERIALS. Excavated materials shall be classified as earth excavation or rock excavation and shall include whatever materials are encountered, to the depths required, as directed by the Engineer.

4.5.1.2.1.1. EARTH EXCAVATION. Earth excavation shall include earth, all rocks or boulders less than one-half (1/2) cubic yard in volume, all rock which may be removed by scarification by excavator or backhoe, asphalt, and all concrete or masonry structures which, in the opinion of the Engineer, do not require drilling or blasting, or use of hoe-ram for removal.

4.5.1.2.1.2. ROCK EXCAVATION. Rock excavation shall include ledge rock, all boulders exceeding one-half (1/2) cubic yard in volume, and concrete or masonry structures or any other material which, in the opinion of the Engineer, requires drilling and blasting or use of hoe-ram for removal.

4.5.1.2.1.2.1. ROCK EXCAVATION FOR PLACING PIPE. Where rock is encountered in the trench, the Contractor shall open the trench to full depth for sufficient distance to lay one length of pipe. The rock shall be excavated a minimum of six inches (6") below the outside surface of the pipe bell, and at least seven inches (7") from the outside of the pipe bell on each side. For rock depths greater than four feet,

rock quantities shall be calculated as in 4.5.1.2.1.2.4. Each section of pipe shall be backfilled immediately after laying. The exposed end of the last pipe shall be covered with sandbags to protect it from damage by flying debris.

4.5.1.2.1.2.2. ROCK EXCAVATION FOR STRUCTURES. For cast-in-place structures, rock excavation shall be no larger than is necessary to facilitate construction and removal of formwork. When precast structures are used, a minimum six inch (6") clearance will be maintained between the structure and any rock. For rock depths greater than four feet, rock quantities shall be calculated as in 4.5.1.2.1.2.4.

4.5.1.2.1.2.3. BLASTING. Blasting will **not be permitted in any circumstances** without written permission of the Utilities Engineer

4.5.1.2.1.2.3.1. GENERAL. The Contractor shall comply with all local, state, and federal laws, ordinances, applicable safety code requirements, and regulations relative to the handling, storage, and use of explosives and the protection of life and property. Suitable methods shall be employed to minimize fly rock. Blasting practices, at the minimum, shall follow the applicable requirements and recommendations of the National Fire Protection Association "NFPA 495-Code for the Manufacture, Transportation, Storage, and Use of Explosives and Blasting Agents", unless local and state requirements are more stringent. The Contractor shall be responsible for obtaining all blasting permits required by all regulating agencies.

Contractor shall erect signboards of adequate size stating that blasting operations are taking place in the area, and such signs shall be clearly visible at all points of access to the area. Contractor shall coordinate the configuration of these signboards with local regulations. Contractor shall utilize a reliable audible warning system to ensure that any personnel in the area are forewarned of the impending detonation of explosives.

Contractor shall be solely responsible for the safety and stability of the excavation slopes for the entire duration of the work. Excavation work and discretionary support methods shall be the responsibility of Contractor. Blasting technique and pattern shall be best suited to the nature of the rock and the particular excavation.

Discretionary support shall be provided by Contractor to maintain safety and stability of the excavation slopes. Discretionary support is likely to be needed depending on several factors, including commonly occurring variability in the subsurface conditions; structure of rock, such as orientation of joints, location of bedding planes, and lithology; and results of blasting. Support may include sheeting and shoring, rock bolts or dowels, concrete, shotcrete, mesh, strapping, and other similar items commonly used in the work of this nature.

The Contractor shall be responsible for all damage caused by his blasting operations.

4.5.1.2.1.2.3.2. BLASTING CONSULTANT. The Contractor shall employ personnel experienced in blasting techniques, and shall retain the services of an independent blasting consultant who shall determine optimum blasting patterns and shall advise Contractor's blasting supervisor. Blasting shall be done under the direct supervision of the blasting consultant. The Contractor shall provide written documentation that the blasting consultant and the person conducting the blast has at least 10 years of experience in design and implementation of rock excavation using controlled blasting methods for similar construction.

The blasting consultant shall maintain a professional liability insurance in the amount of $1,000,000. The evidence of such insurance and the blasting consultant's qualification shall be submitted to the Utilities Engineer at least 14 days in advance of commencing blasting operations.

All drilling and blasting shall be done in a manner which will minimize the disturbance to material outside the required excavation limits. Care shall be taken to ensure against blasts which might damage previously completed portions of the excavation.

4.5.1.2.1.2.3.3. PERMITS AND APPLICABLE STANDARDS**.** All required federal, state, and local permits for blasting and explosives shall be obtained and paid for by the Contractor. Copies of such permits shall be furnished to the Utilities Engineer before any blasting operations may be started.
All blasters and blasting foremen shall be properly licensed in accordance with the applicable laws and regulations of federal, state, and local agencies.

4.5.1.2.1.2.3.4. BLASTING PLAN. At least 14 days before commencing blasting operations, Contractor shall reproduce for record purposes and shall forward to the Utilities Engineer for review, a detailed two part conceptual blasting plan which has been prepared by the independent blasting consultant and reviewed and approved by the Contractor or his safety engineer. After approval by the Utilities Engineer, this blasting plan shall be posted onsite. The plan shall include qualifications of monitoring personnel. Storage and use of explosives at the project site will not be allowed until the blasting plan is approved by the Utilities Engineer.

Part 1 of the conceptual plan shall include a complete summary of proposed transportation, handling, storage, and use of explosives. Part 2 of the conceptual plan shall include the proposed general concept for the blasting and for the control of noise, dust, fly rock, airblast, and vibrations. Test blast planned by Contractor shall be included in Part 2.

In addition to the conceptual plan, individual shot plans shall be reproduced, for record purposes, on a day-to-day basis, and submitted to the Utilities Engineer. Submittal shall be timely so that the plans are received by the Utilities Engineer at least 24 hours before the scheduled time for blasting provided for in the plan. The individual shot plans shall be prepared by the blasting consultant and shall bear his signature. Individual shot plans shall include, but shall not be limited to, the following information:

Drilling patterns

Number, location, inclination, diameter, and depth of drilled holes

Amount, type, and distribution of explosives per hole

Powder factor; time delays; weight of explosives in each delay

Sequence of firing

Time of blast

Total pounds of explosive

Any other pertinent data indicating Contractor's intent and purpose to produce smooth and sound surfaces of excavation and to project adjacent facilities.

The blast plan shall be revised if the results of blasting do not conform to the overall project objectives and technical requirements of these specifications.

After acceptable standard drilling and blasting procedures have been developed, the individual plan need contain only as a minimum the location, date, time of round detonation, foreman's name, and reference with the drawing number of previously submitted individual plan. All loading deviations from the previous individual plan shall be noted to provide an accurate record of blasting operations. If conditions change, requiring modifications to the plan, a revised individual plan shall be submitted to the Utilities Engineer for review. After receiving his approval, the modified plan shall be posted onsite.

Contractor shall assume complete responsibility for protecting the existing facilities and the Work under construction. The Utilities Engineer's receipt of the Contractor's blasting plans and procedures shall not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents and to protect life, property, and the Work under construction. All damage resulting from the blasting operations shall be repaired at the Contractor's expense.

4.5.1.2.1.2.3.5. BLASTING PROCEDURES. Selection of blasting procedures is the responsibility of the Contractor and the blasting consultant. All blasting shall be performed in accordance with the best modern practice, using methods and techniques that will preserve the unexcavated rock face and excavation bottom in the best and most stable condition and which will reduce overbreak to a minimum. Shattering or splitting of unexcavated rock or the opening up of any seams in rock not excavated, and the disturbance of rock outside the excavation lines, shall be avoided. All rock damaged by blasting shall be removed. The Utilities Engineer, at his discretion, may require replacement of said damaged and removed rock with crushed stone or concrete.

4.5.1.2.1.2.3.6. BLAST MONITORING**.** At the Utilities Engineer's discretion, certain projects may require blast monitoring as part of the Contractor's blasting plan. If blast monitoring is required, Contractor shall perform the following procedures.

Contractor shall measure baseline ground vibrations at the facilities nearest to the blast areas prior to the start of blasting procedures. Seismographs shall be used to monitor ground vibrations, frequency content of vibration, and peak particle velocity components in three mutually perpendicular directions. A minimum of three seismographs shall be provided. Seismographs shall be calibrated within 90 days of using on the project. Calibration of each seismograph shall be submitted to the Utilities Engineer for review of certification of calibration and the date of calibration before any blasting is performed. Seismographs shall be the type that provide a hard copy printout.

Monitoring shall be performed at three structures nearest the location of the individual blasts (or as directed by the Utilities Engineer).

For vibration frequencies equal to or less than 40 Hz (cycles per second), the peak particle velocity, defined as the maximum of the three velocity components of vibration, at any location shall be less than 1 inch per second. For vibration frequencies greater than 40 Hz the peak particle velocity at any location shall not exceed 2 inches per second and the displacement shall be less than 0.004 inches. In addition, Contractor shall measure air overpressure at the location of the monitors. Air overpressure in each case shall not exceed 0.02 psi. The blasting consultant shall examine these limits of peak particle velocity, displacement, and air overpressure in view of the blast design and condition, proximity of the structures and pipeline, and shall determine further restrictions as necessary to eliminate the risk of damage to these facilities.

Contractor shall monitor vibration frequencies, peak particle velocities, displacements, and air overpressures for any facility for any blast which may create vibrations, displacements, and air overpressure levels more than 25 percent of these limits, as determined by measurements on trial blasts and early production blasting near each affected facility.

Blasting parameters recorded by seismographs shall be analyzed after each shot. Limiting parameters of these specifications or more restrictive limits set by the blasting consultant shall not be exceeded. If monitoring indicates that the limits have been exceeded, critical areas of the site shall be examined for damage and assessments for repairs shall be immediately undertaken. There shall be no further blasting until charges are adjusted to limit the vibration levels allowed by these specifications and/or to prevent damage to facilities.

Copies of measurement records shall be submitted to the Utilities Engineer within 4 hours after each blast.

Any damage to existing structures resulting from the Contractor's operations shall be repaired to the satisfaction of the Utilities Engineer at the Contractor's expense.

4.5.1.2.1.2.3.7. PREBLAST SURVEY. Contractor shall perform a preblast survey of all facilities within five hundred feet of the area to be blasted to determine and document the structural condition of each facility. Video and photographic documentation of all facilities shall be included with the preblast survey report. The video and photographs shall be of sufficient detail to discern any existing cracks or defects. Contractor shall submit the preblast survey report to the Utilities Engineer.

4.5.1.2.1.2.3.8. POSTBLAST SURVEY. Contractor shall perform a postblast survey of the same facilities surveyed in the preblast survey to determine the effect of blasting operations. Contractor shall submit postblast survey report to the Engineer within 30 days of completing the blasting operations.

4.5.1.2.1.2.4. ROCK EXCAVATION PAY LIMITS. Rock quantities will be calculated from measurements taken in the field by the Engineer or his representative, in consultation with the Contractor or his representative. *Only rock that has been so measured will be paid for as rock excavation under this item*. Rock will be paid to the following limits: six inches (6") below all pipes and structures; seven inches (7") horizontal distance outside all pipes, and six inches (6") horizontal distance outside all structures. ***For rock depths of four feet or less, the trench width for payment purposes shall be outside diameter of the pipe plus 14 inches.*** For rock depths greater than four feet, the pay limit shall be ***outside diameter of the pipe plus 14 inches*** up to one foot above the top of the pipe, then increasing one foot in width on each side of the trench for every three feet of increased depth. All calculation of rock pay quantities for claims shall be done in this exact manner. Any rock removed at the direction of the Engineer or his representative will also be measured for payment. No payment will be made for rock that can be removed by scarification using the bucket of a backhoe or excavator.

Contractor will be paid for rock quantities calculated from the field measurements described above at the rate listed on a schedule included in the bid form.

4.5.1.2.2. STOCKPILING OF EXCAVATED MATERIALS. Excavated materials suitable and required for backfilling shall be stored in a neat pile adjacent to the excavation in a manner which causes a minimum of interference with traffic and ensures a maximum of safety for workers in the trench. Excavated materials shall not be placed with sufficient height or proximity to excavation so as to endanger workers due to earth slides or upheavals.

4.5.1.2.3. DISPOSAL OF EXCESS EXCAVATED MATERIALS. All suitable excess excavated material shall be disposed of in a manner and at such locations as approved by the Engineer, and at the Contractor's expense. All unsuitable excavated material, together with all debris, junk, stone, logs, stumps, and roots, shall be removed from the site and disposed of by, and at the expense of, the Contractor.

4.5.1.2.4. UNAUTHORIZED EXCAVATION. Excavation below grade shall be filled with either #11 or #12 crushed stone bedding as directed by the Engineer at no additional cost to the Owner.

4.5.1.2.5. SHEETING AND SHORING. IOSHA regulations 29 C.F.R. 1926, Subpart P, for trench safety systems, shall be considered incorporated into this section. Excavation shall be adequately sheeted and braced to prevent damage to the line, to adjacent structures, utilities, pavements or walks, and to prevent injury to workmen or others. No extra payment to the Contractor shall be made by reason of the Engineer's order to strengthen support for the protection of the Work or workers.

4.5.1.2.6. REMOVAL OF WATER. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of surface and ground water entering the excavation.

Excavation shall be maintained in a condition that will permit installation of the pipe without flotation or damage. Surface water shall be diverted or otherwise prevented, to the greatest extent practicable, from causing damage to adjacent property.

If the bottom of the excavation is unsuitable for pipe installation, it shall be further excavated and prepared as the Engineer may direct. Such authorized work shall be paid for as extra work.

4.5.1.2.7. TRENCH MAINTENANCE. The Contractor shall be responsible for all settlement of backfill which may occur within a period of one year after the date of final inspection and acceptance. The Contractor shall make, or cause to be made, all necessary backfill and repairs or replacements appurtenant thereto, within 30 days after notice by the Engineer or Owner.

4.5.1.3. BORING OR TUNNELING. As required in the drawings, or by State Highway Permits, concrete or steel pipe casing shall be bored and jacked under the highway with allowance made for grade and/or cover. A suitable lubricant, such as bentonite, may be applied to the outside surface of the jacked pipe to reduce friction.

If an obstruction that stops progress of the pipe is encountered during installation, the cause of stoppage shall be determined and the installation method modified to best suit the conditions encountered, except that line and grade may not be changed. If the Contractor proposes abandonment of in-place piping and initiation of another attempt at an alternate location, the stymied pipe shall be left in place and filled with grout. Any alternate location must be approved by the Engineer.

After casing is installed, Contractor shall push successive lengths of pipe through to make connection to the open-trenched main. Pipe shall be positioned within casing by use of Cascade stainless steel casing spacers, manufactured by Cascade Waterworks Mfg. Company (www.cascademfg.com), APS stainless steel casing spacers, APS carbon steel casing spacers with fusion-bonded epoxy coating, or, for PVC pipe only, APS polyethylene casing spacers, all as manufactured by Advance Products and Systems, Inc. (www.apsonline.com). All casing spacers shall be installed in compliance with manufacturer's instructions. After pipe has been tested for leakage, both ends of casing shall be sealed with end seals or solid concrete brick and non-shrink mortar. A suitable rubber gasket, such as Fernco Waterstop shall be installed around all PVC pipe at point where casing is sealed with mortar.

The unit price per lineal foot of casing required as herein described shall include all such extra work and materials required in tunneling. Payment for the carrier pipe will be made in addition to the unit price for the footage of the casing. ***Any rock encountered and removed in the actual act of boring, i.e., the calculated volume of the casing pipe, will be paid for at the unit price for conventional rock excavation.***

4.5.1.4. BEDDING. The Contractor shall provide the bedding material as noted below and as indicated on the plans. The cost for bedding material shall be included in the bid price for the main, and is not a separate pay item. Bedding shall be either #11 or #12 crushed stone.

4.5.1.4.1. BENEATH PIPE. All pipe shall be bedded on four inches (4") of either #11 or #12 crushed stone when in soil, and on six inches (6") when the pipe is laid in rock. The stone shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between pipe joints. It will be permissible to slightly disturb the finished bedding surface by withdrawal of pipe slings or other lifting tackle. After each pipe has been placed, sufficient pipe embedment material shall be deposited and shovel-sliced beneath the haunches of the pipe up to the spring line to hold the pipe in proper position during subsequent operations. This shall be done uniformly and simultaneously on each side of the pipe to prevent lateral displacement of the pipe before primary backfill.

4.5.1.4.2. BENEATH STRUCTURES. Bedding shall be a minimum of 4" of either #11 or #12 crushed stone in soil and 6" in rock. All over-excavation shall be filled with either #11 or #12 crushed stone or Class D Concrete, as ordered by the Engineer, to achieve elevations indicated on the plans.

4.5.1.5. LAYING OF PIPE. Anchors shall be required for stabilization of any pipe having a slope of 20% or greater, see Standard Detail 17.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. If this proves ineffective, the Engineer may require that, before lowering the pipe into the trench, a heavy, tightly-woven canvas bag of suitable size be placed over each pipe end and left there until connection is to be made to the adjacent pipe.

Each length of pipe shall be inspected while suspended above the trench immediately before installation, with special attention being given to pipe ends and gaskets. Defective pipe or fittings shall be laid aside for inspection by the Engineer, who will prescribe corrective repairs or rejection.

4.5.1.6. BACKFILL. Backfill materials shall be placed and compacted in uniform lifts and shall have a moisture content to assure that maximum density will be obtained with compaction. Primary backfill shall be #11 or #12 crushed stone to a point 12 inches above top of pipe. Secondary backfill above pipe embedment shall conform to the following requirements:

4.5.1.6.1. BENEATH PAVEMENTS, SURFACING, AND DRIVEWAYS. Backfill shall be in accordance with the agency issuing the permit. If no permit is required full-depth #53 stone compacted in six-inch (6") lifts must be used.

4.5.1.6.2. UNDER HIGHWAY SHOULDERS; UNDER FILLS OR EMBANKMENTS. Backfill shall be in accordance with the agency issuing the permit. If no permit is required full-depth #53 stone backfill is required compacted in six-inch (6") lifts if nearest trench edge is within five feet of pavement.

4.5.1.6.3. IN UNIMPROVED AREAS. Backfill may be the same materials as excavated, if it is good native material, but may contain no stone larger than six inches (6") in its greatest dimension.

4.5.1.6.4. AROUND STRUCTURES. Backfill shall be placed and compacted in uniform lifts not to exceed twelve inches (12") in depth.

4.5.1.7. SEPARATION BETWEEN UTILITIES.

4.5.1.7.1. VERTICAL SEPARATION BETWEEN UTILITIES. A minimum of 18 inches vertical separation shall be maintained between all utilities unless otherwise indicated on the Plans or in the Special Conditions, or unless written permission is given by the Engineer.

Sewers crossing water mains shall be laid to maintain a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer main. This shall be the case whether the water main is above or below the sewer. The crossing shall be arranged so that the joints in the sewer main will be equidistant and as far as possible from the joints in the water main. The crossing must be at a minimum angle of forty-five degrees (45°) measured from the centerlines of the sanitary sewer and water main. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to maintain line and grade.

4.5.1.7.2. HORIZONTAL SEPARATION BETWEEN UTILITIES. A minimum of 10 feet horizontal separation shall be maintained between all utilities unless otherwise indicated on the Plans or in the Special Conditions, or unless written permission is given by the Engineer.

4.5.1.7.3. IF IMPOSSIBLE TO MAINTAIN PROPER VERTICAL OR HORIZONTAL SEPARATION. When it is impossible to maintain proper vertical or horizontal separation as stipulated above, the following construction methods shall apply:

A. The sewer shall be designed and constructed equal to water pipe with minimum 200 psi pressure rating. Actual leakage testing shall be that of normal sanitary sewer pipe.

B. Sanitary sewer and water mains shall not be in direct contact.

C. In crossing, all joints in the sanitary sewer main shall be of compression type and placed equidistantly and as far as possible from the water main.

D. In parallelism, the sanitary sewer and water mains shall be laid on separate trench shelves.

4.5.1.8. SEPARATION BETWEEN CBU MAINS AND TREES OR PERMANENT STRUCTURES. Sanitary, water, or storm mains or appurtenances to be taken over and maintained by CBU shall not be constructed within ten (10) feet of any tree or permanent structure, nor shall any tree or permanent structure be placed within ten (10) feet of any existing or proposed CBU main or appurtenance without written permission of the Utilities Engineer. A minimum of eight (8) feet of separation shall be maintained between sanitary manholes and water mains, measured from outside of manhole to outside of pipe.

Permanent structures shall include, but not be limited to, buildings, sheds, retaining walls, planters, business signs, power poles, anchor wires, light standards, flag poles, other utility lines or appurtenances, or any object of a more or less permanent nature which would hinder or preclude excavation to repair CBU infrastructure.

4.5.2. **INSTALLATION OF SANITARY MAINS.** This section describes the specific methods and general practices to be used in installation of sanitary sewer mains.

4.5.2.1. INSTALLATION OF GRAVITY SEWERS. All gravity sewer pipe shall be installed at the grade indicated on the plans by using an automatic pipe laser and appropriate target matched to the diameter of the pipe being installed. Gravity sewers, when flowing full, shall be designed and constructed with slopes that shall result in average flow velocities of not less than two (2) feet per second in accordance with the following table:

Pipe Diameter (inches)	Minimum Slope (percent)
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.067
30	0.058
33	0.052
36	0.046
39	0.041
42	0.037

Pipes may not be oversized solely in order to justify using decreased slopes; volume of flow must justify pipe diameter. Both slope and direction shall remain uniform between manholes. All gravity sewer installation shall begin at the farthest downstream point and proceed upstream with the bell ends facing upstream. Anchors shall be required for stabilization on all pipe having a slope greater than 20%: slopes from 20% to 34% require anchors spaced no more than thirty-six (36) feet on center; from 35% to 49% require anchors spaced no more than twenty-four (24) feet on center; greater than 50% require anchors spaced no more than sixteen (16) feet on center.

During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. As each length of pipe is placed in the trench, both the spigot end of the pipe being laid and the gasket of the last pipe laid shall receive a coating of approved pipe lubricant. The spigot end shall be centered in the bell and the pipe forced home and brought to appropriate alignment and grade. The pipe shall be secured in place with appropriate backfill material tamped over it. Precautions shall be taken to prevent any material from entering the pipe.

Contractor shall be responsible for taking adequate measures to prevent inflow of surface run-off or groundwater into the City's sanitary sewer system during construction.

New Sanitary Sewer: At the start of installation of new sanitary sewer, Contractor shall place a plug in the spigot end of the first new pipe to be placed. This shall be a pneumatic plug with a sealing length greater than the diameter of the pipe. The plug shall be checked periodically and shall remain in place at all times until the sewer is complete and ready for testing.

Sanitary Sewer Replacement: During sanitary sewer replacement projects, Contractor shall make a water-tight, temporary connection between the existing pipe and the new pipe at the end of each work day or whenever inclement weather forces a temporary stop in the work.

If the Contractor fails to take adequate measures to prevent such inflow, the result could be surcharging and backup of sewage into homes and businesses downflow from the project area. If the resulting damages are attributable to negligence on the part of the Contractor, the Contractor shall be held liable for those damages.

4.5.2.1.1. INSTALLATION OF PLASTIC PIPE. This subsection specifies installation methods for pipes made of polyvinyl chloride and polyethylene plastic. ASTM D2321 or AWWA C605 and manufacturer's recommended installation procedures shall be followed. All plastic pipe shall be handled with a canvas or nylon sling.

4.5.2.1.1.1. FIELD-CUTTING PLASTIC PIPE.

4.5.2.1.1.1.1. POLYVINYL CHLORIDE (PVC) PIPE. PVC pipe shall be field-cut with an acceptable saw so as to leave a smooth end at right angles to the axis of the pipe. For SDR-35 PVC pipe the cut end shall be beveled with a hand or power tool for insertion into gasketed joint.

4.5.2.1.1.1.2. POLYETHYLENE (PE) PIPE. Spirolite PE pipe is made up in two different configurations: profile pipe and corewall pipe (used only with written permission of Utilities Engineer). Profile (spiral-ribbed) pipe cannot be field-cut. Adjustments in length are made with corewall (smooth-wall) pipe, which is used only for connecting to manholes. Corewall pipe is to be cut and beveled in the same manner as PVC pipe.

A push-plate will be required in seating P.E. pipe. The push-plate must fit neatly inside the bell and provide a sturdy, flat surface to prevent damage to the bell when pushing with the excavator bucket to seat the pipe. Pipe may also be seated by use of a come-along, and a come-along must always be used when seating curved manufactured fittings.

4.5.2.1.1.2. BEDDING AND BACKFILL FOR PLASTIC PIPE. Since all flexible pipe receives a high degree of its bearing strength from the surrounding material, type of bedding and backfill material and their compaction are very important.

4.5.2.1.1.2.1. PVC PIPE. For all SDR-35, F679, C900, and C905 PVC pipe, bedding to be as stated in 4.5.1.4.1. Primary backfill for all pipe shall be #11 or #12 crushed stone to a point 12 inches above top of pipe. Backfill above this point (secondary backfill) shall be as stated in 4.5.1.6. and following.

4.5.2.1.1.2.2. PE PIPE. Bedding shall be either #11 or #12 crushed stone, 1/8th of pipe diameter (4" minimum) on suitable soils, 1/8th of pipe diameter (6" minimum) over rock. Additional foundation for bedding may be needed if the trench bottom is unstable. Primary backfill shall extend to at least 12 inches above the pipe crown and shall be evenly placed on both sides of the pipe in lifts not exceeding 12 inches. Primary backfill shall be shovel-sliced beneath haunches of pipe and shall be mechanically compacted with a vibratory compactor to at least 90% Standard Proctor Density. Secondary backfill shall be as stated in 4.5.1.6. and following.

4.5.2.1.2. INSTALLATION OF VITRIFIED CLAY PIPE (VCP). All VCP shall be installed (only with written permission of Utilities Engineer) in accordance with ASTM C-12.

4.5.2.1.2.1. BEDDING AND BACKFILL FOR VITRIFIED CLAY PIPE. Bedding to be as stated in 4.5.1.4.1. Backfill to be as stated in 4.5.1.6. and following.

4.5.2.1.3. INSTALLATION OF DUCTILE IRON PIPE (DIP). All installation of DIP shall conform to the latest revision of AWWA C600. DIP shall always be handled with canvas or nylon straps (no chains) to avoid damage to external coating. Any such damage must be repaired by Contractor at no additional cost to Owner.

4.5.2.1.3.1. FIELD-CUTTING DIP. DIP which has been field-cut must be beveled for insertion into gasketed joints and to repair damage to the lining you must use the repair kit for Protecto 401 as directed by the manufacturer.

4.5.2.1.3.2. BEDDING AND BACKFILL FOR DIP. Bedding to be as stated in 4.5.1.4.1. Primary backfill shall be #11 or #12 crushed stone to a point 12 inches above top of pipe. Secondary backfill to be as stated in 4.5.1.6. and following.

4.5.2.1.4. INSTALLATION OF REINFORCED CONCRETE PIPE (R.C.P.).

4.5.2.1.4.1. BEDDING AND BACKFILL FOR REINFORCED CONCRETE PIPE. Bedding shall be as stated in 4.5.1.4.1. Backfill shall be as stated in 4.5.1.6. through 4.5.1.6.3.

4.5.2.1.5. SERVICE CONNECTIONS. Wyes with four inch (4”) for single family residence or six inch (6") laterals all others and being of the same material as the main, shall be installed for each property, developed or undeveloped, or as indicated on the Plans. House service wyes shall be located no more than 10 feet from the downstream side of the vacant lots unless topography obviously indicates otherwise. In the case of occupied lots, it shall be the Contractor's responsibility to determine the location preferred by the property owner.

The use of tee or wye saddles will be permitted only if those of the injection molded or factory-fabricated in-line type cannot be used, as determined by the Utilities Engineer (also see 4.4.2.1.1.1.). Such tee or wye saddles (when approved) must be fitted with a rubber gasket which seals against the main, and must use stainless steel straps for mounting. Fitting and joint material shall be the same as used for the main.

All wyes, unless otherwise specified, shall be SDR-35, for wyes deeper than six feet (6’), SDR-26 shall be used. All wyes shall incline upward at an angle not less than 25 degrees or greater than 45 degrees from the horizontal. Each wye shall be securely sealed by a cap or plug of the same material as the pipe in such a manner that the cap may be removed without injuring the bell or gasket at such time as the house service sewer is installed. Contractor shall place a treated two-by-four or four-by-four extending vertically from the branch of the wye in the trench to a point at least two feet above finished grade to facilitate future location.

4.5.2.1.5.1. SANITARY LATERALS AND CLEAN-OUTS. If the sewer main is laid along one side of the road right-of-way, the service connections for those properties located on the opposite side of the road shall be run to the opposite edge of the right-of-way, maintaining minimum four feet of cover over the lateral at a minimum 1% slope and acceptably plugged or capped. A #10 insulated solid copper locator wire or #12 AWG HS-CCS high strength copper clad steel insulated locate wire shall be wrapped around all nonmetallic pipes in the road right-of-way and easements so that one revolution is made at least every pipe joint. The wire is to be brought to the surface at the property line or edge of the easement with a clean-out in a casting. Contractor shall place a treated two-by-four or four-by-four extending vertically from the end of the service lateral in the trench to a point at least two feet above finished grade to facilitate future location. This marker shall be painted green to indicate "sewer". In special instances the Utilities Engineer may give written permission for the Contractor to place two laterals in a common trench. In such instances, minimum two feet horizontal separation must be maintained between the two pipes at all points. The Contractor shall include in his bid the costs of all labor, materials, and equipment to install all service connections required. These costs shall include the cost of pipe, bedding, backfill, and road restoration.

When a Contractor is installing a sanitary service lateral between a residence or place of business and a lateral stub-out or a City main, the installation shall be in accordance with Uniform Plumbing Code, Section 409(a). This section states that whenever the elevation of the lowest floor to be served is lower than the casting elevation of the upstream manhole on the main where connection is to be made, a back water check valve will be required on the sanitary lateral. All horizontal in-line check valves 6″ or smaller shall be PVC and shall be Clean Check® as manufactured by Rectorseal (www.rectorseal.com) or Plastic Oddities (www.plasticoddities.com), Inc., or pre-approved equivalent. Since check valves may be blocked open by solid particles, Utilities Engineering recommends that the Plastic Oddities check valve

be installed in the basement or in a pit to facilitate periodic clearing of the valve, or removal and replacement if necessary.

All sanitary laterals shall have a clean-out at least every 90 feet. All clean-outs, whether in grassy areas or in pavement, shall be sub-surface and protected by a suitable metal casting such as East Jordan Catalogue No. 2975. In grassy areas, the casting shall be provided with a circular concrete collar (anchor) flush with the top of the casting and the ground surface. The collar shall be minimum 12 inches depth and shall be 12 inches minimum diameter with the casting centered in the collar. In pavement, the top of casting shall be flush with the surrounding pavement. Top of clean-out shall be no more than 3 inches below the top of the casting. (See Standard Detail #19)

4.5.2.1.5.2. AREA DRAINS FOR DUMPSTER PADS. All area drains for dumpster pads must connect to the sanitary sewer. To prevent inflow of surface run-off, the drain intake must be equipped with a traffic-rated floor drain with a solid, ductile iron cover, hinged, with locking device to assure positive closure. Casting shall also have a free-standing sediment bucket with lift bar. Casting shall be Traffic Floor Drains Figure Number 2410, as manufactured by Jay R. Smith Mfg. Co. or pre-approved equivalent, installed in accordance with manufacturer's instructions.

4.5.2.1.6. SEWER PIPE TO MANHOLE CONNECTIONS. To connect a sanitary sewer to a manhole, either a flexible boot KOR-N-SEAL flexible connector (www. trelleborg.com/npc), Press-Seal PSX Positive Seal(www.press-seal.com) or "A"-Lok or "Z" Lok gasket (www.a-lok.com), or a preapproved equal shall be used in accordance with ASTM C923. Connections to an existing manhole shall be by core-drilling the opening and insertion of KOR-N-SEAL, Press-Seal, or approved equal.

If the flexible boot connection is used, it shall be placed in the reinforced concrete manhole base and secured to the pipe by a stainless steel clamp.

All connections shall provide for a watertight seal between the pipe and manhole. The connector shall be the sole element relied upon to assure a watertight seal of the pipe to the manhole.

4.5.2.1.7. INSTALLATION OF MANHOLES. The Contractor shall construct all manholes at the locations and of the materials indicated on the drawings and as specified. Manholes shall be designed and constructed to have no more than one foot of fall from invert in to invert out. Greater than one foot of fall will require construction of an outside drop. During sewer design, the Design Engineer shall determine if there will be adequate vertical space to construct the outside drop of the proper diameter pipe in accordance with CBU Standard Detail #2. If he determines that there is not adequate vertical space, the Design Engineer shall adjust the slope of the incoming pipe to leave maximum one foot of fall through the manhole so that an outside drop is not required.

The Design Engineer shall also be aware that, for manholes having more than one inlet pipe, there shall be no more than 0.3 foot difference between invert elevations of the inlet pipes. This will preserve flow characteristics through the manhole and facilitate construction of table and troughs.

4.5.2.1.7.1. ASSEMBLY OF MANHOLE BASE, BARREL, AND CONE. Base and first riser section shall be one complete precast unit. Joints between the barrels, between the barrels and the base unit, and between the barrels and cone or flattop shall be sealed by using an approved rubber gasket in accordance with ASTM C443, latest revision, and the section joints shall be sealed outside with Trowelable EZ-STIK All Weather Butyl Rubber Sealant as manufactured by Press-Seal Gasket Corporation, in accordance with 4.4.2.2.6. and 4.5.2.1.7.5.

4.5.2.1.7.2. INSTALLATION OF TABLE AND TROUGH. The invert of all pipe openings shall be at least three inches above the base to provide for installation of table and trough. For manholes on a completely new reach of sanitary sewer, the table and trough may be cast as a part of the base unit, or constructed of masonry brick and non-shrink mortar with written permission of the Utilities Engineer. For replacement manholes to which one or more existing pipes must be connected, openings in the base unit shall be core-drilled on site after removing the old structure and shooting elevations of existing pipe(s) to assure accuracy; table and trough shall be installed on site and constructed of masonry brick and non-shrink

mortar. In both cases the invert channels shall be smooth with a semi-circular bottom and vertical sides extending upward to the height of the pipe crown. In the latter case, both table and invert channel shall receive two coats of Drycon (IPA Systems, Inc.) (www.ipasystems.com). Changes of flow direction within manholes shall be made by a smooth curve having as large a radius as possible. The manhole table shall be smooth and slope towards the channel not less than one inch (1") per foot.

4.5.2.1.7.3. INSTALLATION OF MANHOLE STEPS. Manhole steps shall *not* be situated directly above the inlet or outlet pipes, but to one side of the manhole, granting access to the table. Steps shall be installed with non-shrink mortar or epoxy grout.

4.5.2.1.7.4. INSTALLATION OF CASTINGS. Castings shall be set in a nominal 1" bed (approximately 0.75"× 1.05") of sealant made of butyl rubber material in flexible rope form. Sealant shall meet all requirements of ASTM C-990 and AASHTO M-198. Sealant shall be PRO-STIK, as manufactured by Press-Seal Gasket Corporation (www.press-seal.com), or pre-approved equivalent. In paved areas, top of casting shall match finished grade; in unpaved/grassy areas, castings shall be installed so that the top extends a minimum of three inches above finished grade, and surface shall be graded to provide positive surface drainage away from manhole.

No brick or block shall be used to adjust the elevation of the frame and cover without permission of the Utilities Engineer. Cones and flattops shall be set so that no more than 12" of reinforced concrete rings will be required to adjust the top of the manhole casting to grade.

4.5.2.1.7.5. MANHOLE SEALANTS. There are two acceptable methods of assuring water-tight manhole construction. Method #1 is strongly preferred; Method #2 may be used only with written permission of the Utilities Engineer. Regardless of which waterproofing method is used, Contractor shall plug all voids and lift holes and seal around all pipes both internally and externally with a non-shrink grout or an expanding Portland Cement mixture such as OCTOCRETE (IPA Systems, Inc.) (www.ipasystems.com) in accordance with manufacturer's application instructions. The section joints shall be sealed outside with trowelable EZ-STIK all weather Butyl Rubber Sealant as manufactured by Press-Seal Gasket Corporation (www.press-seal.com) or pre-approved equivalent.

> Method #1: The manhole manufacturer shall give written conformation that all reinforced precast concrete manhole sections contain the inorganic copolymer waterproofing admixture IPANEX, manufactured by IPA Systems, Inc. (www.ipasystems.com), in compliance with manufacturer's dosage and mixing instructions.
>
> Method #2: (Only with written permission of the Utilities Engineer) Before assembly, the entire outer surface of the manhole, including the underside of the manhole base, shall receive a minimum of two coats of FARBERTITE (IPA Systems, Inc.) (www.ipasystems.com) in accordance with manufacturer's application instructions. After assembly (sealing all joints between manhole sections and plugging all lift holes as indicated above), Contractor shall apply a minimum of two coats of DRYCON (IPA Systems, Inc.) (www.ipasystems.com) to the entire manhole interior in accordance with manufacturer's mixing and application instructions.

4.5.2.1.7.6. COLD WEATHER INSTALLATION OF MANHOLES: Whenever the atmospheric temperature is 35° F or below, or whenever the atmospheric temperature may fall below 35° F within the curing period, certain phases of manhole installation shall require the written permission of the Utilities Engineer. These critical phases are: sealing of joints between manhole sections, construction of table and trough, waterproofing of manholes (both inside and out), and installation of castings. Contractor must have the approval of the Utilities Engineer for proposed procedures to maintain temperature of grout, mortar, or sealant at a minimum temperature of 50° F while maintaining adequate moisture in the air throughout the curing period. Cold weather installation shall be performed at the risk of the Contractor and shall be removed and replaced at his expense if grout, mortar, or sealant becomes frozen or otherwise damaged due to low temperature.

4.5.2.1.8. SEWER CLEANING. If televising indicates an inordinate amount of silt, stone, or other debris in the new sewer lines, Contractor shall jet-clean those lines with a high-pressure water jetting unit. The

Contractor, at no additional expense to the Owner, shall provide all necessary labor and equipment to jet-clean sewers and to remove and dispose of the collected debris. The Contractor shall also be responsible for providing sufficient water and an appropriate disposal site for debris.

4.5.2.1.9. ABANDONING OF SEWERS. Gravity sanitary sewers which are to be abandoned shall be filled with a thin concrete mix and bulkheaded with a six-inch (6") thick masonry brick and non-shrink, waterproof mortar wall. Manholes to be abandoned shall have the top section removed and shall be filled with #53 stone, compacted in lifts of not more than one foot or flowable fill.

4.5.2.2. DESIGN AND INSTALLATION OF FORCE MAINS. Sanitary force mains shall be designed to avoid the need for air/vacuum release valves. Whenever possible, force mains shall be designed without high points and with the top of the force main below the hydraulic grade line at the minimum pumping rate so that air/vacuum valves will not be needed. If high points in the force main cannot be avoided, an air/vacuum valve or combination valve shall be installed at each significant high point where air could become trapped. A high point shall be considered significant if it is two feet or more above the minimum hydraulic grade line, or, when pumping is intermittent, above the static head line.

Force mains shall incorporate joint restraint to resist thrusts that develop at fittings such as valves, tees, bends, plugs, etc. in the force main pipe. A restrained joint is a special mechanical joint or device that is designed to mechanically couple a calculated number of adjacent joints of pipe together. The entire restrained unit of pipe is then able to transfer thrust forces to the surrounding backfill by friction. Use of joint restraints will be required for all sanitary force main projects within the CBU sewer jurisdictional area. The engineer who designs a force main shall be responsible for incorporating a comprehensive thrust restraint design into the plans. Anchorage design at force main fittings shall be based on pipeline pressures at least 25 percent greater than the maximum pump design shut-off head plus a water hammer allowance with an appropriate factor of safety. The design engineer shall make clear to the contractor in the plan and profile drawings exact lineal footage of pipe and fittings that shall be restrained, and which joint restraints are suitable for each application. The thrust restraint design will be reviewed as a part of standard plan review by CBU Engineering, but the design engineer shall be ultimately responsible for the accuracy and effectiveness of his thrust restraint design for each project. The following restraints are acceptable for use as listed so long as they are made in the U.S.A.:

For Restraining Mechanical Joint Fittings:

EBAA Series 1100 for DIP
EBAA Series 2000PV for C900 PVC, and SDR 21 PR200 PVC
Uni-Flange Series 1300-C for C900 PVC
Uni-Flange Series 1300-S for SDR-21 PR200 PVC
Uni-Flange Series 1400 for DIP
Romac Industries Roma Grip for DIP and PVC

For Restraining Push-on C900 PVC Fittings:

EBAA Series 2500
Uni-Flange Series 1360-C

For Restraining Push-on C900 PVC Pipe Joints:

EBAA Series 1600 (4″ through 12″)
EBAA Series 2800 (14″ through 30″)
Uni-Flange Series 1350-C
Uni-Flange Series 1390-C

For Restraining Push-on SDR-21 PR200 PVC Pipe Joints:

EBAA Series 6600 (3″ through 12″)
Uni-Flange Series 1350-S
Uni-Flange Series 1390-S

For Restraining Push-on DIP Joints:

EBAA Series 1100 HD
EBAA Series 1700
Uni-Flange Series 1450

For Restraining Mechanical DIP Joints:

EBAA Megalug
EBAA Series 1100
Uni-Flange Series 1400
Romac Industries Roma Grip

4.5.2.2.1. DUCTILE IRON PIPE. See 4.5.3.2.1. and following.

4.5.2.2.2. PVC PIPE. See 4.5.3.2.2. and following.
PVC pipe for construction of force mains shall be SDR-21 (PR200), C900 (DR-18), or ULTRA BLUE.

A #10 insulated solid copper wire or #12 AWG HS-CCS high strength copper clad steel insulated locate wire shall be wrapped around the pipe so that one revolution is made at least every pipe joint. Splices are to be made with an approved connector, and are to be suitably protected against corrosion.

Where the main is laid off the road, the wire is to be brought to the surface approximately every 500 feet to a valve box or an air/vacuum valve vault, and a sign post. Where the main is laid in the street, the wire is to be brought into a valve box approximately every 500 feet. Sign posts shall be furnished by the Utilities Department; valve boxes to be furnished by Contractor.

4.5.2.2.3. HIGH DENSITY POLYETHYLENE (HDPE) PIPE. For pipe material see 4.4.3.2.3. For bedding see 4.5.4.3.1. For primary backfill see 4.5.4.4.1.1. For secondary backfill see Sections 4.5.1.6.1. through 4.5.1.6.3.

4.5.2.2.3.1. JOINING OF HDPE. Sections of HDPE pipe shall be joined by the butt fusion process into a continuous length of pipe at the job site. The joining process shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations, including pipe temperature, alignment, and fusion pressure. The heat fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer. Extrusion welding or hot gas welding of HDPE shall not be used. Mechanical joint adapters or flanges may be used to mechanically connect HDPE pipe to transition points. This joining method shall also be performed in strict accordance with the pipe manufacturer's recommendations.

4.5.2.2.3.2. LOCATOR WIRE AND SIGNS. A #10 insulated solid copper wire or #12 AWG HS-CCS high strength copper clad steel locate wire shall be wrapped around the pipe so that one revolution is made at least every 10 feet. Splices are to be made with an approved connector, and are to be suitably protected against corrosion.

Where the force main is laid off the road, the wire is to be brought to the surface approximately every 500 feet to a valve box or air/vacuum valve vault and sign post. Where the force main is laid in the street, the wire is to be brought into a valve box approximately every 500 feet. Sign post shall be furnished by the Utilities Department; valve boxes to be furnished by Contractor.

4.5.2.2.4. FORCE MAIN FITTINGS. All force main fittings shall be as recommended by the pipe manufacturer and shall be installed in accordance with manufacturers' recommendations.

4.5.2.2.4.1. AIR RELEASE VALVES. Air release valves, air/vacuum valves or, combination valves shall be designed for sewer use and shall be installed in a vertical position at significant high points on a force main (see 4.5.2.2.). A saddle with a two-inch (2") tapping corporation shall be installed on the top of the force main at the high point formed by sloping two adjacent joints to a summit. Installations on PVC pipe will require a brace or support to prevent undesired torque on pipe. Air valves are to be installed in an adequately drained and vented air/vacuum valve vault as shown in Standard Detail #3.

4.5.2.2.5. INSTALLATION OF PUMP STATIONS. Specifications for pump stations are available in a separate packet in the office of the Utilities Engineer, 600 East Miller Drive.

4.5.2.2.6. INSTALLATION OF WET WELLS. Wet wells may be pre-cast or poured-in-place structures. Sewer pipes shall connect to the wet well by use of either a flexible boot KOR-N-SEAL 1 OR 2 flexible connector (www. trelleborg.com/npc), "A"-Lok or "Z" Lok gasket www.a-lok.com), or a pre-approved equal. No more than one pipe may connect to a wet well. All other pipes shall connect to a common manhole adjacent to the wet well to facilitate future elimination of the lift station.

4.5.2.2.6.1. PRE-CAST WET WELL STRUCTURES. All pre-cast wet well structures shall be round, and shall be identical to a sanitary sewer manhole. At the discretion of the Utilities Engineer, deep wet wells may require a base wider than the wet well to provide stability. Joints between sections shall be sealed by using an approved rubber gasket in accordance with ASTM C-443, latest edition. In addition, all joints shall be sealed, internally with a non-shrink grout or an expanding Portland Cement mixture such as Octocrete (IPA Systems, Inc.) (www.ipasystems.com) in accordance with the manufacturer's application instructions. The section joints shall be sealed outside with trowelable EZ-STIK all weather Butyl Rubber Sealant as manufactured by Press-Seal Gasket Corporation (www.press-seal.com), or pre-approved equivalent.

4.5.2.2.6.2. POURED-IN-PLACE WET WELL STRUCTURES. Thickness of base and walls, as well as reinforcement, shall depend on size of the structure and will be reviewed on a case-by-case basis. All joints between separate pours shall be keyed and doweled, and shall be sealed with VOLCLAY WATERSTOP RX, as manufactured by CETCO (www.cetco.com), 1350 W. Shure Drive, Arlington Heights, IL 60004, or pre-approved equal.

4.5.2.2.6.3. WET WELL SEALANTS. There are two acceptable methods of assuring water-tight wet well construction. Method #1 is strongly preferred for pre-cast wet wells, and is always required for poured-in-place wet wells; Method #2 may be used only for pre-cast wet wells and requires written permission of the Utilities Engineer. Regardless of which waterproofing method is used, Contractor shall plug all voids and lift holes and seal around internal joints and all pipes both internally and externally with a non-shrink grout or an expanding Portland Cement mixture such as OCTOCRETE (IPA Systems, Inc.) (www.ipasystems.com) in accordance with manufacturer's application instructions. The section joints shall be sealed outside with trowelable EZ-STIK all weather Butyl Rubber Sealant as manufactured by Press-Seal Gasket Corporation (www.press-seal.com), or pre-approved equivalent.

Method #1: The wet well manufacturer shall give written conformation that each reinforced precast concrete wet well section, or the concrete used to form the poured-in-place wet well, contains the inorganic copolymer waterproofing admixture IPANEX, manufactured by IPA Systems, Inc. (www.ipasystems.com), in compliance with manufacturer's dosage and mixing instructions.

Method #2: (Only for pre-cast wet wells ; requires written permission of the Utilities Engineer) Before assembly, the entire outer surface of the wet well, including the underside of the wet well base, shall receive a minimum of two coats of FARBERTITE (IPA Systems, Inc.) (www.ipasystems.com) in accordance with manufacturer's application instructions. After assembly (sealing all joints between wet well sections and plugging all lift holes as indicated above), Contractor shall apply a minimum of two coats of DRYCON (IPA Systems, Inc.) (www.ipasystems.com) to the entire wet well interior in accordance with manufacturer's mixing and application instructions.

4.5.2.3. DESIGN AND INSTALLATION OF INVERTED SIPHONS: An inverted siphon refers to a "depressed sewer" which would stand full, even with no flow. The purpose of an inverted siphon is to carry sewage flow under an obstruction such as a stream or waterway and regain as much elevation as possible after the obstruction has been passed. Inverted siphons shall have at least two barrels, which shall be minimum 6-inch DIP. All pipe and fittings shall be provided with a ceramic epoxy lining, minimum thickness 40 mils and shall be **Protecto 401** as manufactured by Induron Protective Coatings. The two

pipes shall be positioned parallel, with one pipe, often of smaller diameter, designated as the primary barrel. A lateral overflow weir shall be constructed in the inlet structure to direct the maximum dry-weather flow into the primary barrel. The primary barrel shall be designed with appropriate pipe size, slope, and head to achieve scouring velocities of at least 3.0 feet per second for design average flows. During significant rain events, increased flows will overflow the weir, and be carried by the secondary barrel, which shall be designed to handle the maximum anticipated wet-weather flow. Both the inlet and discharge structures, as well as all pipe and fittings, shall accommodate the nozzle and hose of a jet-rodder to facilitate periodic cleaning. Siphons having large diameter barrels may require an "air jumper" pipe. Such a pipe is approximately one-half the diameter of the primary barrel, and is designed to transport the air set in motion by the moving sewage from the inlet structure to the discharge structure. When both barrels are full, the air cannot be carried through the siphon and will inevitably find an exit from the inlet structure and cause odor problems. In ideal circumstances, the air jumper pipe can be suspended above the hydraulic grade line of the sewer, but in most cases it must run parallel to the siphon, requiring that some provision be made for dewatering the condensate. Under most conditions the Utilities Engineer will require that the entire pipe assembly, or at least some portion thereof, shall be encased in Class B Concrete, minimum cover one foot on all sides. All designs for inverted siphons shall be reviewed on a case-by-case basis by the Utilities Engineer.

4.5.2.4. **CURED IN PLACE PIPE (CIPP).**

4.5.2.4.1. INTENT. It is the intent of this section to describe acceptable materials and installation methods for Cured In Place Pipe (CIPP) rehabilitation of sanitary sewers located within the City of Bloomington Utilities (CBU) Sanitary Sewer Jurisdictional Area. These specifications are based on materials and processes developed by Insituform of North America, Inc. and FirstLiner USA, Inc. to install a flexible felt tube, impregnated with a thermosetting resin, into an existing sanitary sewer. Circulating hot water is used to cure the resin into a hard, impermeable, cured-in-place pipe, extending from manhole to manhole in a continuous, tight fitting, watertight pipe-within-a-pipe.

4.5.2.4.1.1. SCOPE OF THE WORK**.** Scope of the work shall be as defined in the Contract, Bid Form and Special Conditions for each individual project.

4.5.2.4.1.2. REFERENCE SPECIFICATIONS AND MANUFACTURER'S STANDARDS. This specification references standard specifications of the American Society for Testing and Materials (ASTM), Insituform of North America, Inc. (INA), and FirstLiner USA, Inc. or CBU approved equal. The latest edition and revision of the manufacturer's standards are made a part of this document by such reference.

4.5.2.4.2. GENERAL REQUIREMENTS.

4.5.2.4.2.1. CORROSION REQUIREMENTS. The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2.

4.5.2.4.2.2. HYDRAULIC CAPACITY. On request, Contractor shall supply calculations to verify that the CIPP shall have at least 100% of the full-flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the original pipe material. A typical roughness coefficient for the CIPP shall be as verified by third-party test data.

4.5.2.4.2.3. CIRCUMFERENTIAL SIZING. The felt-fiber tube shall be fabricated to a size that, when installed, will neatly fit the internal circumference of the existing sanitary sewer pipe as specified by CBU. Allowance for circumferential stretching during insertion shall be made in accordance with manufacturer's standards.

4.5.2.4.2.4. LENGTH. The length of the tube shall be as deemed necessary by Contractor to effectively carry out the insertion from inlet to outlet points. Contractor shall verify the lengths in the field. Individual installation runs can be made over one or more access points as determined in the field by Contractor and approved by CBU.

4.5.2.4.2.5. PHYSICAL PROPERTIES OF MATERIALS. The felt-fiber tubing, including the polyurethane or polyvinyl chloride cover, shall meet the requirements of ASTM F1216, section 5.1. The thermosetting

resin system shall meet the requirements of ASTM F1216, section 5.2. The cured pipe shall conform to the minimum structural standards as listed below:

Cured Pipe	Standard	Results
Tensile Stress	ASTM D-638	3,000 psi
Flexural Stress	ASTM D-790	4,000 psi
Modulus of Elasticity	ASTM D-790	200,000-300,000 psi

If so directed, Contractor shall furnish, prior to use of the materials, satisfactory written certification of his compliance with the manufacturer's standards for all materials and conformance with methods of the manufacturer's process.

4.5.2.4.2.6. DEVIATIONS. The deterioration of a sanitary sewer is an ongoing process. Should pre-lining inspections reveal the pipes to be in substantially different conditions from those stated in the design considerations, the Contractor shall request a change in thickness, supporting such request with design data in accordance with manufacturer's standard design policies. The deviation, if approved, shall be reflected by the appropriate addition or reduction in the unit cost for that size as shown in the optional portion of the proposal.

4.5.2.4.3. PRE-INSTALLATION PROCEDURES. The following pre-installation procedures shall be utilized unless otherwise approved by the Utilities Engineer.

4.5.2.4.3.1. SAFETY. Contractor shall carry out his operations in strict accordance with all IOSHA and manufacturer's safety requirements. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

4.5.2.4.3.2. CLEANING OF SANITARY SEWERS. Prior to reconstruction of any pipe, it will be the responsibility of City of Bloomington Utilities (CBU) to remove internal deposits from the pipe. If condition of pipe is unsatisfactory, Contractor shall inform CBU, and a decision will be made at that time whether CBU or Contractor shall be responsible for correcting the condition. If it is decided that Contractor shall clean the pipe, additional payment will be made by change order at the rate established on the bid form for Intensive Cleaning.

4.5.2.4.3.3. INSPECTION OF SANITARY SEWERS. Inspection will be performed by experienced CBU personnel trained in locating breaks, obstacles, and service connections by closed circuit television. The interior of the sewer pipe will be carefully inspected to determine the location and extent of any structural failures. The location of any conditions that may prevent proper installation of CIPP into the pipelines will be noted so that these conditions can be corrected. CBU will provide a video tape and suitable log in the office of the Utilities Engineer, 600 East Miller Drive, Bloomington, Indiana, so that the Contractor may review and comment on the target sewer lines before he makes his own television inspection and records.

4.5.2.4.3.4. LINE OBSTRUCTIONS. It will be the responsibility of CBU to clear the pipe of obstructions such as roots, solids, dropped joints or broken pipe that would prevent the insertion of cured-in-place pipe. If inspection reveals an obstruction that cannot be removed by conventional cleaning equipment, then CBU personnel will make a point repair excavation, uncover and remove or repair the obstruction.

4.5.2.4.3.5. BYPASSING FLOW. Contractor, when required, shall provide for the transfer of flow around the section or sections of pipe designated for CIPP. The bypass shall be made by diversion of the flow at an existing upstream manhole or other access point and directing the flow around the section to be taken from service. Bypass lines and pumps, if necessary, shall be of adequate capacity and size to handle the flow. When available, flow volumes of the target sewer will be provided to Contractor by CBU. The proposed bypassing system must be approved in advance by CBU.

4.5.2.4.4. INSTALLATION OF CURED-IN-PLACE PIPE: CIPP installation shall be in accordance with ASTM F1216, section 7.

4.5.2.4.4.1. PREPARATION. Contractor shall allow CBU to inspect the materials and "wet-out" procedure. Contractor shall designate a location where the uncured resin in the original containers and the unimpregnated felt-fiber tube will be vacuum impregnated prior to installation. A roller system shall be used to uniformly distribute the resin throughout the tube. The quantities of liquid thermosetting materials shall be in accordance with manufacturer's standards to provide the lining thickness specified. Quantities shall be sufficient to fill the volume of air voids in the tube, with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall.

4.5.2.4.4.2. INSERTION. The wet-out, felt-fiber tube shall be inserted through an existing manhole or other approved access. The manufacturer's standards shall be closely followed during the elevated curing temperatures so as not to overstress the felt-fiber and cause damage or failure prior to cure.

4.5.2.4.4.3. CURING. After installation of wet-out felt tube is completed, Contractor shall supply a suitable heat source and water recirculation equipment. The equipment shall be capable of delivering hot water to the far end of the pipe section through a hose, which has been perforated in accordance with manufacturer's recommendations, to uniformly raise the water temperature in the pipe section above the temperature required to affect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed.

4.5.2.4.4.4. TEMPERATURE MONITORING. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water circulated by the heat exchanger. Another such gauge shall be placed between the impregnated tube and the invert at the far access point to determine the temperature and time of exotherm. Water temperature in the pipe during the cure period shall not be less than 150^{o} F or more than 200^{o} F, as measured at the heat exchanger return line.

4.5.2.4.4.5. COMPLETION OF INITIAL CURE. Initial cure shall be deemed to be completed when inspection of the exposed portions of CIPP indicate that it is hard and sound and the thermocouples indicate than an exotherm has occurred. The cure period shall be of a duration recommended by the resin manufacturer, as modified for the CIPP process being used, during which time the recirculation of the water and cycling of the heat exchanger continue in order to maintain the required temperature.

4.5.2.4.4.6. COOL DOWN. Contractor shall cool the finished CIPP to a temperature below 100^{o} F before relieving the static head in the inversion standpipe. Cool-down may be accomplished by the introduction of cool water into the standpipe, replacing warmer water being drained from the downstream end. Care shall be taken in the release of the static head that a vacuum is not developed that could damage the newly installed CIPP.

4.5.2.4.5. FINISH. The finished CIPP shall be continuous over the entire length of the insertion run and shall be as free as commercially practicable from significant defects, such as foreign inclusions, dry spots, pinholes and delamination. Any defects that will affect the integrity or strength of the CIPP, whether during the warranty period or in the future beyond the warranty period, shall be repaired at the Contractor's expense, in a manner mutually agreeable to both CBU and Contractor.

4.5.2.4.5.1. SEALING THE ENDS. If, due to broken or misaligned pipe at the access points, CIPP fails to make a tight seal, Contractor shall apply a seal at that point. The seal shall be of a resin mixture compatible with the CIPP.

4.5.2.4.5.2. REINSTATEMENT OF SERVICE CONNECTIONS. If Contractor's television inspection indicates that service connection repairs are necessary, all such work will be performed by CBU personnel in advance of CIPP installation. After CIPP has been installed, Contractor shall reinstate all active service connections as designated by CBU. This shall generally be done from the interior of the newly installed CIPP by means of a television camera and a cutting device that reestablishes service connections to minimum 90 percent of previous capacity. If this method should prove impossible, CBU personnel will assist in point-digging and installing an Inserta-Tee to reconnect the service lateral in question. Personnel shall ***never*** physically enter a pipe to reestablish service connections.

4.5.2.4.5.3. TESTING. CIPP samples shall be prepared and tested in accordance with ASTM F1216, section 8.1. The water-tightness of CIPP shall be gauged while curing and under positive head. CIPP products in which the pipe wall is cured while not in direct contact with the pressurizing fluid must be tested by an alternate method acceptable to CBU.

4.5.2.4.5.4. INSPECTION. Visual inspection shall be in accordance with ASTM F1216, section 8.4. Contractor shall televise each run of sewer before start of work. After the work is completed, Contractor shall televise and record the new CIPP, including the restored connections, on the same tape in order to compare and contrast conditions before and after installation. Said tape shall be submitted to the Utilities Engineer for his review and approval and shall thereafter become the property of CBU.

4.5.2.4.5.5. CLEAN-UP. Upon completion of installation and testing, Contractor shall reinstate the project area affected by his operation to the satisfaction of property owners and CBU.

4.5.2.4.6. MISCELLANEOUS ITEMS.

4.5.2.4.6.1. WATER. All water used for prosecution of the Work as defined in the Contract Documents will be supplied by CBU at no charge to Contractor.

4.5.2.4.6.2. COORDINATION AND COOPERATION WITH CUSTOMERS. At least 48 hours prior to installation of the CIPP, Contractor shall notify each affected resident of the exact start-time that his lateral will be out of service. After installation of the CIPP, Contractor shall promptly reinstate all service laterals as designated by CBU, using the techniques specified herein. Immediately after reinstatement of laterals, Contractor shall notify each resident that his lateral is back in service. Any and all damages arising from failure to promptly reinstate a service lateral as designated by CBU shall be the sole responsibility of the Contractor.

Contractor shall provide at least 48 hours notice to any and all homeowners whose properties he must cross to access easement areas, or whose properties abut easement areas where work is designated to be performed. Contractor shall be responsible for securing the appropriate Right-of-Entry from said homeowners.

It shall be the responsibility of the Contractor to give CBU adequate advance notice of any private property (fences, sheds, clothes lines, shrubbery, etc.) located within easements which might interfere with prosecution of the work by the Contractor. CBU personnel will be responsible for timely removal and replacement of any such obstruction.

4.5.2.4.6.3. PATENTS. Contractor shall warrant and indemnify CBU, the Utilities Service Board, and the City of Bloomington against all claims for patent infringement and any loss thereof.

4.5.2.4.6.4. PAYMENT. Payment for the work as described in the Bid Form, Contract, and Special Conditions, shall be in accordance with the General Conditions, Section GC-49, of the CBU Specifications.

4.5.2.4.6.5. TRAFFIC CONTROL. All traffic maintenance necessary for this project, including but not limited to signage, signalization, barricades, and flagmen, shall be the responsibility of the Contractor. Contractor shall submit his traffic maintenance plan to City Engineering Management minimum ten working days before start of work for their review and approval. No additional payment will be made for this item; it shall be part of the lump-sum bid.

4.5.2.4.6.6. PERMITS. Contractor shall be responsible for obtaining any and all permits necessary for carrying out this project. No additional payment will be made for this item; it shall be part of the lump-sum bid.

4.5.2.5. **PIPE BURSTING.**

4.5.2.5.1. GENERAL. It is the intent of this section to describe acceptable materials and methodologies for rehabilitation of existing sanitary sewers in the City of Bloomington Utilities (CBU) jurisdictional area through the use of a pipe bursting system. This specification is based on the draft “Specification for Mainline Sewer Replacement by Pipe Bursting” currently under development by the International Pipe Bursting Association, a division of NASSCO (National Association of Sewer Service Contractors).
Pipe bursting is a process by which a bursting unit splits or fractures an existing pipe while simultaneously installing a new pipe, usually high-density polyethylene (HDPE), of the same or larger size

into the annular space created by the bursting tool's forward movement. The most common methods are referred to as **static**, **impact**, and **dynamic**. The primary difference among these methods is the manner in which the force is generated and transferred to the host pipe during the bursting operation. Static systems are hydraulic, impact systems generally utilize a combination of pneumatic and hydraulic technology, and dynamic systems are based on the use of a horizontal directional drill in combination with either a pneumatic or mechanical bursting tool.

The pipe bursting process is highly dependent on soil conditions, existing pipe material, and the condition of the existing pipe. Burst length, soil conditions, line depth, and new pipe diameter are all critical factors to be considered when planning the pipe bursting process.

The International Pipe Bursting Association (IPBA) normally assigns pipe bursting work to one of three classifications. These classifications are intended for use as general guidelines when considering replacement of existing pipe by bursting techniques.

Project Design Classifications:

4.5.2.5.2. SCOPE OF THE WORK.

Classification	Pipe Depth	Existing Pipe Diameter	New Pipe Diameter Options	Burst Length
A – Routine	<12 ft	4-12 in	Size for Size to 1 Up size	0-350 ft
B – Challenging to Moderately Difficult	>12 ft <18 ft	12-20 in	2 Up Size	350-450 ft
C – Difficult to Extremely Difficult	>18 ft	20-36 in	3 or More Up Sizes	>450 ft

4.5.2.5.2.1. OWNER'S RESPONSIBILITY. The Utilities Engineer shall provide a description of the work to be performed by the Contractor in a Request for Quote or an Invitation to Bid. The Utilities Engineer shall also make available to qualified contractors a copy of a videotape of the pipe to be burst.

4.5.2.5.2.2. BIDDER'S RESPONSIBILITY. The Contractor shall submit a quote or bid for the specified work based on a written and/or graphic description provided by the Utilities Engineer. A quote or bid shall be submitted by the Contractor in the format specified by the Utilities Engineer.

4.5.2.5.3. REFERENCE STANDARDS. American Society for Testing Materials (ASTM), West Conshohocken, PA 14428.

A. ASTM D 1238-99
B. ASTM D 1505 98
C. ASTM D 790-00
D. ASTM D 638-99
E. ASTM D 1693-00
F. ASTM D 3350-99
G. ASTM D 618-99
H. ASTM D 2837-98a
I. ASTM 575

4.5.2.5.4. QUALIFICATIONS OF CONTRACTOR. The Contractor's personnel shall be certified by the system manufacturer as fully trained in utilization of the proposed pipe bursting system. The Utilities Engineer may require the Contractor to provide certificates of training for any employee directly involved in the supervision or operation of the pipe bursting system.

Polyethylene pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with new pipe installation shall receive training in the proper methods for handling and installing polyethylene pipe. Such training shall be conducted by a qualified representative of the fusion equipment manufacturer. Installation of other materials shall also be performed by personnel qualified by the specific product manufacturer.

The Contractor shall hold CBU and its agents wholly harmless in any legal action resulting from patent infringements.

CBU will utilize the following chart as a guideline in pre-qualifying Contractor experience requirements:

Job Classification	Job Value	Minimum Requirements
A - Routine	$500,000 or less	Verification by the manufacturer that Contractor's personnel are trained in the use of the equipment.
B – Challenging to Moderately Difficult	$1,000,000 or less	Verification by the manufacturer that Contractor personnel are trained in the use of the equipment. A minimum of 5,000 feet of experience in Class A or more difficult jobs.
C – Challenging to Moderately Difficult	$1,000,000 or more	Verification by the manufacturer that Contractor's personnel are trained in the use of the equipment. A minimum of 5,000 feet of experience in Class A or more difficult jobs. Cumulative Class A and B Income of $1,000,000.
C – Difficult to Extremely Difficult	$1,000,000 or less	Verification by the manufacturer that Contractor's personnel are trained in the use of the equipment. A minimum of 10,000 feet of experience on Class B jobs, to include 3,000 feet of 20" or larger diameter.
C – Difficult to Extremely Difficult	$1,000,000 or more	Verification by the manufacturer that Contractor's personnel are trained in the use of the equipment. A minimum of 10,000 feet of experience on Class B jobs, to include 3,000 feet of 20" or larger diameter. Cumulative Class B and C Income of $1,000,000.

4.5.2.5.5. QUALITY ASSURANCE. The Contractor shall be solely responsible for quality assurance throughout the project. The Contractor shall also be responsible for any costs associated with corrective measures required to replace or repair items not meeting the quality standards specified by CBU.

4.5.2.5.6. SUBMITTALS. The Contractor shall submit the following items for review and approval of the Utilities Engineer in accordance with the Contract Documents. Contractor shall obtain written approval of the submittals by the Utilities Engineer before ordering pipe materials or initiating the pipe replacement process.

A. Verifications of training by the pipe bursting systems manufacturer stating that the operators have been fully trained in the use of the proposed pipe bursting equipment by an authorized representative of the equipment.

B. Evidence of license issued to the Contractor by British Gas or an authorized British Gas sub-licensee.

C. Verification from the pipe manufacturer of training Contractor's personnel in the proper methods for handling and installing new pipe.

D. Verifications of training by the pipe fusion equipment manufacturer that the operators have been fully trained in the use of the fusion equipment by an authorized representative of the equipment manufacturer.

E. Detailed construction procedures including layout plans to include sequence of construction.

F. Locations, sizes, and construction methods for the service reconnection pits.

G. Methods of construction, reconnection, and restoration of existing service laterals.

H. Methods of modification, if required, for existing manholes.

I. Detailed procedures for the installation and bedding of pipe in launching and receiving pits.

J. Bypass pumping plans, including methods and a list of equipment to be utilized.

K. Description of method to remove and dispose of the host pipe, if required.

L. Safety plan in conformance with the Contract Documents and IOSHA regulations.

M. Manufacturer's technical data containing complete information on material composition, physical properties and dimensions of the new pipe and fittings. Manufacturer's recommendations for transport, handling, storage, and repair of pipe and fittings shall be included.

N. Traffic control plans (Must be submitted to City Engineering Management for review and approval minimum 10 working days before start of work).

O. Project Schedule, including schedule of values.

P. Contingency plans for the following conditions:

1. Unforeseen obstruction causes burst stoppage, such as unanticipated changes in host pipe material, repair sections, concrete encasement or cradle, buried or abandoned manhole, or change in direction not depicted on maps provided by CBU.

2. Substantial surface heaving occurring due to depth of the existing pipe vs. the amount of upsizing.

3. Damage to existing service connections and replacement pipe's structural integrity including methods of repair.

4. Damage to other existing utilities.

5. Loss of, and return to, line and grade.

6. Unexpected soil heaving or settlement.

4.5.2.5.7. CONSTRUCTION AND TESTING.

4.5.2.5.7.1. DELIVERY, STORAGE, AND HANDLING OF PIPE AND MATERIALS.

A. The Contractor shall transport, handle, and store pipe and fittings in accordance with the manufacturer's recommendations.

B. New pipe and fittings that are damaged before or during installation shall be repaired or replaced, as recommended by the manufacturer and approved by the Utilities Engineer. The costs of such repair or replacement shall be borne by the Contractor and shall be accomplished prior to installation. Pipe and fittings damaged during or after installation shall be repaired or replaced in accordance with instructions from the Utilities Engineer.

C. The Contractor shall deliver, handle, and store other materials as required to prevent damage. Materials that are damaged or lost shall be repaired or replaced by the Contractor at no additional cost to CBU.

4.5.2.5.7.2. METHODS OF PIPE BURSTING. The most commonly used methods for pipe bursting use static or impact force. Static systems are hydraulic, while impact systems generally involve a combination of pneumatic and hydraulic technology. The primary difference between these methods is the manner in which the force is generated and transferred to the host pipe during the bursting operation.

The pipe bursting tool shall be designed and manufactured to force its way through existing pipe materials by fragmenting the host pipe and compressing the broken pipe sections into the surrounding soil as it progresses. The bursting unit shall generate sufficient force to burst and compact the existing pipeline. See manufacturer's specifications for tool sizes recommended for various pipe diameters as well as parameters associated with tool sizes for allowable upsize percentages.

The pipe bursting tool shall be pulled through the sewer by a cable or rods located at the machine pit. The bursting unit shall pull the polyethylene (PE) pipe behind it as it moves forward from the insertion pit. The bursting head shall incorporate a shield/expander to prevent collapse of the hole ahead of the new pipe insertion. The pipe bursting unit shall be remotely controlled. Sectional replacement pipe shall be pushed as well as pulled behind the bursting head.

The following are different types of pipe bursting equipment:

A. **On-line Pipe Bursting:** On-line pipe bursting is done by creating an impact load in the pipe by applying a "hoop" stress into the pipe and causing it to burst in tension. The dynamic Bursting System consists of a 24,000, 33,000, 50,000 class Horizontal Directional Drill and a Pneumatic (Air Impactor™) or Mechanical (Rotary Impactor™) bursting tool. Both the Air and Mechanical Impactor rely on percussive hammering action to fragment the host pipe through which the tool travels. Simultaneously, the new replacement pipe is installed into the space created by the bursting tool. The Horizontal Directional Drill is used to drill from the surface down to and through the section(s) of pipe to be replaced, then back to the surface where the appropriate bursting tool is attached to the drill rod. The Horizontal Directional Drill then pulls the bursting tool into the old pipe providing a constant tension pulling force and maintaining correct line and grade while the tool bursts the pipe. The technique is aimed at the replacement of gravity pipes as well as pressure pipes, and has been used in diameters ranging from 4 inches to 54 inches and larger.

B. **Pneumatic Pipe Bursting:** Pneumatic pipe bursting is done by creating an impact load in the pipe by applying a "hoop" stress into the pipe causing it to burst in tension. This technique uses a pneumatic bursting head with a properly sized expander and relies on percussive hammering action to break up the old pipe through which the tool travels. Simultaneously, the new pipe is installed into the space created by the pneumatic bursting head and expander. A winch cable is attached to the nose of the bursting head to maintain correct line and grade by providing constant pulling tension and enhancing the percussive force. Winching forces up to 20 tons are typical for this method. This technique is mainly aimed at the replacement of gravity pipes as well as pressure pipes, and has been used in diameters ranging from 4 inches to 54 inches and larger.

C. **Hydraulic Pipe Bursting:** Rather than the pipe being burst from the transfer of pulling or hammering radial force into the plane of the pipe diameter, the bursting head diameter expands, fragmenting the pipe from the inside. The bursting head is equipped with "petals" which open and close under hydraulic pressure. Using hydraulic cylinders, the bursting head first expands to crack the host pipe, then contracts to allow the winch to pull the pipe string forward, while tension is applied to the nose of the head using a winch cable to maintain directional stability. Hydraulic bursting is primarily used for in-line replacement of gravity sewers 6 inches to 20 inches in diameter or larger.

D. **Static Pipe Bursting:** In static pipe bursting a pulling force is applied to a tapered or blunt-nosed bursting head through steel rods, chain, or cable, and new pipe is new pipe is pulled behind the bursting head through the fragmented host pipe. In this process, the host pipe fails in tension created by the radial force applied to the pipe wall from the bursting head. As the bursting head advances, the host pipe is fragmented and compressed into the adjacent soil, and the new pipe is simultaneously installed into the void. The static pipe bursting winch

equipment is modeled after high-powered hydraulic jacks, mounted horizontally, or a high-tension drum type of winch. Pulling forces of up to 225 tons are typical for this method. This method is used in pipes 4 inches to 40 inches in diameter and larger.

4.5.2.5.7.3. REPLACEMENT PIPE MATERIALS. Replacement pipe materials shall be as specified in the Special Conditions and Contract Documents and shall be one of the following:

A. **Polyethylene Plastic Pipe:** Polyethylene Plastic Pipe shall be high-density and meet the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter or AWWA C906, ASTM D1248 and ASTM D3350.

B. **Ductile Iron Pipe:** Ductile Iron Micro-Tunneling Pipe shall meet the requirements of AWWA C110 and shall be specifically designed for jacking by the pipe manufacturer.

C. **Polyvinyl Chloride (PVC) Pipe:** Polyvinyl Chloride Pipe shall be a restrained joining type such as Certa-Lok™ or Yelomine™ and conform to the requirements of ASTM D2241 and/or AWWA C900 or C905, with a DR 11 rating.

4.5.2.5.7.4. LOCATING UTILITIES. CBU will furnish the Contractor with all available documents relevant to the location of all known utilities adjacent to the pipe to be replaced. Prior to commencing work, the Contractor shall field-verify the location of all adjacent utilities and shall expose all interfering and crossing utilities by spot excavating or “pot-holing” at the planar intersection of utilities with the pipe to be replaced and removing the soil from around the utility. The cost of exposing these utilities shall be included in the lump-sum bid.

4.5.2.5.7.5. SUB-SURFACE CONDITIONS. CBU will furnish to the Contractor all available information regarding sub-surface conditions. The Contractor shall verify this information in the field. All additional sub-surface investigations deemed necessary by the Contractor must be approved in advance and in writing by the Utilities Engineer, and shall be included in the Quote or Bid Proposal at no additional cost to CBU. Settlement or heaving of the ground surface during or after construction will not be permitted. The Contractor shall be solely responsible for the costs of repairing any surface heaving or any damages resulting therefrom. However, at the discretion of the Utilities Engineer, if soil conditions are not favorable and pipe up-sizing is required, a minimal amount of ground heaving may be allowed.

4.5.2.5.7.6. LOCATING SERVICE CONNECTIONS. In order to expedite reconnection of services, the Contractor shall locate and expose all sanitary sewer service connections prior to pipe insertion. The Contractor shall exercise due diligence in excavating the existing pipe sufficiently to allow for uniform circumferential expansion of the existing pipe through the service connection pit. Upon commencement of the bursting process, pipe insertion shall be continuous and without interruption from one entry point to another, except as approved by the Utilities Engineer. Upon completion of insertion of the new pipe, the Contractor shall expedite the reconnection of all services to minimize inconvenience to the customers.

4.5.2.5.7.7. PIPE JOINING. The polyethylene pipe (HDPE) shall be assembled and joined at the site using the butt-fusion method to provide a leak-proof joint. Threaded or solvent cement joints are not permitted. Fusion shall be performed by technicians certified by a manufacturer of pipe fusion equipment. The butt-fused joint shall be in true alignment and shall have uniform roll-back beads resulting from the proper use of temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. The fused joint shall be watertight and shall have tensile strength equal to or greater than that of the pipe. All joints shall be subject to review and approval by a CBU inspector prior to insertion. The Contractor shall cut out and replace defective joints at no additional cost to CBU. Any section of pipe with obvious deleterious faults may be rejected in its entirety by the Utilities Inspector. However, a defective area of the pipe may be cut out and the joint fused in accordance with the processes stated above.

4.5.2.5.7.8. BYPASSING OF FLOWS. During execution of the work, the Contractor shall be responsible for continuity of sanitary sewer service to each facility connected to the affected section(s) of sanitary sewer main, and shall bypass the flow around the section(s) of pipe to be replaced. The pumps and bypass lines shall be of adequate capacity and size to handle all flows without overflows or backups of

sewage to private properties. The Contractor shall be solely responsible for clean-up, repair, property damage costs, and claims resulting from failure of the diversion system.

The Contractor shall present a detailed bypass pumping plan to the Utilities Engineer for his review and approval. This shall include specifications for all pumping equipment, as well as all backup pumping equipment to be held in reserve on the job site. Pumps and by-pass lines shall be of sufficient capacity and size to handle all flows.

All costs for by-pass pumping required during the installation of the pipe and reinstatement of laterals shall be included in the Quote or Bid Proposal at no additional cost to CBU.

4.5.2.5.7.9. PARAMETERS AND CONDITIONS.

4.5.2.5.7.9.1. HOST PIPES SUITABLE FOR BURSTING. CBU will identify the host pipe material and size in the Special Conditions and Contract Documents. Host pipe will be one of the following:

A. **Vitrified Clay Pipe** (VCP) in the 4 inch to 42 inch diameters commonly used in sanitary sewers is very brittle and can be readily burst. The ability to fracture the pipe and compact the fragments into the surrounding soil make it an ideal host pipe. It should be noted that concrete encased point repairs, and concrete adjacent to manholes or structures, may interfere with, or even halt, the bursting process.

B. **Concrete Pipe** of all sizes has been commonly used in sanitary sewers, and may or may not contain steel reinforcement. Normally, 12 inch diameter and smaller is non-reinforced concrete pipe and fractures similarly to VCP. The amount of reinforcement, i.e. single or double cage, will normally dictate the burst type selection and success.

C. **Cast Iron Pipe** (CIP) has been used in sanitary sewers and can be very brittle, but slightly different from VCP. Although it fractures easily, it requires special leading equipment to protect the winch rope from damage. Bell and spigot type joints for CIP require a blade-type nose extension to help crack the relatively large cross-section of material contained in the joint, i.e. lead, jute or hemp, asphalt and/or elastomeric materials. A new HDPE pipe being installed in CIP should have a DR 17 or lower to prevent sharp fragments from damaging the pipe.

D. **Asbestos Cement** (AC) pipe has been used in all utilities and exhibits good bursting features similar to VCP. AC pipe contains asbestos material, which is carcinogenic. Therefore, pipe bursting is much safer than direct excavation and replacement.

E. **Plastic Pipes** (i.e. PVC, PE, ABS, et al) all possess varying material characteristics. Most plastics must be split longitudinally using special cutting blades on nose extensions. This may not permit sufficient soil expansion and create higher levels of friction on the new pipe being pulled in. Normally the fragments are strips and do not cause damage to the new pipe.

F. **Steel and Ductile Iron Pipe** (DIP) must be split by blades. This process is used in lieu of ripping, bursting, or tearing the metal pipe.

4.5.2.5.7.9.2. HOST PIPE SIZE. Host pipe size will effect both hammer/expander combinations and winch selection. Small diameter pipe in difficult soil conditions can present problems because a larger, more powerful hammer will not fit inside the host pipe. Special nose tools may be adapted to solve these problems.

4.5.2.5.7.9.3. HOST PIPE DEPTH. The depth of the host pipe affects the bursting process in a number of ways, such as:

A. Existence of groundwater or greater groundwater depth requires dewatering, or additional dewatering.

B. Soil expansion subsequent to the pipe burst may become more difficult due to the additional soil weight.

C. Depending on the type of soil, upsizing new pipe may require additional soil expansion.

D. Entrance and exit pits will require additional shoring due to required safety procedures.

E. The magnitude of an allowable bend in alignment may require reduction due to the additional soil load.

4.5.2.5.7.9.4. SURROUNDING SOIL TYPES. The type of soil surrounding the host pipe should be identified. Some soil types are easily expanded and may remain in the expanded diameter permitting relative ease of new pipe pull-in. Other soils may be loose and/or running, and may require the use of Bentonite or polymers that provide some structural support, permitting new pipe pull-in. Very weak soils may not support the weight of the pipe bursting equipment, and should be avoided.

4.5.2.5.7.9.5. NEW PIPE AND SIZE. Most pipe bursting projects utilize fused lengths of HDPE pipe. The wall thickness of HDPE is identified by its dimensional ratio (DR) for a given size. The lower the DR the greater the wall thickness. Required pipe DR for a project will be clearly stated in the Special Conditions or Bid Documents.

The ability to upsize or install a new pipe larger in diameter than the host pipe is unique to pipe bursting. The amount of upsize is limited by a combination of all the host pipe parameters, and generally upsizing by one or two sizes can be accomplished (e.g., 6-inch to 8-inch or 6-inch to 10-inch, constituting a 33% to 67% increase in diameter).

4.5.2.5.7.9.6. SERVICE EXCAVATIONS. Contractor shall locate all service laterals in advance by CCTV inspection of the host pipe. All service connections shall be exposed prior to bursting to prevent damage and facilitate and expedite service reinstatement. Excavation of service lateral pits shall allow for equal 360° expansion of the host pipe during bursting.

4.5.2.5.7.9.7. LAUNCHING AND EXIT PITS. Whenever possible, pits shall be located outside traffic areas and generally near manholes to permit gradual entry of the bursting equipment and the new pipe into the host pipe. Length of launch pit should generally be 2.5 times the depth of the existing pipe. Steep entries may put excessive strain and friction on the new pipe. Exit pits must be sized to permit removal of pipe bursting equipment and to allow connection of the new pipe to the manhole. The pipe shall be installed and bedded to correct line and grade within the launching and exit pits.

4.5.2.5.7.9.8. BURST LENGTH. Most proposed sewer burst lengths are from manhole to manhole. Longer bursts are possible, but are heavily dependent on the diameter of the host pipe, amount of upsizing, depth, and soil conditions. The use of lubricants is usually recommended as a means of facilitating longer burst lengths.

4.5.2.5.7.9.9. MANHOLE PREPARATION. Entry and exit holes in the manhole must be enlarged to permit the pipe bursting equipment and the new pipe to pass through and remain on grade. This may also necessitate modifications to manhole table and trough.

4.5.2.5.7.9.10. GENERAL GUIDELINES FOR USE OF LUBRICANTS.

A. When new pipe is equal to, or greater than, two times the diameter of the host pipe.

B. When burst length exceeds 300 feet.

C. When diameter of new pipe exceeds 12 inches.

D. When host pipe is below the water table.

E. When free-flowing soil conditions exist.

F. When recommended by the manufacturer of the pipe bursting equipment.

4.5.2.5.7.9.11. PROJECT CONSIDERATIONS. The following variables shall be considered when determining the method and length of run of a pipe bursting project:

A. Consider the depth of the existing pipe and the replacement pipe. The minimum depth of cover over the host pipe shall be two to three times the diameter of the new pipe, or four feet, whichever is greater. With written approval of the Utilities Engineer, the minimum depth of cover may be reduced.

B. Consider material and present condition of the host pipe. A CCTV inspection must be made.

C. Consider the diameter and profile of the host pipe.

D. Consider condition and type of surrounding soil.

E. Consider topography of the ground surface above the host pipe.

F. Consider adjoining utilities and services. Minimum horizontal clearance from other utilities shall be five feet or greater, and minimum vertical clearance shall be two feet or greater. With written approval of the Utilities Engineer, these minimum clearances may be reduced. All interfering and crossing utilities must be carefully located and may need to be exposed prior to pipe bursting.

G. Consider service excavations.

H. Consider material and wall thickness of the new pipe.

4.5.2.5.7.10. RECONNECTION OF SERVICES. After a suitable pipe relaxation period, as approved by the Utilities Engineer, the Contractor shall reconnect all services to the newly installed main. The newly installed pipe shall be allowed the manufacturer's recommended period of time for cooling and relaxation due to tensile stressing prior to reconnection of service lines. Service lines shall be reconnected to the new pipe by using connectors approved by the pipe manufacturer and the Utilities Engineer, and in conformance with the specified installation procedures. Service connections shall be cast or ductile iron with stainless steel strap and elastomeric gasket, or electro fusion. Submittals for connectors will be reviewed and approved by the Utilities Engineer. Connections to the existing service line shall utilize non-shear couplings.

4.5.2.5.7.11. RESTORATION.

4.5.2.5.7.11.1. RESTORATION OF MANHOLES. The Contractor shall restore all manholes and associated surface areas to their original condition or as required by CBU and specified in the description of work. Prior to restoring manholes, the installed pipe shall be allowed the manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing, prior to sealing the annulus or backfilling the insertion pit. Sufficient excess of pipe, but not less than two (2) to four (4) inches, shall be allowed to protrude into the manhole to provide for occurrence. Restraint of pipe ends within the manhole shall be achieved by means of Central Plastics Electro Fusion coupling, or approved equal. The electro fusion couplings shall be slipped over the protruding pipe ends to rest against the manhole wall and fused in place. Installation of electro fusion couplings shall be done in accordance with the manufacturer's recommended procedures. The annular space shall then be sealed with OCTOCRETE non-shrink waterproof mortar (IPA Systems, Inc.).

Restoration of tables and troughs shall be as follows: Unless otherwise instructed in the Special Conditions, Contractor shall renovate trough and table so that the invert channel has a semi-circular bottom and vertical sides extending upwards to the pipe crown. The table shall be smooth and slope towards the channel not less than one inch (1″) per foot. For restorations up to three inches (3″) thick, Contractor shall use a grout mix exceeding 500 psi compressive strength at 28 days. For restorations greater than three inches thick, concrete brick and non-shrink mortar shall be used. Finished surface of both table and trough shall receive two coats of DRYCON (IPA Systems, Inc.).

4.5.2.5.7.11.2. RESTORATION OF PITS. Contractor shall restore all lateral pits, launching pits, and other areas disturbed by construction, to their original conditions or as specified in the Special Conditions. Prior to backfilling lateral and launching pits, the Contractor shall ensure that #11 or #12 crushed stone bedding is shovel-sliced beneath the new pipe to provide support and prevent sagging after backfill and compaction. #11 or #12 crushed stone backfill shall extend minimum 12 inches above the pipe crown.

4.5.2.5.7.12. CCTV INSPECTION. The Contractor shall perform post-installation closed circuit color television inspection of the newly installed pipe. A video tape of this inspection including audio description and printed stationing of all defects and service laterals shall be made by the Contractor. All such inspections shall be made by personnel trained to locate and identify deficiencies, breaks, obstacles, and service laterals. Said post-construction video tapes shall be presented to CBU for review prior to final payment. Should any portion of the inspection tapes be of inadequate quality or coverage as determined by the Utilities Engineer, the Contractor shall re-inspect the unacceptable portion at no additional expense to CBU. All submitted video tapes shall remain the property of CBU. The Contractor may, at the discretion of CBU, retain a second copy.

4.5.2.5.8. MEASUREMENT AND PAYMENT. Application for partial payment shall normally be submitted no more than once a month for work accomplished up to the cut-off date supplied by CBU. Payment shall be based on a Schedule of Payments supplied in advance of construction by the Contractor and approved by the Utilities Engineer, and shall be made in accordance with the terms and conditions of the contract. The price per foot of installed pipe as specified shall include full compensation for furnishing all labor, materials, tools, equipment, and back-up equipment necessary for carrying out the pipe bursting activity and all associated tasks as described in the Special Conditions and Contract Documents. Pipe shall be measured along the longitudinal axis between the manhole centerlines. Replacement and modification of manhole troughs and tables shall be considered part of the pipe bursting process, and no additional compensation will be made for this work unless otherwise addressed in the Special Conditions and Contract Documents.

Alternately, payment may be based on a payments schedule developed by the Design Engineer and the Utilities Engineer and included in the Request for Quote or Invitation to Bid.

4.5.3. **INSTALLATION OF WATER MAINS.** This section describes the specific methods and general practices to be used in installation of water mains. Water mains shall be laid in accordance with the latest revision of AWWA C600 or AWWA M23.

4.5.3.1. GENERAL.

4.5.3.1.1. MAINTAINING EXISTING WATER SERVICES Contractor shall provide for non-interruption of existing services at all times during the project, except when service line transfers are being performed. With the bid proposal, Contractor shall enumerate in detail the measures proposed for providing non-interruption of existing services.

4.5.3.1.2. INSPECTION BEFORE INSTALLATION. All pipe and fittings shall be carefully examined for cracks and other defects while suspended above the trench immediately before installation. Spigot ends shall be examined with particular care, as they are most vulnerable to damage from handling. All gaskets shall be examined for tears or irregularities.

4.5.3.1.3. CLEANING OF PIPE AND FITTINGS. Both the spigot and the inside of the bell shall be wiped clean and dry and free from dirt, oil and grease before lubricant is applied and the pipe is laid.

4.5.3.1.4. BELL ENDS TO FACE DIRECTION OF LAYING. Pipe shall be laid with bell-ends facing in direction of laying unless otherwise directed by the Engineer. Where pipe is laid on a grade of 10 percent (10%) or greater, the laying shall start at the bottom and shall proceed upward with the bell-ends of the pipe facing upgrade. Anchors shall be required for stabilization on all pipes having a slope greater than 20%.

4.5.3.1.5. PERMISSIBLE DEFLECTION AT JOINTS. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or to plumb stems, or where

long-radius curves are permitted, the amount of deflection allowed shall not exceed that allowed by the pipe manufacturer.

4.5.3.1.6. CROSSING EXISTING UTILITIES. Where the new main crosses existing utilities, the main shall be laid *under* the existing pipe where necessary to obtain minimum cover (48").

4.5.3.1.7. DEAD-END WATER MAINS. The Contractor shall install a gate valve and plug at the end of any dead-end line which might obviously be extended. The dead-end main shall be restrained as per the plans.

4.5.3.2. INSTALLATION OF PIPE. This subsection specifies installation methods for pipes made of ductile iron and polyvinyl chloride.

4.5.3.2.1. INSTALLATION OF DUCTILE IRON PIPE (DIP). All installation of DIP shall conform to the latest revision of AWWA C600. DIP shall always be handled with straps (no chains) to avoid damage to external coating. Any such damage must be repaired by Contractor at no additional cost to Owner.

4.5.3.2.1.1. PUSH-ON JOINTS. Push-on joints shall be assembled in accordance with the instructions and recommendations of the manufacturer. Each spigot end shall be suitably beveled to facilitate assembly. Approved pipe lubricant shall be applied to joint surfaces immediately before seating. Lubricant shall be stored in closed containers to maintain cleanliness.

4.5.3.2.1.2. MECHANICAL JOINTS. Mechanical joints shall be assembled in accordance with the manufacturer's recommendations. If effective sealing is not achieved, the joint shall be disassembled, thoroughly cleaned, and reassembled. Overtightening of bolts to compensate for poor installation practice will not be permitted.

4.5.3.2.1.3. BEDDING AND BACKFILL FOR DIP. Bedding to be as stated in 4.5.1.4.1. Backfill to be as stated in 4.5.1.6. and following.

4.5.3.2.1.4. FIELD-CUTTING DIP. See 4.5.2.1.3.1.

4.5.3.2.1.5. DIFFERENT METALLIC PIPE MATERIALS. Wherever it is necessary to join DIP with pipe of a dissimilar metal, the Contractor shall provide a method of insulating against the passage of electric current to be approved by the Engineer.

4.5.3.2.2. INSTALLATION OF POLYVINYL CHLORIDE (PVC) PIPE. PVC pipe is NOT an approved material for construction of 6” and larger water mains within the City of Bloomington water jurisdiction. In special instances the Utilities Engineer may give written permission to utilize PVC pipe in construction of water mains which are to remain private. This will be done on a case by case basis. In no case shall pressure class be less than 200 psi.

PVC pressure pipe may be used in construction of 2-inch or 4-inch water mains to be taken over and maintained by City of Bloomington Utilities. In such case the 2-inch pipe shall be SDR-21 (PR200), and the 4-inch pipe may be either SDR-21 (PR200) or C900 (DR-14).

2-inch PVC water mains shall be connected to existing water mains by mounting a 2-inch tapping saddle on the main to be tapped and connecting a 2-inch corporation stop to the saddle. After the tap has been made, Contractor shall install an iron pipe to flared copper fitting (corporation nut) on the corporation stop. Contractor shall then thread one end of a 6-inch long, 2-inch diameter brass nipple into the corporation nut. Contractor shall connect a 2-inch brass-bodied, full-port IPS ball valve with a Teflon coated ball to the other end of the nipple, then connect another 6-inch long, 2-inch diameter brass nipple into the other side of the ball valve. Contractor shall then connect a PVC or brass compression coupling to the other end of the nipple. The compression coupling shall connect to the new 2-inch SDR-21 PVC pipe. Pipe restraint shall employ Uni-Flange Series 1300, 1350, or 1390 pipe restraints. All service lines connecting to 2-inch PVC mains shall be 1-inch type K copper and shall connect by means of a self-tapping unit with compression connector outlet. Self-tapping unit shall be **FastTap**, as manufactured by **Continental Water Products**, or pre-approved equal.

4-inch PVC water mains shall be connected to existing water mains by means of a 4-inch tapping saddle and a 4-inch tapping valve in accordance with 4.4.4.2.4. and 4.4.4.2.5. When the tap has been made, Contractor shall connect the new 4-inch SDR-21 PR200 or C900 DR-14 PVC pipe to the valve by using an EBAA Series 3100 or Uni-Flange Series 1300 pipe restraint. A transition gasket is required when connecting SDR-21 pipe to the valve. Additional mechanical restraint on the new main shall be in accordance with 4.5.3.4.1.2.

Both 2-inch and 4-inch valves shall be equipped with road type valve boxes. Meter setup for 2-inch mains shall be in conformance with City of Bloomington Utilities Standard Detail Number 15.

A #10 insulated solid copper wire or #12 AWG HS-CCS high strength copper clad steel insulated locate wire shall be wrapped around all PVC pipe so that one revolution is made at least every pipe joint. Splices are to be made with an approved connector, and are to be suitably protected against corrosion. Where the main is laid off the road, the wire is to be brought to the surface approximately every 500 feet to an air valve vault or a valve box with a sign post. Where the main is laid in the street, the wire is to be brought into a valve box approximately every 500 feet. Sign post shall be furnished by the Utilities Department; valve boxes to be furnished by Contractor.

4.5.3.2.2.1. FIELD-CUTTING PVC PIPE. See 4.5.2.1.1.1.1.

4.5.3.2.2.2. BEDDING AND BACKFILL FOR PVC PIPE.

4.5.3.2.2.2.1. PVC PIPE 6" AND LARGER IN DIAMETER. Bedding to be as stated in 4.5.1.4.1. Backfill to be as stated in 4.5.1.6. and following.

4.5.3.2.2.2.2. PVC PIPE LESS THAN 6" IN DIAMETER. Pipe shall be bedded on 4" of fill sand, and fill sand shall extend 4" above the top of pipe.

4.5.3.2.3. INSTALLATION OF PRESTRESSED CONCRETE CYLINDER PIPE. Installation shall be as directed in AWWA Manual M9, **Concrete Pressure Pipe**.

4.5.3.3. INSTALLATION OF FIRE LINES. Owner or Contractor must contact the City of Bloomington Utilities Engineering Dept. and complete an Application Request for Fire Line Connection and receive CBU approval before start of construction. All fire lines shall remain private, from the valve on the City main to the extremity. Pipe material shall be ductile iron pressure class 350 unless special permission for use of other pipe material is given by the Utilities Engineer. All fire lines shall be equipped with a double check valve and a bypass detector meter. The double check valve shall be AMES Silver Bullet, Model 3000ss, Watts 774DCDA, or Wilkins 350ASTDA (with OS&Y) double check detector assembly (DCDA) and shall be installed in accordance with manufacturer's requirements. Check valve, bypass detector meter (registering in gallons), and piping shall all be sized by a fire system designer according to fire flow demands and area system pressure and flow. This assembly shall be located as close to the City main as possible, and shall be installed in a vault in accordance with CBU Standard Detail Number 7a, 7b, or 7c. The exact location and size of vault must be approved in advance by CBU. The fire department having jurisdiction must approve location of post indicator valve and fire dept. connection. The vault shall be provided with a latching hinged aluminum door, locking when specified, size, brand, and model to be approved by the Utilities Engineer minimum size will be 3' by 3'. Door to be centered over the meter or meters to facilitate reading. All fire lines to the building shall terminate with a permanent indicating control valve such as a resilient seated OS&Y gate valve within 36" of entering the building, other variations must be approved by Utilities Engineer. This valve shall be used to hydrostatic pressure test against and will remain as part of the system. No connection shall be made to any fire line until successful completion of both pressure and purification tests. For testing procedure (see 4.5.8.2.3.).

If a fire line is tapped for domestic service, the tap must be made before the (DCDA) and a valve must be provided between the tap and the assembly to permit work on the (DCDA) without interruption of service. The domestic meter may be placed in the same vault with the (DCDA) if the vault has been sized appropriately. If a fire line is not tapped for domestic service, and the (DCDA) is not within 50' of the City main, an additional single check valve in a manhole may be required adjacent to the City main.

It is the responsibility of the fire system designer to verify all existing conditions of flow, pressure, pipe size, and number and configuration of fittings, contact CBU Engineering for all design requirements. This shall be clearly stated in design calculations to be submitted with the Application for Service. Any changes in the field must be approved in writing by the system designer. Contractor shall pressure test all fire lines at 200 psi for two hours, see 4.5.8.2.3. All fire lines shall be sterilized (see 4.5.3.5.1.), and purification tested (see 4.5.8.2.2.) by the Contractor. All tests on fire lines shall be monitored and supervised by a CBU inspector.

4.5.3.4. **INSTALLATION OF FITTINGS AND APPURTENANCES.**

4.5.3.4.1. THRUST RESTRAINT. The configuration of a water main results in unbalanced hydrostatic or hydrodynamic forces which, unless restrained, can result in joint separation. All fittings such as valves, tees, bends, plugs, etc. must be adequately restrained against thrust forces as follows.

4.5.3.4.1.1. RESTRAINED JOINTS. A restrained joint is a special mechanical joint or device that is designed to mechanically couple a calculated number of adjacent joints of pipe together. The entire restrained unit of pipe is then able to transfer thrust forces to the surrounding backfill by friction. Use of joint restraints will be required for all water projects within the CBU water jurisdictional area. Design of a joint restraint system consists of determining the length of pipe that must be restrained on each side of the focus of a thrust force. This will be determined by pipe size, design pressure, depth of cover, and the characteristics of the soil surrounding the pipe. The engineer who designs a water main shall be responsible for incorporating a comprehensive thrust restraint design into the plans. The design engineer shall make clear to the contractor in the plan and profile drawings the exact lineal footage of pipe and fittings that shall be restrained, and which joint restraints are suitable for each application. The thrust restraint design will be reviewed as a part of standard plan review by CBU Engineering, but the design engineer shall be ultimately responsible for the accuracy and effectiveness of his thrust restraint design for each project.

The following joint restraints are acceptable for use as listed so long as they are made in the U.S.A. and have a **minimum pressure rating of 200 psi**:

For Restraining Mechanical Joint Fittings:
EBAA Series 1100 for DIP
EBAA Series 2000PV for C900 PVC, and SDR 21 PR200 PVC
Uni-Flange Series 1300-C for C900 PVC
Uni-Flange Series 1300-S for SDR-21 PR200 PVC
Uni-Flange Series 1400 for DIP
Romac Industries Roma Grip for DIP and PVC

For Restraining Push-on C900 PVC Fittings:
EBAA Series 2500
Uni-Flange Series 1360-C

For Restraining Push-on C900 PVC Pipe Joints:
EBAA Series 1600 (4″ through 12″)
EBAA Series 2800 (14″ through 30″)
Uni-Flange Series 1350-C
Uni-Flange Series 1390-C

For Restraining Push-on SDR-21 PR200 PVC Pipe Joints:
EBAA Series 6600 (3″ through 12″)
Uni-Flange Series 1350-S
Uni-Flange Series 1390-S

For Restraining Push-on DIP Joints:

EBAA Series 1100 HD
EBAA Series 1700
Uni-Flange Series 1450
Lock Joint Pipe or gaskets (when specified)

For Restraining Mechanical DIP Joints:

EBAA Megalug
EBAA Series 1100
Uni-Flange Series 1400
Romac Industries Roma Grip

4.5.3.4.1.2. THRUST BLOCKS. The use of thrust blocks as a means of thrust restraint on water mains will be permitted only on a case-by-case basis with written permission of the Utilities Engineer. The only exception shall be the concrete thrust block placed on the opposite side of an existing water main when making a hot-tap. Instead of thrust blocks, joint restraints shall be used. When thrust blocks are allowed the fittings must be wrapped in plastic before the concrete is placed.

4.5.3.4.2. INSTALLATION OF HYDRANTS. Connection of fire hydrant arm to new main shall be made by using a restrained mechanical joint tee in the main line. The line valve on the hydrant arm shall be connected directly to this tee by use of an anchor coupling (see Standard detail #8). The hydrant shall be connected to the other end of the fire arm by an anchor coupling or ductile iron pipe with joint restraint glands or see 4.5.3.4.1.1. for equivalent restraints. For connection to existing mains, a tapping sleeve and valve may be substituted for the tee/anchor coupling/gate valve assembly. Any deviation from these two methods requires prior approval from the Utilities Engineer and shall be indicated on the plan drawings. For accepted manufacturers and color of the hydrants see 4.4.4.4.

Contractor shall provide a generous envelope of #5 stone around the drain ports to assure barrel drainage of hydrants. Envelope is to be minimum two feet (2') in diameter and six inches (6") above drain ports.

Contractor shall set ground line mark on hydrant two inches (2") above finished grade.

4.5.3.4.3. INSTALLATION OF FLUSH HYDRANTS. All flush hydrants, whether installed in grassy areas or pavement, shall be **Gil model Aquarius 101 GHS, 2-inch Slim Line Hidden Hydrant**, or **Kupferle Model TF500 Flush Hydrant** (www.hydrants.com). All flush hydrants shall be installed in a traffic-rated six-inch valve box with lid. A 2-inch, brass-bodied, double O-ring, full-port valve with a Teflon coated ball shall be installed immediately before either type of flush hydrant. Valve shall be equipped with road type valve box.

4.5.3.4.4. INSTALLATION OF VALVES. All valves shall be properly restrained, as detailed in the Standard Drawings.

Butterfly and gate valves shall be set vertically. Flanged valves shall be securely bolted utilizing red rubber gaskets and high-strength rustproof steel bolts and nuts. In all areas where system static pressure is greater than 90 psi, cloth insert gaskets as manufactured by BILTRITE or approved equivalent shall be used.
All gate valves shall be buried and have road boxes unless otherwise specified. For valve box installation see 4.5.3.4.8.

All butterfly valves shall be installed in a precast concrete manhole with a minimum interior diameter of 5 feet. The dimensions of larger valves may require 6-foot I.D. manholes. Manhole base shall be minimum 6 inch poured in place Class A concrete having a minimum compressive strength of 4,000 psi, over minimum 4 inches of either #11 or #12 stone bedding. Base shall be provided with a minimum 1' by 1' drain. Manhole casting shall be East Jordan 1020 series with a self-sealing, non-rocking lid imprinted with the word "WATER".

4.5.3.4.5. INSTALLATION OF LINE VALVES. When installing a line valve adjacent to a junction with a new main, a mechanical joint tee shall be installed in that new main, and the line valve shall be connected directly to that tee by an anchor coupling. For connection to existing mains, a tapping sleeve and valve may be substituted for the tee/anchor coupling/gate valve assembly. Any deviation from these two methods requires prior approval from the Utilities Engineer and shall be indicated on the plan drawings.

4.5.3.4.6. INSTALLATION OF TAPPING VALVES. Tapping valves shall be installed by the Contractor and the tap made by City Utilities. Tapping valve connections to existing mains shall be made at the locations shown on the plans. Exact locations of existing mains shall be verified in the field by the Contractor. Contractor shall position tapping valve at best location as determined in the field by the Engineer or his agent, and no extra payment will be made for any relocation.

Tapping valve and sleeve installation shall be made in accordance with the detail in the Standard Drawings. Valves shall be securely supported in vertical position during the tapping operation. Valve shall be checked for leaks before backfilling. Bedding and backfill material shall be thoroughly tamped around and under valve after installation. Thrust restraint shall be provided at all appropriate locations.

4.5.3.4.7. INSTALLATION OF AIR RELEASE VALVES. Air release valves and appurtenances shall be installed in a manhole as shown in Standard Detail #3. A saddle with a tapping corporation shall be installed on the top of the main at the high point formed by sloping two adjacent joints to a summit.

4.5.3.4.8. INSTALLATION OF VALVE BOXES. Valve boxes shall be set squarely over the wrench nut and in a vertical position with a centering device such as a Boxlok or an approved equivalent. Tops shall be flush with the finished grade and readjusted as necessary to conform to the surface until final settlement or paving is complete.

All valve boxes which are *not* in pavement shall be centered in a six inch thick concrete pad, measuring 18 inches in diameter.

4.5.3.4.9. INSTALLATION OF VALVE MARKERS. (When required) At each sectionalizing valve, a marker pipe shall be set at the right-of-way line laterally adjacent to the valve. If this is not possible due to some conflict, the marker shall be set where directed by the Utilities Engineer. A marker will also be required at each air release valve vault. Setting of markers shall be as detailed in the Standard Drawings. No extra payment will be made for markers or their setting; such cost must be included in the price of the valves.

4.5.3.5. FILLING, STERILIZATION, AND FLUSHING OF WATER MAINS. Contractor shall fill, sterilize, and flush all new mains, leads, and appurtenances in accordance with the latest revisions of AWWA C600, C601, and C651.

4.5.3.5.1. FILLING, STERILIZATION, AND FLUSHING PROCEDURE. As each length of pipe is laid, Contractor shall affix an appropriate number of 5 gram Hypochlorite tablets inside the top of the pipe barrel using Permatex #1 adhesive or approved equivalent. Silicone sealant is not an acceptable adhesive. There shall be no adhesive on the tablet except a thin layer on the broad side attached to the surface of the pipe. Pipe must be installed with tablets at the top. The following table indicates the number of 5 gram Hypochlorite tablets required per pipe section as indicated in the latest revision of AWWA C651.

		Length of Pipe Section in Feet (m)				
		13 (4.0) or less	18 (5.5)	20 (6.1)	30 (9.1)	40 (12.2)
Pipe Diameter in inches	(in mm)	Number of 5-g Hypochlorite Tablets				
4	(100)	1	1	1	1	1
6	(150)	1	1	1	2	2
8	(200)	1	2	2	3	4
10	(250)	2	3	3	4	5
12	(300)	3	4	4	6	7
16	(400)	4	6	7	10	13

Also, one such tablet shall be placed in each hydrant, hydrant branch, and other appurtenance. Sterilization for pipe larger than 16 inch shall be addressed in each individual project.

The main shall then be slowly filled with water from the City distribution system at a velocity no greater than one foot per second. Air shall be expelled from the main as it is filled, by use of air valves or hydrants at the high point of the main. Where such vents are not available, Contractor shall install a corporation cock at the high point to assure air removal. When tablets have dissolved, a chlorine residual of not less than 10ppm shall remain in the water after the 48-hour disinfection period has passed.

Valves shall be manipulated so that the strong chlorine solution in the line being treated is not allowed to flow back into the City distribution system. Following chlorination, all treated water shall be flushed from the new main at its extremity, for a period of time determined by the Utilities Engineer, so that the water quality matches that in the City distribution system. All valves shall then be closed until bacterial testing is performed. If for some reason additional flushing is required, City of Bloomington Utilities Department reserves the right to charge Contractor for the water at the standard rate.

If this water is flushed into the sanitary sewer system, the Utilities Department reserves the right to charge the Contractor a sewage treatment fee for that volume of water. Flushing into the sanitary sewer system is never to be performed during wet-weather conditions.

Before the new main is put into use, the City must test the water from the main for bacterial contamination, and monitor the Contractor's pressure and leakage test. All testing is to be conducted within two weeks after pipe is filled. No connections to the main will be permitted until all testing is complete.

4.5.3.6. SERVICE CONNECTIONS.

4.5.3.6.1. Contractor will not be permitted to tap existing water mains; this must be done by City of Bloomington Utilities.

4.5.3.6.2. The Contractor is authorized to make service taps on his newly-installed mains which have passed both pressure and purification tests. However, the Contractor must consult the Utilities Inspector, for approval of all methods and materials used in tapping the main and running services. The tapping machine and bit shall be clean and disinfected and the proper lubricant used such as Mueller cutting grease 681927. Fittings must be Ford, McDonald, or Mueller or an approved equivalent, made in the USA.

Also, the Contractor must consult the Utilities Engineer regarding required diameter of service lines in consideration of system pressure and flow in project area. Service lines shall be 1", 1-1/2", or 2" type K copper in conformance with ASTM B88. Only flared fittings will be permitted.

The Contractor shall install service lines in the following manner:

For 1" service lines, a (CC) threaded tap shall be made on the main at a 45 degree to 90 degree angle from vertical, and a single O-ring, full-port, Teflon-coated, brass corporation stop installed; saddle taps on ductile iron pipe will not be permitted for 1" services.

For service lines 1-1/2" or 2" in diameter, the tap shall be made by installing an approved non-corrosive saddle with stainless steel mounting bolts and a corporation stop.

A type K copper service line of appropriate diameter shall be run to the property line. At this point a double O-ring, full-port, Teflon-coated, ball valve curb stop shall be installed. The curb stop shall be fitted with a female iron thread for later attachment to yoke. This opening shall be fitted with a temporary plastic plug, or covered with duct tape. Contractor shall place a two-by-four or four-by-four extending vertically from the end of the service line in the trench to a point at least two feet above finished grade to facilitate future location. This marker shall be painted blue to indicate "water".

The service line shall be bedded on 4" of fill sand, and shall receive 4" of sand cover over the pipe. The remainder of backfill shall be as required in 4.5.1.6. and following. Street cut repairs shall be in accordance with 4.5.6. and following the requirements of the agency governing the roadway.

4.5.3.7. INSTALLATION OF DOMESTIC METER, YOKE, AND PIT. Developer shall deliver fixture count and a plat indicating addresses to the office of the Utilities Engineer prior to application for meter sets. Domestic meters, service yokes, and pits shall be purchased from City of Bloomington Utilities. Contact the Transmission and Distribution Department, Utilities Service Center, 600 E. Miller Dr., at least 48 hours in advance to make arrangements for installation. If there are conflicts with other utilities developer/builder will bare the expense of correcting the conflict.

The developer/builder shall establish and mark finished grade at the proposed pit location for meters 2” and smaller. The developer/builder will be responsible for all excavation, setting the pit to finish grade, and backfill. The Transmission and Distribution crew will make connection to water stub and install a yoke for the meter at 18” to 24” below marked finish grade. The developer/builder will be responsible for connection to building plumbing, installation of meter pit and backfilled, prior to installation of meter. Top of yoke shall be set minimum 18" and maximum 24" below top of pit at finish grade. Where yokes are not set within this range of depth, City of Bloomington Utilities personnel may refuse to set meters until yokes are properly adjusted.

Dual service setups shall be served by 1-1/2" or 2” diameter type K copper service line as designated unless special permission is given by the Utilities Engineer.

Prices for meters, meter sets, taps, etc. will be evaluated and established periodically. For current prices contact New Services.

4.5.3.8. INSTALLATION OF LARGE METER, AND VAULT. The installation of water meters larger than 2” will be done by the developer/builder or their contractor. The meter assembly must be obtained from the City of Bloomington Utilities. Contact City of Bloomington Utilities, Utilities Service Center, 600 E. Miller Dr., at least 6 weeks in advance to make arrangements. The larger meter must be placed in a vault built to City of Bloomington Utilities standard details or a design accepted by the Utilities Engineer. When you are not using flange type pipe in the vault a restrained flange adapter such as MegaFlange series 2100 or accepted equivalent should be used to make connection from cut pipe to flange type fittings. Set screw type flange adapters are not acceptable.

4.5.4. **INSTALLATION OF STORM SEWERS.** This section describes the specific methods and general practices to be used in installation of storm sewers.

4.5.4.1. LINE AND GRADE. Bench marks shall be set in strategic locations of the project by either the Design Engineer or the Utilities Engineering Department before start of construction. The Contractor shall be responsible for furnishing additional bench marks or reestablishing obscured bench marks, and shall furnish and set all line and grade stakes. The laser method of installation shall be used to set the

grade of all sewer pipe. Any other method must first be approved in writing by the Utilities Engineer. Contractor shall constantly check alignment and grade of pipe.

4.5.4.2. LAYING OF PIPE. The point of commencement for laying storm sewer pipe shall be the lowest point in the proposed storm sewer line. Pipe shall be laid with the bell end of bell and spigot pipe, or the receiving groove end of tongue and groove pipe, pointing upgrade. Each pipe shall be placed on firm, evenly raked bedding material. All pipe shall be homed as per manufacturer's instructions. Any other procedure shall require written permission of the Utilities Engineer.

4.5.4.2.1. LAYING OF PIPE IN COLD WEATHER. Contractor shall discontinue pipe installation whenever there is danger of the quality of work being impaired because of cold weather. Contractor shall be responsible for heating pipe and jointing material to prevent freezing of joints. No pipe shall be laid on frozen ground, and no pipe shall be laid when the air temperature is less than 32° F unless proper precautions, as per the manufacturer's recommendations, are followed.

4.5.4.2.2. UNSTABLE SOIL CONDITIONS: When unstable soil conditions are encountered and the trench bottom is not firm, all soft and compressible material shall be excavated and replaced with #1 or #2 crushed stone before placement of the bedding material. As an alternative, with written permission of the Utilities Engineer, an acceptable geo-fabric may be used beneath the bedding material to stabilize the trench bottom.

4.5.4.2.3. DEWATERING AND CONTROL OF SURFACE WATER. Whenever groundwater is encountered, Contractor shall make every practical effort to secure a dry trench bottom before laying pipe. Contractor shall provide, install, and operate sufficient trenches, sumps, pumps, hoses, piping, well points, etc. to depress and maintain the groundwater level below the base of the excavation. If Contractor is unable to remove the standing water in the trench, Contractor shall over-excavate the proposed grade of the sewer bedding and place not less than three (3) inches of #2 or #3 crushed stone in the over-excavated area at no additional cost to the Owner.

Contractor shall keep the site free of surface water at all times and shall install drainage ditches, dikes, pumps, and perform other work necessary to divert or remove rainfall and other accumulation of surface water from excavations. The diversion and removal of surface and/or groundwater shall be performed in a manner which will prevent the accumulation of water within the construction area.

Under no circumstances shall surface water and/or groundwater be discharged to, disposed of or allowed to flow into an active sanitary sewer system.

4.5.4.3. BEDDING FOR STORM SEWERS. Contractor shall provide bedding material as noted below and as indicated on the plans. The cost for bedding material shall be included in the bid price for the main, and is not a separate pay item. Bedding shall conform to ASTM D 2321 and shall be #11 or #12 crushed stone.

4.5.4.3.1. BENEATH PIPE. All pipe shall be bedded on minimum 4″ of #11 or #12 crushed stone when in soil and 6″ when the pipe is laid in rock, or 1/6 pipe O.D. up to 8-inch maximum thickness, whichever is greater. The stone shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between pipe joints. Bedding material shall be removed for bells so the entire length of the pipe rests evenly on the bedding.

4.5.4.3.2. BENEATH STRUCTURES. Bedding shall be minimum four inches (4″) of either #11 or #12 crushed stone in soil and six inches (6″) in rock. All over-excavation shall be filled with either #11 or #12 crushed stone or flowable backfill, as directed by the Utilities Engineer, to achieve elevations indicated on the plan drawings.

4.5.4.4. BACKFILL FOR STORM SEWERS. Contractor shall provide backfill material as noted below and as indicated on the plans. The cost for backfill material shall be included in the bid price for the main, and is not a separate pay item. Backfill materials shall be placed and compacted in uniform lifts and shall have a moisture content sufficient to assure that maximum density will be obtained with compaction.

4.5.4.4.1. BACKFILL OVER PIPES. Backfill over pipes shall be divided into two categories: Primary Backfill and Secondary Backfill.

4.5.4.4.1.1. PRIMARY BACKFILL. Primary backfill shall be #11 or #12 crushed stone. The stone shall be shovel-sliced beneath the haunches of the pipe. The primary backfill shall extend to a point 12″ above the crown of the pipe.

4.5.4.4.1.2. SECONDARY BACKFILL. Secondary backfill shall be as stated in Sections 4.5.1.6.1. through 4.5.1.6.3.

4.5.4.4.2. BACKFILL AROUND STRUCTURES. Backfill around structures shall be as stated in Sections 4.5.1.6.1. through 4.5.1.6.4.

4.5.4.5. INSTALLATION OF STORM STRUCTURES. Structures shall be placed and aligned to provide vertical sides within a tolerance not to exceed two inches (2″) up to 16 feet in depth, plus 1/8 inch per foot over 16 feet in depth. Tolerance shall be checked with a plumb line. The completed structure shall be rigid, true to dimensions, and soil tight.

4.5.4.5.1. INSTALLATION OF CAST-IN-PLACE STORM STRUCTURES. Cast-in-place storm structures shall be constructed at the locations and elevations shown on the plan drawings, and in accordance with the shop drawings, as noted in Section 4.4.5.5.1.1.

4.5.4.5.2. INSTALLATION OF PRECAST STORM SEWER MANHOLES. Precast storm sewer manholes shall be installed in accordance with Sections 4.5.2.1.7.1. through 4.5.2.1.7.4.

4.5.4.5.3. INSTALLATION OF PRECAST CONCRETE INLETS AND CATCH BASINS. Precast concrete inlets and catch basins shall be constructed at the locations and elevations shown on the plan drawings, and in accordance with Section 4.4.5.5.1.3.

4.5.4.6. SEPARATION BETWEEN UTILITIES. Horizontal and vertical separation between utilities shall be as stated in Sections 4.5.1.7. through 4.5.1.9.

4.5.4.7. ABANDONING OF SEWERS. Storm sewers which are to be abandoned shall be filled with a thin concrete mix or flowable backfill and closed either by means of a cap or plug of the same material as the pipe, or bulkheaded with a masonry brick and non-shrink waterproof mortar wall.

Unless otherwise specified, all abandoned manholes, catch basins, and inlets shall be removed to a depth of three feet (3′) below the proposed or established grade or existing street grade, whichever is lower, and filled with compacted granular material or flowable backfill.

4.5.4.8. DEFLECTION TESTING. All storm sewer mains constructed of flexible pipe (PVC, HDPE, and SRP) and having manholes at each end of the pipe run, shall be deflection tested. Deflection testing shall not be required for pipe runs having an inlet or catch basin on one end.

Pipe sizes 36-inch and smaller diameter shall be mandrelled with a rigid device. For any vertical or horizontal deflection test, the pipe failure shall be defined as a five percent (5%) or greater deflection of the internal pipe diameter when testing with a rigid ball or mandrel of no less than 95% of the base inside diameter of the pipe being tested. The Contractor shall be required to perform a deflection test of all flexible pipe after the final backfill has been in place for at least thirty (30) days. The following pipe types are considered *non-flexible* and do *not* require deflection testing: vitrified clay pipe, ductile or cast iron pipe, concrete pipe, asbestos-cement pipe. Test methods and equipment shall be subject to the Engineer's approval. The test must be conducted in the presence of the Engineer or his representative, and the test results must be reviewed and certified by the Engineer or his representative prior to final acceptance of the sewer. The test is a go/no-go procedure in which the mandrel must be hand-pulled without any type of mechanical assistance. Any pipe which is found to have failed by deflection within the warranty period shall be replaced by the Contractor at no additional cost to the Owner.

Pipe sizes larger than 36-inch shall be deflection tested based on a method agreeable to both the Utilities Engineer and the Contractor.

4.5.5. **CONCRETE MIXING AND PLACING.** Mixing and placing of concrete shall conform to the latest revision of ACI 614. Ready-mixed concrete shall conform to the latest revision of ASTM C94, and shall be as specified in the Special Conditions.

4.5.5.1. COLD WEATHER CONCRETE: Whenever the atmospheric temperature is 35° F or below, or whenever the atmospheric temperature may fall below 35° F within the curing period, concrete may not be placed without the written permission of the Utilities Engineer. Contractor must have the approval of the Utilities Engineer for proposed procedures to maintain temperature of freshly-poured concrete at a minimum temperature of 50° F while maintaining adequate moisture in the air throughout the curing period. Cold weather concrete shall be placed at the risk of the Contractor and shall be removed and replaced at his expense if it becomes frozen or otherwise damaged due to low temperature.

4.5.6. **STREET CUT REPAIRS.**

4.5.6.1. GENERAL. Contractor shall be responsible for obtaining a street cut permit from the proper jurisdictional agency.

4.5.6.2. PAVING. The Contractor shall be aware that several different specifications exist depending on the agency having jurisdiction over the street cut repair. It is the Contractor's responsibility to determine the agency having jurisdiction in the project area, to obtain the proper permits, and comply with the requirements of that agency.

4.5.7. **MISCELLANEOUS RESTORATION AND CLEAN-UP.** After completion of the Work, the Contractor shall restore all fences, shrubs, lawns, culverts, walks, driveways, etc., disturbed by his operations. All excess materials, construction debris, trash, etc., resulting from the Work shall be removed from the site and disposed of by the Contractor.

Any existing sewers, culverts, field tiles, or other conduits encountered in the trenching operation shall be left intact. If cut or removed during construction, they shall be replaced to the satisfaction of the Owner and Engineer without extra payment.

After backfilling trenches in areas outside pavement and shoulders, the excess excavated material shall be windrowed along the top of trenches until sufficient settlement has occurred. After sufficient settlement, trenches shall be graded to match surrounding topography and all excess materials disposed of by the Contractor. All areas shall be restored to original or better condition. No extra payment will be made for replacement of shrubs, fences, mailboxes, driveways, sidewalks, or curbs, or any other items not provided for as a pay item in the proposal.

4.5.8. **TESTING OF SEWER AND WATER MAINS.**

4.5.8.1. TESTING OF SEWER MAINS. Each section of sewer shall meet the requirements of the following tests. All defects exposed by these tests and by inspection shall be repaired by the Contractor to the satisfaction of the Engineer at no cost to the Owner. The Contractor shall be required to provide all materials, equipment, and labor required in the performance of these tests including, but not limited to, water, pumps, cleaning of pipes, etc.

4.5.8.1.1. TESTING OF GRAVITY SEWERS. New gravity sewers shall be required to pass either an air pressure test, or an exfiltration test. The air pressure test shall be the standard, and the exfiltration test may only be conducted with written approval of the Utilities Engineer. All new manholes must pass a vacuum test.

Methods used during all tests shall be subject to the approval of the Engineer. The completed sewer shall be tested for leakage, and inspected for damaged materials and improper installation including straightness of line *before any services are connected to the sewer*.

No additional payment will be made for the performance of these tests.

4.5.8.1.1.1. AIR PRESSURE TEST: The Contractor shall conduct a test on PVC pipe using low-pressure air in place of exfiltration testing. Air pressure test shall conform to ASTM F-1417-92. The section of sewer to be tested shall be isolated with pneumatic plugs that have a sealing length greater than the diameter of the pipe and are capable of resisting test pressure without external bracing or blocking. The sewer shall be pressurized to 4 psi gauge greater than the average back pressure of any ground water over the pipe. This pressure shall be maintained until the temperature of the pipe and the air have equalized, but not less than two minutes. After the temperature has stabilized, the air supply shall be disconnected and the pressure allowed to drop. The time in minutes required for the pressure to drop from 3.5 psi to 2.5 psi shall not be less than as calculated using the following chart:

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP AND MULTIPLIER FOR CALCULATING TIME BY LENGTH OF PIPE (L)

Pipe Diameter (inches)	Minimum Time (min:sec)	Maximum Length for Minimum Time (feet)	Time for Longer Length (seconds)
4	3:46	597	0.380 L
6	5:40	398	0.854 L
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	199	3.418 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L
21	19:50	114	10.470 L
24	22:40	99	13.674 L
27	25:30	88	17.306 L
30	28:20	80	21.366 L
33	31:10	72	25.852 L
36	34:00	66	30.768 L

Column 1 is the diameter of the pipe to be tested. Column 2 is the minimum time permitted for any length of pipe up to and including the length listed in column 3. If the length of the pipe to be tested is greater than the length listed in column 3, multiply the length of the pipe to be tested by the number in column 4. The result is the test time in seconds.

4.5.8.1.1.2. EXFILTRATION TEST. With the written approval of the Utilities Engineer an exfiltration test can be performed by closing all other openings in the upper manhole and plugging the line where it enters the lower manhole of the section to be tested, filling the line and the upper manhole to the top with water and measuring the water required to keep the manhole full.

The total exfiltration shall not exceed 100 gallons per inch of nominal diameter per mile of pipe per day for each section tested. For determining maximum allowable leakage, manholes shall be considered as sections of pipe of equal inside diameter. The exfiltration tests shall be maintained on each section for at least one hour, and as much longer as the Engineer considers necessary to locate all leaks. If the leakage in any section exceeds the allowable maximum, it shall be retested after the leaks are repaired.

4.5.8.1.1.3. VACUUM TEST. All sanitary manholes must be vacuum tested. The vacuum tester shall be as manufactured by P. A. Glazier, Inc. or approved equivalent.

4.5.8.1.1.3.1. VACUUM TEST FOR MANHOLES. Manholes shall be air tested in accordance with ASTM C1244-93, Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test. Testing shall be done after complete assembly of manhole, including the manhole frame and, when pertinent, any outside drop connections. Testing prior to backfilling is highly recommended to facilitate

corrective measures in case of test failure. Contractor shall plug all pipe openings, taking care to securely brace both the plugs and the pipes. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the the vacuum reading drops from 10 inches of mercury to 9 inches of mercury in ***one and one-half (1.5) minutes or more. If the inspector finds a noticible leak, he may immediately declare the test to have failed.*** If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.

4.5.8.1.1.3.2. VACUUM TEST FOR SEWER PIPES. Vacuum testing of gravity sewer pipe is no longer an acceptable alternative in the CBU jurisdictional area.

4.5.8.1.1.4. DEFLECTION TEST. For any vertical or horizontal deflection test, the pipe failure shall be defined as a five percent (5%) or greater deflection of the internal pipe diameter when testing with a rigid ball or mandrel of no less than 95% of the base inside diameter of the pipe being tested. The Contractor shall be required to perform a deflection test of all flexible pipe after the final backfill has been in place for at least thirty (30) days. The following pipe types are considered *non-flexible* and do *not* require deflection testing: vitrified clay pipe, ductile or cast iron pipe, concrete pipe, asbestos-cement pipe. Test methods and equipment shall be subject to the Engineer's approval. The test must be conducted in the presence of the Engineer or his representative, and the test results must be reviewed and certified by the Engineer or his representative prior to final acceptance of the sewer. The test is a go/no-go procedure in which the mandrel must be hand-pulled without any type of mechanical assistance. Any pipe which is found to have failed by deflection within the warranty period shall be replaced by the Contractor at no additional cost to the Owner.

4.5.8.1.1.5. SMOKE TEST. The Owner shall reserve the right to supplement sewer tests with a pressure smoke test when it is considered necessary or desirable by the Owner or Engineer.

4.5.8.1.1.6. TELEVISION INSPECTION. Before final acceptance, all new gravity sewers shall be televised by the City of Bloomington Utilities Department.

The first televising run shall be conducted after all other testing and jet-cleaning is complete. Contractor must give at least 72 hours prior notice (not including weekends or holidays) to the Utilities Department when scheduling televising.

A second televising run shall be conducted 11 months after the date of final acceptance. Both televising runs shall determine wye locations, defective joints, and deformed or cracked pipe or fittings. Both runs will be done by City Utilities without charge to the Contractor. Any additional runs that are considered necessary to reinspect defective pipes, wyes, joints, etc., shall be charged to the Contractor at a rate to be determined by the City of Bloomington Utilities Department.

4.5.8.1.2. TESTING OF FORCE MAINS. All force mains shall be pressure and leak tested in accordance with one (1) of the following methods. If an AWWA standard is not available for the particular installation, the installation and test procedure recommended by the manufacturer shall be followed. Contractor shall supply pump with suitable pressure gauge and acceptable means of connecting to main. Utilities Inspector will monitor all tests.

4.5.8.1.2.1. AWWA STANDARD C600, LATEST UPDATE: Installation of Ductile Iron Force Mains and Their Appurtenances (see 4.5.8.2.1.1.).

4.5.8.1.2.2. AWWA Standard C605, LATEST UPDATE: Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Force Main.

With a Utilities Inspector present, a combined hydrostatic pressure and leakage test shall be performed. The line shall be properly filled with water, flushed, and purged of air by means of an air valve or blow-off. The specified test pressure shall be applied by means of an approved pumping assembly. Test pressure

shall be 150% of the working pressure (pump shut-off head) at the point of test, but not less than 125% of the normal working pressure at the highest elevation of the line. Duration of the test shall be two (2) hours. Leakage shall be defined as the quantity of water that must be supplied into the pipe section being tested to maintain a pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air has been expelled.

The following table indicates allowable leakage per 50 joints of PVC pipe in gallons per hour:

Average Test Pressure, psi	**Nominal Pipe diameter, inches**										
	4	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**
300	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51
275	0.45	0.67	0.90	1.12	1.38	1.57	1.79	2.02	2.24	2.69	3.36
250	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21
225	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48
125	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03
75	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40	1.76
50	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15	1.43

4.5.8.1.3. TESTING OF WET WELLS. Contractor shall perform leakage tests on wet wells under supervision of the Utilities Inspector. This shall be an exfiltration test performed in the following manner:

The test shall be made prior to placing any backfill material. If the water table has been allowed to rise above the bottom of the wet well, it shall be lowered for the duration of the test. Any points of visible inflow/infiltration shall be plugged by use of OCTOPLUG (IPA Systems, Inc.) (www.ipasystems.com). All pipes and other openings into the wet well shall be suitably plugged by means of pneumatic plugs that have a sealing length greater than the diameter of the pipe and are capable of resisting test pressure without external bracing or blocking.

The wet well shall then be filled to the top with water. If the excavation has not been backfilled and there is no visible or measurable indication of leakage after one hour, the wet well shall be considered to be satisfactorily water-tight.

If the test as described above is not satisfactory, or if the wet well excavation has been backfilled, the following test shall be performed. A period of time up to 24 hours shall be permitted to allow for absorption. At The end of this period, the wet well shall be refilled to the top and the measuring period of at least 8 hours begun. At the end of this test period, the amount of loss can be calculated by measuring and calculating the volume lost, or the wet well can be filled to the top while measuring the required volume of water to do so. This amount shall be extrapolated to a 24-hour rate.

Calculation of allowable loss in 24 hours for wet wells shall be similar to that of pipe and manholes, which shall not exceed 100 gallons per inch of nominal diameter per mile of pipe per day.

To calculate allowable loss in gallons for circular wet wells: Multiply wet well diameter in inches times 100 gallons times depth in fractional miles (depth in feet divided by 5280).
To calculate allowable loss in gallons for rectangular wet wells: Multiply wet well perimeter in inches (2 × L plus 2 × W) times 100 gallons / π times depth in fractional miles (depth in feet divided by 5280).

If the wet well does not meet allowable leakage rate, repairs by approved methods may be made as directed by the Utilities Engineer to bring the leakage within the allowable rate. No adjustment to the leakage allowance will be made for unknown causes, such as leaking plugs, absorption, evaporation,

etc.; it will be assumed that all loss of water during the test is a result of leaks through the joints or through the walls. Furthermore, the Contractor shall take any steps necessary to assure the Utilities Inspector that the water table remains below the bottom of the wet well throughout the test.

4.5.8.2. TESTING OF WATER MAINS.

4.5.8.2.1. PRESSURE AND LEAKAGE TEST. The Contractor shall perform a combination pressure and leakage test on all new mains after they have been filled with water as specified in 4.5.3.5.1. This test shall not be performed until the entire main has been backfilled.

4.5.8.2.1.1. PROCEDURE. The test procedure shall be as herein specified and in accordance with the latest revision of AWWA C600.

After the new main has been filled with water and all air evacuated, each valved section, as directed by the Engineer, shall be subjected to water pressure normal to the area and inspected for evidence of leakage. The main shall then be subjected to a combination hydrostatic and leakage test. The test pressure shall be developed by a pump with suitable pressure gauge furnished and connected to the main by the Contractor. Test pressure shall not be less than 125% of the standard working pressure at the highest elevation on the main, and at least 150% of the standard working pressure at the point of testing or 200 psi which ever is greater. Duration of the test shall be two (2) hours. Leakage shall be defined as the quantity of water that must be supplied into the pipe section being tested to maintain a pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air has been expelled.

Leakage shall not exceed a rate of twelve gallons per inch of pipe diameter, per mile of pipe, per twenty-four hours at a pressure of 200 psi.

The following table indicates allowable leakage per 1,000 feet of DIP in gallons per hour:

Average Test Pressure,	**Nominal Pipe diameter, inches**										**psi**
	4	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**
300	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90
275	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73
250	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56
225	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38
200	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19
175	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98
150	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76
125	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52
100	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25

If the leakage from a test section is greater than permitted under this specification, the Contractor shall locate and repair the defective joints, pipes, or appurtenances. The pressure test shall then be repeated until leakage does not exceed the permissible amount.

4.5.8.2.2. PURIFICATION TEST. Purification testing shall be in accordance with the latest edition of AWWA C651. After a new main or fire line has passed the pressure/leakage test, and after it has been flushed as detailed in 4.5.3.5.1., but before the new main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main or fire line by the Utilities Inspector. At least one set of samples shall be collected from every 1,200 feet (366 m) of the new water main, plus one set from the end of the line and at least one set from each branch.

If initial disinfection fails to produce satisfactory bacteriological samples, the main may be reflushed in accordance with 4.5.3.5.1. and new samples taken. If new samples show the presence of coliform organisms, the main shall be rechlorinated.

4.5.8.2.2.1. RECHLORINATION PROCEDURES. Water mains shall be rechlorinated in accordance with the latest edition of AWWA C651 utilizing procedures approved in advance by the Utilities Engineer. 16 hours after flushing is completed, new samples will be taken for testing in accordance with 4.5.8.2.2.

4.5.8.2.3. FIRE LINE MAIN TESTING. The fire line main from the connection valve on the water supply main to the control valve inside the building shall be pressure tested in accordance with NFPA 13 chapter 10 and as follows. The pipe shall be sterilized, filled, and flushed (see 4.5.3.5.1.), and then the double check detector assembly (DCDA) is installed in the pipe. The DCDA and pipe must be hydrostatic pressure tested together at 200 psi for 2 hours the same as all water mains (see 4.5.8.2.1.1.). If the system is taken apart to add components it must be retested. After the fire line main passes the pressure test it shall follow the same purification test as all water mains (see section 4.5.8.2.2.).

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NOTIFICATION

The Contractor will be responsible for contacting the following offices or persons on the list below at least 48 HOURS PRIOR to beginning work (including delivery of materials). Street closures require SEVEN DAYS PRIOR NOTIFICATION.

OFFICE or PERSON	PHONE	FAX
____Mayor's Office	349-3406	349-3455
____Council Office	349-3409	349-3570
____Public Works	349-3411	349-3520
____City Engineer	349-3417	349-3520
____City Utilities Dept..	339-1444	331-5962
____Bloomington Police Dept.	349-4477	349-3353
____I.U. Police Dept.	855-4111	855-1496
____Monroe County Sheriff	349-2534	349-2828
____Bloomington Fire Dept.	332-9763	332-9764
____Bloomington Twp. Fire Dept.	339-1115	339-1120
____Perry Twp. Fire Dept.	334-7026	336-1166
____Van Buren Twp. Fire Dept.	825-9500	825-9700
____IU Health Bloomington Emergency Med.Transport	353-9308	353-9204
____Monroe Hospital Ambulance Service	825-0911	825-0766
____State Highway Dept.	332-1411	332-3368
____Ellettsville Fire Dept.	876-4819	876-8322
____Monroe County Highway Dept.	349-2555	349-2837
____MCCSC Buses	330-7719	330-7791
____I.U. President	855-4613	855-9586
____I.U. Utilities	855-5013	855-8207
____I.U. Engineer	855-7030	855-8207
____I.U. Campus Bus	855-8384	856-5859
____Bloomington Transit	332-5688	332-3660
____Herald-Times	332-4401	331-4383
____Indiana Daily Student	855-0763	855-8009
____Cable TV	332-9486	330-0107
____WTTS/WGCL	332-3366	331-4570
____WBWB	336-8000	336-7000
____WFIU	855-1357	855-5600
____IUPPS* (utility line locations)	811 or 1-800-382-5544	

* The Indiana Underground Facilities Damage Prevention Act requires all persons excavating to call Indiana Underground Plant Protection Services (IUPPS) at least two full working days before digging and request locations of all underground utilities in the work area. This is an Indiana law.

EMERGENCY:

Police, Fire, and Ambulance: 911
Duke Energy: 1-800-521-2232
Vectren: 1-800-227-1376
AT&T: 1-800-868-9696
Smithville Telephone: 1-812-876-2211
Cable T.V. 1-812-332-9486

SECTIONAL VIEW
SANITARY MANHOLE

MANHOLE CONSTRUCTION
Manhole shall be 4500 p.s.i. concrete reinforced with 10 x 10 – W10 x W10 welded wire fabric.
Wall and base thickness shall be a minimum of 5".

PRECAST CONCRETE RISER RINGS
No more than 12" of rings may be used to adjust the frame and cover to grade.

PRECAST ECCENTRIC TOP SECTION
Precast flat tops shall be used when the manhole is less than than 6' deep. See detail below.

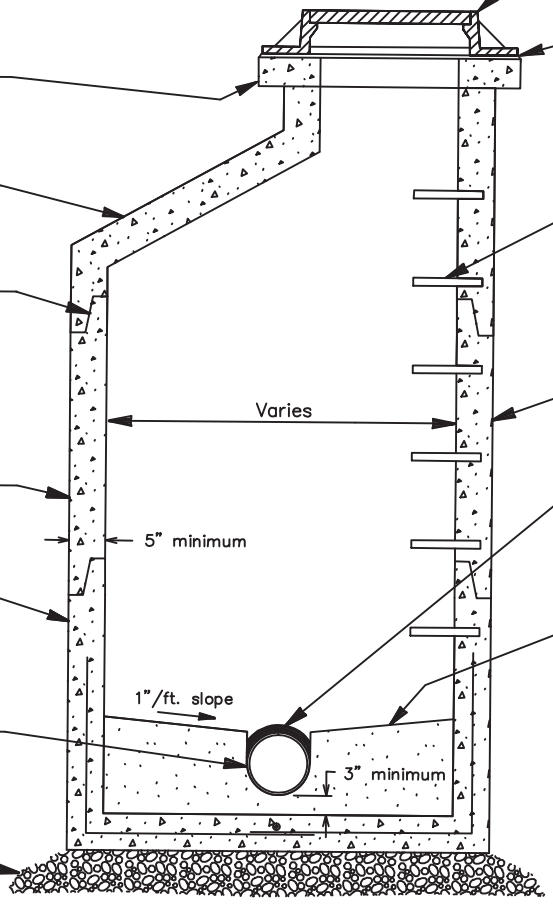
JOINT SEALING
Joints between all manhole sections shall be sealed with an approved rubber gasket. Outside joints shall be sealed with a Trowelable Butyl Rubber.

PRECAST MANHOLE BARREL SECTION

COMBINED PRECAST MANHOLE BASE and BARREL SECTION
The base and first barrel section shall be monolithic and additionally reinforced with 4 – #4 bar els 60" long.

CAST or CORE DRILLED OPENINGS
All openings shall be at least 3" from the top of the base part of the precast section.

BEDDING
4" of #11 stone on soil or
6" of #11 stone on rock



MANHOLE FRAME AND COVER
Frame shall be East Jordan Iron Works casting no. 1020, 1022 or an approved equivalent.
Cover shall be East Jordan Iron Works casting no. 1020A or an approved equivalent. "SANITARY SEWER" shall be cast in each cover.
All castings shall be coated.
Frame shall be set on Butyl Rubber Rope.

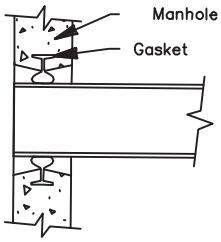
MANHOLE STEPS
Shall be constructed of Fiberglas reinforced polypropolene.
Install with nonshrink mortar or epoxy grout 12" to 16" apart and at a location allowing access to the table.

MANHOLE SEALANT
See 4.4.2.2.6 of CBU Specifications.

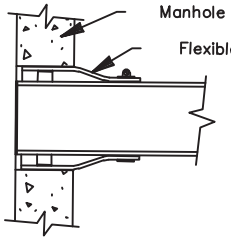
GASKETS and BOOTS
Pipe to manhole connections shall be flexible boot or cast in place gasket. See special detail below and 4.4.2.2.5 of CBU Specifications.

TROUGH and TABLE
Construct with concrete brick, and non–shrink mortar.
Troughs shall be smooth with a semicircular bottom and extend upward to the height of the pipe crown. The table shall be smooth and slope toward the trough at 1"/ft.

PIPE CONNECTIONS TO MANHOLE

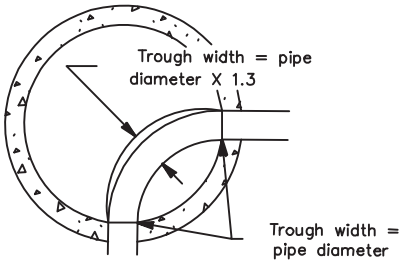


Cast in place gasket



Flexible boot connector

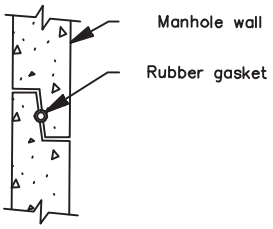
TROUGH CONSTRUCTION



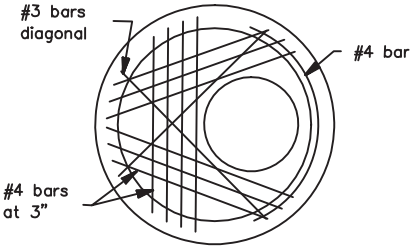
MINIMUM PIPE INVERT DROP THROUGH MANHOLE

TROUGH DEFLECTION	MIN. DROP (Ft.)
0° – 22°	.10
23° – 45°	.20
46° – 90°	.30

PRECAST SECTION JOINT



FLAT TOP CONSTRUCTION



City of Bloomington Utilities Engineering Department

NO SCALE
2/21/94
by: M. Hicks

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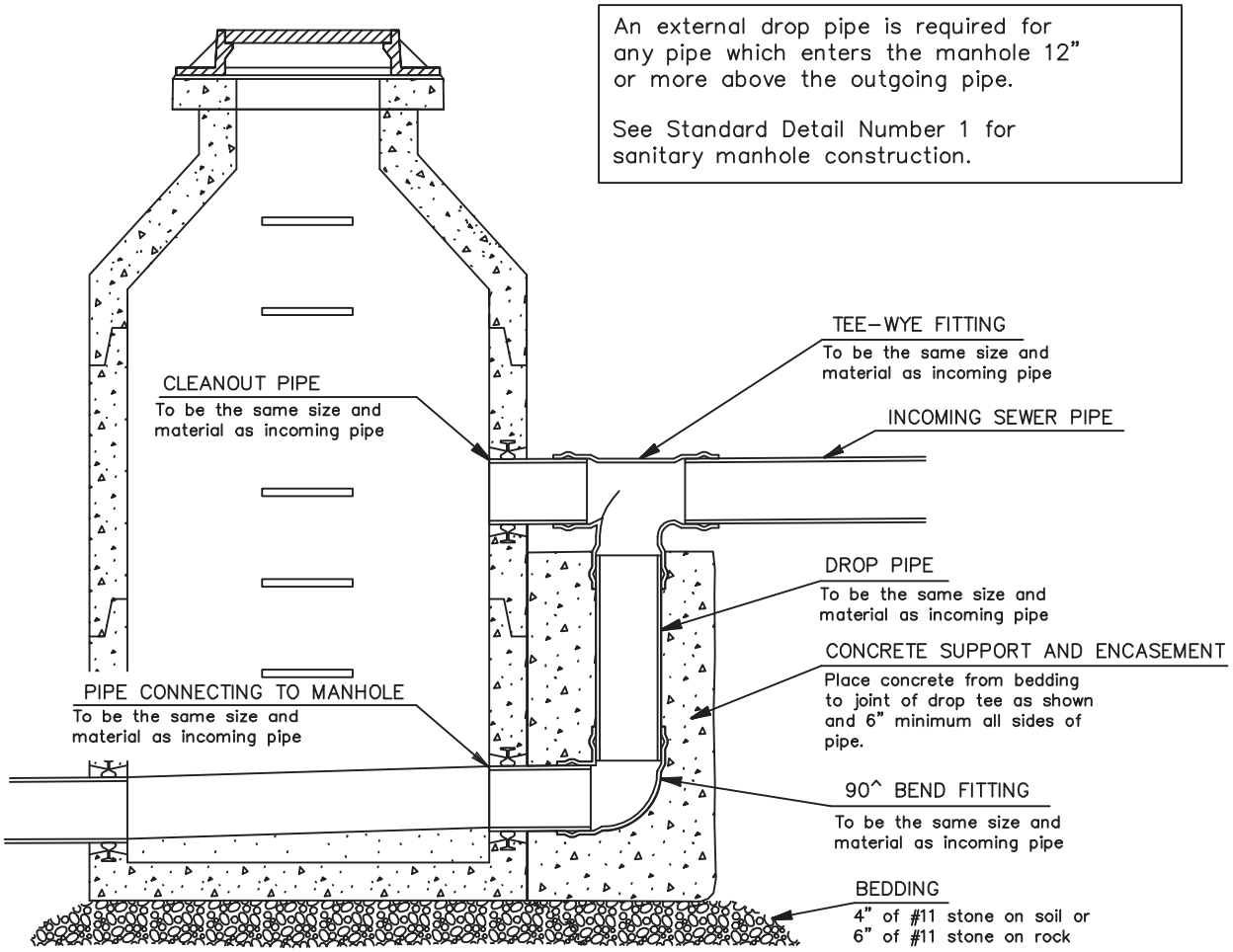
REVISED 02/18/08 T.A.

STANDARD SANITARY MANHOLE

STANDARD DETAIL NUMBER 1

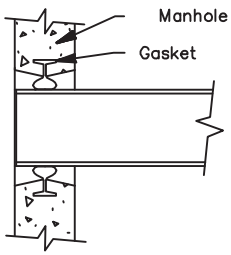
An external drop pipe is required for any pipe which enters the manhole 12" or more above the outgoing pipe.

See Standard Detail Number 1 for sanitary manhole construction.

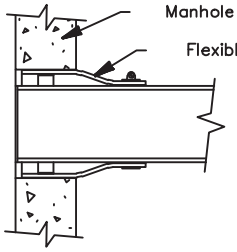


SECTIONAL VIEW

PIPE CONNECTIONS TO MANHOLE



Cast in place gasket



Flexible boot connector

MINIMUM PIPE INVERT DROP THROUGH MANHOLE

TROUGH DEFLECTION	MIN. DROP (Ft.)
0° – 22°	.10
23° – 45°	.20
46° – 90°	.30

City of Bloomington Utilities Engineering Department

NO SCALE
10/5/98
by: M. Hicks

Drawing File: I:\COMMON\STANDARD DRAWINGS\STD2.DGN
REVISED 02/18/08 T.A.

EXTERNAL DROP PIPE DETAIL FOR SANITARY MANHOLE

STANDARD DETAIL NUMBER 2

PRECAST CONCRETE RISER RINGS

A minimum 2" of riser ring shall be installed in areas to be sodded or seeded. No more than 12" of rings may be used to adjust the frame and cover to grade.

PRECAST TOP SECTION

A precast flat top shall be used when pipe depth is less than 6'. An eccentric top shall be used when pipe depth is 6' or greater.

JOINT SEALING

Joints between all manhole sections shall be sealed with a Rubber Gasket or Butyl Rubber Rope..

PRECAST MANHOLE BARREL SECTION(S)

The minimum total height of barrel sections is 5'–0".

CAST or CORE DRILLED OPENINGS

All openings shall be at least 4" from the top of the base.

GASKETS and BOOTS

Pipe to manhole connections shall be flexible boot or cast in place gasket. See special detail below and 4.4.2.2.5 of CBU Specifications.

MANHOLE DRAIN

Drain shall be a 1' x 1' opening through the concrete base and filled with #11 stone.

MANHOLE BASE

The base shall be precast or cast–in –place. A cast–in–place base must form into the barrel section joint.

MANHOLE CONSTRUCTION

Manhole shall be 4500 p.s.i. concrete reinforced with 10 x 10 – W10 x W10 welded wire fabric.
Wall and base thickness shall be a minimum of 5".

MANHOLE FRAME AND COVER

Frame shall be East Jordan Iron Works casting no. 1020, 1022 or an approved equivalent.
Cover shall be East Jordan Iron Works casting no. 1020A or an approved equivalent. "WATER" or "SEWER" shall be cast in each cover (as applicable).
All castings shall be coated.
Frame shall be set on Butyl Rubber Rope.

MANHOLE STEPS

Shall be constructed of Fiberglas reinforced polypropolene.
Install with nonshrink mortar or epoxy grout 12" or 16" apart and at a location allowing access to the table.

AIR VALVE

The air release, air vacumm, or combination air valve shall be sized according to system capacity and operating pressure.
The air valve shall be installed upright from a tap at the top of the water main.

CORPORATION STOP BALL VALVE

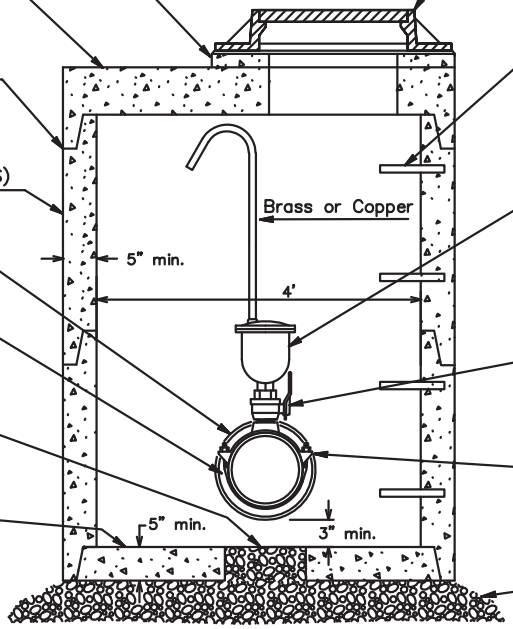
The corporation stop ball valve shall be sized to match the inlet size of the air valve. The valve shall have a lever for operation.

TAPPING SADDLE AND TAP

The tap and tapping saddle shall be sized to match the inlet size of the air valve. The tap shall be made at the top of the water main.

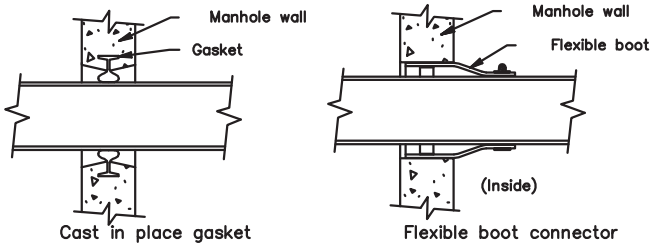
BEDDING

4" of #11 stone on soil or
6" of #11 stone on rock



SECTIONAL VIEW

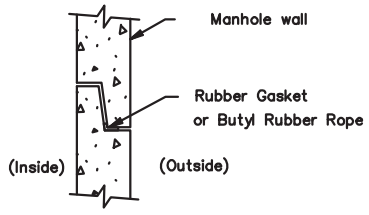
PIPE INTERSECTIONS WITH MANHOLE



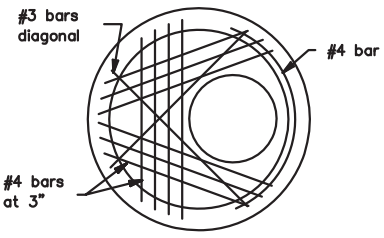
Cast in place gasket

Flexible boot connector

PRECAST SECTION JOINT

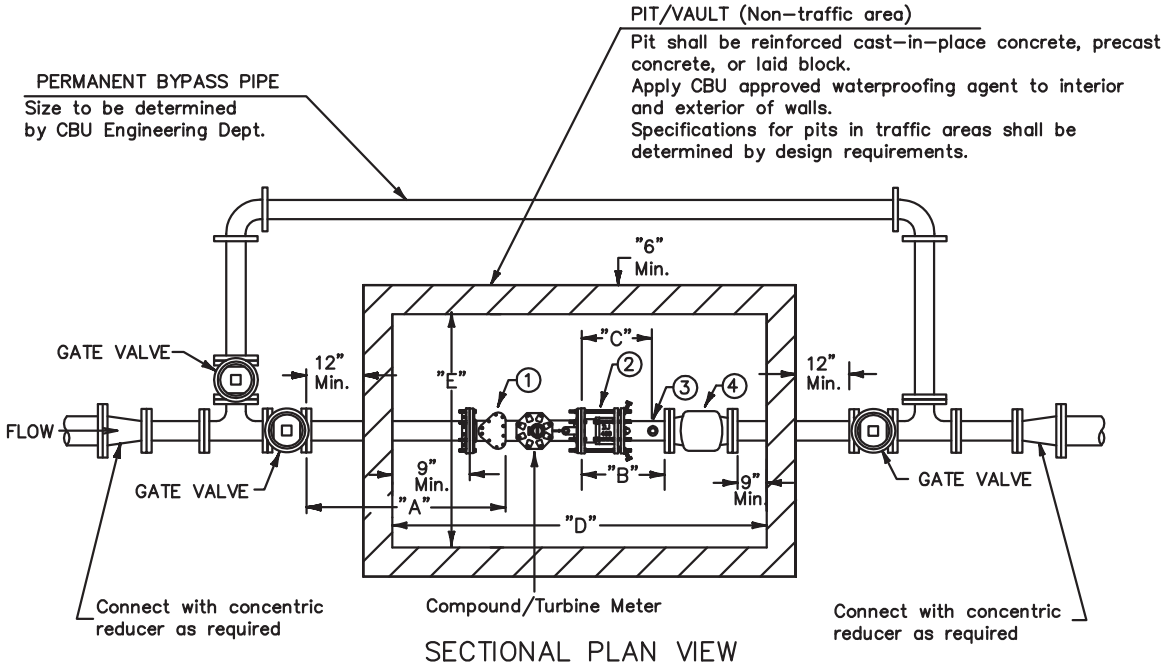


FLAT TOP CONSTRUCTION

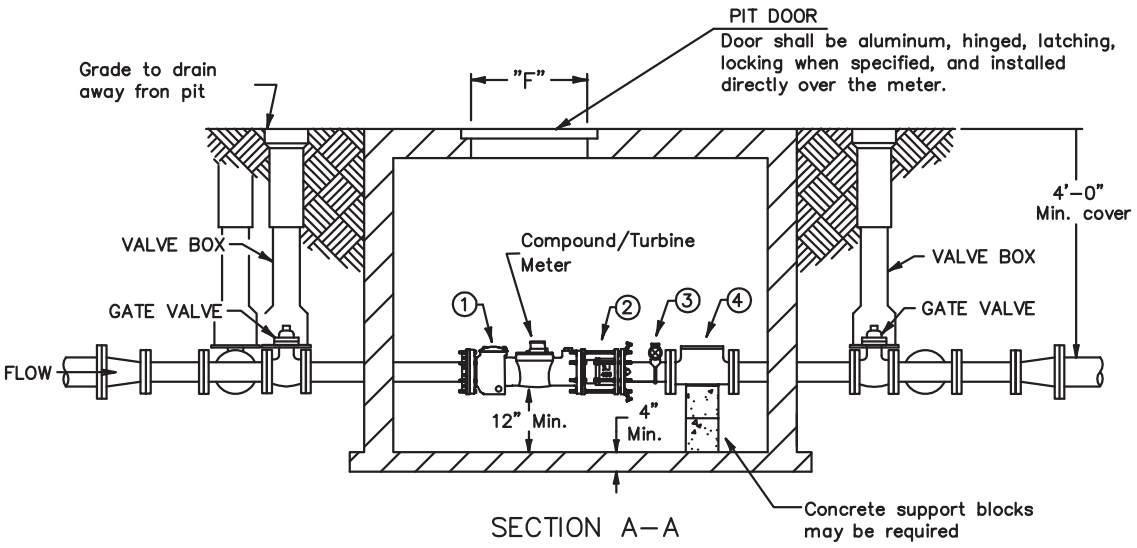


City of Bloomington Utilities Engineering Department		
NO SCALE 2/21/94 by: M. Hicks	Drawing File: I:\COMMON\STANDARD DRAWINGS\STD3.DGN REVISED 02/16/11 G.N.	STANDARD AIR VALVE VAULT 12" OR SMALLER PIPE

STANDARD DETAIL NUMBER 3



SECTIONAL PLAN VIEW



SECTION A-A

LEGEND

1. STRAINER, Plate Type Only!
2. Dismantling Joint, Romac DJ400 or DJ405 (Set at Nominal Length)
3. 2" Test Tap, With Full Port Corporation Stop
4. Swing Arm Check Valve

NOTES

All construction and materials shall meet CBU specifications.

* If an 8" Rockwell manifold meter is used add 33".

** Use of any other type of strainer must be approved by CBU Engineering.

METER SIZE	"A" Min. length straight pipe before meter (Includes strainer)	"B" Min. length straight pipe after meter	"C" 2" test plug min. distance after meter	"D" Pit minimum inside length	"E" Pit minimum inside width	"F" Min. pit door size
3"	21"	15"	9"	63"	48"	36"x36"
4"	28"	20"	12"	78"	48"	36"x36"
6"	42"	30"	18"	91"	60"	36"x48"
8"	56"	40"	24"	124" *	96"	48"x48"
10"	70"	50"	30"	150"	96"	48"x48"

City of Bloomington Utilities Engineering Department

NO SCALE
2/21/94
by: M. Hicks

Drawing File: I:\COMMON\STANDARD DRAWINGS\STD4.DGN
Revised: 1/27/2011 G.N.

STANDARD METER PIT DETAIL
3"-10" Meter Installation

STANDARD DETAIL NUMBER 4

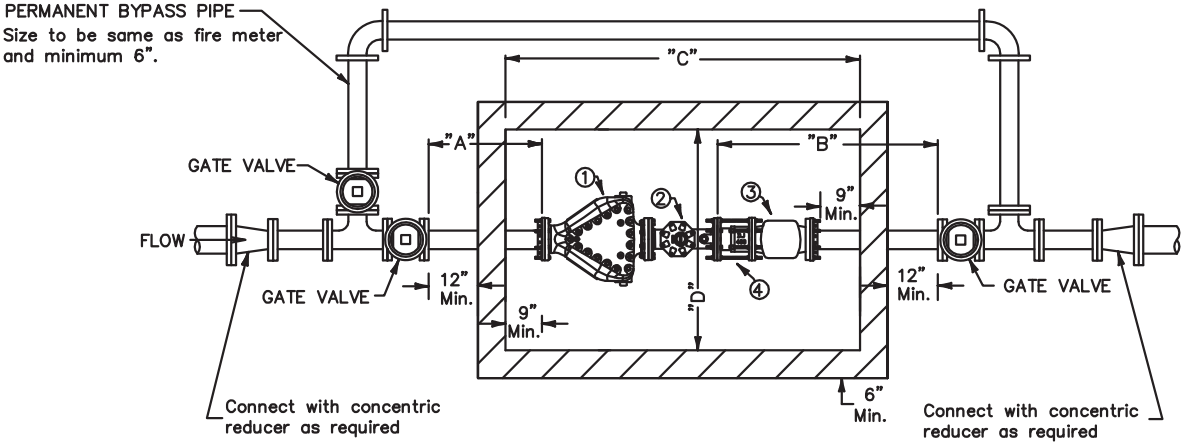
NOTES

1. All materials and construction shall meet CBU Construction Specifications.
2. All meter assemblies shall be specified by City of Bloomington Utilities (CBU).
3. A compact dual meter assembly is a factory assembled unit and tested for accuracy as a unit by the manufacturer.
4. Each meter shall be equipped with a pit door mounted electronic device for use with a touch reading system.
5. All fittings such as bends and tees shall be properly restrained.

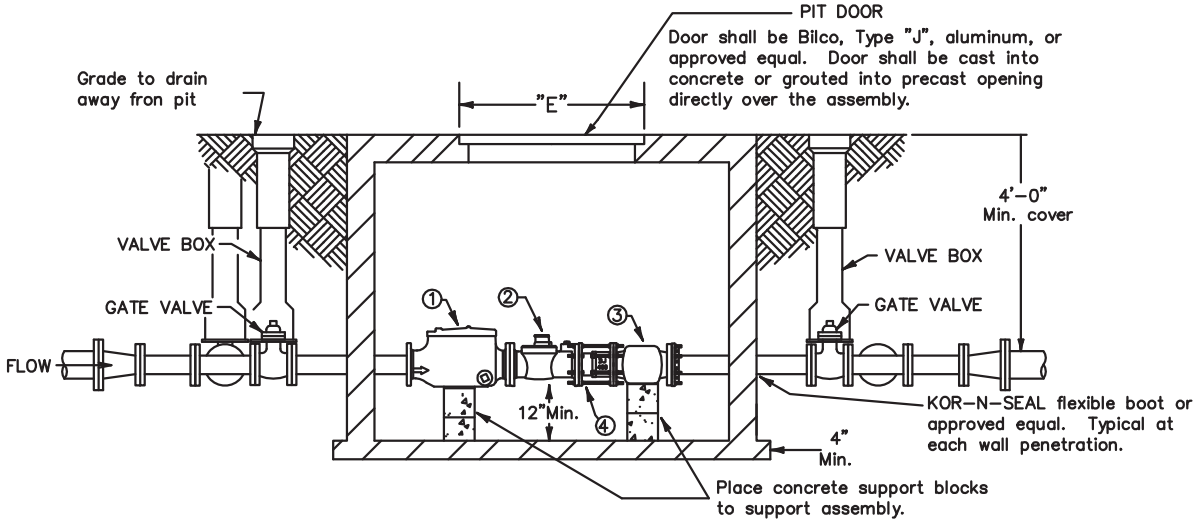
PIT/VAULT (Non-traffic area)
Pit shall be reinforced cast-in-place concrete, precast concrete, or laid block.
Apply CBU approved waterproofing agent to interior and exterior of walls.
Specifications for pits in traffic areas shall be determined by design requirements.
Refer to CBU Specifications, Section 4.5.3.3 for additional information.

LEGEND

① UL/FM APPROVED STRAINER
② METER See Notes at left
③ CHECK VALVE
④ Dismantling Joint
Romac DJ400 or DJ405.
(Set at Nominal Length)



SECTIONAL PLAN VIEW



FIRE METER SIZE	"A" Min. length straight pipe before compact assembly	"B" Min. length straight pipe after compact assembly	"C" Pit minimum inside length	"D" Pit minimum inside width	"E" Min. pit door size
4"	24"	30"	70"	60"	36"x36"
6"	30"	30"	84"	66"	36"x36"
8"	40"	30"	T.B.D.	70"	48"x48"
10"	50"	30"	T.B.D.	74"	48"x48"

City of Bloomington Utilities Engineering Department

NO SCALE
REVISED 01/28/11

Drawing File: I:\COMMON\STANDARD DETAIL DRAWINGS/STD6.DGN

DUAL FIRE/DOMESTIC METER ASSEMBLY 4"-10" Meter Installation

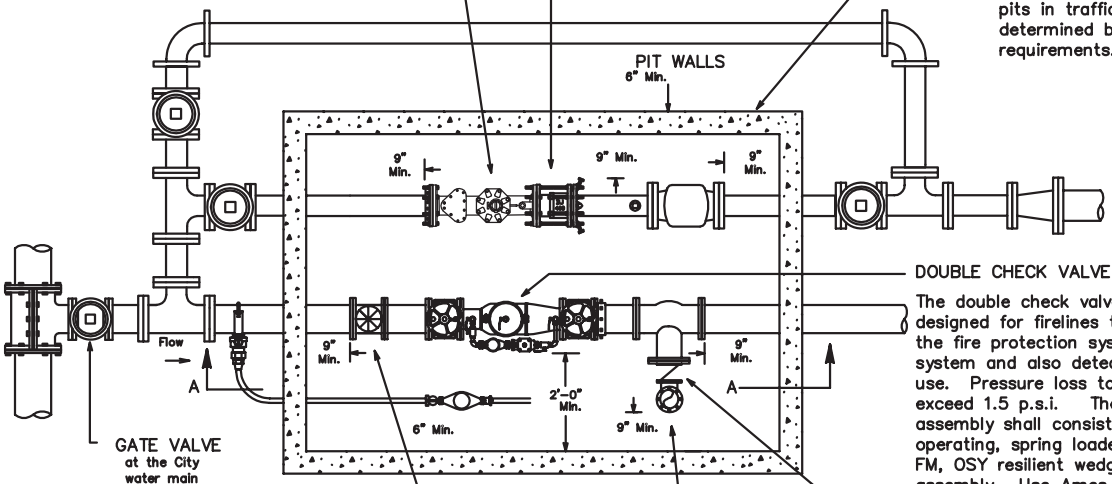
STANDARD DETAIL NUMBER 6

IMPORTANT NOTE
If the detector check valve is greater than 50 feet from the City water main, a check valve in a pit shall be required at the City main.

DISMANTLING JOINT
Romac Industries
DJ 400 or DJ405
(Set at Nominal Length)

PIT/VAULT (Non-traffic area)
Pit shall be reinforced cast-in-place concrete, precast concrete, or laid block. Apply CBU approved waterproofing agent to interior and exterior of walls. Specifications for pits in traffic areas shall be determined by design requirements.

WATER METER
For more Water Meter Construction Specifications see "Standard Detail No. 4"



DOUBLE CHECK VALVE DETECTOR ASSEMBLY
The double check valve detector assembly shall be designed for firelines to prevent backflow from the fire protection system to the potable water system and also detect leakage or unauthorized use. Pressure loss to open the valve shall not exceed 1.5 p.s.i. The double check detector assembly shall consist of two independently operating, spring loaded check valves, two UL, FM, OSY resilient wedge gate valves, and bypass assembly. Use Ames 3000SS or approved equal. Connect to piping with a flange adapter coupling.

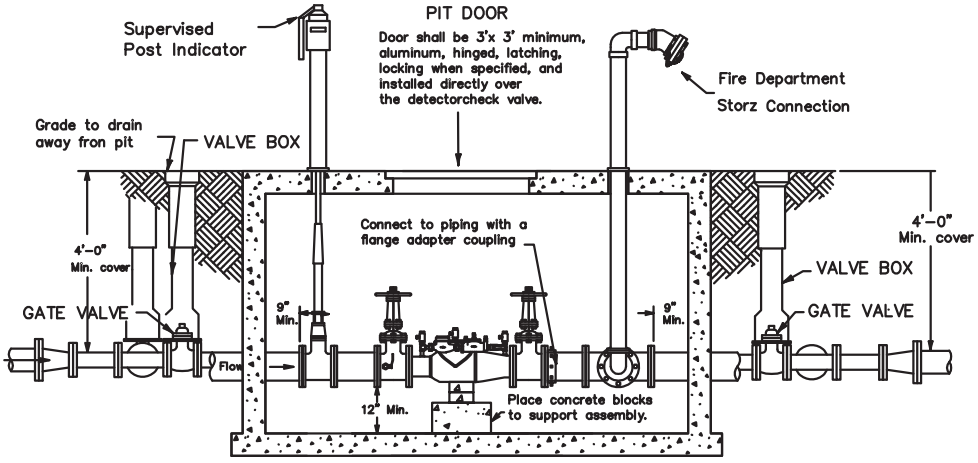
OPTIONAL DOMESTIC SERVICE
Shall be tapped before the dector check valve. all service lines shall be type "K" copper with flare type joints. All fittings shall conform to ANSI/AWWA C800 and 4.4.4.1.4.1 of CBU construction specifications.

O, S & Y Valve with supervised Post Indicator

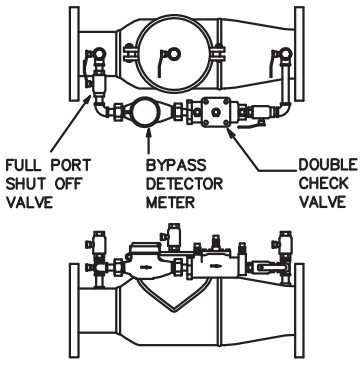
4" Extension up to Fire Department Storz Connection

Check Valve with Ball Drip Valve To Floor Drain

SECTIONAL PLAN VIEW



SECTION A-A



BYPASS ASSEMBLY
Bypass Detector Meter to read gallons

NO SCALE

City of Bloomington Utilities Engineering Department	
G.A.N REVISED 01/31/2011	Drawing File: I:\COMMON\STANDARD DRAWINGS\STD7A.dgn

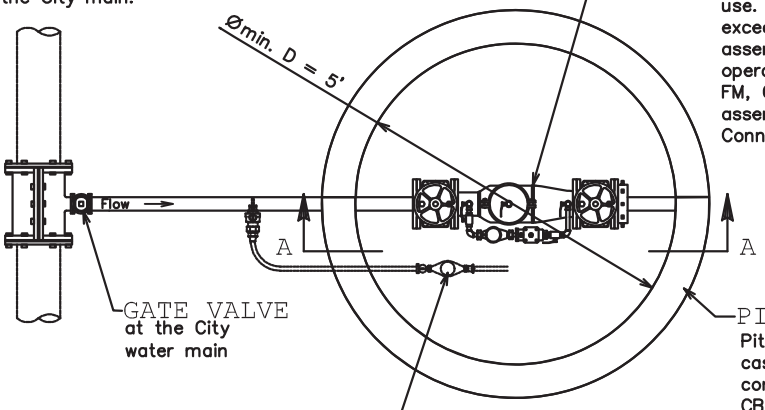
STANDARD FIRE LINE DOUBLE CHECK VALVE 3" OR LARGER DOMESTIC METER INSTALLATION DETAIL

STANDARD DETAIL NUMBER 7a

SECTIONAL PLAN VIEW

IMPORTANT NOTE

If the detector check valve is greater than 50 feet from the City water main, a check valve in a pit shall be required at the City main.



DOUBLE CHECK VALVE DETECTOR ASSEMBLY

The double check valve detector assembly shall be designed for firelines to prevent backflow from the fire protection system to the potable water system and also detect leakage or unauthorized use. Pressure loss to open the valve shall not exceed 1.5 p.s.i. The double check detector assembly shall consist of two independently operating, spring loaded check valves, two UL, FM, OSY resilient wedge gate valves, and bypass assembly. Use Ames 3000SS or approved equal. Connect to piping with a flange adapter coupling.

PIT/VAULT (Non-traffic area)

Pit shall be reinforced cast–in–place concrete, precast concrete, or laid block. Apply CBU approved waterproofing agent to interior and exterior of walls. Specifications for pits in traffic areas shall be determined by design requirements.

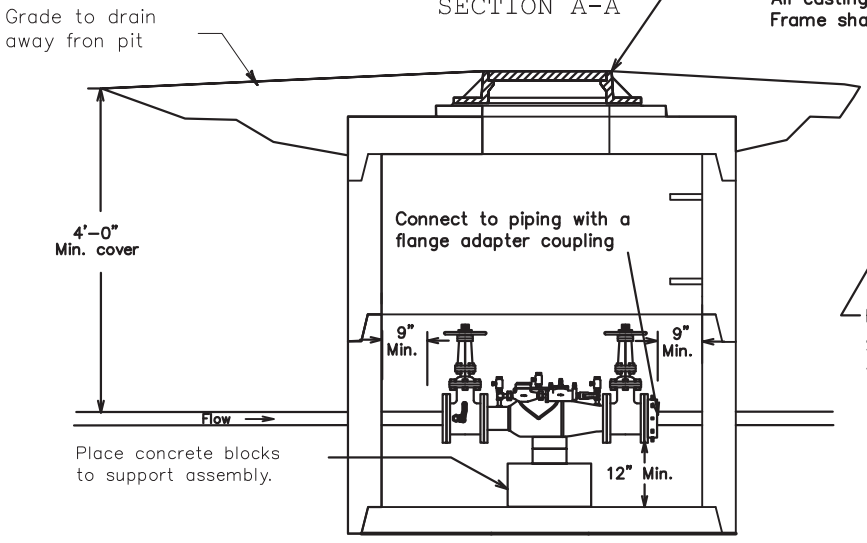
OPTIONAL DOMESTIC SERVICE tapped on fire line

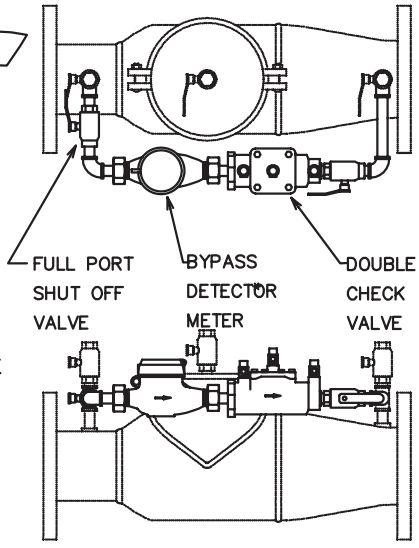
shall be before the detector check valve. All service lines shall be type "K" copper with flair type joints. All fittings shall conform to ANSI/AWWA C800 and 4.4.4.1.4.1 of CBU Construction Specifications. Install in a yoke with an angle yoke valve each side of meter. Install 24" to 36" from the bottom of the door.

Frame & LID

Frame shall be East Jordan Iron works casting # 1020, 1022 or an approved equivalent.
Cover shall be East Jordan Iron Works casting # 1020A or an approved equivalent.
"WATER" shall be cast in each cover.
All castings shall be coated.
Frame shall be set on Butyl Rubber Rope.

SECTION A-A





BYPASS ASSEMBLY

* Bypass Detector Meter to read gallons

LAST REVISION 02 / 15 / 11 by G.N.

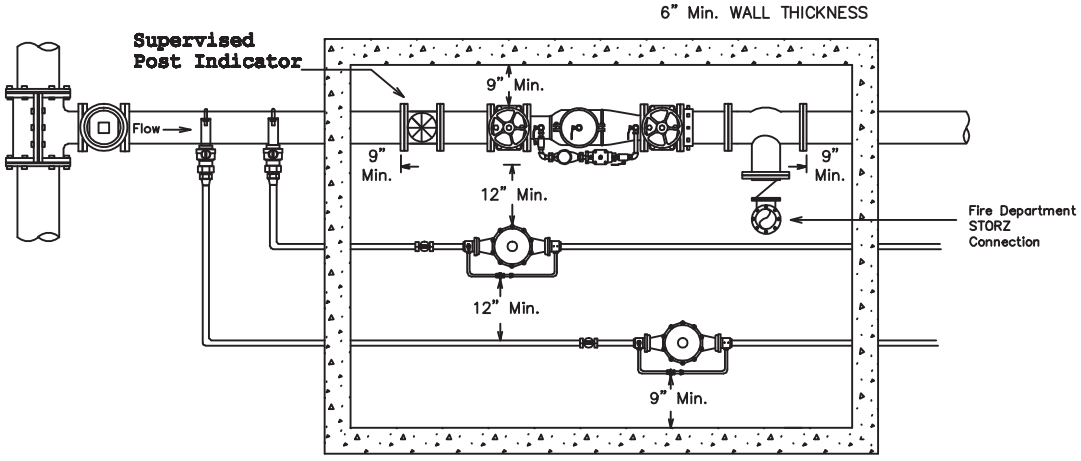
City of Bloomington Utilities Engineering Department

NO SCALE
7/28/04
By: B.Kiele–Dunsche

Drawing File: P:\ENGINEER\DRAW\STD7.HGL
Word File: P:\RULES\STD7–2/97.DOC

STANDARD 2 1/2" FIRE LINE DOUBLE CHECK VALVE / DETECTOR METER INSTALLATION DETAIL

STANDARD DETAIL NUMBER 7b



4"–6" DOUBLE CHECK VALVE VAULT WITH DOMESTIC METERS

4"–6" AMES 3000SS WITH ONE 2" METER SETTER
"MINIMUM INSIDE VAULT DIMENSIONS" 10'L X 5'W

4"–6" AMES 3000SS WITH TWO 2" METER SETTERS
"MINIMUM INSIDE VAULT DIMENSIONS" 10'L X 7'W

VAULT DOOR MINIMUM 3'X3'

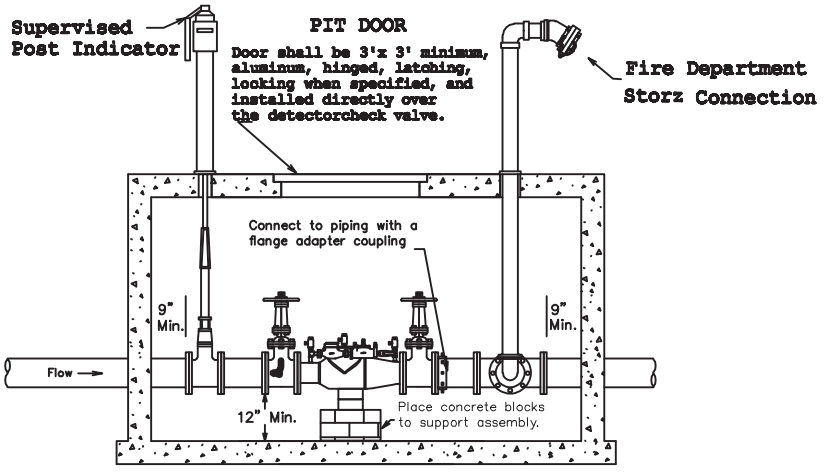
8"–12" DOUBLE CHECK VALVE VAULT WITH DOMESTIC METERS

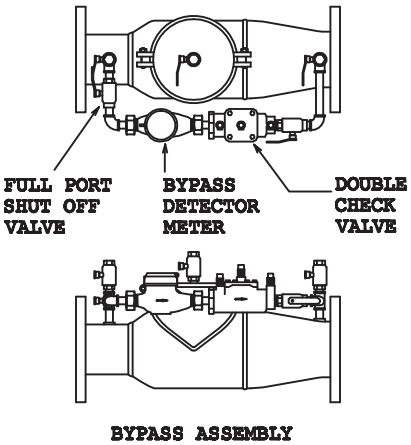
8"–12" AMES 3000SS WITH ONE 2" METER SETTER
"MINIMUM INSIDE VAULT DIMENSIONS" 11'L X 5'W

8"–12" AMES 3000SS WITH TWO 2" METER SETTERS
"MINIMUM INSIDE VAULT DIMENSIONS" 11'L X 7'W

VAULT DOOR MINIMUM 4'X4'

SECTIONAL PLAN VIEW





BYPASS ASSEMBLY

Bypass Detector Meter to read gallons

NO SCALE

City of Bloomington Utilities Engineering Department	
T. AXSOM REVISED 06/19/09	Drawing File: I:\COMMON\STANDARD DRAWINGS\STD7C.dgn

STANDARD FIRE LINE DOUBLE CHECK VALVE 2" OR SMALLER DOMESTIC METER INSTALLATION DETAIL

STANDARD DETAIL NUMBER 7C

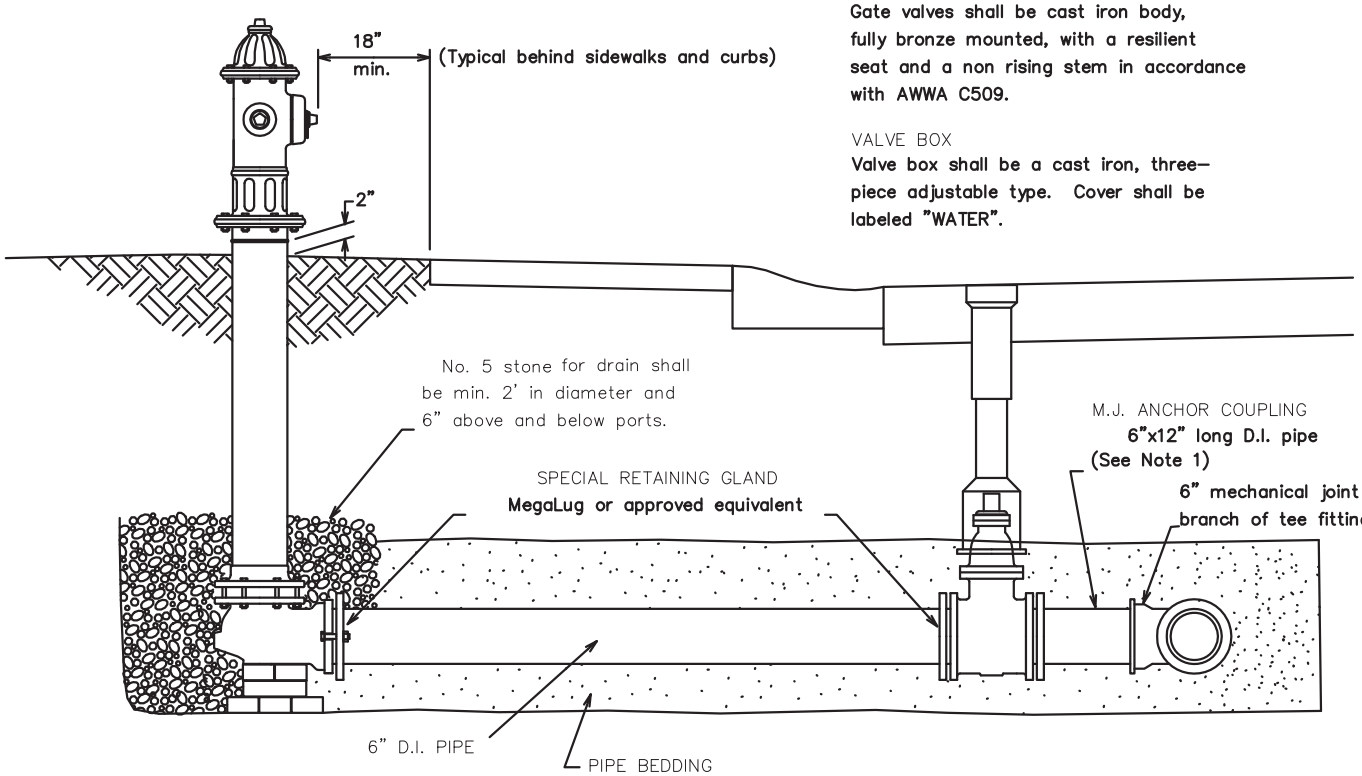
NOTES

1. For connection to existing water mains, a 6" tapping valve and saddle shall be used in place of the gate valve and anchor coupling.

FIRE HYDRANT

Fire hydrants shall conform to ANSI/AWWA C502 and must be Kennedy Guardian model K81 or Mueller Super Centurion 200 (catalog no. A–423) or Waterous Pacer Classic. These are dry–barrel type firehydrants with a 5" main valve opening, two hose nozzles and one pumper nozzle. Hydrants shall have a mechanical joint type connection and shall be painted according to 4.4.4.4. FIRE HYDRANTS.

Install fire hydrant at a minimum of 2' from structures or obstructions and set the hydrant bury line 2" above finished grade. The pumper nozzle must face the street.



6" M.J. GATE VALVE (See Note 1)
Gate valves shall be cast iron body, fully bronze mounted, with a resilient seat and a non rising stem in accordance with AWWA C509.

VALVE BOX
Valve box shall be a cast iron, three–piece adjustable type. Cover shall be labeled "WATER".

PIPE BEDDING
4" of no. 11 stone in soil or
6" of no. 11 stone in rock

BACKFILL
No. 11 stone from bedding to 1' over top of pipe. Compacted No. 53 stone beneath and within 5' of pavement or clean native soil in other areas.

REVISED 02/15/2011 G.N.
REVISED 02/23/2010 T.L.
REVISED 02/08/2008 T.A.

City of Bloomington Utilities Engineering Department

NO SCALE
9/1/94
M. Hicks

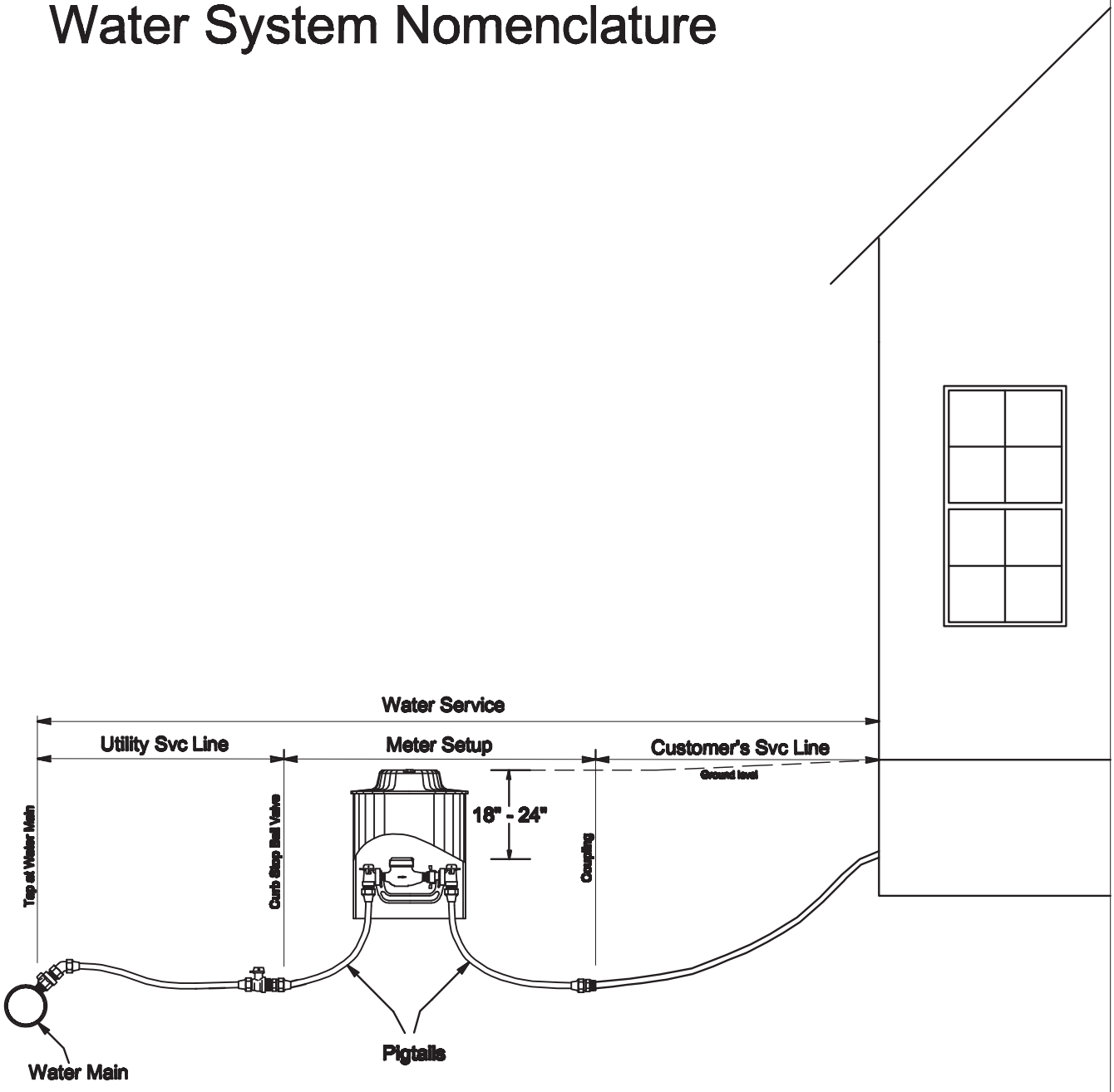
Drawing File: I:\COMMON\STANDARD DRAWINGS\STD8.DGN

STANDARD FIRE HYDRANT AND CONNECTION DETAIL

STANDARD DETAIL NUMBER 8

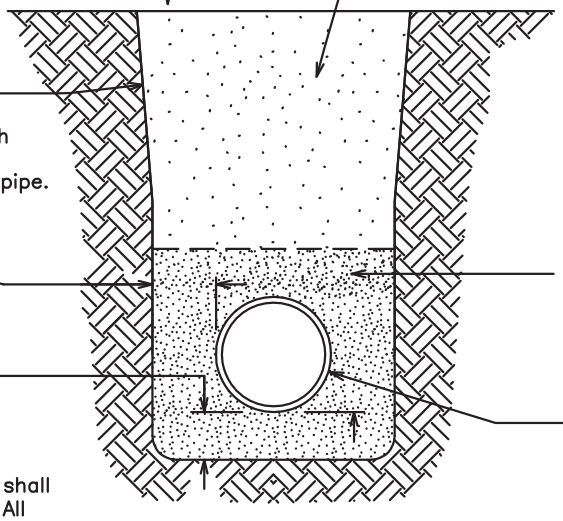
City of Bloomington Utilities
Typical Standard for

Water System Nomenclature



City of Bloomington Utilities Engineering Department			
NO SCALE 03/30/06 N. Axsom	Drawing File: I:Common\Standard Drawing\std10.dwg	*WATER SYSTEM NOMENCLATURE*	*STANDARD DETAIL NUMBER* 10

TYPICAL TRENCH SECTION



SECONDARY BACKFILL
Under or within 5' of pavement backfill shall be in accordance with the agency issuing the permit. If no permit is required full depth #53 stone compacted in six inch (6") lifts must be used. In unimproved areas backfill may be the same materials as excavated if it is good native material, but may contain no stone larger than six inches (6") in its greatest dimension.

Repair surface as indicated in the Special Conditions.

TRENCH BANKS
Where necessary, banks may be cut back on slopes which shall not extend lower than 12 inches above the top of pipe.

TRENCH WALL
Shall be 7" minimum from the pipe each side.

PIPE BEDDING
4" No. 11 stone on soil
6" No. 11 stone on rock

Bedding shall conform to ASTMD–2321, Class 1, and shall be no. 11 crushed stone. All over–excavation shall be filled with no. 11 crushed stone or Class D concrete.

PRIMARY BACKFILL
Backfill to 12" above top of pipe with no.11 stone.

PVC PIPE
Shovel cut and compact backfill beneath the haunch area of the pipe.

TRENCH SAFETY SYSTEMS
All trench work shall be in compliance with OSHA Part 26 of the Code of Federal Regulations.

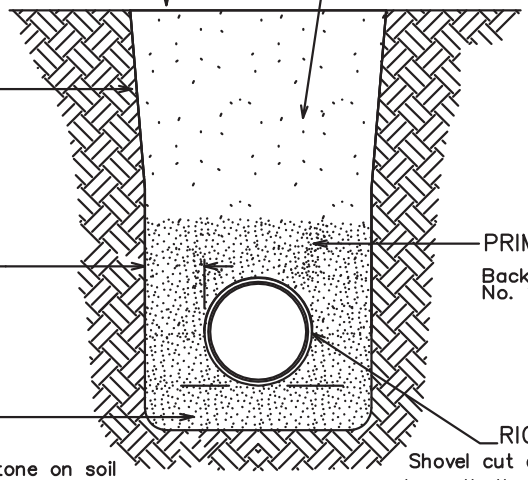
EXCAVATION DEPTH
When pipe grades are not defined on the contract drawings, maintain a minimum of 48 inches of cover over the top of the pipe except as otherwise ordered by the Engineer.

Revised 2/11/2011 G.N.
Revised 2/13/2008 T.A.

City of Bloomington Utilities Engineering Department		
NO SCALE 10/5/98 M. Hicks	Drawing File: I:\COMMON\STANDARD DRAWINGS\STD11.DGN	**BEDDING AND BACKFILL DETAIL FOR PVC AND HDPE PIPE**

STANDARD DETAIL NUMBER **11**

TYPICAL TRENCH SECTION



SECONDARY BACKFILL

Under, or within 5' of pavement, backfill shall be in accordance with the agency issuing the permit. If no permit is required, full depth #53 stone compacted in six inch (6") lifts must be used. In unimproved areas, backfill may be the same materials as excavated if it is good native material, but may contain no stone larger than six inches (6") in its greatest dimension.

Repair surface as indicated in the Special Conditions.

TRENCH BANKS

Where necessary, banks may be cut back on slopes which shall not extend lower than 12 inches above the top of pipe.

TRENCH WALL

Shall be 7" minimum from the pipe each side.

PRIMARY BACKFILL

Backfill to extend 12" above pipe with No. 11 or No. 12 stone.

PIPE BEDDING

4" No. 11 stone or no. 12 stone on soil
6" No. 11 stone or no. 12 stone on rock
Bedding shall conform to ASTMD–2321, Class 1, and shall be no. 11 or 12 crushed stone. All over–excavation shall be filled with crushed stone or class D concrete

RIGID PIPE

Shovel cut and compact backfill beneath the haunch area of the pipe.

EXCAVATION DEPTH

When pipe grades are not defined on the contract drawings, maintain a minimum of 48 inches of cover over the top of the pipe except as otherwise ordered by the Engineer.

TRENCH SAFETY SYSTEMS

All trench work shall be in compliance with OSHA Part 26 of the Code of Federal Regulations.

Revised 2/15/2011 G.N.
Revised 2/13/2008 T.A.

City of Bloomington Utilities Engineering Department

NO SCALE
02/01/08

Drawing File:
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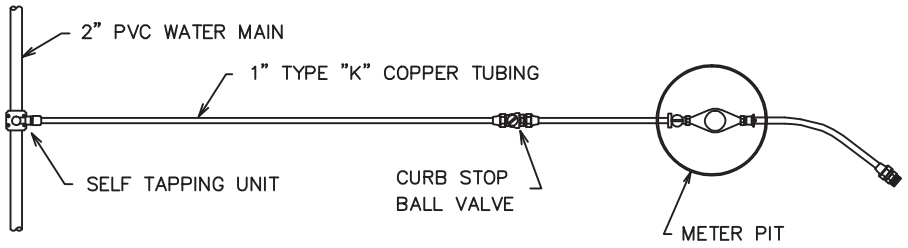
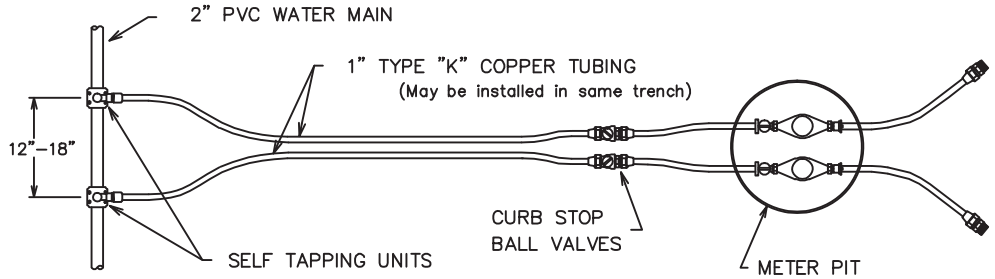
BEDDING AND BACKFILL DETAIL FOR ALL RIGID PIPES

STANDARD DETAIL NUMBER 12

WATER SERVICE FROM A 2" PVC WATER MAIN TO A SINGLE METER SETUP

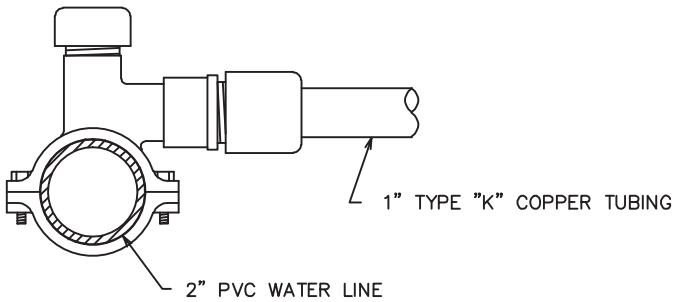


WATER SERVICE FROM A 2" PVC WATER MAIN TO A DOUBLE METER SETUP



SELF TAPPING UNIT WITH COMPRESSION CONNECTOR OUTLET
(2" MAIN X 1" COPPER TUBING STYLE)

Self tapping unit shall be FastTap by Continental Water Products or equal.



DRAWING FILE:
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City of Bloomington Utilities Engineering Department	STANDARD WATER SERVICE FROM A 2" PVC WATER MAIN	NO SCALE 5–5–93 by M. Hicks	STANDARD DETAIL NUMBER 15

Updated Rainfall Data

Source: http://hdsc.nws.noaa.gov/hdsc/pfds/index.html

Rainfall Duration

Duration		Return Period Rainfall Depth (in)						
Hours	Minutes	1 year	2 year	5 year	10 year	25 year	50 year	100 year
0.0833	5	0.38	0.46	0.55	0.62	0.72	0.79	0.87
0.1667	10	0.60	0.71	0.85	0.96	1.10	1.20	1.31
0.25	15	0.73	0.87	1.05	1.18	1.35	1.49	1.62
0.5	30	0.97	1.17	1.44	1.64	1.91	2.13	2.34
1	60	1.18	1.43	1.80	2.08	2.48	2.80	3.13
2	120	1.38	1.67	2.11	2.46	2.97	3.38	3.83
3	180	1.47	1.79	2.26	2.65	3.21	3.67	4.18
6	360	1.78	2.15	2.73	3.20	3.89	4.47	5.11
12	720	2.11	2.54	3.18	3.70	4.43	5.05	5.70
24	1440	2.55	3.07	3.82	4.44	5.31	6.04	6.80

Rainfall Intensity

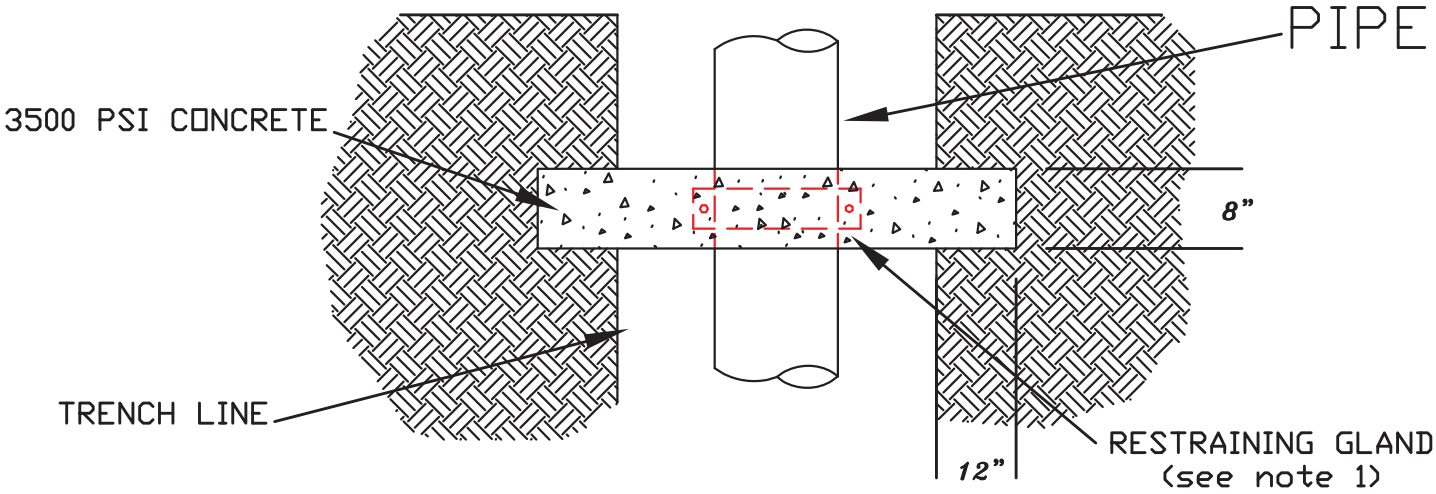
Duration		Return Period Rainfall Intensity (in/hr)						
Hours	Minutes	1 year	2 year	5 year	10 year	25 year	50 year	100 year
0.0833	5	4.61	5.48	6.59	7.45	8.60	9.52	10.42
0.1667	10	3.58	4.28	5.12	5.75	6.58	7.21	7.84
0.25	15	2.92	3.49	4.19	4.72	5.42	5.95	6.49
0.5	30	1.93	2.34	2.87	3.28	3.83	4.25	4.69
1	60	1.18	1.43	1.80	2.08	2.48	2.80	3.13
2	120	0.69	0.84	1.05	1.23	1.48	1.69	1.91
3	180	0.49	0.59	0.75	0.88	1.07	1.22	1.39
6	360	0.30	0.36	0.46	0.53	0.65	0.75	0.85
12	720	0.18	0.21	0.26	0.31	0.37	0.42	0.47
24	1440	0.11	0.13	0.16	0.18	0.22	0.25	0.28

NOTE1:

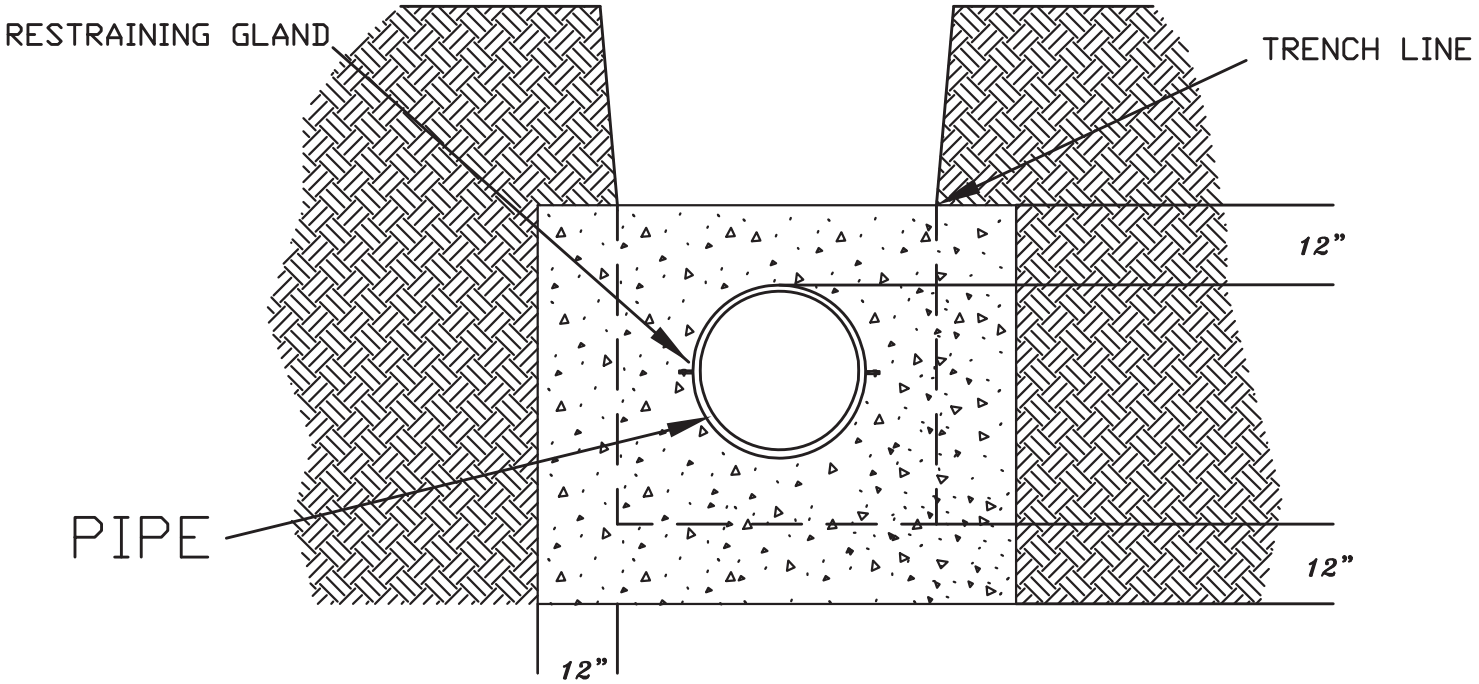
* PVC PIPE *
USE UNI-FLANGE 1390

* DUCTILE IRON PIPE *
USE MEGA LUG SERIES 1100 SDB

SECTIONAL PLAN VIEW



ANCOR SHALL EXTEND 12" BEYOND TRENCH INTO UNDISTURBED SOILS AND 12" ABOVE THE PIPE AND 12" BELOW THE TRENCH



SECTION

NOTE2:
INSTALL ANCHORS AT LOCATIONS AS DIRECTED BY THE UTILITIES ENGINEER.

Revised 2-15-2011 G.N.

City of Bloomington Utilities Engineering

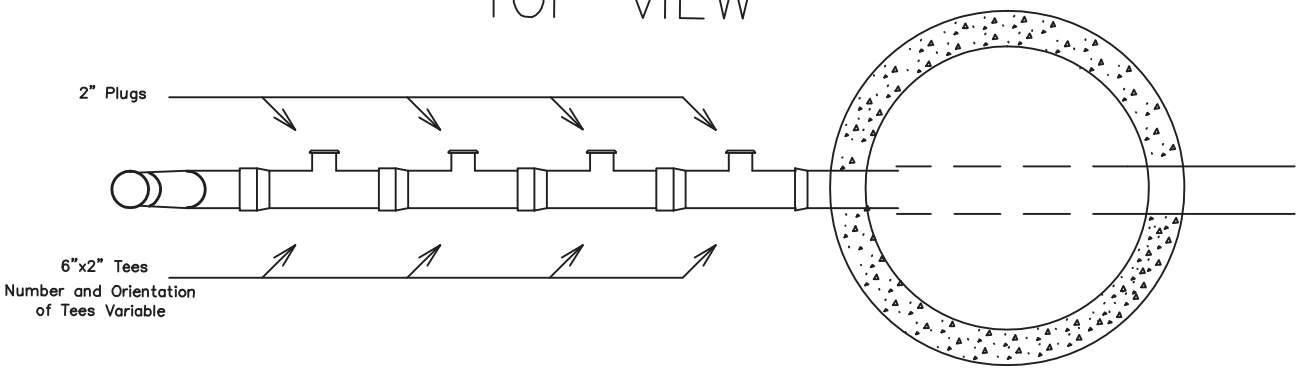
NO SCALE
02/20/08
T.AXSOM

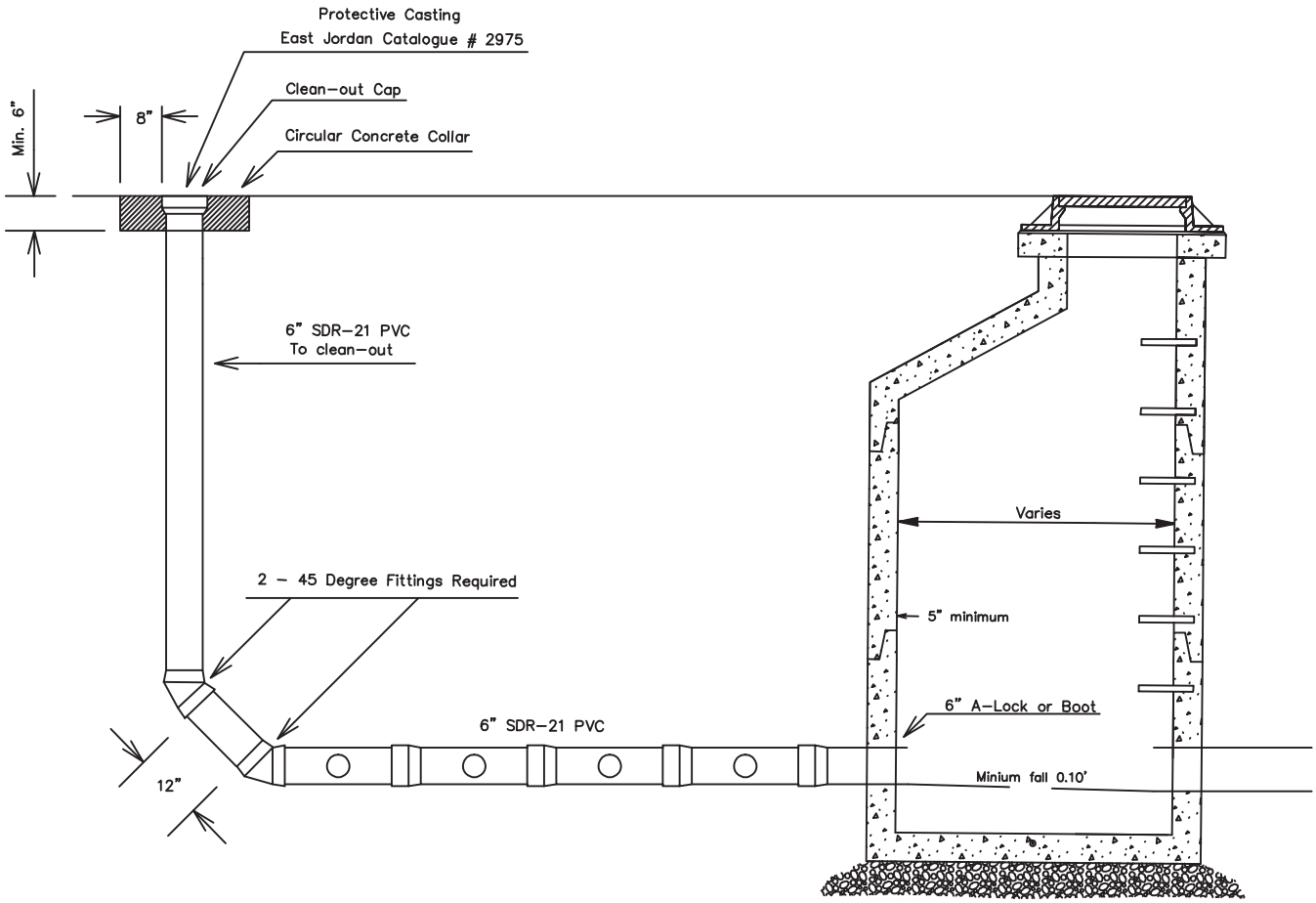
Drawing File:
I:\COMMON\STANDARD DRAWINGS\STD17.DGN

CONCRETE PIPE ANCHOR

STANDARD DETAIL NUMBER 17

TOP VIEW





PROFILE

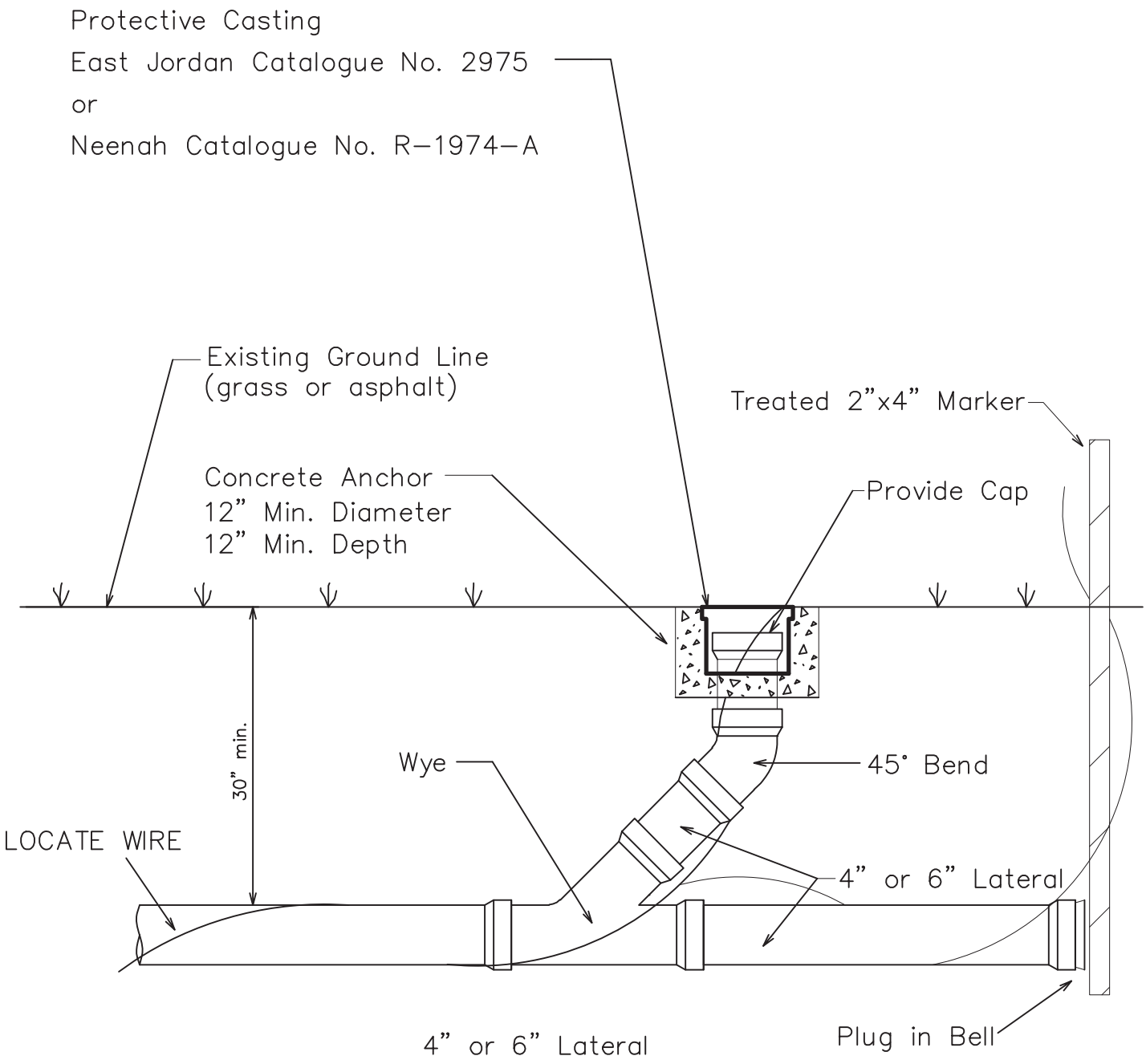
City of Bloomington Utilities Engineering Department

NO SCALE
02/12/08
T.AXSOM

DRAWING FILE
I\COMMON\STANDARD DRAWINGS\STD.18.dwg

FORCE MAIN MANIFOLD DEVICE

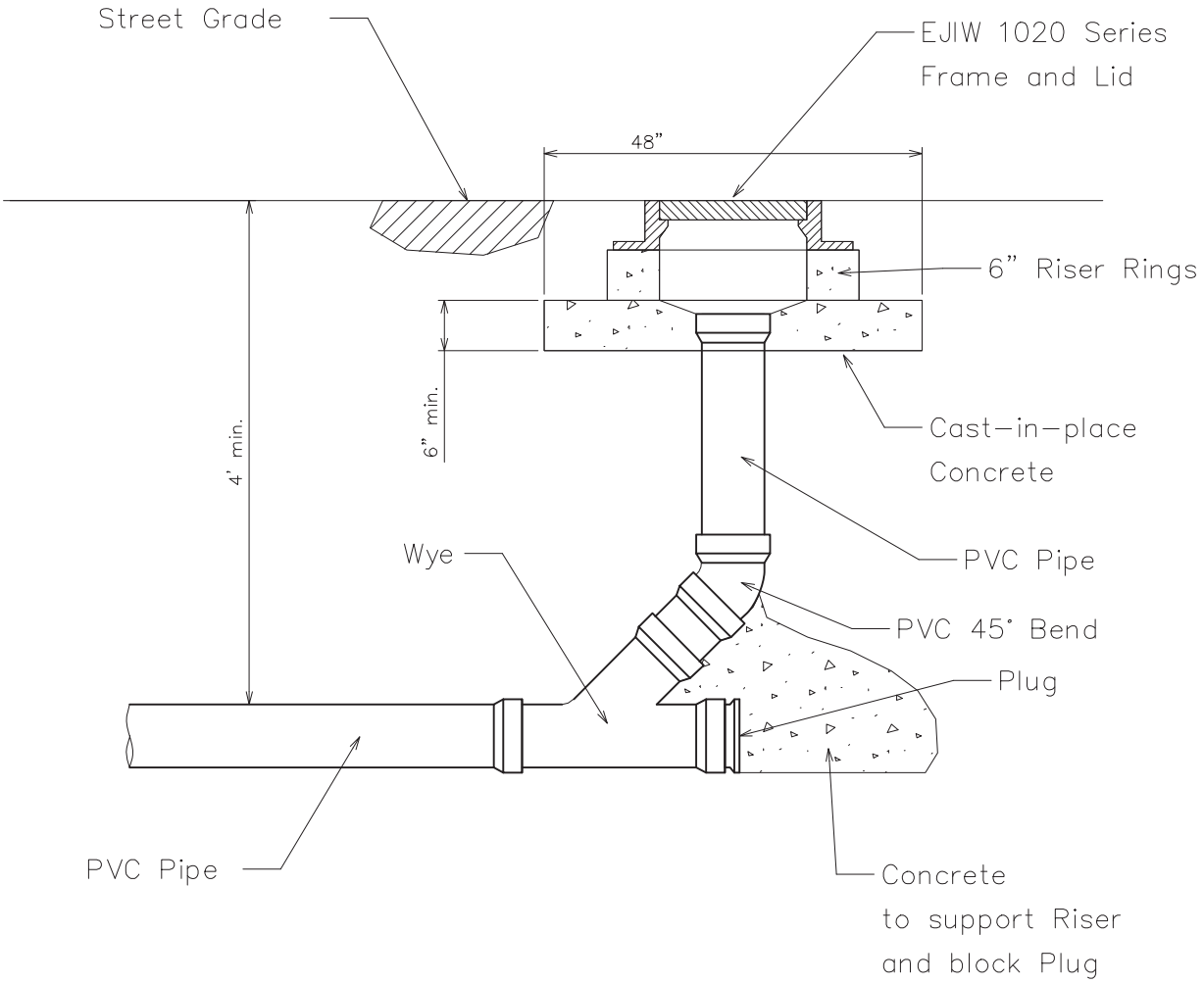
STANDARD DETAIL NUMBER 18



#10 solid insulated locate wire required from the city main to the clean-out at the property line.

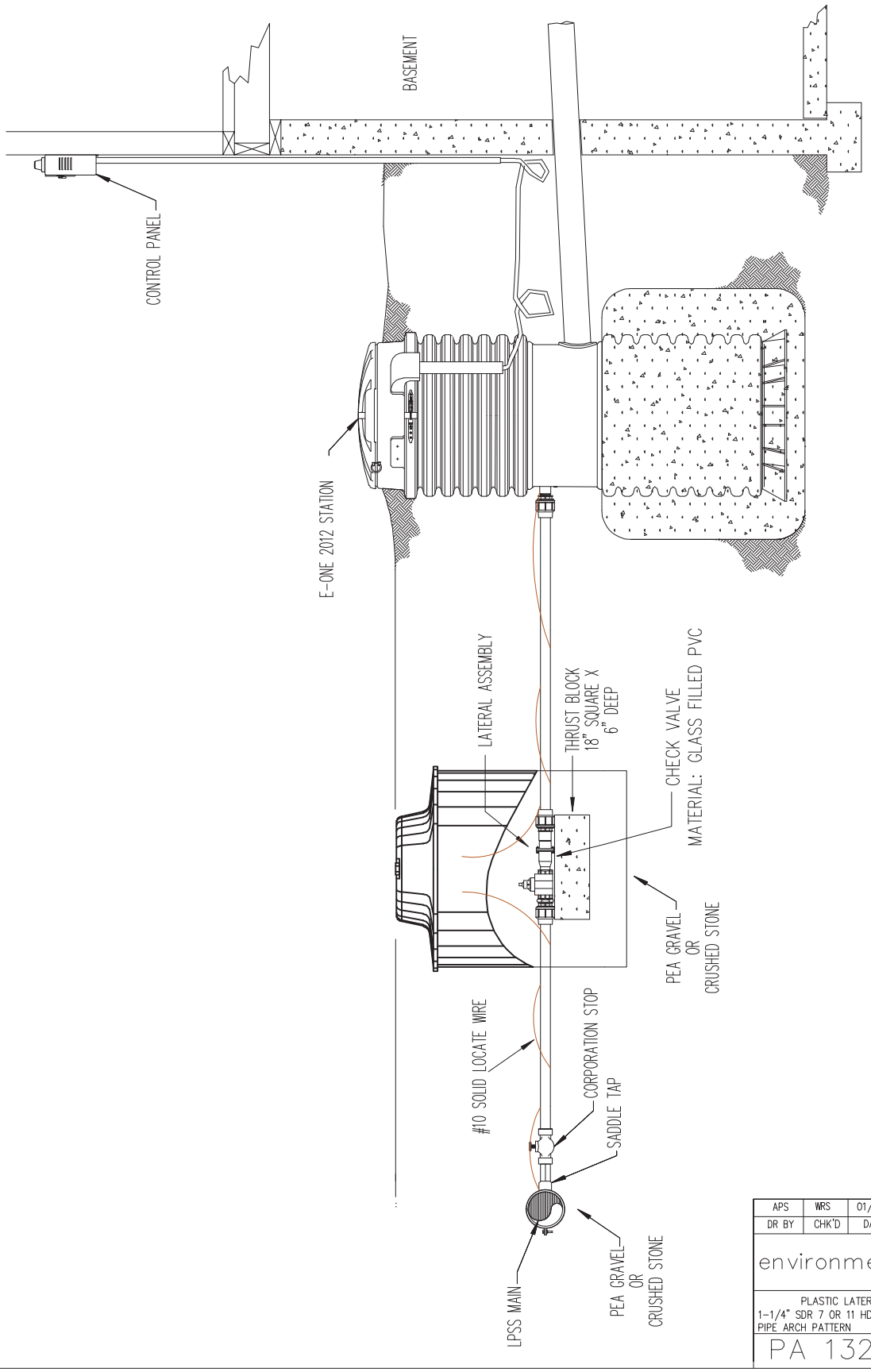
PROFILE

City of Bloomington Utilities Engineering Department		STANDARD SANITARY LATERAL CLEAN-OUT FOR 4" AND 6" PIPES	STANDARD DETAIL NUMBER 19
NO SCALE REVISED 02/26/10	Drawing File: I:\COMMON\STANDARD DRAWINGS\STD19.DGN		



PROFILE

City of Bloomington Utilities Engineering Department		STANDARD SANITARY MAIN CLEAN-OUT FOR 8" PIPES AND LARGER	STANDARD DETAIL NUMBER 20
NO SCALE 03/11/03 Kal Schnippe	Drawing File: I:\common\Standard Drawings\std20.DGN		



TYPICAL LATERAL INSTALLATION

LM000114 REV. -

APS	WRS	01/06/97	-	
DR BY	CHK'D	DATE	ISSUE	SCALE

environment one CORPORATION

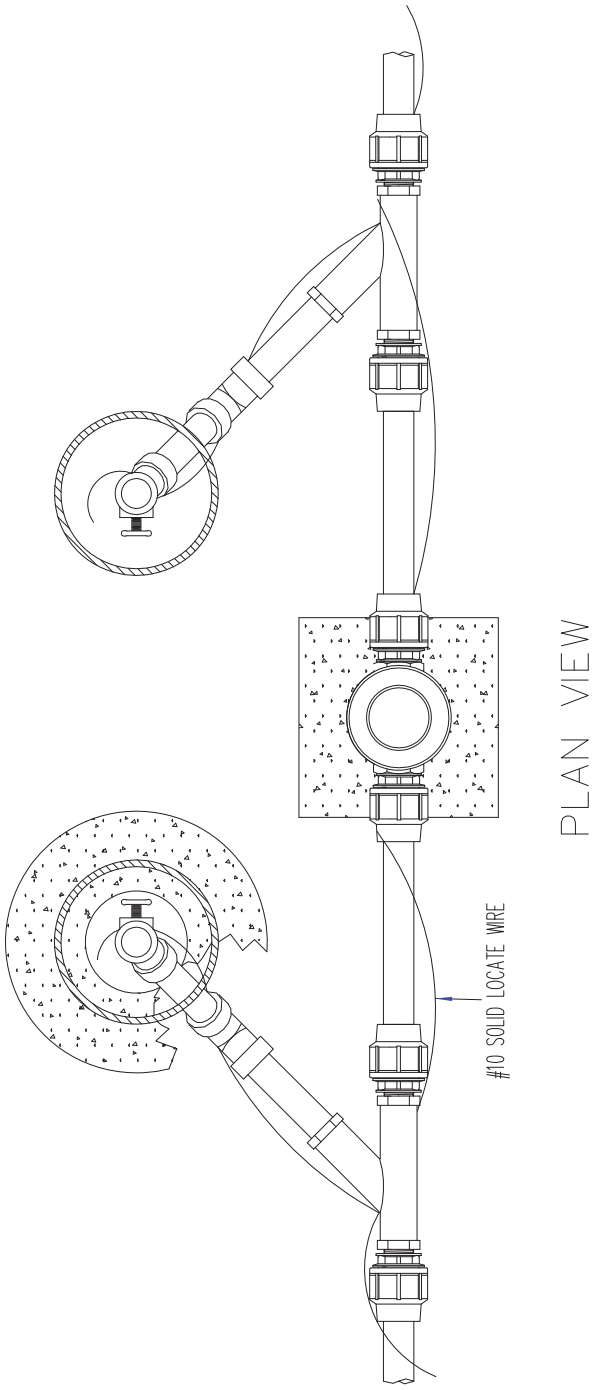
PLASTIC LATERAL ASSEMBLY
1-1/4" SDR 7 OR 11 HDPE OR SDR 21 PVC
PIPE ARCH PATTERN

PA 1329 P02

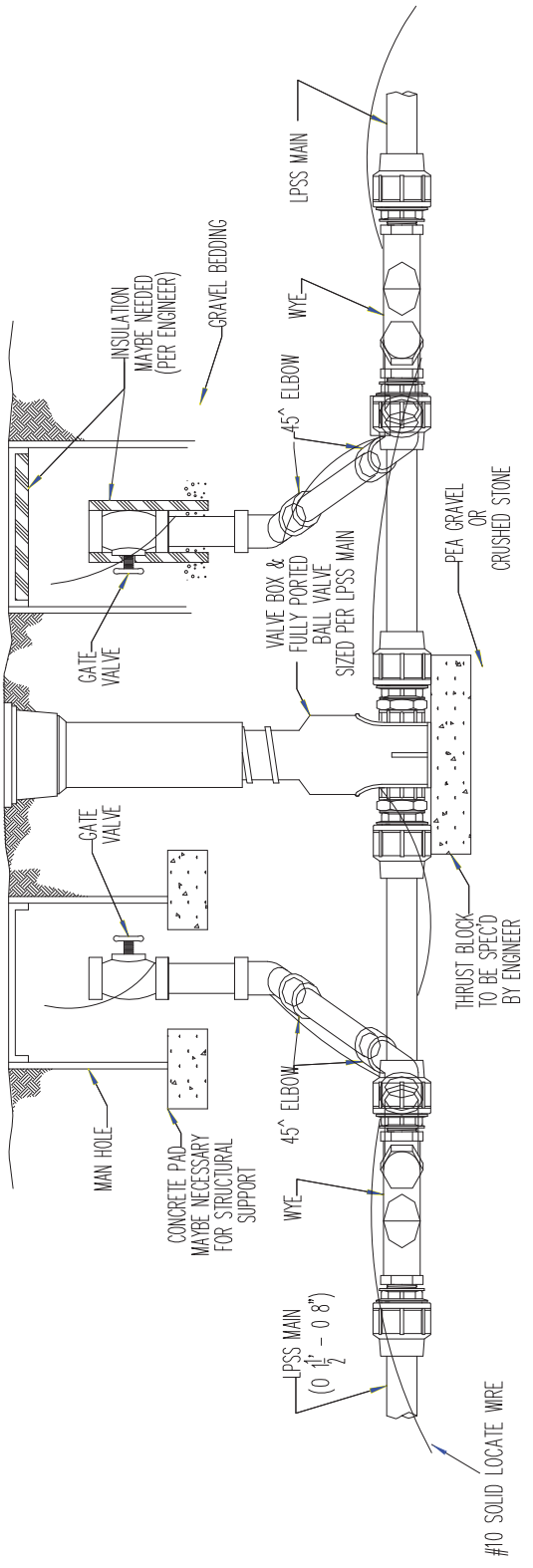
City of Bloomington Utilities Engineering Department	
NO SCALE REVISED 1/05/09	Drawing File: I:\COMMON\STANDARD DRAWINGS\STD24.DGN

TYPICAL LATERAL INSTALLATION

STANDARD DETAIL NUMBER 24



PLAN VIEW



DOUBLE FLUSHING CONNECTION ON LPSS MAIN

City of Bloomington Utilities Engineering Department	
NO SCALE REVISED 2/16/11	Drawing File: I:\COMMON\STANDARD DRAWINGS\STD25.DGN

DOUBLE FLUSHING CONNECTION ON LPSS MAIN

STANDARD DETAIL NUMBER 25

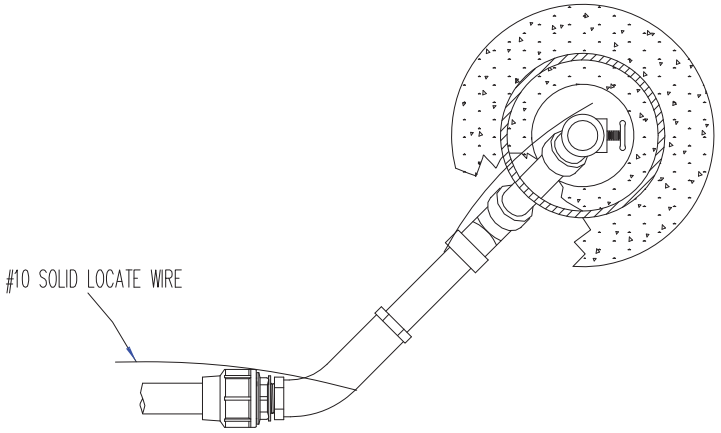
City of Bloomington Utilities Engineering Department

NO SCALE
REVISED
2/16/11

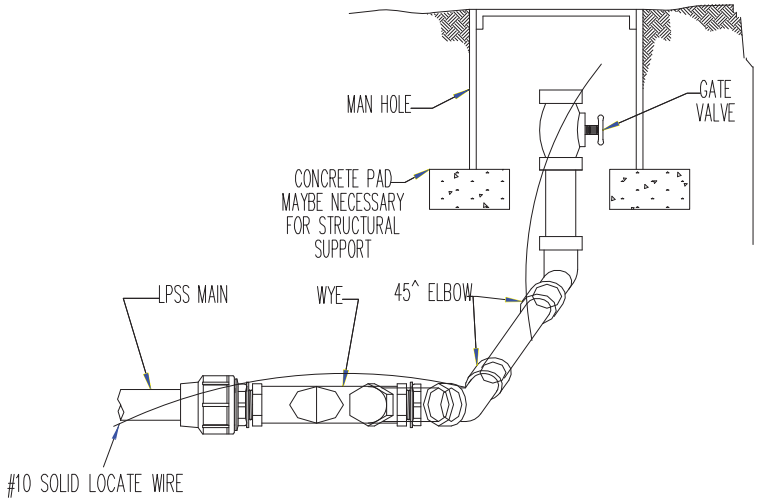
Drawing File:
I:\COMMON\STANDARD DRAWINGS\STD26.DGN

SINGLE FLUSHING CONNECTION ON LPSS MAIN

STANDARD DETAIL NUMBER 26



PLAN VIEW



SINGLE FLUSHING CONNECTION ON LPSS MAIN

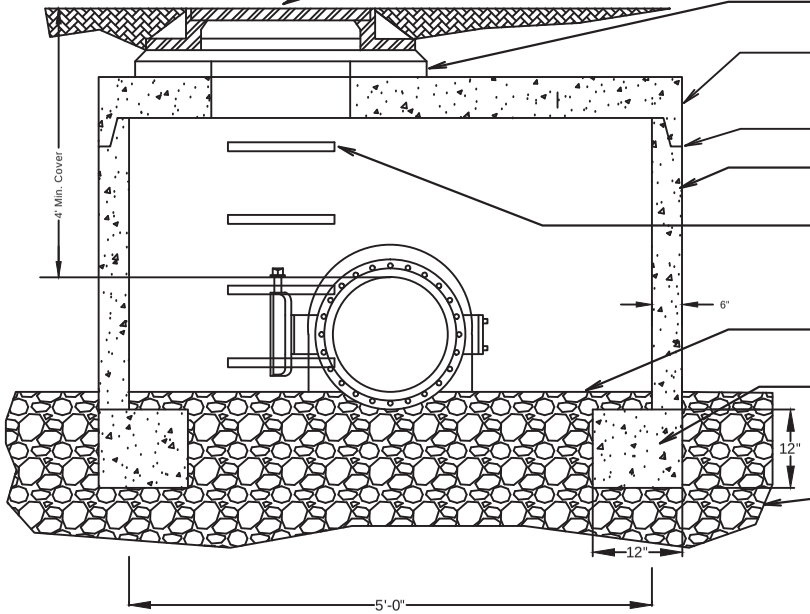
CITY OF BLOOMINGTON UTILITIES ENGINEERING

NO SCALE
03/12/12
J. DODDS

Drawing File:
I:\common\standard drawing\STD27.dwg

Valve Vault with Butterfly Valve

STANDARD DETAIL NUMBER 27



Manhole Frame and Cover
Frame shall be East Jordan iron works casting No. 1020, 1022, or approved equivalent. Cover shall be East Jordan iron works casting No. 1020A or approved equivalent. The word 'water' shall be cast into each cover. All castings shall be coated. Frame shall be set on Butyl rubber rope.

A minimum 2" of riser ring shall be installed in areas to be sodded or seeded. No more than 12" of rings may be used to adjust the frame and cover to grade.

A precast flat top shall be used when pipe depth is less than 6". An Ecentric top shall be used when pipe depth is 6" or greater.

Vault top shall be set on butyl-rubber sealant

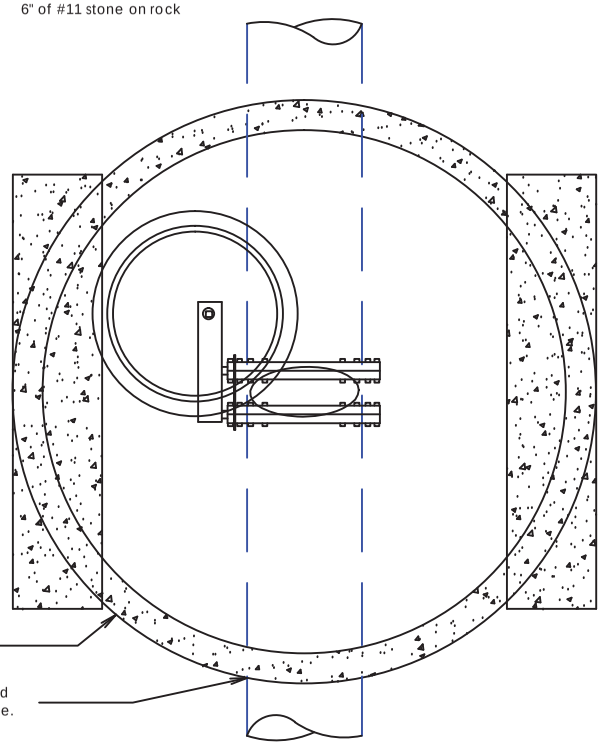
Precast Manhole Barrel Section(s)
The minimum total height of barrel sections is 6'-0"

Mahole steps shall be constructed of fiberglass reinforced polypropylene. Install with nonshrink mortar or epoxy grout 12" or 16"apart and at a location allowing access to the table.

Pipe embedment material shall be crushed stone size number 11 or 12 ASTM D-2321, Class 1.

Concrete footer cast-in-place

Bedding 4" of #11 stone on soil or 6" of #11 stone on rock



Manhole construction shall be 4500 PSI concrete reinforced with 10x10-W10xW10 welded wire fabric.

Plug annular space between the main and the manhole with brick and and mortar to prevent backfill materials from entering into the manhole.

I-69 SECTION 5

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

ATTACHMENT 15-3
Lift Station Specifications – City of Bloomington Utilities

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Lift Station Specifications

City of Bloomington Utilities

last update: December 2012

City of Bloomington Utilities

Engineering Department

P.O. Box 1216

600 E. Miller Dr.

Bloomington, IN 47402

(812)339-1444

CITY OF BLOOMINGTON UTILITIES

SUBMERSIBLE LIFT STATION STANDARD SPECIFICATIONS

LAST UPDATE: DECEMBER 2012

CITY OF BLOOMINGTON UTILITIES

SUBMERSIBLE LIFT STATION STANDARD SPECIFICATIONS

LS-1. SCOPE OF WORK.

A. The Contractor shall furnish all labor, materials, and equipment to construct one fully operational, duplex submersible sewage pumping station. The station shall include but not be limited to such equipment as

1. pumps and motors,
2. wet well,
3. valve vault,
4. electrical controls,
5. alarms,
6. piping and valves,
7. remote monitor package,
8. hatches,
9. guide rails,
10. pump removal components,
11. control center,
12. level control switches,
13. disconnects,
14. interconnecting electrical wiring,
15. incoming power supply,
16. emergency power generation equipment and transfer switch components, unless otherwise stipulated by Utility Engineer. If the requirement for emergency power generation is waived, Contractor shall install a dual interlocked main breaker
17. any other equipment normally supplied to function as a part of a complete and functional lift station.

B. All work is to be performed in accordance with these Standard Specifications, the City of Bloomington Utilities's Construction Specifications, the plans and specifications, 327 IAC 3 and other IDEM requirements and manufacturer's recommendations.

LS-2. GENERAL REQUIREMENTS.

C. All of the mechanical and electrical equipment shall be furnished by one coordinating supplier who shall be responsible for the preparation of shop drawings, schematics, interconnecting diagrams, panel layouts, and other data required for complete system description. The manufacturer shall verify that all system components are compatible with each other and that all the necessary equipment has been furnished to provide for a properly operating system.

D. The system shall be manufactured by Hydromatic Pumps or Flygt Corporation.

Hydromatic Supplier:	Flygt Supplier:	Gorman Rupp
BBC Pump & Equipment	Henry P. Thompson Co.	Covalen
P.O. Box 22098	6525 E. 82nd St., Suite 208	6939 Brookville Rd.
1125W. 16th Street	Indianapolis, IN 46250	Indianapolis, IN 46239
Indianapolis, IN 46202	Phone: 800-597-5099	Phone: 317-308-6300
Phone: 317-636-1111	Fax: 317-576-6569	Fax:
Fax: 317-636-5467		

E. Exceptions to these specifications shall be submitted in writing and clearly stated and shall be approved by the City Utilities Engineer in writing 10 days prior to the bid date.

LS-2.1. Detail Drawings.

Detail drawings must be submitted to the Utilities Engineer for the wet well, valve vault, concrete pad, hard surface access road and any other site related features that are necessary to review the proposed construction. The details must show all elevations and geometrics of the proposed lift station, including a location map. Drawings shall include average and peak flow used to design the lift station, total dynamic head calculations, a map showing the area to be served by the proposed lift station, and the location and elevation of the force main discharge.

Drawings shall be submitted in digital format as well as on full size paper prints.

LS-2.2. Shop Drawings.

The Contractor shall submit a minimum of five (5) copies of shop drawings to the City Utilities Engineer for review and approval. If the Contractor wants more than 2 copies returned, Contractor shall submit additional copies. Shop drawings shall contain detailed specifications, performance data, and warranty information for all of the equipment proposed to be installed at this lift station. The City Utilities Engineer will review the documents and return a written approval to the Contractor. Without written approval, the work performed may not be accepted.

LS-2.3. Contractor's Responsibility.

The City Utilities Engineer's review of the shop drawings and related documents does not relieve the Contractor from responsibility for errors, omissions, deviations, or compliance with the Contract documents.

LS-2.4. Exceptions.

Any exceptions to these specifications must be identified clearly on the submittals and must be approved by the City Utilities Engineer prior to proceeding with the work. If submittals are marked "RETURNED FOR CORRECTION", then five (5) copies must be resubmitted by the Contractor for approval. If submittals are marked "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", OR "RECORD COPY", resubmittals are not necessary.

LS-2.5. Materials.

All equipment and system components which will be installed outdoors or within the wet well basin must be manufactured from non-corrosive materials such that additional protective coatings will not be necessary and that will require minimum maintenance throughout the expected life of the lift station. Non-corrosive materials shall include but not be limited to stainless steel, fiberglass reinforced plastic, or PVC (ultraviolet stabilized).

LS-2.6. Power Requirements.

Lift stations shall be equipped with 3 phase power for all installations greater than 5 horsepower. Exceptions may be granted if request is made in writing to the Utilities Engineer at the time of design.

LS-2.8. Concrete Pad.

The area surrounding the wet well and valve vault shall have a 6-inch reinforced rectangular poured-in-place concrete pad. The pad shall extend 2-feet outside the largest structure and shall have a 12-inch wide and 12-inch deep turn down section at all edges. Reinforcing shall be W2.0 x W2.0 WWF.

LS-2.9. Station Piping.

A. All station piping shall be flanged, ductile iron pipe with calcium aluminate cement or ceramic epoxy lining. Pipe and flanges shall meet all requirements of ANSI/AWWA C115/A21.15 and C151/A21.51 standards. Pipe shall have a pressure rating of 250 psi.

B. All fittings shall be flanged, ductile iron with aluminate cement or ceramic epoxy lining. Pipe and flanges shall meet all requirements of ANSI/AWWA C110/A21.10 and C111/A21.11 standards. Fitting flanges shall be adequate for water pressure of 250 psi with the body of the fitting being suited for 150 psi or 250 psi.

C. All reducers shall be eccentric.

D. Piping between the valve vault and wet well shall be mechanical joint with Mega-Lug restraints or Uniflange restraints.

E. All connections between flanged piping and plain end pipe shall be restrained with Mega-Lug or Uniflange devices.

LS- 3 ACCESS.

All lift station structures and components shall remain accessible and operable during a 25-year flood. The lift station and all components shall be protected from the 100- year flood.

LS-3.1. Access Road.

Each lift station shall be accessible by a hard-surfaced all-weather road (either blacktop or concrete) for use by City maintenance vehicles. The road shall be at least 14-feet wide and shall include a turn-around for the maintenance vehicles. The minimum requirements shall be 8 inches of compacted #53 stone and 4 inches of asphalt. Access shall remain above the 100-year floodplain.

LS-3.2 Fencing.

The lift stations shall be secured with 6-foot high chain link fence. The fence shall have a 12-foot wide gate for vehicular access into the lift station area. The gate shall have a hasp for a padlock, which will be supplied by Owner.

LS-4. OPERATING CONDITIONS.

At least two identical pumps of equal size and pumping characteristics shall be provided and shall be capable of individually pumping the peak hourly flow. The pump shall be selected to operate near the best efficiency point of the pump/impeller combination. Each pump shall be capable of operating under the following conditions:

Pump:

_____ gallons per minute @ _____ feet TDH _____ RPM

Motor:

_____ RPM _____ Volts _____ Phase

_____ Horsepower _____ Cycles per second

Approved Pumps:

Hydromatic Model _____ with a _____ inch impeller.

Flygt Model _____ with a _____ impeller.

LS-5. PUMPING EQUIPMENT.

The pumps furnished under this section shall be of the submersible type capable of continuous operation at a depth of at least 65' without loss of watertight integrity. The pumps shall be capable of handling a 3" solid sphere, fibrous material, heavy sludge, and any other constituents normally found in raw, unscreened sewage.

LS-5.1. Major Components.

All major components, such as the stator casing, volute, oil casing, sliding bracket, and impeller shall be of high-quality gray cast iron. All surfaces coming in contact with raw sewage shall be protected by a coating resistant to sewage. All nuts, bolts, and fasteners shall be of 304 stainless steel.

LS-5.2 Impeller And Volute.

The impeller shall be the non-clog type slip fit or taper fit with key to securely lock the impeller to the driving shaft. The pump volute shall be fit with a replaceable wear ring installed between the volute and impeller to help achieve longer balanced operating life.

LS-5.3 Seals.

The seals shall be provided by the pump manufacturer and be either carbon-ceramic or tungsten-carbide.

LS-5.4 Seal Failure Sensor Probe.

The seal chamber shall be equipped with a seal failure sensor probe which will sense water intrusion through the lower seal. This sensor is to be connected to an alarm light in the control panel to indicate lower seal failure.

LS-5.5 O-Ring Seals.

All mating surfaces of major parts shall be machined and fitted with nitrile o-rings where watertight sealing is required. Machining and fitting shall be such that sealing is accomplished by automatic compression in two planes and o-ring contact made on four surfaces, without the requirement of specific torque limits.

LS-5.6 Pump Motor.

The pump motor shall be housed in an oil-filled or air-filled watertight casing and shall have moisture resistant Class F insulation with maximum temperature capability of 155 degrees Celsius. The motor shall be NEMA Design B and designed for continuous duty. The motor shall be provided with heat sensing units attached to the motor windings which shall be wired in the control panel to shut down the pump and activate the alarm light should overheating occur. There is a 5 HP minimum for pumps that are to be maintained by CBU following construction.

LS-5.7 Pump Motor and Sensor Cables.

Pump motor cable and heat sensor/seal failure sensor cable shall be suitable for submersible pump applications and this shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall conform to NEC specifications for pump motors and shall be of adequate size to allow motor voltage conversion without replacing the cable. Cable of the proper length shall be provided to eliminate need for splices or junction boxes between pump and the control panel. The cable shall enter the motor through a cord cap assembly which is double-sealed allowing disassembly and disconnect of the wires at the motor and still not damage the sealed characteristics of the motor housing.

LS-5.8 Thermal Sensors.

All units of 100 HP or more shall have thermal sensors monitoring bearing temperatures in addition to the motor thermal sensors described above. Bearing thermal monitors shall be independent of the motor sensors and available at the control panel circuitry to affect alarm and/or shut down functions.

LS-5.9 Guide Bracket, Rails And Discharge Flange.

A sliding guide bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron discharge connection, which when bolted to the floor of the sump and discharge line, will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps or similar devices. The rails and rail guides shall function to allow the complete weight of the pumping unit to be lifted on dead center without binding and stressing the pump housing. Installation of the pump unit to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by fiberglass reinforced plastic or 304 stainless steel rails suitable for the pumps installed. No other motion of the pump unit, such as tilting or rotating, shall be required. The system shall not require a person to enter the wet well to remove the pump and motor assembly. Sealing of the discharge interface shall be a metal-to-metal or diaphragm-type contact of the pump discharge flange and mating discharge connection. No portion of the pump unit shall bear directly on the floor of the wet well. There shall be no more than one 90-degree bend between the volute discharge flange and station piping. The guide rails for each pump shall be positioned and supported by the pump mounting base at the bottom and by the frame of the access hatch at the top. The guide rails shall be aligned vertically and one intermediate support must be installed for each 15 feet of FRP and each 20 feet of 304 stainless steel guide rail length. A stainless steel lifting chain or Flygt lift and grip eye system of adequate length for the specific installation shall be provided for each pump.

LS-5.10 Warranty

The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation and service. The warranty shall be in printed form, apply to all similar units, and shall cover the units regardless of ownership after installation. A copy of the warranty documents shall be submitted with the submittals and shop drawings.

LS-6. WET WELL.

The wet well shall be positioned as shown on the plans and detail drawings. The wet well shall be sized according to the recommendations and requirements of the supplier and may be sized larger if the design dictates for peak flow volume storage.

LS-6.1. Minimum Dimensions.

The minimum diameter for the wet well shall be 6'-0". The minimum dimension for the depth of the wet well shall be determined by the standards listed in LS-12.1, but in no case shall the wet well be less than 10 feet from surface to bottom of pit, nor less than 6 feet from lowest inflow invert to bottom of pit.

LS-6.2. Materials

The wet well barrel and top shall be constructed of pre-cast reinforced concrete conforming to ASTM C-478 and City of Bloomington Utilities Specifications section 4.4.2.2 (manholes).

LS-6.3 Wet Well Table.

A concrete or brick and mortar table shall be installed along the perimeter of the base of the wet well. The dimensions shall be 8 inch high by 8 inch wide with a 45-degree angle slope.

LS-6.4 Wet Well Vent.

A 4-inch downward pointing PVC vent pipe shall be installed in the top with a screened inlet opening.

LS-6.5 Wet Well Access Doors.

A locking double door aluminum access hatch shall be installed in the top of the wet well so that each pump can be removed from service. The frame of the access cover shall support the guide rails. The doors shall be furnished with recessed locking hardware, have a non-skid finish, support 300 psf loading, and be manufactured by either Bilco or American Foundry, or pre-approved equal. 304 stainless steel cable holders shall be mounted to the wet well access doorframe.

LS-7. VALVE VAULT.

The valve vault shall be located adjacent to the wet well as shown on the plans.

LS-7.1. Minimum Dimensions.

The minimum diameter for the valve vault shall be 5'-0". The minimum depth of the valve vault shall be 5 feet from surface to bottom of pit. The bottom of the valves and/or piping shall be a minimum of 12-inches above the bottom of the valve vault. A minimum of 12-inches shall be provided between the sides of the valve vault and any bolted flanges.

LS-7.2. Materials

The valve vault shall be constructed of pre-cast reinforced concrete manhole sections conforming to ASTM C-478, or poured-in-place concrete, or concrete block. The valve vault shall be water proofed in accordance with City of Bloomington Utilities Specifications section 4.4.2.2. for manholes.

LS-7.3 Valve Vault Access Door.

A 36" X 48" locking aluminum access hatch shall be installed in the top of the valve vault. The aluminum hatch shall be similar to the one described above for the wet well. The hatch shall be positioned so the valves may be operated from the surface, portable pump connection made from the surface, and allowing man-entry into the vault.

LS-7.4 Valve Vault Drain.

The valve vault shall contain a 3-inch PVC drain pipe installed such that the floor of the valve vault can be drained to the wet well. A duckbill check valve shall be installed on the wet well end of the drain pipe to prevent sewage from backing up into the valve vault from the wet well.

LS-7.5 Valve Vault Bypass Pumping Connection.

The fitting where the two pump's discharge piping comes together shall be made with a flanged ductile iron cross. The back side of the cross shall be fitted with a plug valve, a long radius 90 degree upward bend, and a quick disconnect fitting for connection to an emergency pump. Alternative piping arrangements incorporating these concepts may be addressed through submittals.

LS-8. VALVES.

A. The valve vault shall contain one outside swing-arm check valve and one-quarter turn eccentric plug valve on the discharge piping for each pump.

B. The valves shall be designed for use in a sanitary sewer system.

C. All valves shall be operable from the surface by use of hand wheels or shall have 2” square nut fittings to be operated by a “T” handle.

LS-8.1 Plug Valves

LS-8.2 Swing Check Valves

Contractor shall install a guard to protect workers from sudden movement of the outside lever.

LS-8.3 Duckbill Check Valves

LS-10. ELECTRICAL CONTROLS

LS10-1 Control Panel

The Contractor shall furnish and install a control panel suitable for the horsepower and voltage specified for the lift station. The panel shall be located so that the wet well and valve vault hatches and the panel door can be open at the same time. The panel shall be a minimum of 48-inches from any opening in the wet well or valve vault. The panel stand shall be large enough to also mount the disconnect switch, the meter base, and remote monitor.

A. The panel shall be a rain-tight, kevlar or stainless steel NEMA 4X panel.

B. The panel shall be supported on aluminum (for kevlar) or stainless steel (for stainless steel panels) supports.

C. The door shall be hinged and have a blank face with provisions for locking with a padlock.

D. The electrical components, switches, relays, timers, and other circuitry shall be located inside the control panel.

E. The panel shall be UL listed.

F. Terminal boards for connection of power, pumps, alarms and level sensors shall be provided.

G. All controls shall be located above ground.

H. A transformer to provide 120 volt, 24 volt and/or 4-20 milliamp power for control panel pilot circuitry, control and alarms circuits shall be provided and installed.

I. Install magnetic contacts on main control cabinet to signal entry into the station.

LS-10.2. Disconnect Switch.

The Contractor shall furnish and install a fused**,** main disconnect switch adequately sized for the equipment within the lift station. The disconnect switch shall be located adjacent to the control panel within a NEMA 4X stainless steel panel with provisions for locking the switch in either the open or closed position.

LS-10.3. Motor Controls

Each pump motor control shall include the following:

A. Combination circuit breaker/overload unit providing overload protection, short-circuit protection, reset and disconnect for all phases.

B. Across-the-line magnetic contactors.

C. Hand/off/automatic pump operations selector switch with a green run light.

LS-10.4. Automatic Alternation

The panel shall include an automatic electric alternator for two pumps providing alternating operation of pumps under normal conditions, or in cases of high level, allowing both pumps to operate simultaneously.

LS-10.5. Heat Sensors.

The motor heat sensors shall be connected within the control panel such that the starter shall be disconnected once a high temperature signal is received and shall be automatically reset when the high temperature condition is corrected. The sensors shall be factory set for conditions to be expected during normal operation of the lift station. The alarm shall be connected to the remote monitor.

LS-10.6 Seal Failure.

Each pump shall have a seal failure alarm light installed within the control panel. The seal failure alarm, indicating a failure of the lower mechanical seal, shall be an indication only and will not shut down the pump. The alarm shall be connected to the remote monitor.

LS-10.7 Elapsed Time Meter.

Each pump shall have an elapsed time meter installed within the control panel to indicate and totalize the pump motor running time. The timer shall also be connected to the remote monitor.

LS-10.8 High Water Alarm.

The control panel shall have a high water alarm built in and made a part of the panel. The alarm shall consist of a horn mounted on the side of the control panel and a flashing red light mounted on the top of the control panel, protected by a metal guard, and visible from all directions. Controls shall be provided on the side of the control cabinet to test the horn and the light and to silence the horn. The alarm shall be connected to the remote monitor.

LS-10.9. Condensate Heater.

The control panel shall include a condensate heater to protect against condensation buildup inside the cabinet.

LS-10.10 Time Delay Relay.

An adjustable time delay relay shall be provided to delay start of second pump should a power outage occur.

LS-10.11. ALLEN BRADLEY *COMPONENTS.*

All of the major components of the control panel such as circuit breakers, relays, switches and overload protection shall be manufactured by Allen Bradley and be available from local electrical supply sources.

LS-10.12 Lightning Protection.

The control panel shall include lightning protection.

LS-10.13 Phase Monitor Relay.

The control panel shall include a phase monitor relay to shut down the power supply and control circuit and protect the equipment due to loss of phase or phase reversal.

LS-10.14 Security Light.

A. Contractor shall provide and install a _____ (type) security light located _____(where) to provide illumination at _____(how many) foot-candles at the surface.

B. The light shall be installed on _____ (type) pole.

C. The control panel shall include a switch controlled, inside security light (fluorescent) with a circuit breaker. The switch shall be located inside the control panel.

LS-10.15 Connections For Remote Monitor Package.

The control panel shall incorporate the remote monitor package, as described in section LS-11, inside the control panel. Terminal strips shall be installed to provide connection of the various alarms and signals to the remote monitor package.

LS-10.16. Written Confirmation From Pump Manufacturer.

In order to maintain unit responsibility and warranty on the pumping equipment and control panel, the control panel must be accepted in writing by the pump manufacturer as suitable for operation with the pumping equipment.

LS-10.17. Conduit.

A minimum of 4 - 2.5-inch schedule 40 conduit shall be installed from the wet well to the control panel such that control cables, wiring, sensor cables, and alarm cables can be pulled through without difficulty. Each pump cable shall be pulled through one conduit. The remaining conduits shall be used for signal cables (and/or spare). The conduit shall be sealed at the control panel and inside the wet well to avoid the entrance of sewer gases into the control panel. A slip coupling shall be mounted to the bottom of the control panel to permit settling of the concrete pad without separating the conduit from the panel.

LS-10.18 AUXILIARY POWER OUTLET.

A minimum 15 amp ground fault receptacle shall be installed on the inside face of the control panel**.**

LS-11. PUMP START/STOP CONTROL

A. Contractor shall provide one of the following types of pump control devices.

1. Sealed float type mercury switches

a) Shall control the operation of the pumps and high water alarm.

b) The float shall be coated with polyurethane or polypropylene for corrosion and shock resistance.

c) The float shall be supported by its power cable from a support bar suspended from the wet well top and shall be adjustable from outside the wet well.

2. Hydrostatic pressure sensor

a) The hydrostatic pressure sensor shall provide a two-wire, loop-powered, 4-20 mA signal proportional to the hydrostatic head of the liquid. In addition to the analog signal, the transmitter shall also provide a simultaneous digital signal superimposed on the analog output, but shall not affect this analog value. The digital signal shall utilize the HART protocol. The unit shall operate with 11.5 to 30 VDC in non-hazardous and FM approved installations.

b) The sensor shall be constructed with a Hastelloy C diaphragm and 316 SST body. It shall be available in compact threaded or flanged versions for bottom or side mounting and shall have the option to be mounted via a cable or rod probe (threaded, flanged, or clamp) for top mounted installations. This sensor design shall eliminate the need for diaphragm seal assemblies. The rod probe version shall be constructed of 316 SST material, while the cable shall be polyethylene (PE) or fluoroethylenepropylene (FEP) material. There shall also be versions, which mount via Tri-Clamp fittings or weld spud fittings, which meet 3-A Sanitary Standards.

c) The sensor shall incorporate a polysilicon resistive measuring element and shall be of an all welded construction and hermetically sealed from outside influences such as moisture, dirt, etc. The device shall incorporate multiple integral moisture Gortex filters to prevent condensation from forming in the atmospheric reference tube. This filter mechanism shall not require use of any desiccant devices, which need to be routinely replaced. The transmitter shall have plastic, aluminum, or 304 SST housing options available. The unit shall also be capable of remote mounting the housing and electronics. With this

remote electronics option, the sensor measuring point shall be completely submersible.

d) The sensor accuracy shall be 0.2% of calibrated span over a 10:1 turndown. The unit shall be capable of ranges as low as 0-15 inH2O and as high as 0-60 PSIG (0-1660 inH2O). This accuracy shall include the effects of linearity, hysteresis, and repeatability. The sensor shall incorporate temperature compensation directly at the sensor to reduce the inherent effects of temperature changes on the sensor output. The temperature effects shall be less than 0.006% per ºF product temperature change. The sensor shall also be capable of withstanding an overload pressure of up to twenty (20) times the measuring range without performance degradation.

e) The transmitter shall incorporate all of the sensor calibration and characterization data on a DAT module so as to be completely replaceable and interchangeable without the need for recalibration. The 0.2% accuracy shall be maintained on an interchanged sensor. The electronics shall also be replaceable without the need for recalibration on the sensor. The calibration shall be via non-interactive digital push buttons, which will allow the transmitter to be rearranged without the need for any pressure source or other external handheld devices. The electronics module shall incorporate level linear, level horizontal cylinders, and other linearization functions so as to be configurable in process engineering units. The unit shall also implement a density factor field which can be modified via the local display or via the HART signal to account manually for changing product densities. In addition, there shall be capability to supply a system, which continuously or at a discrete point calculates product density and recalculates the product level automatically based on this new density value.

f) The transmitter shall have an optional digital display with any of the housings showing both the digital value and a 0-100 % bar graph. The display shall be universal to all ranges and incorporate a plug-in modular design to allow field retrofit without the need for software or electronics modification. The display shall also be capable of accessing the entire configuration matrix to program the transmitter locally without the need for other external HART devices.

g) The transmitter shall be Factory Mutual (FM) Approved Intrinsically Safe Class I, II, and III, Division 1, Groups A through G with appropriate barriers and FM approved Non-Incendive Class I and II, Division 2 without the need for barriers. All the housing options shall be rated NEMA-6P.

h) The unit shall be Endress + Hauser or approved equal.

LS-12. SYSTEM OPERATION.

A. As the wet well level rises, the lowest control point (float or hydrostatic pressure setting) will energize.

B. As the wet well level continues to rise, the second control switch will then energize and start the lead pump.

C. If the wet well level drops, then the lowest control point will stop the lead pump and activate an alternator so that the lag pump will be the lead pump on the next sequence.

D. If the wet well level does not drop during the operation of the lead pump, then the third control point will activate the lag pump and both pumps will operate simultaneously until the lowest control point is activated to stop both pumps.

E. If the wet well level continues to rise during the operation of both pumps, then the fourth control point will activate the high water alarm.

LS-12.1. Control Point Elevations

The elevations of the control point settings shall be determined by using the following standards:

A. 4 foot minimum cover on gravity and pressure sanitary sewers.

B. 2 foot minimum from lowest inflow invert to high water alarm.

C. 1 foot minimum from high water alarm float to lag pump on control point.

D. 2 foot minimum from lag pump on float to lead pump on control point.

E. 15 minute full developed average flow volume from lead pump on to pump off control point.

F. 1 foot minimum from pump off control point to bottom of wet well.

G. Average detention time not greater than 30 minutes.

LS-13. REMOTE MONITOR PACKAGE.

The station shall be equipped with a Remote Monitor Package (RMP) capable of monitoring the status of the lift station and communicating either to the Service Control Center via cellular calls (omni-site.net)or with the existing OMNI alarm system at the Service Control Center.

LS-13.1. RMP Operation.

The Remote Monitor Package shall monitor:

1. High water in wet well.

2. High water in dry well (if a dry well station).

3. Seal failure, high temperature, and bearing failure if these signals are available in the pump control.

4. Pump ON/OFF - for cycle time studies - to be activated on an as needed basis.

5. Pump run time

5. Pump breaker tripped - each pump.

6. Low backup battery voltage.

7. AC power failure.

8. Pump Call (start) failure.

8. Station entry

LS-13.2. RMP Installation.

The Contractor shall coordinate installation of the RMP and connection to pump control equipment that is equipped to provide contact closure signals for all monitored conditions described above that are applicable to the type of station. The RMP shall be installed in complete conformance to the manufacturer's installation specifications, with special attention given to proper electrical grounding. The contractor shall coordinate installation of a telephone line (if needed) to the RMP and coordinate testing to assure that the RMP communicates properly with the central receiving location.

LS-13.3. Alarm Bypass Switches

Each circuit shall use two relays. Each relay shall be wired to an individual pump to remove the shock hazard. Bypass switches shall be installed for each relay so that when a pump is removed for service, the circuit can be bypassed to allow monitoring the status of the remaining pump. Switches will be labeled PUMP 1 ALARM BYPASS and PUMP 2 ALARM BYPASS.

LS-13.4 Covert Alarm System

No longer used.

LS-13.5 Omni-Site.net Cellular Autodialer

LS-13.5.1 General

A. The contractor shall furnish, install and place into operation a comprehensive monitoring system for the lift station as described herein. All equipment is to be completely factory assembled, wired and tested prior to shipment. The system shall be Omni-site.net XR-50 Series as manufactured by Logical Concepts, Inc. The local representative for this equipment is BBC Pump & Equipment Company

B. The naming of manufacturer in this specification is not intended to eliminate competition or prohibit qualified manufacturers from offering equipment. Rather, the intent is to establish a standard of excellence for the material used, and to indicate a principle of operation desired.

C. The equipment provided shall be a completely integrated automatic monitoring system consisting of the required power equipment (circuit breakers, transformers etc.), automation and alarm monitoring equipment in a factory wired and tested assembly. The automatic control and alarm/monitoring system components shall be standard, cataloged, stocked products of the system supplier to assure one source responsibility, immediately available spare/replacement parts, proper system interconnections and reliable long term operation.

D. Shop Drawings shall be submitted for approval for all equipment herein specified. The Shop Drawing Submittal shall include a Document List. An Order Specification shall be included which shall describe in detail all equipment provided. Each panel shall be provided job-specific wiring diagrams, parts list, enclosure door layout and enclosure dimension drawing. The wiring diagram requirement applies to all field mounted instruments, control and telemetry equipment as well as all required interfacing to the power panel. Interconnection details shall be shown for all field-mounted instrumentation. A description of Operation shall be provided detailing the operation of the complete system, including the telemetry, control and alarm handling.

E. Provide Record Drawings and Instruction Manuals. These manuals shall include corrected Shop Drawings. In addition, a detailed Programming and Operations Manual for the Microprocessor-based Controller Unit shall be included. The manual shall include all information as detailed for the Shop Drawing Submittals above.

LS-13.5.2 Communications Network

A. The cellular modems shall be Omni-site.net #XR-40 Radios, operating in the AMPS Spectrum at a full 3-watt rating

B. Each radio shall be designed for internal/external mounting, housed in a die-cast aluminum enclosure, provided with an external 12 Volt DC rechargeable battery. The system shall accept 120 Volt AC power, and shall be provided with all accessories required, which shall include, but not be limited to, the following:

1. All interconnecting cables.

2. Antenna as required for the most reliable operation.

3. All required surge protection.

4. All mounting hardware

LS-13.5.3 Antennas

A. The antenna for each location shall be selected based on the results of the cellular survey.

B. All antennas shall be provided and installed by the CONTRACTOR as per recommendations from the manufacturer, the antenna manufacturer.

C. The Systems supplier shall be responsible for installation, set-up, adjustment and tuning of the antenna to provide optimal communications for the system.

D. The antenna installation shall be external to the enclosure and shall be outdoors. The antenna shall be a phantom style.

E. The Systems supplier shall utilize the XR-50 built-in Radio Frequency signal meter during antenna installation to ensure that the antenna are installed for optimum signal reception.

LS-13.5.4 System Installation

A. The Contractor shall ensure that the cellular Network system work is properly interfaced with equipment and other work not furnished by the Systems supplier.

B. The Systems supplier shall install, make final connections to, adjust, test, and start-up the complete cellular Radio Network.

LS-13.5.5 General Equipment Requirements

A. All wiring shall be minimum 600-volt UL type MTW or AWM and have a current-carrying capacity of not less than 125% of the full load current. The conductors shall be in complete conformity with the national electric codes, state, local and NEMA electrical standards. For ease of servicing and maintenance, all wiring shall be color-coded. The wire color code shall be clearly shown on the drawings, with each wire's color indicated.

B. All control wiring shall be contained within plastic/PVC wiring duct covers. Where dimensional constraints prevent the use of wiring duct, wires shall be trained to panel components in groupings. The wire groupings shall be bundled and tied not less than every 3 inches with nylon self-locking cable ties as manufactured by Panduit or equal.

C. Every other cable tie shall be fastened to the enclosure door or inner device panel with a cable tie mounting plate with pressure tape. Where wiring crosses hinged areas such as when trained from the inner device panel to the enclosure door, spiral wrap shall be used.

LS-13.5.6 Nameplates

All major components and sub-assemblies shall be identified as to function with laminated nameplates.

LS-13.5.7 Products

A. The Overall System Shall perform the following:

1. Transmit Flow Meter Data
2. Monitor High Water Alarm
3. Monitor Pump 1 Call Failure
4. Monitor Pump 2 Call Failure
5. Monitor Pump 1 Shaft Seal Failure
6. Monitor Pump 2 Shaft Seal Failure
7. Monitor Power Failure

B. Products to Include:

1. Weatherproof 4X enclosure.
2. Surge Arrestor.
3. XR-50 MicroRTU Remote Telemetry Unit.
4. Power supply, charger, battery and filter.
5. Transient Protector.
6. XR-40 Cellular Modem.
7. 12VDC power supply

LS-13.5.8 Incoming Service and Light Arrestor

A. The incoming service for the control system shall be 120 volt, 1 phase, 2 wire, 60 Hertz. A single phase lightning arrestor shall be supplied in the control system and connected to each line of the incoming side of the power input terminals. The arrestor shall protect the control system against damage as the result of transient voltage surges caused by lightning interference, switching loads and power line interference's. It shall begin shunting to ground at 500 volts maximum.

B. All metering shall be done ahead of the main disconnect and control panel. The meter shall be supplied and installed by the Contractor in accordance with local power company requirements.

C. The electrical service shall be provided by the OWNER. Electric meter base shall be provided by the OWNER and installed in accordance with the requirements of Lawrenceburg Municipal Utilities. A UL rated main disconnect switch, circuit breaker panel, conduit and wiring between the power company termination and the control panel shall be furnished and installed by the contractor. The power supply to the control panels shall be 120 volts, one phase, three wire, 60 Hertz.

LS-13.5.9 12 VDC Power Supply

A. A regulated 12 VDC power supply shall be provided for the radios and other monitoring system components as required. The power supply shall include a terminal block for incoming AC, output DC and ground connections. The power supply shall be powered from a 120 VAC and include tapered charge type battery charging circuitry to maximize battery life. The power supply shall be rated at minimum of 2.0A @ 12 VDC.
B. The power supply system shall include (1) 12 Volt battery sized to allow for 36 hours continued system operation during a power outage.

LS-13.5.10 Signal Transient Protection

A. Transient protection shall be provided with all equipment to protect all instrumentation and telemetry devices either receiving or sending signals.
B. The transient protectors shall be 4000V optical isolators which shall effectively arrest most transients encountered in an instrumentation environment.

LS-13.5.11 Enclosure

a. All of the seams shall be continuously welded and ground smooth with one hole knockout.
b. Door and body stiffeners shall be provided for extra rigidity.
c. Captive door screws thread into sealed well.
d. Oil resistant gasket and adhesive.
e. NEMA 4x epoxy powder coated aluminum enclosure. Size = 4”W x 4”H x 2”D

LS-13.5.12 Microprocessor Based Controller

A. A Microprocessor-based Controller Unit shall be provided for monitoring of the Lift Station based on alarm contact closures.
B. The Microprocessor-based monitor shall be a standard, catalogued product of a water and wastewater pumping automation equipment manufacturer regularly engaged in the design and manufacture of such equipment. The pump/alarm monitor shall be specifically designed for water and wastewater pumping automation utilizing standard

hardware and software. "One of a kind" systems using custom software with a generic programmable controller will not be acceptable. The controller shall be Omni-site.net XR-50 as mfg. by Logical Concepts, Inc.

C. The controller shall accept (10) DI in its base form. It shall have Phoenix type removable terminal blocks for easy field wiring.

Automatic Dialing and Voice Annunciation Software for Omni-site.net XR-50 MicroRTU(s)

General

1. Upon Alarm condition: facilitate the compilation and transmission of alarm information to commercially available alphanumeric pager systems.

2. Upon Alarm condition: facilitate the compilation and transmission of alarm information to commercially available numeric pager systems.

3. Upon Alarm condition: facilitate the compilation and transmission of alarm information to commercially available voice pagers.

4. Upon Alarm condition: facilitate the compilation and transmission of alarm information over standard telephone lines to residential or commercial sites, or cellular phones, provide for verbalization of alarm information and allow for the password secured remote acknowledgment of such alarms.

5. Allows for Voice Dial-in Connection via telephone line to facilitate the Acknowledgment of active alarms.

6. Allows for Voice Dial-in Connection via telephone line to facilitate the inquiry of and the alteration of values of digital tags.
7. Both Voice Dial-in and Voice Dial-out access modes shall be protected by mandatory redundant password entry system.

Software

Configuration Software

A. Shall allow for the configuration of unique alphanumeric pager transmission formats.

B. Shall be configurable to be compatible with 110, 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400 BAUD Paging Systems and shall adhere to the TAP protocol standard. It shall be configurable to be compatible with most major brands of data modem by allowing individual configuration of baud rate, modem initialization string, dialing prefix, dialing suffix and modem hang-up strings and accommodate paging systems requiring "passwords".

C. The omni-site software supplies the unique ability of text-to-speech conversion of typed-in alarm messages so that sound files do not have to be manually recorded. This saves

much time and programming complexity. Systems that do not employ advanced text-to-speech conversion will not be considered.

D. Shall allow for the configuration and maintenance of a set of "global" voice data files used in the construction of voice output messages.

E. Shall allow for the creation and maintenance of a "phone book" of destinations for alarm transmissions. The quantity of eligibility entries in the phone book shall be unlimited.

F. Shall have the ability to archive collected data and export this data to common Microsoft packages and SCADA systems supporting Windows DDE.

G. Shall provide for the creation of "Groups" consisting of selected entries from the Phone Book. A "Group" may be considered to be a logical grouping of alarms, based upon the type of transmission desired as a result of any alarm condition. Group configuration shall allow for:

1. Allow for selection of recipient list for alarm transmissions along with recipient priority determination.

2. Allow for creation of user configurable delays prior to commencement of alarm transmissions.

3. Allow for user selection of "single pass" or "continuous loop" modes through recipient list until alarms are acknowledged.

4. Allow for user enable/disable of: data logging to disk file, automatic acknowledgment upon return to normal of alarm condition, mandatory user acknowledgment of alarms.

H Shall provide for Digital Alarm handling and allow a textual description field and voice verbalization files for each Digital Alarm. Standard alarm acknowledgment requires personal involvement. Each alarm can be selected to "acknowledge upon return to normal state", or allow for automatic acknowledgment of any alarm generated

I Shall allow for the creation and maintenance of "reports" or organized collections of tags. Such reports may be Voice accessed via telephone line employing a mandatory password protection system. The report feature shall make it possible to inquire and receive a verbalization of the description of the tag requested, along with the current value. This alteration process calls for the pre-configuration of the tag, making it available for inquiry and/or change.

Execution Software

A. Shall be capable of displaying on screen, current alarm status and alarm history status of a minimum of 65,000 simultaneous alarm tags.

B. Shall allow for manual transmission of user entered alphanumeric or numeric pages by selection of destination from the phone book and message entry.

C. Shall be capable of maintaining a group-by-group activity log which may capture: Any alarms that may occur (along with user configurable time and date stamp), any return to normal transactions, any alphanumeric or numeric pages, any voice dial-outs, any voice-dial-ins (including who has accessed the system and who has acknowledged alarms).

D. No other special hardware is required for system operation.

3. EXECUTION

Field Installation

A The services of a factory trained, qualified representative shall be provided to install the completed system, make all adjustments necessary to place the system in trouble-free operation and instruct the operating personnel in the proper care and operation of the equipment.

Guarantee

All equipment shall be guaranteed against detects in material and workmanship for a period of one year from the date of Owner's final inspection and acceptance to the effect that any defective equipment shall be repaired or replaced without cost or obligation to the Owner.

LS-14 FLOW MEASUREMENT.

A. A recording flow measuring device shall be provided for lift stations with pumping capacities in greater than or equal to 1,200 gpm. Flow measurement shall be accomplished by an Endress + Hauser magnetic flow meter. Flow shall be recorded by a continuous strip chart which also records date and time. The flow data shall be capable of being transmitted, in the future, by SCADA system. The output shall be both 4 to 20 mA and frequency/pulse output.

B. The flow meter shall be installed in a concrete manhole/vault. An aluminum hatch shall be installed to allow access to the meter and removal of the meter without removing the top of the manhole.

C. The flow meter shall be installed a minimum of 5 pipe diameters downstream of the last elbow, valve, tee, cross, or reducer and a minimum of 2 pipe diameters upstream of similar fittings.

D. The minimum velocity through the flow meter shall be 1 fps.

LS-15. EMERGENCY POWER REQUIREMENTS.

An emergency electrical generator shall be installed, on-site, to provide uninterrupted and automatic station power in the event of power failure unless otherwise stipulated by the Utility Engineer. Utility Engineer will consider the following factors when determining if a generator is required: size of the pump station, storage time in the wetwell, and other factors. Contractor shall assume the generator will be required.

If the Utility Engineer waives the requirement for a generator, Contractor shall install a dual interlocked main breaker and generator connection.

LS-151 Single Supplier

All emergency electrical backup equipment, transfer switches, generator enclosure, switches and controls shall be furnished by one coordinating supplier who shall be responsible for the preparation of shop drawings, schematics, interconnecting diagrams, panel layouts, and other data required for complete system description. The manufacturer shall verify that all system components are compatible with each other and the pumping equipment and that all the necessary equipment has been furnished to provide for a properly operating system.

LS-15.2 Manufacturers

The system shall be manufactured by Onan Electric Power Systems or Caterpillar. Exceptions must be submitted in writing and clearly stated and must be approved by the City Utilities Engineer in writing 10 days prior to the bid date.

Onan Supplier
Cummins Mid-States
3762 W Morris Street
Indianapolis, IN 46242
Phone: 317-240-1931
Fax: 317-240-1925

Caterpillar Supplier
MacAllister Machinery Company
7575 East 30th Street
Indianapolis, IN 46219
Phone: 317-860-3326
Fax: 317-860-4433

LS-2.7.2 Contractor shall supply and install an enclosure, with sound attenuation for the generator.

LS-2.7.3 Generator set shall meet the following requirements:

1.01 SECTION INCLUDES

A. Engine Generator Set

B. Automatic Transfer Switch.

1.02 REFERENCES

A. NEMA MG 1 - Motors and Generators

B. NFPA 37 - Installation and Use of Stationary combustion Engines and Gas Turbines.

C. NFPA 70 - National Electrical Code

1.03 SYSTEM DESCRIPTION

A. The work includes supplying and installing a complete integrated emergency generator system to provide an alternate source of power to the lift station in the event of a utility outage. The system consists of a diesel generator set with related component accessories and automatic transfer switch.

B. The Contractor shall provide a full tank of diesel fuel at the completion of all testing.

1.04 REGULATORY REQUIREMENTS AND CERTIFICATIONS

A. Conform to NFPA 70 and applicable inspection authority.

B. Generator manufactured to NEMA standards.

C. Certification of performance of this electric plant by an independent testing laboratory as to the plant's full power rating, stability and voltage and frequency regulation.

1.05 SUBMITTALS

A. Engine-generator submittals shall include the following information:

1. Factory published specification sheet indicating standard and optional accessories, ratings, etc.

2. Manufacturer's catalog cut sheets of all auxiliary components such as isolators, battery charger, silencer, exhaust flex, main circuit breaker, etc.

3. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.

4. Weights of all equipment.

5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.

6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, remote alarm indications.

7. Engine mechanical data at varying loads up to full load, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.

8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.

9. Generator resistances, reactances and time constants.

10. Generator current decrement curve.

11. Generator motor starting capability.

12. Generator thermal damage curve.

13. Jacket water heater connection diagram.

14. Control panel schematics.

15. Automatic load transfer switch.

16. Oil sampling analysis, laboratory location, and information.

17. Manufacturer's and dealer's written warranty.

18. Emissions data.

19. Automatic transfer switch published specification sheet.

1.06 WARRANTY AND SERVICE

A. The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing distributor. Submittals received without written warranties as specified will be rejected in their entirety.

B. The engine-generator supplier shall have service facilities within 50 miles of the project site and maintain 24-hour parts and service capability. The distributor shall stock parts as needed to support the generator set package for this specific project.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Caterpillar Tractor Co.

B. Kohler Company

C. Cummins Onan Power, Inc.

2.02 GENERAL REQUIREMENTS

A. The generator set shall be standby rated to supply the maximum starting (surge) loads and steady-state running loads of the connected load equipment, including radiator fan and all parasitic loads. The Control system shall have an adjustable timer to delay the start of the second pump in the event of a power failure. The Generator shall be sized to start the second pump while the first one is running.

B. All materials and parts comprising the unit shall be new and unused.

2.03 DIESEL ENGINE

A. The engine shall be water-cooled inline or vee-type, four-cycle compression ignition diesel. It shall meet specifications when operating on number 2 domestic burner oil. Two cycle engines will not be considered. The engine shall be equipped with fuel, lube oil, and intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, service meter, gear-driven water pump.

B. The governor shall be mechanical with hydraulic assist as required. It shall maintain 3% or less speed droop from no load full rated load. Steady state speed regulation shall be +/- 0.33%. The governor shall be equipped with a vernier control and positive locking to allow manual speed adjustment.

C. The complete engine block shall be machined from one casting. Designs incorporating multiple blocks bolted together are not acceptable.

D. The engine shall utilize a gear-type, positive displacement, full pressure lubricating oil pump and water-cooled lube oil cooler. Pistons shall be spray-cooled. Provide oil filters, oil pressure gauge, dipstick and oil drain.

E. Fuel filter and serviceable fuel system components shall be located to prevent fuel from spilling onto gen set batteries.

2.04 GENERATOR

A. The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling.

B. The insulation material shall meet NEMA standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the rotor and stator shall not exceed NEMA class F (130 ºC rise by resistance over 40 C ambient). The excitation system shall be of brushless construction.

C. The self-excited, brushless exciter shall consist of a three-phase armature and a three-phase full wave bridge rectifier mounted on the rotor shaft. Surge suppressors shall be included to protect the diodes from voltage spikes.

D. The automatic voltage regulator (AVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid state design, which includes electronic voltage buildup, volts per Hertz regulation, three phase sensing, overexcitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.

E. Provide motor starting capability of 394.27 kVA SKVA at 30% instantaneous voltage dip as defined per NEMA MG 1.

2.05 CIRCUIT BREAKER

A. Provide a generator mounted circuit breaker, molded case or insulated case construction, *** amp trip, * pole, (sized for the load) NEMA 1P22. Breaker shall be Merlin Gerin or equal and utilize a thermal magnetic trip unit and 24 VDC shunt trip. The breaker shall be UL listed with shunt trip device connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box mounted on the side of the generator. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

2.06 CONTROL PANEL

A. Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation; adjustable cycle cranking, digital AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cooldown timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid.

B. Provide the following digital readouts:

1. Engine oil pressure
2. Coolant temperature
3. Engine RPM
4. System DC Volts
5. Engine running hours
6. Generator AC volts
7. Generator AC amps
8. Generator frequency

C. Alarm NFPA 110

Provide the following indications for protection and diagnostics according to NFPA 110 level 1:

1. Low oil pressure
2. High water temperature
3. Low coolant level
4. Overspeed
5. Overcrank
6. Emergency stop depressed
7. Approaching high coolant temperature
8. Approaching low oil pressure
9. Low coolant temperature
10. Low voltage in battery
11. Control switch not in auto. position

12. Low fuel main tank

13. Battery charger ac failure

14. High battery voltage

15. EPS supplying load

16. Spare

D. Provide a remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.

E. Provide programmable protective relay functions inside the control panel to include the following:

1. Undervoltage

2. Overvoltage

3. Overfrequency

4. Underfrequency

5. Reverse power

6. Overcurrent (phase and total)

7. KW level (overload)

8. Three spare LED's

9. Four spare inputs

2.07 COOLING SYSTEM

A. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110° F ambient air entering the room or enclosure without derating the unit and 50/50 anti-freeze mixture. The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction

2.08 FUEL SYSTEM

A. Fuel Filter: Filter/Separator - In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.

B. Fuel Piping: All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted

C. Fuel Line Rating: Flexible fuel lines rated 300 degrees F and 100 PSI

D. A UL listed fuel subbase fuel tank shall be supplied, to provide 48 hours of fuel for the generator set, when operating at full rated load. It shall be equipped with low level and leak detection contacts, vents, gauge, engine supply/return lines, and fill provision. The subbase fuel tank shall be factory installed and delivered to the jobsite as an integral part of the generator set package.

2.09 EXHAUST SYSTEM

A. A critical type silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed in the sound attenuated enclosure. The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine manufacturer.

B. The muffler and all indoor exhaust piping shall be "lagged" by the contractor to maintain a surface temperature not to exceed 150°F. The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fitting.

2.10 STARTING SYSTEM

A. Starting Motor: A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

B. Jacket Water Heater: A unit mounted thermal circulation type water heater. The heater Watt rating shall be sized by the manufacturer to maintain jacket water temperature at 90 degrees F, and shall be a 120 volt, single phase, 60 hertz.

C. A lead-acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated no less than 172-ampere hours. Necessary cables and clamps shall be provided.

D. A battery tray shall be provided for the batteries and shall conform to NEC 480-7(b). It shall treated to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.

E. A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. Ac input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts. Amperage output shall be no less than ten (10) amperes. Charger shall be wall-mounting type in NEMA 1 enclosure.

2.11 AUTOMATIC TRANSFER SWITCH

A. The automatic transfer switch shall be *** amps, * pole, *** volt AC, (rated for the load) fully rated enclosed switch which complies to NEMA ICS2-447, NFPA 70, NFPA 99, NFPA 110, and UL 1008. It shall have front access to all control panels and contacts. Main contact material shall consist of silver (87% min) and cadmium. Plexiglas covers shall shield electronic controls and main contact connections. Wiring shall be numbered for easy identification. The Break before Make transfer action shall require no more than 3 cycles, and the mechanism shall incorporate lifetime lubrication within a temperature range of -29 C to 60 C (-20 F to 140 F). It shall incorporate solid state programmable logic, be assembled and tested, and include:

1 - Sheet steel NEMA 1 enclosure with hinged.

1 - Operating transfer switch consisting of single solenoid, electrically operated, mechanically held

1 - Frequency of emergency at transfer, 70 to 90 percent (factory 13% full)

1 - Solderless connectors for normal source cables, emergency source cables, load cable, and solid neutral bar.

1 - No load manual transfer

1 - Remote automatic transfer switch control

1 - High fault withstanding capacity

1 - Voltage monitoring of each phase of normal source (full protection), adjustable 70 to 90 percent

1 - Voltage of emergency at transfer, 70 to 90 percent (factory set 90 percent)

1 - Frequency of emergency at transfer, 70 to 90 percent (factory set 90 percent)

1 - Voltage and frequency monitoring of one phase of emergency source.

1 - Time delay, engine starting, adjustable 0.1 to 10 seconds, set at 3 seconds.

1 - Engine minimum run (5 to 30 minutes) (factory set 20 minutes)

1 - Engine cool down timer (1 to 30 minutes) factory set 10 minutes)

1- Engine warm-up (5 seconds to 3 minutes), with override switch (factory set 1 minute)

1 - Time delay, normal to emergency (0.1 to 10 seconds adjustable)

1- Time delay, emergency to normal (1 to 30 minutes (factory set 5 minutes)

1 - Time delay neutral (0.1 to 10 seconds) with bypass switch (factory set 5 seconds)

1 - In-phase monitor with override to time delay neutral

1 - Three position mode selector switch in the face of the enclosure, marked auto, test, and fast test.

1 - Fast test mode: resets engine minimum run (to 10 seconds), engine cool down (to 0 seconds), and return to utility (0 to 5 seconds)

1 - Self check built-in (at start-up, routine check of ATS circuits, LEDs shall flash to confirm integrity.

1 - Exerciser (7 days from initial command)

1 - Transfer when exercising (on/off switch)

2 - Pilot lights in face of enclosure indicating source to which the ATS is connected.

1 - Auxiliary C-form contacts for normal and emergency

1 - Neutral lug.

1 - Internal cabling, terminal boards, fuses, fuse blocks, nameplates, and miscellaneous hardware as needed.

1 - Software consisting of: dimensional drawing, layout drawing, electrical schematic, and parts list.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes.

3.02 START-UP AND TESTING

A. Coordinate all start-up and testing activities with the Engineer and Owner.

B. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

1. Verify that the equipment is installed properly.

2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater, remote annunciator, etc.

3. Test all alarms and safety shutdown devices for proper operation and annunciation.

4. Check all fluid levels.

5. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.

6. Verify proper voltage and phase rotation at the transfer switch before connecting to the load.

7. Connect the generator to building load and verify that the generator will start and run all designated loads in the plant.

8. Perform a 4-hour load bank test at .80 power factor at full nameplate load using a reactive load bank and cables supplied by the local generator dealer. Observe and record the following data at 15-minute intervals:

a. Service meter hours

b. Volts AC - All phases

c. Amps AC - All phases

d. Frequency

e. Jacket water temperature

f. Oil Pressure

g. Fuel pressure

h. Ambient temperature

LS-16. TRANSFER SWITCH FOR EMERGENCY POWER.

A manual transfer switch of adequate size to provide power via incoming electrical service or emergency generator power shall be provided. The transfer switch shall be built in the same enclosure as the main control center. An outside receptacle shall be provided to fit the City of Bloomington Utilities portable generator.

LS-17. DOCUMENTATION.

The Contractor shall provide to the City Utilities Engineer three (3) lift station manuals each containing copies of the following information:

1. Operating instructions.
2. Maintenance instructions including lubrication schedules.
3. Recommended spare parts list including parts ordering information.
4. Structural and as-built wiring diagrams.
5. Bill of materials.

LS-18 SPARE PARTS.

The Contractor shall provide a complete set of ***"O" rings and gaskets*** for the lift station supplied.

I-69 SECTION 5 PROJECT

PUBLIC-PRIVATE AGREEMENT

TECHNICAL PROVISIONS

ATTACHMENT 17-2
ROW ACQUISITION STATUS

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ROW Acquistion Status I-69 Section 5 (As of December 19, 2013)

Parcel No.	Reference Parcel No.	Mitigation	Anticipated Date Available	Demolition Complete	Right-of-Way Agreements based on Right-of-Way Negotiations	
					Reference	Item
6		NA	11/7/2013	No		Parcel is clear
7		NA	8/1/2014	No		
8		NA	3/1/2014	No		
15		NA	8/1/2014	No		
16		NA	8/1/2014	No		
17		NA	8/1/2014	No		
18		NA	8/1/2014	No		
23		NA	8/1/2014	No		
24		NA	8/1/2014	No		
25		NA	3/1/2014	No		
26		NA	6/1/2014	No		
27		NA	8/1/2014	No		
28		NA	8/1/2014	No		
29		NA	8/1/2014	No		
30		NA	8/1/2014	No		
31		NA	6/1/2014	No		
32		NA	6/1/2014	No		
33		NA	6/1/2014	No		
35		NA	8/1/2014	No		
36		NA	6/1/2014	No		
37		NA	8/1/2014	No		
39		NA	8/1/2014	No		
40		NA	10/1/2014	No		
41		NA	10/1/2014	No		
42		NA	3/1/2014	No		
46		NA	8/1/2014	No		
47		NA	8/1/2014	No		
48		NA	8/1/2014	No		
49		NA	5/1/2014	No	owners signed a tree clearing right of entry	
50		NA	6/1/2014	No		
51		NA	10/1/2014	No		
52		NA	8/1/2014	No		
54		NA	10/1/2014	No		
55		NA	3/1/2014	No		
56		NA	3/1/2014	No		
57		NA	3/1/2014	No		
58		NA	3/1/2014	No		
59		NA	10/1/2014	No		
60		NA	3/1/2014	No		
61		NA	3/1/2014	No		
63		NA	10/1/2014	No		
64		NA	10/1/2014	No		

ROW Acquistion Status I-69 Section 5 (As of December 19, 2013)

Parcel No.	Reference Parcel No.	Mitigation	Anticipated Date Available	Demolition Complete	Right-of-Way Agreements based on Right-of-Way Negotiations	
					Reference	Item
89		NA	6/1/2014	No		
90		NA	6/1/2014	No		
91		NA	3/1/2014	No		
92		NA	3/1/2014	No		
93		NA	6/1/2014	No		
94		NA	6/1/2014	No		
95		NA	10/1/2014	No		
96		NA	3/1/2014	No		
97		NA	6/1/2014	No		
98		NA	10/1/2014	No		
99		NA	6/1/2014	No		
100		NA	10/1/2014	No		
101		NA	10/1/2014	No		
102		NA	3/1/2014	No		
103		NA	3/1/2014	No		
104		NA	3/1/2014	No		
105		NA	3/1/2014	No		
106		NA	8/1/2014	No		
107		NA	3/1/2014	No		
108		NA	3/1/2014	No		
109		NA	3/1/2014	No		
110		NA	3/1/2014	No		
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113		NA	3/1/2014	No		
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117		NA	6/1/2014	No		
120		NA	6/1/2014	No		
121		NA	3/1/2014	No		
124		NA	6/1/2014	No		
125		NA	10/1/2014	No		
126		NA	8/1/2014	No		
127		NA	10/1/2014	No		
128		NA	8/1/2014	No		
130		NA	8/1/2014	No		
131		NA	10/1/2014	No		
133		NA	6/1/2014	No		
135		NA	10/1/2014	No		
137		NA	10/1/2014	No		
138		NA	10/1/2014	No		
139		NA	8/1/2014	No		
140		NA	10/1/2014	No		

ROW Acquistion Status I-69 Section 5 (As of December 19, 2013)

Parcel No.	Reference Parcel No.	Mitigation	Anticipated Date Available	Demolition Complete	Right-of-Way Agreements based on Right-of-Way Negotiations	
					Reference	Item
141		NA	8/1/2014	No		
167		NA	8/1/2014	No		
170		NA	8/1/2014	No		
171		NA	8/1/2014	No		
207		NA	8/1/2014	No		
209		NA	8/1/2014	No		
215		NA	8/1/2014	No		
216		NA	8/1/2014	No		
217		NA	8/1/2014	No		
219		NA	8/1/2014	No		
222		NA	8/1/2014	No		
223		NA	8/1/2014	No		
224		NA	10/1/2014	No		
225		NA	10/1/2014	No		
226		NA	8/1/2014	No		
227		NA	8/1/2014	No		
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229		NA	6/1/2014	No		
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232		NA	8/1/2014	No		
233		NA	8/1/2014	No		
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235		NA	6/1/2014	No		
236		NA	6/1/2014	No		
237		NA	8/1/2014	No		
238		NA	6/1/2014	No		
239		NA	8/1/2014	No		
268		NA	10/1/2014	No		
269		NA	10/1/2014	No		
276		NA	10/1/2014	No		
282		NA	10/1/2014	No		
283		NA	12/31/2014	No		
284		NA	10/1/2014	No		
285	801	Yes	10/1/2014	No		
286	802	Yes	10/1/2014	No		
288	803	Yes	10/1/2014	No		
289		NA	10/1/2014	No		
290		NA	10/1/2014	No		
291		NA	6/1/2014	No		
295		NA	8/1/2014	No		
296		NA	10/1/2014	No		

ROW Acquistion Status I-69 Section 5 (As of December 19, 2013)

Parcel No.	Reference Parcel No.	Mitigation	Anticipated Date Available	Demolition Complete	Right-of-Way Agreements based on Right-of-Way Negotiations	
					Reference	Item
297		NA	10/1/2014	No		
298		NA	8/1/2014	No		
299		NA	8/1/2014	No		
312		NA	6/1/2014	No		
313		NA	8/1/2014	No		
314		NA	10/1/2014	No		
400		NA	12/1/2014	No		
402		NA	6/1/2014	No		
403		NA	12/1/2014	No		
404		NA	12/1/2014	No		
405		NA	12/1/2014	No		
406		NA	12/1/2014	No		
407		NA	12/1/2014	No		
408		NA	12/1/2014	No		
414		NA	12/31/2014	No		
416		NA	12/31/2014	No		
417		NA	12/31/2014	No		
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422		NA	12/31/2014	No		
423		NA	12/31/2014	No		
424		NA	12/31/2014	No		
425	808	Yes	12/31/2014	No		
426	809	Yes	12/31/2014	No		
427		NA	12/31/2014	No		
428		NA	12/31/2014	No		
429		NA	6/1/2014	No		
430		NA	8/1/2014	No		
431		NA	6/1/2014	No		
432		NA	12/31/2014	No		
433		NA	12/31/2014	No		
435		NA	12/1/2014	No		
436		NA	12/1/2014	No		
437		NA	12/1/2014	No		
438		NA	12/1/2014	No		
439		NA	12/1/2014	No		
440		NA	10/1/2014	No		
441		NA	12/1/2014	No		
442		NA	12/1/2014	No		
443		NA	12/1/2014	No		
444		NA	12/1/2014	No		

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Parcel No.	Reference Parcel No.	Mitigation	Anticipated Date Available	Demolition Complete	Right-of-Way Agreements based on Right-of-Way Negotiations	
					Reference	Item
445		NA	12/1/2014	No		
446		NA	12/1/2014	No		
447		NA	12/1/2014	No		
448		NA	12/1/2014	No		
451		NA	12/1/2014	No		
452		NA	12/1/2014	No		
453		NA	12/1/2014	No		
454		NA	12/1/2014	No		
455		NA	12/1/2014	No		
457		NA	10/1/2014	No		
458		NA	12/1/2014	No		
459		NA	6/1/2014	No		
460		NA	6/1/2014	No		
461		NA	6/1/2014	No		
462		NA	12/1/2014	No		
463		NA	12/1/2014	No		
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468		NA	12/1/2014	No		
469		NA	12/1/2014	No		
471		NA	12/1/2014	No		
472		NA	12/1/2014	No		
473		NA	12/1/2014	No		
474		NA	12/1/2014	No		
476		NA	10/1/2014	No		
479		NA	10/1/2014	No		
482		NA	12/31/2014	No		
483		NA	12/31/2014	No		
484		NA	12/31/2014	No		
486		NA	12/31/2014	No		
487		NA	10/1/2014	No		
488		NA	12/31/2014	No		
489		NA	12/31/2014	No		
491		NA	12/31/2014	No		
495		NA	12/31/2014	No		
496		NA	12/31/2014	No		
497		NA	12/31/2014	No		
498		NA	12/31/2014	No		
499		NA	12/31/2014	No		
500		NA	12/31/2014	No		

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Parcel No.	Reference Parcel No.	Mitigation	Anticipated Date Available	Demolition Complete	Right-of-Way Agreements based on Right-of-Way Negotiations	
					Reference	Item
501		NA	12/31/2014	No		
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511		NA	12/1/2014	No		
512		NA	12/1/2014	No		
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532		NA	12/1/2014	No		
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534		NA	12/1/2014	No		
536		NA	12/31/2014	No		
538	815	Yes	10/1/2014	No		
540	816	Yes	12/31/2014	No		
542	817	Yes	12/31/2014	No		
545		NA	12/31/2014	No		
546		NA	12/31/2014	No		
548		NA	12/31/2014	No		
550		NA	12/31/2014	No		
553	818	Yes	12/31/2014	No		
554	819	Yes	12/31/2014	No		
555	820	Yes	12/31/2014	No		
556		NA	12/31/2014	No		
557		NA	12/31/2014	No		
558		NA	12/31/2014	No		
559		NA	12/31/2014	No		
560		NA	12/31/2014	No		
561		NA	12/31/2014	No		
562		NA	12/31/2014	No		

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Parcel No.	Reference Parcel No.	Mitigation	Anticipated Date Available	Demolition Complete	Right-of-Way Agreements based on Right-of-Way Negotiations	
					Reference	Item
563		NA	12/31/2014	No		
600		NA	12/31/2014	No		
601	821	Yes	12/31/2014	No		
602		NA	12/31/2014	No		
605		NA	12/31/2014	No		
607		NA	12/31/2014	No		
611		NA	12/31/2014	No		
619		NA	12/31/2014	No		
621		NA	12/31/2014	No		
624		NA	10/1/2014	No		
629		NA	12/31/2014	No		
631		NA	12/31/2014	No		
633		NA	12/31/2014	No		
635		NA	12/31/2014	No		
636		NA	12/1/2014	No		
642		NA	12/1/2014	No		
643		NA	12/1/2014	No		
644		NA	12/1/2014	No		
645		NA	12/1/2014	No		
646		NA	12/1/2014	No		
649		NA	10/1/2014	No		
650		NA	12/1/2014	No		
651		NA	12/1/2014	No		
652		NA	12/1/2014	No		
653		NA	12/1/2014	No		
654		NA	12/1/2014	No		
656		NA	12/31/2014	No		
657		NA	12/31/2014	No		
658		NA	12/31/2014	No		
659		NA	12/31/2014	No		
666		NA	12/1/2014	No		
669		NA	12/1/2014	No		
670		NA	12/1/2014	No		
671	830	Yes	12/1/2014	No		
672		NA	12/1/2014	No		
673		NA	12/1/2014	No		
675	822	Yes	10/1/2014	No		
676	823	Yes	12/1/2014	No		
677	824	Yes	12/1/2014	No		
678	825	Yes	12/1/2014	No		
679	826	Yes	12/1/2014	No		
800		NA	12/31/2014	No		

ROW Acquistion Status I-69 Section 5 (As of December 19, 2013)

Parcel No.	Reference Parcel No.	Mitigation	Anticipated Date Available	Demolition Complete	Right-of-Way Agreements based on Right-of-Way Negotiations	
					Reference	Item
801		NA	12/31/2014	No		
802		NA	12/31/2014	No		
803		NA	12/31/2014	No		
805		NA	12/31/2014	No		
806		NA	12/31/2014	No		
807		NA	12/31/2014	No		
808		NA	12/31/2014	No		
809		NA	12/31/2014	No		
811		NA	12/31/2014	No		
812		NA	12/31/2014	No		
813		NA	12/31/2014	No		
814		NA	12/31/2014	No		
815		NA	12/31/2014	No		
816		NA	12/31/2014	No		
817		NA	12/31/2014	No		
818		NA	12/31/2014	No		
819		NA	12/31/2014	No		
820		NA	12/31/2014	No		
821		NA	12/31/2014	No		
822		NA	12/31/2014	No		
823		NA	12/31/2014	No		
824		NA	12/31/2014	No		
825		NA	12/31/2014	No		
826		NA	12/31/2014	No		
827		NA	12/31/2014	No		
828		NA	12/31/2014	No		
829		NA	12/31/2014	No		
830		NA	12/31/2014	No		
831		NA	12/31/2014	No		
832		NA	12/31/2014	No		
833		NA	12/31/2014	No		
834		NA	12/31/2014	No		
835		NA	12/31/2014	No		
836		NA	12/31/2014	No		
837		NA	12/31/2014	No		
838		NA	12/31/2014	No		
37SA		NA	8/1/2014	No		
37SB		NA	8/1/2014	No		
419SA		NA	12/31/2014	No		
424SA		NA	12/31/2014	No		
435SA		NA	12/1/2014	No		
445SA		NA	12/1/2014	No		

ROW Acquistion Status I-69 Section 5 (As of December 19, 2013)

Parcel No.	Reference Parcel No.	Mitigation	Anticipated Date Available	Demolition Complete	Right-of-Way Agreements based on Right-of-Way Negotiations	
					Reference	Item
462SA		NA	12/1/2014	No		
462SB		NA	12/1/2014	No		
463SB		NA	12/1/2014	No		
479SA		NA	12/1/2014	No		
486SA		NA	12/31/2014	No		
491SA		NA	12/31/2014	No		
498SA		NA	12/31/2014	No		
510SA		NA	12/1/2014	No		
511SA		NA	12/1/2014	No		
511SB		NA	12/1/2014	No		
546SA		NA	12/31/2014	No		
556SA		NA	12/31/2014	No		
635SA		NA	12/31/2014	No		
636SA		NA	12/31/2014	No		
642SA		NA	12/31/2014	No		
643SA		NA	12/31/2014	No		
646SA		NA	12/31/2014	No		

I-69 SECTION 5

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

ATTACHMENT 18-1
PERFORMANCE AND MEASUREMENT TABLES

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Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
1) ROADWAY								
	1.1	Obstructions and debris	Roadway and clear zone free from obstructions and debris	2 hrs	N/A	N/A	Visual Inspection	Number of c debris
	1.2	Pavement - Rigid	All roadways shall be safe for road users and shall maintain or exceed the condition as identified in the BACR (including shoulders, bridge decks, covers, gratings, frames and boxes)	24 hrs	28 days	1 mo.	**a) Localized deficiencies** Physical measurement.	Maintain or as identifiec
				24 hrs	28 days	1 mo.	**b) Faulting**	Maintain or as identifiec
				7 days	28 days	1 mo.	**c) Lane to Shoulder Drop-Off** Physical measurement	Maintain or identified in
	1.3	Pavement - Flexible	All roadways shall be safe for road users and shall maintain or exceed the condition as identified in the BACR (including shoulders, bridge decks, covers, gratings, frames and boxes)	24 hrs	28 days	1 mo.	**a) Potholes** Visual inspection.	Potholes gre square feet i depth.
				24 hrs	28 days	1 mo.	**b) Depression or Bump** Physical measurement.	Maintain or as identifiec
				7 days	28 days	1 mo.	**c) Lane to Shoulder Drop-Off** Physical measurement.	Maintain or identified in
	1.4	Curbs	All curbs shall maintain or exceed the condition as identified in the BACR	7 days	28 days	1 mo.	Visual inspection	Maintain or as identifiec
2) DRAINAGE								

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
	2.1	Pipes and Channels	Each element of the drainage system is maintained in its proper function by cleaning, clearing and/or emptying as appropriate from the point at which water drains from the travel way to the outfall or drainage way.	24 hrs	7 days	1 mo.	Visual inspection supplemented by CCTV where required to inspect buried pipe work	Maintain or identified in
			Maintain condition rating.	24 hrs			Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Maintain or identified in
	2.2	Drainage treatment devices, including erosion and sediment control devices	Drainage treatment and balancing systems, flow and spillage control devices function correctly and their location and means of operation is recorded adequately to permit their correct operation in Emergency.	24 hrs	7 days	1 mo.	Visual inspection	Devices fun with means displayed (N

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
	2.3	Travel Way	Water does not encroach on the travel way to the extent that such water would represent a hazard by virtue of its position and depth.	24 hrs	7 days	1 mo.	Visual inspection of water on surface	Instances of build-up
	2.4	Discharge systems	Surface water discharge systems perform their proper function and discharge to groundwater and waterways complies with the relevant legislation and permits.	24 hrs	7 days	1 mo.	Visual inspection and records	Non-compli Standards a
	2.5	Underdrains	Underdrain pipes and outlets in a fully functioning condition to maintain the design drainage flow.	24 hrs	7 days	1 mo.	Visual inspection.	Maintain or identified in
	2.6	Protected Species	Named species and habitats are protected.	24 hrs	28 days	1 mo.	Visual inspection	Compliance requirement

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
3) STRUCTURES								
	3.1	Structures having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or springlines of arches or extreme ends of openings or multiple boxes	Substructures and superstructures are free of: • blocked drains, weep pipes, manholes, and chambers • blocked drainage holes in structural components • defects in pedestrian protection measure • scour damage • deck and wearing surface defects	24 hrs 24 hrs 24 hrs 24 hrs 24 hrs	N/A	1 mo.	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Maintain or identified in

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
			Maintain condition rating.	24 hrs	N/A	1 mo.	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Maintain or identified in
	3.2	Structure components	-Expansion joints are free of: -dirt debris and vegetation -defects in drainage systems -loose nuts and bolts -defects in gaskets	7 days	N/A	1 mo.	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Records as Department Manual All condition all structure Maintain or identified in
			The deck drainage system is free of all obstructions and operates as intended.	24 hrs				

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
			-Parapets are free of: -loose nuts or bolts -blockages of hollow section drain holes -graffiti -vegetation -accident damage	24 hrs	N/A	1 mo.		
			-Railings and Parapets are functioning as intended.	24 hrs				
			-Bearings and bearing shelves are clean.	7 days				
			-Bridge bearing are functioning within their original design parameters to ensure satisfactory performance. Additional advice contained in bearing manufacturers' instructions	7 days				
			-Barrier railings are maintained in a structurally sound manner to function as intended.	24 hrs				
	3.3	Non-bridge class culverts	Maintain condition rating.	24 hrs	N/A	1 mo.	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Maintain or identified in
			Non-bridge-class culverts are free of: -scour damage	24 hrs			Visual inspection	Number with

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
	3.4	Gantries and high masts	Sign signal gantries, high masts are structurally sound and free of: -loose nuts and bolts -defects in surface protection systems -graffiti *Hazard Mitigation response 48 hrs in inclement weather	24 hrs* 48 hrs 72 hrs	N/A	1 mo.	Visual inspection	Maintain or identified in
	3.5	Load ratings	All structures maintain the design load capacity.	24 hrs	N/A	9 mo.	Inspection and assessment in accordance with the requirements of AASHTO's Guide Manual for Condition Evaluation and Load and Resistance Factor Rating (LRFR) of Highway Bridges, the INDOT Bridge inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Number of l Indiana lega legally perm
	3.6	Structural assessment	Evaluate structural damage to structures and liaise with emergency services to assure safe working in clearing the Incident, safety for traffic and adequate structural capacity.	24 hrs	28 days	N/A	Inspections and surveys as required by incident	Incident rep compliance

Table 18-A: Performance and Measurement Table for O&M During Construction								
Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measu
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
	3.7	Retaining Walls	Maintain retaining walls to ensure there are no defects affecting performance	48 hrs.	28 days	1 mo.	Exposure of the bottom of retaining wall footings due to soil settlement or other reasons Proper vertical and horizontal alignment Physical defects or chemical deterioration	Maintain or identified in
	3.8	Mechanically Stabilized Earthwork Retaining Walls	MSE retaining walls remain intact with no loss of backfill or mechanical connection	48 hrs.	28 days	1 mo.	Instances of granular backfill observed leaking through panel joints MSE walls retain constructed shape and is free of unrepaired settlement, bowing and discontinuities Drainage is free of obstruction and vegetation	Maintain or identified in

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
	3.9	Graffiti	Graffiti is removed in a manner and using materials that restore the surface to a like appearance similar to adjoining surfaces.	N/A	1 mo.	N/A	All graffiti is considered a Category 1 Defect	Inspection re compliance
	3.10	Permit Load Analysis	Analyze and respond to permit load request.	N/A	N/A	7 days		Analyze and Department Carrier Serv days.
4) PAVEMENT MARKINGS, OBJECT MARKERS, BARRIER MARKERS AND DELINEATORS								
	4.1	Pavement markings & symbols	Pavement markings and symbols are: -clean and visible during the day and at night -whole and complete and of the correct color, type, width and length -placed to meet the MUTCD	24 hrs	28 days	1 mo.	As specified in Standard Specification 808.07 and Indiana Test Method (ITM) 931. Physical measurement	Maintain or as identified
	4.2	Delineators & Markers	Markers and delineators are: -clean and visible -of the correct color and type -legible and reflective -straight and vertical	7 days	28 days	9 mo.	Visual inspection	Number of d delineators d

Table 18-A: Performance and Measurement Table for O&M During Construction								
Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
5) GUARDRAILS, SAFETY BARRIERS AND IMPACT ATTENUATORS								
	5.1	Guard rails and safety	All guardrails, safety barriers, concrete barriers, etc.) are repaired or replaced if they are damaged or destroyed.	24 hrs	7 days	1 mo.	Visual inspection	Maintain or as identifie
6) TRAFFIC SIGNS								
	6.1	Regulatory Signs	Signs shall: -convey a clear and appropriate message -be clean and visible during day and night -be repaired or replaced if they are damaged or destroyed	2 hrs	7 days	1 mo.	Visual inspection	Maintain or identified in
	6.2	Non-Regulatory Signs	Signs shall: -convey a clear and appropriate message -be clean and visible during day and night -be repaired or replaced if they are damaged or destroyed	7 days	28 days	1 mo.	Visual inspection	Maintain or identified in

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
7) TRAFFIC SIGNALS								
	7.1	General	i) Traffic Signals and their associated equipment are: -clean and visible -correctly aligned and operational -free from damage caused by accident or vandalism – convey clear and appropriate message ii) Signal timing and operation is correct iii) Contingency plans are in place to rectify Category 1 defects not immediately repairable to assure alternative traffic control is provided during a period of failure	2 hrs	24 hrs	1 mo.	**a) General condition** Visual inspection **b) Damage** Visual inspection **c) Signal timing** Timed measurements **d) Contingency plans** Records Review	Maintain or identified in Installations timings Full continge place
	7.2	Soundness	Traffic Signals are structurally and electrically sound	24 hrs	28 days	1 mo.	a) Structural soundness Visual inspection b) Electrical soundness Testing to meet NEC regulations	Maintain or identified in
	7.3	Identification marking	Signals have identification markers and the telephone number for reporting faults are correctly located, clearly visible, clean and legible	N/A	28 days	6 mo.	Visual inspection	Inspection r identificatio information

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
8) LIGHTING								
	8.1	Roadway Lighting – General	i) Lighting is free from defects and provides acceptable uniform lighting quality ii) Lanterns are clean and correctly positioned iii) Lighting units are free from accidental damage or vandalism iv) Columns are upright, correctly founded, visually acceptable and structurally sound	24 hrs	28 days	6 mo.	**a) Mainline lights operable** Night time inspection or automated logs **b) Mainline lights out of action** Night time inspection or automated logs	Less than 9 functioning Instances of consecutive
	8.2	Electrical Supply	Electricity supply, feeder pillars, cabinets, switches and fittings are electrically, mechanically and structurally sound and functioning	24 hrs	7 days	1 mo.	Testing to meet NEC regulations, visual inspection	Inspection r installation a

Table 18-A: Performance and Measurement Table for O&M During Construction								
Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
	8.3	High Mast Lighting	i) High mast luminaries functioning on each pole ii) All obstruction lights are present and working (if required) iii) Compartment door is secure with all bolts in place iv) All winch and safety equipment is correctly functioning and maintained without rusting or corrosion (for structural requirements refer to Element Category 3)	24 hrs	48 hrs	1 mo.	Yearly inspection and night time inspections or automated logs	Instances of not working Identificatio
9) FENCES, WALLS AND SOUND ABATEMENT								
	9.1	Design and Location	Fences and walls act as designed and serve the purpose for which they were intended	7 days	28 days	6 mo.	Visual Inspection	Inspection re compliance

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
10) LANDSCAPING								
	10.1	Vegetated Areas – Except landscaped areas – General	Vegetation is maintained so that: i) Height of grass and weeds is kept within the limits described for urban and rural areas. Mowing begins before vegetation reaches the maximum height. ii) Spot mowing at intersections, ramps or other areas maintains visibility of appurtenances and sight distance. iii) Grass or vegetation does not encroach into or on paved shoulders, main lanes, islands, riprap, traffic barrier or curbs. iv) A herbicide program is undertaken to control noxious weeds and to eliminate grass in pavement or walkways.	7 days	14 days	28 days	**a) Urban areas** Physical measurement of height of grass and weeds **b) Rural areas** Physical measurement of height of grass and weeds **c) Encroachment** Visual inspection of instances of encroachment of vegetation **d) Wildflowers** Visual Inspection with audit of process. **e) Sight lines** Visual inspection	Individual m areas to hav of grass and 5 inches and Individual m to have 95% and weeds b and 30 inche Occurrences encroachme Adherence t managemer Instances of lines or sigh

Table 18-A: Performance and Measurement Table for O&M During Construction								
Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
			v) A full width mowing cycle is completed after the first frost. vi) Wildflowers are preserved utilizing the aesthetic guidelines					
	10.2	Trees, shrubs and ornamentals	i) Trees, shrubs and ornamentals are trimmed to insure they do not interfere with vehicles or sight distance, or inhibit the visibility of signs. ii) Dead trees, shrubs, ornamentals and branches are removed. Potentially dangerous trees or limbs are removed. iii) All invasive or noxious trees and vegetation are removed. Diseased trees or limbs are treated or removed by licensed contractors.	7 days 7 days N/A	28 days 28 days N/A	6 mo. 6 mo. 12 mo.	Visual inspection	Inspection r compliance
	10.3	Wetlands	Wetlands are managed in accordance with the permit requirements	24 hrs	7 days	28 days	Visual inspection, assessment of permit issuers	Instances of requirement

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
11) EARTHWORKS, EMBANKMENTS AND CUTTINGS								
	11.1	Slope Failure	All structural or natural failures of the embankment and cut slopes of the Facility are repaired	24 hrs	28 days	1 mo.	Visual inspection by geotechnical specialist and further tests as recommended by the specialist	Recorded in failure
	11.2	Slopes - General	Slopes are maintained in general conformance to the original graded cross-sections, the replacement of landscaping materials, reseeding and revegetation for erosion control purposes and removal and disposal of all eroded materials from the roadway and shoulders	24 hrs	28 days	1 mo.	Visual inspection	Inspection re compliance
12) SNOW AND ICE CONTROL								
	12.1	Continuous plowing and deicing	Continuous plowing and deicing application to achieve a maximum circuit time of 2 hours.	2 hrs	N/A	N/A	Circuit time measurement.	Winter opera
	12.2	Snow accumulation	Snow accumulation adjacent to barrier walls removed concurrent with mainline pavement snow removal.	**	N/A	N/A	** Noncompliance is a Category 1 Defect.	Winter opera
	12.3	Lanes and ramps (as defined in Section 10.3.1)	Achieve bare pavement after end of the winter event.	2 hr	N/A	N/A	Visual inspection	Winter opera

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
	12.4	Shoulders/ Medians/ Crossovers	Plowed within eight hours of the end of winter event, up to 6 inch total accumulation winter event.	8 hr	N/A	N/A	Visual inspection	Winter opera
			Plowed within 12 hours of the end of winter event, over 6 inch and up to 10 inch total accumulation winter event.	12 hr	N/A	N/A		
			Plowed within 16 hours of the end of winter event over 10 inch total accumulation winter event.	16 hr	N/A	N/A		
	12.5	Hazards	Address any hazard immediately upon detection or being made aware.	1 hr	N/A	N/A		Winter opera
			Address isolated slippery conditions 100% of the time.	1 hr	N/A	N/A	Visual inspection or being made aware.	Winter opera
	12.6	Salt storage	Salt stored in covered buildings at all times.	**	N/A	N/A	** Noncompliance is a Category 1 Defect.	Instances of storage.
	12.7	Reporting requirements	All reporting requirements identified in Section 18 are accurate, complete, and timely 100% of the time.	1 day	7 days	N/A	Audit.	Audit record

Table 18-A: Performance and Measurement Table for O&M During Construction								
Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
13) INCIDENT RESPONSE								
	13.1	Incident re-opening	Re-open lane(s) to traffic following return to Developer of operational control following an Incident or Emergency in accordance with Section 18.3.1.11.	1 hr	N/A	N/A	No complaints from Emergency responders. Inspection records showing compliance	Following tra control by th Services: (i) re-open la minutes in 9 Emergencie year rolling (ii) re-open minutes in 1
	13.2	Incident response	Provide Equipment and Personnel for Incident Response	1 hr	N/A	N/A	Inspection records showing compliance	Following fir incident (i) attend the within 30 mi Incidents me rolling basis (ii) attend th Incident with 100% of cas
	13.3	Hazardous Materials	For any hazardous materials spills, comply with the requirements of Section 18.1.7	1 hr	N/A	N/A	Developers O&M Safety Plan details the process and procedures in place and followed.	Inspection re compliance
	13.4	Structural assessment	Evaluate structural damage to structures and liaise with emergency services to ensure safe working in clearing the incident	1 hr	N/A	N/A	Inspections and surveys as required by incident.	Incident rep compliance

Table 18-A: Performance and Measurement Table for O&M During Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
	13.5	Temporary and permanent remedy	Propose and implement temporary measures or permanent repairs to Defects arising from the Incident. Ensure the structural safety of any structures affected by the incident	24 hrs	28 days	N/A	Review and inspection of the incident site.	Inspection re compliance
14) CUSTOMER RESPONSE								
	14.1	Response to inquiries	Timely and effective response to customer inquiries and complaints.	48 hrs	28 days	N/A	Contact the customer within 48 hours following initial customer inquiry. All work resulting from customer requests is scheduled within 48 hours of customer contact. Follow-up contact with the customer within 72 hours of initial inquiry. All customer concerns/requests are resolved to IFA's satisfaction within 2 weeks of the initial inquiry.	Number of re specified tim
	14.2	Customer contact line	Telephone line manned during business hours and 24 hour availability of messaging system. Faults to telephone line or message system rectified	24 hrs	28 days	N/A	Instances of line out of action or unmanned	Operations r availability in from public.

Table 18-A: Performance and Measurement Table for O&M During Construction								
Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Base Repair		
15) SWEEPING AND CLEANING								
	15.1	Sweeping	i) Keep all channels, hard shoulders, gore areas, ramps, intersections, islands and frontage roads swept clean, ii) Clear and remove debris from traffic lanes, hard shoulders, verges and central reservations, footways and cycle ways iii) Remove all sweepings without stockpiling in the right of way and dispose of at approved location.	7 days	28 days	6 mo.	Buildup of dirt, ice rock, debris, etc. on roadways and bridges not to accumulate greater than 24 inches wide or 0.50 inches deep	Inspection re compliance
	15.2	Litter	i) Keep the right of way in a neat condition, remove litter regularly	N/A	28 days	N/A	No more than 20 pieces of litter per roadside mile shall be visible when traveling at highway speed.	Inspection re compliance

Notes to Table 18-A:

* Items in these columns shall be reviewed annually by Developer as part of the MP to comply with Technical Provisions and/or

"Hazard Mit." denotes Hazard Mitigation which is defined as an action taken to mitigate a danger to users.

"Perm. Remedy" denotes Permanent Remedy which is defined as an action taken to provide temporary remediation to eliminate level of service reduction until a permanent repair can be undertaken.

"Base Repair" denotes Baseline Repair which is defined as the repair necessary to ensure each Element achieves the specified co time period. The necessary repair shall be the reinstatement of the condition of the Element to meet or exceed the condition re Asset Condition Report (BACR) unless a more stringent condition is specified in Table 18-A.

"Category 1" denotes Category 1 Defect which means a Defect which requires prompt attention because it represents an immed there is a risk or immediate or imminent structural deterioration, or there is an immediate or imminent risk of damage to a third equipment, or there is an immediate or imminent risk of damage to the environment.

"Cat. 2" denotes Category 2 Defect which means any Defect other than a Category 1 Defect.

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
1) ROADWAY								
	1.1	Obstructions and debris	Roadway and clear zone free from obstructions and debris	2 hrs	N/A	N/A	Visual Inspection	Number of c debris
	1.2	Pavement - Rigid	All roadways have a smooth surface course (including shoulders, bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	N/A	N/A	8 mo.	**a) Cracks** Automated condition distress survey.	Total numbe mile with an longitudinal, corner break Cracks grea wide with sp wide. Intersecting a pattern tha into three or Unsealed cr 0.125 inches
				N/A	N/A	8 mo.	**b) Corner Breaks** Visual inspection.	Corner brea 0.50 inch dr
				24 hrs	28 days	8 mo.	**c) Localized deficiencies** Physical measurement.	Wheel path localized def spalling, pop greater than a depth of 0 than 6 inche
				24 hrs	28 days	8 mo.	**d) Faulting** Automated condition distress survey.	Faulting that elevation ch or cracks gr inches.
				7 days	28 days	8 mo.	**e) Lane to Shoulder Drop-Off**	Instances of greater than length of 18

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
							Physical measurement.	more than 2 shoulder len
				N/A	N/A	8 mo.	**f) Roadway Smoothness** (excluding shoulders and gores) Measurement of International Roughness Index (IRI) shall meet the requirements in the FHWA Highway Performance Monitoring System (HPMS) Field Manual.	Meet Table Requiremen
				N/A	N/A	8 mo.	**g) Skid resistance** (excluding gores) ASTM E274 and a smooth tire in accordance with ASTM E524 at 40 MPH using a full scale smooth tire meeting the requirements of ASTM E 524. A minimum of 11 equally spaced tests shall be performed in each 0.25 mile segment of each lane and averaged to obtain the average test value for each 0.25 mile segment.	The average 0.25 mile se less than 35 value less th
	1.2 cont		Road users warned of potential skidding hazards	24 hrs	7 days	N/A	**Skid resistance** (as above)	Instances w warned of p hazard when identified.
	1.3	Pavement - Flexible	All roadways have a smooth surface course (including shoulders, bridge decks, covers, gratings, frames and boxes) with adequate skid resistance and free from Defects.	N/A	N/A	8 mo.	**a) Cracks** Automated condition distress survey.	Cracks grea wide over a 6 feet or gre Unsealed cr 0.125 inches
				24 hrs	28 days	8 mo.	**b) Potholes**	Potholes gre

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
	Ref	Element		Category 1		Cat. 2		
				Hazard Mit.	Perm. Remedy	Perm. Repair		
							Visual inspection.	square feet depth.
				N/A	N/A	8 mo.	**c) Shoving** Physical measurement.	Shoved area square feet.
				N/A	N/A	8 mo.	**d) Rutting** Automated condition distress survey. ASTM E950. Measurements of localized areas shall be carried out using a 6 foot straight edge in accordance with ASTM E1707.	Rutting dept inches avera section, 0.2 per 300 foot instance gre inches
				24 hrs	28 days	8 mo.	**e) Depression or Bump** Physical measurement.	Depression 0.5 inches fo than 1 squa No single m exceed 1 inc
				7 days	28 days	8 mo.	**f) Lane to Shoulder Drop-Off** Physical measurement.	Instances of greater than continuous l in aggregate percent of to (Number)
				N/A	N/A	8 mo.	**g) Roadway Smoothness** (excluding shoulders and gores) Measurement of International Roughness Index (IRI) shall meet the requirements in the FHWA Highway Performance Monitoring System (HPMS) Field Manual.	Meet Table Requiremer
				N/A	N/A	8 mo.	**h) Skid resistance** (excluding shoulders and gores) ASTM E274 and a smooth tire in	The average 0.25 mile se less than 35

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
							accordance with ASTM E524 at 40 MPH using a full scale smooth tire meeting the requirements of ASTM E 524. A minimum of 11 equally spaced tests shall be performed in each 0.25 mile segment of each lane and averaged to obtain the average test value for each 0.25 mile segment.	value less th
			Road users warned of potential skidding hazards	24hrs	7days	N/A	**Skid resistance** (as above)	Instances wi warned of po hazard when identified.
	1.4	Joints in concrete	Joints in concrete paving are sealed and watertight Longitudinal joint separation	24 hrs	28 days	8 mo.	Visual inspection of joints Measurement of joint width and level difference of two sides of joints	Length of inc joints greate 12-foot lengt Joint width n faulting more
	1.5	Curbs	Curbs are free of defects	7 days	28 days	8 mo.	Visual inspection	Length out o inch in 10 fe

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
2) DRAINAGE								
	2.1	Pipes and Channels	Each element of the drainage system is maintained in its proper function by cleaning, clearing and/or emptying as appropriate from the point at which water drains from the travel way to the outfall or drainage way.	24 hrs	7 days	6 mo.	Visual inspection supplemented by CCTV where required to inspect buried pipe work	Length with cross sectio
			Maintain condition rating.	24 hrs	3 mo.	8 mo.	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Maintain an rating no lo structure.
	2.2	Drainage treatment devices, including erosion and sediment control devices	Drainage treatment and balancing systems, flow and spillage control devices function correctly and their location and means of operation is recorded adequately to permit their correct operation in Emergency.	24 hrs	7 days	6 mo.	Visual inspection	Devices fun with means displayed (N

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
	2.3	Travel Way	Water does not encroach on the travel way to the extent that such water would represent a hazard by virtue of its position and depth.	24 hrs	7 days	6 mo.	Visual inspection of water on surface	Instances of build-up
	2.4	Discharge systems	Surface water discharge systems perform their proper function and discharge to groundwater and waterways complies with the relevant legislation and permits.	24 hrs	7 days	6 mo.	Visual inspection and records	Non-compli Standards a
	2.5	Underdrains	Underdrain pipes and outlets in a fully functioning condition to maintain the design drainage flow.	24 hrs	7 days	6 mo.	Visual inspection.	Devices fun (number)
	2.6	Protected Species	Named species and habitats are protected.	24 hrs	28 days	6 mo.	Visual inspection	Compliance requirement
3) STRUCTURES								
	3.1	Structures having an opening measured along the	Substructures and superstructures are free of: -undesirable vegetation -debris and bird droppings	 N/A N/A	 90 days 90 days	 8 mo. 8 mo.	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations,	Records as Department Manual All condition

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
		center of the roadway of more than 20 feet between undercopings of abutments or springlines of arches or extreme ends of openings or multiple boxes	-blocked drains, weep pipes manholes and chambers	24 hrs	28 days	8 mo.	23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	all structure
			-blocked drainage holes in structural components	24 hr	28 days	8 mo.		Longitudinal cracks great for a continu or greater.
			-defects in joint sealants	N/A	28 days	8 mo.		
			-defects in pedestrian protection measure	24 hrs	28 days	8 mo.		Spalling gre feet.
			-scour damage	24 hrs	28 days	8 mo.		
			-corrosion of rebar	N/A	N/A	8 mo.		Defects in p
			-deck and wearing surface defects	24 hrs	28 days	8 mo.		greater than any location of overall co structural m
			Maintain substructure settlement within specified requirements.	N/A	28 days	8 mo.	Physical measurement with straight edge.	Post-constru bridge piers Less than settlement inch differe adjacent p
								Differential s approach sla Less than 1- and less tha between enc

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
			Maintain condition rating.	24 hrs	3 mo.	8 mo.	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Maintain a c lower than 6 element for Maintain an rating no lov structure.
	3.2	Structure components	-Expansion joints are free of: dirt debris and vegetation defects in drainage systems loose nuts and bolts defects in gaskets -The deck drainage system is free of all obstructions and operates as intended.	7 days 24 hrs	3 mo.	8 mo.	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Records as Department Manual All condition all structure

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
			-Parapets are free of: • loose nuts or bolts • blockages of hollow section drain holes • graffiti • vegetation • accident damage	24 hrs				
			-Railings and Parapets are functioning as intended.	24 hrs				
			-Bearings and bearing shelves are clean.	7 days				
			-Bridge bearing are functioning within their original design parameters to ensure satisfactory performance. Additional advice contained in bearing manufacturers' instructions	7 days				
			-Barrier railings are maintained in a structurally sound manner to function as intended.	24 hrs				

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
	3.3	Non-bridge class culverts	Non-bridge-class culverts are free of: -Any combination of vegetation, debris or silt causing >10% loss in cross-section of the structure -defects in sealant to movement joints -scour damage	24 hrs	28 days	6 mo.	Visual inspection	Number with or silt > 10% not including applicable Number with sealant and Number with
			Maintain condition rating.	24 hrs	3 mo.	8 mo.	Inspection and assessment in accordance with the requirements of federal National Bridge Inspection Standards (NBIS) of the Code of Federal Regulations, 23 Highways – Part 650, the Department Bridge Inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Maintain an rating no low structure.

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
	3.4	Gantries and high masts	Sign signal gantries, high masts are structurally sound and free of: loose nuts and bolts defects in surface protection systems graffiti *Hazard Mitigation response 48 hrs in inclement weather	 24 hrs* 48 hrs 72 hrs	3 mo.	9 mo.	Visual inspection	Number with Number with protection Number with
	3.5	Load ratings	All structures maintain the design load capacity.	24 hrs	3 mo.	9 mo.	Inspection and assessment in accordance with the requirements of AASHTO's Manual for Bridge Evaluation and Load, the INDOT Bridge inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Number of l Indiana lega legally perm
	3.6	Surface coating	Include a re-coating schedule in the MP.	N/A	N/A	1 year	Visual inspection of surface condition	Greater thar area is ruste delaminated inspection.
	3.7	Structural assessment	Evaluate structural damage to structures and liaise with emergency services to assure safe working in clearing the Incident, safety for traffic and adequate structural capacity.	24 hrs	28 days	N/A	Inspections and surveys as required by incident	Incident rep compliance

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
	3.8	Retaining Walls	Maintain retaining walls to ensure there are no defects affecting performance	48 hrs	28 days	12 mo.	Physical Measurement and Inspections Cracks measured on the surface of the retaining wall in the AM prior to 3 hours after sunrise at a concrete age > 28 days	Exposure of retaining wa settlement o Occurrences horizontal al exceeding 0 with a 10 ft. Physical def deterioration Surface scal light scaling of 10% Occurrences than 0.031 i measureme cracking per Occurrences notches, cra and cracked steel compo
	3.9	Mechanically Stabilized Walls	MSE retaining walls remain intact with no loss of backfill or mechanical connection	48 hrs	28 days	12 mo.	Physical Measurement and Inspections	Instances of observed lea joints MSE walls re shape and is settlement, b discontinuitie Drainage is and vegetati

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
	3.10	Graffiti	Graffiti is removed in a manner and using materials that restore the surface to a like appearance similar to adjoining surfaces.	N/A	1 mo.	N/A	All graffiti is considered a Category 1 Defect	Inspection re compliance
	3.11	Permit Load Analysis	Analyze and respond to permit load request.	N/A	N/A	7 days		Analyze and Department Carrier Serv days.
4) PAVEMENT MARKINGS, OBJECT MARKERS, BARRIER MARKERS AND DELINEATORS								
	4.1	Pavement markings & symbols	Pavement markings and symbols are: • clean and visible during the day and at night • whole and complete and of the correct color, type, width and length • placed to meet the MUTCD	24 hrs	28 days	9 mo.	As specified in Standard Specification 808.07 and Indiana Test Method (ITM) 931. Physical measurement	90% of lengt retro-reflecti specified in Specification to Novembe Length with of area of m Length with 10% of spec Length perfo function and relevant regu Pavement s each symbo intended
	4.2	Delineators	Markers and delineators	7 days	28 days	9 mo.	Visual inspection	Number of c

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
		& Markers	are: -clean and visible -of the correct color and type -legible and reflective -straight and vertical					delineators c
5) GUARDRAILS, SAFETY BARRIERS AND IMPACT ATTENUATORS								
	5.1	Guard rails and safety	All guardrails, safety barriers, concrete barriers, etc.) are maintained free of Defects. They are appropriately placed and correctly installed at the correct height and distance from roadway or obstacles.	24 hrs	7 days	9 mo.	Visual inspection	Length of ro correctly ins Length free Length at co Length at co roadway and
6) TRAFFIC SIGNS								
	6.1	Regulatory Signs	i) Signs are clean, correctly located, clearly visible, legible, reflective, at the correct height and free from structural and electrical defects ii) Identification markers are provided, correctly located, visible, clean and legible iii) Sign mounting posts are vertical, structurally sound and rust free iv) All break-away sign mounts are clear of silt or other debris that could	2 hrs	7 days	9 mo.	**a) Retroreflectivity** Coefficient of retro reflectivity **b) Face damage** Visual inspection **c) Placement** Visual inspection **d) Obsolete signs** Visual inspection **e) Sign Information** Visual inspection	Number of s below the re MUTCD Number of s damage gre Signs placed Project Stan twisted or le Number of c Sign informa size, locatio to meet its in

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
			impede break-away features and shall have correct stub heights v) Obsolete and redundant signs are removed or replaced as appropriate vi) Visibility distances meet the stated requirements vii) Sign information is of the correct size, location, type and wording to meet its intended purpose and any statutory requirements viii) All structures and elements of the signing system are kept clean and free from debris and have clear access provided. ix) All replacement and repair materials and equipment are in accordance with the requirements of the MUTCD					
	6.2	Non-Regulatory Signs	Requirements of 6.1	7 days	28 days	9 mo.	Visual inspection	Number of d critical signs
7) TRAFFIC SIGNALS								
	7.1	General	i) Traffic Signals and their associated equipment are: clean and visible	2 hrs	24 hrs	6 mo.	**a) General condition** Visual inspection	Signals are

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measu
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
			-correctly aligned and operational -free from damage caused by accident or vandalism -correctly aligned and operational ii)Signal timing and operation is correct iii)Contingency plans are in place to rectify Category 1 defects not immediately repairable to assure alternative traffic control is provided during a period of failure				**b) Damage** Visual inspection **c) Signal timing** Timed measurements **d) Contingency plans** Records Review	Signals are Installations timings Full conting place
	7.2	Soundness	Traffic Signals are structurally and electrically sound	24 hrs	28 days	6 mo.	a) Structural soundness Visual inspection b) Electrical soundness Testing to meet NEC regulations	Inspection r installation
	7.3	Identification marking	Signals have identification markers and the telephone number for reporting faults are correctly located, clearly visible, clean and legible	N/A	28 days	6 mo.	Visual inspection	Inspection r identificatio information
8) LIGHTING								
	8.1	Roadway Lighting – General	i)Lighting is free from defects and provides acceptable uniform lighting quality ii) Lanterns are clean and	24 hrs	28 days	6 mo.	**b) Mainline lights operable** Night time inspection or automated logs **c) Mainline lights out of action**	Less than 9 functioning Instances o consecutive functioning

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
			correctly positioned iii)Lighting units are free from accidental damage or vandalism iv)Columns are upright, correctly founded, visually acceptable and structurally sound				Night time inspection or automated logs	
	8.2	Electrical Supply	Electricity supply, feeder pillars, cabinets, switches and fittings are electrically, mechanically and structurally sound and functioning	24 hrs	7 days	1 mo.	Testing to meet NEC regulations, visual inspection	Inspection r installation a
	8.3	High Mast Lighting	v)High mast luminaries functioning on each pole vi)All obstruction lights are present and working (if required) vii)Compartment door is secure with all bolts in place viii) All winch and safety equipment is correctly functioning and maintained without rusting or corrosion (for structural requirements refer to Element Category 3)	24 hrs	48 hrs	1 mo.	Yearly inspection and night time inspections or automated logs	Instances of not working Identificatio

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
9) FENCES, WALLS AND SOUND ABATEMENT								
	9.1	Design and Location	Fences and walls act as designed and serve the purpose for which they were intended	7 days	28 days	6 mo.	Visual Inspection	Inspection re compliance
10) LANDSCAPING								
	10.1	Vegetated Areas – Except landscaped areas – General	Vegetation is maintained so that: i)Height of grass and weeds is kept within the limits described for urban and rural areas. Mowing begins before vegetation reaches the maximum height. ii)Spot mowing at intersections, ramps or other areas maintains visibility of appurtenances and sight distance. iii)Grass or vegetation does not encroach into or on paved shoulders, main lanes, sidewalks, islands, riprap, traffic barrier or curbs. iv)A herbicide program is undertaken to control noxious weeds and to eliminate grass in pavement	7 days	14 days	28 days	**a) Urban areas** Physical measurement of height of grass and weeds **b)Rural areas** Physical measurement of height of grass and weeds **c)Encroachment** Visual inspection of instances of encroachment of vegetation **d)Wildflowers** Visual Inspection with audit of process. **e)Sight lines** Visual inspection	Individual m areas to hav of grass and 5 inches and Individual m to have 95% and weeds b and 30 inche Occurrences encroachme Adherence t managemer Instances of lines or sight

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
			or walkways. v)A full width mowing cycle is completed after the first frost. vi)Wildflowers are preserved utilizing the aesthetic guidelines					
	10.2	Landscaped Areas	i) All landscaped areas are maintained to their originally constructed condition. Landscaped areas are maintained as designated in the Plans. ii) Mowing, litter pickup, plant maintenance, pruning, insect, disease and pest control, fertilization, mulching, bed maintenance; watering is undertaken as per MP. iii) The height of grass and weeds is kept between 2 inches and 8 inches. Mowing begins before vegetation reaches 8 inches.	3 days	7 days	28 days	Visual inspection	Inspection r compliance
			Damaged or dead vegetation is removed and replaced, as supplied in its originally constructed condition.	24 hrs	N/A	12 mo.	Visual inspection	Inspection r compliance

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
	10.3	Trees, shrubs and ornamentals	i) Trees, shrubs and ornamentals on the right of way, except in established no mow areas, are trimmed in accordance with Project Standards.	N/A	N/A	12 mo.	Visual inspection	Inspection r compliance
			ii) Trees, shrubs and ornamentals are trimmed to insure they do not interfere with vehicles or sight distance, or inhibit the visibility of signs.	7 days	28 days	6 mo.		
			iii) Dead trees, shrubs, ornamentals and branches are removed. Potentially dangerous trees or limbs are removed.	7 days	28 days	6 mo.		
			iv) All invasive or noxious trees and vegetation are removed. Diseased trees or limbs are treated or removed by licensed contractors.	N/A	N/A	12 mo.		
			Damaged or dead vegetation is removed and replaced, as supplied in its originally constructed	N/A	N/A	12 mo.	Visual inspection	Inspection r compliance
	10.4	Wetlands	Wetlands are managed in accordance with the permit requirements	24 hrs	7 days	28 days	Visual inspection, assessment of permit issuers	Instances of requirement

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
11) EARTHWORKS, EMBANKMENTS AND CUTTINGS								
	11.1	Slope Failure	All structural or natural failures of the embankment and cut slopes of the Facility are repaired	24 hrs	28 days	6 mo.	Visual inspection by geotechnical specialist and further tests as recommended by the specialist	Recorded in failure
	11.2	Slopes - General	Slopes are maintained in general conformance to the original graded cross-sections, the replacement of landscaping materials, reseeding and revegetation for erosion control purposes and removal and disposal of all eroded materials from the roadway and shoulders	24 hrs	28 days	6 mo.	Visual inspection	Inspection re compliance
12) SNOW AND ICE CONTROL								
	12.1	Continuous plowing and deicing	Continuous plowing and deicing application to achieve a maximum circuit time of 2 hours.	2 hrs	N/A	N/A	Circuit time measurement.	Winter opera
	12.2	Snow accumulation	Snow accumulation adjacent to barrier walls removed concurrent with mainline pavement snow removal.	**	N/A	N/A	** Noncompliance is a Category 1 Defect.	Winter opera
	12.3	Lanes and ramps (as defined in Section 10.3.1)	Achieve bare pavement after end of the winter event.	2 hr	N/A	N/A	Visual inspection	Winter opera

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
	12.4	Shoulders/ Medians/ Crossovers	Plowed within eight hours of the end of winter event, up to 6 inch total accumulation winter event.	8 hr	N/A	N/A	Visual inspection	Winter opera
			Plowed within 12 hours of the end of winter event, over 6 inch and up to 10 inch total accumulation winter event.	12 hr	N/A	N/A		
			Plowed within 16 hours of the end of winter event over 10 inch total accumulation winter event.	16 hr	N/A	N/A		
	12.5	Hazards	Address any hazard immediately upon detection or being made aware.	1 hr	N/A	N/A		Winter opera
			Address isolated slippery conditions 100% of the time.	1 hr	N/A	N/A	Visual inspection or being made aware.	Winter opera
	12.6	Salt storage	Salt stored in covered buildings at all times.	**	N/A	N/A	** Noncompliance is a Category 1 Defect.	Instances of storage.
	12.7	Reporting requirements	All reporting requirements identified in Section 18 are accurate, complete, and timely 100% of the time.	1 day	7 days	N/A	Audit.	Audit record

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
13) INCIDENT RESPONSE								
	13.1	Incident re-opening	Re-open lane(s) to traffic following return to Developer of operational control following an Incident or Emergency in accordance with Section 18.3.1.11.	1 hr	N/A	N/A	No complaints from Emergency responders. Inspection records showing compliance	Following tra control by th Services: (i) re-open la minutes in 9 Emergencie year rolling (ii) re-open l minutes in 1
	13.2	Incident response	Provide Equipment and Personnel for Incident Response	1 hr	N/A	N/A	Inspection records showing compliance	Following fir incident (i) attend the within 30 mi Incidents me rolling basis (ii) attend th Incident with 100% of cas
	13.3	Hazardous Materials	For any hazardous materials spills, comply with the requirements of Section 18.1.7	1 hr	N/A	N/A	Developers O&M Safety Plan details the process and procedures in place and followed.	Inspection re compliance
	13.4	Structural assessment	Evaluate structural damage to structures and liaise with emergency services to ensure safe working in clearing the incident	1 hr	N/A	N/A	Inspections and surveys as required by incident.	Incident rep compliance

Table 18-B: Performance and Measurement Table for O&M After Construction

Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
	13.5	Temporary and permanent remedy	Propose and implement temporary measures or permanent repairs to Defects arising from the Incident. Ensure the structural safety of any structures affected by the incident	24 hrs	28 days	N/A	Review and inspection of the incident site.	Inspection re compliance
14) CUSTOMER RESPONSE								
	14.1	Response to inquiries	Timely and effective response to customer inquiries and complaints.	48 hrs	28 days	N/A	Contact the customer within 48 hours following initial customer inquiry. All work resulting from customer requests is scheduled within 48 hours of customer contact. Follow-up contact with the customer within 72 hours of initial inquiry. All customer concerns/requests are resolved to IFA's satisfaction within 2 weeks of the initial inquiry.	Number of r specified tim
	14.2	Customer contact line	Telephone line manned during business hours and 24 hour availability of messaging system. Faults to telephone line or message system rectified	24 hrs	28 days	N/A	Instances of line out of action or unmanned	Operations r availability in from public.

Table 18-B: Performance and Measurement Table for O&M After Construction								
Element Category			Performance Requirement	Response to Defects			Inspection and Measurement Method*	Measur
				Category 1		Cat. 2		
	Ref	Element		Hazard Mit.	Perm. Remedy	Perm. Repair		
15) SWEEPING AND CLEANING								
	15.1	Sweeping	iv) Keep all channels, hard shoulders, gore areas, ramps, intersections, islands and frontage roads swept clean, v) Clear and remove debris from traffic lanes, hard shoulders, verges and central reservations, footways and cycle ways vi) Remove all sweepings without stockpiling in the right of way and dispose of at approved location.	7 days	28 days	6 mo.	Buildup of dirt, ice rock, debris, etc. on roadways and bridges not to accumulate greater than 24 inches wide or 0.50 inches deep	Inspection re compliance
	15.2	Litter	i) Keep the right of way in a neat condition, remove litter regularly	N/A	28 days	N/A	No more than 20 pieces of litter per roadside mile shall be visible when traveling at highway speed.	Inspection re compliance

Notes to Table 18-B:

* Items in these columns shall be reviewed annually by Developer as part of the MP to comply with Technical Pr
Industry Practice.

“Hazard Mit.” denotes Hazard Mitigation which is defined as an action taken to mitigate a danger to users.

“Perm. Remedy” denotes Permanent Remedy which is defined as an action taken to provide temporary remedia
dangerous condition or level of service reduction until a permanent repair can be undertaken.

“Perm. Repair” denotes Permanent Repair which is defined as the action taken to restore the asset to full compli
Performance Requirements.

“Category 1” denotes Category 1 Defect which means a Defect which requires prompt attention because it repre
immediate or imminent hazard, or there is a risk or immediate or imminent structural deterioration, or there is an
imminent risk of damage to a third party’s property or equipment, or there is an immediate or imminent risk of da
environment.

“Cat. 2” denotes Category 2 Defect which means any Defect other than a Category 1 Defect.

Table 18-C: IRI Requirements

Pavement Smoothness for HMA and PCCP		
Design Speed (mph)	**IRI (in./mile) (1 Mile Average)**	**IRI (in./mile) (300 ft Section)**
>55	120	160
>45 ≤55	130	190
>35 ≤45	140	190
≤35	150	190

I-69 SECTION 5

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

ATTACHMENT 18-3
BASELINE ASSET CONDITION REPORT FRAMEWORK

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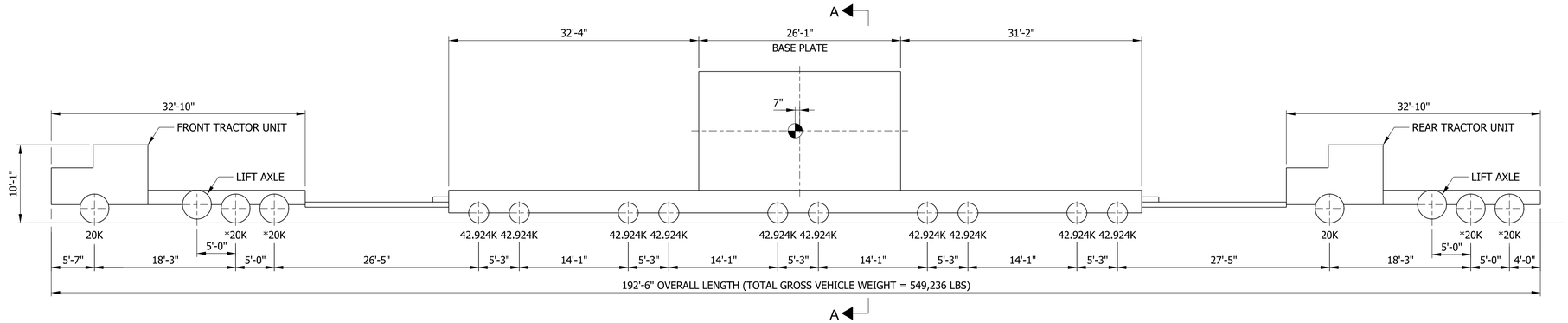
Baseline Asset Condition Report Framework	
Element	**Minimum Baseline Condition to be Maintained**
1) Roadway	
Rigid Pavement- Localized deficiencies	To be completed as part of the BACR by Developer
Rigid Pavement- Faulting	To be completed as part of the BACR by Developer
Flexible Pavement- Potholes	To be completed as part of the BACR by Developer
Flexible Pavement- Depression or Bump	To be completed as part of the BACR by Developer
Curb	To be completed as part of the BACR by Developer
2) Drainage	
Pipes and Channels	Maintain condition no lower than currently shown in folder 08.2 Small Culvert Inspection Reports of the RID
Drainage treatment devices	To be completed as part of the BACR by Developer
Discharge Systems	To be completed as part of the BACR by Developer
Underdrains	To be completed as part of the BACR by Developer
3) Structures	
Structures having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or springlines of arches or extreme ends of openings or multiple boxes	Maintain a condition rating no lower than currently shown in the SR 37 Bridge Inspection Reports in folder 14.2 Bridge Inspection Reports of the RID for each structure.
Non-bridge class culverts	Maintain condition no lower than currently shown in folder 08.1 Large Culvert Inspection Reports of the RID
Gantries and high masts	To be completed as part of the BACR by Developer
Retaining Walls	To be completed as part of the BACR by Developer
MSE Retaining Walls	To be completed as part of the BACR by Developer
4) Pavement Markings, Object Markers, Barrier Markers and Delineators	
Pavement Markings and Symbols	To be completed as part of the BACR by Developer
Delineators and Markers	To be completed as part of the BACR by Developer
5) Guardrails, Safety Barriers and Impact Attenuators	
Guardrails, Safety Barriers, and Concrete Barriers	To be completed as part of the BACR by Developer

Baseline Asset Condition Report Framework	
Element	**Minimum Baseline Condition to be Maintained**
6) Traffic Signs	
Regulatory Signs	To be completed as part of the BACR by Developer
Non-Regulatory Signs	To be completed as part of the BACR by Developer
7) Traffic Signals	
Traffic Signals	To be completed as part of the BACR by Developer
8) Lighting	
Roadway Lighting	To be completed as part of the BACR by Developer
Electrical Supply	To be completed as part of the BACR by Developer
High Mast Lighting	To be completed as part of the BACR by Developer
9) Fences, Walls and Sound Abatement	
Walls	To be completed as part of the BACR by Developer
10) Earthwork, Embankments, and Cuttings	
Slopes	To be completed as part of the BACR by Developer

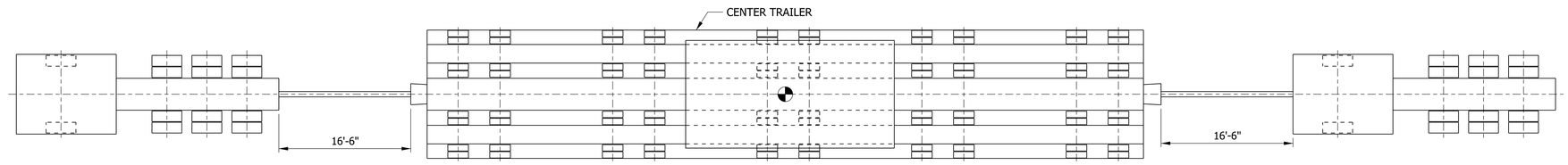
I-69 SECTION 5

PUBLIC-PRIVATE AGREEMENT
TECHNICAL PROVISIONS

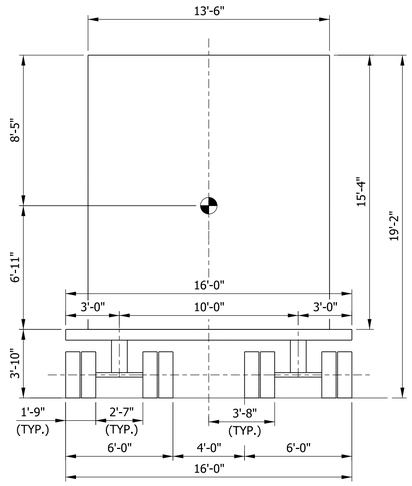
ATTACHMENT 18-4
ANTICIPATED OVERWEIGHT VEHICLE



ELEVATION



PLAN



SECTION A-A

LEGEND:

- CENTER OF GRAVITY OF VEHICLE
- * LOAD WITH LIFT AXLE RAISED

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE		INDIANA DEPARTMENT OF TRANSPORTATION	SCALE: NTS; BRIDGE FILE: 37-53-2441B
			VERTICAL SCALE: NTS; DESIGNATION: 1297885
DESIGNED: _____	DRAWN: HLB	ANTICIPATED OVERWEIGHT VEHICLE	SURVEY BOOK: ; SHEETS: 1 of 1
CHECKED: _____	CHECKED: BDL		CONTRACT: TBD; PROJECT: 1297885

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12/18/2013 5:01:42 pm
model: Sheet 1
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