				for the pump					
MAXSPEED	Integer	4	Maximum Speed (RPM)	Maximum rotational speed of a pump			true		
VFD	SmallInteger	2	VFD?	Indicates if the drive of the pump is variable frequency			true		
HORSEPOWER	SmallInteger	2	Horsepower	The horsepower rating of the asset			true		
POWERPHASE	String	50	Power Phase	Power phasing configuration	vertElectricalPhase		true		
INFPIPEDIAM	Double	8	Influent Pipe Diameter	The diameter of the influent pipe			true		
EFFPIPEDIAM	Double	8	Effluent Pipe Diameter	The diameter of the effluent pipe			true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsPumpStationARV - Table

Name swpsPumpStationARV
AliasName swpsPumpStationARV
HasAttachments false
Description A valve within a pump station to allow air and/or vacuum to escape from pipes, not otherwise represented by a GIS horizonral feature asset

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier populated by database admin created database trigger			true		
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset			true		

				record will show up pink on the Cityworks work order					
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		
SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as the impact due to asset failure			true		
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and			true		

				updated from there to GIS					
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
PIPEDIAMETER	Double	8	Pipe Diameter	The diameter of a pipe			true		
INVAULT	String	1	In Vault?	Indicates if asset is contained within a valve vault			true		
CURRENTSTATE	String	50	Current State	The operating position of a valve at last interaction	vertCurrentState		true		
DIAMETER	Double	8	Diameter	The diameter of the asset			true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsPumpStationValve - Table

Name swpsPumpStationValve
AliasName swpsPumpStationValve
HasAttachments false
Description Valve contained within the pump station not otherwise represented by a GIS horizontal feature asset

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier populated by database admin created database trigger			true		
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		
SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service)			true		

				failure will occur and is adjusted for backup and redundancy of the asset					
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as the impact due to asset failure			true		
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset			true		

				management analysis					
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
VALVETYPE	String	50	Valve Type	The type or mechanism by which a valve interacts with fluid			true		
VALVEFUNCTION	String	50	Valve Function	The purpose or function of a valve	vertPSValveFunction		true		
VALVECONTROL	String	50	Valve Control	The manner in which a valve is manipulated	vertValveControl		true		
DIAMETER	Double	8	Diameter	The diameter of the asset			true		
NORMALOPERATINGPOSITION	String	50	Normal Operating Position	Indicates the regular operating position of a valve	vertNormalOperatingPosition		true		
DIRECTIONTOOPEN	String	50	Open Direction	Direction of turn for valves in a utility system			true		
MOTORIZED	SmallInteger	2	Motorized?	Indicates if a pump station valve is operated by motor or not			true		
NUMTURNSOPEN	Double	8	Turns to Open	The number of turns a valve takes to open it			true		
NUMTURNSCLOSE	Double	8	Turns to Close	The number of turns a valve takes to close it			true		
CURRENTSTATE	String	50	Current State	The operating position of a valve at last interaction	vertCurrentState		true		
INVAULT	String	1	In Vault?	Indicates if asset is contained within a valve vault			true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		

GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsSCADAEquipment - Table

Name swpsSCADAEquipment
AliasName swpsSCADAEquipment
HasAttachments false
Description Omnibus asset covering SCADA systems, including PLC, I/O, Operator Interface Terminals, and network switches

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier populated by database admin created database trigger			true		
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		

SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as the impact due to asset failure			true		
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset			true		

				management analysis and repair/replace decisions					
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
PSSCADAEQUIPMENTTYPE	String	50	SCADA Equipment Type	The specific type or function of a SCADA equiment for a pump station	vertPSSCADAEquipmentType		true		
OS	String	50	Operating System	Operating system for a unit of SCADA equipment			true		
SOFTWARE	String	255	Software	Type of SCADA system component			true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsScrubber - Table

Name swpsScrubber
AliasName swpsScrubber
HasAttachments false
Description Device to treat foul air extracted from wet well

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric			true		

				unique identifier populated by database admin created database trigger					
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		
SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as			true		

				the impact due to asset failure					
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
SCRUBBERTYPE	String	100	Scrubber Type	The type of scrubber			true		
MEDIA	String	50	Media	The media material by which a scrubber processes odor			true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		

NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsTransferSwitch - Table

Name swpsTransferSwitch
AliasName swpsTransferSwitch
HasAttachments false
Description Automatic transfer switches to switch between electrical current sources

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier populated by database admin created database trigger			true		
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		

SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as the impact due to asset failure			true		
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		

PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
AUTOMATIC	SmallInteger	2	Automatic?	Whether or not a transfer switch is manually or automatically triggered			true		
MAKEMODEL	String	100	Make and Model	The make and model of a switch			true		
VOLTAGE	String	50	Voltage	The voltage of the asset	vertVoltage		true		
AMPS	Double	8	Amperage (Amps)	A measure of electrical current			true		
NEMAENCLOSURE	SmallInteger	2	In NEMA Enclosure?	Indicates if an asset is stored in a NEMA rated enclosure			true		
NEMARATING	String	100	NEMA Rating	Indicates the NEMA rating of an asset	vertNEMARating		true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsTransformer - Table

Name swpsTransformer
AliasName swpsTransformer
HasAttachments false
Description Device to convert one electrical current circuit to one or more electrical circuits with different currents and/or voltages

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier			true		

				populated by database admin created database trigger					
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		
SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as			true		

				the impact due to asset failure					
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
PRIMARYVOLTAGE	String	50	Primary Volts	The input voltage for a power transformer	vertVoltage		true		
SECONDARYVOLTAGE	String	50	Secondary Volts	Output voltage of a power transformer	vertVoltage		true		
KVARATING	Double	8	KVA Rating	Transformer kVA rating			true		
SECONDARYAMPS	Integer	4	Secondary Amps	Output current of a power transformer			true		

FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsUPS - Table

Name swpsUPS
AliasName swpsUPS
HasAttachments false
Description Uninterruptible power supply units

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier populated by database admin created database trigger			true		
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the			true		

				asset					
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		
SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as the impact due to asset failure			true		
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and			true		

				repair/replace decisions					
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
VOLTAGE	String	50	Voltage	The voltage of the asset	vertVoltage		true		
WATTS	Integer	4	Watts	The maximum rated wattage			true		
VOLTAMPERES	Integer	4	Volt-Ampere Rating	The maximum power in Volt-Amperes of the UPS unit			true		
RUNTIME	String	20	Runtime at Total Connected Load	The expected uptime of the UPS at the total draw of the connected load			true		
UPSPURPOSE	String	255	Purpose	A description of the purpose or system the UPS is supporting			true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsValveVault - Table

Name swpsValveVault
AliasName swpsValveVault
HasAttachments false
Description Sunken box containing valves by which individual pumps can be isolated from the force lines and other purposes

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric			true		

				unique identifier populated by database admin created database trigger					
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		
SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as			true		

				the impact due to asset failure					
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
DEPTHVES	Double	8	Depth (Ft)	Depth measured to the top of the holding structure			true		
TOPELEVATION	Double	8	Top Elevation (Ft NAVD)	The elevation at the surface of the vault			true		
BOTTOMELEVATION	Double	8	Bottom Elevation (Ft NAVD)	The lowest elevation of a well, vault, or fuel tank in ft NAVD datum			true		

INFPIPEINV	Double	8	Influent Pipe Invert (Ft NAVD)	The invert elevation of the influent pipe in feet NAVD			true		
INFPIPEDIAM	Double	8	Influent Pipe Diameter	The diameter of the influent pipe			true		
EFFPIPEINV	Double	8	Effluent Pipe Invert	The invert elevation of the effluent pipe in feet NAVD			true		
EFFPIPEDIAM	Double	8	Effluent Pipe Diameter	The diameter of the effluent pipe			true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsVentilation - Table

Name swpsVentilation
AliasName swpsVentilation
HasAttachments false
Description HVAC, fans and related appurtenances

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier populated by database admin created database trigger			true		
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic			true		

				location					
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		
SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as the impact due to asset failure			true		
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from			true		

				Cityworks Inspection to the GIS					
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
EQUIPMENTTYPE	String	100	Equipment Type	The type of HVAC, blower, or other ventilation equipment			true		
PROCESSCRITICAL	SmallInteger	2	Process Critical?	Indicates if the asset is essential to the main process or function of the system or if it is secondary			true		
CAPACITYAIR	String	50	Capacity (Air)	The rated capacity of a blower or ventilation unit			true		
VOLTAGE	String	50	Voltage	The voltage of the asset	vertVoltage		true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsVFD - Table

Name swpsVFD
AliasName swpsVFD
HasAttachments false
Description Adjustable speed motor for pumps or other applications

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier populated by database admin created database trigger			true		
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		
SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service)			true		

				failure will occur and is adjusted for backup and redundancy of the asset					
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as the impact due to asset failure			true		
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset			true		

				management analysis					
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
VOLTAGE	String	50	Voltage	The voltage of the asset	vertVoltage		true		
POWERPHASE	String	50	Power Phase	Power phasing configuration	vertElectricalPhase		true		
AMPS	Double	8	Amperage (Amps)	A measure of electrical current			true		
HORSEPOWER	Double	8	Horsepower	The horsepower rating of the asset			true		
COMMUNICATIONPROTOCOL	String	50	Communication Protocol	The protocol in which a device communicates with a SCADA system or other network	vertInstrumentCommProtocol		true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		
NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

swpsWatQualityPanel - Table

Name swpsWatQualityPanel
AliasName swpsWatQualityPanel
HasAttachments false
Description Devices for analyzing potabable water quality parameters such as turbidity and chlorine residual

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier populated by database admin			true		

				created database trigger					
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		
SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as the impact due to asset failure			true		

RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		
PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
WATQUALITYPANEL	String	255	Water Quality Control Panel Type	Type, make or other features of the water quality control panel			true		
CHEMICALS	String	255	Chemicals	Analytical reagents used at water quality panel			true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		

NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

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swpsWetWell - Table

Name swpsWetWell
AliasName swpsWetWell
HasAttachments false
Description Well from which influent is collected and ultimately pumped out

Field	DataType	Length	AliasName	Description	Domain	DefaultValue	IsNullable	Precision	Scale
FACILITYNUM	Integer	4	Facility Number	Locally asssigned numeric unique identifier populated by database admin created database trigger			true		
FACILITYID	String	20	Facility ID	Locally asssigned alpha-numeric unique identifier populated by database admin created database trigger			true		
LEGACYID	String	20	Legacy ID	Former asset identifier. To be moved to a related table			true		
ASSETNAME	String	100	Asset Name	The common parlance reference name to a feature, eg "High Service Pump 13"			true		
INSTALLDATE	Date	8	Install Date	The date the asset was installed			true		
WARRANTYDATE	Date	8	Warranty Date	The date the warranty expires on the asset. If populated and asset is still under warranty, asset record will show up pink on the Cityworks work order			true		
LOCATION	String	100	Location	A description of the asset's basic location			true		
PARENTFACILITYID	String	20	Parent Facility ID	A field for cross-referencing assets with associated object-class assets			true		
ACTIVESTATUS	String	10	Active Status	Identifies whether the asset is in use, not in use or removed from the ground			true		
MANUFACTURER	String	30	Manufacturer	The manufacturer or brand of the asset			true		
MODEL	String	30	Model Number	The model number of the asset			true		
SERIAL	String	30	Serial Number	The serial Number of the asset			true		

SCADATAG	String	20	SCADA Tag	The SCADA tag associated with the asset			true		
POF	SmallInteger	2	Probability of Failure	Probability of Failure. Used in the BRE model to estimate the likelihood the predicted asset (or service) failure will occur and is adjusted for backup and redundancy of the asset			true		
BRE	SmallInteger	2	Business Risk Exposure	Business Risk Exposure is a the product of probablity of failure (POF) and consequence of failure (COF). Values range from 1 (low risk) to 100 (high risk) and is used to prioritize investments			true		
COF	SmallInteger	2	Consequence of Failure	The consequence of failure. Used in the BRE model as the impact due to asset failure			true		
RUL	SmallInteger	2	Remaining Useful Life	The Remaining Useful Life of an asset calculated by subtracting the number of years since installation, from the sevice life. It will be heavily relied upon for asset management analysis			true		
CONDITION	SmallInteger	2	Condition Rating	The condition rating of the asset. Used by Cityworks Analytics for condition analysis output. May be calculated within a Cityworks Inspection and updated from there to GIS			true		
CONDITIONDATE	Date	8	Condition Date	The date of the last condition assessment. Can be updated from Cityworks Inspection to the GIS			true		
REPLACEMENTCOST	Double	8	Replacement Cost	The total cost to replace the asset			true		
ASSETCOST	Double	8	Initial Cost	The replacement cost of the asset. If populated, this will be used for asset management analysis and repair/replace decisions			true		

PURCHASEDATE	Date	8	Purchase Date	The purchase date of the asset. Used for future asset management analysis			true		
DATECALCULATED	Date	8	Date Calculated	Cityworks Operational Insights Requirement			true		
PUMPSTATIONNAME	String	100	Pump Station Name	The name of the specific pump station the asset is associeted with			true		
SYSTEMNAME	String	50	System Name	The name of the system the asset is primarily associated with	PSVerticalSystem		true		
PUMPSTATIONFACID	String	50	Pump Station Facility ID	The FACILITYID of the pump station the asset is associated with			true		
DEPTHVES	Double	8	Depth (Ft)	Depth measured to the top of the holding structure			true		
RIMELEVATION	Double	8	Rim Elevation (Ft NAVD)	The elevation of the top of the wet well (NAVD)			true		
INVELEVATION	Double	8	Lowest Pipe Invert Elevation (Ft NAVD)	The elevation of the lowest influent pipe in a wet well (NAVD)			true		
INFPIPEDIAM1	Double	8	Lowest Influent Pipe Diameter	The diameter of the lowest influent pipe			true		
INFPIPEINV2	Double	8	Secondary Influent Pipe Invert	The elevation of the secondary influent pipe in a wet well in feet NAVD			true		
INFPIPEDIAM2	Double	8	Secondary Influent Pipe Diam	The diameter of the secondary influent pipe in a wetwell			true		
EFFPIPEINV	Double	8	Effluent Pipe Invert	The invert elevation of the effluent pipe in feet NAVD			true		
EFFPIPEDIAM	Double	8	Effluent Pipe Diameter	The diameter of the effluent pipe			true		
PUMPELEVATION	Double	8	Pump Suction Elevation (Ft NAVD)	The suction elevation of the pump units within a wetwell (NAVD)			true		
BOTTOMELEVATION	Double	8	Bottom Elevation (Ft NAVD)	The lowest elevation of a well, vault, or fuel tank in ft NAVD datum			true		
VOLUME	Double	8	Structure Volume (Gal)	The volume of a structure			true		
DIAMETERFT	Double	8	Diameter (Ft)	The diameter of the asset in Feet			true		
LIDSIZE	String	100	Lid Size and Shape	The size and shape of a well lid, eg 4'x4' square lid			true		
COATING	SmallInteger	2	Coating?	Indicates if a wet well has been coated			true		
FIELDNOTES	String	255	Field Notes	Comments or notes from field staff, including surveyors, that are relevant to the asset			true		

NOTES	String	255	GIS Notes	GIS entry notes or comments relevant to the asset			true		
created_user	String	255	created_user	created_user			true		
created_date	Date	8	created_date	created_date			true		
last_edited_user	String	255	last_edited_user	last_edited_user			true		
last_edited_date	Date	8	last_edited_date	last_edited_date			true		
GlobalID	GlobalID	38	GlobalID	GlobalID			false		

sspsAlarmTossPumpStation - RelationshipClass

Name sspsAlarmTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsAlarm
BackwardPathLabel ssPumpStation
Description sspsAlarmTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsAlarm		

sspsBuildingTossPumpStation - RelationshipClass

Name sspsBuildingTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsBuilding
BackwardPathLabel ssPumpStation
Description sspsBuildingTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsBuilding		

sspsCameraTossPumpStation - RelationshipClass

Name sspsCameraTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsCamera
BackwardPathLabel ssPumpStation
Description sspsCameraTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsCamera		

sspsChemicalSystemTossPumpStation - RelationshipClass

Name sspsChemicalSystemTossPumpStation
Cardinality OneToMany
IsAttributed false

IsComposite false
ForwardPathLabel sspsChemicalSystem
BackwardPathLabel ssPumpStation
Description sspsChemicalSystemTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsChemicalSystem		

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sspsCivilTossPumpStation - RelationshipClass

Name sspsCivilTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsCivil
BackwardPathLabel ssPumpStation
Description sspsCivilTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsCivil		

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sspsCommunicationEquipmentTossPumpStation - RelationshipClass

Name sspsCommunicationEquipmentTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsCommunicationEquipment
BackwardPathLabel ssPumpStation
Description sspsCommunicationEquipmentTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsCommunicationEquipment		

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sspsControlPanelTossPumpStation - RelationshipClass

Name sspsControlPanelTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsControlPanel
BackwardPathLabel ssPumpStation
Description sspsControlPanelTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsControlPanel		

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sspsDebrisScreenTossPumpStation - RelationshipClass

Name sspsDebrisScreenTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsDebrisScreen
BackwardPathLabel ssPumpStation
Description sspsDebrisScreenTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsDebrisScreen		

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sspsDryWellTossPumpStation - RelationshipClass

Name sspsDryWellTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsDryWell
BackwardPathLabel ssPumpStation
Description sspsDryWellTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsDryWell		

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sspsFencingTossPumpStation - RelationshipClass

Name sspsFencingTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsFencing
BackwardPathLabel ssPumpStation
Description sspsFencingTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsFencing		

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sspsFlowMeterTossPumpStation - RelationshipClass

Name sspsFlowMeterTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsFlowMeter
BackwardPathLabel ssPumpStation
Description sspsFlowMeterTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsFlowMeter		

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sspsFuelTankTossPumpStation - RelationshipClass

Name sspsFuelTankTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsFuelTank
BackwardPathLabel ssPumpStation
Description sspsFuelTankTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsFuelTank		

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sspsGeneratorTossPumpStation - RelationshipClass

Name sspsGeneratorTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsGenerator
BackwardPathLabel ssPumpStation
Description sspsGeneratorTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsGenerator		

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sspsLevelInstrumentTossPumpStation - RelationshipClass

Name sspsLevelInstrumentTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsLevelInstrument
BackwardPathLabel ssPumpStation
Description sspsLevelInstrumentTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsLevelInstrument		

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sspsMiscInstrumentTossPumpStation - RelationshipClass

Name sspsMiscInstrumentTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsMiscInstrument
BackwardPathLabel ssPumpStation
Description sspsMiscInstrumentTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsMiscInstrument		

sspsPipingTossPumpStation - RelationshipClass

Name sspsPipingTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsPiping
BackwardPathLabel ssPumpStation
Description sspsPipingTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsPiping		

sspsPressureInstrumentTossPumpStation - RelationshipClass

Name sspsPressureInstrumentTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsPressureInstrument
BackwardPathLabel ssPumpStation
Description sspsPressureInstrumentTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsPressureInstrument		

sspsPumpStationARVTossPumpStation - RelationshipClass

Name sspsPumpStationARVTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsPumpStationARV
BackwardPathLabel ssPumpStation
Description sspsPumpStationARVTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsPumpStationARV		

sspsPumpStationValveTossPumpStation - RelationshipClass

Name sspsPumpStationValveTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsPumpStationValve
BackwardPathLabel ssPumpStation
Description sspsPumpStationValveTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsPumpStationValve		

sspsPumpTossPumpStation - RelationshipClass

Name sspsPumpTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsPump
BackwardPathLabel ssPumpStation
Description sspsPumpTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsPump		

sspsSCADAEquipmentTossPumpStation - RelationshipClass

Name sspsSCADAEquipmentTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsSCADAEquipment
BackwardPathLabel ssPumpStation
Description sspsSCADAEquipmentTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsSCADAEquipment		

sspsScrubberTossPumpStation - RelationshipClass

Name sspsScrubberTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsScrubber
BackwardPathLabel ssPumpStation
Description sspsScrubberTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsScrubber		

sspsTransferSwitchTossPumpStation - RelationshipClass

Name sspsTransferSwitchTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false

ForwardPathLabel sspsTransferSwitch
BackwardPathLabel ssPumpStation
Description sspsTransferSwitchTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsTransferSwitch		

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sspsTransformerTossPumpStation - RelationshipClass

Name sspsTransformerTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsTransformer
BackwardPathLabel ssPumpStation
Description sspsTransformerTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsTransformer		

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sspsUPSTossPumpStation - RelationshipClass

Name sspsUPSTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsUPS
BackwardPathLabel ssPumpStation
Description sspsUPSTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsUPS		

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sspsValveVaultTossPumpStation - RelationshipClass

Name sspsValveVaultTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsValveVault
BackwardPathLabel ssPumpStation
Description sspsValveVaultTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsValveVault		

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sspsVentilationTossPumpStation - RelationshipClass

Name sspsVentilationTossPumpStation

Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsVentilation
BackwardPathLabel ssPumpStation
Description sspsVentilationTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsVentilation		

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sspsVFDTossPumpStation - RelationshipClass

Name sspsVFDTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsVFD
BackwardPathLabel ssPumpStation
Description sspsVFDTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsVFD		

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sspsWatQualityPanelTossPumpStation - RelationshipClass

Name sspsWatQualityPanelTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsWatQualityPanel
BackwardPathLabel ssPumpStation
Description sspsWatQualityPanelTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsWatQualityPanel		

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sspsWetWellTossPumpStation - RelationshipClass

Name sspsWetWellTossPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel sspsWetWell
BackwardPathLabel ssPumpStation
Description sspsWetWellTossPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
ssPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
sspsWetWell		

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swpsAlarmToswPumpStation - RelationshipClass

Name swpsAlarmToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsAlarm
BackwardPathLabel swPumpStation
Description swpsAlarmToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsAlarm		

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swpsBuildingToswPumpStation - RelationshipClass

Name swpsBuildingToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsBuilding
BackwardPathLabel swPumpStation
Description swpsBuildingToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsBuilding		

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swpsCameraToswPumpStation - RelationshipClass

Name swpsCameraToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsCamera
BackwardPathLabel swPumpStation
Description swpsCameraToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsCamera		

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swpsChemicalSystemToswPumpStation - RelationshipClass

Name swpsChemicalSystemToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsChemicalSystem
BackwardPathLabel swPumpStation
Description swpsChemicalSystemToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsChemicalSystem		

swpsCivilToswPumpStation - RelationshipClass

Name swpsCivilToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsCivil
BackwardPathLabel swPumpStation
Description swpsCivilToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsCivil		

swpsCommunicationEquipmentToswPumpStation - RelationshipClass

Name swpsCommunicationEquipmentToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsCommunicationEquipment
BackwardPathLabel swPumpStation
Description swpsCommunicationEquipmentToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsCommunicationEquipment		

swpsControlPanelToswPumpStation - RelationshipClass

Name swpsControlPanelToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsControlPanel
BackwardPathLabel swPumpStation
Description swpsControlPanelToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsControlPanel		

swpsDebrisScreenToswPumpStation - RelationshipClass

Name swpsDebrisScreenToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsDebrisScreen
BackwardPathLabel swPumpStation
Description swpsDebrisScreenToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsDebrisScreen		

swpsDryWellToswPumpStation - RelationshipClass

Name swpsDryWellToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsDryWell
BackwardPathLabel swPumpStation
Description swpsDryWellToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsDryWell		

swpsFencingToswPumpStation - RelationshipClass

Name swpsFencingToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsFencing
BackwardPathLabel swPumpStation
Description swpsFencingToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsFencing		

swpsFlowMeterToswPumpStation - RelationshipClass

Name swpsFlowMeterToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsFlowMeter
BackwardPathLabel swPumpStation
Description swpsFlowMeterToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsFlowMeter		

swpsFuelTankToswPumpStation - RelationshipClass

Name swpsFuelTankToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false

ForwardPathLabel swpsFuelTank
BackwardPathLabel swPumpStation
Description swpsFuelTankToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsFuelTank		

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swpsGeneratorToswPumpStation - RelationshipClass

Name swpsGeneratorToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsGenerator
BackwardPathLabel swPumpStation
Description swpsGeneratorToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsGenerator		

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swpsLevelInstrumentToswPumpStation - RelationshipClass

Name swpsLevelInstrumentToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsLevelInstrument
BackwardPathLabel swPumpStation
Description swpsLevelInstrumentToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsLevelInstrument		

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swpsMiscInstrumentToswPumpStation - RelationshipClass

Name swpsMiscInstrumentToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsMiscInstrument
BackwardPathLabel swPumpStation
Description swpsMiscInstrumentToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsMiscInstrument		

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swpsPipingToswPumpStation - RelationshipClass

Name swpsPipingToswPumpStation

Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsPiping
BackwardPathLabel swPumpStation
Description swpsPipingToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsPiping		

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swpsPressureInstrumentToswPumpStation - RelationshipClass

Name swpsPressureInstrumentToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsPressureInstrument
BackwardPathLabel swPumpStation
Description swpsPressureInstrumentToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsPressureInstrument		

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swpsPumpStationARVToswPumpStation - RelationshipClass

Name swpsPumpStationARVToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsPumpStationARV
BackwardPathLabel swPumpStation
Description swpsPumpStationARVToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsPumpStationARV		

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swpsPumpStationValveToswPumpStation - RelationshipClass

Name swpsPumpStationValveToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsPumpStationValve
BackwardPathLabel swPumpStation
Description swpsPumpStationValveToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsPumpStationValve		

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swpsPumpToswPumpStation - RelationshipClass

Name swpsPumpToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsPump
BackwardPathLabel swPumpStation
Description swpsPumpToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsPump		

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swpsSCADAEquipmentToswPumpStation - RelationshipClass

Name swpsSCADAEquipmentToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsSCADAEquipment
BackwardPathLabel swPumpStation
Description swpsSCADAEquipmentToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsSCADAEquipment		

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swpsScrubberToswPumpStation - RelationshipClass

Name swpsScrubberToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsScrubber
BackwardPathLabel swPumpStation
Description swpsScrubberToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsScrubber		

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swpsTransferSwitchToswPumpStation - RelationshipClass

Name swpsTransferSwitchToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsTransferSwitch
BackwardPathLabel swPumpStation
Description swpsTransferSwitchToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsTransferSwitch		

swpsTransformerToswPumpStation - RelationshipClass

Name swpsTransformerToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsTransformer
BackwardPathLabel swPumpStation
Description swpsTransformerToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsTransformer		

swpsUPSToswPumpStation - RelationshipClass

Name swpsUPSToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsUPS
BackwardPathLabel swPumpStation
Description swpsUPSToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsUPS		

swpsValveVaultToswPumpStation - RelationshipClass

Name swpsValveVaultToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsValveVault
BackwardPathLabel swPumpStation
Description swpsValveVaultToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsValveVault		

swpsVentilationToswPumpStation - RelationshipClass

Name swpsVentilationToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsVentilation
BackwardPathLabel swPumpStation
Description swpsVentilationToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsVentilation		

swpsVFDToswPumpStation - RelationshipClass

Name swpsVFDToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsVFD
BackwardPathLabel swPumpStation
Description swpsVFDToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsVFD		

swpsWatQualityPanelToswPumpStation - RelationshipClass

Name swpsWatQualityPanelToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsWatQualityPanel
BackwardPathLabel swPumpStation
Description swpsWatQualityPanelToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsWatQualityPanel		

swpsWetWellToswPumpStation - RelationshipClass

Name swpsWetWellToswPumpStation
Cardinality OneToMany
IsAttributed false
IsComposite false
ForwardPathLabel swpsWetWell
BackwardPathLabel swPumpStation
Description swpsWetWellToswPumpStation

Origin Class Name	Origin Primary Key	Origin Foreign Key
swPumpStation	FACILITYID	PUMPSTATIONFACID

Destination Class Name	Destination Primary Key	Destination Foreign Key
swpsWetWell		

AncillaryRoleDomain - Domain

DomainName AncillaryRoleDomain
FieldType SmallInteger
Domain Type CodedValue

Code	Name

0	None
1	Source
2	Sink

AssetManager - Domain

DomainName AssetManager
Description Indicates the manager of the asset
FieldType SmallInteger
Domain Type CodedValue

Code	Name
1	City
2	County
3	State
4	Private
5	Other
-99	Unknown

AssetOwner - Domain

DomainName AssetOwner
Description Indicates the owner of the asset
FieldType SmallInteger
Domain Type CodedValue

Code	Name
1	City
2	County
3	State
4	Private
5	Other
-99	Unknown

BackflowDeviceType - Domain

DomainName BackflowDeviceType
Description Backflow Device Type
FieldType String
Domain Type CodedValue

Code	Name
AVB	AVB
DC	DC
DCDA	DCDA
PVB	PVB
RPZ	RPZ
AIR GAP*	AIR GAP*
RPDA	RPDA
UNK	Unknown
NONE	No Backflow
ACCTCLOSED	N/A Account Closed

BackflowInspectionStatus - Domain

DomainName BackflowInspectionStatus
Description BackflowInspectionStatus
FieldType String
Domain Type CodedValue

Code	Name
Open	Open
CompleteFV	Complete Field Verified

CompleteCR	Complete Customer Reported

BooleanDomain - Domain

DomainName BooleanDomain
Description A 0/1 boolean domain
FieldType SmallInteger
Domain Type CodedValue

Code	Name
0	False
1	True

BooleanSymbolValue - Domain

DomainName BooleanSymbolValue
Description Valid values are Yes and No
FieldType SmallInteger
Domain Type CodedValue

Code	Name
1	Yes
0	No

ControlSetRef - Domain

DomainName ControlSetRef
FieldType String
Domain Type CodedValue

Code	Name
N	North
NE	North East
E	East
SE	South East
S	South
SW	South West
W	West
NW	North West
NORTH RIM	North Rim

Datum - Domain

DomainName Datum
Description Verical Datum for Elevation Data (COFL Domain)
FieldType String
Domain Type CodedValue

Code	Name
NGVD 29	NGVD 29
NAVD 88	NAVD 88
Unknown	Unknown

DC_METHOD - Domain

DomainName DC_METHOD
Description The data collection method of the GIS by consultants. Temporary domain.
FieldType String
Domain Type CodedValue

Code	Name
00	GNSS
01	Mobile Lidar

02	Aerial Lidar
03	Aerial
04	Survey

Direction - Domain

DomainName Direction
Description A general description of cardinal direction
FieldType String
Domain Type CodedValue

Code	Name
East	East
North	North
South	South
West	West
Northeast	Northeast
Northwest	Northwest
Southeast	Southeast
Southwest	Southwest
North/South	North/South
East/West	East/West
Northeast/Northwest	Northeast/Northwest
Southeast/Southwest	Southeast/Southwest
Northeast/Southwest	Northeast/Southwest
Northwest/Southeast	Northwest/Southeast

EasementStatus - Domain

DomainName EasementStatus
Description Indicates if an easement is dedicated or vacated
FieldType String
Domain Type CodedValue

Code	Name
Dedicated	Dedicated
Vacated	Vacated

EasementType - Domain

DomainName EasementType
Description The type of easement recorded
FieldType String
Domain Type CodedValue

Code	Name
Drainage	Drainage Easement
Sewer	Sewer Easement
Water	Water Easement
Utility	Utility Easement
Non-Utility	Non-Utility Easement

EnabledDomain - Domain

DomainName EnabledDomain
FieldType SmallInteger
Domain Type CodedValue

Code	Name
0	False
1	True

HorizontalAlignment - Domain

DomainName	HorizontalAlignment
Description	Valid horizontal symbol alignment values
FieldType	Integer
Domain Type	CodedValue

Code	Name
0	Left
1	Center
2	Right
3	Full

InventoryClass - Domain

DomainName	InventoryClass
Description	Source of the location of the asset (COFL Domain)
FieldType	String
Domain Type	CodedValue

Code	Name
DGPS	DGPS (1-meter)
GPS	GPS (< 1-foot)
GPS-Converted	GPS Asbuilt Converted (< 1-foot)
GIS	Office Entry

LastEditor - Domain

DomainName	LastEditor
Description	Last Editor of the Feature Class
FieldType	String
Domain Type	CodedValue

Code	Name
Broward County GIS	Broward County GIS
Broward County Public Schools	Broward County Public Schools
Broward Sheriff's Office	Broward Sheriff's Office
Broward County Property Appraiser	Broward County Property Appraiser's Office
Fort Lauderdale GIS\Automated Process	Fort Lauderdale GIS Automated Process
Fort Lauderdale\Engineering	Fort Lauderdale Engineering Bureau
Fort Lauderdale\Police	Fort Lauderdale Police Department
Unknown	Unknown
CITY-HALL\AshokV	CITY-HALL\AshokV
CITY-HALL\DavidRu	CITY-HALL\DavidRu
CITY-HALL\IanW	CITY-HALL\IanW
PUBLIC_SERV\JonSt	PUBLIC_SERV\JonSt
CITY-HALL\KearyC	CITY-HALL\Keary
CITY-HALL\RollinM	CITY-HALL\RollinM
CITY-HALL\HaitingH	CITY-HALL\HaitingH
CITY-HALL\LuciaH	CITY-HALL\LuciaH

piAccessDiameter - Domain

DomainName	piAccessDiameter
Description	Valid range of infrastructure access diameters
FieldType	Double
Domain Type	Range

Minimum Value	Maximum Value
0	72

piAccessType - Domain

DomainName piAccessType
Description List of infrastructure access types
FieldType String
Domain Type CodedValue

Code	Name
Door	Door
Grate	Grate
Cover	Cover
Hand	Hand
Lid	Lid
Unknown	Unknown

piActiveStatus - Domain

DomainName piActiveStatus
Description Identifies whether the asset is in use, not in use or removed from the ground
FieldType String
Domain Type CodedValue

Code	Name
Abandoned	Abandoned
Active	Active
Inactive	Inactive
Removed	Removed
Not Found	Not Found

piCleanoutTypes - Domain

DomainName piCleanoutTypes
FieldType String
Domain Type CodedValue

Code	Name
Cleanout	Cleanout
Flushing Structure	Flushing Structure
Lamp Hole	Lamp Hole
Other	Other
Unknown	Unknown

piConditionIIMM - Domain

DomainName piConditionIIMM
Description International Infrastruture Management Manual (IIMM) Condition Grading
FieldType SmallInteger
Domain Type CodedValue

Code	Name
0	Not Rated
1	Very Good
2	Good
3	Fair
4	Poor
5	Very Poor

piConditionPACP - Domain

DomainName piConditionPACP
Description NASSCO Pipeline Assessment Certification Program (PACP) condition rating
FieldType SmallInteger
Domain Type CodedValue

Code	Name

1	Severity 1 - Minor defect grade
2	Severity 2 - Minor to moderate defect grade
3	Severity 3 - Moderate defect grade
4	Severity 4 - Significant defect grade
5	Severity 5 - Most significant defect grade

piControlValveType - Domain

DomainName piControlValveType
Description List of infrastructure Control Valve Types
FieldType String
Domain Type CodedValue

Code	Name
Altitude	Altitude
Blowoff	Blowoff
Combination	Combination
Vacuum	Vacuum
Air Control	Air Control
Air Gap	Air Gap
Air Release	Air Release
Atmospheric Vacuum	Atmospheric Vacuum
Backflow Control	Backflow Control
Double Check	Double Check
Pressure Vacuum	Pressure Vacuum
Pressure Reducer	Pressure Reducer
Simple Check	Simple Check
Vacuum Breaker	Vacuum Breaker
Vacuum Release	Vacuum Release
Surge Relief	Surge Relief
Snubber	Snubber
CLA	CLA
RPZ	Reduced Pressure Zone
Tidal	Tidal
Other	Other
Unknown	Unknown

piDischargePointType - Domain

DomainName piDischargePointType
Description List of infrastructure Discharge Point Types
FieldType String
Domain Type CodedValue

Code	Name
Outfall	Outfall
Overflow	Overflow
Standard Outlet	Standard Outlet
Well - Pressurized	Well - Pressurized
Well - Unpressurized	Well - Unpressurized
Other	Other
Unknown	Unknown

piFittingType - Domain

DomainName piFittingType
Description List of pipe fitting types
FieldType String
Domain Type CodedValue

Code	Name
Bend	Bend
Cap	Cap

Coupling	Coupling
Cross	Cross
Expansion Joint	Expansion Joint
Offset	Offset
Over Under	Over Under
Plug	Plug
Reducer	Reducer
Reducing Cross	Reducing Cross
Reducing Tee	Reducing Tee
Sleeve	Sleeve
Tap	Tap
Tee	Tee
Transition	Transition
Wye	Wye
Other	Other
Unknown	Unknown
Tapping Tee	Tapping Tee

piInletTypes - Domain

DomainName piInletTypes
Description List of inlet types
FieldType String
Domain Type CodedValue

Code	Name
Catchbasin	Catchbasin
Closed Lid Manhole	Closed Lid Manhole
Combination	Combination
Curb	Curb
DryWell	DryWell
Grate	Grate
Open Lid Manhole	Open Lid Manhole
Rear Yard	Rear Yard
Roof	Roof
Standard	Standard
Unknown	Unknown
Valley	Valley
Other	Other

piLiningMethod - Domain

DomainName piLiningMethod
Description The pipe lining method based on LACP and PACP standards
FieldType String
Domain Type CodedValue

Code	Name
NONE	None
CCPP	Centrifugally Cast Concrete Pipe Liner
FF	Fold and Form or Deform/Reform
SN	Segmented Panel
SP	Segmented Pipe
SW	Spiral Wound
CIP	Cured in Place
ZZ	Other
XX	Not Known

piManholeCoverShape - Domain

DomainName piManholeCoverShape
Description List of infrastructure Manhole Cover Types
FieldType String

Domain Type CodedValue

Code	Name
Curb Cover	Curb Cover
Rectangular	Rectangular
Round	Round
Valley Cover	Valley Cover
Other	Other
Unknown	Unknown

piManholeCoverType - Domain

DomainName piManholeCoverType
Description List of infrastructure Manhole Cover Types
FieldType String
Domain Type CodedValue

Code	Name
ADA Compliant	ADA Compliant
Grated-City	Grated-City
Grated-FDOT	Grated-FDOT
Solid-City	Solid-City
Solid-FDOT	Solid-FDOT
Unknown	Unknown
Other	Other
Standard W/ Lock	Standard W/ Lock
Standard W/ Ears	Standard W/ Ears
Non-District	Non-District
Water Tight	Water Tight
27" Diameter	27" Diameter
42" Diameter	42" Diameter
Large - Water Tight	Large - Water Tight
Rectangular	Rectangular

piManholeType - Domain

DomainName piManholeType
Description List of infrastructure Manhole Types
FieldType String
Domain Type CodedValue

Code	Name
STD	Standard
DRP	Drop
SPL	Split
DIV	Diversion
SED	Sedimentation
OTH	Other
UNK	Unknown
CON	Conflict
TRM	Terminal
WEI	Weir

piPipeDiameter - Domain

DomainName piPipeDiameter
Description A list of pipe diameters
FieldType Double
Domain Type CodedValue

Code	Name
0.75	3/4"
1	1"

1.25	1 1/4"
1.5	1 1/2"
2	2"
2.5	2 1/2"
3	3"
4	4"
6	6"
8	8"
10	10"
12	12"
14	14"
15	15"
16	16"
18	18"
20	20"
24	24"
30	30"
36	36"
40	40"
42	42"
48	48"
54	54"
60	60"
66	66"
72	72"
75	75"
-1	Other
11	11"
13	13"
19	19"
21	21"
22	22"
23	23"
27	27"
33	33"
45	45"
84	84"
96	96"
102	102"
-99	Unknown
-88	Not Applicable
41	41"
52	52"

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piPipeMaterial - Domain

DomainName	piPipeMaterial
Description	The list of pipe materials types based on the NASSCO standards
FieldType	String
Domain Type	CodedValue

Code	Name
ABS	ABS Plastic
ASP	Asphalt
BR	Brick
CT	Clay Tile
CSB	Concrete Segments (Bolted)
CSU	Concrete Segments (Unbolted)
CMP	Corrugated Metal
CIPP	Cured In Place
DIP	Ductile Iron
FRP	Fiberglass Reinforced
EARGEO	Earth & Geotextile

EAR	Earthen
GEO	Geotextile
GRC	Glass Reinforced Cement
OB	Pitch Fiber (Orangeburg)
PSC	Plastic/Steel Composite
PP	Polypropylene
PVC	Polyvinyl Chloride
PCCP	Pre-Stressed Concrete Cylinder
RCP	Reinforced Concrete
RPM	Reinforced Plastic (Truss)
SB	Segmented Block
SP	Steel
TTE	Transite
VCP	Vitrified Clay
WD	Wood
BMP	Brick Masonry
HDPE	High Density Polyethylene
STL	Stainless Steel
RCPC	Reinforced concrete pipe w/ cylinder
PBL	Polybutylene
CSTL	Corrugated Steel
CAL	Corrugated Aluminum
CPEL	Corrugated Polyethylene
ALU	Aluminum pipe
CONC	Concrete (Non-Reinforced)
ACP	Asbestos Cement
CIP	Cast Iron
CUP	Copper
GIP	Galvanized Pipe
PE	Polyethylene
ZZZ	Other
XXX	Unknown
LEAD	Lead

piPipeShape - Domain

DomainName piPipeShape
Description Sanitary and stormwater pipe shapes
FieldType String
Domain Type CodedValue

Code	Name
A	Arched
C	Circular
R	Rectangular
S	Square
Z	Other
E	Egg-Shaped
H	Horseshoe
OB	Oblong
T	Trapezoidal
TRI	Triangular
O	Oval (Elliptical)
UN	Unknown

piSystemValveType - Domain

DomainName piSystemValveType
Description List of system valve types
FieldType String
Domain Type CodedValue

Code	Name

Ball	Ball
Butterfly - Sidemount	Butterfly - Sidemount
Butterfly - Unknown Orientation	Butterfly - Unknown Orientation
Butterfly - Vertical	Butterfly - Vertical
Bypass	Bypass
Check	Check
Cone	Cone
Gate - Sidemount	Gate - Sidemount
Gate - Unknown Orientation	Gate - Unknown Orientation
Gate - Vertical	Gate - Vertical
Plug	Plug
Roundway	Roundway
Tapping	Tapping
Other	Other
Unknown	Unknown

piValveTurnDirection - Domain

DomainName piValveTurnDirection
Description Direction of turn for valves in a utility system
FieldType String
Domain Type CodedValue

Code	Name
Clockwise	Clockwise
Counter-Clockwise	Counter-Clockwise

piValveTurnDirection - Domain

DomainName piValveTurnDirection
Description Direction of turn for valves in a utility system
FieldType String
Domain Type CodedValue

Code	Name
Clockwise	Clockwise
Counter-Clockwise	Counter-Clockwise

piValveUse - Domain

DomainName piValveUse
Description Listing of different uses for valves in a utility system
FieldType String
Domain Type CodedValue

Code	Name
Bypass	Ball
Shutoff/Isolation	Shutoff/Isolation
Backflow Preventor	Backflow Preventor
Tapping	Tapping
Unknown	Unknown

PSVerticalSystem - Domain

DomainName PSVerticalSystem
Description List of pump station vertical systems
FieldType String
Domain Type CodedValue

Code	Name
Electrical	Electrical
Pumping	Pumping
Property	Property

Instrumentation	Instrumentation
Odor Control	Odor Control
Auxiliary	Auxiliary

ServiceProviderAgency - Domain

DomainName	ServiceProviderAgency
Description	The names of agencies that provide services (COFL)
FieldType	String
Domain Type	CodedValue

Code	Name
Broward County	Broward County
City of Fort Lauderdale	City of Fort Lauderdale
City of Tamarac	City of Tamarac
No Service	No Service

SeverityIndicator - Domain

DomainName	SeverityIndicator
Description	Indicates the serverity of blockage and/or structural collapse observed within the asset
FieldType	String
Domain Type	CodedValue

Code	Name
N	None
P	Partial
C	Complete
U	Unknown/Inaccessible

ssNetworkStructureType - Domain

DomainName	ssNetworkStructureType
Description	The type of control structure
FieldType	String
Domain Type	CodedValue

Code	Name
Diversion Chamber	Diversion Chamber
Diversion Point	Diversion Point
Junction Chamber	Junction Chamber
Production Well	Production Well
Pump Station	Pump Station
Split Manhole	Split Manhole
Storage Basin	Storage Basin
Tide Chamber	Tide Chamber
Treatment Plant	Treatment Plant
Lift Station	Lift Station
Discharge Structure	Discharge Structure
Unknown	Unknown
Other	Other
Virtual Junction	Virtual Junction
Flow Meter	Flow Meter
Monitoring Well	Monitoring Well
Pump	Pump
Backflow Prevention	Backflow Prevention
Grease Separator	Grease Separator
Injection Well	Injection Well
ASR Well	Aquifer Storage and Recovery Well
Master Meter	Master Meter

ssPumpStationType - Domain

DomainName ssPumpStationType
Description Type of pump station
FieldType String
Domain Type CodedValue

Code	Name
Lift Station	Lift Station
Pump Around Station	Pump Around Station
Pump Station	Pump Station
Repump Station	Repump Station
Unknown	Unknown

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ssValveUse - Domain

DomainName ssValveUse
Description Use of the valve
FieldType Integer
Domain Type CodedValue

Code	Name
23	Bypass
24	Shutoff/Isolation
25	Backflow preventor
26	Tapping
-99	Unknown

---

ssWaterType - Domain

DomainName ssWaterType
Description Type of control valve
FieldType String
Domain Type CodedValue

Code	Name
Treated	Treated Water
Combined	Combined Waste Water
Potable	Potable Water
Raw	Raw Water
Reclaimed	Reclaimed Water
Salt	Salt Water
Sewage	Sewage
Storm	Storm Runoff
Effluent	Waste Water Effluent
Overflow	Overflow

---

swBottomType - Domain

DomainName swBottomType
Description The type of bottom opening the structure has.
FieldType String
Domain Type CodedValue

Code	Name
Open	Open Bottom
Closed	Closed Bottom

---

swConflictType - Domain

DomainName swConflictType
Description The type of conflict or conflicts inside the structure.
FieldType String
Domain Type CodedValue

Code	Name
Water	Water Main
Sewer	Sewer Main
Gas	Gas Pipe
Water and Sewer	Water and Sewer pipes
Water and Gas	Water and Gas pipes
Sewer and Gas	Sewer and Gas pipes
Water and Sewer and Gas	Water and Sewer and Gas pipes
Other	Other (specify type/s in comments)
Unknown	Unknown

swIllicitConnectionStatus - Domain

DomainName swIllicitConnectionStatus
Description The status of the illicit connection inside the structure
FieldType String
Domain Type CodedValue

Code	Name
Permitted	Permitted
Not Permitted	Not Permitted
Unknown	Unknown
Illicit	Illicit

swManufacturer - Domain

DomainName swManufacturer
Description List of manufacturers of stormwater assets
FieldType String
Domain Type CodedValue

Code	Name
CheckMate	CheckMate
LayFlat	LayFlat
RedValve	RedValve
Suntree	Suntree
TideFlex	TideFlex
WaStop	WaStop

swNetworkStructureType - Domain

DomainName swNetworkStructureType
Description Stormwater network structure types
FieldType String
Domain Type CodedValue

Code	Name
Discharge Structure	Discharge Structure
Diversion Chamber	Diversion Chamber
Diversion Point	Diversion Point
Junction Chamber	Junction Chamber
Lift Station	Lift Station
Endpoint	Pipe End
Split Manhole	Split Manhole
Storage Basin	Storage Basin
Tide Chamber	Tide Chamber
Virtual Junction	Virtual Junction
Other	Other
Unknown	Unknown

swOpenPosition - Domain

DomainName swOpenPosition

Description The opening position of a stormwater control baffle
FieldType String
Domain Type CodedValue

Code	Name
Bottom Opening	Bottom Opening
Top Opening	Top Opening

swOutfallLocation - Domain

DomainName swOutfallLocation
Description Indicates the location of an outfall asset (COFL Domain)
FieldType String
Domain Type CodedValue

Code	Name
Bottom of Headwall	Bottom of Headwall
Bottom Seawall	Bottom of Seawall
Bottom Pipe	Bottom Pipe
Invert	Invert
Middle of Headwall	Middle of Headwall
Middle of Seawall	Middle of Seawall
Natural Bank	Natural Bank
Top of Headwall	Top of Headwall
Top of Pipe	Top of Pipe
Top of Seawall	Top of Seawall
UN	Unknown

swPipeDirection - Domain

DomainName swPipeDirection
Description The cardinal direction on the pipe invert of a stormwater asset
FieldType String
Domain Type CodedValue

Code	Name
N	N
S	S
E	E
W	W
NE	NE
NW	NW
SE	SE
SW	SW

swPipeType - Domain

DomainName swPipeType
Description Indicates the type of stormwater pipe (COFL Domain)
FieldType String
Domain Type CodedValue

Code	Name
PERF	Perforated
SOLID	Solid
UNK	Unknown

swPollControlDeviceType - Domain

DomainName swPollControlDeviceType
Description Lists the type of pollution control device
FieldType String
Domain Type CodedValue

Code	Name
Aluminum Baffle	Aluminum Baffle
Fiber Glass Snout	Fiber Glass Snout

swPollControlStructureType - Domain

DomainName swPollControlStructureType
Description Lists the type of pollution control structure
FieldType String
Domain Type CodedValue

Code	Name
Nutrient Separating Baffle Box	Nutrient Separating Baffle Box
Upflow Filtration System	Upflow Filtration System
Wetlands Biofilter	Wetlands Biofilter

swPondType - Domain

DomainName swPondType
Description Indicates the type of stormwater pond (COFL Domain)
FieldType String
Domain Type CodedValue

Code	Name
Dry Detention	Dry Detention
Wet Detention	Wet Detention
Dry Retention	Dry Retention
Wet Retention	Wet Retention
Other	Other

swWeirShape - Domain

DomainName swWeirShape
Description The shape of the stormwater weir
FieldType String
Domain Type CodedValue

Code	Name
Adjustable Weir	Adjustable Weir
Circular	Circular
Compound	Compound
Irregular	Irregular
Rectagular	Rectagular
Trapezoid	Trapezoid
V-Notched	V-Notched
Other	Other

swWeirType - Domain

DomainName swWeirType
Description The type of weir
FieldType String
Domain Type CodedValue

Code	Name
Broad-Crested	Broad-Crested
Combination	Combination
Horizontial	Horizontial
Labyrinth	Labyrinth
Minimum Energy Loss	Minimum Energy Loss
Sharp-Crested	Sharp-Crested
Vertical	Vertical

V-Notch	V-Notch
Other	Other

swWellAccessShape - Domain

DomainName	swWellAccessShape
Description	The shape of a stormwater access point
FieldType	String
Domain Type	CodedValue

Code	Name
Circle	Circle
Rectangle	Rectangle
Square	Square
Unknown	Unknown

ValueMethod - Domain

DomainName	ValueMethod
FieldType	String
Domain Type	CodedValue

Code	Name
ANGLE	ANGLE
AUTONUMBER	AUTONUMBER
CASCADE_ATTRIBUTE	CASCADE_ATTRIBUTE
COPY_FEATURE	COPY_FEATURE
COPY_LINKED_RECORD	COPY_LINKED_RECORD
CREATE_LINKED_RECORD	CREATE_LINKED_RECORD
CREATE_PERP_LINE	CREATE_PERP_LINE
CREATE_PERP_LINE_TO_LINE	CREATE_PERP_LINE_TO_LINE
CURRENT_USER	CURRENT_USER
EDGE_STATS	EDGE_STATS
EXPRESSION	EXPRESSION
FEATURE_STATS	FEATURE_STATS
FIELD	FIELD
FIELD_TRIGGER	FIELD_TRIGGER
FROM_EDGE_FIELD	FROM_EDGE_FIELD
FROM_EDGE_MULTI_FIELD_INTERSECT	FROM_EDGE_MULTI_FIELD_INTERSECT
FROM_EDGE_STATS	FROM_EDGE_STATS
FROM_JUNCTION_FIELD	FROM_JUNCTION_FIELD
GENERATE_ID	GENERATE_ID
GENERATE_ID_BY_INTERSECT	GENERATE_ID_BY_INTERSECT
GET_ADDRESS_FROM_CENTERLINE	GET_ADDRESS_FROM_CENTERLINE
GET_ADDRESS_USING_ARCGIS_SERVICE	GET_ADDRESS_USING_ARCGIS_SERVICE
GET_ADDRESS_USING_GEOCODER	GET_ADDRESS_USING_GEOCODER
GUID	GUID
INTERSECT_STATS	INTERSECT_STATS
INTERSECTING_BOOLEAN	INTERSECTING_BOOLEAN
INTERSECTING_COUNT	INTERSECTING_COUNT
INTERSECTING_EDGE	INTERSECTING_EDGE
INTERSECTING_FEATURE	INTERSECTING_FEATURE
INTERSECTING_FEATURE_DISTANCE	INTERSECTING_FEATURE_DISTANCE
INTERSECTING_LAYER_DETAILS	INTERSECTING_LAYER_DETAILS
INTERSECTING_RASTER	INTERSECTING_RASTER
JUNCTION_ROTATION	JUNCTION_ROTATION
LAST_VALUE	LAST_VALUE
LATITUDE	LATITUDE
LENGTH	LENGTH
LINK_TABLE_ASSET	LINK_TABLE_ASSET
LONGITUDE	LONGITUDE
MAP_INFO	MAP_INFO
MINIMUM_LENGTH	MINIMUM_LENGTH

MULTI_FIELD_INTERSECT	MULTI_FIELD_INTERSECT
NEAREST_FEATURE	NEAREST_FEATURE
NEAREST_FEATURE_ATTRIBUTES	NEAREST_FEATURE_ATTRIBUTES
OFFSET	OFFSET
PREVIOUS_VALUE	PREVIOUS_VALUE
PROMPT	PROMPT
SET_MEASURES	SET_MEASURES
SIDE	SIDE
SPLIT_INTERSECTING_FEATURE	SPLIT_INTERSECTING_FEATURE
TIMESTAMP	TIMESTAMP
TO_EDGE_FIELD	TO_EDGE_FIELD
TO_EDGE_MULTI_FIELD_INTERSECT	TO_EDGE_MULTI_FIELD_INTERSECT
TO_EDGE_STATS	TO_EDGE_STATS
TO_JUNCTION_FIELD	TO_JUNCTION_FIELD
TRIGGER_AAEVENT_FROM_EDGE	TRIGGER_AAEVENT_FROM_EDGE
TRIGGER_AAEVENT_FROM_JUNCTION	TRIGGER_AAEVENT_FROM_JUNCTION
TRIGGER_AAEVENT_INTERSECTING_FEATURE	TRIGGER_AAEVENT_INTERSECTING_FEATURE
TRIGGER_AAEVENT_TO_EDGE	TRIGGER_AAEVENT_TO_EDGE
TRIGGER_AAEVENT_TO_JUNCTION	TRIGGER_AAEVENT_TO_JUNCTION
UPDATE_FROM_EDGE_FIELD	UPDATE_FROM_EDGE_FIELD
UPDATE_FROM_JUNCTION_FIELD	UPDATE_FROM_JUNCTION_FIELD
UPDATE_INTERSECTING_FEATURE	UPDATE_INTERSECTING_FEATURE
UPDATE_LINKED_RECORD	UPDATE_LINKED_RECORD
UPDATE_TO_EDGE_FIELD	UPDATE_TO_EDGE_FIELD
UPDATE_TO_JUNCTION_FIELD	UPDATE_TO_JUNCTION_FIELD
VALIDATE_ATTRIBUTE_LOOKUP	VALIDATE_ATTRIBUTE_LOOKUP
VALIDATE_ATTRIBUTES	VALIDATE_ATTRIBUTES
VALIDATE_CONNECTIVITY	VALIDATE_CONNECTIVITY
VALIDATE_DOMAIN	VALIDATE_DOMAIN
X_COORDINATE	X_COORDINATE
Y_COORDINATE	Y_COORDINATE

---

vertAlarmType - Domain

DomainName vertAlarmType
Description Specific fault or warning alarm
FieldType String
Domain Type CodedValue

Code	Name
Fire	Fire
Security	Security
Dual Alarm	Dual Alarm
Other	Other
Unknown	Unknown

---

vertBearingType - Domain

DomainName vertBearingType
Description List of bearing types
FieldType String
Domain Type CodedValue

Code	Name
Babbit	Babbit
Ball	Ball
Needle	Needle
Pillow Block	Pillow Block
Roller	Roller
Sealed	Sealed
Sleeve	Sleeve
Other	Other
Unknown	Unknown

vertCommunicationEquipment - Domain

DomainName	vertCommunicationEquipment
Description	List of communication equipment types
FieldType	String
Domain Type	CodedValue

Code	Name
Managed Switch	Managed Switch
Unmanaged Switch	Unmanaged Switch
Media Converter	Media Converter
Wireless Radio	Wireless Radio
Other	Other
Unknown	Unknown

vertCurrentState - Domain

DomainName	vertCurrentState
Description	The position of the valve at point of last work
FieldType	String
Domain Type	CodedValue

Code	Name
Open	Open
Closed	Closed
Throttled	Throttled
Unknown	Unknown

vertElectricalPhase - Domain

DomainName	vertElectricalPhase
Description	Power phasing configuration
FieldType	String
Domain Type	CodedValue

Code	Name
Single Phase	Single Phase
Split Phase	Split Phase
Two-Phase	Two-Phase
Monocyclic	Monocyclic
Three-Phase	Three-Phase
Unknown	Unknown

vertElementFunction - Domain

DomainName	vertElementFunction
Description	List of element functions for miscellaneous instruments
FieldType	String
Domain Type	CodedValue

Code	Name
Chlorine	Chlorine
Conductivity	Conductivity
Level	Level
Oxidation Reduction Potential	Oxidation Reduction Potential
pH	pH
Pressure	Pressure
Solids	Solids
Temperature	Temperature
Turbidity	Turbidity
Density	Density
Voltage	Voltage

Power Factor	Power Factor
Wattage	Wattage
Weight	Weight
Hardness	Hardness
Amperage	Amperage
Torque	Torque
Headloss	Headloss
Vibration	Vibration
Streaming Current Potential	Streaming Current Potential
Dissolved Oxygen	Dissolved Oxygen
Salinity	Salinity
Current	Current
Valve Position	Valve Position
Particle Count	Particle Count
Bed Depth	Bed Depth
Combination	Combination
Flow	Flow
Rain Gauge	Rain Gauge
Other	Other
Unknown	Unknown

vertExternalCoating - Domain

DomainName vertExternalCoating
Description Lists of external coating types for pipes or other assets
FieldType String
Domain Type CodedValue

Code	Name
Mortar	Mortar
Zinc	Zinc
Mastic	Mastic
Insulation	Insulation
Paint	Paint
Bituminous	Bituminous
Other	Other
Unknown	Unknown

vertFenceType - Domain

DomainName vertFenceType
Description The structural style of a piece of fencing
FieldType String
Domain Type CodedValue

Code	Name
Chainlink	Chainlink
Wood	Wood
Wrought Iron	Wrought Iron
Expanded Metal	Expanded Metal
Other	Other
Unknown	Unknown

vertFlowInstrumentType - Domain

DomainName vertFlowInstrumentType
Description The primary element used by a flow instrument to interact with a fluid
FieldType String
Domain Type CodedValue

Code	Name
Transit Time	Transit Time
Magnet	Magnet

Orifice Plate	Orifice Plate
Venturi	Venturi
Thermal Dispersion	Thermal Dispersion
Paddle Wheel	Paddle Wheel
Coriolis	Coriolis
Ultrasonic	Ultrasonic
Positive Displacement	Positive Displacement
Turbine	Turbine
Rotometer	Rotometer
Insert Venturi	Insert Venturi
Misc	Misc
Unknown	Unknown

vertFlowUnits - Domain

DomainName vertFlowUnits
Description Units for measuring the volume of flow through a flow instrument
FieldType String
Domain Type CodedValue

Code	Name
Million Gallons per Day	Million Gallons per Day
Gallons per Minute	Gallons per Minute
Gallons Per Hour	Gallons Per Hour
Misc	Misc
Unknown	Unknown

vertImpellerMaterial - Domain

DomainName vertImpellerMaterial
Description The material of a pump impeller
FieldType String
Domain Type CodedValue

Code	Name
Bronze	Bronze
Stainless Steel	Stainless Steel
Iron	Iron
Other	Other
Unknown	Unknown

vertInstrumentCommProtocol - Domain

DomainName vertInstrumentCommProtocol
Description The manner in which a device communicates with other devices
FieldType String
Domain Type CodedValue

Code	Name
Current Loop (4 – 20 mA)	Current Loop (4 – 20 mA)
HART	HART
MODBUS	MODBUS
Profibus	Profibus
Fieldbus	Fieldbus
Ethernet	Ethernet
IP67	IP67
Radio	Radio
Fiber	Fiber
Other	Other
Unknown	Unknown

vertInstrumentVoltage - Domain

DomainName vertInstrumentVoltage
Description The nameplate voltage rating, including instruments in loop powered configuration
FieldType String
Domain Type CodedValue

Code	Name
120 VAC	120 VAC
24 VDC	24 VDC
12 VDC	12 VDC
Loop Powered	Loop Powered
Unpowered	Unpowered
Other	Other
Unknown	Unknown

vertLevelInstrumentType - Domain

DomainName vertLevelInstrumentType
Description List of instrument mechanisms to measure level
FieldType String
Domain Type CodedValue

Code	Name
Ultrasonic	Ultrasonic
Radar Guided Wave	Radar Guided Wave
Radar Nonguided Wave	Radar Nonguided Wave
Pressure	Pressure
Magnetic	Magnetic
Float	Float
Bubbler	Bubbler
Misc	Misc
Unknown	Unknown

vertLevelUnits - Domain

DomainName vertLevelUnits
Description List of units to measure level
FieldType String
Domain Type CodedValue

Code	Name
Feet	Feet
Inches	Inches
Yards	Yards
Meters	Meters
Centimeters	Centimeters
Misc	Misc
Unknown	Unknown

vertNEMARating - Domain

DomainName vertNEMARating
Description NEMA enclosure rating for designated environmental conditions
FieldType String
Domain Type CodedValue

Code	Name
1 General Purpose Primarily Prevents Contact with Live Parts	1 General Purpose Primarily Prevents Contact with Live Parts
2 Drip Tight	2 Drip Tight
3/3S Weather Resistant	3/3S Weather Resistant
3R Outdoor Use	3R Outdoor Use
4/4X Watertight (Weatherproof)	4/4X Watertight (Weatherproof)
5 Dust Tight	5 Dust Tight
6/6P Submersible	6/6P Submersible

7 Hazardous Indoor Class I, Groups A, B, C, and D NEC	7 Hazardous Indoor Class I, Groups A, B, C, and D NEC
8 Hazardous Indoor/Outdoor Class I, Groups A, B, C, and D NEC	8 Hazardous Indoor/Outdoor Class I, Groups A, B, C, and D NEC
9 Hazardous Indoor/Outdoor Class II, Groups E, F, and G NEC	9 Hazardous Indoor/Outdoor Class II, Groups E, F, and G NEC
General Purpose Indoor Corrosive Effects Liquids and Gases	General Purpose Indoor Corrosive Effects Liquids and Gases
12/12K General Purpose Indoor Noncorrosive Liquids	12/12K General Purpose Indoor Noncorrosive Liquids
General Purpose Spraying Water, Oil, and Noncorrosive Coolants	General Purpose Spraying Water, Oil, and Noncorrosive Coolants
Unknown	Unknown
N/A	N/A

vertNormalOperatingPosition - Domain

DomainName vertNormalOperatingPosition
Description Indicates the regular position of a valve when in normal use
FieldType String
Domain Type CodedValue

Code	Name
Open	Open
Closed	Closed
Throttled	Throttled
Variable	Variable

vertPanelMaterial - Domain

DomainName vertPanelMaterial
Description The material of a panel
FieldType String
Domain Type CodedValue

Code	Name
Stainless Steel	Stainless Steel
Fiberglass	Fiberglass
Aluminum	Aluminum
Other	Other
Unknown	Unknown

vertPowerSource - Domain

DomainName vertPowerSource
Description The power or fuel source the device draws from
FieldType String
Domain Type CodedValue

Code	Name
Diesel	Diesel
Gasoline	Gasoline
Propane	Propane
Natural Gas	Natural Gas
Battery	Battery
Electrical	Electrical
Unknown	Unknown
N/A	N/A

vertPressureInstrumentType - Domain

DomainName vertPressureInstrumentType
Description List of pressure instrument types
FieldType String
Domain Type CodedValue

Code	Name
Gauge	Gauge
Transmitter	Transmitter

Switch	Switch
Combination	Combination
Misc	Misc
Unknown	Unknown

vertPressureUnits - Domain

DomainName vertPressureUnits
Description List of units of measure for pressure
FieldType String
Domain Type CodedValue

Code	Name
PSIG	PSIG
PSIA	PSIA
Inches W.C.	Inches W.C.
Feet W.C.	Feet W.C.
Compound	Compound
Misc	Misc
Unknown	Unknown

vertPSSCADAEquipmentType - Domain

DomainName vertPSSCADAEquipmentType
Description The type of equipment attached to a SCADA system
FieldType String
Domain Type CodedValue

Code	Name
Server	Server
Workstation	Workstation
Laptop	Laptop
Printer	Printer
OIT	OIT
Backup Device	Backup Device
PLC	PLC
Other	Other
Unknown	Unknown

vertPSValveFunction - Domain

DomainName vertPSValveFunction
Description The specific purpose of a valve in a Pump Station, excluding Air Release Valves
FieldType String
Domain Type CodedValue

Code	Name
Blow-Off	Blow-Off
Bypass	Bypass
Vacuum Break	Vacuum Break
Check	Check
Drain	Drain
Flow Control	Flow Control
Isolation	Isolation
Level Control	Level Control
Rate of Flow Controller	Rate of Flow Controller
Pressure Reducing	Pressure Reducing
Pressure Sustaining	Pressure Sustaining
Surge Relief	Surge Relief
Pump Control Valve	Pump Control Valve
Other	Other
Unknown	Unknown

vertPumpMode - Domain

DomainName	vertPumpMode
Description	The type of mechanical drive for the pump
FieldType	String
Domain Type	CodedValue

Code	Name
Diesel	Diesel
Electric	Electric
Diesel Electric	Diesel Electric
Pnuematic	Pnuematic
Other	Other
Unknown	Unknown

vertPumpType - Domain

DomainName	vertPumpType
Description	Wet-end configuration of pump
FieldType	String
Domain Type	CodedValue

Code	Name
Centrifugal	Centrifugal
Vertical	Vertical
Diaphragm	Diaphragm
Peristaltic	Peristaltic
Progressive Cavity	Progressive Cavity
Submersible	Submersible
Flygt	Flygt
Vortex	Vortex
Other	Other
Unknown	Unknown

vertTankMaterial - Domain

DomainName	vertTankMaterial
Description	List of materials for a tank
FieldType	String
Domain Type	CodedValue

Code	Name
Plastic (Poly)	Plastic (Poly)
Steel Liner	Steel Liner
Steel	Steel
Stainless Steel	Stainless Steel
Concrete	Concrete
Fiberglass	Fiberglass
Aluminum	Aluminum
Other	Other
Unknown	Unknown

vertValveControl - Domain

DomainName	vertValveControl
Description	The manner in which a valve operating position is manipulated
FieldType	String
Domain Type	CodedValue

Code	Name
Hydraulic	Hydraulic
Electric	Electric
Manual	Manual

Pneumatic	Pneumatic
Electrohydraulic	Electrohydraulic
Other	Other
Unknown	Unknown

vertVoltage - Domain

DomainName vertVoltage
Description Nameplate voltage rating
FieldType String
Domain Type CodedValue

Code	Name
12 (DC)	12 (DC)
24 (DC)	24 (DC)
240 (DC)	240 (DC)
12/24 (AC)	12/24 (AC)
90 (AC)	90 (AC)
110/120 (AC)	110/120 (AC)
115/230 (AC)	115/230 (AC)
120/240 (AC)	120/240 (AC)
208 (AC)	208 (AC)
220 (AC)	220 (AC)
240 (AC)	240 (AC)
460/480 (AC)	460/480 (AC)
2400 (AC)	2400 (AC)
4000 (AC)	4000 (AC)
4160 (AC)	4160 (AC)
12.47K (AC)	12.47K (AC)
2.3kV (AC)	2.3kV (AC)
4.76 kV	4.76 kV
15 kV	15 kV
208/120 V	208/120 V
230/460 V	230/460 V
240/480 V	240/480 V
4760 V	4760 V
11000 V	11000 V
11500 V	11500 V
Other	Other
Unknown	Unknown
N/A	N/A

wDimension - Domain

DomainName wDimension
Description Type of standardized dimesions for meter housing assemblys
FieldType String
Domain Type CodedValue

Code	Name
12”x20”x12”	12”x20”x12” Deep
13”x24”x12”	13”x24”x12” Deep
17”x30”x12”	17”x30”x12” Deep
64”x126”x72”	64”x126”x72” Deep
104”x152”x72”	104”x152”x72” Deep
Other	Other
Unknown	Unknown

wLateralType - Domain

DomainName wLateralType
Description Type of service
FieldType String

Domain Type CodedValue

Code	Name
Commercial	Commercial
Domestic	Domestic
Fire	Fire
Hydrant	Hydrant
Industrial	Industrial
Irrigation	Irrigation
Other	Other
Unknown	Unknown

---

wLongShort - Domain

DomainName wLongShort
Description Indicates whether the main is on the same side of street of meter (short side), if not then it is on the long side
FieldType String
Domain Type CodedValue

Code	Name
Long	Long
Short	Short

---

wManufacturer - Domain

DomainName wManufacturer
Description List of manufacturers of water distribution system assets
FieldType String
Domain Type CodedValue

Code	Name
American Darling	American Darling
American Flow	American Flow
Clow	Clow
Iowa	Iowa
Kennedy	Kennedy
M and H	M and H
Mueller	Mueller
Unknown	Unknown
US Pipe	US Pipe

---

wMaterial - Domain

DomainName wMaterial
Description Type of material used for the meter boxes and lids
FieldType String
Domain Type CodedValue

Code	Name
Cast Iron	Cast Iron
Concrete	Concrete
Plastic	Plastic
Polyethylene	Polyethylene
Polymer	Polymer
Other	Other
Unknown	Unknown

---

wPumpType - Domain

DomainName wPumpType
Description The type of water pump in the water distribution system
FieldType String
Domain Type CodedValue

Code	Name
Axial Flow	Axial Flow
Centrifugal Other	Centrifugal Other
Centrifugal Split Case	Centrifugal Split Case
Jet	Jet
Reciprocating	Reciprocating
Rotary	Rotary
Turbine	Turbine
Other	Other
Unknown	Unknown

wServicePointType - Domain

DomainName wServicePointType
Description The types of service points in a water distribution system
FieldType String
Domain Type CodedValue

Code	Name
Commercial	Commercial
Domestic	Domestic
Fire	Fire
Hydrant	Hydrant
Industrial	Industrial
Irrigation	Irrigation
Other	Other
Unknown	Unknown

wShape - Domain

DomainName wShape
Description Type of shape for the meter housing
FieldType String
Domain Type CodedValue

Code	Name
Oblong	Oblong
Rectangular	Rectangular
Other	Other
Unknown	Unknown

wStructureType - Domain

DomainName wStructureType
Description The type of structures associated with a water distribution system
FieldType String
Domain Type CodedValue

Code	Name
Enclosed Storage Facility	Enclosed Storage Facility
Injection Well	Injection Well
Intake	Intake
Meter Station	Meter Station
Monitoring Well	Monitoring Well
Production Well	Production Well
Pump Station	Pump Station
Storage Basin	Storage Basin
Storage Tank	Storage Tank
Treatment Plant	Treatment Plant
Vault	Vault
Other	Other
Unknown	Unknown

wWaterType - Domain

DomainName	wWaterType
Description	The type of water flowing through pipes in a water distribution system
FieldType	String
Domain Type	CodedValue

Code	Name
Potable Water	Potable Water
Process Water	Process Water
Raw Water	Raw Water
Reclaimed Water	Reclaimed Water
Salt Water	Salt Water
Treated Water	Treated Water
Other	Other
Unknown	Unknown

YesNo - Domain

DomainName	YesNo
Description	A yes/no indicator
FieldType	String
Domain Type	CodedValue

Code	Name
Y	Yes
N	No

SECTION 01400 QUALITY CONTROL

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Testing Laboratory Services

1. Laboratory testing and checking and all certifications required by the Specifications, including the cost of transporting all samples and test specimens, shall be provided and paid for by the Contractor. These costs shall be considered incidental to existing bid items and no separate payments shall be made.
2. The Contractor shall retain the services of an independent, certified testing laboratory to perform all testing required by the Contract Documents and by permitting agencies. The Contractor shall submit the name of the testing laboratory and evidence of all appropriate certifications for approval by the Engineer and the City.
3. In the case of a conflict between this Specification Section and the Contractor's Quality Management Plan, the more stringent requirement between the two documents shall govern.
4. Procedure
   a. The Contractor shall plan and conduct his operations to permit taking of field samples and test specimens, as required, and to allow adequate time for laboratory tests.
   b. The collection, field preparation and storage of field samples and test specimens shall be performed by the Contractor as required by the Specifications and as directed by the City.
5. Supplementary and Other Testing
   a. Nothing shall restrict the Contractor from conducting tests he may require. Should the Contractor at any time request the City to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the City. Testing of this nature shall be conducted at no additional cost to the City.

1.02 OBSERVATION AT PLACE OF MANUFACTURE

A. Unless otherwise specified, all products, materials, and time and equipment shall be subject to observation by the Engineer at the place of manufacture.

B. The presence of the Engineer at the place of manufacture however, shall not relieve the Contractor of the responsibility for furnishing products, materials, and equipment which comply with all requirements of the Contract Documents. Compliance is a duty of the Contractor, and said duty shall not be avoided by any act or omission on the part of the Engineer.

1.03 SAMPLING AND TESTING

A. Unless otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered; however, the City reserves the right to use any generally-accepted system of sampling and testing which, in the opinion of the Engineer, will ensure the

City that the quality of the work is in full accord with the Contract Documents.

B. Any waiver by the City of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial Work, shall not be construed as a waiver of any requirements of the Contract Documents.

C. Notwithstanding the existence of such waiver, the Engineer reserves the right to make independent investigations and tests and failure of any portion of the Work to meet any of the requirements of the Contract Documents, shall be reasonable cause for the Engineer to require the removal or correction and reconstruction of any such Work in accordance with the General Conditions.

D. Materials to be tested include, but are not necessarily limited to the following:

1. cement,
2. concrete aggregate,
3. concrete,
4. bituminous paving materials,
5. structural and reinforcing steel,
6. waterproofing,
7. select backfill, subgrade, base material, crushed stone or gravel and sand
8. water during pipeline disinfection and bacteriological testing

1.04 SITE INVESTIGATION AND CONTROL

A. The Contractor shall verify all dimensions in the field and shall check field conditions continuously during construction. The Contractor shall be solely responsible for any inaccuracies built into the Work due to its failure to comply with this requirement.

B. The Contractor shall inspect related and appurtenant Work and shall report in writing to the Engineer any conditions which will prevent proper completion of the Work. Failure to report any such conditions shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor within the scope of the Project.

1.05 OBSERVATION AND TESTING

A. The work or actions of the testing laboratory shall in no way relieve the Contractor of its obligations under the Contract. The laboratory testing work will include such observations and testing required by the Contract Documents, existing laws, codes, ordinances, etc. The testing laboratory will have no authority to change the requirements of the Contract Documents, nor perform, accept or approve any of the Contractor's Work.

B. The Contractor shall allow the Engineer ample time and opportunity for field observation and testing materials and equipment to be used in the Work. The Contractor shall advise the Engineer promptly upon placing orders for materials and equipment so that arrangements may

be made, if desired, for observation before shipment from the place of manufacture. The Contractor shall at all times furnish the Engineer and its representatives, facilities including labor, and allow proper time for inspecting and testing materials, equipment, and installation. The Contractor must anticipate that possible delays may occur in the execution of its work due to the necessity of materials and equipment being inspected and accepted for use. The Contractor shall furnish, at its own expense, all samples of materials required by the Engineer for testing, and shall make its own arrangements for providing water, electric power, or fuel for the various observations and tests of structures and equipment.

C. The Contractor shall furnish the services of representatives of the manufacturers of certain equipment, as prescribed in other Sections of the Specifications. The Contractor shall also place his orders for such equipment on the basis that, after the equipment has been tested prior to final acceptance of the work, the manufacturer will furnish the City with certified statements that the equipment has been installed properly and is ready to be placed in functional operation. Tests and analyses required of equipment shall be paid for by the Contractor, unless specified otherwise in the Section which covers a particular piece of equipment.

D. The City will bear the cost of all tests, observations, or investigations undertaken by the order of the Engineer for the purpose of determining conformance with the Contract Documents if such tests, observations, or investigations are not specifically required by the Contract Documents, and if conformance is ascertained thereby. Whenever nonconformance is determined by the Engineer as a result of such tests, observations, or investigations, the Contractor shall bear the full cost thereof or shall reimburse the City for said cost. In this connection, the cost of any additional tests and investigations, which are ordered by the Engineer to ascertain subsequent conformance with the Contract Documents, shall be borne by the Contractor.

E. Significance of Tests

1. Test results shall be binding on both the Contractor and the City, and shall be considered irrefutable evidence of compliance or noncompliance with the Specification requirements, unless supplementary testing shall prove, to the satisfaction of the City, that the initial samples were not representative of actual conditions.

F. Supplementary and Other Testing

1. Nothing shall restrict the Contractor from conducting tests he may require. Should the Contractor at any time request the City to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the City. Testing of this nature shall be conducted at the Contractor's expense.

1.06 RIGHT OF REJECTION, IMPERFECT WORK, EQUIPMENT, OR MATERIALS

A. The Engineer, acting for the City, shall have the right, at all times and places, to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the Work at the site, or during the subsequent guarantee period. If the Engineer or its representative, through an oversight or otherwise, has accepted materials or Work which is defective, or which is contrary to the Contract Documents, such materials, no matter in what stage or condition of manufacture, delivery, or erection, may be subsequently rejected by the Engineer for the City. Any defective or imperfect work, equipment, or materials furnished by the Contractor which is discovered shall be removed immediately even though it may have been overlooked by the Engineer and

estimated for payment. Satisfactory work or materials shall be substituted for that rejected.

B. The Contractor shall promptly remove rejected articles or materials from the site of the Work after notification of rejection. All costs of removal and replacement of rejected articles or materials as specified herein shall be borne by the Contractor.

C. The Engineer may order tests of imperfect or damaged work, equipment, or materials to determine the required functional capability for possible acceptance, if there is no other reason for rejection. The cost of such tests shall be borne by the Contractor; and the nature, tester, extent and supervision of the tests will be as determined by the Engineer. If the results of the tests indicate that the required functional capability of the work, equipment, or material was not impaired, consistent with the final general appearance of same, the work, equipment, or materials may be deemed acceptable. If the results of such tests reveal that the required functional capability of the questionable work, equipment, or materials has been impaired, then such work, equipment, or materials shall be deemed imperfect and shall be replaced. The Contractor may elect to replace the imperfect work, equipment, or material in lieu of performing the tests.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 BUOYANCY

A. The Contractor shall be completely responsible for any tanks, pipelines, utility access, foundations or similar improvements that may become buoyant during the construction operations due to groundwater levels. Should there be any possibility of buoyancy, the Contractor shall take the necessary steps to prevent damage due to floating or flooding, and shall repair or replace said improvements at no additional cost to the City.

- END OF SECTION -

SECTION 01430 OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SUMMARY

A. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at

B. Required operation and maintenance data groupings are listed in this Section. At minimum, submit operation and maintenance data for all:

1. Equipment
2. Valves

1.02 PRELIMINARY OPERATION AND MAINTENANCE MANUAL SUBMITTAL

A. Quantity: One electronic copy.

B. Timing: 60 days prior to starting training of operations and maintenance personnel.

1.03 FINAL OPERATION AND MAINTENANCE MANUAL SUBMITTAL

A. Quantity:

1. Printed Copies: Two copies.
2. Electronic Copies: One copy.

B. Timing: Provide prior to Final Completion.

C. Release of Final Retainage Requires Acceptance of Final Operation and Maintenance Manuals: In accordance with the “Construction Agreement”, final retainage will not be paid until all final record drawings (as-builts), shop drawings, including all manufacturers’ instructional and parts manuals are delivered to and accepted by the City.

1.04 FORMAT OF PRINTED COPIES

A. Binding and Cover:

1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.

2. Provide the following information on cover of each volume:

a. Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.

b. Name or type of material or equipment covered in the manual.

c. Volume number, if more than one volume is required, listed as “Volume __ of __”, with appropriate volume-designating numbers filled in.

d. Name of Project and, if applicable, Contract name and number.

e. Name of building or structure, as applicable.

3. Provide the following information on spine of each volume:

a. Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.

b. Name or type of material or equipment covered in the manual.

c. Volume number, if more than one volume is required, listed as “Volume __ of __”, with appropriate volume-designating numbers filled in.

d. Project name and building or structure name.

B. Drawings:

1. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing.

2. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.

C. Copy Quality and Document Clarity:

1. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color.

2. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content.

D. Organization:

1. Provide table of contents in each volume for each chapter or section.

2. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

1.05 FORMAT OF ELECTRONIC COPIES

A. Each electronic copy shall include all information included in the corresponding printed copy.

B. Submit electronic copy via transferable method acceptable to Engineer.

C. File Format:

1. Acceptable formats include Adobe PDF, Microsoft Word, Autodesk DWF, and AutoCAD.

2. All drawing-type submittals and documentation specified herein shall also be rendered and submitted in the latest version of AutoCAD as well as Adobe PDF format. All AutoCAD drawings shall conform to owner CAD standards in effect at the time of contract bidding. Owner's CAD standards are available at the following link:

   https://www.fortlauderdale.gov/government/departments-i-z/public-works/engineering-division/cadd-standards

3. All textual-type submittals and documentation shall be rendered and submitted in the latest version of Adobe PDF format. All text within PDF documents shall be electronically searchable text and shall not be a scanned image of text. When available, submit original manufacturers' PDFs with software generated annotations to indicate project-specific data.

4. Submit separate file for each separate document in the printed copy.

5. Within each file, provide bookmarks for the following:

   a. Each chapter and subsection listed in the corresponding printed copy document's table of contents

   b. Each figure

   c. Each table

   d. Each appendix

6. Failure to provide bookmarks will result in rejection of the submittal.

D. Submit drawings and figures in one of the following formats: ".bmp", ".tif", ".jpg", ".gif", "dwf", or "dwg".

1.06 GENERAL CONTENT REQUIREMENTS

A. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.

B. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

C. Submit written explanations of all safety considerations relating to operation and maintenance procedures.

D. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:

1. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.
2. Recommended schedule for each preventive maintenance task.
3. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
4. Table of alternative lubricants.
5. Troubleshooting instructions.
6. List of required maintenance tools and equipment.

E. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:

1. Manufacturer’s name, address, telephone number, fax number, and Internet website address.
2. Manufacturer’s local service representative’s or local parts supplier’s name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
3. Manufacturer’s shop order and serial number(s) for materials, equipment or assembly furnished.
4. For each part or piece include the following information:
    a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
    b. Part name or description.
    c. Manufacturer’s part number.
    d. Quantity of each part used in each assembly.
    e. Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

F. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number).

G. Submit manufacturer’s recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the

equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

H. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.

I. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

J. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.

K. Submit copy of warranty bond and service contract as applicable.

L. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

1.07 SUBMITTALS

A. Submittals shall comply with the Section titled "Submittal Procedures".

B. Submit preliminary and final operation and maintenance manuals

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01510 TEMPORARY UTILITIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. It shall be the Contractor's responsibility to provide equipment that is adequate for the performance of the Work under this Contract within the time specified. All equipment shall be kept in satisfactory operating condition, shall be capable of safely and efficiently performing the required Work, and shall be subject to review by the City's representative at any time within the duration of the Contract. All Work hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.

B. The Contractor shall provide for utilities and services for its own operations. The Contractor shall furnish, install and maintain all temporary utilities during the contract period including removal upon completion of the Work.

1.02 POWER AND LIGHTING

A. Power: The Contractor shall provide all necessary power required for its operations under the Contract, and shall provide and maintain all temporary power lines required to perform the Work in a safe and satisfactory manner.

B. Construction Lighting: All Work conducted at night or under conditions of deficient daylight shall be suitably lighted to ensure proper Work and to afford adequate facilities for inspection and safe working conditions. Temporary lighting shall be maintained during nonworking periods if the area is subject to access by the public or City's personnel.

C. Electrical Connections: All temporary connections for electricity shall be subject to review by the Engineer and the power company representative, and shall be removed in like manner at the Contractor's expense prior to final acceptance of the Work.

D. Separation of Circuits: Unless otherwise permitted by the Engineer, circuits separate from lighting circuits shall be used for all power purposes.

E. Construction Wiring: All wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. All electrical facilities shall conform to the requirements of Subpart K of the OSHA Safety and Health Standards for Construction.

1.03 WATER SUPPLY

A. General: Except as noted otherwise, the Contractor shall make arrangements for and pay for all costs for all water used during construction including general construction used, testing, Contractor's trailer and Engineer's trailer. The Contractor shall provide and maintain all piping, fittings, adapters, and valving as may be required.

B. If a temporary connection is made to a potable water system on-site (e.g., a fire hydrant), the Contractor must install a back flow prevention device and a meter, obtained from the City. The Contractor shall provide temporary piping for the metering and use of potable water. The cost of the water for the testing will be charged to the Contractor at the standard City rates including deposits, monthly charges and usage charges.

C. Water Connections: The Contractor shall not make connection to, or draw water from, any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the agency owning the affected water system. For each such connection made, the Contractor shall first attach to the fire hydrant or pipeline a valve and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.

D. Removal of Water Connections: Before final acceptance of the Work on the project, all temporary connections and piping installed by the Contractor shall be entirely removed, and all affected improvements shall be restored to their original condition, or better, to the satisfaction of the Engineer and to the agency owning the affected utility.

E. Fire Protection: The construction, and all other parts of the Work shall be connected with the Contractor's water supply system and shall be adequately protected against damage by fire. Hose connections and hose, water casks, chemical equipment, or other sufficient means shall be provided for fighting fires in the temporary structures and other portions of the Work, and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire. The Contractor's fire protection program shall conform to the requirements of Subpart F of the OSHA Standards for Construction and all local Fire Department Requirements.

1.04 TEMPORARY SANITARY FACILITIES

A. The Contractor shall provide and maintain adequate and clean sanitary facilities for the construction work force and visitors. The facilities shall comply with local codes and regulations and be situated in an acceptable location.

1.05 CONFINED SPACES

A. The Contractor shall provide and maintain a safe working environment in confined spaces. The Contractor shall follow the applicable requirements of the OSHA Standards for Construction and NIOSH Publications for working in confined spaces.

1.06 TEMPORARY VENTILATION

A. The Contractor shall provide and maintain adequate ventilation for a safe working environment. In addition, forced air ventilation shall be provided for the curing of installed materials, humidity control and the prevention of hazardous accumulations of dust, gases or vapors.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01520 CONSTRUCTION CONSTRAINTS

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The intent of this Section is to outline the minimum requirements necessary to provide continuous public services throughout the construction period.

B. Work under the Contract shall be scheduled and performed in such a manner as to result in the least possible disruption to the operation of existing water, wastewater, and stormwater transmission facilities and nearby residents and businesses.

C. Work under the Contract shall minimize disruption of electrical power.

D. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without cost to the City (including additional City labor) and provided that all requirements of these Specifications are fulfilled. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements and constraints and construction requirements outlined hereinafter. All references to days in this Section shall be consecutive calendar days.

1.02 CONNECTION OF EXISTING SYSTEMS

A. All connections to existing systems shall be performed in such a manner that no damage and minimal interruption is caused to the existing installation. Any damage caused to existing installations shall be repaired or replaced by the Contractor at no additional cost to the City.

B. The Contractor shall note that some of the work in this Contract will require the Contractor to connect to existing pipelines and structures. The Contractor shall be responsible for the proper containment and disposal of wastewater, or other materials drained from existing pipelines and structures during construction, unless otherwise specifically noted to be performed by the City.

C. The Contractor shall contain such wastewater or other materials (in accordance with all applicable codes) and shall dispose of such within the existing collection system as approved by the City. The Contractor shall be responsible for the prevention of wastewater or other material spills within the Work.

1.03 OPERATION REQUIREMENTS

A. Coordination with Private Property Owners: Stormwater work is located in City of Fort Lauderdale right-of-way areas. Work is also adjacent to private residences and public access areas. The Contractor shall coordinate work with the City and shall minimize impacts to private property owners and public access areas. Contractor shall replace surrounding ground affected including but not limited to pavers, sidewalks, sod, landscape and bring it to original or better conditions.

B. Sequence of certain major events and identification of time constraints for removing existing facilities from active service and installation of new facilities are described below. No phase of work (or tasks within a phase) shall preclude or be performed in parallel with a subsequent phase unless specifically defined so in these documents. In all cases, work in each phase shall be accepted for satisfactory use, subject to the City's approval, prior to the Contractor proceeding to the next phase of construction.

C. Critical events in the sequence of construction are specified herein. The outlined sequence of construction does not include all items necessary to complete the Work, but is intended to identify the sequence of critical events necessary to eliminate disruption to the public and to the City's facilities. It shall be understood by the Contractor that the critical events identified are not all inclusive and that additional items of work not shown may be required. The sequence of construction is a precedence requirement and does not attempt to schedule the Contractor's work.

1.04 SEQUENCE OF CONSTRUCTION

A. Mobilization / Site Preparation

1. Mobilize for work – video roadways, swales and adjacent area, establish field offices, obtain permits, develop and submit construction schedule, submit shop drawing schedule and begin shop drawing submittals and procurement of materials.
2. For interfering utilities, construct new utilities up to tie-in points, perform tests, make final connections with minimum amount of shut down time. After acceptance of new utilities, remove existing interfering underground utilities and structures. Provide temporary services as required to maintain continuous operation.

B. Detailed Construction

1. Project Notification shall be performed in accordance with the requirements of Section 01580 – Project Identification and Signs.
2. The Contractor shall be responsible for all damages/claims resulting from its activities on the surrounding neighborhood and its residents.
3. The Contractor shall divide the overall project area into contiguous areas (Work Areas), each comprising no more than 5,000 linear feet of open cut installation. The Contractor may undertake work that results in disturbance of existing conditions (e.g. any excavations, interruption of normal traffic, etc.), in only one identified Work Area at a time and must complete all work, including restoration of all utility services, driveway/sidewalk repairs, and asphalt restoration, with the exception of final milling and resurfacing of roadway pavement within that area prior to moving to the next construction area. Upon request of the Contractor, contingent upon satisfactory demonstration of timely and adequate restoration, the City and Engineer may grant approval for the Contractor to exceed the 5,000 linear feet limitation of open cut construction at any given time.
4. After proposed improvements are installed, the Contractor shall restore the first and second lifts of asphalt within 14 days after installation of buried piping/structures.
5. Final milling and resurfacing of the entire roadway (for all areas where pipe or structures are installed) shall be completed in a maximum of two sections, after completion of pipeline testing, acceptance, and complete pavement restoration of all Work Areas.
6. With approval from the City, the Contractor may choose to implement two Work Areas within the project limits at the same time. It is required that the two Work Areas must have a minimum of three City blocks separation between them until one of the Work Areas is deemed substantially complete. Additional materials and equipment required for this approach shall be the responsibility of the Contractor at no additional cost to the City.
7. The Contractor shall be responsible for all damages/claims resulting from its activities on the surrounding neighborhood, its residents, and businesses.

8. The Contractor shall provide pedestrian access to all businesses and residences within the project limits at all times.
9. Construction within a Work Area shall be scheduled so that all improvements are completed at one time and impacted residents/businesses are only disrupted for one time period.
10. The Contractor shall be responsible for the removal and replacement of miscellaneous street furnishings which shall include, but are not necessarily limited to, the following: benches, newspaper racks, telephones, bus shelters, trash receptacles, mailboxes, etc. in order to complete construction as necessary.
11. Construction activities related to the pump station and pipeline installations shall not commence until the Broward County Environmental Resources Permit modification has been secured by the City, which is anticipated within 60 calendar days from the issuance of the NTP. If said permit is received prior to 60 calendar days from the issuance of the NTP, the Contractor may commence activities related to the construction of said pump station and pipeline installations upon written authorization from the City and in accordance with the Contract Documents.
12. Construction of the seawall VP01, 42-inch RCP outfall pipe from pump station discharge structure to outfall, and pipe penetration for outfall structure at the intracoastal shall not commence until the US Army Corps of Engineers permit is secured by the City, which is anticipated within 180 calendar days from the issuance of the NTP. If said permit is received prior to 180 calendar days from the issuance of the NTP, the Contractor may commence activities related to the construction of the seawall, outfall pipe, and outfall structure upon written authorization from the City and in accordance with the Contract Documents. The Contractor is advised that activities related to the construction of the seawall, outfall pipe, and outfall structure also requires authorization under South Florida Water Management District Environmental Resources Permit. However, this permit is anticipated to be secured before 180 calendar days from NTP.

C. Final Site Work and Closeout

1. Final grading, milling and resurfacing, sodding, landscaping, miscellaneous work, demobilization and related closeout activities shall be as defined elsewhere in the Contract Documents.

1.05 CONTRUCTION CONSTRAINTS

A. Construction Dewatering

1. All dewatering equipment such as pumps, air compressors, generators, etc. proposed for use during construction in residential areas shall be provided with noise enclosures suitable to meet the requirements of the City of Fort Lauderdale Noise Ordinance.
2. The Contractor is responsible for draining and dewatering all existing utilities impacted by the work as required to complete the relocation, demolition, bypass, or tie-in connections. Contractor is responsible for disposal of the contents of each line.
3. Additional requirements for construction dewatering are defined on the Drawings.

B. Work in City of Fort Lauderdale Right-of-Way

1. Contractor shall coordinate with City of Fort Lauderdale Engineering Department prior to start of restoration.

2. At any time, the entire length of the project area shall remain unobstructed and open to through traffic for each section. Access for emergency vehicles shall be maintained at all times to all homes and businesses. Excavation must be backfilled or barricaded at the end of each workday to prevent hazardous conditions. If a trench, excavation, or structure is to be left open, it must be covered with a steel plate and barricaded at the end of each workday or when work will be suspended for more than eight (8) hours.
3. Transportation provisions for handicapped or disabled residents shall be made by the Contractor if construction temporarily prevents access to homes. Constant access shall be provided for residents on the Special Needs List.
4. The Contractor shall also make provisions with local bus, school bus, garbage collection, mail delivery, and other agencies for continuation of service. A traffic maintenance plan indicating detours, schedules, and alternate routes which has been approved by the Engineer, the City, and Broward County Traffic Engineering Division shall be submitted to all affected agencies for coordination and routing purposes.
5. Pipe and material shall not be strung out along installation routes for longer than two (2) weeks prior to installation.
6. A safe walk route for all schools within the vicinity of the construction zone shall be maintained during the arrival and dismissal of school. Contractor shall not block bus access to schools during school hours.

C. Maintenance of Existing Facilities

1. It may be necessary to interrupt the operation of the existing water and/or sewer system. In all cases where the Contractor must cause an interruption, the Contractor shall prepare and submit to the Engineer seven (7) working days prior to commencing work, a complete description of the proposed procedure and a guaranteed time schedule. At least 24 hours prior to the time proposed for starting the Work, the Contractor will be notified by the Engineer whether or not the Work will be permitted as proposed.
2. The Engineer reserves the right to require the Contractor to work 24 hours per day in all cases where interference with operation of the system may result in dangerous health hazards or offensive conditions.
3. In no case will the Contractor be permitted to interfere with the existing system until all materials, supplies, equipment, tools and incidentals necessary to complete the work are on site. Backup equipment and/or materials on key items shall be required on work necessitating interference with the existing system.

D. Mangrove Trimming and Removal

1. All work associated with mangrove trimming and removal shall be in accordance with Broward County guidelines as outlined in the Environmental Resource License.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 COORDINATION WITH EXISTING UTILITIES AND OTHER AGENCIES

A. The Contractor shall notify all utilities in writing with a copy to the City/Engineer prior to construction commencement. The Contractor shall cooperate with these utility owners as necessary to minimize service interruptions.

- END OF SECTION -

SECTION 01525 MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 GENERAL

A. The Contractor shall maintain pedestrian and vehicular traffic within the limits of the projects for the duration of the construction period, including any temporary suspensions of the work, construct and maintain detours, provide facilities for access to adjacent residences, schools, bus pick up and drop off locations, common grounds, businesses, etc., along the project, furnish, install and maintain traffic control and safety devices during construction, furnish and install work zone pavement markings for maintenance of traffic in construction areas and provide any other special requirements for safe and expeditious movement of pedestrian and vehicular traffic in accordance with the Contract Documents. Maintenance of Traffic includes all facilities, devices and operations as required for safety and convenience of the public within the work zones, and shall include provisions for pedestrian, residential, and school student traffic as well as vehicular traffic.

   The Contractor shall not maintain traffic over those portions of the project where no work is to be accomplished or where construction operations will not affect existing roads. Do not obstruct or create a hazard to any traffic during the performance of the work, and repair any damage to existing pavement open to traffic.

B. Beginning Date of Contractor's Responsibility: The Contractor shall maintain traffic starting the day work begins on the project. No work shall commence without approved and constructed Traffic Control Plans in place.

C. Worksite Traffic Supervisor: The Contractor shall provide a Worksite Traffic Supervisor. Requirements are as follows:

   1. Ensure that the Worksite Traffic Supervisor is available on a 24-hour per day basis, participates in all changes to traffic control and reviews the project on a day-to-day basis.

   2. Ensure that the Worksite Traffic Supervisor is present to direct the initial setup of the traffic control plan and any changes. Provide the Worksite Traffic Supervisor with all equipment and materials needed to set up and maintain traffic control and handle traffic-related situations.

   3. Ensure that the Worksite Traffic Supervisor immediately corrects all safety deficiencies. Do not allow minor deficiencies that are not immediate safety hazards to remain uncorrected for more than 24-hours.

   4. Ensure that the Worksite Traffic Supervisor is available within 45 minutes after notification of an emergency situation and is prepared to positively respond to repair the work zone traffic control or to provide alternate traffic arrangements.

   5. The City may disqualify and remove from the project a Worksite Traffic Supervisor that fails to comply with the provisions of this specification. The City may suspend all activities, except traffic and erosion control and such other activities that are necessary for project maintenance and safety, for failure to comply with these provisions.

   6. Ensure that the Worksite Traffic Supervisor performs a drive-through inspection and observes traffic flow as soon as the work zone is activated and in each subsequent phase

of work as they are opened to traffic. Provide to the Engineer and City a report that includes a listing of any deficiencies and proposed corrective measures.

7. Ensure that the Worksite Traffic Supervisor conducts within the limits of the project, daily daytime and weekly night time inspections within the limits of the project for projects with predominate daytime work activities and daily nighttime and weekly daytime inspections for projects with predominate nighttime work, of all traffic control devices, traffic flow, pedestrian, bicyclist, student, bus rider, school, residence and business accommodations.

8. Advise the project personnel of the schedule of these inspections and give them the opportunity to join in the inspection as is deemed necessary. Submit a comprehensive weekly report to the Engineer and City and include the condition of all traffic control devices (including pavement markings) being used. The inspection report shall also include assurances that pedestrians are accommodated with a safe travel path around work sites and safely separated from mainline traffic, that existing or detoured bicyclist paths and bus routes and stops are being maintained satisfactorily throughout the project limits, that existing residences in the work areas are being provided with adequate access for vehicular and pedestrian traffic at all times and that existing businesses in the work areas are being provided with adequate entrances for vehicular and pedestrian traffic during business hours. The Worksite Traffic Supervisor shall sign the report and certify that all of the above issues are being handled in accordance with the Contract Documents. If deficiencies are noted, the Worksite Traffic Supervisor shall note such deficiencies and include the proposed corrective actions in the report and implement immediate corrective action.

D. Traffic Control Plan

1. The Contractor is responsible for preparing a Traffic Control Plan (TCP) to be signed and sealed by a licensed Florida Engineer competent and trained in the preparation of TCP. The licensed Florida Engineer (TCPE) signing and sealing the Traffic Control Plan shall review all of the reports from the Worksite Traffic Supervisor and inspect the installation for compliance with his approved plan upon the initial installation and for each subsequent phase of the plan. The Contractor shall provide the Engineer and City with an inspection report from the TCPE indicating compliance with his approved TCP. The TCP shall meet the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) Part VI, and the following jurisdictional agencies.

    a. City of Fort Lauderdale Transportation and Mobility
    b. City of Fort Lauderdale Department of Sustainable Development
    c. City of Fort Lauderdale Fire Department
    d. City of Fort Lauderdale Police Department
    e. School Board of Broward County

2. Standards: FDOT Design Standards (DS) are the minimum standards for the use in the development of all traffic control plans. The MUTCD Part VI is the minimum national standard for traffic control for highway construction, maintenance, and utility operations. Follow the basic principles and minimum standards contained in these documents for the design, application, installation, maintenance, and removal of all traffic control devices, warning devices and barriers which are necessary to protect the public and workers from hazards within the project limits.

3. The Contractor shall provide sufficient time in the construction schedule to develop and obtain approval for each TCP.

4. The Contractor shall include provisions for detouring pedestrians and providing maintenance of traffic plans and conveyances that meet current ADA (Americans with Disabilities Act) requirements.

5. The Contractor shall submit approved maintenance of traffic plans and schedules for the development, review, approval and implementation of the maintenance of traffic plan in accordance with the Contract Documents and Section 01300 – Submittals.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

A. Maintenance of Roadway Surfaces: Maintain all lanes that are being used for the maintenance of traffic, including those on detours and temporary facilities, under all weather conditions. Keep the lanes free of dust, dirt, muck, potholes and rutting. Provide the lanes with the drainage facilities necessary to maintain a smooth riding surface under all weather conditions.

B. Number of Traffic Lanes:

1. Maintain one lane of traffic in each direction.

2. Maintain two lanes of traffic in each direction at existing four (or more) lane cross roads.

3. Construct each lane used for maintenance of traffic at least as wide as the traffic lanes existing in the area before commencement of construction. Do not allow traffic control and warning devices to encroach on lanes used for maintenance of traffic.

4. The Engineer may allow the Contractor to restrict traffic to one-way operation for short periods of time provided that the Contractor employs adequate means of traffic control and does not unreasonable delay traffic, and conforms to the approved requirements in the TCP. The Contractor shall include as a part of the TCP the estimated periods of one-way traffic operations and estimation of reasonable time delays and shall obtain the prior approval of the City for these time periods and time delays. The Contractor shall include the TCP as a part of its Plan of Operation and MOT plan and in accordance with Section 01300 – Submittals.

C. Crossings and Intersections: Provide and maintain adequate accommodations for intersecting and crossing traffic. Do not block or unduly restrict any road or street crossing the project unless approved by the Engineer and City. Maintain all existing actuated or traffic responsive mode signal operations for main and side street movements for the duration of the Contract. Restore any loss of detection within twelve (12) hours. Use only detection technology approved by the Engineer to restore detection capabilities. Before beginning any construction, provide the Engineer a plan for maintaining detection devices for each intersection and the name(s) and phone numbers of persons that can be contracted when signal operation malfunctions.

D. Access for Residences and Businesses: Provide continuous access to all residences and all places of business, adjacent schools, common property and community facilities.

E. Safe Walk Route: The safe walk route for all school students within the vicinity of the construction zone shall be maintained during the times students are arriving at or leaving school. If the current walking surface cannot be maintained, a temporary road-rock four- ft walkway shall be created in accordance with Broward County requirements. Accommodations shall be made immediately by the Contractor for the disabled persons.

F. Protection of the Work from Injury by Traffic: Where traffic would be injurious to a base, surface course, or structure constructed as a part of the work, maintain all traffic outside the limits of such areas until the potential for injury no longer exists.

G. Flagger: Provide trained flaggers as required by approved TCPs. State certified school crossing guards or off duty police officers shall be required to cross students at any locations other than those currently used.

H. Use of High Visibility Safety: Provide personnel with appropriate high visibility safety garments. Ensure that these garments be worn whenever the workers are within fifteen (15) feet of the edge of the travel way and during nighttime operations. Workers operating machinery or equipment in which loose clothing could become entangled during operation shall be required to wear appropriate high visibility clothing that will not be subject to entanglement such as orange shirts or jackets. Require Contractor personnel to wear reflective orange vest/garment during nighttime operations.

I. Existing Pavement Markings: Where a detour changes the lane use of where normal vehicle paths are altered during construction, remove all existing pavement markings that will conflict with the adjusted vehicle paths. Do not overpaint. Remove existing pavement markings using a method that will not damage the surface texture of the pavement and which will eliminate the previous marking pattern regardless of weather and light conditions. Remove all pavement markings that will be in conflict with “next phase of operation” vehicle paths as described above, before opening to traffic.

J. Detours

1. General: Construct and maintain detour facilities wherever it becomes necessary to divert traffic from any existing roadway or bridge, or wherever construction operations block the flow of traffic.

2. Construction: Plan, construct, and maintain detours for the safe passage of traffic in all conditions of weather. Provide the detour with all facilities necessary to meet this requirement.

3. Construction Methods: Select and use construction methods and materials that provide a stable and safe detour facility. Construct the detour facility to have sufficient durability to remain in good condition, supplemented by maintenance, for the entire period that the detour is required.

4. Removal of Detours: Remove detours when they are no longer needed and before the Contract is completed. Restore the area used for detours to a condition equal to or better than existed before beginning of construction. Take ownership of all materials from the detour and remove them.

5. Detours Over Existing Roads and Streets: When the TCP specifies that traffic be detoured over roads or streets outside the project area, do not maintain such roads or streets; however, maintain all signs and other devices placed for the purpose of the detour.

K. Traffic Control Officer.

1. Provide uniformed law enforcement officers, including marked law enforcement vehicles, to assist in controlling and directing traffic in the work zone when traffic control in a signalized intersection is necessary when signals are not in use.

L. Driveway Maintenance.

1. General: Ensure that each residence and or business has safe, stable, and reasonable access.

2. Construction Methods: Place, level, manipulate, compact, and maintain the material, to the extent appropriate for the intended use. As permanent driveway construction is accomplished at a particular location, the Contractor may salvage and reuse previously placed materials that are suitable for reuse on other driveways.

M. Temporary Traffic Control Devices.

1. Installation and Maintenance: Install and maintain adequate traffic control devices, warning devices and barriers to protect the traveling public and workers, and to safeguard the work area. Erect the required traffic control devices, warning devices and barriers to prevent any hazardous conditions and in conjunction with any necessary traffic re-routing. Immediately remove, turn or cover any devices or barriers that do not apply to existing conditions.

2. Notify the Engineer and City of any scheduled operation, which will affect traffic patterns or safety, sufficiently in advance of commencing such operation to permit his review of the plan for the proposed installation of traffic control devices, warning devices of barriers.

3. Ensure an employee is assigned the responsibility of maintaining the position and condition of all traffic control devices, warning devices and barriers throughout the duration of the Contract. Keep the Engineer and City advised at all times of the identification and means of contacting this employee on a 24-hour basis.

4. Keep traffic control devices, warning devices, safety devices and barriers in the correct position, properly directed, clearly visible and clean, at all times. Immediately repair, replace or clean damaged, defaced or dirty devices or barriers.

N. Work Zone Signs: Provide signs in accordance with the approved TCPs and Design Standards.

O. High Intensity Flashing Lights: Furnish lights in accordance with the approved TCPs and Design Standards.

P. Warning/Channelizing Devices: Furnish warning/channelizing devices in accordance with the approved TCPs and Design Standards.

Q. Guardrail (Temporary): Furnish guardrail (temporary) in accordance with the approved TCPs.

R. Advance Warning Arrow Panel: Furnish advance warning panel in accordance with the approved plans, Design Standards and approved TCPs.

S. Temporary Traffic Control Signals: furnish, install and operate temporary traffic control signals

as indicated in the approved TCPs. Temporary traffic control signals will consist of either portable or fixed traffic signals. Provide certification that the portable traffic signals meet the requirements of the Design Standards. The Engineer may approve used signal equipment if it is in acceptable condition.

T. Work Zone Pavement Marking.

1. Description: Furnish and install Work Zone Pavement Markings for maintenance of traffic construction areas and in close conformity with the lines and details shown on the plans. Measure the reflectivity of white and yellow stripes in accordance with Florida Method FM 5-541. Re-stripe anytime the reflectivity falls below the final values shown in FM 5-541. Use only pavement marking materials that do not contain any lead or chromium compounds.

2. Centerlines, lane lines, edge lines, stop bars and turn arrows in work zones will be required in accordance with the MUTCD with the following additions:

   a. Install edge lines on paved shoulders.

   b. Place edge lines on all detours where vehicle paths are altered from normal operations and where a lane is narrowed from its normal width for any reason.

   c. Apply Work zone Pavement Markings, including arrows and messages as determined by the TCPE to be required for the safe operation of the facility, before the end of the day if the highway is open to traffic. Channelizing devices may be used to direct traffic during the day before placing the Work Zone Pavement Markings.

   d. Work Zone Pavement Markings shall be designated in the approval TCPs as removable or non-removable.

- END OF SECTION -

SECTION 01530 PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall be responsible for the preservation and protection of property adjacent to the work site against damage or injury as a result of its operations under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the Contractor shall be restored in a proper and satisfactory manner or replaced by and at the expense of the Contractor to an equal or superior condition than previously existed.

B. The Contractor shall comply promptly with such safety regulations as may be prescribed by the City or the local authorities having jurisdiction and shall, when so directed, properly correct any unsafe conditions created by, or unsafe practices on the part of, its employees. In the event of the Contractor's failure to comply, the City may take the necessary measures to correct the conditions or practices complained of, and all costs thereof will be deducted from any monies due the Contractor. Failure of the Engineer to direct the correction of unsafe conditions or practices shall not relieve the Contractor of its responsibility hereunder.

C. In the event of any claims for damage or alleged damage to property as a result of work under this Contract, the Contractor shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of work in the vicinity of property adjacent to the work site, the Contractor, at its own expense, shall take such surveys as may be necessary to establish the existing condition of the property. Before final payment can be made, the Contractor shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

1.02 PROTECTION OF WORK AND MATERIAL

A. During the progress of the work and up to the date of final payment, the Contractor shall be solely responsible for the care and protection of all work and materials covered by the Contract.

B. All work and materials shall be protected against damage, injury or loss from any cause whatsoever, and the Contractor shall make good any such damage or loss at its own expense. Protection measures shall be subject to the approval of the Engineer.

1.03 BARRICADES, WARNING SIGNS AND LIGHTS

A. The Contractor shall provide, erect and maintain as necessary, strong and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to insure safety to the public. All barricades and obstructions along public roads shall be illuminated at night and all lights for this purpose shall be kept burning from sunset to sunrise.

B. Each Contractor shall provide and maintain such other warning signs and barricades in areas of and around their respective work as may be required for the safety of all those employed in the work, City operating personnel, or those visiting the site.

1.04 TEMPORARY BRIDGES

A. Construct temporary bridges at all points where maintenance of traffic across pipeline construction is necessary.

B. Make bridges over public streets, roads, and highways acceptable to authority having jurisdiction thereover.

C. Bridges erected over private roads and driveways shall be adequate for service to which they will be subjected.

D. Provide substantial guardrails and suitably protected approaches.

E. Provide foot bridges not less than 4 feet wide with handrails and uprights of dressed lumber.

F. Maintain bridges in place as long as conditions of the Work require their use for safety of public, except that when necessary for proper prosecution of the Work in immediate vicinity of bridge. Bridge may be relocated or temporarily removed for such period as Engineer may permit.

1.05 EXISTING UTILITIES AND STRUCTURES

A. The term existing utilities shall be deemed to refer to both publicly-owned and privately- owned utilities, such as electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.

B. Where existing utilities and structures are indicated on the Drawings, it shall be understood that all of the existing utilities and structures affecting the work may not be shown and that the locations of those shown are approximate only. It shall be the responsibility of the Contractor to ascertain the actual extent and exact location of existing utilities and structures. In every instance, the Contractor shall notify the proper authority having jurisdiction and obtain all necessary directions and approvals before performing any work in the vicinity of existing utilities.

C. Prior to beginning any excavation work, the Contractor shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If interference exists, the Contractor shall bring it to the attention of the Engineer as soon as possible. If the Engineer agrees that interference exists, it shall modify the design as required.

D. Additional costs to the Contractor for this change shall be processed through a Change Order as detailed elsewhere in these Contract Documents. In the event the Contractor fails to bring a potential conflict or interference to the attention of the Engineer prior to beginning excavation work, any actual conflict or interference which does arise during the Project shall be corrected by the Contractor, as directed by the Engineer, at no additional expense to the City.

E. The work shall be carried out in a manner to prevent disruption of existing services and to avoid damage to the existing utilities. Temporary connections shall be provided, as required, to insure uninterrupted existing services. Any damage resulting from the work of this Contract shall be promptly repaired by the Contractor at its own expense in a manner approved by the Engineer and further subject to the requirements of any authority having jurisdiction. Where it is required by the authority having jurisdiction that they perform their own repairs or have them done by others, the Contractor shall be responsible for all costs thereof.

F. Where excavations by the Contractor require any utility lines or appurtenant structures to be temporarily supported and otherwise protected during the construction work, such support and protection shall be provided by the Contractor. All such work shall be performed in a manner satisfactory to the Engineer and the respective authority having jurisdiction over such work. In the event the Contractor fails to provide proper support or protection to any existing utility, the Engineer may, at its discretion, have the respective authority to provide such support or protection as may be necessary to ensure the safety of such utility, and the costs of such measures shall be paid by the Contractor.

G. Protection of existing utilities, structures and other facilities: The underground pipes, utilities and structures shown on the Plans are located according to the best information available, but may vary by several feet from both the position and elevation shown. The Contractor shall explore far enough ahead of its work to determine the exact location and condition of such utilities, structures or facilities so that, before the Work is installed, the Engineer may change the line or grade of the pipe or other facility, should that become necessary to avoid a conflict. Should this exploration reveal that adjustments to the work are necessary; the Contractor shall immediately notify the Engineer and coordinate with him to adjust the work in a timely fashion avoiding delays to construction. No request for additional compensation or Contract time (except for a non-compensable time extension at the sole discretion of the Engineer, whose decision shall be final) resulting from encountering utilities or structures not shown, or differing in location or elevation from that shown, will be considered. The Contractor shall explore sufficiently ahead of the Work to allow time for any necessary adjustment without delay occasioned by encountering underground utilities or structures which could have or should have been discovered by timely exploration ahead of the Work shall rest solely with the Contractor.

H. Relocation of existing utilities: The relocation of existing utilities, as noted on the Plans, or for the convenience of the Contractor shall be the responsibility of the Contractor. This work shall be completed by either the forces of the existing utility or the Contractor's forces at the discretion of the responsible utility. If the work is to be performed by the Contractor, all work shall be done in accordance with the utility company's requirements. Under no circumstances shall the Contractor be authorized extra payment for this work, and all cost for the relocation shall be the responsibility of the Contractor.

I. Any conflicts between the field investigation and the information shown on the Plans shall be brought to the immediate attention of the Engineer

1.06 TREES WITHIN PROJECT LIMITS

A. General: The Contractor shall exercise all necessary precautions so as not to damage or destroy any trees on the project site and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or City. All existing trees which are damaged during construction shall be replaced by the Contractor or a certified tree company to the satisfaction of the City.

B. Replacement: The Contractor shall immediately notify the City if any tree is damaged by the Contractor's operations. If, in the opinion of the City, the damage is such that replacement is necessary, the Contractor shall replace the tree at its own expense. The tree shall be of a like size and variety as the tree damaged, or, if of a smaller size, the Contractor shall pay to the City compensatory payment acceptable to the City.

1.07 NOTIFICATION BY THE CONTRACTOR

A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than three days nor more than seven days prior to excavation.

1.08 DETOURS

A. Where authority having jurisdiction requires that traffic be maintained over construction work in a public street, road, or highway, and traffic cannot be maintained on original roadbed or pavement, construct and maintain detour around the Work. Coordinate traffic routing with that of others working in same or adjacent areas.

1.09 RESTORATION OF PAVEMENT

A. General: All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents. All pavements which are subject to partial removal shall be neatly saw cut in straight lines.

B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction or as required by the Contract Documents, the Contractor shall place temporary surfacing, signage, striping and/or other traffic controls as required, promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

C. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, the Contractor shall saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01550 SITE ACCESS AND STORAGE

PART 1 – GENERAL

1.01 HIGHWAY LIMITATIONS

A. The Contractor shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the Work. It shall be the Contractor's responsibility to construct and maintain any haul roads required for its construction operations.

1.02 TEMPORARY CROSSINGS

A. General: Continuous, unobstructed, safe, and adequate pedestrian and vehicular access shall be provided to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, and hospitals. Safe and adequate public transportation stops and pedestrian crossings at intervals not exceeding 300 feet shall be provided. The Contractor shall cooperate with parties involved in the delivery of mail and removal of trash and garbage so as to maintain existing schedules for such services. Vehicular access to residential driveways shall be maintained to the property line except when necessary construction precludes such access for reasonable periods of time.

B. Emergency Access and Security: In order to provide protection to the workers and residents, the Contractor shall maintain emergency access to all adjacent properties at all times during construction. If a road is required to be closed to vehicular traffic and the distance of the closure exceeds 150 feet between stabilized surfaces or prevents access to properties for a distance that exceeds 150 feet, the Contractor shall provide a 10 foot wide stabilized accessway on one side of the trench capable of supporting a Fire Truck. Contractor shall also provide stabilized accessways across the trench or unstabilized area a minimum of 6 feet in width at a spacing not to exceed 100 feet capable of supporting foot traffic. These accessways shall be protected and delineated with lighted barricades or other such devices as approved by the regulatory agency. Both ends of the emergency accessway shall be blocked in accordance with the MOT permit approved by Owner with signage indicating that this accessway is to be used by emergency vehicles only.

C. No trenches or holes shall be left open after working hours. In the event a trench must be left open after hours, it shall be done so only with the express written permission from the Engineer, and it shall be the Contractor's responsibility to provide proper protection of the open trench or hole as required by the regulatory agency. In addition, the Contractor shall provide a security guard at the site whenever the Contractor's personnel are not present, 24 hours per day/7 days per week. It shall be the Security Guard’s responsibility to protect the open trench or hole from trespassers and to direct emergency personnel on site. The Security Guard shall not have any other responsibilities such as operating pumps or equipment but shall be dedicated to protecting the trench or open hole. The Security Guard shall be equipped with a wireless telephone capable of calling 911 to report an emergency and shall keep that telephone on their person at all times. In addition to this provision the Contractor shall maintain trench safety and comply with current OSHA regulations and the Trench Safety Act. The Contractor shall maintain and keep all safety barricades, signage, flashers, and detours, in operating condition. A copy of the approved MOT plans, and details, shall be on site at all times.

D. Measurement and payment for security guard services shall be included in the Mobilization unit price.

E. Temporary Bridges: Wherever necessary, the Contractor shall provide suitable temporary bridges or steel plates over unfilled excavations, except in such cases as the Contractor shall secure the written consent of the individuals or authorities concerned to omit such temporary bridges or steel plates, which written consent shall be delivered to the Engineer prior to excavation. All such bridges or steel plates shall be maintained in service until access is provided across the backfilled excavation. Temporary bridges or steel plates for street and highway crossing shall conform to the requirements of the authority having jurisdiction in each case, and the Contractor shall adopt designs furnished by said authority for such bridges or steel plates, or shall submit designs to said authority for approval, as may be required.

F. Street Use: Nothing herein shall be construed to entitle the Contractor to the exclusive use of any public street, alleyway, or parking area during the performance of the Work hereunder, and it shall so conduct its operations as not to interfere unnecessarily with the authorized Work of utility companies or other agencies in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of the Engineer and proper governmental authority. Where excavation is being performed in primary streets or highways, one lane in each direction shall be kept open to traffic at all times unless otherwise indicated. Toe boards shall be provided to retain excavated material if required by the Engineer or the agency having jurisdiction over the street or highway. Fire hydrants on or adjacent to the Work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the Contractor to assure the use of sidewalks and the proper functioning of all gutters, storm drain inlets, and other drainage facilities.

G. Traffic Control: For the protection of traffic in public or private streets and ways, the Contractor shall provide, place, and maintain all necessary barricades, traffic cones, warning signs, lights, and other safety devices in accordance with the requirements of Owner and the "Manual of Uniform Traffic Control Devices, Part VI - Traffic Controls for Street and Highway Construction and Maintenance Operations," published by U.S. Department of Transportation, Federal Highway Administration (ANSI D6.1).

H. The Contractor shall take all necessary precautions for the protection of the Work and the safety of the public. All barricades and obstructions shall be illuminated at night, and all lights shall be kept burning from sunset until sunrise. The Contractor shall station such guards or flaggers and shall conform to such special safety regulations relating to traffic control as may be required by the public authorities within their respective jurisdictions. All signs, signals, and barricades shall conform to the requirements of the Florida Department of Transportation.

I. The Contractor shall submit a traffic control plan to the City of Fort Lauderdale and/or the Broward County Traffic Engineering Division as required for approval prior to construction. The Owner reserves the right to observe these traffic control plans in use and to make any changes as field conditions warrant. Any changes shall supersede these plans and be done solely at the Contractor's expense

J. The Contractor shall remove traffic control devices when no longer needed, repair all damage caused by installation of the devices, and shall remove post settings and backfill the resulting holes to match grade.

K. Temporary Driveway Closure: The Contractor shall notify the Owner of the closure of the driveways to be closed more than one eight-hour work day at least 2 weeks prior to the closure. The Contractor shall minimize the inconvenience and minimize the time period that the driveways will be closed. The Contractor shall fully explain to the Owner/occupant how long the Work will take and when closure is to start.

1.03 CONTRACTOR'S WORK AND STORAGE AREA

A. The Contractor shall designate and arrange for the use of a portion of property, adjacent to the Work for its exclusive use during the term of the Contract as a storage and shop area for its construction operations relative to this Contract. This shall include but not be limited to interim storage of suitable materials for fill or backfill. Storage areas shall be fenced for the safety of the surrounding neighborhood (minimum 6 foot chain link fence).

B. The Contractor shall make its own arrangements for any necessary off-site storage or shop areas necessary for the proper execution of the Work. This shall include but not be limited to interim storage of suitable materials for fill or backfill.

C. The Contractor shall construct and use a separate storage area for hazardous materials used in constructing the Work.

1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are all products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, two-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.
2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.
3. The Contractor shall develop and submit to the Engineer a plan for storing and disposing of the materials above.
4. The Contractor shall obtain and submit to the Engineer a single EPA number for wastes generated at the site.
5. The separate storage area shall meet all the requirements of all authorities having jurisdiction over the storage of hazardous materials.
6. All hazardous materials which are delivered in containers shall be stored in the original containers until use. Hazardous materials which are delivered in bulk shall be stored in containers which meet the requirements of authorities having jurisdiction.

1.04 PARKING

A. The Contractor shall:

1. Provide temporary parking areas as follows:
   a. Four spaces for the Owner and Engineer
   b. One space designated for the handicapped or as required by regulatory agencies

2. The Contractor shall direct its employees to park in designated areas secured by the Contractor.

3. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The Contractor shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01560 TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.01 EXPLOSIVES AND BLASTING

A. The use of explosives on the Work will not be permitted.

1.02 DUST ABATEMENT

A. The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary (as determined by the Engineer) to prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for any damage resulting from any dust originating from its operations. The dust abatement measures shall be continued until the Contractor is relieved of further responsibility by the Engineer. No separate payment will be allowed for dust abatement measures and all costs thereof shall be included in the Contractor's bid price.

1.03 RUBBISH CONTROL

A. During the progress of the Work, the Contractor shall keep the site of the Work and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the Work site, and shall establish regular intervals of collection and disposal of such materials and waste. The Contractor shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the site of construction in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

1.04 SANITATION

A. Toilet Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.

B. Such facilities shall be made available when the first employees arrive on the Work, shall be properly secluded from public observation, and shall be constructed and maintained in suitable numbers and at such points and in such manner as may be required.

C. The Contractor shall maintain the sanitary facilities in a satisfactory and sanitary condition at all times and shall enforce their use. It shall rigorously prohibit the committing of nuisances on the site of the Work, on the lands of the City, or on adjacent property.

D. The City and the Engineer shall have the right to inspect any building or other facility erected, maintained, or used by the Contractor, to determine whether or not the sanitary regulations have been complied with.

E. Sanitary and Other Organic Wastes: The Contractor shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's

operations shall be disposed of away from the site in a manner satisfactory to the Engineer and in accordance with all laws and regulations pertaining thereto.

1.05 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, paint, fuel, solvent or reactant of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. The handling, storage, use and disposal of all such chemicals and disposal of residues shall be in strict accordance with all applicable rules and regulations of Federal, State and local jurisdictional agencies and the printed instructions of the manufacturer and all regulatory requirements. Copies of antidote literature shall be kept at the storage site and at the Contractor's job site office. A supply of antidotes shall be kept at the Contractor's office.

1.06 NOISE CONTROL

A. Noise resulting from the Contractor's work shall not exceed the noise levels and other requirements stated in local ordinances. The Contractor shall be responsible for curtailing noise resulting from its operation. It shall, upon written notification from the Engineer or noise control officers, make any repairs, replacements, adjustments, additions and furnish mufflers when necessary to fulfill requirements.

1.07 EROSION ABATEMENT AND WATER POLLUTION

A. It is imperative that any Contractor dewatering operation not contaminate or disturb the environment of the properties adjacent to the Work. The Contractor shall, therefore, schedule and control its operations to confine all runoff water from disturbed surfaces, water from dewatering operations that becomes contaminated with silt, muck and other deleterious matter, fuels, oils, bitumens, calcium chloride, chemicals and other polluting materials.

B. The Contractor shall comply with the requirements of the section entitled “Erosion and Sedimentation Control – Stormwater Pollution Prevention”.

1.08 MANATEE CONDITIONS FOR IN WATER WORK

A. The Contractor shall comply with the conditions outlined in the “Standard Manatee Conditions for In-Water Work” as published by the Florida Fish and Wildlife Conservation Commission. See the attached document at the end of this specification section for additional information.

1.09 PRECAUTIONS DURING ADVERSE WEATHER

A. During adverse weather, and against the possibility thereof, the Contractor shall take all necessary precautions so that the Work may be properly done and satisfactory in all respects. When required, protection shall be provided by use of tarpaulins, wood and building paper shelters, or other acceptable means. The Contractor shall be responsible for all changes caused by adverse weather.

B. The City may suspend construction operations at any time when, in its judgment, the conditions are unsuitable or the proper precautions are not being taken, whatever the weather conditions may be, in any season.

1.10 HURRICANE PRECAUTIONS

A. The requirements of Article 8.24 of the Contract Documents apply to the work of this section.

B. The Contractor shall take all precautions necessary to protect the job site during hurricane and tropical storm watches and warnings.

C. Within 30 days of the date of Notice to Proceed, the Contractor shall submit to the Engineer and City a Hurricane Preparedness Plan. The plan should outline the necessary measures which the Contractor proposes to perform at no additional cost to the City. The Plan shall be provided for informational purposes only and will not be reviewed by the Engineer or City.

1.11 PERIODIC CLEANUP AND BASIC SITE RESTORATION

A. During construction, the Contractor shall regularly remove from the site all accumulated debris and surplus materials of any kind which results from its operations. Unused equipment and tools shall be stored at the Contractor's yard or base of operations for the project.

B. The Contractor shall perform the cleanup work on a regular basis and as frequently as ordered by the Engineer. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such work shall also be accomplished, when ordered by the Engineer, if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.

C. Upon failure of the Contractor to perform periodic clean-up and basic restoration of the site to the Engineer's satisfaction, the Engineer may, upon five days prior written notice to the Contractor, employ such labor and equipment as it deems necessary for the purpose, and all costs resulting therefrom shall be charged to the Contractor and deducted from amounts of money that it may be due.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

STANDARD MANATEE CONDITIONS FOR IN-WATER WORK

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The permittee shall comply with the following conditions intended to protect manatees from direct project effects:

a. All personnel associated with the project shall be instructed about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act.

b. All vessels associated with the construction project shall operate at "Idle Speed/No Wake" at all times while in the immediate area and while in water where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

c. Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.

d. All on-site project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shutdown if a manatee(s) comes within 50 feet of the operation. Activities will not resume until the manatee(s) has moved beyond the 50-foot radius of the project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 feet of the operation. Animals must not be herded away or harassed into leaving.

e. Any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation Commission (FWC) Hotline at 1-888-404-3922. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service in Jacksonville (1-904-731-3336) for north Florida or in Vero Beach (1-772-562-3909) for south Florida, and emailed to FWC at ImperiledSpecies@myFWC.com.

f. Temporary signs concerning manatees shall be posted prior to and during all in-water project activities. All signs are to be removed by the permittee upon completion of the project. Temporary signs that have already been approved for this use by the FWC must be used. One sign which reads *Caution: Boaters* must be posted. A second sign measuring at least 8½ " by 11" explaining the requirements for "Idle Speed/No Wake" and the shut down of in-water operations must be posted in a location prominently visible to all personnel engaged in water-related activities. These signs can be viewed at http://www.myfwc.com/WILDLIFEHABITATS/manatee_sign_vendors.htm. Questions concerning these signs can be forwarded to the email address listed above.

CAUTION: MANATEE HABITAT

All project vessels

IDLE SPEED / NO WAKE

When a manatee is within 50 feet of work
all in-water activities must

SHUT DOWN

Report any collision with or injury to a manatee:

Wildlife Alert:

1-888-404-FWCC(3922)

cell *FWC or #FWC

SECTION 01580 PROJECT IDENTIFICATION AND SIGNS

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, install and maintain project identification signs and provide temporary on-site informational signs to identify key elements of construction facilities. Signs shall be removed upon completion of construction.

B. The Contractor shall notify property owners that may be affected by construction operation at least ten (10) working days in advance.

1.02 RELATED REQUIREMENTS

A. All applicable sections of the Technical Specifications.

B. Conditions of the Contract.

1.03 PROJECT IDENTIFICATION SIGN

A. Up to two (2) painted signs, of not less than 32 square feet area each, with painted graphic content. Signs shall be in accordance with the General Conditions. Project signs must be submitted to the City for approval prior to fabrication and installation.

B. Graphic design, style of lettering, and colors: As designated by Engineer.

C. Erect on the site at a lighted location of high public visibility at a location outside the public Right-of-Way, as approved by Engineer.

D. An example project sign is provided at the end of this section on supplemental 01580A Construction Sign Sample.

1.04 INFORMATIONAL SIGNS

A. Painted signs and painted lettering, or standard products:

1. Size of signs and lettering: As required by regulatory agencies, or as appropriate to usage.
2. Colors: As required by regulatory agencies, otherwise of uniform colors throughout project.

B. Erect at appropriate locations to provide required information.

1.05 PROPERTY OWNER NOTIFICATION

A. All homes and businesses affected by construction activities shall be notified by use of a “doorhanger” type announcement describing at a minimum, the nature of the Work, the proposed schedule, and the Contractor’s contact information. An example door hanger is provided at the end of this section on supplemental 01580B Door Hanger Notification Template.

B. Door hangers shall be submitted to the City for approval prior to use.

C. Door hangers shall be printed and distributed by the Contractor.

1.06 QUALITY ASSURANCE

A. Sign Painter: Professional experience in type of Work required.

B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

PART 2 - PRODUCTS

2.01 SIGN MATERIALS

A. Structure and Framing: May be new or used, wood or metal, in sound condition structurally adequate to Work and suitable for specified finish.
B. Sign Surfaces: Exterior softwood plywood with medium density overlay, standard large sizes to minimize joints.
C. Thickness: As required by standards to span framing members, to provide even, smooth surface without wave or buckles.
D. Rough Hardware: Galvanized.
E. Paint: Exterior quality:
   1. Use Bulletin colors for graphics.
   2. Colors for structure, framing, sign surfaces and graphics: As selected by Engineer.

PART 3 - EXECUTION

3.01 PROJECT IDENTIFICATION SIGN

A. Paint exposed surfaces of supports, framing and surface material; one coat of primer and one coat of exterior paint.
B. Paint graphics in styles, sizes and colors selected.

3.02 INFORMATIONAL SIGNS

A. Paint exposed surfaces: One coat of primer and one coat of exterior paint.
B. Paint graphics in styles, sizes and colors selected.
C. Install at a height for optimum visibility, on ground-mounted poles or attached to temporary structural surfaces.

3.03 MAINTENANCE

A. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing or sign.
B. Relocate informational signs as required by progress of the Work.

3.04 REMOVAL

A. Remove signs, framing, supports and foundations at completion of project.

3.05 MEASUREMENT AND PAYMENT

A. There shall be no special measurement or payment for the Work under this section, it shall be included in the lump sum price bid for item ‘Mobilization’.

- END OF SECTION -

01580A CONSTRUCTION SIGN SAMPLE

City of Fort Lauderdale

Stormwater Master Plan Improvements

Creating a resilient and safe coastal community

What's Happening?

What's Happening: The City of Fort Lauderdale is proactively preparing for the future by investing in new stormwater infrastructure to reduce flooding throughout our community.

(954) 828-8000
www.fortlauderdale.gov

WE BUILD COMMUNITY

Planned Improvements

- Installing a tidal valves
- Installing a new seawall
- Pavement Restoration
- Landscaping Restoration
- Installing new drainage pipe
- Installing new drainage structures

Cost

Expected Completion

Project Number

Contractor

Fort Lauderdale City Commission

Dean J. Trantalis	John C. Herbst	Steven Glassman	Pamela Beasley-Pittman	Ben Sorensen	Susan Grant
Mayor	Commissioner, District I	Vice Mayor, District II	Commissioner, District III	Commissioner, District IV	City Manager

01580B DOOR HANGER NOTIFICATION TEMPLATE

[CONTRACTOR'S NAME]

[CONTRACTOR'S STREET ADDRESS]

[CONTRACTOR'S CITY, STATE AND ZIP]

[CONTRACTOR'S TELEPHONE NUMBER]

[CONTRACTOR'S FAX NUMBER]

MEMORANDUM

TO: **RESIDENTS OF [LOCATION OF CONSTRUCTION]**

DATE: **[CURRENT DATE]**

RE: **CONSTRUCTION IN YOUR AREA**

FROM: **[CONTRACTOR'S NAME}**

Construction in your area will commence on [date of construction commencement].

The construction area is from [boundary #1] to [boundary #2].

Access to the area will be limited at certain times due to the construction activities. We apologize for any inconvenience and we will do our best to accommodate access to residents.

Thank you,

[Contractor Name]

SECTION 01590 FIELD OFFICE, EQUIPMENT, AND SERVICES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish and install one field office trailer for its own use and the use of the Engineer at the project site, during the entire time of construction, beginning at the commencement date stated in the Notice to Proceed until 30 days after the date of final acceptance of the Work by the Owner.

B. The Contractor shall locate the field office in the location approved by the City and Engineer. The field office shall be located within the Victoria Park neighborhood. The field office shall remain the property of the Contractor and shall be removed (including mountings, connections and hookups) from the site upon completion of the Work, returning the site and all improvements to their pre-Notice-To-Proceed condition.

C. No invoice for mobilization will be recommended for payment for any work done under the Contract until all field office facilities specified herein have been provided and accepted by the Engineer.

1.02 SUBMITTALS

A. Submit shop drawings and other information as required demonstrating that the field office meets the requirements of this Section.

B. Prior to installation of the field trailer, Contractor shall submit a certification from the supplier indicating that trailer walls, floor, and ceiling are free from mold.

1.03 GENERAL FIELD OFFICE REQUIREMENTS

A. The Contractor shall provide steps and platforms with handrails to permit entry to the offices. This work shall conform to the Florida Building Code and OSHA requirements.

B. The trailers shall be blocked up and hurricane straps installed conforming to the applicable building codes.

C. The Contractor is responsible for procuring all necessary permits for the installation of the field offices at the location approved by the City and Engineer.

1.04 FIELD OFFICE

A. The Contractor shall furnish, equip, and maintain a field office at the site. The field office shall be new, or like new, and consist of a nominal 56-foot by 12-foot single wide (or equivalent) trailer adequate for the joint use of the Engineer and Contractor. Contractor shall provide two private offices and conference area, each separated by walls and with an interior door. One private office (minimum 12’x 12’) shall be provided for the exclusive use of the Engineer and/or Owner Inspector. A unisex restroom shall be provided. Floor plan subject to acceptance by Engineer.

B. The structure shall be watertight with suitable windows and doors with substantial locks. All windows shall have venetian blinds and aluminum screens. Adequate lighting shall be furnished with wall switches provided for all ceiling lighting fixtures which shall either be installed flush or recessed into the ceiling.

C. The trailer shall conform to HUD requirements. Minimum ceiling height shall be 7 foot 6 inches. The interior shall have vinyl tile floor covering, wall paneling, 100 amp electrical service, copper wiring, 20-gallon electric water heater, copper water piping, a six cubic foot refrigerator, 600 watt microwave oven and two wall mounted fire extinguishers. Washroom shall be equipped with a flush toilet, cabinet mounted wash basin and medicine cabinet complete with supplies. Plumbing fixtures shall be acceptable house type, trapped and vented.

D. Air conditioning shall be provided which is capable of lowering the temperature to 72 degrees Fahrenheit in South Florida, worst case, summer heat and humidity conditions. Heating shall be provided which is capable of raising the temperature to 78 degrees Fahrenheit in cold weather. Contractor shall be responsible for providing a new air filter once every month for the duration of the project.

E. The Contractor shall install the field office trailer and provide services for the specified project duration as follows and as identified on the Drawings:

1. The Contractor shall furnish and install necessary sanitary, water, electric, and telephone connections between the source and its trailer as shown on the drawings. In addition, the Contractor shall coordinate with the local utility to arrange for startup and invoicing of electric and telephone services accordingly. The Contractor shall make arrangements for and pay for all costs for all water used during construction as specified in the Section 01510 – Temporary Utilities.

2. The Contractor shall provide and maintain adequate and clean sanitary facilities for the construction work force and visitors. The facilities shall comply with local codes and regulations and be situated in an acceptable location.

3. The Contractor shall furnish the field office with voice over internet protocol phone, high speed Wi-Fi internet services and a 4-port DSL router. The trailer shall be provided with seven (7) two-line speaker/intercom telephones. All jack locations shall be subject to review and acceptance by the Engineer.

4. The Contractor shall permit the Engineer, the Owner, or their authorized representatives or employees free and unlimited use of said telephone facilities for all calls that do not involve published toll charges. Calls originated by the Engineer, the Owner, the authorized representative or employees which involve toll or message unit charges shall be billed to the Owner by the Contractor at the rates charged by the telephone company.

5. The Contractor shall furnish and replace electric bulbs and/or fluorescent tubes, toilet paper, towels and soap, water cooler with reusable jugs, cups, and maintain the office copiers, telecopiers and other equipment in first-class condition, including all paper, ink, and repairs until final acceptance of the work under this Contract. Single-use plastic water bottles are not acceptable.

6. The Contractor shall provide fire insurance, extended coverage and vandalism, malicious mischief and burglary and theft insurance coverage for the field office trailer in the amount of $100,000 and for field office equipment in the amount of $50,000.

7. The Contractor shall furnish a free standing electric water cooler to dispense hot and cold water from 5-gallon bottles with regular water bottle delivery service.

8. The Contractor shall furnish weekly janitorial service to the trailer.

9. The Contractor shall provide 500 feet of Category 6E Ethernet Cable for computer network wiring to the field office. Layout of the cable shall be subject to comment and revision by the Engineer prior to acceptance. The Contractor shall install cables to approved locations. Terminations shall be furnished by the Contractor as directed by the Engineer.

10. The Contractor shall provide monthly pest control services covering both the interior and exterior areas of the trailer.

F. The field office trailer shall remain the property of the Contractor and shall be removed upon completion of the work. All affected work areas shall be restored to their original condition.

G. The Contractor shall furnish and install/arrange new or like new office furniture for the field office. Model numbers listed below are to establish minimum product quality. Office furniture shall consist of the following:

1. Two double-pedestal desks, Hon Metrostandard Series No. HON-34961-WP with 60 inches x 30 inches top size, or equal.

2. Two conventional office chairs HON HVL702 mesh chair, United Chari Co. Model No. UP13, or equal.

3. Two four-drawer letter size (52 inches high) filing cabinets, with lock HON 510 series, Steelmaster, or equal.

4. One 72 inch high storage cabinet with five adjustable shelves 36W x 24D HON model HSC2472, or equal.

5. Two 30 inches x 60 inches reference tables HON UTM 3060, or equal.

6. Two bookcases - 60 inches high x 36 inches wide x 11 inches deep with five shelves, HON Model No. H1895, or equal.

7. Two desk lamps with two 15-watt tubes, Dazor Model 2324, LUDU F 30L, or equal.

8. Ten conventional office chairs, HON Model HLV702, United Chair Co. Model No. UP12, or equal.

9. One dry erase "white board" 4 feet x 6 feet wall mount type Quartet Aluminum Frame QRT-S537, full length marker rail, two erasers and two boxes of four color dry erase markers, or equal.

10. Three wastepaper baskets.

11. One aluminum framed cork faced bulletin board 36 inch x 60 inch wall mount type.

12. Lease one Xerox WorkCentre 7800i series color copier complete with scanner, fax and email including Wi-Fi, automatic document feeder, stapling, sorter, stand, service contract should include a minimum of 2500 copies per month for duration of Project, consumables and other necessary accessories, or equal. Copier shall be set and provided with trays to print copies on 8-1/2 x 11 inches, 8-1/2 x 14 inches and 11 x 17 inches paper.

13. One first aid cabinet conforming to OSHA requirements for an office up to 5 persons or a construction site of up to 5 persons.

1.05 UTILITIES FOR FIELD OFFICES

A. The CONTRATOR shall arrange with Florida Power and Light (FPL) for construction power service and pay all costs for the Work and power necessary for the field offices. The Contractor shall be responsible for all connections and wiring to and from the point of service. In addition, the Contractor shall coordinate with the local utility to arrange startup and invoicing for service.

B. Telephone service connections shall be obtained from off-site by the Contractor. The Contractor shall be responsible for all connections and wiring between the telephone carrier service point and the field office. In addition, the Contractor shall coordinate with the local phone company to arrange startup and invoicing for service.

C. Contractor shall supply water service to the field office. Water supply shall be in accordance with the Section 01510 – Temporary Utilities. Cleaning, flushing, and related permit requirements for all connections are the Contractor's responsibility.

D. Contractor shall supply sanitary service to the field office. The Contractor shall be responsible for connection and piping requirements between municipal collection system and its office trailer to meet all applicable code and regulatory requirements.

E. The Contractor retains responsibility for procuring all necessary permits for the installation of field offices at the approved location.

F. The Contractor shall familiarize itself with the existing power, telephone, water and sewer connections. All costs associated with “hooking-up” to these existing items shall be included in the Contractor’s base bid.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

(Not Used)

- END OF SECTION –

SECTION 01600 MATERIALS AND EQUIPMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The word "Products," as used herein is defined to include purchased items for incorporation into the Work, regardless of whether specifically purchased for project or taken from Contractor's stock of previously purchased products.

B. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of Work.

C. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items).

D. Definitions in this Section are not intended to negate the meaning of other terms used in Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," “special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

1.02 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of Work, the Contractor shall provide products, materials, or equipment of a singular generic kind from a single source.

B. Compatibility of Options: Where more than one choice is available as options for Contractor's selection of a product, material, or equipment, the Contractor shall select an option which is compatible with other products, materials, or equipment already selected. Compatibility is a basic general requirement of product/material selections.

1.03 DESIGN

A. Equipment and appurtenances shall be designed in conformity with the ASME, AIEE, NEMA and other generally accepted applicable standards and shall be of rugged construction and sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation and all conditions of operation. All bearings and moving parts shall be adequately protected by bushings or other acceptable means against wear, and provision shall be made for adequate lubrication by readily accessible devices. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance.

B. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

1.04 PRODUCT DELIVERY-STORAGE-HANDLING

A. The Contractor shall deliver, handle, and store products in accordance with supplier's written recommendations and by means and methods that will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at site and overcrowding of construction spaces. In particular, the Contractor shall provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss.

1.05 TRANSPORTATION AND HANDLING

A. Products shall be transported by methods to avoid product damage and shall be delivered in undamaged condition in supplier's unopened containers or packaging, dry.

B. The Contractor shall provide equipment and personnel to handle products, materials, and equipment including those provided by City, by methods to prevent soiling and damage.

C. The Contractor shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.06 STORAGE AND PROTECTION

A. Products shall be stored in accordance with supplier's written instructions, with seals and labels intact and legible. Sensitive products shall be stored in weather-tight enclosures and temperature and humidity ranges shall be maintained within tolerances required by supplier's written instructions.

B. For exterior storage of fabricated products, they shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering; ventilation shall be provided to avoid condensation.

C. Loose granular materials shall be stored on solid surfaces in a well-drained area and shall be prevented from mixing with foreign matter.

D. Storage shall be arranged to provide access for inspection. The Contractor shall periodically inspect to assure products are undamaged and are maintained under required conditions.

E. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.07 MAINTENANCE OF STORAGE

A. Stored products shall be periodically inspected on a scheduled basis.

B. The Contractor shall maintain a log of inspections and make said log available to the Engineer on request.

C. The Contractor shall verify that storage facilities comply with supplier's product storage requirements.

D. The Contractor shall verify that supplier-required environmental conditions are maintained continually.

E. The Contractor shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.

1.08 MAINTENANCE OF EQUIPMENT STORAGE

A. For mechanical and electrical equipment in long-term storage, the Contractor shall provide a copy of the supplier's service instructions to accompany each item, with notice on enclosed instruction shown on exterior of package.

B. Equipment shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document to the Engineer.

1.09 LUBRICANTS

A. During testing and prior to acceptance, the Contractor shall furnish all lubricants necessary for the proper lubrication of all equipment furnished under this Contract.

1.10 SPECIAL TOOLS

A. For each type of equipment furnished by it, the Contractor shall provide a complete set of all special tools (including calibration and test equipment) which may be necessary for the adjustment, operation, maintenance and disassembly of such equipment.
B. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the Work, at which time they shall be delivered to the City.

1.11 PROTECTION AGAINST ELECTROLYSIS

A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

1.12 FASTENERS

A. All necessary bolts, anchor bolts, nuts, washers, plates and bolt sleeves shall be furnished by the Contractor in accordance herewith.
B. Bolts shall have suitable washers and, where so required, their nuts shall be hexagonal.
C. All bolts, anchor bolts, nuts, washers, plates, and bolt sleeves shall be Type 316 stainless steel unless otherwise specifically indicated or specified.
D. Unless otherwise specified, stud, tap, and machine bolts shall be of the best quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used.

1.13 SALVAGED AND EXCAVATED MATERIALS

A. In the absence of special provisions in other Sections of the Specifications, salvage materials, equipment or supplies that occur are the property of the City and shall be cleaned and stored as directed by the Engineer.
B. All excavated materials needed for backfilling operation shall be stored on site. Where additional area is needed for stockpiling, it shall be obtained by the Contractor.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01660 EQUIPMENT TESTING AND STARTUP

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the contract time. The Contractor shall allow sufficient time in its construction schedule to complete testing, trouble shooting and start-up activities.

B. As construction of the project enters the final stages of completion, the Contractor shall, in accordance with the requirements set forth in the Contract Documents, attend to the following items:

1. Schedule equipment manufacturer's visits to site.
2. Calibration of instruments and controls.
3. Perform required testing, adjusting and balancing of project components.
4. Schedule start-up and initial operation.
5. Furnish skilled personnel during initiation operation to provide back-up maintenance services to equipment, as necessary.
6. Furnish operation and maintenance training to City's personnel per requirements of the Contract documents.

1.02 EQUIPMENT TESTING

A. The Contractor shall provide the services of an experienced and authorized representative of the supplier of each item of equipment (excluding minor items of equipment specifically exempted by the Engineer in writing), who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the Contractor shall arrange to have the supplier's representative revisit the job site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory to the Engineer. The Contractor shall provide effective coordination of all parties necessary for complete system testing, including Suppliers, subcontractors, the Engineer, and the City.

B. The Contractor shall require that each supplier's representative furnish to the Engineer a written report addressed to the City, and copied to the Engineer, certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, has been operated satisfactorily under full-load conditions is ready for operation and the City's operating personnel have been instructed in the operation, maintenance and lubrication of the equipment.

C. The Contractor shall be responsible for scheduling all operations testing. The Contractor is advised that the Engineer and the City's operating personnel will witness operations testing.

D. The supplier's representative shall instruct the City's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the City at least 2 weeks in advance and shall be provided while the respective representative's equipment is fully operational. On-site instruction shall be given by qualified persons who have been made familiar in advance with the equipment and systems in the plant. The Contractor shall have submitted, and had accepted, the O&M Manuals (specified in the Section entitled "Submittals") prior to commencement of training.

E. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or City training session.

F. Training shall be provided to two separate shifts of the City's personnel. Training may occur anytime over a 24-hour period.
G. The Contractor shall furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary equipment, facilities, and services required for conducting the tests except as otherwise accepted by the Engineer.

1.03 STARTUP

A. The Contractor shall provide the effective coordination of all parties necessary for the successful startup, including suppliers, subcontractors, the Engineer, and the City.
B. It is not the intent of the Engineer to instruct the Contractor in the startup of the facilities; however, the Engineer will be available prior to and during startup to provide technical support to the Contractor.
C. The Contractor shall be required to startup the equipment, under direction of the Engineer and City, and operate it for a continuous 7-day (24 hours per day) period at design conditions. The Contractor shall be available at all times during this period to provide necessary maintenance support services as may be deemed necessary by the City and/or Engineer. This 7-day period must be successfully completed prior to the issuance of Substantial Completion.
D. Not less than 3 months prior to startup, the Contractor shall submit to the Engineer for review, a detailed schedule of operations which will be necessary for a successful initial operation and sustained period of operation for the duration of the required startup period as specified in the Section entitled "Submittals."
E. The startup shall not be commenced until all required leakage tests, disinfection, and equipment tests, as applicable, have been completed to the satisfaction of the Engineer.
F. All defects in materials or quality which appear during this startup period shall be immediately corrected by the Contractor. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons which actually interrupt the startup may, at the discretion of the Engineer, be justifiable cause for extending the startup test duration or beginning the startup test period again.
G. During the startup, the Contractor shall provide the services of authorized representatives of the suppliers, in addition to those services required under operations testing, as necessary, to correct faulty equipment operation.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01700 PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Final Cleaning

1. At the completion of the work, the Contractor shall remove all rubbish from and about the site of the work, and all temporary structures, construction signs, tools, scaffolding, materials, supplies and equipment which he or any of his Subcontractors may have used in the performance of the work. Contractor shall broom clean paved surfaces and rake clean other surfaces of grounds.
2. Contractor shall thoroughly clean all materials, equipment and structures; all marred surfaces shall be touched up to match adjacent surfaces; dirty filters and burned out lights replaced as required; all glass surfaces cleaned and floors cleaned and polished so as to leave work in a clean and new appearing condition.
3. Contractor shall maintain cleaning until project, or portion thereof, is occupied by the City.

B. Lubrication Survey

1. A lubrication survey, made by a lubricant supply firm, subject to the approval of the City shall be provided and paid for by the Contractor.
2. The lubrication survey shall list all equipment, the equipment manufacturer's lubrication recommendations, and an interchangeable lubricants tabulation standardizing and consolidating lubricants whenever possible.
3. The Contractor shall supply all lubricants, applicators and labor for lubricating the equipment, in accordance with manufacturer's recommendations, for field testing and prior to final acceptance. A supply of required lubricants sufficient for start-up and one year of operation shall also be supplied by the Contractor.
4. Ten (10) copies of the approved lubrication survey shall be furnished to the Engineer prior to final acceptance.

C. Spare Parts and Special Tools

1. As soon as practicable after approval of the list of equipment, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply.
2. Contractor shall also furnish a list of parts, and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified to be furnished as part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for a period of one-hundred and twenty (120) days for the particular installation.
3. All parts shall be securely boxed and tagged and clearly marked on the box and individually for identification as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten (10) years.
4. Unless otherwise specified in the Contract Documents, the Contractor shall, as a minimum,

furnish at no additional cost to the City with each piece of equipment, one (1) complete set, or the number of sets called for in the Technical Specifications (whichever is greater), of suitably marked special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment.

5. The Contractor shall submit, for approval by the Engineer, a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys.

D. Equipment Start-Up Services

1. Equipment start-up period, for the training of plant personnel, shall begin after satisfactory completion and acceptance of the field tests and coincidentally with the certified date of substantial completion for the part of the work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the work, the period shall begin upon substantial completion of the project.
2. During the equipment start-up period the Contractor shall furnish, at no additional cost to the City the services of factory trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:
   a. Assist in the start-up and operations of the equipment.
   b. Assist in the training of plant personnel, designated by the City in the proper operation and maintenance of the equipment.
3. The City shall:
   a. Provide the necessary plant personnel to be instructed in the operation and maintenance of the equipment. The City's personnel shall operate all equipment.
   b. Pay for all fuel, power and chemicals consumed beyond quantities specified in the Contract Documents. The Contractor shall pay for fuel, power, and chemicals consumed up to the date of "certified substantial completion" except as otherwise specified herein.
4. Contractor shall be available to promptly repair all work during the start-up period so as to cause minimum disruption to the total plant operation.
5. Upon completion of a minimum of ten (10) consecutive and continuous days of satisfactory operation, or the number of days called for in the Technical Specifications, the City will assume operation and operating cost of the equipment. If the equipment malfunctions during this start-up period, the start-up period will be repeated until satisfactory operation is achieved.
6. In the event a system, equipment or component proves defective or is unable to meet specified performance criteria, the Contractor shall replace the defective item and the minimum one (1) year guarantee period, or the guarantee period called for in the Technical Specifications shall start after satisfactory replacement, testing and acceptance of the item along with the completion of all other pre-requisites as required in the Contract Documents.

   In.

E. Final Cleanup; Site Rehabilitation

1. Before finally leaving the site, the Contractor shall wash and clean all exposed surfaces which have become soiled or marked, and shall remove from the site of work all accumulated debris and surplus materials of any kind which result from his operation,

including construction equipment, tools, sheds, sanitary enclosures, etc. The Contractor shall leave all equipment, fixtures, and work, which he has installed, in a clean condition. The completed project shall be turned over to the City in a neat and orderly condition.

2. The site of the work shall be rehabilitated or developed in accordance with other sections of the Specifications and the Drawings. In the absence of any portion of these requirements, the Contractor shall completely rehabilitate the site to a condition and appearance equal or superior to that which existed just prior to construction, except for those items whose permanent removal or relocation was required in the Contract Documents or ordered by the City.

F. Final Inspection

1. Final cleaning and repairing shall be so arranged as to be finished upon completion of the construction work. The Contractor will make his final cleaning and repairing, and any portion of the work finally inspected and accepted by the Engineer shall be kept clean by the Contractor, until the final acceptance of the entire work.
2. When the Contractor has finally cleaned and repaired the whole or any portion of the work, he shall notify the Engineer that he is ready for final inspection of the whole or a portion of the work, and the Engineer will thereupon inspect the work. If the work is not found satisfactory, the Engineer will order further cleaning, repairs, or replacement.
3. When such further cleaning or repairing is completed, the Engineer, upon further notice, will again inspect the work. The "Final Payment" will not be processed until the Contractor has complied with the requirements set forth, and the Engineer has made his final inspection of the entire work and is satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

G. Project Close Out

1. As construction of the project enters the final stages of completion, the Contractor shall, in concert with accomplishing the requirements set forth in the Contract Documents, attend to or have already completed the following items as they apply to his contract:
   a. Scheduling equipment manufacturers' visits to site.
   b. Required testing of project components.
   c. Scheduling start-up and initial operation.
   d. Scheduling and furnishing skilled personnel during initial operation.
   e. Correcting or replacing defective work, including completion of items previously overlooked or work which remains incomplete, all as evidenced by the Engineer's "Punch" Lists.
   f. Attend to any other items listed herein or brought to the Contractor's attention by the Engineer.
2. Just before the Engineer's Certificate of Substantial Completion is issued, the Contractor shall accomplish the cleaning and final adjustment of the various building components as specified in the Specifications and as follows:
   a. Clean all glass and adjust all windows and doors for proper operation.
   b. Clean all finish hardware after adjustment for proper operation.
   c. Touch up marks or defects in painted surfaces and touch up any similar defects in

factory finished surfaces.

d. Wax all resilient flooring materials.

e. Remove bitumen from gravel stops, fascias, and other exposed surfaces.

f. Remove all stains, marks, fingerprints, soil, spots, and blemishes from all finished surfaces, tile, stone, brick, and similar surfaces.

3. In addition, and before the Certificate of Substantial Completion is issued, the Contractor shall submit to the Engineer (or to the City if indicated) certain records, certifications, etc., which are specified elsewhere in the Contract Documents. A partial list of such items appears below, but it shall be the Contractor's responsibility to submit any other items which are required in the Contract Documents:

   a. Test results of project components.

   b. Performance Affidavits for equipment.

   c. Certification of equipment or materials in compliance with Contract Documents.

   d. Operation and maintenance instructions or manuals for equipment.

   e. One set of neatly marked-up record drawings showing as-built changes and additions to the work under his Contract.

   f. Any special guarantees or bonds (Submit to City).

4. The Contractor's attention is directed to the fact that required certifications and information under Item 3 above, must be submitted earlier in accordance with other Sections of the Specifications.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

(NOT USED)

SPARE PARTS INVENTORY
SUMMARY SHEET

DATE: _____

SPEC SECTION: _____

EQUIPMENT: _____

LOCATION: _____

MANUFACTURER NAME: _____

ADDRESS: _____

CONTACT: _____
PHONE: _____

SPARE PARTS INVENTORY

PART NO.	QUANTITY	DESCRIPTION	MANUFACTURER

Received:

_____ _____ _____
Resident Inspector Contractor's Representative City Representative

- END OF SECTION -

SECTION 02015 MOBILIZATION AND DEMOBILIZATION

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Work specified in this section consists of all Work necessary to move in personnel and equipment and prepare the site for construction, complete and to remove the same personnel and equipment from the site when construction is complete.

B. The limits of the Contractor's staging area and other applicable restrictions are shown on the Drawings or shall be submitted for approval by Engineer and City.

PART 2 – PRODUCTS

2.01 TEMPORARY UTILITIES

A. The Contractor shall provide all temporary facilities required for performing the Work as specified in Section entitled "Temporary Utilities".

PART 3 – EXECUTION

3.01 LAYOUT

A. The Contractor shall set up construction facilities in a neat and orderly manner within designated areas as noted on the Staging Plan drawing of the Contract documents. It shall accomplish all required Work in accordance with applicable portions of these specifications and shall confine its operations to Work areas as shown on the drawings or as approved by Engineer and City.

3.02 DEMOBILIZATION

A. At the completion of Work the Contractor shall remove its personnel, equipment, and temporary facilities from the site in a timely manner. The Contractor shall also be responsible for transporting all unused materials belonging to the City to a place of storage on site designated by the City and for removing from the site and disposing of all other materials and debris resulting from the construction. It shall then return all areas used for its activities to a condition as noted on the Contract documents.

- END OF SECTION -

SECTION 02100 EROSION AND SEDIMENTATION CONTROL - STORMWATER POLLUTION PREVENTION

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide all work and take all measures necessary to control soil erosion resulting from construction operations, prevent flow of sediment from construction site, and contain construction materials (including excavation and backfill) within protected working area as to prevent damage to any stream or wetlands.

B. The Contractor is responsible for creating a Stormwater Pollution Prevention Plan (SWPPP) for regulatory approval and enforcing its requirements in accordance with applicable Federal, State, and local regulations. The complete SWPPP shall be submitted by the Contractor and approved by the regulatory agencies having jurisdiction before the start of construction. The Contractor shall provide all labor, materials, and equipment required in the prevention of environmental pollution and degradation and thereby for the protection of all environmental resources encountered during construction.

C. The Contractor is responsible for all permitting and reporting forms as required through the Florida Department of Environmental Protection (FDEP) – National Pollutant Discharge Elimination System (NPDES) program for construction activities.

D. Temporary erosion controls may include, but are not limited to, mulching, netting, and watering on site surfaces and spoil and borrow area surfaces and providing interceptor ditches at ends of berms and at those locations that will ensure erosion during construction will be either eliminated or maintained within acceptable limits as established by the City.

E. Temporary sedimentation controls may include, but are not limited to, silt dams, barriers, turbidity curtains, hay bales, drop inlet protection, curb inlet protection, and appurtenances at the foot of sloped surfaces and other areas that will ensure sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the City.

1.02 REFERENCE

A. “Guidelines for Erosion and Sediment Control, Planning and Implementation” published by the United States Environmental Protection Agency.

B. “Processes, Procedures and Methods to Control Pollution Resulting from all Construction Activity”, published by the United States Environmental Protection Agency.

C. “The Florida Stormwater, Erosion, and Sedimentation Control Inspector’s Manual” published by the Florida Department of Environmental Protection.

D. NPDES Stormwater Program: www.dept.state.fl.us/water/stormwater/npdes/

1.03 SUBMITTALS

A. Contractor shall provide a copy of all permit applications, approvals, and reporting documentation submitted in support to SWPPP.

B. Contractor shall submit a copy of the SWPPP in accordance with Section 01300.

1.04 QUALITY ASSURANCE

A. Operations restricted to areas of work indicated on drawings and area which must be entered for construction of temporary or permanent facilities.

B. Engineer has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations and to direct immediate permanent or temporary pollution control measures to prevent contamination of any stream or wetlands, including construction of temporary berms, dikes, dams, sediment basins, sediment traps, slope drains, and use of temporary mulches, mats, or other control devices or methods as necessary to control erosion.

PART 2 – PRODUCTS

2.01 GENERAL

A. All products shall be in accordance with Drawings and approved SWPPP.

PART 3 – EXECUTION

3.01 GENERAL

A. Prior to the start of work, provide and install the site sedimentation and erosion control as indicated on the Drawings and the Contractor prepared SWPPP and as required by applicable regulations. Maintain such system for the duration of the project.

B. Should any of the temporary erosion and sediment control measures employed by the Contractor fail to produce results that comply with the requirements of the City or SWPPP, Contractor shall immediately take any and all necessary steps to correct the deficiency at his own expense.

C. Construct earth berms or diversions to intercept and divert runoff water from critical areas.

D. Discharge silt-laden water from excavations onto filter fabric mat and/or baled hay or straw sediment traps to ensure that only sediment-free water is returned to watercourses.

E. Do not place excavated soil material adjacent to watercourse in manner that will cause it to wash away by high water or runoff.

F. Prevent damage to vegetation by excessive watering or silt accumulation in the discharge area.

G. Do not dump soiled material into any streams, wetlands, surface waters, or unspecified locations.

H. Do not pump silt-laden water from trenches or excavations into surface waters, streams, wetlands, or natural or man-made channels leading thereto.

I. Prevent damage to vegetation adjacent to or outside of construction area limits.

J. Do not dispose of trees, brush, debris, paints, chemicals, asphalt products, concrete curing

compounds, fuels, lubricants, insecticides, washwater from concrete trucks or hydroseeders, or any other pollutant in streams, wetlands, surface waters, or natural or man-made channels leading thereto, or unspecified locations.

K. Do not alter flow line of any stream unless indicated or specified.

L. All exposed graded, cleared, filled, etc. land to remain shall be stabilized with sod, filter fabric, and/or vegetation acceptable to the Owner.

- END OF SECTION -

SECTION 02200 SITE PREPARATION

PART 1 - GENERAL

1.01 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2 inches caliper to a depth of 12 inches below subgrade.

D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.

E. Stripping: Removal of topsoil remaining after applicable scalping is completed.

F. Project Limits: Areas, as specified, within which Work is to be performed.

1.02 QUALITY ASSURANCE

A. Obtain Engineer's approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.03 SCHEDULING AND SEQUENCING

A. Prepare site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls.

PART 2 - MATERIALS

(NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. Clear, grub, and strip areas actually needed for waste disposal, borrow, or site improvements within limits specified.

B. Property obstructions which are to remain in-place, such as buildings, sewers, drains, water or gas pipes, bridges, etc., are to be carefully protected from damage.

C. Do not injure or deface vegetation that is not designated for removal. All branches potentially interfering with construction operations shall be pruned prior to starting work and following approval of the City and the City of Fort Lauderdale Urban Forester.

3.02 LIMITS

A. As Follows, but not to extend beyond project limits.

1. Excavation Including Trenches: 5 feet beyond top of cut slopes or shored wall.
2. Fill:
    a) Clearing and Grubbing: 5 feet beyond toe of permanent fill.
    b) Stripping and Scalping: 2 feet beyond toe of permanent fill.
3. Waste Disposal:
    a) Clearing: 5 feet beyond perimeter.
    b) Scalping and Stripping: Not required.
    c) Grubbing: Around perimeter as necessary for neat finished appearance.
4. Overhead Utilities:
    a) Clearing, Grubbing, Scalping, and Stripping: Wherever grading is required, including borrow pits, ditches, etc.
    b) Other Areas: As shown.

B. Remove rubbish, trash, and junk from entire area within Project limits.

3.03 TEMPORARY REMOVAL OF INTERFERING PLANTINGS

A. Remove and store, as specified in the Contract Documents, trees, plants, and ground covers, shrubs and trees that are not designated for removal but do interfere with construction or could be damaged by construction activities.

B. Photograph and document location, orientation, and condition of each plant prior to its removal. Record sufficient information to uniquely identify each plant removed and to assure accurate replacement.

3.04 CLEARING

A. Clear areas within limits specified.

B. Fell trees so that they fall away from facilities and vegetation not designated for removal.

C. Cut stumps not designated for grubbing 12 inches below the ground surface.

D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.05 GRUBBING

A. Grub areas within limits specified.

3.06 SCALPING

A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.

B. Scalp areas within limits specified.

3.07 STRIPPING

A. Do not remove topsoil until after scalping is completed.

B. Strip areas within limits to minimum depths specified. Do not remove subsoil with topsoil.

C. Stockpile strippings, meeting requirements of Section 02911, Soil Preparation, for topsoil, separately from other excavated material.

3.08 TREE REMOVAL OUTSIDE CLEARING LIMITS

A. Remove Within Project Limits:

1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.
2. Trees designated by Engineer.
3. Cut stumps off flush with ground, remove debris, grind stump and if disturbed, restore surrounding area to its original condition.

3.09 TREE TOPPING

A. Top trees designated by the City so remaining portion will not strike facilities in falling. Where topping will remove more than 1/2 of a tree's crown, remove entire tree.

B. Treat wounds resulting from topping in accordance with standard horticultural practice to preserve the natural character of the tree.

3.10 PRUNING

A. Remove branches below the following heights:

1. Sixteen feet above roadways and shoulders.
2. Nine feet above sidewalks.
3. Six feet above roofs.

B. Prune only after planting and in accordance with standard horticultural practice to preserve the natural character of the plant. Perform in presence of the Engineer. Remove all dead wood, suckers, and broken or badly bruised branches. Use only clean, sharp tools. Do not cut lead shoot.

3.11 DISPOSAL

A. Clearing and Grubbing Debris:

1. Woody debris may be chipped. Chips may be sold to Contractor's benefit or used for landscaping onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Maximum dimensions of chipped material used onsite shall be 1/4-inch by 2 inch. Dispose of chips that are unsaleable or unsuitable for landscaping or other uses with unchipped debris.
2. Limit offsite disposal of clearing and grubbing debris to locations that are approved by

federal, state, and local authorities, and that will not be visible from Project.

B. Scalpings: As specified for clearing and grubbing debris.

C. Strippings:

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite or in waste disposal areas approved by Engineer.
2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

- END OF SECTION -

SECTION 02220 DEMOLITION

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Removal and disposal of structures, pavement surfaces, sidewalks, underground obstructions, and other facilities necessary to prepare the area for construction of proposed facilities.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Utilities:

1. Notify City or appropriate utilities to turn off affected services before starting demolition or alterations. Provide not less than seven (7) days notice to the owner of the utility prior to the shutdown.
2. Remove utility lines exposed by demolition excavation.
3. Remove electric, sanitary, and storm drainage adjacent to buildings to be demolished.
4. Excavate utility lines serving buildings to be demolished and provide a permanent leak-proof closure for water and gas lines.
5. Plug sewerlines at locations shown or at limits of excavation if not shown with concrete length of plug, 5 feet minimum to prevent groundwater infiltrating sewer systems.

B. Removal and Storage of Equipment for Reuse:

1. Do not remove equipment and materials without approval of Engineer.
2. Properly store and maintain equipment and materials in same condition as when removed.
3. Engineer will determine condition of equipment and materials prior to removal.

3.02 DEMOLITION

A. Additional quantities of new construction or additional work caused by the demolition, beyond the limits, will be performed at the Contractor’s expense.

B. Drawings define minimum portion of structures to be removed. Unless otherwise shown, rough cuts or breaks may be made exceeding limits of demolition shown. Provide sawcut at limits of all pavement removal. Structures shall be removed in such a way as to leave no obstructions to any proposed new structures or to any waterways.

C. Core drill floor slabs, catch basins, and other concrete improvements to remain in place below ground, or break holes at structure's lowest point to allow water to freely migrate through.

D. Remove piping from areas to be backfilled. Pipe, valves, and fittings adjacent to those to be removed may also be removed as salvage.

E. Remove all materials associated with existing equipment that is to be removed or relocated.

F. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 2 inches below final finished surface.

G. Extract existing piling, which conflict with new piles, prior to driving new piles.

3.03 DISPOSAL

A. Dispose of debris and other nonsalvaged materials offsite in licensed landfills.

3.04 BACKFILLING

A. Demolished Areas: Backfill to existing ground level or foundation level of new construction.

B. Backfill Material and Compaction:
1. Conform to Sections 02222 and 02224.
2. Do not use demolition debris as backfill material.

3.05 SALVAGE

A. Equipment and materials, including piping within the limits of demolition, unless otherwise specified, will become the property of Contractor.

B. Any material designated to remain by the City shall be stored in neat piles in a location directed by the City.

C. Fire Hydrants:

1. Salvage for future use by City.
2. Remove and leave for City in location directed by the City.

- END OF SECTION -

SECTION 02222 EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Excavate, grade and backfill as required for underground piping systems and appurtenances as shown on the Drawings and specified herein.

B. All excavation for the project is unclassified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 15

B. Division 16

C. Division 2, Specification Section 02300 – Earthwork

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section 01090 – Reference Standards.

B. Commercial Standards:

ASTM D 422	Standard Test Method for Particle-Size Analysis of Soils.
ASTM D 698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
ASTM D 2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.04 SUBMITTALS

A. General: Submit information and samples to the Engineer for review as specified herein in accordance with the Section 01300 – Submittals.

B. Dewatering: The Contractor shall submit to the Engineer its proposed methods of handling trench water and the locations at which the water will be disposed of. Methods shall be acceptable to the Engineer before starting the excavation.

C. Bedding and Backfill Materials: The Contractor shall notify the Engineer of the off-site sources of bedding and backfill materials.

1. Submit to the Engineer a representative sample weighing approximately 25 lbs. The sample shall be delivered to a location at the work site determined by the Engineer.

2. The Contractor shall notify the Engineer in writing of the sources of each material at least ten calendar days prior to the anticipated use of the materials.

D. Sheeting System: Drawings of the sheeting system and design computations shall be submitted to the Engineer; however, the review of these drawings shall in no way relieve the Contractor of the responsibility to provide a safe and satisfactory sheeting and shoring system. Sheeting and shoring shall be designed by the Contractor, and the proposed design shall be sealed by a Professional Engineer registered in the State of Florida. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, it may order additional supports put in at the Contractor's expense.

E. Dewatering Permits: If the quantity or nature of water withdrawn requires approval/permits from regulatory agencies, the Contractor shall procure such permits at its expense and submit copies to the Engineer before commencing the work.

1.05 QUALITY CONTROL

A. An independent testing laboratory will be retained by the City to do appropriate testing as described in the Section 01400 – Quality Control. The Contractor shall schedule its work so as to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of his progress. A minimum of 48 hours of notice shall be provided to the testing laboratory to mobilize its activities.

B. Field Density Testing Frequency for Pipeline Backfill: Refer to specification Section 02300 – Earthwork.

1.06 SUBSURFACE INFORMATION

A. A separate geotechnical report is provided for information purposes with the Contract Documents. The report identifies properties below grade and also offers recommendations for foundation design, primarily for use of the Engineer. The recommendations shall not be construed as requirements of the Contract.

B. The City and the Engineer will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the geotechnical investigation was made. The Contractor shall examine the site and review the available geotechnical report or undertake its own subsurface investigation prior to submitting its bid, taking into consideration all conditions that may affect its work.

1.07 GROUNDWATER

A. The Contractor shall be responsible for anticipating groundwater conditions and shall provide positive control measures as required. Such measures shall ensure stability of

excavations, groundwater pressure control, prevention of tanks, pipes, and other structures from being lifted by hydrostatic pressures, and avoiding the disturbance of subgrade bearing materials.

B. The Contractor shall be responsible for obtaining all permits required for dewatering operations.

1.08 TRENCH SAFETY ACT COMPLIANCE

A. The Contractor by signing and executing the contract is, in writing, assuring that it will perform any trench excavation in accordance with the Florida Trench Safety Act, Section 553.60 et. seq.. The Contractor has further identified the separate item(s) of cost of compliance with the applicable trench safety standards as well as the method of compliance as noted in the "Bid Forms" Section of the Contract front-end documents.

B. The Contractor acknowledges that this cost is included in the applicable items of the Proposal and Contract and in the Grand Total Bid and Contract Price.

C. The Contractor is, and the City and Engineer are not, responsible to review or assess the Contractor's safety precautions, programs or costs, or the means, methods, techniques or technique adequacy, reasonableness of cost, sequences or procedures of any safety precaution, program or cost, including but not limited to, compliance with any and all requirements of Florida Statute Section 553.60 et. seq. cited as the "Trench Safety Act". The Contractor is, and the City and Engineer are not, responsible to determine if any safety or safety related standards apply to the project, including but not limited to, the "Trench Safety Act".

1.09 PROTECTION OF PROPERTY AND STRUCTURES

A. The Contractor shall, at its own expense, sustain in place and protect from direct or indirect injury, all pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of its Work. Such sustaining shall be done by the Contractor. The Contractor shall take all risks attending the presence or proximity of pipes, poles, conduits, walls, buildings, and all other structures, utilities, and its Work. It shall be responsible for all damage, and assume all expenses, for direct or indirect injury and damage, caused by its Work, to any such pipe, structures, etc., or to any person or property, by reason of injury to them, whether or not such structures, etc., are shown on the Drawings.

B. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Barricades with flashing lights shall also be placed along excavation from sunset each day to sunrise of the next day until such excavation is entirely refilled, compacted, and paved. All excavations shall be barricaded where required to meet OSHA, local and Federal Code requirements, in such a manner to prevent persons from falling or walking into any excavation within the site fenced property limits.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Materials shall be furnished as required from on-site excavations or from acceptable off-site sources as required. The Contractor shall notify the Engineer in writing of the sources of each material at least ten calendar days prior to the anticipated use of the materials.

2.02 BEDDING

A. Pipe Bedding: In general, clean sandy materials excavated from the utility trench, that is free from organics, clay and construction debris, can be used as pipe bedding when construction is in a dry condition and when the bedding is not sided by muck. Pipe bedding material shall be able to pass through a 3/4-inch sieve. Separation of suitable material for pipe bedding from other material shall be made during the excavation.

B. Sand shall be used for all copper and other service lines.

C. In the case of a “dry” installation, sand shall be used for PVC and ductile iron pipe where the bottom of the trench is located in the limestone zone.

D. In the case of a “wet” installation, pearock shall be used for PVC and ductile iron pipe where the bottom of the trench is located in the limestone zone.

E. Precast concrete items shall use crushed stone.

2.03 PEAROCK

A. Pearock shall consist of hard, durable particles of proper size and gradation, and shall be free from organic material, wood, trash, sand, loam, clay, excess fines, and other deleterious materials. Refer to specification Section 02300 – Earthwork for size and gradation conformance requirements.

2.04 CRUSHED STONE (3/4-INCH ROCK)

A. Crushed stone shall consist of hard, durable, subangular particles of proper size and gradation, and shall be free from organic material, wood, trash, sand, loam, clay, excess fines, and other deleterious materials. Refer to specification Section 02300 – Earthwork for size and gradation conformance requirements.

2.05 SAND

A. Sand shall be used for bedding polyvinyl chloride, fiberglass, HDPE and other plastic pipe when installed under dry trench conditions. Refer to specification Section 02300 – Earthwork for size and gradation conformance requirements.

2.06 SELECT BACKFILL

A. Select Backfill: It is the intent of these specifications to obtain clean sandy material passing through a 3/4-inch sieve as select backfill material for utility and structural applications.

B. At locations where subsurface preparations for structures have been performed under this or other previous construction contracts, clean excavated material (structural fill) may be used as select backfill. Any excess fill shall be disposed of off-site by the Contractor.

2.07 GENERAL BACKFILL

A. General backfill (for grading applications) shall be placed above the select backfill. General backfill shall be clean granular soil, free of organics or other deleterious material. Refer to specification Section 02300 – Earthwork for size and gradation conformance requirements.

B. General backfill used under roadways shall be compatible with the materials and compaction specified under the Sections 02772 – Asphalt Pavement and Section 02771 – Concrete Curb and Sidewalk.

PART 3 - EXECUTION

EXECUTION

3.01 EXCAVATION

A. The Contractor shall perform all excavation of every description and of whatever substance encountered, to the dimensions, grades and depths shown on the Drawings, or as directed. For projects within the right-of-way, unless shown otherwise on the Drawings, all excavations shall be made by open cut, except for service connections to houses located across the road from the watermain, where directional boring shall be used. All existing utilities such as pipes, poles and structures shall be carefully located, supported and protected from injury; in case of damage, they shall be restored at the Contractor's expense.

B. Pipe trenches for piping shall be excavated to a width within the limits of the top of the pipe and the trench bottom so as to provide a clearance on each side of the pipe barrel, measured to the face of the excavation, or sheeting if used as defined in specification Section 02300 – Earthwork. Excavation depths in other types of materials and conditions shall be made as hereinafter specified.

C. In areas where trench widths are not limited by right-of-way and/or easement widths, property line restrictions, existing adjacent improvements, including pavements, structures and other utilities, and maintenance of traffic, the trench sides may be sloped to a stable angle of repose of the excavated material but only from a point one foot above the crown of the pipe. A substantially and safely constructed movable shield, "box" or "mule" may be used in place of sheeting when the trench is opened immediately ahead of the shield and closed immediately behind the shield as pipe laying proceeds inside the shield.

D. Ladders or steps shall be provided for and used by Workmen to enter and leave trenches, in accordance with OSHA requirements.

E. Excavation for appurtenances shall be sufficient to provide a clearance between their outer surfaces and the face of the excavation or sheeting, if used, of not less than 12 inches.

F. Excavated unsuitable material shall be removed from the site and disposed of by the Contractor. Materials removed from the trenches shall be stored and in such a manner that will not interfere unduly with any on-site operations, traffic on public roadways and sidewalks and shall not be placed on private property. In congested areas, such materials as cannot be stored adjacent to the trench or used immediately as backfill shall be removed to other convenient places of storage acceptable to the City at the Contractor's expense.

G. Excavated material that is suitable for use as backfill shall be used in areas where sufficient material is not available from the excavation. Suitable material in excess of backfill requirements shall be either used on the site as directed by the Engineer or disposed of the Contractor.

H. Barriers shall be placed at excavations in accordance with OSHA requirements.

3.02 SHEETING AND BRACING

A. The Contractor shall furnish, place and maintain sheeting and bracing to support sides of the excavation as necessary to provide safe working conditions in accordance with OSHA requirements, and to protect pipes, structures and other Work from possible damage. Where wood sheeting or certain designs of steel sheeting are used, the sheeting shall be cut off at a level of 2 feet above the top of the installed pipe and that portion below the level shall be left in place. If interlocking steel sheeting is used, it may be removed providing removal can be accomplished without disturbing the bedding, pipe or alignment of the pipe. Any damage to the pipe bedding, pipe or alignment of the constructed utility caused by the removal of sheeting shall be cause for rejection of the affected portion of the work. The City may permit sheeting to be left in place at the request and expense of the Contractor, or the City may order him in writing to leave in place, for the preventing of damage to structures or property. Payment for sheeting ordered to remain in place shall be paid for at a negotiated price.

B. If the Engineer is of the opinion that at any point sufficient or proper supports, have not be provided, he may order additional supports put in at the Contractor’s expense. The Contractor shall be responsible for the adequacy of all sheeting used and for all damage resulting from sheeting and bracing failure or from placing, maintaining and removing it.

3.03 REMOVAL OF WATER

A. General: It is a basic requirement of these Specifications unless otherwise authorized per Article 3.10 that excavations shall be free from water before pipe or structures are installed.

B. The Contractor shall provide pumps, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in a dry condition. The Contractor shall continue dewatering operations until backfilling has progressed to a sufficient depth over the pipe to prevent flotation or movement of the pipe in the

trench or so that it is above the water table. If at any point during the dewatering operation it is determined that fine material is being removed from the excavation sidewalls, the dewatering operation shall be stopped. If any of the subgrade or underlying material is disturbed by movement of groundwater, surface water, or any other reason, it shall be replaced at the Contractor's expense with crushed stone or gravel.

C. The Contractor shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps.

D. Disposal: Water from the trenches and excavation shall be disposed of in such a manner as will not cause injury to public health, to public or private property, to the Work completed or in progress, to the surface of the streets, cause any interference with the use of the same by the public, or cause pollution of any waterway or stream. The Contractor shall submit his proposed methods of handling trench water and locations at which the water will be disposed of to the Engineer for review and shall receive acceptance before starting the excavation. Disposal to any surface water body will require silt screens to prevent any degration in the water body. The Contractor shall have responsibility for acquiring all necessary permits for disposal.

3.04 TRENCH STABILIZATION

A. No claim for extras, or additional payment will be considered for cost incurred in the stabilization of trench bottoms which are rendered soft or unstable as a result of construction methods, such as improper or inadequate sheeting, dewatering or other causes. In no event shall pipe be installed when such conditions exist and the Contractor shall correct such conditions so as to provide proper bedding or foundations for the proposed installation at no additional cost to the City before placing the pipe or structures.

3.05 PIPE BEDDING

A. Pipe trenches shall be excavated as described in specification Section 02300 – Earthwork. The resulting excavation shall be backfilled with acceptable pipe bedding material, up to the level of the centerline of the proposed pipe barrel. This backfill shall be tamped and compacted to provide a proper bedding for the pipe and shall then be shaped to receive the pipe. Bedding shall be provided under the branch of all fittings to furnish adequate support and bearing under the fitting.

B. Any over excavation below the levels required for installation of the pipe shall be backfilled with acceptable bedding material, tamped, compacted and shaped to provide proper support for the proposed pipe, at the Contractor's expense.

3.06 BACKFILL

A. Pipeline trenches shall be backfilled to a level 12 inches above the top of the pipe with select backfill. When placed in the dry, such material shall be placed in 6-inch layers, each compacted to the densities specified in Article 3.07. Only hand operated mechanical compacting equipment shall be used within six inches of the installed pipe.

B. After the initial portion of backfill has been placed as specified above, and after all excess water has completely drained from the trench, backfilling of the remainder of the trench may proceed. The remainder of the backfill shall be selected material obtained from the excavation and shall be placed in horizontal layers, the depth of which shall not exceed the ability of the compaction equipment employed, and in no event shall exceed a depth of 9 inches. Each layer shall be moistened, tamped, puddled, rolled or compacted to the densities specified in Article 3.07.

3.07 COMPACTION AND DENSITIES

A. Compaction of backfill shall be per specification Section 02300 – Earthwork. More thorough compaction may be required when Work is performed in other regulatory agencies jurisdictions, such as the FDOT. Methods of control and testing of backfill construction are described in specification Section 02300 – Earthwork.

B. Testing: Laboratory and field density tests, which in the opinion of the Engineer are necessary to establish compliance with the compaction requirements of these Specifications, shall be ordered by the Engineer. The Contractor shall coordinate and cooperate with the testing laboratory. The testing program will be implemented by the Engineer establishing depths and locations of tests. Modifications to the program will be made as job conditions change.

C. Trench backfill which does not comply with the specified densities, as indicated by such tests, shall be reworked and recompacted until the required compaction is secured, at no additional cost to the City. The costs for retesting such Work shall be paid for by the Contractor.

3.08 ADDITIONAL EXCAVATION AND BACKFILL

A. Where organic material, such as roots, muck, or other vegetable matter, or other material which, in the opinion of the Engineer, will result in unsatisfactory foundation conditions, is encountered below the level of the proposed pipe bedding material, it shall be removed to a depth of two feet below the outside bottom of the pipe or to a greater depths as directed by the Engineer and removed from the site. Sheeting shall be installed if necessary to maintain pipe trenches within the limits identified by the Engineer. The resulting excavation shall be backfilled with suitable backfill material, placed in 12-inch layers, tamped and compacted up to the level of the bottom of the proposed pipe bedding material. Sufficient compaction of this material shall be performed to protect the proposed pipe against settlement. Lean concrete may be used in lieu of backfill when pipe installation is in the wet or at the Contractor's option. Construction shall then proceed in accordance with the provisions of Article 3.05 "Pipe Bedding".

B. Additional excavation (more than two feet below the pipe) shall be performed when ordered by the Engineer. Where organic or other material is encountered in the excavation, the Contractor shall bring the condition to the attention of the Engineer and obtain his determination as to whether or not the material will require removal, prior to preparing the pipe bedding. The excavation of material up to a depth of two feet below the outside bottom is an incidental item of construction and the Work shall be done at no additional cost to the City. Where ordered by the Engineer, excavation greater than two feet below the pipe and additional backfill will be compensated by the City.

3.09 FINE GRADING

A. After piping trenches backfilled, the disturbed areas of the site shall be fine graded. Any lumber, undesirable materials and rocks larger than the 3-inch size shall be removed from the surface. The completed surface shall be to the preconstruction elevation unless otherwise directed by the City. Minor adjustments to line and grade may be required as the work progresses in order to satisfy field conditions.

3.10 ALTERNATE METHOD OF CONSTRUCTION

A. Use of This Method: A combination of conditions in the substrate, water table, or method of disposal may be encountered during the course of the work which makes dewatering impossible, or only possible through the use of unusual methods, the cost of which is excessive. When such conditions are encountered, but only after all reasonable means (pumps, well points, etc.) to dewater the excavation have been employed without success, the Contractor, may request to employ the following Alternate Method of Construction. The concurrence of the Engineer shall be obtained in writing and shall limit the use of the alternate method of construction to such specific portions of the Work as the Engineer shall determine.

B. The requirements set forth in other sections of these Specifications shall establish the required standards of construction quality for this work. Use of the alternate method of construction described hereinafter shall in no way be construed as relieving the Contractor of the work. No additional payment will be made to the Contractor for excavation, backfill, sheeting or any cost incurred for Work or materials, or any other costs incurred as a result of the use of this alternate method of construction. The prices established in the Proposal shall be for full payment for the various items of work.

C. Subject to all the requirements stated herein, including written acceptance of the Engineer, construction will be permitted in accordance with the following specifications. All requirements of these Specifications shall apply to this construction unless otherwise specifically modified herein.

D. Removal of Water: The installation of pipe and appurtenances under water will be permitted and the requirements of Article 3.03 will be waived.

E. Excavation shall be performed in accordance with Article 3.01.

F. Pipe Bedding: Pipe bedding shall be placed from 6 inches below the outside bottom of the proposed pipe barrel up to the centerline of the pipe barrel. The bedding material shall be pearock as specified in Article 2.03 "Pearock". Limerock screenings, sand or other fine organic material shall not be used.

G. The bedding material shall be placed and then be shaped to receive the pipe at the intended elevation. Bedding shall be provided under the branch of all fittings to furnish adequate support and bearing under the fitting.

H. Backfill: After the pipe is installed, backfilling shall proceed in accordance with the provisions of Article 3.06 "Backfill" and 3.07 "Compaction and Densities". Select backfill material shall be used to backfill around the pipe and to a level one foot above

the crown of the pipe. Under no circumstances will material other than select backfill or specified pipe bedding material be considered satisfactory for this purpose.

I. If the Alternate Method of Construction is used, all backfill material, including specified pipe bedding material, shall be carefully lifted into the trench and not released to fall freely therein until the bucket or container is at or just above water level. Under no circumstances will backfill material be dumped or pushed into the trenches containing water. Below existing water level, the backfill material shall be carefully rammed into place in uniform layers, of equal depth on each side of the pipe, up to the water level. Above the water level, backfill material shall be placed and compacted for normal backfill as previously specified.

3.11 RESTORATION OF EXISTING SURFACES

A. Restore all grassed areas disturbed by the trenching operations by resodding in accordance with the Section 02920 – Sodding and/or Section 02900 – Landscaping.

B. Restore all asphaltic concrete pavement areas disturbed by the trenching operations in accordance with the Section 02772 – Asphalt Pavement.

C. Restore all concrete pavement, curbs, and sidewalks disturbed by the trenching operations in accordance with the Section 02771 – Concrete Curb and Sidewalks.

- END OF SECTION -

SECTION 02224 EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. This Section includes, except as elsewhere provided, excavation, filling and compacting within the limits defined on the Contract Drawings for complete construction of structures for this project.

B. All excavation for the project is unclassified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 2, Specification Section 02300 – Earthwork.

1.03 QUALITY CONTROL

A. Codes and Standards: Excavation and backfill work shall be performed in compliance with applicable codes, standards and requirements of governing authorities having jurisdiction in the area.

B. Testing and Inspection Service: An independent testing laboratory shall be retained by the City to conduct appropriate soils and other testing in accordance with the Contract Documents.

1.04 JOB CONDITIONS

A. General

1. A separate geotechnical report is provided for information purposes with the Contract Documents. The report identifies properties below grade and also offers recommendations for foundation design, primarily for use of the Engineer. The recommendations shall not be construed as requirements of the Contract unless specifically referenced by the Contract Documents.

2. The City and/or the Engineer will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the geotechnical investigation was made. The Contractor shall examine the site and review the available geotechnical report or undertake its own subsurface investigation prior to submitting its bid, taking into consideration all conditions that may affect its work.

B. Existing Utilities

1. Locate existing underground utilities in the areas of work. Accurate "As Built" Information describing existing pipelines and underground utilities is not available. Test pits and hand excavation in critical areas will be required prior to initiating work.

2. All existing utilities including piping, electrical conduits, electric duct banks and telephone cables that are shown on the Contract Drawings to be relocated, shall be relocated prior to initiating earth work. Excavation and backfill for relocation of existing utilities shall conform to the requirements of Section 02222. The Contractor shall coordinate relocation of utilities with utility companies having jurisdiction in the area. Should unknown or incorrectly identified piping or other utilities be encountered during excavation, the Contractor shall consult the City and the Engineer of such piping or utility immediately for directions.

3. The Contractor shall cooperate with the City and utility companies in keeping respective services and facilities in operation.

1.05 PROHIBITION OF BLASTING

A. The use of explosives for excavation work is strictly prohibited on this project.

1.06 SUBMITTALS

A. The Contractor shall submit information and samples to the Engineer for review as specified herein in accordance with Section 01300. The information shall include:

1. Detailed description of dewatering method chosen and sequence of dewatering operations.

2. Plans showing the methods and location of dewatering and discharge. The drawings shall include a sufficient number of detailed sections to clearly illustrate the scope of work. The drawings showing all of the above information, including calculations, shall be prepared by a qualified Professional Engineer registered in the state of Florida, and shall bear its seal and signature. If required by regulatory agencies, a copy of the dewatering permit shall be submitted.

3. Lists of materials and equipment to be used. Detailed description of the method(s) of excavation, fill and compaction to be used.

4. Plans of open cut excavations showing side slopes and limits of the excavation at grade where not shown on the Contract Drawings.

5. Design computation of sheeting system. Sheeting and shoring plans shall be designed and sealed by a Professional Engineer registered in the State of Florida. Submittals shall indicate depth of penetration.

6. The Contractor shall furnish the Engineer, for approval, a representative sample of structural fill material from off-site sources at least ten calendar days prior to the date of anticipated use of such material. The sample shall be delivered to the site at a location determined by the Engineer. The submittal shall identify the source of the material.

1.07 PROTECTION OF PROPERTY AND STRUCTURES

A. The Contractor shall, at its own expense, sustain in place and protect from direct and indirect injury, its work at all times as well as all pipes, poles, conduits, walls, buildings,

and all other structures, utilities and property in the vicinity of its work. Such sustaining shall be done by the Contractor. The Contractor shall take all risks attending the presence or proximity of pipes, poles, conduits, walls, buildings and all other structures, utilities, and property in the vicinity of its work. It shall be responsible for all damage, and assume all expenses, for direct or indirect injury and damage, caused by its work, to any such pipes, structures, etc., or to any person or property, by reason of injury to them, whether or not such structures, etc., are shown on the Drawings.

B. Barriers and lights shall be placed at all excavations in accordance with OSHA requirements.

C. Safe and suitable ladders for access to trenches shall be provided in accordance with OSHA requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Specific locations/areas of work where these materials shall be utilized are defined on the Drawings.

2.02 STRUCTURAL FILL

A. Fill material shall be noncohesive, nonplastic, granular mixture of local clean sand or local clean sand and limerock free from vegetation, organic material, muck or deleterious matter per specification Section 02300 – Earthwork. Broken Portland cement or asphaltic concrete shall not be considered an acceptable fill material. Fill material containing limerock shall have sufficient sand to fill the voids in the limerock. All structural fill materials shall be obtained from off-site sources.

2.03 CRUSHED LIMESTONE

A. Crushed limestone placed below foundation slabs shall be hard, durable, subangular particles of proper size and gradation, and shall be free from organic materials, wood, trash, sand, loam, chalk, excess fines and other deleterious materials. Refer to specification Section 02300 – Earthwork for additional information.

2.04 OTHER MATERIALS

A. Requirements for any other fill material, if needed, are defined in the Drawings and under specification Section 02300 – Earthwork.

PART 3 - EXECUTION

3.01 CONTRACTOR INSPECTIONS

A. Examine the areas and conditions under which excavating, filling, and grading are to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Examine and accept existing grade of the project site walkways, pavements, etc., prior to commencement of work and report to Engineer if elevations of existing subgrade substantially vary from elevations shown on the Drawings.

3.02 EXCAVATION FOR STRUCTURES

A. Unless otherwise indicated on the Drawings, all excavation shall be made in such a manner, and to such widths, as will give ample room for properly constructing and inspecting the structures they are to contain. Excavation shall be made in accordance with the details shown on the Drawings, and as specified herein. Attention shall be given to the proper handling of storm water runoff. The Contractor shall intercept and collect surface run off both at the top and bottom of cut slopes. The excavating equipment shall operate in an organized fashion so as to remove silt from one edge of the excavation to the other so as not to trap silt within the undercut area.

B. Where required on the Drawings, unsuitable material (silt layer) beneath the groundwater encountered at the site shall be removed using a drag line or hydraulic excavator, as approved by the Engineer. The equipment shall operate in an organized manner so as to remove silt from one edge of the excavation to the other so as not to trap silt within the undercut area. Unsuitable material shall be hauled to and stockpiled temporarily by the Contractor at the “Temporary Muck Storage” location defined on the Drawings. Once drained, and during “dry” weather as determined by the Engineer in the field, the Contractor shall remove and dispose of it off-site. The Contractor shall be responsible for managing and maintaining the temporary muck storage area and shall ensure impact of this area, including providing dust control, runoff control, etc. is minimized. Also, the Contractor shall clean all roadways impacted by his demucking, hauling, temporary stockpiling and removal operations at a frequency as determined by the Engineer in the field.

C. In excavating for footings, structures, and foundations, the Contractor shall take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete.

D. The Contractor shall ensure that its excavation work does not adversely affect the bearing capacity of the structural subsurface. Also, the Contractor shall proceed with foundation work immediately after excavation work and as expeditiously as possible so as to minimize any potential for subsurface disturbance due to environmental factors, adverse weather, etc. The Contractor shall also take all necessary precautions to protect its work from potential adverse impacts. Where excavated areas are disturbed by subsequent operations or adverse weather, scarify surface reshape, fill as required and compact to required density.

E. All excavated soil material, removed underground utilities including pipes and fittings, electrical conduits and duct banks, and other undefined materials removed within the limits of the excavation, shall be disposed off-site by the Contractor.

F. Refer to the Drawings for additional requirements for excavation for specific locations/areas of work.

3.03 UNAUTHORIZED EXCAVATION

A. Excavation work carried outside of the work limits required by the Contract Documents shall be at the Contractor's expense, and shall be backfilled by the Contractor at its own expense with structural fill, as directed by the Engineer. Where, in the judgement of the Engineer, such over-excavation requires use of lean concrete or crushed stone, the Contractor, at its expense, shall furnish and place such materials.

3.04 SHEETING AND BRACING

A. The term "sheeting" shall represent any type of shoring used to support sides of the excavation. Walls of the excavation shall be kept vertical where open cut is not practical and, if required to protect the safety of workmen, the general public, this or other work or structure, or excavation walls, the excavation shall be properly sheeted and braced for conditions encountered and OSHA requirements. Excavation for the structures shall be sufficient to provide a clearance between their outer surfaces and the face of the excavation, sheeting, or bracing, of not less than two feet, unless otherwise indicated on the Drawings. Materials encountered in the excavation, which have a tendency to slough or flow into the excavation, undermine the bank, weaken the overlying strata, or are otherwise rendered unstable by the excavation operation shall be retained by sheeting, stabilization, grouting or other acceptable methods.

B. Minimum length of embedment below the deepest part of the excavation shall be 0.3 times the depth of excavation being supported or greater depending on the sheeting. The design of the sheeting arrangement shall be the responsibility of the Contractor.

C. Sheeting shall be removed provided its removal will not jeopardize pipes or structures. Any sheeting left in place shall be cut-off two feet below finished grade, or as directed. The Contractor will not receive extra compensation for sheeting left in place or the cut off work required.

3.05 REMOVAL OF WATER

A. General

1. The Contractor shall provide pumps, well points, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in the dry where defined on the Drawings. The ground water level shall be controlled so as to permit the placing and curing of concrete and the maintenance of supporting foundations and adjacent work and structures in the dry.

2. The Contractor shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps.

3. If excavations to be dewatered cannot be maintained dry by the Contractor's dewatering efforts, then the Contractor shall provide tremie seals at no additional cost to the City. The placement of tremie seals shall not preclude dewatering operations specified herein. The limits of tremie seals shall be recommended by the Contractor and reviewed and accepted by the Engineer.

B. Disposal: The Contractor shall be responsible to dispose of water from the dewatering operation in accordance with the Contract Documents and shall obtain all necessary permits and conform to all local regulations and codes. Water from the excavation shall be disposed of in such a manner as will not cause injury to public health, to public or private property, to the work completed or in progress, to the surface of the streets, will not cause any interference with the use of the same by the public, or will not cause pollution of any waterway or stream. Water from dewatering operation may be disposed at locations directed by the City with the proper installation of siltation screens and operation of the dewatering system in accordance with all local regulations and codes. The Contractor shall submit its dewatering method and point(s) of discharge to the Engineer for review at least twenty (20) days prior to any dewatering activities. The Contractor shall provide maintenance of canal(s) and drainage ditches to which it discharges. The cost of maintaining drainage ditches and canal(s) shall be included in the bid price. The Contractor shall remove siltation and haul, and dispose of this material on a regular basis to maintain the original base conditions at all time, so as not to impact drainage in the general area.

3.06 FILL PLACEMENT AND COMPACTION

A. General

1. Fill material (including structural fill and other fill material) shall be placed within the limits of excavations as shown on the Drawings. When placed in the wet, fill material shall be placed in standing groundwater to a level one foot above stabilized groundwater. The material shall be placed at one edge of the excavation and pushed to the other so as to move residuals across the bottom of the excavation. The leading edge of the fill should be cleaned regularly to remove it of the advancing residuals. All residuals shall be disposed at off-site locations shown on the Drawings or specified herein.

2. Once fill materials have been placed one foot above the stabilized groundwater, then the entire lift should be rolled with six passes from an 10-ton roller. The coverages shall be overlapping and shall occur while the compactor operated at a travel speed of not more than two feet per second. If a vibratory compactor is used, it should be operated with the vibrator off so as not to induce capillary moisture into the dry fill soils.

3. Fill materials placed following this initial lift shall be placed in the dry with loose lift thickness of eight inches or less. Refer to specification Section 02300 – Earthwork for additional information. Fill materials shall be placed within two percent of optimum moisture content.

B. Inspection and Testing: The fill placement and compaction shall be observed by the Engineer. Refer to specification Section 02300 – Earthwork for in-place density testing requirements. The Contractor shall coordinate and cooperate with the testing laboratory.

C. Final Grades: Final structure fill grades shall be within 0.1 feet of elevations shown. Where shown on the Drawings, surfaces shall be sloped for drainage or other surfaces.

D. Refer to the Drawings for additional fill and compaction requirements for specific locations/areas of work.

3.07 BACKFILL AGAINST STRUCTURES

A. Backfill against nonwater holding structures shall not be performed until the concrete has been inspected by the Engineer. Backfill against walls shall also be deferred until the structural slab for floors above the top fill line have been placed and attained design strength. Partial backfilling against adequately braced walls may be considered by the Engineer on an individual situation basis. Where walls are to be waterproofed, all work shall be completed and membrane materials dried or cured according to the manufacturers instructions before backfilling.

B. Backfill against tanks and other structures which are to retain liquids shall not be performed until leakage tests are completed and accepted by the Engineer.

- END OF SECTION -

SECTION 02225 CONTAMINATED SOILS AND GROUNDWATER

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. This Section includes, except as elsewhere provided, the work necessary to remove, transport, and properly dispose of contaminated soils and groundwater required for complete construction of structures and underground piping systems and appurtenances as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02222 – Excavation and Backfill for Utilities
B. Section 02224 – Excavation and Backfill for Structures

1.03 QUALITY CONTROL

A. Codes and Standards: All work associated with dewatering, excavation, removal, transportation and disposal of contaminated soils and groundwater shall be performed in compliance with applicable codes, standards and requirements of governing authorities having jurisdiction in the area.

B. Testing and Inspection Service: A testing laboratory certified by the Broward County Environmental Protection and Growth Management Department (BCEPGMD) and the State of Florida shall be retained by the Contractor to conduct appropriate soils and groundwater testing in accordance with regulatory requirements and the Contract Documents.

1.04 SUBMITTALS

A. The Contractor shall submit information and samples to the City for review as specified herein in accordance with Section 01300. The information shall include:

1. Detailed description of the proposed methods for temporary stockpiling, transportation, and disposal of all contaminated soils and groundwater.
2. Copies of permits for all disposal facilities.
3. Copies of all manifest and documentation for handling and disposing of all contaminated soil and groundwater in full compliance with local, state and federal requirements. This documentation must be provided prior to requesting payment under this Bid item.
4. Copies of all laboratory analyses required for transportation and disposal of all contaminated soils and groundwater in full compliance with local, state and federal requirements.
5. Names, addresses, and contact numbers of all subcontractors.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 CONTAMINATED SOILS

A. The Contractor shall retain a laboratory certified by the BCEPGM and the State of Florida to sample the groundwater in the excavation, the stored soil and soil samples in the perimeter of the excavated hole for petroleum contamination (EPA Methods 601, 602, 610). The number of samples shall be sufficient to comply with the requirements of the Contractor's approved Dewatering Plan and all local, state and federal regulations. The results of the tests shall be forwarded to the City.

B. Excavated materials which are deemed to be contaminated shall be removed, treated and disposed of by the Contractor in accordance with all applicable regulatory requirements. The soil may be contaminated with petroleum product which may be partly or entirely diesel fuel or gasoline. When such soil conditions are encountered, they shall be brought to the City's attention. The extent of excavation shall be determined in the field by the City. Payment for this work shall be in accordance with the allowance bid item for excavation, treatment and disposal of contaminated soil, included in the Schedule of Prices Bid.

C. All contaminated soil which is excavated shall be stockpiled in an area designated for contaminated soils. The Contractor shall take whatever precautions are necessary to ensure that contaminated soils are not co-mingled with non-contaminated stockpiled soils and/or mucks.

D. Contaminated soils must be placed on an impermeable barrier when temporarily stockpiled and must be covered with visquine to prevent runoff. All stockpile leachate or runoff must be collected for disposal in accordance with federal, state and local regulations.

E. Contaminated soils shall be processed and treated at a state licensed facility. These soils shall be transported and disposed of in accordance with federal, state and local regulations.

F. The Contractor shall be responsible for testing soil which has been treated to certify treated soil meets applicable federal, state, and local regulations for final disposal.

3.02 CONTAMINATED GROUNDWATER

A. All water generated, pumped or removed from excavations as a result of excavation dewatering activities shall be collected, containerized, and managed prior to discharge and/or treatment at an approved discharge point in accordance with local, state and federal regulations and the requirements of the Contract Documents. If groundwater contamination is identified at any time during the performance of the Work, Contractor shall immediately notify the City.

B. If contaminated groundwater in the dewatering excavation area is encountered, the contaminated groundwater shall be removed, treated and discharged by the Contractor in accordance with all applicable regulatory requirements. Payment for this work shall be in accordance with the allowance bid item for treatment and discharge of contaminated groundwater, included in the Schedule of Prices Bid.

C. Treatment of contaminated groundwater will include the following options, depending on the

magnitude of the contamination in the trench: Granular Activated Carbon (GAC) Treatment vessels, mobile air stripping units, vacuum truck removal and disposal or other method as approved by the City and regulatory agencies with jurisdiction.

D. If contaminated groundwater is encountered during construction, Contractor shall provide reference information for the qualified groundwater remediation subcontractor to be utilized, including phone number, contact name, and address. The selected groundwater treatment/recycling facility for hauling contaminated groundwater shall also be identified.

E. Effluent water from the treatment system will be analyzed by the certified laboratory to confirm that concentrations are below regulatory limits. Effluent water will then be directed to a pre-approved location as determined by local regulatory agencies and/or the City.

3.03 TRANSPORT AND DISPOSAL

A. Transport Regulations: The Contractor shall be responsible for the loading, labeling, placarding, marking, weighing, and transporting of all waste materials in accordance with the Florida Department of Transportation Regulations, and U.S. Department of Transportation Regulations. The Contractor shall use only transporters that are licensed and competent to haul these wastes.

3.04 WASTE CONTAINERS

A. Each transport container of waste shall be visually inspected by the Contractor for leaks, drips, or container damage prior to being loaded. Containers which are found to be leaking or damaged shall not be loaded until the damage is repaired. The Contractor shall prepare the transport container to prevent spillage or contamination. The Contractor shall notify the City two hours before any loaded transport leaves the site.

B. All transport containers leaving the site shall be inspected by the Contractor to ensure that no waste material adheres to the wheels or undercarriage.

C. All vehicles on which waste is adhering shall be cleaned by sweeping tires and undercarriage or by other dry methods prior to leaving the site.

3.05 SHIPPING RECORDS

A. The Contractor shall prepare accurate shipping records for any wastes leaving the site in accordance with applicable federal and state regulations. The Contractor shall be responsible for providing copies of the records to the City and shall immediately notify the City of any problems in completing shipments and disposal of wastes.

B. The Contractor shall:

1. Be responsible for appropriate measurement of unit quantity (weight or volume) of waste material removed from the site.
2. Coordinate vehicle inspection and recording of quantities leaving the site with the City. These quantities shall be compared to recorded quantities received at the treatment or disposal facilities. The Contractor shall resolve any discrepancies occurring immediately, determining the probable cause for the discrepancy.
3. Be solely responsible for any and all actions necessary to remedy situations involving waste spiked in transit.

C. The Contractor shall ensure that a copy of the manifest is returned to the City by the designated treatment or disposal facility within 14 days of receipt of the material to be disposed.

- END OF SECTION -

SECTION 02240 DEWATERING

PART 1 – GENERAL

(NOT USED)

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor shall be responsible for design, installation, and operation of a dewatering system to dewater specified excavations.

1. The dewatering system shall be designed in accordance with the Best Management Practices (BMP's) adopted by FDEP.
2. Inspection and control of dewatering system operations will be in accordance with the FDEP guidelines established in the Florida Erosion and Sediment Control Inspector's Manual (current edition).

B. Continuously manage and control excavation water recharge in order to facilitate and not impede construction activities at all times, including weekends, holidays, and during periods of work stoppages, and furnish and install, and operate, a contingency backup dewatering system to maintain control of excavation water levels to facilitate construction (i.e.; no construction delays).

3.02 SUBMITTALS

A. Submittals shall be made in accordance with the requirements specified in Contract Documents and the requirements of this Section.

B. Provide name, address, and phone numbers of all subcontractors.

C. The Contractor shall submit a Dewatering Best Management Practices (BMP) Plan prior to the start of excavation expected to include dewatering operations. The Plan shall provide detailed descriptions of dewatering procedures to be utilized to meet the requirements of this Section. Methodologies to control dewatering discharge contamination include, but are not limited to:

1. Holding tanks of adequate size and volume.
2. Wellpoint systems.
3. Sump pumping systems.
4. Chemical precipitation of particulates.
5. Filter systems and siltation controls.
6. Outfall booms.

D. The Contractor shall provide a Site Health and Safety Plan and Activity Hazard Analysis (AHA) for contaminated soil as specified in the Contract Documents and/or groundwater as specified in this Section, to include the following:

1. A written description of the proposed method for temporary stockpiling, transportation, and disposal of all wastes.
2. Copy of permits of disposal facilities.
3. Certification of disposal of all wastes.
4. Directions to the nearest hospital and phone number.
5. Emergency contact phone numbers.
6. Laboratory analyses and sampling plan required for transportation and disposal of all wastes in accordance with applicable federal, state, and local requirements.

E. Upon Completion of Remediation Activities, the following shall be provided:

1. Copy of manifests for all wastes leaving the site.
2. Copy of the laboratory analyses results from all sampling activities.
3. Copy of closure reports that may be required.

3.03 SURFACE WATER CONTROL

A. Remove surface runoff controls when no longer needed.

B. Seal off or berm catch basins in the area of construction to prevent discharge of untreated dewatering effluent or runoff from unstabilized construction areas into storm drains.

C. All drain inlets or catch basins used for dewatering discharge shall be provided with silt and sediment removal barriers as approved by the Engineer.

1. All barriers shall be cleaned regularly to avoid sediment discharge into the storm drain system.
2. Construction activities will be stopped at no cost to the City until sediment controls are properly maintained, installed, and in compliance with the dewatering permit.
3. All barriers shall be removed upon issuance of a hurricane warning.

3.04 DEWATERING SYSTEMS

A. Design, furnish, and install, operate, and maintain a dewatering system of sufficient size and capacity to permit excavation and subsequent construction activities in water- free conditions, and to lower and maintain the excavation area groundwater level a minimum of 2 feet below the lowest point of excavation. The dewatering system shall be designed and operated such that the system continuously maintains excavations water levels so as to maintain the excavation water level in order to allow for the initiation and completion of excavation backfill compaction and restoration activities.

B. Dewatering systems shall include, but is not limited to, furnishing and installing wells or well points, and or other equipment and appurtenances as may be necessary, including system components or equipment, installed outside the outermost perimeter of the excavation limits, and sufficiently below lowest point of excavation, to maintain the specified or required groundwater elevation.

C. Open trench pumping may be permitted upon the approval of the Engineer.

D. Design and Operate Dewatering Systems:

1. To prevent loss of ground as water is removed.
2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
3. Avoid surface water pollution or discharge of sediment to storm drain systems or waterways.

E. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering. The Contractor shall not direct any flow of water over pavement surfaces. Discharge of water shall be conducted as approved by the local, state, and federal agencies and the Engineer.

F. Provide controls to prevent surface water from entering excavation pits, trenches, or stockpiled materials.

3.05 PIPELINES CONSTRUCTED UNDER WATER

A. In the event that it is found that the water in a trench cannot be lowered by ordinary means, i.e., well points and pumps, an alternate construction method may be proposed by the Contractor. Complete details, specifications, manufacturer's descriptive literature, installation lists and any other pertinent data regarding the proposed alternate method shall be submitted as an alternate by the Contractor to the City within 5 calendar days of the time that the Contractor anticipates using such alternate method.

B. If the City approves the alternate method in writing, it may be used, so long as the Work is performed in a manner which, in the opinion of the Engineer, conforms to the method and procedure as set forth in the information supplied by the Contractor in his original application for use of an alternate method. The City may revoke approval of the alternate method if at any time, in his opinion, the Work is not conforming to any applicable portion of these Specifications.

C. No pipeline shall be laid under water without approval of the City.

D. If the dewatering system is eliminated or the effort reduced, and the pipe is laid underwater, additional pipe zone material will be required as backfill to the water table elevation, or to the level it was reduced to.

3.06 DISPOSAL OF WATER

A. All water generated, pumped, or removed from excavations as a result of excavation dewatering activities shall be collected, containerized, and managed prior to discharge and or treatment at an approved discharge point or facility, in accordance with Broward County Code of Regulation, Sections 27. Contractor shall secure, obtain, and pay for all necessary local, state, and federal permits, licenses, fees, and or approvals to discharge water or perform onsite or offsite treatment and disposal. Treat water collected by dewatering operations as required by regulatory agencies, prior to discharge.

B. Discharge water as permitted, and in regulatory compliance with Contractor obtained discharge permits/licenses.

1. All discharge activities shall be performed so as to prevent silt and sediment discharge and eliminate any soil erosion or flooding, or otherwise damage existing facilities, completed

Work, or adjacent property.
2. Maximum allowable turbidity of discharges to surface waters or storm drains will be 10 NTU's or the maximum permitted by the agency having jurisdiction, whichever is less.
3. Sump discharges cannot be discharged directly to storm drains or surface waters without treatment.

C. Affected storm sewer outfalls shall be protected with floating silt booms as approved by the Broward County Resilient Environment Department (BCRED) and the Engineer. All accumulated debris resulting from the dewatering discharge collecting in the boom shall be removed on a daily basis.

D. Visible silt plumes emanating from the area around the outfalls will be considered a failure of the silt and sediment removal measures and may result in a Notice of Violation issued by BCRED. The Contractor will be responsible for all fines associated with the violation of the dewatering permit conditions issued to the Contractor.

E. Failure to control dewatering discharges as described above and as detailed in the Florida Erosion and Sediment Control Inspector's Manual, may result in an order to cease dewatering operations until the discharge problems are corrected. No claims will be accepted for costs or delays associated with unacceptable dewatering discharge practices.

3.07 WELL POINT REMOVAL

A. Well point holes shall be filled with sand which shall be washed into the hole.

B. Well point holes located within asphalt pavement surfaces or concrete pavements, shall be filled with sand to the subgrade. The remaining hole shall be filled with non shrink grout.

3.08 CONTAMINATED GROUNDWATER AND DISPOSAL REQUIREMENTS

A. If Contractor suspects, witnesses, or identifies, groundwater contamination at any time during the performance of the Work, Contractor shall notify the City immediately. Results will be obtained by the onsite mobile laboratory.

B. If analytical testing documents and indicates elevated concentrations above FDEP action levels (Chapter 62-777, Florida Administrative Code) dewatering operations will be suspended until appropriate treatment and or construction measures can be implemented. Contractor shall not resume operations until notified to do so in writing by the City and construction of the remaining pipelines in that area will be installed in the wet or normal construction activities shall be resumed in another areas determined by the Engineer. There shall be no delay or mobilization claim associated with moving to another project area, unless all other Work has been completed. In addition, the local agency will be immediately notified via telephone and in writing by the Contractor. Dewatering activities in the area will not proceed until review of the matter with the local agency is resolved and written authorization is issued.

C. The Contractor shall submit a dewatering plan to the City for review. The Contractor is advised that the SFWMD, BCRED, etc. May require that a dewatering plan, prepared by a state of Florida licensed Professional Engineer or registered professional geologist, be submitted and approved prior to issuance of a dewatering permit. The Contractor will retain a state of Florida licensed Professional Engineer or registered Professional Geologist to provide an initial report of potential dewatering issues in the site vicinity. The Contractor shall retain a state of Florida licensed Professional Engineer or registered geologist to provide any additional services required by regulatory agencies regarding dewatering and contaminated sites.

D. The Contractor is advised that the BCRED may have identified contaminated sites within ¼ mile radius of the project site. The Contractor may be required to provide testing and monitoring of the dewatering operations, and to institute dewatering methods and controls, as required by BCRED, SFWMD, etc. The contractor will be responsible for all costs associated with means and methods of dewatering which will be set forth by dewatering permits.

E. Treatment of the groundwater will include three options depending on the magnitude of the contamination in the trench or as determined by the Engineer: Granular Activated Carbon (GAC) Treatment Vessels, Mobile Air Stripping Units, or Vacuum Truck Removal and Disposal or other method as approved by the Engineer. The Contractor will provide a submittal list of all qualified groundwater remediation subcontractors for GAC vessel treatment/portable air stripping unit and vacuum truck disposal including phone numbers, contact names, and addresses prior to start of construction. The selected groundwater treatment/recycling facility for hauling contaminated groundwater shall also be identified.

F. If contaminated groundwater in the dewatering trench is encountered, the remediation operations will begin once local agency approval is obtained. Contaminated water will be disposed first into a high volume holding (FRAC) tank and then treated through a GAC unit/portable air stripper or recovered into vacuum hauling trucks for disposal.

G. Effluent water from the treatment system will be analyzed by the onsite mobile laboratory to confirm that concentrations are below regulatory limits. Effluent water will then be directed to a pre-approved alternative location as determined by local agency and/or the Engineer.

- END OF SECTION -

SECTION 02300 EARTHWORK

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the Work under this Section.

1.02 WORK INCLUDED

A. Provide all labor, materials, necessary equipment and services to complete the Earthwork, as indicated on the Drawings, as specified herein or both, except as for items specifically indicated as "Not in Contract (N.I.C.) Items"

B. Including but not necessarily limited to the following:

1. Excavation, including demucking.
2. Backfilling.
3. Filling.
4. Grading, general site and building pads.
5. Compaction.
6. Coordination with Engineer for offsite disposal of all excess materials and stock piling of suitable materials to be used as fill or backfill.

C. Cutting, proof rolling, filling and grading to required lines, dimensions, contours and elevations for proposed improvements as shown and implied on the Drawings and required by these specifications.

D. Scarifying, compaction, moisture content conditioning and control, and removal of unsuitable material to ensure proper preparation of areas for the proposed improvements.

E. Undertake any special construction procedures for the site recommended in the geotechnical report for preparation of building and pavement areas.

F. There shall be no classification of excavation for measurement of payment regardless of materials encountered.

G. The Work of this Section includes all earthwork required for construction of the Work. Such earthwork shall include, but not be limited to, the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials wet and dry, as required for the purposes of completing the Work specified in the Contract Documents, which shall include, but not be limited to, the furnishing, placing, and removing of sheeting and bracing necessary to safely support the sides of all excavation; all pumping, ditching, draining, and other required measures for the removal or exclusion of water from the excavation; the supporting of structures above and below the ground; all backfilling around structures and all backfilling of trenches and pits; the disposal of excess excavated materials; borrow of materials to makeup deficiencies for fills; and all other incidental earthwork, all in accordance with the requirement of the Contract Documents.

1.03 RELATED WORK

A. All applicable sections of Technical Specifications.

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes: All codes, as referenced herein, are specified in Section 01090, "Reference Standards".

B. American Society for Testing and Materials (ASTM) – latest edition

1. ASTM D 422 - Method for Particle-Size Analysis of Soils.
2. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil- Aggregate Mixtures, using 5.5-lb (2.49-kg) Rammer and 12-in (304.8- mm) Drop.
3. ASTM D 1556 - Test Method for Density of Soil in Place by the Sand Cone Method.
4. ASTM D 1557 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (457- mm) Drop.
5. ASTM D 1633 - Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
6. ASTM D 2216 - Laboratory Determination of Moisture content of Soil.
7. ASTM D 2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
8. ASTM D 2487 - Classification of Soils for Engineering Purposes.
9. ASTM D 2901 - Test Method for Cement Content of Freshly-Mixed Soil-Cement.
10. ASTM D 2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
11. ASTM D 3017 - Test for Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
12. ASTM D 4253 - Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
13. ASTM D 4254 - Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
14. ASTM D 4318 - Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
15. ASTM D 4429 - Standard Test Method for CBR (California Bearing Ratio) of Soils in Place

C. American Association of State Highway and Transportation Officials (AASHTO) - latest edition

1. T 88 Particle Size Analysis of Soils

1.05 SUBSOIL INFORMATION

A. Refer to the Appendix for the Geotechnical Investigation report.

1.06 SITE INSPECTION

A. The Contractor shall visit the site and acquaint themselves with all existing conditions. Make their own subsurface investigation to satisfy themselves as to site and subsurface conditions, but such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the City and Engineer.

1.07 TOPOGRAPHIC INFORMATION

A. The existing grades shown on the Drawings are approximate only and no representation is made as to their accuracy or consistency. The Contractor shall verify all existing grades to the extent necessary to ensure completion of the job to the proposed grades indicated on the Drawings.

B. Refer to the Appendix for the Topographic Survey.

1.08 DISPOSAL OF SURPLUS OR UNSUITABLE MATERIAL

A. Unsuitable material encountered during the course of construction shall be removed from the construction site at the expense of the Contractor. Unsuitable material shall not be stockpiled on-site. All suitable material shall be stockpiled at areas approved by the Engineer.

1.09 BENCHMARKS AND MONUMENTS

A. Contractor shall employ a registered Professional Surveyor and Mapper to lay out lines and grades as indicated. Benchmarks shall be established by a Professional Surveyor and Mapper registered in the State of Florida. Benchmarks shall be permanent and easily accessible and maintained and replaced if disturbed or destroyed. All benchmarks shall be North American Vertical Datum 1988 (NAVD).

1.10 UTILITIES

A. Before starting site operations, disconnect or arrange for the disconnection of all utility services designated to be removed.

B. Locate all existing active utility lines traversing the site and determine the requirements for their protection. Preserve in operating condition all active utilities adjacent to or traversing the site and/or designated to remain.

C. Observe rules and regulations governing respective utilities in working under requirements of this section. Adequately protect utilities from damage, remove or replace as indicated, specified or required. Remove, plug or cap inactive or abandoned utilities encountered in excavation. Record location of all utilities.

1.11 QUALITY ASSURANCE

A. A geotechnical engineer may be retained by the City to observe performance of Work in connection with excavating, filling, grading, and compaction. This inspection will not relieve the Contractor from responsibility to complete the Work in accordance with the Drawings and specifications. The Contractor shall re-adjust all Work performed that does not meet technical or design requirements but make no deviations from the Contract documents without specific and written acceptance of the Engineer.

B. Visual field confirmation and density testing of subgrade preparation and fill placement procedures shall be performed by the field geotechnical engineer as part of the construction testing requirements. The Contractor shall be informed as soon as possible of the test results.

C. The Engineer shall prepare field reports that indicate compaction test location, elevation data, testing results and acceptability. The City and Contractor shall be provided with written copies of the results within 24 hours of time test was performed.

D. All costs related to reinspection, due to failures, shall be paid for by the Contractor at no additional expense to City. The City reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

E. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with ASTM D 1557. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 1556, ASTM D 2922, or by such other means acceptable to the Engineer.

F. In case the tests of the fill or backfill show non-compliance with the required density, the Contractor shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the City and shall be at the Contractor's expense.

G. Particle size analysis of soils and aggregates will be performed using ASTM D 422.

H. Determination of sand equivalent value will be performed using ASTM D 2419.

I. Unified Soil Classification System: References in these specifications are to soil classification types and standards set forth in ASTM D 2487. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

J. Comply with requirements of all applicable building codes and other public agencies having jurisdiction upon the Work.

1.12 SUBMITTALS

A. Within 10 days after Notice to Proceed (NTP), the Contractor shall submit to the City, a schedule detailing the sequence, and time of completion of all phases of Work under this section.

B. At least 2 weeks in advance of imported fill use, the Contractor shall submit the following laboratory test data to the Engineer for each type of imported soil/gravel material to be used as compacted fill.

1. Moisture and Density Relationship - ASTM D1557 or D698 as required by project geotechnical engineering study;
2. Mechanical Analysis - AASHTO T-88; and,
3. Plasticity Index - ASTM D 4318.

C. Together with the above test data, the Contractor shall submit a 5-pound sample of each type of off-site fill material in an air tight container for the approval of the Engineer and City.

D. Submit the name of each material supplier and specific type and source of each material. Any change in source or soil type throughout the job requires approval of the City and the Engineer.

PART 2 - PRODUCTS

2.01 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General: Fill, backfill, and embankment materials shall be suitable selected or processed clean, fine earth, rock, or sand, free from grass, roots, brush, or other vegetation.

B. Fill and backfill materials to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 2 inches.

C. Suitable Materials: Soils not classified as unsuitable as defined in Paragraph entitled, "Unsuitable Material" herein, are defined as suitable materials and may be used in fills, backfilling, and embankment construction subject to the specified limitations. In addition, when acceptable to the Engineer, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.

D. Suitable materials may be obtained from on-site excavations, may be processed on- site materials, or may be imported. If imported materials are required to meet the requirements of this Section or to meet the quantity requirements of the project the Contractor shall provide the imported materials at no additional expense to the City, unless a unit price item is included for imported materials in the bidding schedule.

E. On-site Fill

1. On-site materials for use as fill shall consist of excavated soil from other portions of the site;
2. The Contractor shall use the on-site soil judiciously to facilitate the construction schedule including the use of the most readily compactable soil for fill in building areas and as fill within 2 feet of pavement subgrade;
3. Topsoil shall not be utilized as engineered fill;
4. Excavated material containing rock, stone or masonry debris smaller than 2 feet in its largest dimension, may be mixed with suitable material and utilized up to 3 feet below proposed subgrade;
5. Excavated material containing rock, stone or masonry debris smaller than 6 inches in its largest dimension may be mixed with suitable material and utilized up to 18 inches below proposed subgrade;
6. No material greater than 2 inches in its largest dimension may be utilized within 18 inches of proposed subgrade;
7. No material greater than 2 inches in its largest dimension may be utilized as backfill for storm drainage or utility trenches.
8. Prior to placement, on-site material to be used as fill shall not contain:
   a. Debris other than crushed concrete and brick meeting the above requirements.
   b. Timber or railroad ties.
   c. Other deleterious materials such as steel rails, rebar, trash, etc.
   d. Hazardous material - Unsuitable and deleterious materials and debris shall be disposed of off-site in accordance with all applicable regulations.

F. Off-site Imported Fill

1. If necessary, off-site fill shall be obtained and provided by the Contractor;
2. Fill shall be clean, well graded granular soil which is non-expansive and non- collapsible and shall have less than 20% by weight passing the #200 sieve. The portion passing the #200 shall be non-plastic.
3. Fill with less fines (less than #200) may be required on project specific basis and as required by Engineer. Likewise, fill with more than 20% fines may be acceptable on a project specific basis or as identified in a geotechnical engineering study;
4. Imported fill shall be free of all hazardous substances. Certification of compliance and, if requested, test results substantiating compliance shall be furnished to the City and Engineer by the Contractor not less than one week prior to its intended use;
5. The City reserves the right to test off-site fill material for conformance with these specifications; and,
6. The Contractor shall be responsible for all permits and regulatory requirements associated with offsite borrow sources.

G. The following types of suitable materials are designated and defined as follows:

1. Type 1 (one inch minus granular backfill): Crushed rock, gravel, or sand with 100 percent passing a 1-inch sieve and a sand equivalent value not less than 50.
2. Type 2 (one half inch minus granular backfill): Crushed rock, gravel, or sand with 100 percent passing a 1/2-inch sieve and a sand equivalent value not less than 50.
3. Type 3 (sand backfill): Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a number 4 sieve, and a sand equivalent value not less than 30.
4. Type 4 (coarse rock backfill): Crushed rock or gravel with 100 percent passing a 1- inch sieve and not more than 10 percent passing a Number 4 sieve.
5. Type 5 (pea gravel backfill - ASTM #89): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve, 90 percent passing a Number 8 sieve and not more than 10 percent passing a Number 4 sieve.
6. Type 6 (coarse drainrock - ASTM #4): Crushed rock or gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
2-inch	100
1 1/2-inch	90 - 100
1-inch	20 - 55
3/4-inch	0 - 15
No. 200	0-3

7. Type 7 (graded drainrock): Crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements.

Sieve Size	Percentage Passing
1-inch	100
3/4-inch	90 - 100
3/8-inch	40 - 100
No. 4	25 - 40
No. 8	18 - 33
No. 30	5 - 15
No. 50	0 - 7
No. 200	0 - 3

8. The drainrock shall have a sand equivalent value not less than 75. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs.
9. Type 8 (Ballast Rock / ¾ inch Rock): Crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements.

Sieve Size	Percentage Passing
1-inch	100
3/4-inch	40 - 60
No. 4	0 - 3
No. 8	0 - 3

10. Type 9: (Bedding rock - ASTM #67): Well graded crushed rock or gravel meeting the following gradation:

Sieve Size	Percentage Passing
1-inch	100
3/4-inch	98 - 100
1/2-inch	55 - 70
3/8-inc	30 - 40
No. 4	0 - 6

11. Type 10 (Class I crushed stone - ASTM #57): Manufactured angular, granular crushed stone, rock, or slag, with 100 percent passing a 1-inch sieve and less than 5 percent passing a Number 4 sieve.
12. Type 11 (aggregate base): Crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. At the option of the Contractor, the grading for either the 1-1/2-inch maximum size or 3/4-inch maximum size shall be used. The sand equivalent value shall be not less than 22, and the material shall meet the following gradation requirements.

Sieve Size	3/4-inch Max.	Percent Passing
2-inch	100	--
1-1/2-inch	90 – 100	--
1-inch	--	100
3/4-inch	50 - 85	90 - 100
No. 4	25 - 45	35 - 55
No. 30	10 - 25	10 - 30

13. Type 12 (aggregate subbase): Crushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a firm stable base. The sand equivalent value shall be not less than 18 and shall meet the following gradation requirements.

Sieve Size	Percentage Passing
3-inch	100
2 1/2-inch	87 - 100
No. 4	35 - 95
No. 200	0 - 29

14. Type 13 (cement-treated backfill): Material which consists of Type 7 material, or any mixture of Types B, C, G and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633.
15. Type 14 (topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris as specified.
16. Type 15 (trench plug): Low permeable fill material, a nondispersible clay material having a minimum plasticity index of 10.

H. If approved by the Engineer, any bituminous concrete on the site shall be milled/removed prior to placing any fill and shall be reused only onsite immediately below the pavement stone base course.

2.02 UNSUITABLE MATERIAL

A. Unsuitable soils for fill material shall include soils which, when classified under ASTM D 2487, fall in the classifications of Pt, OH, CH, MH or OL.

B. In addition, any soil which cannot be compacted sufficiently to achieve the percentage of maximum density specified for the intended use shall be classed as unsuitable material.

2.03 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

A. The Contractor shall use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.

B. Where these Specifications conflict with the requirements of any local agency having

jurisdiction, or with the requirements of a material manufacturer, the Engineer shall be immediately notified. In case of conflict therewith, the Contractor shall use the most stringent requirement, as determined by the Engineer.

C. Fill and backfill types shall be used in accordance with the following provisions:

1. Embankment fills shall be constructed of any mixture of Type 1 through Type 11 materials.
2. Pipe zone backfill, as defined under Paragraph 3.15 "Pipe and Utility Trench Backfill" herein, shall consist of the following materials for each pipe material listed below. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a Number 4 sieve, trench plugs of Type 13 or 14 materials shall be provided at maximum intervals of 200 feet or as shown on the Drawings.
    a. Mortar coated pipe, concrete pipe, and uncoated ductile iron pipe shall be provided Type 1, 2, 3, 4, 5, 9 or 10 pipe zone backfill materials.
    b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other non-mortar coated pipe shall be backfilled with Type 3 pipe zone backfill material.
    c. Plastic pipe and vitrified clay pipe shall be backfilled with Type 9 or 10 pipe zone backfill material.
3. Trench zone backfill for pipelines as defined under Paragraph 3.15 "Pipe and Utility Trench Backfill" shall be or any of Types 1 through 11 backfill materials or any mixture thereof, except that Type K material may be used for trench zone backfill in agricultural areas unless otherwise shown or specified.
4. Final backfill material for pipelines under paved area, as defined under Paragraph

    3.15 "Pipe and Utility Trench Backfill" shall be Type 11 backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill, except that Type K material shall be used for final backfill in agricultural areas unless otherwise shown or specified.
5. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.
6. Aggregate base materials under pavements shall be Type 11 material constructed to the thicknesses shown or specified. Where specified or shown, aggregate subbase shall be Type 12 Material.
7. Backfill around structures shall be or Types 1 through Type 11 materials, or any mixture thereof.
8. Backfill materials beneath structures shall be as follows:
9. Drainrock materials under hydraulic structures or other water retaining structure with underdrain systems shall be Type 7 or Type 8 material.
10. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types 7, 8 or 11 materials shall be used.
11. Under structures where groundwater must be removed to allow placement of concrete, Type 6 material shall be used.
12. Under all other structures, Type 4, 5, 6, 7, 8, 9 or 11 material shall be used.
13. Backfill used to replace pipeline trench over-excavation shall be a layer of Type 6, 7, 8, 9

or 10 materials. This backfill material shall be wrapped with filter fabric to prevent migration of fines for wet trench conditions. The same material as used for the pipe zone backfill may be used if the trench conditions are not wet. Filter fabric shall be Mirafi 140 N, Mirafi 700 X, or equal.

14. The top 6 inches of fill on reservoir roofs, embankment fills around hydraulic structures, and all other embankment fills shall consist of Type 14 material, topsoil.

2.04 EMBANKMENT

A. The maximum sizes of rock which will be permitted in the completed fill areas are as follows:

Depth Below Finish Grade	Maximum Allowable Diameter
Up to 4-inches	1 inch
4-inches to 12 inches	3.5 inches
1 feet to 2 feet	6 inches
2 feet to 4 feet	12 inches
4 feet to 8 feet	24 inches
Below 8 feet	36 inches

B. Embankments shall be constructed of material containing no muck, stumps, roots, brush, vegetable matter, rubbish or other material that will not compact into a suitable and enduring roadbed, and material designated as undesirable shall be removed from the site. Where embankments are constructed adjacent to bridge end bents or abutments, rock larger than 3-1/2 inches in diameter shall not be placed within three feet of the location of any abutment.

C. Fill material containing debris, sod, biodegradable materials shall not be used as fill in construction areas.

D. Fill material required for the building pads and for pavement subgrade shall be granular fill, free of organic material.

E. Fill material required for pervious and sodded areas shall have a maximum organic component of 10%. Contractor shall provide, at without any cost to the City, organic content test results for approval by the Engineer.

2.05 EQUIPMENT

A. Compactor for mass earthwork shall be minimum 3 ton static drum weight vibratory roller or 5 ton static drum weight sheeps footed compactor as appropriate for the type of soil material at the site or other compactor approved by the Engineer.

B. Compactor for trenches and where access or maneuverability is limited use, a double drum walk behind roller or vibratory plate compactor or "jumping jack" tampers.

PART 3 - EXECUTION

3.01 GENERAL

A. Prior to bidding of all Work within this section, the Contractor shall become thoroughly familiar with the geotechnical engineering study, if available, as well as the site, site conditions, and all portions of the Work falling within this section.

B. The Contractor shall refer to the erosion control Drawings, if provided, for staging of earthwork operations and for erosion control measures to be implemented prior to commencement of earthwork.

C. Locate and identify existing utilities that are to remain and protect them from damage.

D. Notify utility companies to allow removal and/or relocation of any utilities that are in conflict with the proposed improvements.

E. Protect fences, structures, sidewalks, paving, curbs, etc. to remain from equipment and vehicular traffic.

F. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed/relocated it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same at no additional cost to the City.

G. Remove from the site, material encountered in grading operations that, in opinion of City or Engineer, is unsuitable or undesirable for backfilling in pavement or building areas as per Paragraph 2.01.

H. Identify required lines, levels, contours and datum to bring site grades to the proposed subgrade conditions inferred from the Drawings.

I. Do not perform any Work associated with this section prior to completion of all required inspections, tests and approvals.

J. When performing grading operations during periods of prolonged wet or dry weather, provide adequate measures for surface drainage and ground water control, and moisture control of soils (i.e., wetting or drying, scarify and discing) so as to place and compact the soil within the moisture content range a few percentage points of its optimum water content. Any disturbed areas should be proofrolled at the end of each day.

K. Sloping, shoring, bracing, and fencing shall be installed in accordance with Federal OSHA requirements as well as the requirements of all regulatory authorities having jurisdiction.

L. Allow no debris to accumulate on-site. Haul debris away from the site and dispose of at no cost to the City.

M. The Contractor shall remove and dispose of all excess excavated material at a site selected by the Contractor and reviewed by the Engineer.

3.02 JOB CONDITIONS

A. Protection: Use all means necessary to protect existing objects and vegetation. In the event of damage, immediately make all repairs, and replacements necessary to the acceptance of

the Engineer at no cost to the City.

3.03 BACKFILL, FILLING & GRADING

A. Grades:

1. Cut, backfill, fill and grade to proper grade levels indicated. The proposed grades shown on the Drawings are for establishing a finished grade over the site.

B. Filling:

1. Fill material shall be placed in horizontal layers and spread to obtain a uniform thickness.
2. After compaction, layers of fill are not to exceed twelve (12) inches for cohesive soils or eight (8) inches for noncohesive soils.

3.04 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of said materials shall conform to the lines and grades shown or ordered. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other measure for the removal or exclusion of water, including taking care of storm water, groundwater, and wastewater reaching the site of the Work from any source so as to prevent damage to the Work or adjoining property. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

B. Excavation Beneath Structures and Embankments: Except where otherwise specified for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where shown or ordered, areas beneath structures or fills shall be over-excavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such over excavation is shown, both over-excavation and subsequent backfill to the required grade shall be performed by the Contractor. When such over-excavation is not shown but is ordered by the Engineer, such over- excavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or over-excavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 98 percent of maximum density.

C. Excavation Beneath Paved Areas: Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 98 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-

draining subgrade.

D. Notification of Engineer: The Contractor shall notify the Engineer at least 3 days in advance of completion of any structure excavation and shall allow the Engineer a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

3.05 PIPELINE AND UTILITY TRENCH EXCAVATION

A. General: Unless otherwise shown or ordered, excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as is practical for the method of pipe zone densification selected by the Contractor, but shall have a minimum width at the bottom of the trench equal to the outside diameter of the pipe plus 24 inches for mechanical compaction methods and 18 inches for water consolidation methods. The maximum width at the top of the trench shall be equal to the outside diameter of the pipe plus 36 inches for pipe diameters 18 inches and larger and to the outside diameter of the pipe plus 24 inches for pipe diameters less than 18 inches, or as shown on the Drawings.

B. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe. The trench bottom shall be given a final trim, using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Rounding out the trench to form a cradle for the pipe will not be required. Excavations for pipe bells and welding shall be made as required.

C. Open Trench: The maximum amount of open trench permitted in any one location shall be determined by FDOT MOT approvals. All trenches shall be fully backfilled at the end of each day. The above requirements for backfilling will be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure. In such cases, however, barricades meeting OSHA requirements shall be provided and maintained. Requirements of Section 01550, paragraph 1.02B shall also apply.

D. Trench Over-Excavation: Where the Drawings indicate that trenches shall be over- excavated, they shall be excavated to the depth shown, and then backfilled to the grade of the bottom of the pipe.

E. Over-Excavation: When ordered by the Engineer, whether indicated on the Drawings or not, trenches shall be over-excavated beyond the depth shown. Such over- excavation shall be to the depth ordered. The trench shall then be backfilled to the grade of the bottom of the pipe. All Work specified in this Section shall be performed by the Contractor when the over-excavation ordered by the Engineer is less than 6 inches below the limits shown.

F. When the over-excavation ordered by the Engineer is 6 inches or greater below the limits shown, additional payment will be made to the Contractor for that portion of the Work which is located below said 6-inch distance. Said additional payment will be made under separate unit price bid items for over-excavation and bedding if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.

G. Where pipelines are to be installed in embankment or structure fills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

3.06 OVER-EXCAVATION NOT ORDERED, SPECIFIED, OR SHOWN

A. Any over-excavation carried below the grade ordered, specified, or shown, shall be backfilled to the required grade with the specified material and compaction. Such Work shall be performed by the Contractor at its own expense.

3.07 EXCAVATION IN LAWN AREAS

A. Where excavation occurs in lawn areas, the sod shall be carefully removed, kept damp, and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced and lightly rolled in a manner so as to restore the lawn as near as possible to its original condition. Contractor shall provide new sod if stockpiled sod has not been replaced within 72 hours.

3.08 EXCAVATION IN VICINITY OF TREES

A. Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the Engineer. Trees shall be supported during excavation by any means previously reviewed and approved by the Engineer.

3.09 ROCK EXCAVATION

A. Rock is defined as follows:

1. Rock shall be classified as material having a blow count in excess of 30 blows per foot from a Standard Penetration Test (ASTM D-1586) and exceeding 1000 psi from an Unconfined Compression Strength Test (ASTM D-2938); and,
2. General Excavation - Any material that cannot be excavated with a single-toothed ripper drawn by a crawler tractor having a minimum draw bar pull rated at not less than 71,000 lbs. (Caterpillar D9N or equivalent), and occupying an original volume of at least 2 cubic yards or more; and,
3. Trench Excavation - Any material that cannot be excavated with a backhoe having a break out force rated at not less than 44,000 pounds (Caterpillar 235D or equivalent), and occupying an original volume of at least 2 cubic yards.

B. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of rock as described in Paragraph 3.09(A).

C. Said rock excavation shall be performed by the Contractor; provided, that should the quantity of rock excavation be affected by any change in the scope of the Work, an appropriate adjustment of the contract price will be made under a separate bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price.

D. Explosives and Blasting: Blasting will not be permitted, except by express permission of the Engineer on a case-by-case basis. The use of explosives will be subject to the approval and

regulations of all agencies having jurisdiction. If blasting is utilized at the site of the Work, the Contractor shall take all precautions and provide all protective measures necessary to prevent damage to property and structures or injury to person. Prior to blasting, the Contractor shall secure all permits required by law for blasting operations and shall provide any additional hazard insurance required by the City. The Contractor shall have a fully qualified and experienced blasting supervisor in charge of all blasting operations.

E. The Contractor will be held responsible for all and shall make good any damage caused by blasting or resulting from its possession or use of explosives on the Work.

F. All operations involving the handling, storage, and use of explosives shall be conducted in accordance with the requirements of the OSHA Standards for Construction, and in accordance with all local laws and regulations.

3.10 DISPOSAL OF UNSUITABLE EXCAVATED MATERIAL

A. The Contractor shall remove and dispose of all unsuitable excavated material. This shall include muck, tree roots, rocks, garbage, debris, or any other material designated as unsuitable by Part 2 of this Section. Disposal shall be at a site selected by the Contractor that is designated as an approved disposal site for the unsuitable material.

3.11 BACKFILL - GENERAL

A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after all water is removed from the excavation.

3.12 PLACING AND SPREADING OF BACKFILL MATERIALS

A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment the layers shall be evenly spread so that when compacted each layer shall not exceed 6 inches in thickness.

B. During spreading each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread, tamped, and haunched around the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.

C. Where the backfill material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.

D. Where the backfill material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

3.13 COMPACTION - GENERAL

A. Compact each layer of fill in designated areas with approved equipment to achieve a maximum density at optimum moisture, AASHTO T 180 - latest edition.

1. Building Pads: compaction shall be to 98% of maximum density, unless otherwise shown on the DRAWINGS or specifications. Building pads shall be within plus or minus one-tenth (0.1) of a foot of the elevations shown on the plans.
2. Refer to Sections 02772 Asphaltic Pavement for compaction requirements in the affected areas.
3. Under landscaped area, compaction shall be to 85% of maximum density, unless otherwise shown on the Drawings.

B. No backfill shall be placed against any masonry or other exposed building surface until permission has been given by the Engineer and in no case until the masonry has been in place seven days.

C. Heavy construction equipment will not be permitted within ten (10) feet of any masonry or other exposed building surface.

D. Compaction in limited areas shall be obtained by the use of mechanical tampers or approved hand tampers. When hand tampers are used, the materials shall be deposited in layers not more than four inches thick. The hand tampers used shall be suitable for this purpose and shall have a face area of not more than 100 square inches. Special precautions shall be taken to prevent any wedging action against masonry, or other exposed building surfaces.

3.14 COMPACTION OF FILL, BACKFILL, AND EMBANKMENT MATERIALS

A. Each layer of Types 1, 2, 3, 7, 8, and 14 backfill materials as defined herein, where the material is graded such that at least 10% passes a No. 4 sieve, shall be mechanically compacted to the specified percentage of maximum density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.

B. Each layer of Type 4, 5, 6, and 13 backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.

C. Type 9 and 10 material requires mechanical spreading and placement to fill voids but does not require mechanical compaction or vibration. Tamping shall be used in pipe zone areas.

D. Fill on structure roof slabs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.

E. Flooding, ponding, or jetting shall not be used for fill on roofs, backfill around structures, backfill around reservoir walls, for final backfill materials, or aggregate base materials.

F. Pipe zone backfill materials that are granular may be compacted by a combination of flooding and vibration using concrete vibrators or by jetting, when acceptable to the Engineer. Tamping shall be used to ensure adequate bedding in the pipe zone.

G. Pipeline trench zone backfill materials, containing 5% or less of material passing a No. 200 sieve, may be compacted using flooding and jetting or vibration if the Contractor uses effective procedures that yield the specified compaction test results. Flooding and jetting shall not be

done in such a manner that the pipe or nearby utilities are damaged, in areas of poorly draining or expansive soils, or where the use of the procedure is prohibited by any agency having jurisdiction over the street or right-of-way. Approved jet pipes or immersible vibrators shall be used so that each backfill layer is saturated and consolidated to its full depth before the next layer is placed. Jet pipes shall be kept at least 6 inches away from the pipe where the backfills being consolidated and 2 feet away from other pipes or utilities.

H. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.

I. Compaction Requirements: The following compaction test requirements shall be in accordance with AASHTO T-180, T-99-C or ASTM D 2487 as applicable. Where agency or utility company requirements govern, the highest compaction standards shall apply.

Location or Use of Fill	Percentage of Maximum Dry Density per AASHTO T180	Testing Frequency per Lift
Pipe zone backfill portion above bedding for flexible pipe	100	150 LF
Excavated zones under bedding/pipe for flexible pipe (including trench plugs)	100	150 LF
Pipe zone backfill portion above bedding for rigid pipe	98	150 LF
Pipe zone backfill bedding and over excavated zones under bedding/pipe for rigid pipe	98	100 LF
Final backfill beneath paved areas or structures	98	2,500 SF
Trench zone backfill not beneath paved areas or structures (including trench plugs)	95	150 LF
Embankments	98	2,500 SF
Embankments beneath paved areas or structures	100	2,500 SF
Backfill beneath hydraulic structures	100	100 SF
Backfill around structures	98	100 SF
Topsoil (Type 14 material)	85	5,000 SF
Aggregate base or subbase (Type 11/12 material)	98	2,500 SF

J. Trench Backfill Requirements: the pipe has been structurally designed based upon the trench configuration specified herein.

K. The Contractor shall maintain the indicated trench cross section up to a horizontal plane lying 6 inches above the top of the pipe.

L. If, at any location under said horizontal plane, the Contractor slopes the trench walls or exceeds the maximum trench widths indicated in the Contract Documents, the pipe zone backfill shall be "improved" or the pipe class increased as specified herein, at no additional cost to the City. "Improved" backfill shall mean sand-cement backfill or other equivalent materials acceptable to the Engineer.

M. If the allowable deflection specified for the pipe is exceeded, the Contractor shall expose and reround or replace the pipe, repair all damaged lining and coating, and reinstall the pipe zone material and trench backfill as specified at no additional expense to the City.

3.15 PIPE AND UTILITY TRENCH BACKFILL

A. Pipe Zone Backfill: The pipe zone is defined as that portion of the vertical trench cross- section lying between a plane 6 inches below the bottom surface of the pipe, i.e., the trench subgrade, and a plane at a point 6 inches above the top surface of the pipe. The bedding for flexible pipe is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe. The bedding for rigid pipe is defined as that portion of the pipe zone backfill material between the trench subgrade and a level line which varies from the bottom of the pipe to the springline as shown.

B. Bedding shall be provided for all sewers, drainage pipelines, and other gravity flow pipelines. Unless otherwise specified or shown, for other pipelines the bedding may be omitted if all the following conditions exist.

1. The pipe bears on firm, undisturbed native soil which contains only particles that will pass a one-inch sieve.
2. The excavation is not through rock or stones.
3. The trench subgrade soils are classified as suitable fill and backfill materials per Paragraph 2.01.
4. The trench subgrade soils have, as a maximum, a moisture content that allows compaction.

C. Where bedding is required, after compacting the bedding the Contractor shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.

D. The pipe zone shall be backfilled with the specified backfill material. The pipe zone shall be well tamped per manufacturer's recommendation to prevent sags or settlement of the pipe. The Contractor shall exercise care to prevent damage to the pipeline coating, cathodic bonds, or the pipe itself during the installation and backfill operations.

E. Trench Zone Backfill: After the pipe zone backfill has been placed as specified above, and after all excess water has completely drained from the trench, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade. If flooding, ponding, or jetting is used the pipe shall be filled with water to prevent flotation.

F. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, of if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

3.16 EMBANKMENT CONSTRUCTION

A. The area where an embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be moistened, scarified to a depth of 6 inches, and rolled or otherwise mechanically compacted. Embankment fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the Engineer, each layer shall not exceed 6 inches of compacted thickness. The embankment fill and the scarified layer of underlying ground shall be compacted to 95% of maximum density under structures and paved areas, and 90% of maximum density elsewhere.

B. When an embankment fill is to be made and compacted against hillsides or fill slopes steeper than 4:1, the slopes of hillsides or fills shall be horizontally benched to key the embankment fill to the underlying ground. A minimum of 12 inches normal to the slope of the hillside or fill shall be removed and recompacted as the embankment fill is brought up in layers. Material thus cut shall be recompacted along with the new fill material at the Contractor's expense. Hillside of fill slopes 4:1 or flatter shall be prepared in accordance with Paragraph A, above.

C. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe. Heavy construction equipment shall maintain a minimum distance from the edge of the trench equal to the depth of the trench until at least 4 feet of fill over the pipe has been completed.

3.17 COMPACTION OF SUBGRADE SURFACES

A. Any soft areas exhibiting excessive weaving or unsatisfactory material identified during excavation, fill placement, compaction and proof testing shall be removed, replaced with suitable fill, and compacted as specified.

B. Prior to preparing the subgrade in low lying areas, perform the following procedures:

1. Drain standing water by gravity or with a pump. Water should not be discharged directly to a storm drain system;
2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material using equipment and methods that will minimize disturbance to the underlying soils;
3. Thoroughly compact subgrade as specified.
4. If proposed for fill, all muck, mud and other materials removed from above low areas shall be dried on-site by spreading in thin layers for observation by City or Engineer. If, after observation by City material is found to be unsuitable, it shall be removed from the site.

3.18 UNDERCUT EXCAVATION

A. When approved by City and recommended by the Engineer, the Contractor may be required to remove natural soil materials in areas where fills are to be placed when determined to be undesirable in their location or condition. The Contractor shall be required to remove the undesirable material and backfill with approved material properly compacted.

B. At locations where unstable soil is shown on the Drawings or identified within the geotechnical engineering study, the removal and replacement of such soil shall be as directed on the

Drawings or as directed by the Engineer and the City.

C. At locations where soil is wet of optimum moisture, the Contractor shall provide a "good faith" effort in drying and discing these areas prior to completing undercut excavation as approved by the Engineer and City.

D. Where undercutting is required adjacent or beneath the location of the proposed drainage structure, undercut and backfill shall be done over a sufficient distance adjacent to the installation to prevent future operations from disturbing the completed drainage structure.

E. All material removed in the Work of undercut excavation will be classified by the geotechnical engineer and City as either suitable for other use without excessive manipulation and utilized by the Contractor elsewhere in the Work, or unsuitable for future use and disposed of by the Contractor as directed by the Engineer.

F. The Contractor shall conduct undercut operations in such a way that the necessary measurements can be taken before any backfill is placed.

G. Backfill in undercut areas shall be placed as a continuous operation along with the undercutting operation. No backfill material shall be placed in water unless otherwise permitted by the Engineer.

3.19 EXCAVATION, FILL, AND SUBGRADE PREPARATION

A. General

1. The building limits shall be as identified on the construction DRAWINGS. The building subgrade shall be constructed to include a minimum of 10 feet beyond the building limits, or as directed by the City;
2. Structures include buildings, footings, foundations, retaining walls, embankment berms for storm water detention basins, slabs, tanks, curbs, mechanical and electrical appurtenances or other man-made stationary features constructed above or below the ground surface;
3. The building pad subgrade shall be prepared in strict accordance with the geotechnical engineering study and these specifications, whichever is more stringent; and,
4. The Contractor shall cut or fill to the proposed subgrade elevations based on finished grades and the pavement thicknesses as shown on the DRAWINGS. Subgrade elevations shall be constructed to within 0 to minus ½ inch of the proposed grades specified.

B. Excavation

1. Where existing grades are above proposed subgrade elevation, excavate materials in the building areas to line and grade as shown in the Drawings being careful not to over excavate beyond the elevations needed for building subgrades;
2. Excavate organic soils from within the building area. Excavated on-site organic soils, which are unsuitable for building fill, may be used in landscaped areas. Otherwise this material shall be disposed of off-site;
3. Unsuitable material, such as wood and any other deleterious materials determined to be unsuitable by the geotechnical engineer for use as on-site fill, shall be disposed of offsite.

C. Subgrade Preparation for Fill

1. Existing grades below building areas shall be leveled prior to fill placement. The Contractor shall remove existing lawn and top soil in these areas prior to placement of any fill; and,
2. All existing grades below building areas shall be proofrolled and compacted per this section.

D. Fill Placement

1. No fill material shall be placed in areas of standing water, in areas of frozen or thawing ground, or in areas that have not been approved by the Engineer;
2. No fill materials shall be placed during unfavorable weather conditions. When Work is interrupted by heavy rains, fill operations shall not be resumed until all saturated surficial soils are returned to satisfactory moisture content as determined by the Engineer;
3. Fill lift surfaces shall be made smooth and free from ruts or indentations at the end of any workday when precipitation is forecast to prevent saturation of surficial fill material. Fill surfaces shall be graded to drain and sealed with a smooth drum roller at the completion of each work day;
4. The fill shall be placed in uniform loose lifts not exceeding 12 inches and compacted in systemic method to achieve at least 6 passes of the compactor. Larger lift thickness, but no greater than 2 feet shall be permitted if broken rock is utilized and placed at least 6 feet below of finished grade;
5. Shot rock may be utilized as engineered fill as approved by the Engineer;
6. Each lift shall be compacted to the minimum densities listed in this section as appropriate for the project and as specified in the geotechnical engineering study;
7. The Contractor shall adjust the water content by aeration or adding water to achieve the required density. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to achieve proper compaction and facilitate the construction schedule;
8. Wet, saturated material shall be air dried as necessary to achieve the field densities specified in this Section. Removal and replacement shall not occur without prior approval or City. Removal and replacement shall be used if necessary to facilitate the construction schedule;
9. Remove areas of finished subgrade found to have insufficient compaction density of depth necessary and replace with suitable compacted fill as approved by the City or Engineer. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section; and,
10. Fill placed on slopes greater than 1 vertical to 3 horizontal shall have each lift benched onto the slope at least 3 feet.

3.20 PROOFROLLING

A. The Work covered by this subsection consists of furnishing and operating, proofrolling equipment at the direction of the Engineer.

B. Proofrolling shall be under the observation of the geotechnical engineer as described herein and under the following schedule:

1. Immediately following the completion of excavation to proposed subgrades in cut areas, proofrolling shall be performed as specified; and,
2. Immediately prior to and following stone base course placement, in pavement and building pad areas for final floor slab preparation, all subgrade and stone base areas shall be proofrolled. Any areas which deflect, rut or pump under the loaded dump truck shall be undercut and replaced with compacted fill material or stone base course as directed by the Engineer and approved by the City, at no additional cost to the City.

C. Proofrolling shall be done with 1 pass of a fully loaded tandem dump truck equal to or exceeding 50,000 pounds or other construction equipment if approved by the Engineer.

D. Construction methods shall be as follows:

1. After the subgrade or stone base course has been completed the subgrade or stone base course shall then be proofrolled. The coverage areas and methods will be identified by the Engineer.
2. The equipment shall be operated at a speed that the Engineer can comfortably and slowly walk alongside the equipment;
3. If it becomes necessary to take corrective action, such as but not limited to underdrain installation, undercut and backfill of an unsuitable material, and aeration of excessively wet material in areas that have been proofrolled, see Paragraph

   3.18. These areas shall be proofrolled again following the completion of the necessary corrections. If the corrections are necessary due to the negligence of the Contractor, the corrective Work and additional proofrolling shall be performed by the Contractor at no cost to the City;

4. The Contractor shall protect all structural facilities on the project, such as but not limited to box culverts, pipe culverts, and utilities, from damage by the proofrolling equipment.

3.21 MAINTENANCE OF SUBGRADE

A. Finished subgrades shall be verified by the Contractor to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive construction traffic and wheel loading including concrete and dump trucks.

C. Remove areas of finished subgrade judged to be unsatisfactory to the depth necessary and replace in a manner that will comply with compaction requirements by use of material equal to or better than the best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross- section.

3.22 CORRECTION OF GRADE

A. Bring to required grade levels areas where settlement, erosion or other grade changes occur.

3.23 MAINTENANCE AND PROTECTION OF WORK

A. While construction is in progress adequate drainage for the roadbed shall be maintained at all times.

B. The Contractor shall maintain all earthwork construction throughout the life of the contract,

unless otherwise provided, and shall take all reasonable precautions to prevent loss of material from the roadway due to the action of wind or water. The Contractor shall repair without any additional expense to the City, except as otherwise provided herein, any slides, washouts, settlement, subsidence, or other mishap which may occur prior to final acceptance of the Work.

C. All channels excavated as a part of the contract Work shall be maintained against natural shoaling or other encroachments to the lines, grades, and cross sections shown on the plans, until final acceptance of the project.

3.24 AS-BUILT SURVEY

A. At the completion of the Work and prior to final inspection of the area, the Contractor shall provide the Engineer with an as-built topographic survey made by a Florida Licensed Professional Surveyor & Mapper.

B. The Florida Licensed Professional Surveyor & Mapper is to certify on the survey whether or not the as-built conditions conform to the elevations shown on the Drawings to within plus or minus one- tenth (0.1) of a foot.

3.25 MEASUREMENT AND PAYMENT

A. There shall be no special measurement or payment for the Work under this section, it shall be included in the associated bid item for this Work.

- END OF SECTION -

SECTION 02314 VIBRATION AND NOISE MONITORING

PART 1 – GENERAL

1.01 DESCRIPTION

A. This specifies requirements for furnishing all labor, materials, equipment to perform all activities related to vibration and noise monitoring as specified herein:

1. Vibration monitoring associated with the installation of earthwork and/or installation of piles, piping, and sheet piling.
2. Provide vibration monitoring for each building structure within 100 feet of the vibration-inducing construction activity for the new pump station, the proposed 42-inch outfall, and proposed seawall or as necessary to capture the extent of potential damage. The Contractor shall provide seismographs at locations determined in the vibration monitoring plan as approved by the Engineer and Construction Manager. A preconstruction building condition survey of the existing buildings and structures located within 100 feet of the vibration-inducing construction activities shall be completed by the Contractor prior to the start of construction.
3. Furnish, install, maintain, monitor, and remove vibration monitoring equipment as specified herein.
4. Monitor vibrations and noise levels originating from construction operations as indicated herein.
5. Modify construction operation procedures if existing operation creates vibration or noise exceedances as specified herein.
6. Provide noise monitoring during all construction activities within the new pump station area.
7. Furnish, install, maintain, monitor, and remove noise monitoring equipment as specified herein.

1.02 REFERENCES

A. Unless otherwise noted, the latest edition of the following codes and standards shall govern this work. If any conflicts exist between these codes and standards the more restrictive requirements shall govern.

B. American Society for Testing and Materials International (ASTM)

1. ASTM E90: Standard Test Method for Laboratory Measurement of Air-borne Sound Transmission Loss of Building Partitions and Elements.
2. ASTM C423: Standard Test Methods for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

C. Federal Highway Administration (FHWA)

1. FHWA Highway Construction Noise Handbook, FHWA-HEP-06-02

D. United States Department of Interior, Bureau of Mines

1. Report of Investigations 8507, Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting

1.03 QUALITY ASSURANCE

A. Provide in accordance with Section 01400.

B. The Contractor's or Contractor's Vibration consultant and/or Acoustical Engineer, responsible for furnishing and installing all vibration and noise instruments, including all equipment specified here in, maintaining the instruments, as required, and interpreting all data provided or collected shall have the qualifications specified here in. The personnel may be employed by the Contractor or may be employed by a specialized consulting firm.

C. Vibration and/or Acoustical Engineer Qualifications:

1. A State of Florida Licensed Professional Engineer responsible for designing and monitoring vibration and noise specified here in and interpretation of the data.
2. Not less than six (6) years' experience in the installation and monitoring of the vibration and noise instrumentation specified herein.
3. Completed not less than five (5) successful vibration and noise installation and monitoring projects of similar scope and magnitude within the past ten (10) years.
4. Shall be onsite to supervise and conduct the pre/post installations of each type of instrumentation. The qualified engineer shall be onsite and supervise the first five (5) installations of each type of instrument, shall oversee and establish the formal initial readings, shall oversee interpretation of all collected and provide vibration and noise data.

D. Engineering Technician Qualifications:

1. To be responsible full-time on site during the implementation of the vibration and noise monitoring plan.
2. Not less than three (3) years of direct field experience in the installation and monitoring of the types of vibration and noise instruments specified herein and have supervised vibration and noise monitoring programs of a similar scope and magnitude with similar work conditions.
3. Shall be available to supervise all instrument installations, establish initial readings, collect baseline data, and vibration and noise data when the acoustical engineer is not present on-site.

1.04 SUBMITTALS

A. Submit the following shop drawings in accordance with General Conditions.

1. Submit the following qualifications four (4) weeks prior to the start of any construction activities.
   a. Qualifications of the Contractor's vibration consulting firm, as specified in Paragraph 1.03.C.
   b. Qualifications of the Contractor's Acoustical Engineer, as specified in Paragraph 1.03.C.
   c. Qualifications of the Contractor's Engineering Technician, as specified in Paragraph 1.03.D.

B. At least two (2) weeks prior to the start of any construction activities provide Vibration and Noise Monitoring Plans, prepared by the Vibration consulting firm and/or the Acoustical Engineer, and installation details specified herein. This shall include but not limited to the following:

1. Drawings showing the layout and locations of instruments, including wire diagrams for power and/or communications. Power lines carrying 110 volts or more shall be enclosed in conduits of the size and materials required by the NEC.
2. The scheduled start date and length of construction operations which require vibration and noise monitoring.
3. Instrument identification numbers.
4. Details of supports, fixtures, etc. required for installation of instruments and associated systems.
5. The location of any underground utilities in proximity to the construction operation.
6. Proposed construction method(s). The duration and type of equipment to be used during construction and an explanation of how the vibrations will be maintained at an acceptable level.
   a. Identify equipment location and processes.
7. Identification of the zones of potential construction influence for vibrations and noise.
8. Identification of vibration and noise sensitive structures including fragile, sensitive, and historic buildings near the project.
9. Vibration Calculations: Prepare calculations of maximum peak particle velocity vibration level expected at the nearest residential, commercial, and all other structures and railways.
10. Noise Calculations: prepare calculations of one-hour Leq noise levels expected at the nearest residential and commercial buildings.
11. Update the Vibration and Noise Monitoring plans at least in three (3) month intervals from the initial acceptance date.
12. Vibration and Noise reduction Methods: To the extent required to meet the ground vibration peak particle velocity, and exterior noise limits specified herein, modify construction operations to reduce vibration and noise.
13. Manufacturers materials and equipment data sheets.
14. Design of noise mitigation strategies, methods, procedures, and technology and locations and types of noise reduction measures that may be required. The Contractor is hereby notified that the noise mitigation plan for all work within the new pump station area use zoning area must require review and approval by the Architect/Engineer and Construction Manager.
15. Location of noise sensitive locations and any specified measures to be undertaken to minimize the impact of work on these locations.

C. Provide vibration and noise measurement equipment calibration certificates for equipment used on site by the Contractor.

D. The procedure for tracking peak particle velocity (PPV) throughout construction operations (e.g., Pile Driving Operations: pile tip vs. vibrations may be correlated through time of day. A record of the time of day at each depth interval, included on the pile driving records, would be required to correlate to a time-based readout of (PPV).

E. Equipment Sound Level Data Reporting Form for each item of construction equipment to be used.

F. Laboratory calibration conformance certificate for all noise measuring equipment used by the Contractor prior to performing any noise level monitoring. Submit updated certificates following subsequent yearly calibrations, or upon completion of repairs to the instrument, for the duration of the Contract.

G. Manufactures Certificate of Compliance that equipment is noise attenuated.

H. Daily reports, while performing vibration-inducing operations, detailing each source of vibration,

location of monitoring, and the vibration records highlighting peak particle velocities. All daily reports shall be stamped and signed by the Vibration Consulting Firm's Professional Engineer and provided within 24 hours of the end of each day's activities indicating a site plan drawing showing the location of the instrument and maximum and average vibration recorded during the workday period.

I. The Contractor shall submit a final report summarizing the collected data upon completion of each construction operation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements specified in Section 01550.

1.06 SITE CONDITIONS

A. Geotechnical Investigation Results Report: The report is for information only, which is part of the Contract Documents. The boring logs and soil profiles are available and indicate subsurface conditions encountered only at the borehole location. This information shall not be construed as to guarantee that other subsurface materials will not be present or that proportions of materials will not vary from that shown on the boring logs.

B. Preconstruction Building Condition Survey: A preconstruction building condition survey shall be completed by the Contractor prior to the start of construction of the Pump Station, 42-Inch Outfall, and seawall (including but not limited to pipeline, water treatment facility, gate valve, headwall, erosion and sediment controls). The survey will document exterior preconstruction conditions of structures within a 100-foot radius of the new pump station construction site to establish a precondition baseline condition. Contractor shall utilize this document in conjunction with preparation of its monitoring plans as required.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Seismographs shall be "Minimate Pro4" manufactured by Instantel Inc., or approved equal, and shall have the following minimum features:

1. Seismic Range: 0.01 to 10 inches per second with an accuracy of plus or minus 5- percent of measured peak particle velocity or better at frequencies between 4 and 125 Hertz, and with a resolution of 0.001 inch per second or less.
2. Acoustic Range: 88 to 148 dB (L) with an accuracy and resolution of plus or minus 1 decibel.
3. Frequency Response (plus or minus 3 decibel points) 2 to 250 Hertz.
4. Three Channels for vibration monitoring plus a fourth channel for linear or sound level microphone.
5. Two power sources: Internal rechargeable battery and a charger and 115 volts ac. Battery must be capable of supplying power to monitor vibrations continuously for up to 24 hours.
6. Capable of internal dynamic calibration.
7. Computer software to perform analysis, produce reports of continuous monitoring, and to perform zero-crossing frequency analyses of waveform data on magnetic disks.
8. Self-triggering waveforms capture mode that provides the following information: plot of waveforms, peak particle velocities, and frequency peaks.
9. Continuous monitoring mode capable of recording events up to 10 seconds long, and histogram mode to record events continuously.

10. All geophones shall be external to the seismograph to allow solid bolting or anchoring to surfaces with “Red Head” anchors or approved equals.

B. Sound Level Meters provided by the Contractor shall comply with the requirements of the current revision of ANSI S1.4, Type 2 (Precision) Sound Level Meters (SLM). SLM to be capable of measuring the L_{max} and ten minute to one hour L_{eq} on the A-weighted scale required for the noise level limits specified herein.

2.02 NOISE CONTROL MATERIALS

A. Noise control materials may be new or used. Used materials shall be sound and free of damage and defects and shall be of quality and condition to perform their design function. All equipment and materials specified herein will remain the property of the Contractor or Contractor’s subcontractors, vendors, and suppliers, as applicable.

B. All construction equipment shall incorporate the latest noise attenuation features available to the manufacturer.

C. Acoustical materials and curtains shall have a Sound Transmission Class (STC) rating of STC 30 or greater, based on sound transmission loss data according to ASTM E90. The noise absorption face of the curtain shall have a Noise Reduction Coefficient (NRC) rating of 0.85 or greater, based on sound absorption coefficient data taken according to ASTM C423.

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS

A. Provide access to instrument locations and maintain instrument locations from damage.

B. Perform Work within the permissible noise and vibration levels, Work Schedule limitations, and procedures provided herein, and applicable Federal, State, County, and Municipal codes, regulations, and standards.

C. The property owners for any and all structures to be monitored for vibration with seismographs shall be notified in writing two (2) weeks in advance of any work and prior to accessing any property to install equipment.

D. No vibration producing construction activities may be started until the appropriate instrumentation is provided by the Contractor and approved by the Construction Manager.

E. Other than those provided as part of the Contract, the Contractor is responsible for obtaining permits, variances, equipment certifications, and other documents required.

F. Modify vibration and noise control measures based on results of the vibration and noise measurements undertaken and any reported nuisance conditions, define operational and/or equipment restrictions.

G. The Construction Manager may issue a Stop Work notice if the vibration and noise level limits set herein are exceeded and cannot be mitigated.

3.02 VIBRATION AND NOISE MONITORING

A. Furnish specified instruments to be installed, operated and interpreted by the vibration consulting firm and/or Acoustical Engineer 's personnel, as specified below and indicated. Noise monitoring stations shall be installed in three (3) locations at the pumping station/seawall site (at property boundaries closest to residential structures).

B. Vibration monitoring stations shall be located at each building structure within 100 feet of the vibration-inducing construction activity for the entire project area and shall be maintained as required as the construction moves from municipal block to municipal block to adequately capture the vibration effects of the construction.

C. Take initial background readings of all noise stations for a one-week period prior to the start of construction activity in the area.

D. Take initial background readings at all seismograph locations for three days prior to the start of construction activities in the area.

E. Perform all vibration-inducing operations so that vibrations reaching adjacent structures and facilities are within specified limits.

F. All vibration and noise reporting shall comply with this Section as specified herein.

3.03 VIBRATION LEVEL LIMITS

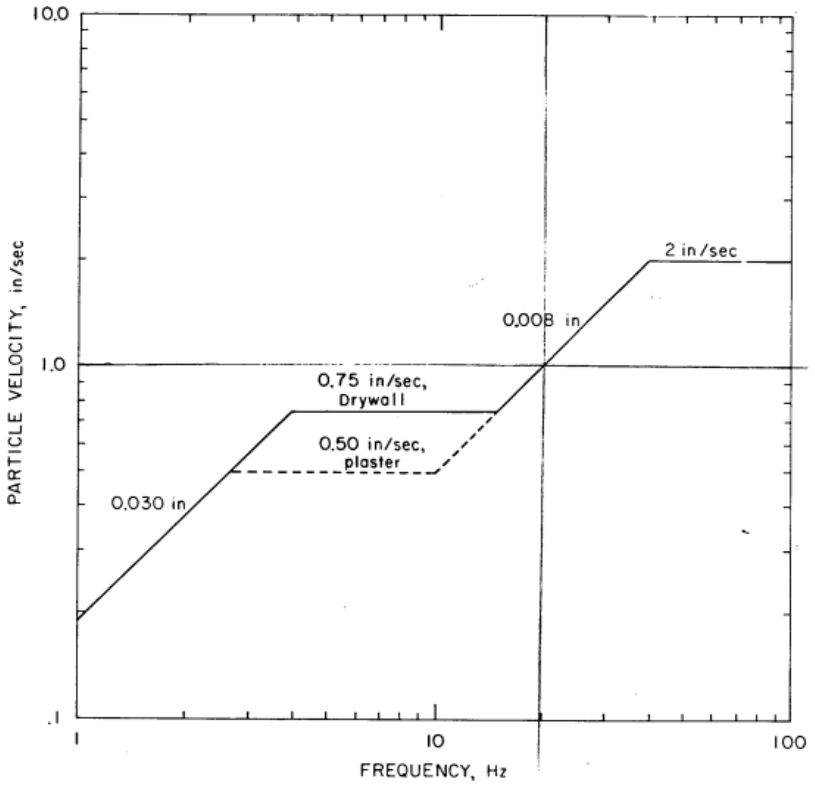
A. Monitor vibrations by measuring the peak particle velocity in the vicinity of work. Peak particle velocity is defined as the maximum of the ground motion velocities measured in the vertical, longitudinal, and transverse directions measured in inches per second (in/s), for construction activities and operations of temporary systems shall be follows:

1. New Construction:
   a. The maximum PPV level limits, in any direction, for all new concrete construction shall not exceed the table below measured by a portable seismograph place adjacent to the new construction at the closest point to the vibration source. The maximum permissible PPV shall be reduced if damage is detected. It is assumed that the vibration-inducing construction activity shall have an influence zone of 100 feet radius when considering the protection of new construction.

Type of Concrete	**Age of concrete (hours)**	**Peak Particle Velocity (in./sec)**
Mass Concrete footings, mats, slab-on-grade	0-10	1.0
fill concrete, etc.	11 and over	2.0
Concrete Structures	0-11	0.5
walls, columns, elevated	11-24	1.0
slabs, etc.	24 and over	2.0

2. Existing structures:
   a. The maximum PPV level limits, in any direction, for all construction activities at buildings and structures, as indicated in the Contract documents, shall not exceed the

vibration criteria shown in Figure 02 32 14-1 as measured by a portable seismograph placed adjacent to or within the building or structure at the location closest to the vibration source. The maximum permissible PPV shall be reduced if movement or cracking is detected or if the pre-construction survey identifies a building or structure with a lower PPV threshold that should be imposed. It is assumed that the vibration-inducing construction activity shall have an influence zone of approximately 100 feet radius depending on activity when considering the protection of sensitive buildings and structures. Monitoring of vibrations at such buildings shall be undertaken for the duration of construction activities that will influence the structure.



Source: United States Bureau of Mines, RI 8507.

Figure 02314-1: Construction Vibration Criteria

B. In the event any data indicates that vibration level limits are being exceeded, immediately suspend all vibration-inducing operations and submit a report to the Construction Manager. Revise operations to reduce vibrations and submit a copy of the revised procedure to the Construction Manager at no additional cost to the DEP.

C. If evidence of displacement or damage to utilities, equipment, or structures is observed or reported, immediately notify the Construction Manager and Stop Work in the area. Revise operation to reduce vibrations and submit a copy of the revised procedure to the Construction Manager.

D. Restore or replace utilities, equipment, or structures damaged by vibrations at no additional cost to the DEP.

3.04 NOISE LEVEL LIMITS

A. Noise levels for public exposure shall comply with the following exterior noise level restrictions in all areas:

1. In no case expose the public to construction equipment noise levels exceeding 90 dBA on "slow" response or impulsive noise level exceeding 125 dBA maximum transient level "fast" response as measured on a general-purpose sound level meter.
2. Conduct construction activities in such a manner that the noise levels at the nearest affected building do not exceed the levels listed in Table 02 32 14-1 below.
3. In areas outside of the Work area and not designated as a special zone, prevent stationary noise sources, parked mobile sources or any other source or combination of sources from producing repetitively scheduled or long-term noise lasting more than 10 percent of the construction duration from exceeding the limit in Table 02 32 14-1 below.

B. Test the equipment and demonstrate compliance with noise limits specified herein.

C. Perform the work in a manner to minimize nuisance conditions such as noise that exhibits a specific audible frequency or tone (e.g. back-up alarms, unmaintained equipment, and brake squeal) or impact noise.

Table 02314-1: Construction Noise Limits

Land Use	Noise Level – Leq (dBA) (whichever is greater)	Lmax Level (dBA, slow)
Daytime (8 am to 5 PM)		
Residence and building where people normally sleep	75 or Background +5	85 90 (impact equipment)
Commercial Spaces	80 or Background +5	None
Industrial Spaces	80 or Background +5	None
Evening (5 pm to 10 pm)		
Residence and building where people normally sleep	65 or Background +5	85
Commercial Spaces	80 or Background +5	None
Industrial Spaces	80 or Background +5	None
Nighttime (10 pm to 8 am)		
Residence and building where people normally sleep	Background +5 (if <70 dBA) Background +3 (if > 70 dBA)	80 80
Commercial Spaces	None	None
Industrial Spaces	None	None

Notes:
1. Noise from impact equipment is exempt from the Leq requirement, however, is subject to a lot-line Lmax limit of 90 dBA.
2. All measurements will be taken at the affective lot-line in accordance to what is stated herein.
3. Noise level limits are averaged over 20-minute intervals.
4. Lmax noise level limits are the maximum noise level that occurs over a 20-minute period.

3.05 EQUIPMENT NOISE CERTIFICATION

A. Requirements for Construction Equipment:

1. Ensure the Contractor and subcontractor construction equipment used in the Work area is tested for compliance with state noise emission limits during the first day of use on the Project, with compliance data provided to the Construction Manager for review.

2. Retest equipment at six-month intervals while in use in the Work Area and certify new equipment before being placed into service at the Work area.

3. For each piece of equipment used, provide an Application for Certificate of Equipment Noise Compliance. Ensure that the equipment identification number used for the Certificates is consistent with the identification number used in the Noise Monitoring Plan. Do not use equipment onsite without valid Certificates of Noise Compliance. The Certificates at a minimum shall have the following information:
   a. Contractor Name
   b. Contract name and number
   c. Equipment type, manufacturer, and model number
   d. Identification number
   e. Rated power & capacity
   f. Operating condition during test
   g. Measured noise level at 20 to 50 feet from equipment on both the left and right sides
   h. Maximum allowable noise level for equipment based on FHWA-HEP-06- 02.
   i. Authorized signature from the Contractor.

B. Test Procedures for Construction Equipment:

1. Operate engine-powered equipment by Contractor at maximum governed rpm under full load conditions during tests.
2. Test portable and mounted impact hammers, such as hoes rams, jackhammers, to be used for concrete breaking, during first day of actual operation at the Work area under maximum load conditions as rated by the equipment manufacture.
3. Noise Certification Measurement: Use an acoustic calibrator of the type recommended by the sound level meter manufacturer before measurements.
4. As specified herein, take measures at two locations: two from the right and left sides of the equipment, at a distance of 50 feet and a height of five feet above ground level, with equipment operating at maximum governed rpm under full load conditions for a minimum period of one minute. Reduce noise measurements made at less than 50 feet, due to space limitations at test location by the values in the following Table 02 32 14-2:

Table 02314-2: Adjustments for Close-In Equipment Noise Measurements

Distance (feet)	Measured Values to be Subtracted from Measured Noise Level to Estimate Sound Level at 50 feet (dBA)
19-21	8
22-23	7
24-26	6
27-29	5
30-33	4
34-37	3
38-42	2
43-47	1
48-50	0

C. Noise Certificate Compliance:

1. Complete and maintain a noise report for each piece of equipment used with certification that the equipment noise emissions does not exceed those prescribed in FHWA-HEP-06-02.
2. If noise levels obtained during tests exceed those specified in FHWA-HEP-06- 02, remove such equipment from use until equipment is modified and retested, or substitute other equipment to meet the noise level requirements.
3. Equipment will be subject to spot noise level testing at the Construction Manager's discretion to determine that the equipment in use meets the requirements specified herein.

3.06 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01770.

- END OF SECTION -

SECTION 02369 STEEL SHEET PILING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnish and install steel sheet piling, complete with bracing, tiebacks wales, and other incidentals required for a complete system as shown on the Drawings. Sheet piling where shown is mandatory for this project. The Contractor assumes responsibility for any excavation support needed to allow construction regardless of whether system is shown on the drawings.

B. Contractor shall consider the possibility of encountering hard rock materials during sheet piling installation. No additional payment will be made for installation of sheet piling through hard rock materials.

1.02 QUALITY ASSURANCE

A. Unless otherwise indicated, all workmanship and practices shall be in accordance with ASTM A328. Welding shall conform to AWS DI.1 Structural Welding Code. Steel for sheet piling shall conform to ASTM A572 Grade 50. Protective tape for tie rods (if required) shall conform to F.S. L-T-1512A and Military Spec. MIL, 1-631D and AM5.

DESIGN

A. Sheet piling design for seawalls shall be as shown on the Drawings.

1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings specifying the following:

- Sheeting type and manufacturer data sheet, layout (including but not limited to termination details, and orientation to North), pipe penetrations, connection details, special corner piles (for turns) and elevations.
- Overhead obstructions such as powerlines shall be clearly indicated and clearances from such obstructions shall be followed per local regulations.
- Coating for piles per Specification 09900 – Painting.
- Driving guide, falsework, sequence of construction, driving equipment including pile hammer, power plant, leads, and cushion material and helmet.
- Steel mill reports, certifying the ASTM designation of the material.
- Connection details and dimensions of the wales and struts to be installed under this Contract, if applicable.

1.05 DESIGN CRITERIA

A. The layout of the sheeting shall not be changed without the written permission of the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sheet Piling: Sheet pile material and section shall be as shown on the drawings. Sheet piles shall be Z-shaped, hot-rolled and with Larssen interlocks. The sheet pile shall have a minimum thickness of 3/8-inch and be continuously interlocked throughout their entire length. Piling shall conform to ASTM A572 with a minimum yield strength of 50,000 psi.

B. Corner Piles (Connection Knuckles): Special corner piles (connection knuckles) shall be furnished from the manufacturer and installed where there are turns in the sheet pile wall which are beyond the allowable turn for standard sheet pile. The standard sheet pile shall not be turned at an angle greater than what is allowable by the manufacturer.

PART 3 - EXECUTION

3.01 PLACING PILES

A. Carefully locate piling as shown on the approved Contractor submittals. Place piles in a plumb position with each pile interlocked with adjoining piles for its entire length, so as to form a continuous diaphragm throughout the length of each run of wall. Place all piles as true to line as possible and provide suitable temporary wales or guide structures to ensure that the piles are driven to correct alignment.

3.02 DRIVING PILES

A. Driving: Drive all piles to the elevation required and extend to the elevation indicated for the top of piles. A tolerance of +/- ½-inch top elevation will be permitted. Drive piles by approved methods in such manner as not to subject the piles to serious damage and to ensure proper methods throughout the length of the piles. Pile hammers shall be maintained in proper alignment during driving operations by use of suitable leads or by guides attached to the hammer. A protecting cap shall be employed in driving to prevent damage to the top of piles. Adequate precautions shall be taken to ensure that piles are driven plumb. If at any time the forward or leading edge of the piling is found to be out of plumb in the plane of the wall, the piles already assembled and partly driven shall be removed to the first plumb pile, and the Contractor shall take corrective measures to ensure the plumbness upon installation. Each run of piling shall be driven to grade progressively from the start and no pile shall be driven to a lower grade than those behind it in the same run except when the piles behind it cannot be driven deeper. If the pile next to the one being driven tends to follow below final grade it may be pinned to the next adjacent pile. Should obstructions render it impracticable to drive a pile to the specified penetration, the Contractor shall make such changes in design alignment of the pile structure as may be deemed necessary by the City's representative to ensure the adequacy and stability of the structure. Piles driven out of interlock with adjacent piles or otherwise damaged shall be removed and replaced by new pile at the Contractor's expense. If the Contractor encounters difficulty driving the sheet piling to

the specified tip elevation, he shall provide driving shoes for sheets and/or pre-auger and backfill with concrete in order to obtain the specified tip elevation. No additional payment will be made for driving shoes, auguring and backfill with concrete or spudding.

B. Pile Hammer: Select and use a vibratory type hammer which has sufficient weight and energy to suitably install the specified pile, without damage, into the soils as indicated on the Drawings.

C. Driving Shoes: The Contractor will be permitted to provide hardened cast steel shoes which fully support the pipe pile and sheet pile tips for driving. Driving shoes shall be installed according to manufacturer's recommendations.

3.03 SETTLEMENT MONITORING, VIBRATION MONITORING AND MITIGATION

A. The work required under this section does not modify the requirements or responsibilities for the preservation of existing property from damage. The Contractor shall evaluate the need for, design of and provide any necessary precautionary features to protect existing structures from damage. Employ construction methods that will not produce damaging vibrations, soil movement, soil loss, or instability of existing structures.

B. The Contractor will retain the services of a vibration monitoring and inspection consultant (VMC).

C. The Contractor shall, at his own expense and no cost to the CITY, implement settlement and vibration mitigation measures to prevent any damage to existing property.

D. Vibration monitoring shall comply with the requirements specified in Section 02314 – Vibration and Noise Monitoring.

E. Before starting work, the Contractor shall check and verify governing dimensions and elevations of the work to be performed. The VMC will provide a list of adjacent structures to be inspected prior to the work at the project. Inspections will be conducted within 100 feet of the piles being driven. Inspections will consist of interior and exterior written documentation and digital photographs of visible existing defects. A summary report will be prepared and retained by the ENGINEER, the City and copies provided to the Contractor. Individual copies of inspections will be provided to the property owners.

F. The Contractor shall survey adjacent structures and improvements, establishing exact elevations at fixed points to act as reference benchmarks. The Contractor shall clearly identify bench marks and record existing elevations. Datum level used to establish benchmark elevations shall be located at a sufficient distance so as not to be affected by movement resulting from sheet piling, excavation activities or other construction operations.

G. During pile driving or excavation, the Contractor shall resurvey benchmarks weekly, employing a licensed Land Surveyor or registered Professional Engineer. The Contractor shall maintain an accurate log of surveyed elevations for comparison with original elevations. The Contractor shall promptly notify the VMC if benchmark changes occur or if cracks, sags or other damage becomes evident nearby.

H. Vibration monitoring will be performed by the VMC at nearby structures when sheet piling work is ongoing. The Contractor shall facilitate full access to the site, as is required by the VMC, for them to perform monitoring. Vibration monitoring points will include structures within a radius deemed appropriate by the VMC from the locations of installation. If at any time the Contractor or VMC detects damage to any structure, the sheet piling shall be stopped immediately. If at any time settlement, heave or vibration exceeds the following values, sheet piling shall be stopped immediately, and a corrective mitigation plan shall be implemented in order to meet threshold values.

- Maximum allowable settlement of structures = 0.00833-feet (i.e. 0.10 inches)

- Maximum allowable peak particle vibration (PPV) level and maximum allowable vibration level shall be as specified in Section 02314 – Vibration and Noise Monitoring.

I. Written complaints or claims (Claims) by property owners for damage to property shall be responded to by the Contractor in writing within 10 calendar days of receiving the Claim. The response shall include acknowledgement of the Claim and a plan to work towards resolution. The Contractor shall submit a copy of the response to the VMC, for informational purposes only, within five (5) calendar days of receiving the Claim and prior to submitting the response to the property owner. The property shall be inspected by the Contractor and a follow-up response with proposed resolution shall occur within 30 days of receiving the Claim. The follow-up response shall be submitted to the VMC within 15 days of receiving the Claim, for informational purposes only.

3.04 NOISE ABATEMENT LAWS, MONITORING AND MITIGATION

A. The Contractor shall establish, at his own expense, that the proposed method of sheet pile installation will meet all applicable local, state or federal noise abatement laws, by-laws, ordinances and regulation in effect.

B. The Contractor will choose and retain the services of a noise monitoring consultant (NMC).

C. The Contractor shall, at his own expense and no cost to the CITY, implement noise mitigation measures complying with the City of Fort Lauderdale Noise Control Ordinance Chapter 17 and Section 02314 – Vibration and Noise Monitoring. Noise levels monitored by the NMC shall be the basis for review of construction activity and determined compliance. The contractor will be provided daily summary reports of the noise levels measured to allow ongoing noise compliance.

D. Noise monitoring will be performed when sheet piling work is ongoing. The Contractor shall facilitate full access to the site, as is required by the NMC, for them to perform monitoring. If at any time levels exceed values established by applicable local, state or federal noise abatement laws, by-laws, ordinances or regulation in effect, or specified in Section 02314 – Vibration and Noise Monitoring, sheet piling shall be stopped immediately, and a corrective mitigation plan shall be implemented in order to meet such values.

E. Written complaints or claims (Claims) regarding noise shall be responded to by the Contractor in writing within five (5) calendar days of receiving the Claim. The response shall include acknowledgement of the Claim. The response shall also contain either proof of compliance, a proposed resolution or a plan to work towards a resolution. The Contractor shall submit the response to the NMC, for informational purposes only, within three (3) calendar days of receiving the Claim and prior to submitting the response to the Claim. A follow-up response with a proposed resolution shall occur within 15 days of receiving the Claim, if either proof of compliance or a resolution has not been proposed initially. The follow-up response shall be submitted to the NMC within seven (7) days of receiving the Claim, for informational purposes only.

- END OF SECTION -

SECTION 02371 GEOTEXTILES

PART 1 – GENERAL

1.01 DEFINITIONS

A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.

B. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile furnished.

C. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile furnished.

D. Nondestructive Sample: Sample representative of finished Work, prepared for testing without destruction of Work.

E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.

F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D4884.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Deliver each roll with sufficient information attached to identify it for inventory and quality control.

B. Handle products in manner that maintains undamaged condition.

C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

PART 2 – PRODUCTS

2.01 SUBMITTALS

A. Submittals shall be in accordance with Section 01300 – Submittals.

2.02 NONWOVEN GEOTEXTILE

A. Pervious sheet of polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other. Nonwoven geotextile shall be composed of continuous or discontinuous (staple) fibers held together through needle-punching, spun-bonding, thermal-bonding, or resin-bonding.

B. Geotextile Edges: Selvaged or otherwise finished to prevent outer material from pulling away from geotextile.

C. Unseamed Sheet Width: Minimum 6 feet.

D. Physical Properties: Conform to requirements in Table No. 1.

TABLE NO 1 PHYSICAL PROPERTY REQUIREMENTS FOR NONWOVEN GEOTEXTILE		
Property	**Requirement**	**Test Method**
Water Permittivity	14 $sec.^{-1}$, MinARV	ASTM D4491 (Falling Head)
Air Permeability	200 cf/min/sq ft, MinARV	ASTM D737
Transmissivity, Planar Waterflow/Siphonage	0.5 ft^2/sec., MinARV	ASTM D4716
Apparent Opening Size (AOS)	30 U.S. Standard Sieve Size	ASTM D4751
Grab Tensile Strength, Machine Direction	400 lb/in, MinARV	ASTM D4632
Grab Elongation, Machine Direction	50 percent, MaxARV	
Puncture Strength	400 lb, MinARV	ASTM D4833
Trapezoid Tear Strength	400 lb, MinARV	ASTM D4533
Abrasion Resistance	20 percent loss, 250 cycles, MaxARV	ASTM D4886
Ultraviolet Radiation Resistance	80 percent strength retention, MinARV after 500 hours	ASTM D4355

PART 3 – EXECUTION

3.01 LAYING GEOTEXTILE

A. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

3.02 SHEET ORIENTATION FOR SUBSURFACE DRAINAGE

A. Orient geotextile in the trench with the long dimension parallel to the trench.

B. The filter material shall not be dropped on the geotextile from heights greater than 3 feet.

3.03 JOINTS

A. Unseamed Joints:

1. Overlapped.
2. Overlap, unless otherwise shown:
   a. Foundation/Subgrade Stabilization: Minimum 18 inches.
   b. Riprap: Minimum 18 inches.
   c. Other Applications: Minimum 12 inches.

3.04 INSTALLING GEOTEXTILE IN TRENCHES

A. Place geotextile in a way that will completely envelope granular drain material to be placed in trench and with specified overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.

B. After granular drain material is placed to required grade, fold geotextile over top of granular drain material, unless otherwise shown. Maintain overlap until overlying fill or backfill is placed.

3.05 REPAIRING GEOTEXTILE

A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile.

B. Repair Procedure:

1. Place patch of undamaged geotextile over damaged area and at least 18 inches in all directions beyond damaged area.
2. Remove interfering material as necessary to expose damaged geotextile for repair.
3. Sew patches or secure them with heat fusion tacking or with pins and washers, as specified above in Article SECURING GEOTEXTILE, or by other means approved by Engineer.

3.06 REPLACING CONTAMINATED GEOTEXTILE

A. Protect geotextile from contamination that would interfere, in Engineer's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

- END OF SECTION -

SECTION 02481 TREE RELOCATION AND PROTECTION

PART 1 – GENERAL

1.01 WORK TO BE PERFORMED AND WORK INCLUDED

A. Prepare and relocate trees and palms required for relocation within the project boundaries, to include all aspects of preparation, relocation, protection, and maintenance.

B. Protection and care of existing trees and palms to remain within the project boundaries, to include all aspects of protection, pruning, fertilization, and watering.

C. Watering by water truck.

D. Follow up maintenance as required by these Specifications.

E. Labor, materials, equipment, and services to complete all preparation, relocations and protection work as shown on the Drawings, as specified herein, or both.

1.02 SUBMITTALS

A. Copy of all permits submitted for tree relocations.

B. The Contractor shall utilize the services of a Licensed Landscape Architect or Certified Arborist for preparation of tree disposition plans, tree removal permits, tree relocation permits, and all required supporting documentation.

C. Verification of Qualifications: The Contractor shall provide a list of references and project list of a minimum of five (5) projects that the Contractor has successfully completed that are similar in scope and nature.

D. List of all equipment to be utilized during tree preparation and transplanting.

E. Literature on specified wetting agents, fertilizers, and soil conditioners.

1.03 APPLICABLE STANDARDS AND SPECIFICATIONS

A. Comply with the following standards and specifications for all materials, methods, and workmanship unless otherwise noted:

1. Codes and Standards of the American Association of Nurserymen.
2. Codes and Standards of the National Arborists Association.
3. Codes and Standards of the International Society of Arboriculturists.

1.04 PERMITS

A. The Contractor shall secure any permits required, including tree removal and tree relocation permits, in order to complete the work under this Section. Cost of permit fees associated with tree removals and/or relocations shall be paid for under the “Permits Allowance” bid item.

1.05 DESCRIPTION

A. Trees to be relocated within the project area will be specifically designated in the field as project work progresses or as noted in the drawings.

B. Existing trees to be relocated shall be crown pruned and be treated with soil amendments prior to relocation.

C. Existing trees to be relocated or to remain shall be protected with barricades during construction. Trees or shrubs to remain which are scarred or destroyed shall be replaced at the direction of the City Forester with the same species, size, and quality at no cost to the City.

D. Tree pits resulting from relocated material shall be backfilled with clean fill and brought flush with surrounding grade.

1.06 GUARANTEES

A. The Contractor shall guarantee his work in the following way:

1. Any tree or palm that dies or is deemed in unacceptable condition for one year following final project acceptance shall be removed by the Contractor, including root ball, and backfilling of pit, at no cost to the City.
2. The Contractor shall provide a comparable specimen at no additional cost to the City.
3. The guarantee shall be enforced if it is deemed by the City Forester that tree mortality or decline is a product of negligence by the Contractor.

PART 2 – MATERIALS

2.01 SOIL AMENDMENTS

A. Root stimulant shall be Roots Biostimulant, concentrate or powder, as manufactured by LISA Products Corp., (305) 797-6801, or City-approved equal. Stimulant shall be applied either as a wash, or by injection, mixed per manufacturer's recommendation.

B. Soil conditioner shall be Lesco Wet, as manufactured by Lesco, Inc. or NoburN, as manufactured by Roots or City-approved equal.

C. Minor element liquid fertilizer mix shall be Micro Mix liquid as produced by Lesco, Inc., or equal; to be diluted at a rate of 1 gallon per 100 gallons of water and applied at a rate of 50 gallons per 1,000 square feet of canopy, or Iron Roots, applied per manufacturer's instructions.

D. Time Release Fertilizer tablets shall be Agriform, 15 grams, designation 8-8-8; or approved equal.

2.02 EQUIPMENT

A. Soil amendments shall be injected into the soil by means of a spray apparatus utilizing mechanical agitation to keep powdered amendments suspended.

B. Root pruning equipment shall be designed for this task, and shall produce clean cuts of roots without damage to the resulting root ball.

C. Relocation equipment shall be capable of lifting and transporting trees without damage.

2.03 SOIL

A. Soil to be placed once trees or palms are transplanted shall meet the requirements specified in the Contract Documents.

2.04 WATER

A. Water shall be clean and potable.

2.05 MULCH

A. Grade A Eucalyptus mulch, free of viable weed seeds.

2.06 BRACING AND STAKES

A. All bracing and stakes shall be pressure treated pine. Compression bands shall be stainless steel.

PART 3 – EXECUTION

3.01 EXCAVATING NEAR EXISTING TREES

A. Maintain a minimum 6-foot clearance from all tree trucks except palm trees.

B. Use a 24-inch minimum depth saw cut in pavement or dirt/gravel roadway before start of excavation in areas where there are large trees close to the construction area. No coating application is required after saw cutting roots.

3.02 PREPARATION FOR RELOCATION OF TREES AND PALMS WITHIN THE PROJECT BOUNDARIES

A. Crown Pruning: All trees and palms shall be crown pruned prior to relocation.

1. Broadleaf Trees:
   a. All trees are to be trimmed by thinning the crown only, and not by reducing crown dimensions. Trim to conform to NAA Standards, including removal of dead wood.
   b. Repair any existing injuries to trees including cavities and machinery marks.
2. Palms:
   a. Remove all fruits and seed pods, and all but the seven (7) youngest fronds.
   b. Tie all remaining fronds with untreated cotton twine or burlap straps.

B. Fertilization and Watering:

1. Preparation: Clear the root ball area of all foreign material, trash, etc., to expose undisturbed soil.
2. Application/Schedule:
   a. Trees shall be deep injection fertilized a minimum of 14 days prior to relocation. Specified liquid fertilizer shall be used and applied at the concentration and application rates stated herein.
   b. Mix wetting agent, biostimulant, and minor element mix to produce a single fluid with each component included at the specified concentration. Inject into the root zone within the limits of proposed root ball at the rate of 50 gallons fluid per 1,000 square feet of tree canopy,

using only approved spray equipment.

c. Form an earth berm 6 inches high outside the proposed root ball prior to watering. Water application shall saturate the root ball to its entire depth.

C. Root Pruning:

1. Technique:
   a. All trees shall be excavated by digging a trench a minimum of 36 inches deep by 6 inches wide, either by hand or with a trenching machine designed for this purpose. Provide continuous trenching around the tree or palm at a minimum distance of 30 inches from the trunk. Hand cut broadleaf tree roots after trenching to produce clean cuts with no splits or tears.
   b. Barricades: Barricade all root pruned trees and palms at outside of soil berm with minimum 4-foot chain link fence or other barricade approved by the City.
   c. Timing:
      1) All oaks to be relocated shall be maintained for a minimum of 10 weeks after root pruning prior to relocation.
      2) Palms shall be maintained a minimum of 4 weeks prior to relocation.

3.03 RELOCATION OF TREES AND PALMS

A. General: Trees to be relocated shall be as directed by the Engineer.

B. Preparation:

1. Trees and palms shall be injected with soil amendments a minimum of 14 days prior to relocation. Apply at manufacturer's recommended concentration and application rates.
2. Trees and palms shall be thoroughly soaked to the full depth of the root ball daily for seven (7) consecutive days prior to relocation.
3. Accurately locate position and elevation where all trees are intended to be planted, for verification by City Forester. Verify that no overhead or underground utilities, existing or proposed, conflict with proposed locations.
4. Ascertain that all proposed paths for machinery are clear of utilities and other obstructions.

C. Excavation of Tree Pits: Dig all pits with vertical sides and flat bottom. Existing soil may be utilized as backfill as directed by the City Forester. All Tree Pits to be lined with root barrier adjacent to roadways and sidewalks as directed by City.

D. Digging and Handling - Broadleaf Trees:

1. Notify City 2 business days in advance of each relocation to allow for observation of procedures.
2. Determine line of previous root pruning and excavate around root mass to leave area 12 inches out from line of root pruning undisturbed. Digging shall be accomplished so as to produce clean cuts on all roots without tearing or splitting. Trenching shall be a minimum of 36 inches deep.
3. Trees are to be handled in such a way as to avoid damage to bark and limbs subject to support cables or chains. Attach padded support cables or chains at multiple points where possible. Alternatively, tree trunks may be drilled and doweled for broadleaf trees. The City Forester reserves the right to require doweling in lieu of lifting by straps.
4. Root balls are to be undercut prior to lifting. Do not force tree from ground prior to undercutting. Ball depth to be determined upon assessing conditions at time of trenching, to keep intact the entire root ball.
5. Trees shall be properly wrapped during moving so trunks will not be scarred and damaged and to avoid broken limbs. Broken limbs or scarred trunks shall cause tree to be unacceptable and

rejected at the City's option. Broken limbs and wounds which do not (in the judgment of the City Forester) cause the tree to be rejected shall be cleanly cut.

6. Transport plant material on vehicles of adequate size to prevent overcrowding, broken limbs, foliage damage or root ball damage.
7. Root balls and foliage shall be kept moist during all phases of relocation.
8. Partially backfill tree pits with 12 inches of approved planting soil prior to setting tree. This layer of soil to be thoroughly drenched prior to relocation to achieve a stable platform at the correct elevation so that the top of rootball is 1 inch above proposed grade.
9. Rotate tree prior to setting to achieve best positioning relative to adjacent trees and viewing angles.

E. Backfilling:

1. Flood bottom soil layer to settle tree into best position and to remove air pockets.
2. Continue to flood root ball as planting soil is deposited to ensure removal of all air pockets.
3. Create a saucer to retain water.

F. Bracing:

1. Support tree with machinery until bracing is complete.
2. Buttresses may support separate trunks on multiple trunk trees.
3. Maintain braces until completion of project. Removal of braces shall be by others.

G. Watering: Relocated trees shall by watered using water-truck. Watering schedule shall be once per day for first six weeks; followed by three times per week for following six weeks.

- END OF SECTION -

SECTION 02535 STRUCTURES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

1.03 WORK INCLUDED

A. The work covered by this section shall include the furnishing of all labor, equipment, services, materials, products and tests to perform all operations in connection with the construction of all structures as shown on the plans, defined in these specifications and subject to the terms and conditions of this contract, including, but not limited to, manhole, catch basins, and inlets.

1.04 SUBMITTALS

A. The Contractor shall furnish the Engineer shop drawings of the precast manhole for approval. Shop drawings should illustrate all dimensions, reinforcements and specifications for the complete manual.

PART 2 – PRODUCTS

2.01 MORTAR

A. Mortar for use in constructing and plastering sewer structures shall conform to ASTM C-270, "Specifications for Mortar for Unit Masonry". A Portland cement-hydrated lime mixture or a masonry cement may be used provided that the same materials are used throughout the project.

B. Mortar materials shall be proportioned by volume and shall consist of one part Type II Portland Cement to two parts aggregate (sand). Portland Cement shall conform to ASTM C-150, "Specifications for Portland Cement". Aggregate shall conform to ASTM C-144, "Specifications for Aggregate for Masonry Units."

2.02 PRECAST CONCRETE MANHOLE

A. Precast manhole sections shall conform to the plans or ASTM C-478, Specifications for Precast Reinforced Concrete Manhole Sections as modified thereto whichever is more restrictive. Concrete shall attain a minimum compressive strength of 4,000 psi at 28 days. Minimum wall thickness shall be eight (8”) inches. All manholes shall be designed and manufactured for a minimum H-20 traffic loading.

B. Unless otherwise specified on the plans, all joints shall be made with neoprene or rubber "O" ring compression joints; mastic joint sealing compound, or approved equal. After assembly, all joints shall be filled with mortar and pointed to provide a smooth surface without joint voids.

C. The base and walls that compose the bottom section of precast manhole shall be of monolithic construction, minimum 8 inches thick, and the edge of the base slab shall project a minimum 4 inches beyond the outside diameter of the wall.

D. Holes for piping shall be 6 inches larger than the outside diameter of the respective pipe. After the pipe is set, the void space between the pipe and the hole perimeter shall be completely filled with non-shrinking, quick-setting, waterproof cement mortar and struck smooth.

E. The minimum height of precast base section shall be 36 inches from the bottom of the base slab; however, no holes for piping shall be cast less than 8 inches from the top of the base section or less than 2 inches from the top of the base slab.

2.03 ENDWALLS, CATCH BASINS, INLETS AND JUNCTIONS BOXES

A. Endwalls, catch basins, inlets and junction boxes shall be constructed at the locations shown and to the dimensions indicated on site plans. Unless otherwise specified on the plans, inlets, junction boxes, catch basins, and similar structures may be constructed of brick, concrete block, poured concrete or precast concrete. Precast catch basins shall conform to latest A.C.I. and P.C.A. specifications. Concrete shall have not less than 4,000 psi compressive strength at 28 days. Minimum wall thickness shall be six (6”) inches. All structures shall be designed and manufactured for a minimum H-20 traffic loading.

B. Unless otherwise specified on the plans, all concrete for these structures shall be Class I concrete as specified in the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction", latest revision, Section 345. Mortar for use in constructing and plastering shall be as previously set forth in this section.

C. Brick shall be solid hard-burned clay conforming to ASTM Serial C-32-93, Grade SM. Concrete brick shall conform to ASTM Serial C-55-75, Grade P-I. Concrete block shall conform to ASTM Serial C-90-78, Grade PI.

D. All brick or concrete block structures covered in this Section shall be plastered inside and outside with 1/2 inch of cement mortar. Inside surfaces shall be smooth and even.

E. Base slabs and walls of concrete structures shall be constructed in a continuous pour between expansion joints.

F. For each grate type inlet, two layers of Mirafi 140 fabric of "Poly Filter X" polypropylene material or approved equal, shall be sandwiched between 2 x 2 x 10/10 welded wire fabric cut to the grate size and attached to the underside of the grate. The sandwiched filter material shall be wired to the cross members of the grate each way on 4-inch centers. After inlet construction and the roadway construction is completed and the project site work (including landscaping) has been established, the filter material and fabric shall be removed with any retained silt or sand.

2.04 CASTINGS (INCLUDING FRAMES, COVERS AND GRATINGS)

A. Iron castings shall conform to ASTM A-48, "Specifications for Gray Iron Castings", and shall be Class 30. Frames and grates may be Class 20.

B. All castings shall be made of clean, even grain, tough grey cast iron. The castings shall be smooth, true to pattern and free from projections, san holes, warp and other defects. The horizontal surface of the frame cover seats and the under surface of the frame cover seat which rests upon the cover seat shall be machined. After machining, it shall not be possible to rock any after it has been seated

in any position in its associated frame. Machining shall be required only on those frames and covers intended for vehicular traffic.

C. Bearing surfaces between cast frames, covers and grates shall be machined and fitted together to assure a true and even fit. Within areas of vehicular traffic, the frames, covers and gratings shall be machined-ground so that irregularity of contact will be reduced to a minimum and will be rattle-proof.

D. All manhole covers shall be provided with concealed pick holes. Manufacturer's name and catalog number shall be cast on all frames, covers, grates, etc. Covers shall be lettered "Storm" "Storm Drain" or "Storm Sewer" or "Sanitary Sewer" as applicable and shall be plainly visible. The manhole frames and covers shall be flush with finished grade. Sanitary Sewer manhole covers shall bear the City logo as manufactured by US Foundry or approved equal.

E. Grates and covers for inlets shall be as shown on the plans, set to the grades indicated and conforming with the requirements of the castings described above. Grates shall be furnished complete with frames specifically constructed to provide full bearing at all points of contract.

PART 3 – EXECUTION

3.01 CHANNELS

A. Channels shall be accurately and smoothly formed in accordance with the plans. Channels shall be constructed of concrete with trowel finished surfaces. The upper surface of the manhole shall be sloped toward the channels as shown.

B. Drop pipe at sanitary sewer manhole shall be installed when the difference in elevation between the pipe invert and the invert at the center of the manhole exceeds two feet (2'), or where directed by the City. The drop manhole shall be built according to the plans and specifications.

C. After channels are formed and section joints are pointed, the interior of the manhole shall be painted with two coats of Koppers Bitumastic 300-M (7 mils per coat) or approved equal. The exterior shall be painted in a similar manner, if required by local regulations.

3.02 CONCRETE GRADE RINGS

A. All concrete grade rings shall meet ASTM C478 and shall be a minimum 4,000 psi @ 28 days. Concrete grade rings shall be a minimum thickness of 2 inches and a maximum thickness of 6 inches. No more than 8 inches of concrete grade rings shall be installed on one manhole. Concrete grade rings shall be laid in mortar and all joints shall be finished smooth and not be less than ¼ inch or more than ½ inch in thickness. Concrete grade rings shall be painted with two coats of Koppers Bitumastic 300-M (7 mils per coat) or approved equal.

3.03 MANHOLE AND STRUCTURES

A. All joints shall be finished water tight, all openings for sewers, frames, etc., in precast manhole and catch basins shall be cast at time of manufacture. Spaces around all piping entering or leaving manhole shall be completely filled with Embeco mortar or equal.

B. All manhole shall be set plumb to line and grade and shall rest on a firm carefully graded subgrade which shall provide uniform bearing under base.

C. Grout for manhole bottoms shall consist of broken block, brick and 2:1 cement mortar.

3.04 CLEANING AND MAINTENANCE

A. All structures shall be cleaned and maintained in workable condition until accepted by the City.

- END OF SECTION -

SECTION 02575 SURFACE RESTORATION

PART 1 – GENERAL

1.01 STANDARD SPECIFICATIONS

A. When referenced in this Section, Standard Specifications shall mean Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition.

1.02 INTENT

A. Specific surface restoration requirements are detailed in this and other sections.

B. For pipeline projects, the intent of these Specifications and the criteria of the Measurement and Payment Section is that the roadway, adjacent Right-of-Way, and properties affected by construction activity shall be returned to their pre-existing condition, unless otherwise indicated by these Contract Documents.

1. For pipelines constructed in the Right-of-Way between the sidewalk and edge of pavement, the ground surface will be graded into a swale as shown on the Drawings and provided with sod.

    a. St. Augustine “Floritam” sod will be used for areas with irrigation systems and in locations with similar, existing turf.

    b. Seashore Paspalum sod will be used in areas prone to salt water flooding, Driveways and sidewalks will be replaced in kind, using similar materials of construction.

2. Trees, shrubs, and personal property (e.g., mailboxes) located in the swale area shall be relocated or replaced in kind, in accordance with the provisions of the Contract Documents.

C. For work areas disturbed by the Contractor for convenience, the area affected shall be restored in kind.

1. The costs of this restoration shall be incidental to the cost of the Work.

2. Payment for restoration outside the limits of work shall be repaired at the Contractor’s expense.

1.03 WORK INCLUDED

A. This Section covers the Work necessary to replace all pavement, pavers, curbs, sidewalks, rock surfacing, vegetation, and other street features damaged either directly or indirectly by the operations incidental to the construction described in other sections of the Contract Documents.

B. Where the materials, construction procedures, degree of compaction of materials, and the method of control and testing, as required in the Contract Documents differ from the Standard Specifications requirements, the more stringent requirements shall apply.

C. The intent of the Drawings is to provide a full lane, permanent trench repair for all work crossing or running parallel with roadways. Temporary restoration to provide a passable surface is also required.

D. Overlay of asphalt pavement may be required as shown on the Drawings.

E. Provide finished gradation and grassing in accordance with the Contract Documents.

1.04 OPTIMUM MOISTURE CONTENT

A. "Optimum moisture content" shall be determined by the ASTM standard specified to determine the maximum dry density for relative compaction.

1.05 TEMPORARY TRENCH REPAIR OR STABILIZATION

A. Following pipe installation and prior to permanent trench repair or asphalt replacement, temporary trench repair will be defined as one of the following:

1. Installation of flowable fill as described in this Section and the Contract Documents.

2. Installation of the compacted base course and an asphalt prime coat as described in this Section and the Contract Documents.

B. Temporary trench repair shall be maintained in accordance with the requirements of this Section and the Contract Documents until the final trench repair or asphalt surface is installed to provide a dust-free, drivable, and safe roadway surface.

1.06 STANDARDS

A. AASHTO T180: Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. ASTM A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

C. FM 5-509: Florida Method of Test for Measurement of Pavement Smoothness With the 15-Foot Rolling and Manual Straightedges

PART 2 – MATERIALS

2.01 GENERAL

A. All materials for replacement of existing base course and asphalt surfacing shall conform to the Standard Specifications except as modified herein.

B. The Contractor will be responsible for furnishing satisfactory materials that meet the specifications of the Contract Documents and shall provide such tests during the course of the Work as are necessary to assure that the quality of the material used meets the specifications of the Contract Documents.

2.02 LIME ROCK BASE COURSE

A. Aggregate quality and gradation shall meet the requirements of the Standard Specifications.

2.03 BITUMINOUS PRIME AND TACK COAT

A. Prime Coat: Material shall be cutback asphalt, Grade RC-70 or RC-250 meeting the requirements of the Standard Specifications, or approved equal.

B. Tack Coat: Material shall be emulsified asphalt, Grade RS-2, SS-1, or SS-1H meeting the requirements of the Standard Specifications.

C. Tack coats used for temporary trench stabilization shall be sanded to prevent damage to vehicles.

2.04 ASPHALT CONCRETE

A. The asphalt concrete for trench leveling, restoration and overlay shall be Type SP-9.5, meeting the requirements of the Standard Specifications and the Contract Documents.

B. Aggregate: The aggregate shall meet the requirements of the Standard Specifications.

C. Submit test results from commercial testing laboratories to the City to show that the materials meet the quality and gradation requirements.

2.05 CONCRETE PAVERS

A. Pavers shall be placed on approved restored base and subgrade with a 1” layer of bedding sand meeting the requirements of the Standard Specifications.

2.06 FLOWABLE FILL

A. Provide flowable fill with a mix design meeting the requirements of the (FDOT) Standard Specifications for excavatable, flowable fill. Flowable fill may be allowed as a substitute for compacted base upon approval of the Engineer, at no additional cost.

2.07 CONCRETE

A. Concrete shall be 3,000 psi minimum concrete meeting the requirements of the Standard Specifications.

B. Concrete Forms: All forms for curbs and sidewalks shall be either 2-inch dimensioned lumber, plywood, or metal forms. Forms on the face of the curb shall have no horizontal form joints within 7 inches of the top of the curb.

C. Curing Compound: Meeting the requirements of the Standard Specifications.

D. Reinforcing Steel: Conform to ASTM A615, Grade 60.

2.08 TRAFFIC MARKINGS

A. All traffic striping markings (i.e., lane, edge of pavement, directional, informational, etc.) damaged by the Contractor during construction shall be replaced with new markings meeting the requirements of the Broward County Traffic Engineering Division and the Standard Specifications.

B. Raised reflective pavement markers (rpm's) damaged by the Contractor during construction shall be replaced with new rpm's meeting the requirements of the Broward County Traffic Engineering Division and the Standard Specifications.

C. The Contractor shall place and maintain temporary striping markings throughout the course of the work until the permanent striping marking is placed on the final roadway surface.

D. The Contractor shall provide traffic stripping at all intersections including stop bars and crosswalks as required whether they are currently stripped or not. It shall be the Contractor's responsibility to take a complete inventory and provide the appropriate permanent stripping after the completion of the Work.

2.09 SWALE STABILIZATION

A. Materials used for stabilization of swale areas as indicated on the Drawings shall consist of suitable excess existing base material removed from trenching operations, if approved by the Engineer, crushed limerock, rock screenings, or other suitable material as approved by the Engineer.

1. Materials having a plasticity index of more than 10, or a liquid limit greater than 40 shall not be used.

2. Maximum dimension shall not exceed 1.5 inches.

PART 3 – EXECUTION

3.01 CONSTRUCTION PROCEDURE

A. The City reserves the right to vary the type of resurfacing as best serves the interest of the Owner. Trench backfill shall be as specified in the Contract Documents.

B. Replace all bituminous and concrete roadway pavement damaged or removed under this Contract with asphalt concrete regardless of original type. Pavement thickness shall be in accordance with the Drawings.

C. In addition to the requirements set forth herein, the work shall conform to the applicable workmanship requirements of the state and county highway or municipal specifications.

D. Water to control dust shall be used as directed by the City until the trench repair has been stabilized. If control of dust is inadequate by these means, the City may direct the immediate application of a prime or tack coat in accordance with the provisions of this Section, at no additional cost to the Owner. The City reserves the right to delay additional excavation activities until dust control measures are adequate.

E. Base course and prime coat shall be installed to provide temporary trench stabilization within 5 working days of trench backfill or as soon thereafter as the as-built conditions and pipe slopes have been verified.

F. Final, permanent trench repair, and paving shall be installed within 3 weeks of pipe verification and temporary trench stabilization, unless flowable fill is used for temporary trench repair, in accordance with the provisions of this Section.

3.02 REMOVAL OF PAVEMENT, SIDEWALK, CURBS, AND GUTTERS

A. Removal of all pavement, sidewalks, curbs, and gutters shall conform to the Contract Documents, and payment for removal shall be included in that Section of the Contract Documents. Payment for removal is incidental to the cost of pipe installation except where required for water and sewer service installation.

3.03 CUTTING EXISTING PAVEMENT

A. Where new pavement abuts existing pavement, the old pavement shall be trimmed by saw cutting to a straight line. Any pavement which has been damaged or which is broken and unsound shall be removed to provide a smooth, sound edge for joining new pavement.

3.04 STREET MAINTENANCE

A. Maintain all trenches as specified in this section and the Contract Documents.

3.05 CONSTRUCTION OF BASE COURSE

A. Base course shall be constructed in accordance with the City of Fort Lauderdale Standards and the Standard Specifications.

B. Compact base materials to a minimum of 98 percent of the maximum density as determined by AASHTO T180. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Engineer. Where the base is constructed in more than one course, the density shall be obtained in each lift.

C. Alternately, and with the approval of the Engineer, the Contractor shall provide a minimum 10 inches of excavatable, flowable fill. The flowable fill shall be placed up to 1 ½ inches from the top of the existing pavement or to the fill line without vibration or compaction. Flowable fill shall not be placed during periods of inclement weather and rainfall. Provide a means to confine the material within the designated space. Flowable fill installed in accordance with this provision shall comply with temporary pavement restoration provisions.

3.06 MILLING OR GRINDING OF EXISTING ASPHALT PAVEMENT

A. Milling of existing asphalt pavement shall meet the requirements of the Standard Specifications.

B. Milling shall be used to lower the grade of adjacent existing asphalt prior to trench repair to completely remove existing asphalt.

C. Milled and ground asphalt can be mixed for use with the limerock base course material.

3.07 BITUMINOUS PRIME AND TACK COAT

A. The bituminous prime coat shall be applied to the lime rock base immediately following the placement of the compacted base course. The prime coat shall be maintained with additional coats as determined by the City as temporary restoration until the final asphalt surface is installed. Additional prime coats will be provided at no cost to the Owner.

B. The lime rock base shall be hard planed with a blade grader immediately prior to the application of the prime coat.

C. The rate of application of the bituminous prime coat shall meet the requirements of the Standard Specifications.

D. The bituminous tack coat shall be applied to existing asphalt surfaces prior to the placement of new asphalt, between layers of asphalt concrete surface courses, surfaces of concrete footings that will come in contact with the asphalt concrete pavement, and vertical faces of all longitudinal and transverse joints that have become compacted or cooled.

E. The rate of application for the bituminous tack coat shall meet the requirements of the Standard Specifications.

3.08 ASPHALT CONCRETE PAVEMENT REPLACEMENT

A. Preparation for Paving:

1. A prime coat shall be applied over the full length of the roadway, and asphalt concrete pavement shall not be placed until the prime coat has cured as per the manufacturer's recommendations.

2. Should any holes, breaks, or irregularities develop in the roadway surface after the prime coat has been applied, they shall be patched with asphalt concrete immediately in advance of placing the asphalt concrete.

3. After the maintenance, patching, or repair work has been completed and immediately prior to placing the asphalt concrete pavement, the surface of the prime coat shall be swept clean of all dirt, dust, or other foreign matter.

B. The proposed pavement reconstruction schedule consists of immediately paving over trenches as soon as possible after it has been determined that subbase and base have achieved required compactions. The base course will be brought up to the elevations indicated on the Drawings and asphalt placed to bring grade up to match existing pavement elevations as shown on the Drawings.

C. For deep excavations where the pavement repair constitutes a full lane or roadway, workmanship shall conform to the standards and details of new road way construction.

1. Existing pavement more than 2 feet wide beyond the trench area shall be left in place and a full overlay applied to the limits of the existing road width.

2. Existing base beyond the trench area shall be left in place.

3. Full lane or width roadways shall have a consistent cross-section and straight edge of pavement delineation’s.

3.09 CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT OVERLAY – IF REQUIRED

A. The Contractor shall place a layer of tack coat at a rate of 0.05 to 0.12 gallon per square yard over all areas to receive asphalt concrete.

B. Lay asphalt concrete over all areas designated to be resurfaced. The asphalt concrete pavement overlay shall be placed in minimum 1-inch lift and maximum lift as shown in the Contract Documents. The method of proportioning, mixing, transporting, laying, processing, rolling the material, and the standards of workmanship shall meet the applicable requirements of the Standard Specifications. At no time shall the coarse aggregate segregated from the mix either from hand spreading or raking of joints be scattered across the paved mat. Such material shall be collected and disposed of.

C. The City will examine the prepared roadway before the paving is begun and bring any deficiencies to the Contractor’s attention to be corrected before the paving is started. Roll each lift of the asphalt concrete until roller marks are eliminated and compacted to 100 percent of the laboratory compacted mixture. The grade, line, and cross section of the finished surface shall conform to the Drawings. Asphalt or asphalt stains which are

noticeable upon surfaces of concrete or materials which will be exposed to view shall be promptly and completely removed.

3.10 ASPHALT CONCRETE PAVEMENT

A. Workmanship in producing, hauling, placing, compacting, and finishing asphalt concrete shall meet the applicable portions of the Standard Specifications.

3.11 CONNECTIONS WITH EXISTING FACILITIES

A. Where the bituminous pavement is to be connected with an existing roadway surface or other facility, the Contractor will be required to modify the existing roadway profile in such a manner as to produce a smooth riding connection to the existing facility. The Contractor shall meet existing neat lines where required.

B. Where it is necessary to remove existing asphalt surfaces or oil mat surfaces to provide proper meet lines and riding surfaces, the Contractor shall sawcut the existing surface so that there will be sufficient depth to provide a minimum of 1-inch of asphalt concrete, and the waste material shall be disposed of to the satisfaction of the Engineer. Prior to placing the asphalt concrete, these areas shall be tacked. Meet lines shall be straight and the edges vertical. The edges of meet line cuts shall be painted with liquid asphalt or emulsified asphalt prior to placing asphalt concrete. After placing the asphalt concrete, the meet line shall be sealed by painting with a liquid asphalt or emulsified asphalt and immediately covered with clean, dry sand.

3.12 CONSTRUCTION OF COURSES

A. The asphalt concrete pavement shall be constructed in one or more courses as shown on the Drawings.

B. Rolling shall continue until all roller marks are eliminated and compacted to 100 percent of the laboratory compacted mixture has been obtained.

3.13 SURFACE TOLERANCE

A. Tests for conformity with the specified grade shall be made by the Contractor immediately after initial compression. Any variation shall be immediately corrected by the removal or addition of materials and by continuous rolling.

B. The completed surface of the pavement shall be of uniform texture, smooth, uniform as to grade, and free from defects of all kinds. The completed surface shall not vary more than 1/8 inch from the lower edge of a 12-foot straightedge placed on the surface along the centerline or across the trench.

C. After completion of the final rolling, the smoothness and grade of the surface shall again be tested by the Contractor.

D. When deviations in excess of the above tolerances are found, the pavement surface shall be corrected as stated in the Standard Specifications.

E. All areas in which the surface of the completed pavement deviates more than twice the allowable tolerances described above shall be removed and replaced to the satisfaction of the Engineer.

F. All costs involved in making the corrections of defects described above shall be borne by the Contractor and no compensation will be made for this Work.

G. For all State of Florida jurisdictions roads, and other jurisdiction roads when required by the permit, test pavement smoothness via FM 5-509.

3.14 SAMPLES

A. If directed by the Engineer, the Contractor shall without additional charge, provide the City with test results of samples of asphalt concrete cut from the completed pavement or the individual courses thereof for each occurrence. Provide a minimum of three test cores located as directed by the Engineer. He shall also provide the City with test results of samples of the uncompressed asphalt concrete mixtures and all materials incorporated in the Work.

3.15 WEATHER CONDITIONS

A. Asphalt shall not be applied to wet material. Asphalt shall not be applied during rainfall or any imminent storms that might adversely affect the construction. The City will determine when surfaces and materials are dry enough to proceed with construction. Asphalt concrete shall not be placed during heavy rainfall or when the surface upon which it is to be placed is wet.

3.16 PROTECTION OF STRUCTURES AND ADJUSTMENT OF APPURTENANCES

A. Provide whatever protective coverings may be necessary to protect the exposed portions of bridges, culverts, curbs, gutters, posts, guard fences, road signs, and any other structures from splashing oil and asphalt from the paving operations. Remove any oil, asphalt, dirt, or any other undesirable matter that may come upon these structures by reason of the paving operations.

B. Where water valve boxes, manholes, catch basins, or other underground utility appurtenances are within the area to be surfaced, the Contractor shall adjust the tops of these facilities to conform with the proposed surface elevations. The Contractor shall notify the proper authority and either raise or lower the appurtenances or make arrangements with that authority for having the facilities altered at the Contractor's expense before proceeding with the resurfacing. The Contractor will be responsible for making certain that appurtenances are brought to proper grade to conform with finished surface elevations and any delays experienced from such obstructions will be considered as incidental to the paving operation. No additional payment will be made. Protect all covers during asphalt application. All adjustments shall be made in accordance with the requirements of the respective utility.

C. To extend manhole use grade rings as specified, do not use leveling rings. Remove the frame and cover, rebuild the manhole top to raise it so that the new height meets the overlay elevations and then replace the frame and cover in accordance with the Contract Documents.

3.17 EXCESS MATERIALS

A. Legally dispose of all excess materials. Make arrangements for the disposal and bear all costs or retain any profit incidental to such disposal.

3.18 CONTRACTOR'S RESPONSIBILITY

A. Settlement of replaced pavement over trenches within the warranty period shall be considered the result of improper or inadequate compaction of the subbase or base materials. The Contractor shall promptly repair all pavement deficiencies noted during the warranty period at the Contractor's sole expense.

3.19 SIDEWALKS AND CURBS

A. Replace concrete sidewalks and curbs to the same section width, depth, line, and grade as that removed or damaged or as shown on the Drawings. The minimum thickness of sidewalks shall be 6 inches. Cut ends of existing curb to a vertical plane. Prior to replacing the sections, properly backfill and compact the trench to prevent subsequent settlement.

B. Replace concrete sidewalks at scored joints and make replacement in a manner that will avoid a patched appearance. Provide a minimum 2-inch thick compacted leveling course of clean sand or gravel of quality hereinbefore specified. Finish concrete surface similar to the adjacent sidewalks. All curbs and all gutters shall have a minimum of 4” LBR 100 limerock “curb pad”.

3.20 DRIVEWAYS AND WALKS

A. Replace asphalt driveways and walks in accordance with Paragraph Asphalt Concrete Pavement Replacement.

B. Replace concrete and paver driveways in kind, using similar materials of construction. Concrete driveways shall consist of a reinforced, 6-inch section installed in accordance with the Contract Documents.

3.21 TRAFFIC STRIPES

A. All areas having traffic stripes prior to paving shall be restriped. Temporary traffic striping shall be applied immediately after asphalt pavement has been placed. Permanent traffic striping may be applied only after the proper curing time for the asphalt. Traffic stripes (temporary and permanent) shall meet the requirements of Broward County Traffic Engineering Division Standards and the Standard Specifications.

3.22 INSTALLATION OF RAISED REFLECTIVE PAVEMENT MARKERS

A. All areas having raised reflective pavement markers prior to paving shall have those markers replaced. Temporary pavement markers shall be applied immediately after asphalt pavement has been placed. Permanent pavement markers may be applied only after the proper curing time for the asphalt. Pavement markers and adhesive (temporary and permanent) shall meet the requirements of Broward County Traffic Engineering Division and the Standard Specifications.

B. Spacing: As shown in the Roadway and Traffic Design Standards for Design, Construction, Maintenance and Utility operations on the State Highway System by the State of Florida, Department of Transportation, current edition and the Broward County Traffic Engineering Division Standards.

3.23 PAVEMENT REPAIR

A. All damage to pavement as a result of work under this Contract shall be repaired in a manner satisfactory to the City and at no additional cost to the Owner. The repair shall include preparation of the subgrade, placing and compaction of the lime rock base and placement of the final asphalt surface as described in this Section.

B. The width of all repairs shall extend at least 12 inches beyond the limit of the damage with the edge of pavement left saw cut to a true edge with no irregularities. For county roads and City streets recently constructed or overlaid, the repair may be required to be full-lane width as shown on the Drawings.

3.24 SWALE RESTORATION

A. New or existing swale areas (areas between pavement edge and sidewalks, or right-of-way line if there is no existing or proposed sidewalk) shall be graded and reshaped to the cross section shown on the Drawings. Where storm inlets are present, the swale shall have a consistent longitudinal slope towards the inlet.

B. Swale areas with previously existing improved surfaces, including but not limited to asphalt, concrete, pavers, crushed or decorative rock, shall be restored in kind. Asphalt paved areas shall be constructed with a minimum 6-inch stabilized subbase and minimum 6-inch compacted limerock base, primed and topped with minimum 1-inch asphalt.

C. Swale areas with previously unimproved or turfed surfaces will be restored with soil stabilization where existing natural soil will not support vehicle loads normally imposed by movement and parking of heavy vehicles without rutting and shifting of soil. Subject to the approval of the Engineer, this work may be performed in connection with preparation of subgrade or construction of the limerock base course.

D. Swale areas with previously unimproved or turfed surfaces will be topped with sod. St. Augustine “Floritam” and two inches of topsoil shall be used in irrigated areas and where St. Augustine sod was previously established.

3.25 SWALE STABILIZATION

A. Where swale stabilization is required as indicated above, stabilization shall be achieved by the addition and mixing in of suitable stabilizing materials. It shall be incorporated into the existing swale soils by plowing, disking, harrowing, blading or mixing with rotary tillers or other appropriate equipment approved by the Engineer, until the mixed materials are of uniform bearing value throughout the width and at least 6-inch depth from the top of the swale after the swale is graded and shaped to the section indicated on the plans.

B. The swale areas shall be mixed and compacted to achieve a minimum average dry density of 90 percent throughout the 6-inch thickness, as determined by AASHTO T180. In the determination of such average, the minimum acceptable density shall be 85 percent and the maximum density which shall be used in calculations shall be 100 percent (if the tested density is reported above 100 percent).

C. Density tests for swale stabilization shall be made at intervals not less than one set of three per City block on each side of the roadway, or at increased intervals as directed by the City when required to measure small or isolated sections (except where such testing may be considered unnecessary by the Engineer). Each set of three shall be averaged as indicated above for determination of meeting the minimum requirements.

3.26 SPECIAL SWALE REPAIR

A. Certain swale areas (designated on Drawings) have longitudinal trench filled with ballast rock for drainage. If appropriate, a separate pay item applies for removal and reconstruction of ballast rock drainage damaged during installation of pipelines. All other aspects of restoration work in the swale will be paid for separately under the restoration item. Swale stabilization will not be required in those areas with ballast rock drainage.

3.27 BRICK OR PAVER RESTORATION

A. Remove and salvage bricks or paver materials to be disturbed by the work. Payment will be made in accordance with the unit price for these items.

B. Restore pavers and apron area shall be constructed as shown in the Drawings. Payment will be made in accordance with the unit price for these items.

C. Paver and apron areas shall be constructed as shown in the Drawings.

D. If brick and paver materials are damaged, new materials shall match or all materials within the crossing must be replaced at no additional cost. New materials shall be approved by the Owner.

END OF SECTION

SECTION 02630 STORM DRAIN FACILITIES

PART 1 – GENERAL

1.01 SUMMARY

A. Work under this section shall consist of providing all labor, plant facilities, materials, tools, equipment, shop drawings and supervision necessary and required to install all the storm drainage facilities, including piping, fittings, and structures, as specified in accordance with the contract documents.

1.02 WORK INCLUDED

A. Provide all labor, materials, necessary equipment and services to complete the Storm Drainage Facilities work, as indicated on the drawings, as specified herein or both, except as for items specifically indicated as "NIC ITEMS".

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):

1. A185 – Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
2. A615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
3. A760 – Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
4. A798 – Installation of Corrugated-Steel Pipe for Sewers and Other Applications
5. A929 – Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
6. C76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
7. C478 – Precast Reinforced Concrete Manhole Sections
8. C1479 – Installation of Reinforced Concrete Pipe
9. C990-01A – Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
10. D2321 – Installation of Thermoplastic Pipe for Sewer/Gravity-Flow Applications
11. D3034 – Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
12. D3212 – Joints for Drain and Sewer Plastic Pipes Using Elastomeric Seals
13. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe
14. F794 – Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
15. F949 – Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

B. American Association of State Highway and Transportation Officials (AASHTO):

1. M198 – Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
2. M252 – Corrugated Polyethylene Drainage Tubing
3. M274 – Aluminum-Coated (Type 2), for Corrugated Steel Pipe
4. M294 – Corrugated Polyehtylene Pipe. 12 to 14 inch Diameter
5. M36 – Metallic Coated Corrugated Steel Culverts and Underdrains
6. M190 – Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
7. M199 – Standard Specification for Precast Reinforced Concrete Manhole Sections

C. American Water Works Association (AWWA):

1. C110 – Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids (revision of ANSI/AWWA C110/A21.10-93)
2. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
3. C151 – Ductile-Iron Pipe, Centrifugally Cast, for Water

D. American Concrete Institute (ACI):

1. 301 – Structural Concrete for Buildings, Specifications for
2. 318 – Building Code Requirements for Structural Plain Concrete

1.04 EXISTING UTILITIES

A. Furnish temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, cables, etc., and other obstructions encountered in the progress of the work.

B. When the grade of alignment of the pipe is obstructed by existing utility structures, such as conduits, ducts, pipes, branch connections to water or sewer mains, and other obstructions, the obstructions shall be permanently supported, relocated, removed or reconstructed by the Contractor in cooperation with the owners of such structures. No deviation shall be made from the required line or grade except as directed in writing by the Engineer.

C. It shall be the responsibility of the Contractor to notify the owners of existing utilities in the area of construction a minimum of 48 hours prior to any excavation adjacent of such utilities, so that field locations of said utilities may be established.

D. Temporary relocation of existing utilities (to be removed) to accommodate installation of storm drain pipe shall be the responsibility of the Contractor and approved by the Engineer. No additional payment shall be made for temporary relocation of existing utilities and shall be considered part of the bid item for the pipe.

1.05 QUALITY ASSURANCE

A. All costs related to re-inspection due to failures shall be paid for by the Contractor at no additional expense to the City. City reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

PART 2 – PRODUCTS

2.01 REINFORCED CONCRETE PIPE (RCP)

A. Reinforced Concrete Pipe – ASTM C 76

1. Unless noted otherwise, all RCP pipe shall be in accordance with the requirements of “Reinforced Concrete Pipe – ASTM C 76”.
2. RCP shall be manufactured in accordance with ASTM C 76, Wall Type B or C, unless otherwise specified herein; and shall be minimum Type III, subject to recommendation from the pipe manufacturer based on project specific requirements unless noted otherwise in the Contract Documents. Minimum pipe laying lengths shall be four (4) feet. Portland cement shall conform to ASTM C 150, Type II.

3. Pipe shall have bell and spigot ends with O-ring rubber gaskets. The gaskets shall be smooth solid rubber of circular and uniform cross section conforming to ASTM C 43. The spigot end of the pipe shall contain a special groove or slot to receive and hold the gasket in position during the joint assembly. The complete joint shall be subjected to hydrostatic tests conforming to ASTM C 443.
4. All pipe and specials shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.

B. Reinforced Concrete Pipe – ASTM C361

1. Reinforced concrete low-head pressure pipe shall be manufactured in accordance with ASTM C361, and shall be minimum Type III, subject to recommendation from the pipe manufacturer based on project specific requirements unless noted otherwise in the Contract Documents. Minimum pipe laying lengths shall be twelve (12) feet.
2. Pipe shall have steel joint rings with O-ring rubber gaskets. The gaskets shall be smooth solid rubber of circular and uniform cross section and shall be confined in an annular space formed by shoulders on the bell and spigot or in a special groove in the spigot to receive and hold the gasket in position during the joint assembly. The complete joint shall be subjected to hydrostatic tests conforming to ASTM C361.
3. All pipe and specials shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.

C. Concrete Culvert And Drain Pipe

1. All reinforced concrete culvert and drain pipe shall be manufactured in accordance with ASTM C76, Wall Type B or C, and shall be of the class that equals or exceeds the pipe class as specified herein or as shown on the Contract Drawings. Minimum pipe laying lengths shall be four (4) feet. Testing shall be in accordance with FDOT Road and Bridge Manual (latest edition). Portland cement shall conform to ASTM C150, Type II.
2. Joints for the reinforced concrete culvert and drain pipe shall have bell and spigot ends with flexible plastic gaskets meeting the requirements of AASHTO M198, Type B.
3. All pipe shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.

2.02 CORRUGATED POLYPROPYLENE DRAINAGE PIPE

A. Corrugated Polypropylene Drainage Pipe shall comply with the requirements specified in the Section titled “Corrugated Polypropylene Drainage Pipe”.

PART 3 – EXECUTION

3.01 GENERAL

A. Contractor shall only use the pipe material as specified on the plans. Alternate materials will not be allowed unless approved by the Engineer in writing.

B. The Contractor shall install all drainage structures and pipe in the locations shown on the drawings and/or as approved by the City. Pipe shall be of the type and sizes specified on the drawings and shall be laid accurately to line and grade. Structures shall be accurately located and properly oriented.

C. Excavation and Backfilling for Utilities – The provisions of the Contract Documents for Excavation and Backfilling shall govern all work under this Section.

D. Storage and Handling of Pipe – All pipe shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe. Storage of pipe on the job shall be in accordance with the pipe manufacturer's recommendations.

E. Damage to Pipe

1. Pipe which is defective from any cause, including damage caused by handling, and determined by the City as unrepairable, shall be unacceptable for installation and shall be replaced at no cost to the City and as directed by the City; and,
2. Pipe that is damaged or disturbed through any cause prior to acceptance of the work, shall be repaired realigned or replaced as directed by the City, at the Contractor's expense.

F. Manholes, catch basins and drain inlets shall be constructed as soon as the pipe laying reaches the location of the structures. Should the Contractor continue his pipe laying without making provisions for completion of the structures, the City shall have the authority to stop the pipe laying operations until the structure is completed.

G. Any structure, which is mislocated or oriented improperly, shall be removed and re-built in its proper location, alignment and orientation at the Contractor's expense.

3.02 EXCAVATION AND BACKFILL

A. Excavation and backfill shall be as per the Section entitled "Excavation and Backfill for Utilities".

3.03 PIPE INSTALLATION

A. Laying Pipe

1. Unloading and Handling: All pipes shall be unloaded and handled with reasonable care. Pipes shall not be rolled or dragged over gravel or rock during handling. The Contractor shall take necessary precautions to ensure the method used in lifting or placing the pipe does not induce stress fatigue in the pipe and the lifting device used uniformly distributes the weight of the pipe along its axis or circumference.
2. Each length of pipe shall be inspected for defects and cracks before carefully lowered into the trench. Any damaged or any pipe that has had its grade disturbed after laying shall be removed and replaced. Bituminous coated pipe shall be handled with special care and repair of damaged coating shall conform with AASHTO M190.
3. Lay pipe on prepared foundation starting at the downgrade end according to line and grade with the necessary drainage structures, fittings, bends and appurtenances as shown on the drawings. Rigid pipes shall be laid with the bell or groove ends upgrade with the spigot or tongue fully inserted. Reinforced concrete pipe shall be installed in accordance with ASTM C1479.
4. Pipe sections shall be firmly joined together with appropriate gaskets or bands.
5. Pipe shall be protected during handling against impact shocks and free falls. Pipe shall be kept clean at all times and no pipe shall be used that does not conform to the Specifications.
6. The laying of the pipe shall be commenced at the lowest point with spigot ends pointing in the direction of flow. All pipe shall be laid with ends abutting and true to line and grade. They shall be laid in accordance with manufacturer's requirements as approved by the Engineer.
7. Pipe shall be laid accurately to the line and grade as designated on the plans. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be jointed, or of the factory made jointing material, shall be clean and dry. Lubricant, primers, adhesive, etc., shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined and adjusted in such a manner as to obtain a water tight line. As soon as possible after the joint is made, sufficient backfill material

shall be placed along each side of the pipe to prevent movement of pipe off line and grade.

8. The exposed ends of all pipe shall be suitably plugged to prevent earth, water, or other substances from entering the pipe when construction is not in progress.

3.04 CONCRETE ENCASEMENT OF DRAINAGE PIPE

A. Trenches in which encasement for pipe are to be placed may be excavated completely with mechanical equipment. Prior to formation of the encasement, temporary supports consisting of timber wedges or masonry shall be used to support the pipe in place. Temporary supports shall have minimum dimensions and shall support the pipe at no more than two places, one at the bottom of the barrel of the pipe adjacent to the shoulder of the socket and the other near the spigot end.

3.05 DRAINAGE STRUCTURES

A. All structures shall be built to the line and grade shown on drawings. All reinforced concrete work shall be in strict conformance with the concrete specifications contained herein. After erection of the forms and placing of the steel, the Contractor must have inspection and approval from the Engineer before placing any concrete. After removal of the forms, the Contractor shall backfill around each structure with approved granular fill. The fill shall be placed in layers not exceeding 6 inches in depth measured loose and compacted to 98% of the maximum density as determined by the modified proctor, AASHTO T-180. No defects of any kind in the pipe section will be accepted. All pipe stubs shall be made of the same type of pipe. Pipe stubs shall be sealed with a concrete plug, water tight. The ends of the pipes which enter masonry shall be neatly cut to fit the inner face of the masonry. Cutting shall be done before the pipes are built in.

3.06 INFILTRATION AND EXFILTRATION TESTS

A. Tests for watertightness shall be made by the Contractor. Leakage of completed storm drainage system shall not exceed 500 U.S. gallons per day per inch diameter per mile of pipe under minimum hydrostatic pressure of 2 feet. Test shall be conducted in a manner satisfactory to the Engineer. Any portion of the project not conforming to the above requirements shall be corrected by the Contractor, at his own expense, prior to acceptance by the Engineer.

3.07 PROTECTION AND CLEANING

A. The Contractor shall maintain all pipe installations and drainage structures in a condition such that they will function continuously and shall be kept clean of silt, debris and other foreign matter from the pipe and drainage structure is installed until the project is accepted.

3.08 FINAL INSPECTION

A. All storm sewers shall be lamped by the Contractor prior to acceptance of the work. Repairs or misalignment shown necessary by the tests shall be corrected at the Contractor's expense. All sewers shall be thoroughly cleaned before being placed into use and shall be kept clean until final acceptance by the Engineer.

B. Upon completion of the work and before final acceptance by the City, the entire drainage system shall be subject to a final inspection in the presence of the City and/or Engineer. The work shall not be considered as complete until all requirements for line, grade, cleanliness, and workmanship have been completed.

C. For flexible pipes, 48 inches or less in diameter, the Contractor shall submit to the Engineer a video file and Pipe Ovality Report for each pipe run using low barrel distortion video equipment with laser

profile technology, non-contact video micrometer and associated software. The report shall include pipe stationing and pipe deformation/deflections measurements with deflection limits clearly delineated. Laser profiling and measurement technology must be certified by the company performing the work to be in compliance with the calibration criteria posted at https://www.fdot.gov/construction/Engineers/Environment/Laser.shtm. The Engineer may waive this requirement for side drains and cross drains which are short enough to inspect manually from each pipe end.

- END OF SECTION -

SECTION 02631 EXFILTRATION TRENCH DRAINS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

1.02 WORK INCLUDED

A. Provide all labor, materials, necessary equipment and services to complete the Exfiltration Trench System work, as indicated on the Drawings, as specified herein or both, except as for items specifically indicated as "NIC ITEMS".

1.03 EXISTING UTILITIES

A. Locate and stake all existing underground utilities that may be in the area of the drainage system.

1.04 SUBMITTALS

A. Submit Plan Drawings showing the locations of all piping and underground utilities that may be in conflict with the Drainage System.

B. Submit samples of the 3/4" washed rock (ASTM No. 5) for approval.

C. Submit samples and product data of filter fabric.

PART 2 - PRODUCTS

2.01 DRAINAGE PIPE AND BALLAST ROCK

A. Drainage pipe shall be in conformance with material as specified in Contract Documents and have the maximum number of perforations allowable per the manufacturer’s recommendations.

B. Ballast rock shall be from fresh water and washed free of deleterious matter.

C. Trench liner shall be non-woven filter fabric.

2.02 FILTER FABRIC

A. Filter fabric shall be non-woven geotextile in accordance with Section 02371 – Geotextiles.

B. Minimum Characteristics:

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D4632	lbs (N)	100 (445)	100 (445)
Grab Tensile Elongation	ASTM D4632	%	50	50
Trapezoid Tear Strength	ASTM D4533	lbs (N)	45 (200)	45 (200)
CBR Puncture Strength	ASTM D6241	lbs (N)	250 (1113)	
			Maximum Opening Size	
Apparent Opening Size (AOS)	ASTM D4751	U.S. Sieve (mm)	70 (0.212)	
			Minimum Roll Value	
Permittivity	ASTM D4491	sec^{-1}	2.0	
Flow Rate	ASTM D4491	$gal/min/ft^2$ ($l/min/m^2$)	140 (5704)	
			Minimum Test Value	
UV Resistance (at 500 hours)	ASTM D4355	% strength retained	70	

Physical Properties	Unit	Roll Sizes	
Roll Dimensions (width x length)	ft (m)	12.5 x 360 (3.8 x 110)	15 x 360 (4.57 x 110)
Roll Area	yd^2 (m^2)	500 (418)	600 (502)

PART 3 – EXECUTION

3.01 INSTALLATION

A. Lay out Exfiltration Trench System as shown on the Plans.

B. The bottom of the trench shall provide a minimum of 12" of ballast rock below the drain pipe.

C. Drain pipes shall terminate a minimum of two feet beyond the end of the trench or connect to a catch basin as required.

D. Cover temporary pipe ends with No. 10 galvanized or aluminum screen with openings no larger than 1/2" x 1/2".

E. Bottom, sides and top of trench to be lined with trench lining material with a minimum of 2 feet of overlap at the top of the trench.

F. A minimum of 4 feet of solid drain pipe shall be installed between drainage structures and the beginning of the trench.

G. Concrete pipe shall be placed with the slots on the sides of the pipe equal distance from the plumb line.

3.02 CLEANUP

A. Remove all excess rock, liner and pipe from the site.

- END OF SECTION -

SECTION 02632 CORRUGATED POLYPROPYLENE DRAINAGE PIPE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Furnish corrugated high-performance polypropylene (PP) stormwater gravity piping as shown on the Drawings and specified herein.

1.02 ABBREVIATIONS

A. AASHTO: American Association of State Highway and Transportation Officials

B. ASTM: American Society for Testing and Materials

C. PP: Polypropylene

D. RCP: Reinforced Concrete Pipe

1.03 STANDARDS

A. ASTM D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

B. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

C. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

D. ASTM F2487: Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene and Polypropylene Pipelines

E. ASTM F2510: Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated Dual- and Triple-Wall Polyethylene and Polypropylene Pipes

F. ASTM F2881: Standard Specification for 12 to 60 in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

G. AASHTO M330: Standard Specification for Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

1.04 SUBMITTALS

A. Submit shop drawings in accordance with the Section titled “Submittals”.

B. Submit pipe product data showing conformance to these specifications.

C. Provide a copy of ASTM F2487 (latest edition).

D. Provide a copy of the pipe manufacturer's installation guidelines.

E. Shop drawing shall include product information for the "Water-Tight Repair Products" along with a letter from the PP pipe manufacturer documenting the water-tight products and method is suitable to create a water-tight joint.

F. Submit work experience documentation for the PP pipe manufacturer's field representative.

G. Submit report from PP pipe manufacturer's field representative documenting installation observations.

PART 2 – PRODUCTS

2.01 CORRUGATED POLYPROPYLENE DRAINAGE PIPE

A. Manufacturer, or Engineer Approved Equal:

1. HP Storm by ADS, Inc.

B. Pipe and Fittings:

1. Material: High-performance PP

2. Joint Type: water-tight

3. Type S: Double wall with a corrugated exterior and a smooth interior wall.

4. Pipe and Fittings: Conform to ASTM F2881 and AASHTO M330.

C. Joints:

1. Joints shall be integral bell and spigot type.

2. Joints shall meet the requirements of ASTM F2881 or AASHTO M330.

3. Joints shall be "watertight" as defined in ASTM D3212.

D. Gaskets:

1. Comply with ASTM F477.

2. Gasket material shall be manufacturer's standard.

E. Water-Tight Repair Products:

1. If the Contractor anticipates the need for field cut piping, it shall propose products and methods for creating water-tight joints that comply with the manufacturer's recommendations.

2. Include products proposed in the shop drawing submittal.

3. Shop drawing shall include a letter from the PP pipe manufacturer documenting that the water-tight products and method is suitable to create a water-tight joint.

2.02 PIPE TO MANHOLE CONNECTION

A. Provide product that complies with ASTM F2510.

B. Coordinate with submittal requirements in the Section titled "Precast Concrete Manholes, Handholes, and Vaults".

2.03 FLOWABLE FILL

A. Flowable fill may be used where accepted by the City.

B. If the Contractor proposes to use flowable fill, it shall submit a map indicating the locations of proposed use.

C. Flowable fill mix design shall comply with pipe manufacturer's written recommendations. The pipe manufacturer's flowable fill mix design requirements shall supersede the flowable fill specification contained in the Contract Documents.

D. If flowable fill is accepted by City, the Contractor shall retain a professional engineer registered in the State of Florida to design the anchoring system. Submit signed and sealed anchoring system design.

E. Submit shop drawing for flowable fill mix design. The shop drawing shall include the pipe manufacturer's written recommendations.

PART 3 – EXECUTION

3.01 DELIVERY INSPECTION

A. Each length of pipe and fittings delivered to the property shall be inspected by the Contractor, for flaws, cracks, dimensional tolerances and compliance with the referenced Standards.

3.02 INSTALLATION

A. Installation shall be in accordance with ASTM D2321 and the pipe manufacturer's installation guidelines.

B. Under no condition shall pipe be laid in water or when trench conditions or weather are unsuitable for such work.

C. All pipes and fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists or lowered on skidways in such a manner as to avoid shock. Derricks, ropes, or other suitable equipment shall be used for lowering the pipe into the trench. Pipe and fittings shall not be dropped or dumped.

D. Each pipe and fitting shall be inspected before it is lowered into the trench. The interior of the pipe and all joint surfaces shall be thoroughly cleaned and shall thereafter be maintained clean.

E. The open ends of pipe shall be securely plugged whenever pipe laying is not in progress.

F. Pipe and fittings shall be selected so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. All joints shall be installed, made up and inspected in accordance with approved printed instructions of the manufacturer. Pipe and fittings which do not fit together to form a tight joint will be rejected.

G. Cutting of pipe shall be done only with mechanical cutters and in accordance with the manufacturer's recommendations.

H. Pipe shall be laid accurately to the lines and grades shown on the drawings or as directed by the Engineer.

I. If an adequate foundation for the pipe is not available at the desired depth, additional excavation shall be required, and the foundation brought to desired grade with suitable granular material.

J. Rock outcroppings, very soft soils such as muck, and other similar materials not providing proper foundation support shall be removed/replaced with suitable granular material.

K. Bedding material directly under the pipe invert shall be left in native condition and not compacted. Pipe shall be placed on the bedding, then backfilled under the pipe haunches before further backfill is placed.

L. Any section of the pipe that is found defective in material, alignment, grade, joints, or otherwise, shall be satisfactorily corrected by the Contractor at no additional cost to the Owner.

3.03 PIPE MANUFACTURER REPRESENTATIVE

A. The PP pipe manufacturer shall have a qualified representative on site at the start of PP pipe installation. Representative shall observe pipe installation for a minimum of two 8-hour days. Document observations in a report; submit report to Engineer.

B. The Contractor shall submit work experience documentation for the representative for review by the Engineer.

C. The representative shall be available for consultation as needed throughout the PP pipe installation for the project.

3.04 PLACEMENT OF METALLIC WARNING TAPE

A. Width: 6 inches.

B. Tape shall include aluminum backing, allowing easy detection using a non-ferrous locator.

C. Tape shall include black text printed on APWA (American Public Works Association) approved colors.

D. Text shall be manufacturer's standard text, such as, "Caution Buried Water Line Below" to suit the application.

E. Text shall include custom wording upon request.

F. Supplier, or Engineer Approved Equal: Seton.

3.05 VISUAL INSPECTION

A. Examine structures and pipes for:

1. Physical damage.

2. Indication of displacement of pipes or structures, reinforcement, forms, or bedding.

3. Porous areas or voids.

4. Proper placement of seals, gaskets, and embedments.

5. Visible infiltration.

B. Verify structures and pipes are set to proper line, grade as per the Contract Drawings, and are plumb.

C. Verify structure and pipe dimensions and thickness match Contract Drawings.

3.06 CLEANING AND LAMP TESTING

A. All storm sewers shall be lamped by the Contractor prior to acceptance of the work. All storm sewers shall be thoroughly cleaned before being placed into use and shall be kept clean until final acceptance by the Engineer.

3.07 INFILTRATION/EXFILTRATION TESTING

A. Conduct “Leakage Test Procedure” (a.k.a., infiltration/exfiltration testing) as described in the Section titled "Storm Drain Facilities” except as modified herein.

B. Testing shall comply with ASTM F2487.

C. Allowable Leakage: The allowable leakage rate is 200 gallons/in-dia/mi-pipe/day for both infiltration and exfiltration when tested in accordance with ASTM F2487.

3.08 REPAIR

1. Repair or replace any unacceptable work at no additional cost to the Owner.

2. Repair all visible leaks.

END OF SECTION

SECTION 02665 CURED-IN-PLACE PIPE LINING

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide all materials, equipment, labor and incidentals for the installation and testing of cured-in-place pipe lining (CIPPL) within the storm sewer pipe between structure runs.

B. The CIPPL process shall consist of inserting a resin-impregnated flexible tube into an existing sewer, expanding the tube out against the sewer pipe, and curing the tube to form a pipe liner. Curing shall be accomplished by circulating heated water or steam to affect the desired cure throughout the tube extending full length from manhole to manhole.

C. The CIPPL shall cure into a hard, impermeable liner pipe of the specified thickness and form a structurally sound liner pipe with a uniformly smooth interior providing hydraulic flow equal to or greater than the existing sewer in original condition.

1.02 RELATED SECTIONS

A. Section 01510 – Temporary Utilities.

1.03 REFERENCE STANDARDS

A. Comply with applicable provisions and recommendations of the following:

1. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
2. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
3. ASTM D2122 – Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
4. ASTM D2990 - Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
5. ASTM D5813 – Standard Specification for Cured-In-Place Thermosetting Resin Sewer Pipe.
6. ASTM F1216-05 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
7. Standards of American National Standards Institute, ANSI

1.04 QUALIFICATIONS

A. For each method of installation and curing used on this project, CONTRACTOR shall have a history of at least 150,000 linear feet of CIPPL work in 8” to 18” sewers using a similar resin and felt and using the specific method of installation and curing being used.

B. For each method of installation and curing used on this project, the CIPPL Work shall be supervised by a foreman having previously supervised a minimum of 15,000 linear feet of CIPPL in 8” to 18” sewers using a similar resin and felt and using the specific method of installation and curing proposed.

C. The entity performing the wet-out of the CIPPL shall have been performing this type of work for a minimum of two years and previously wet-out at least 250,000 linear feet of 8” to 18” diameter CIPPL.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Care shall be taken in shipping, handling and storage to avoid damaging the liner. Extra care shall be taken during cold weather construction. Any liner damaged in shipment shall be replaced as directed by the OWNER at no additional cost to OWNER.

B. While stored, the CIPPL shall be adequately supported and protected. CIPPL shall be stored in a manner as recommended by the manufacturer and as approved by the ENGINEER.

1.06 QUALITY CONTROL

A. Though the process may be licensed, no change of material, design values, or procedures may be made during the course of the Work without the prior written approval of the ENGINEER.

B. All liner to be installed under this Work may be inspected at the wet-out facility for compliance with these specifications by OWNER or ENGINEER. The CONTRACTOR shall require the wet-out facility’s cooperation in these inspections. The cost of inspection will be the responsibility of the OWNER.

C. At the time of manufacture, each lot of liner shall be inspected for defects and tested in accordance with applicable ASTM standards. At the time of delivery, the liner shall be homogeneous throughout, uniform in color, free of cracks, holes, foreign materials, blisters, or deleterious faults.

D. For testing purposes, a production lot shall consist of all liner having the same marking number. It shall include any and all items produced during any given work shift and must be so identified as opposed to previous or ensuing production.

E. CONTRACTOR shall have a Quality Control Plan or Procedure in place that will allow the ENGINEER to monitor the resin impregnation process.

1.07 WARRANTY

A. All lining work shall be fully guaranteed by the CONTRACTOR for a period of 10 years from the date of Conditional Acceptance. During this period, all defects discovered by the OWNER or ENGINEER shall be removed and replaced by the CONTRACTOR in a satisfactory manner at no cost to the OWNER. In addition to the Warranty Inspection specified under Paragraph 3.9, the OWNER may conduct independent television inspections, at its own expense, of the lining Work at any time prior to the completion of the guarantee period.

1.08 SUBMITTALS

A. Name and qualifications of independent testing laboratory provided by CONTRACTOR.

B. Cured-In-Place Pipe:

1. Structural design calculations and specification data sheets listing all parameters used in the liner design and thickness calculations based on Appendix XI of ASTM F1216-05 for

each pipe segment. All calculations shall be prepared under and stamped by a Professional Engineer registered in the State of Delaware. Submit P.E. Certification Form for all CIPPL design data.

2. The name of the liner and resin manufacturer, the location of the facility where each was manufactured, and a list of appurtenant materials and accessories to be furnished.
3. The Quality Control Plan or procedures for the wet-out facility that ensure proper materials are used in the resin impregnation process and in liner shipping and storage.
4. Certified test reports demonstrating that the exact resin/liner combination to be used for this project meets the requirements for initial structural properties (performed in accordance with ASTM F1216-05 and ASTM D790) and chemical resistance (performed in accordance with ASTM F1216-05, Appendix X2 and ASTM D543).
5. Certified test reports demonstrating that the exact resin and comparable liner to be used for this project has been tested for long-term flexural modulus of elasticity (i.e. 10,000 hour creep testing performed in accordance with ASTM D2990 for design conditions applicable to this project). If the liner used for testing is not the exact liner to be used on this project, submit a detailed description of the physical properties of both the liner used in the test and the liner to be used for this project to demonstrate that the two liners are comparable in terms of physical properties.
6. Installation and quality control plan, including bypass pumping plans, mainline sewer cleaning plan and cleanliness requirements, liner shot plan and sequence, liner installation standard procedures, intermediate manhole exposed liner restraining method, boiler sizing calculations, temperature monitoring plan, and plan to manage flow to/from laterals during lining.
7. Curing schedule for each shot, including heating, curing, and cool-down schedules.
8. Copies of curing log sheets for each inversion. Curing logs must be submitted weekly.

C. Resin:

1. Technical data sheet showing physical and chemical properties.

D. Flexible Tube:

1. Technical data sheet showing physical properties.

E. Hydrophilic end seal material to be used and method of installation.

F. Contingency Plan, including methods and equipment to be used to repair unacceptable liner defects and for removing failed liners, and for availability and accessibility of backup equipment such as air compressors and boilers.

G. Documentation of Pre-Construction Inspection and Post-construction Inspection

H. Available standard written warranty from the manufacturer of wet-out liner.

I. Quality control report for resin impregnation of each CIPPL segment showing information such as resin lot numbers, volumes of resin, and catalyst used. Include a checklist so that each critical step in the resin impregnation process is checked off and initialed.

J. Curing log of CIPPL temperatures at the upstream and downstream manholes during the curing process to document that proper temperatures and cure times have been achieved.

K. Copies of test results performed by the CONTRACTOR'S independent testing laboratory as required by paragraph 3.7.

PART 2 - PRODUCT

2.01 DESIGN REQUIREMENTS

A. The CIPPL lining shall be a resin-impregnated, flexible polyester felt, or equivalent material tube which is inserted into the sewer to be rehabilitated and cured-in-place by an acceptable curing method. The tube shall have a suitable polyurethane membrane coating for protection of the interior surface and to provide a uniform, smooth flow surface. When installed, there shall be no film or plastic membrane between the existing inner sewer surface and the resin filled felt liner. The resin shall be a liquid thermosetting resin and shall be suitable for the design conditions as well as the curing process.

B. CIPPL Thickness:

1. The required structural CIPPL wall thickness shall be based, as a minimum:
   a. In accordance with ASTM F1216-05, Appendix X1, Design Considerations for a fully deteriorated or partially deteriorated host pipe, as indicated in the Lining Summary at the end of this Section.
   b. A minimum overall safety factor of 2.0.
   c. A minimum service life of 50 years under continuous service.
   d. A modulus of soil reaction of 950 psi.
   e. A soil density of 120 lbs/ft^3
   f. A Poisson's ratio of 0.3.
   g. An enhancement factor of 7.
   h. A groundwater elevation over the pipe equivalent to surface grade unless otherwise noted in the Lining Summary at the end of this Section.
   i. Ovality for each segment to be lined is noted in the Lining Summary at the end of this Section.
   j. Live loads for each segment to be lined are noted in the Lining Summary at the end of this Section.
   k. Fully or partially deteriorated condition for each segment to be lined is noted in the Lining Summary at the end of this Section.
   l. Soil depth for each segment to be lined is noted in the Lining Summary at the end of this Section.
2. The flexural modulus and flexural strength used in the design shall be the values as rated for the specified service life. Independent third party test data of the proposed liner performed in accordance with ASTM D790 and ASTM D2990 is required as evidence of the values used in design.
3. The liner thickness of each pipe segment shall be determined by the CONTRACTOR and submitted per Paragraph 1.8 of this Section.

C. Installed thickness of the CIPPL shall be within minus 5 percent and plus 15 percent of the design thickness as certified by an independent testing laboratory in accordance with paragraph 3.7.

D. When cured, the liner shall form a continuous, tight fitting, hard, impermeable liner that is chemically resistant to chemicals found in domestic sewage and which provides the maximum available abrasion resistance.

E. The liner shall be fabricated to a size that when reformed will tightly fit the sewer being rehabilitated. Allowance for longitudinal and circumferential expansion shall be taken into account when sizing and installing the liner. Field verify all dimensions prior to delivery of the liner. The contact tolerance is 1.0 mm. Where any space or gap between the outside surface of the liner and the inside surface of the existing pipe exceeds 1.0 mm, the liner fit will be deemed deficient and corrective action will be required. Where irregularities of the existing pipe exists such as offset joints, protrusions, bumps, and deformations, and the irregularities remain after the sewer has been prepared in accordance with the Contract Documents, exception to the contact tolerance will be allowed in the irregularity zone. The exception shall not present an obstruction to sewage flow.

F. The length of the liner shall be that deemed necessary by the CONTRACTOR to effectively carry out installation and seal the liner at the inlet and outlet of each manhole as specified herein. Field verify all lengths prior to construction.

G. Ensure that the correct liner is installed in each sewer being rehabilitated.

2.02 FLEXIBLE TUBE

A. The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216-05.

B. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the CIPPL. No dry or unsaturated layers shall be evident.

C. The felt content of the liner shall be determined by the CONTRACTOR, but shall not exceed 25 percent of the total impregnated liner volume.

D. The wall color of the interior pipe surface of CIPPL after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

2.03 RESIN

A. The liquid thermosetting resin shall saturate the tube and produce a properly cured liner which is resistant to abrasion due to solids, grit, and sand.

B. Polyester, vinyl ester, or epoxy resin and catalyst system shall comply with the following requirements and that when properly cured meets the requirements of ASTM F1216-05.

1. Polyester Resin: A resin created by reaction products between isophthalic/tetrathalic acid, maleic anhydride, and a glycol characterized by reactive unsaturation located along the molecular chain. This resin is compounded with a reactive styrene monomer and reacted together with initiators/promoters to produce cross-linked copolymer matrices.
2. Vinyl ester Resin: A resin created by reaction products of epoxy resins with methacrylic acid and characterized by reactive unsaturation located in terminal positions of the molecular chain. This resin is compounded with a reactive styrene monomer and reacted together with initiators/promoters to produce cross-linked copolymer matrices.
3. Epoxy Resin: A resin created by reaction products of biphenyl A and epichlorohydrin producing glycidyl ether reactive sites in the terminal position of the molecular chain. This resin is cross-linked with the reactive equivalent of a curing agent suitable for the cured-in-place process.

PART 3 - EXECUTION

3.01 PREPARATION

A. Review survey television inspection logs and/or conduct additional inspection of the sewer line to plan rehabilitation work. Determine the location of all active sanitary services prior to lining. Dye test to verify all active service connections, if necessary. Taps that cannot be attributed to a specific building shall not be reopened unless subsequent evidence to the contrary is obtained.

B. Inspect and confirm the inside diameter, alignment and condition of each manhole to manhole segment to be lined. Use the data and information collected from this inspection to verify the size of the liner and refine the installation techniques. If unknown physical conditions in the work area are uncovered during the investigation that materially differ from those ordinarily encountered, notify the ENGINEER.

C. Clean sewer lines prior to CIPPL lining, such that the sewer lines are free of roots, grease, sand, rocks, sludge and other debris.

D. The pump and bypass lines shall be of adequate capacity and size to handle the flow of the sewers. The proposed bypassing system shall be reviewed in advance by the ENGINEER. The review of the bypassing system by the ENGINEER shall in no way relieve the CONTRACTOR of his responsibility and/or public liability.

E. Clear the line of obstructions such as solids, dipped joints or broken pipe that will prevent the insertion of the liner. If inspection reveals an obstruction that cannot be removed by the conventional cleaning equipment, make an excavation and repair the obstruction. This work shall be approved the ENGINEER prior to commencement of the work and shall be paid under a Change Order.

F. For pipe segments found to have any actively leaking defects that would be categorized as Runners or Gushers by the PACP Defect Rating Codes, grout every joint on said pipe segment if instructed by the ENGINEER. When so instructed, render the pipe free of Runners or Gushers. Payment for grouting joints in pipes to be lined, when directed by the ENGINEER, shall be paid as Contingent Packer Injection Grouting of Pipe Joints Prior to CIPPL Rehabilitation in accordance with Section 01025.

G. Remove pockets of water from the pipe.

H. Provide Pre-Construction Inspection in accordance with City Inspection requirements, no more than four hours prior to CIPPL lining to demonstrate that the pipe is clean and free of roots, grease, sand, rocks, sludge, PACP Runners or Gushers, pockets of water, or structural impediments that would affect long-term viability of the pipe liner.

I. See notification requirements under Division 01.

3.02 BYPASS PUMPING

A. Maintain commercial and residential sewer service during the installation process. If necessary to properly complete the work, the CONTRACTOR may interrupt flow from services if such interruption is first coordinated with and allowed by the property owner(s). Contact the property owners in accordance with Section 01041 of the Specifications. Upon completion of the work, immediately reinstate all services and notify the property owner(s) that service is again available. The CONTRACTOR assumes all responsibility for notifying property owners of service interruptions. The CONTRACTOR also assumes all responsibility for blockages, back-ups or damages caused to public or private property as a result of the interruption of service, whether caused by the CONTRACTOR'S or property owner's actions.

B. Bypass pump sewage from individual laterals, if needed.

C. Clearwater bypassed from laterals may be discharged to ground surface if Contractor has confirmed the property owner is not using any sanitary facilities. Measure volume of clear water removed from each property.

3.03 CIPPL INSTALLATION PROCEDURES

A. Maintain two working lateral reinstatement cutters at the job site at all times. Lining work shall not commence if the CONTRACTOR does not have the required number of working cutters on site. No additional time or compensation shall be awarded to the CONTRACTOR in the event that work is stopped due to the CONTRACTOR'S failure to comply with this requirement.

B. Resin Impregnation (Wet Out): Designate a location where the flexible tube will be impregnated with resin. Thoroughly saturate flexible tube prior to installation. A catalyst system, or additive compatible with the resin and flexible tube, may be used as recommended by the manufacturer and with approval of the ENGINEER. Handle the resin-impregnated flexible tube to retard or prevent resin setting until it is ready for insertion.

C. Insertion: Insert flexible tube through an existing manhole by means of the inversion. Connect tube ends by an attachment so that a leak-proof seal is created. The liner material shall be inserted through a manhole by means and method required by the manufacturer, and shall be fully extended to the lower manhole. The use of a lubricant may be indicated and, if used, such lubricant shall be as approved by the manufacturer's standards. Follow the manufacturer's standards during the elevated curing temperature so as not to over stress the felt fiber and cause damage or failure of the liner prior to cure. Make allowance for circumferential stretching during inversion. Do not utilize overlapped layers of felt in longitudinal seams that cause lumps in the final product.

D. CIPPL restraint sleeves shall be approved for use at the insertion and receiving manholes only. Ensure that the sleeve system does not enter the host pipe. Sleeve restraint systems will not be allowed in intermediate manholes. Use other methods of restraint (i.e., sandbags, cut PVC pipe) at intermediate manholes.

E. Insert continuous or properly trimmed hydrophilic waterstops at each manhole opening approximately three inches from manhole. Trimmed waterstop edges shall be butted up against each other at the crown of the pipe using a 45° miter cut. Waterstops with any gap between the ends will not be accepted. For manholes with outside or inside drops, install hydrophilic waterstops approximately one inch and four inches upstream of the drop and trim back CIPPL to the drop opening.

F. The pressure head used during the installation process shall be sufficient to hold the liner tight to the pipe wall, producing dimples at all service connections and the two access manholes, and preventing wrinkles in the cured liner. The same head shall be great enough to prevent infiltration from entering the pipeline during the curing process. Pressure head shall be maintained sufficiently long enough to allow pockets of water to exfiltrate through the host pipe and prevent lifts in the liner and resin washout.

G. Curing:

1. Follow submitted cure schedule in curing of liner.
2. After insertion is completed, apply a suitable recirculation system capable of delivering air, steam, or water, as required by the liner system manufacturer, uniformly throughout the section to achieve a consistent cure of the resin. Maintain the curing temperature as recommended by the liner system manufacturer. Prevent excessive temperatures that could scald or bubble the liner. Scalded or blistered liner will be rejected if, in the opinion of the ENGINEER, the performance of the liner is compromised.
3. Fit suitable monitors to any heat source to gauge the temperature of incoming and outgoing water or steam supply, where appropriate. Place additional gauges between impregnated tube and invert of the original pipe at each manhole to monitor outside liner temperatures during resin curing.
4. Continue uninterrupted curing until the desired product is achieved.
5. Provide for vapor tight connections in the downstream manhole such that no vapors enter downstream pipes. Alternatively, provide styrene odor reducing agents, venting, and downstream plugs sufficient to prevent steam, styrene, or other odors from entering downstream buildings.

H. Cool Down: Initiate a controlled cool-down to cool the hardened liner to a temperature below 110°F, in accordance with the cure schedule. Take care in release of the pressure column so that a vacuum will not develop that could damage the newly installed liner. Do not discharge water in excess of 110°F into the sewer system. Ambient cooling shall not be allowed.

I. Finished Pipe: Provide a finished CIPPL that is continuous and free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, delamination, and wrinkles at any location totaling more than 5% of host pipe inside diameter.

J. If a point repair is required after the liner has cured, use a tube segment with compatible (preferably identical) properties as the liner to splice across the point repair. Point repair shall extend a minimum of 3-feet on each side of the defect.

K. Reopen all of the existing active service connections in each length of sewer immediately following installation of the liner. Reopen the active service connections from inside the sewer by means of a television camera controlled cutting device appropriate for the liner material and the rehabilitated sewer pipe. All of the liner penetrations or openings shall be watertight. Each active service connection shall be cut completely open and shall have smooth edges with no protruding material capable of hindering flow or catching and holding solids contained in the flow stream. If the service connection cannot be fully reopened due to time constraints, open each service connection to a minimum of 75% before the end of each working day. Partially opened service connections must be entirely opened by no later than the next working day.

L. Capped lateral connections shall not be reopened. Confirm the locations of all capped laterals during pre-construction CCTV inspections.

3.04 SEALING AT MANHOLES

A. Final trimming and sealing of the liner at manholes shall provide watertight pipe and manhole seals and shall not occur until at least 48 hours after completion of the cool-down period.

B. The finished ends of the liner shall be neat and smoothly trimmed to within two inches of host pipe end. Thoroughly seal all cut edges of the cured liner with the same resin as was used in the liner. The catalyst or hardener used shall be compatible with the resin/catalyst used in the liner previously, but shall not require an external heat source to begin the exothermic reaction (curing).

C. Form a tight seal between the CIPPL and the manhole wall at the pipe penetration. Do not leave any annular gaps. Seal any annular space greater than ½-inch with manhole wall repair material. Finish off the seal and seal any annular spaces less than ½-inch with urethane, grout or fiber reinforced cementitious material placed around the pipe opening from inside the manhole in a band at least 4-inches wide.

D. Provide a smooth transition between the existing manhole channel invert and the liner using cementitious or other approved material to prevent settling of sediments or debris from catching on the liner.

3.05 POST-CONSTRUCTION INSPECTION OF COMPLETED WORK

A. Provide Post-construction Inspection video documentation showing completed work after all mainline lining and lateral lining work for a given pipe segment has been completed.

B. Correct all defects discovered during the television inspection before Conditional Acceptance. After the defects are corrected, repeat the Post-construction Inspection for that sewer line.

C. Submit the Post-construction Inspection video to the ENGINEER in sufficient time to allow the ENGINEER to review the video prior to Conditional Acceptance.

3.06 FINAL CLEANUP

A. Upon completion of rehabilitation work and testing, clean and restore project area affected by the Work.

3.07 QUALITY CONTROL TESTS

A. For each inversion, place a section of PVC pipe of the same diameter as the existing sewer on the tail end of the liner in the manhole. The length of PVC pipe shall be 2-feet plus 1.5 times the diameter of the existing sewer. Run the impregnated tube through the pipe and cure the CIPPL under restrained conditions. The center 2 feet of this liner will be used to obtain samples for testing. Label samples with the project number, date of installation, location, manhole number and specified thickness. Send samples to an independent laboratory approved by the ENGINNER for analysis as specified below and pay all laboratory fees. Provide a duplicate sample from the same pipe liner section to the ENGINEER, who may perform additional inspection and testing by a laboratory retained and paid for by the OWNER or ENGINEER.

B. The following tests shall be performed for each inversion of CIPPL lining installed.

1. Short-term Flexural (Bending) Properties – The initial tangent flexural modulus of elasticity and flexural yield strength shall be measures in accordance with ASTM D790.
2. Thickness shall be measured in accordance with ASTM D2122.

C. The following tests shall be performed once for each diameter of CIPPL installed. After installation of all CIPPLs, the ENGINEER will determine which manhole-to-manhole segments are to be tested:

1. Long-term Flexural Modulus of Elasticity shall be measured in accordance with ASTM D2990. Test shall be performed for 10,000 hours under test conditions and loadings applicable to this project.

D. The ENGINEER may, at any time, require the CONTRACTOR to sample resin from each liner and send it to an independent laboratory retained by the CONTRACTOR and approved by the ENGINEER for an Infrared Spectrophotometric analysis. The Spectrograph shall be generated by the same test method as employed by the resin supplier and shall include all components that will be incorporated into the final resin design. If the test results indicate that the resin is in compliance with this Specification and the approved shop drawings, the OWNER will pay for the laboratory fees out of the contingency allowance. If the test results indicate that the resin is not in compliance with this Specification and the approved shop drawings, the CONTRACTOR will pay all laboratory fees.

3.08 CIPPL ACCEPTANCE

A. Acceptance of the CIPPL shall be based on the ENGINEER's evaluation of the resin impregnation quality control reports, CIPPL temperature curing logs, Post-construction Inspection video, laboratory test results for the resin and installed pipe samples, which shall demonstrate:

1. Compliance with the required resin and CIPPL physical properties and CIPPL thickness.
2. Observed groundwater infiltration of the liner is zero.

3. All active service connections are open, clear and watertight.
4. There is no evidence of excessive wrinkles, splits, cracks, breaks, lifts, kinks, scalds, blisters, delaminations or crazing in the liner.

B. If any defective liner is discovered after it has been installed, it shall be removed and replaced with either a sound liner or a new pipe at no additional cost to the OWNER. Obtain approval of the ENGINEER for method of repair, which may require field or workshop demonstration.

3.09 WARRANTY INSPECTION

A. Provide a CCTV inspection 18 to 24 months after completion of CIPPL work showing all completed work. Actual period for inspection shall be determined by the ENGINEER and will ideally be conducted during high groundwater conditions. CONTRACTOR will be provided with a 60 days notice prior to period of inspection. Conduct all inspections in the presence of the ENGINEER.

B. Correct all defects discovered during the warranty period at no additional compensation. After the defects are corrected, inspect the sewer again at no additional compensation.

- END OF SECTION –

SECTION 02710 LIMEROCK BASE

PART 1 – GENERAL

1.01 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross section.

B. Completed Lift: Compacted with uniform surface reasonably true to cross-section.

PART 2 – MATERIALS

2.01 LIMEROCK BASE ROCK

A. The material used in limerock base shall be material classified as Miami Oolite Formation.

B. The minimum of carbonates of calcium and magnesium in the limerock shall be 70 percent. The maximum percentage of water-sensitive clay material shall be 3.

C. Limerock material shall be uniform in color and not contain cherty or other extremely hard pieces, or lumps, balls, or pockets of sand or clay size material in sufficient quantities as to be detrimental to the proper bonding, finishing, or strength of the limerock base.

D. The limerock base shall be uniformly graded from coarse to fine with 97 percent passing a 3-1/2-inch sieve, 80 percent passing a 2-inch sieve. The fine material shall consist entirely of dust of fracture. All crushing or breaking up, which might be necessary in order to meet such size requirements, shall be done before the material is placed on the road.

E. Physical Qualities:

1. Liquid Limit, AASHTO T89: Maximum 35 percent.
2. Nonplastic.
3. Limerock material shall have an average limerock bearing ratio (LBR) value of not less than 100.

2.02 SOURCE QUALITY CONTROL

A. Contractor: Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on materials' test results on installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

PART 3 – EXECUTION

3.01 SUBGRADE PREPARATION

A. As specified in the Contract Documents.

B. Obtain City's acceptance of subgrade before placement of limerock base rock.

C. Do not place base materials on soft, muddy subgrade.

3.02 EQUIPMENT

A. Use mechanical rock spreaders, equipped with a device that strikes off the rock uniformly to laying thickness, capable of producing even distribution. For areas where the use of a mechanical spreader is not practicable, the Contractor may spread the rock using bulldozers or blade graders.

3.03 HAULING AND SPREADING

A. Hauling Materials:

1. The limerock shall be transported to the point where it is to be used and dumped on the end of the preceding spread.
2. Do not haul over surfacing in process of construction.
3. Loads: Of uniform capacity.
4. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. Distribute material to provide required density, depth, grade and dimensions with allowance for subsequent lifts.
2. Produce even distribution of material upon roadway without segregation.
3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

3.04 CONSTRUCTION OF COURSES

A. General: Complete each lift in advance of laying succeeding lift to provide required results and adequate inspection.

B. Limerock Base:

1. Maximum Completed Lift Thickness: 6 inches or equal thickness.
2. Completed Course Total Thickness: As shown on the Drawings.
3. Spread lift on preceding course to required cross-section.
4. Lightly blade and roll surface until thoroughly compacted.
5. Blade or broom surface to maintain true line, grade, and cross-section.

C. Gravel Surfacing:

1. Maximum Completed Lift Thickness: 6 inches or equal thickness.
2. Completed Course Total Thickness: As shown on the Drawings.
3. Spread on preceding course in accordance with cross-section shown.
4. Blade lightly and roll surface until material is thoroughly compacted.

3.05 ROLLING AND COMPACTION

A. Commence compaction of each layer of base after spreading operations and continue until density of 98 percent of maximum density has been achieved as determined by AASHTO T 180.

B. Density tests will be conducted every 500 square yards or as directed by the City.

C. Roll each course of surfacing until material shall not creep under roller before succeeding course of surfacing material is applied.

D. Commence rolling at outer edges of surfacing and continue toward center; do not roll center of road first.

E. When the material does not have the proper moisture content to ensure the required density, wet or dry, as required. When adding water, uniformly mix it in by disking to the full depth of the course that is being compacted. During wetting or drying operations, manipulate as a unit, the entire width and depth of the course that is being compacted.

F. Place and compact each lift to required density before succeeding lift is placed.

G. Bind up preceding course before placing leveling course. Remove floating or loose stone from surface.

H. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

I. Surface Defects: Remedy surface defects by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.

J. Finished Surface: True to grade and crown before proceeding with surfacing.

3.06 SURFACE TOLERANCES

A. Finished Surface of Base Course and Leveling Course: Within plus or minus 0.04-foot of grade shown at any individual point.

B. Compacted Surface of Leveling Course: Within 0.04-foot from lower edge of 10-foot straightedge placed on finished surface, parallel to centerline.

C. Overall Average: Within plus or minus 0.01-foot from crown and grade specified.

3.07 GRAVEL DRIVEWAY RESURFACING

A. Replace gravel surfacing on driveways which were gravel surfaced prior to construction.

B. Provide compacted gravel surfacing to depth equal to original, but not less than 4 inches.

C. Leave each driveway in as good or better condition as it was before startof construction.

3.08 FIELD QUALITY CONTROL

A. In-Place Density Tests:

1. Construct base course so areas shall be ready for testing.
2. Allow reasonable length of time for City to perform tests and obtain results during normal working hours.

3.09 CLEANING

A. Remove excess material; clean stockpile areas of aggregate.

- END OF SECTION -

SECTION 02723 STORMWATER PIPE CLEANING AND INTERNAL TV INSPECTION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. All applicable provisions of the Bidding and Contract Requirements, and Division 1-General Requirements shall govern the WORK under this section.

1.02 RELATED WORK

A. Section 15000 – Basic Mechanical Requirements.
B. Section 02630 – Storm Drain Facilities

1.03 SEQUENCE OF WORK

A. Clean storm sewer lines and maintenance access structures in accordance with this specification. The intent of storm sewer line cleaning is to remove all sludge, dirt, sand, rocks, grease, and other solids or semisolid material from the pipe so that defects are not obscured and to allow the water level to drop so that defects are visible. The pipe interior shall be clean enough to allow adequate viewing of the pipe during inspection. Since the success of the other phases of work depends a great deal on the cleanliness of the lines, the importance of this phase of the operation is emphasized. It is recognized that there are some conditions such as broken pipe and major blockages that prevent cleaning from being accomplished or where additional damage would result if cleaning were attempted or continued. Should such conditions be encountered, OWNER shall be notified within 24 hours and shall direct CONTRACTOR on how to proceed with those specific storm sewer segments. If, in the course of normal cleaning operations, damage does result from pre-existing and unforeseen conditions such as broken pipe, CONTRACTOR will not be held responsible.

B. After cleaning, the pipe sections shall be visually inspected by means of closed circuit television.

1. Inspect storm sewer interior using WinCan or approved equal. Provide hard copy of inspection logs.

2. Additional TV inspections may be required at other stages of operation.

1.04 WORK HOURS

A. Work will be performed during the hours of 7:00 a.m. to 4:00 p.m., Monday through Friday, unless nighttime work is indicated because of flow conditions or traffic control requirements. Nighttime work must be approved by OWNER and scheduled in coordination with the OWNER.

1.05 ENTRY ONTO PRIVATE PROPERTY

A. Before any entry onto private property is made, CONTRACTOR shall obtain permission from resident or business owner or manager. If resident or business owner/manager is not available, then CONTRACTOR shall leave a project door hanger requesting resident or

business owner/manager to call CONTRACTOR to schedule a time for inspection. If CONTRACTOR encounters any difficulty in obtaining resident's or business owner/manager's permission to access the easement in order to perform the inspection, then CONTRACTOR shall contact OWNER for assistance. In such cases, CONTRACTOR shall provide a minimum of two weeks notice to the OWNER prior to the need to access private property. CONTRACTOR is responsible for scheduling work such that this two-week notification period does not interfere with the overall work schedule.

1.06 SAFETY

A. CONTRACTOR shall be solely responsible for safety during the performance of all Work. CONTRACTOR shall not enter into any storm sewer segment where hazardous conditions may exist until such time as the source of those conditions is identified and eliminated by CONTRACTOR and/or OWNER. CONTRACTOR shall perform all work in accordance with the latest OSHA confined space entry regulations. CONTRACTOR shall coordinate his work with local fire, police and emergency rescue units.

B. CONTRACTOR shall be responsible for any damage to public or private property resulting from their televising activities and shall repair or otherwise make whole such damage at no cost to OWNER.

C. Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed-circuit television inspection techniques.

PART 2 – MATERIALS AND EQUIPMENT

2.01 STORM SEWER LINE CLEANING EQUIPMENT

A. High-Velocity Hydraulic (Hydro-Cleaning) Equipment: Equipment shall be capable of removing dirt, grease, rocks, sand, roots, and other materials and obstructions from storm sewer lines and maintenance access structures.

B. Storm sewer line cleaning equipment shall have selection of two or more high-velocity nozzles.

C. Nozzles shall be capable of producing scouring action from 15 to 45 degrees in all size lines designated to be cleaned, with nozzle capable of producing flows from fine spray to solid stream.

D. Equipment shall carry its own water tank, auxiliary engines, and high pressure water pump.

E. Combination Unit Pump: Capable of pumping at least 80 gallons per minute (300 liters per minute) at 2,000 psi (13.8 MPa), measured at beginning of hose reel.

F. Water Pump: Able to run at 2,000 psi (13.8 MPa) while pulling full vacuum, completely independent from vacuum system, with ability to vary vacuum without affecting water pressure.

G. Do not use chemicals without written approval of the ENGINEER. Do not use chemical which may be considered hazardous or detrimental to organisms or equipment of wastewater treatment plant.

H. When water from fire hydrants is necessary, apply to OWNER for permission to use potable water source.

I. Provide temporary piping, valves, certified reduced pressure backflow preventors, equipment, and other items for handling potable water and wastewater.

J. Do not utilize water source until it has been approved for use by OWNER.

2.02 INTERNAL TELEVISION INSPECTION EQUIPMENT

A. DVD: 120 minute minimum, high-quality color, type DVD-R, DVD-RW, or DVD+R

1. Audio portion of composite DVD shall be sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.

2. Store in upright position with temperature range of 45 to 80 degrees F (7 to 27 degrees C) in an appropriate CD or DVD case to prevent scratches.

3. Identify each disk with tape labels showing Project's name, CONTRACTOR's name, and each maintenance access structure-to-maintenance access structure pipe segment of storm sewer line represented on DVD or provide an index or table of contents if more than one segment is on the disk.

B. Television Inspection Camera(s): Equipped with rotating head, capable of 90 degree rotation from horizontal and 360-degree rotation about its centerline.

1. Minimum Camera Resolution: 400 vertical lines and 460 horizontal lines.

2. Camera Lens: Not less than l40-degree viewing angle, with automatic or remote focus and iris controls.

3. Focal Distance: Adjustable through range of 6 inches (152 mm) to infinity.

4. Camera(s) shall be intrinsically safe and operative in 100 percent humidity conditions.

5. Lighting Intensity: Remote-controlled and adjusted to minimize reflective glare.

6. Lighting and Camera Quality: Provide clear, in-focus picture of entire inside periphery of storm sewer.

C. WinCAM or equal screen recording and editing application,

D. Footage Counter: Measures distance traveled by camera in storm sewer, accurate to plus or minus 2 feet (0.6 m) in 1,000 feet (305 m).

E. DVD Titling: Each segment shown on the DVD should have its own Chapter titled with the beginning and end point of the pipe segment.

F. Cable and Footage Counter: A minimum 1,500 feet of TV cable on the spool reel shall be provided. The TV cable will be supported by an equal length tag line for removal of the equipment from the pipeline.

PART 3 – EXECUTION

A. Submit letter that identifies methods that will be used to remove sediment, debris, grease, scale, encrustations, loose concrete, and roots throughout section of storm sewer to be cleaned. Include the following:

1. Detailed explanation of cleaning process.

2. Schedule of activities.

3. References where identified cleaning method has been used successfully in the past by CONTRACTOR.

4. List of the actions to mitigate impact during cleaning operation.

5. Provide traffic control measures as required by the jurisdiction in which the work is located. In compliance with or in addition to the jurisdiction's requirements, flashing lights shall be used for all night work.

3.01 EXAMINATION

A. CONTRACTOR shall be aware of flow conditions, and be able to identify potential access problems to storm sewer access points.

3.02 APPLICATION

A. Clean designated storm sewer lines using approved methods and equipment.

1. Remove internal obstructions such as roots or gaskets by trenchless techniques when obstruction encountered prevents further pipe cleaning.

a. Provide special attention during cleaning operation to assure almost complete removal of roots from joints.
b. Procedures to remove internal obstructions may include use of equipment such as rodding machines, root saws, bucket machines and winches using root cutters, porcupines, and jet machines equipped with hydraulically driven cutters.

2. If cleaning of entire section cannot be successfully performed from one maintenance access structure, set up equipment at other maintenance access structure and attempt cleaning again.

a. If successful cleaning cannot be performed or equipment fails to traverse entire storm sewer line section, it will be assumed that major blockage exists.
b. Temporarily suspend cleaning effort and immediately notify the ENGINEER.
c. Upon removal of obstruction, complete cleaning operation.

3. Employ satisfactory precautions to protect storm sewer line from damage that might be inflicted by improper use of cleaning equipment.

a. Immediately notify the ENGINEER if fresh soil, pieces of pipe, or other visible signs of potential problems occur during cleaning operation.
b. Insure that water pressure created does not cause damage due to flooding of property being served by storm sewer section(s) involved.

B. Maintenance access structure cleaning: Include entire maintenance access structure interior, including maintenance access structure benches and walls. Incorporate into line cleaning operation by scouring walls with high velocity nozzle after pipe segment cleaning operation is complete.

Do not discharge sewage or solids removed from downstream maintenance access structures, onto streets, or into ditches, catch basins or storm drains.

3.03 CLEANING

A. Keep premises free from accumulations of waste materials, rubbish and other debris resulting from work

B. Remove waste materials, rubbish, and debris from and about premises.

C. Remove tools, construction equipment and machinery, and surplus materials.

D. Restore to original condition portions of site not designated for alterations by Contract Documents.

3.04 INTERNAL TELEVISION INSPECTION: STORM SEWER FLOW REQUIREMENTS

A. Do not exceed depth of flow shown in Table 1 for respective pipe sizes as measured in maintenance access structure when performing TV inspection.

C. When depth of flow at upstream maintenance access structure of storm sewer line section being worked is above maximum allowable for TV inspection, reduce flow to level shown in Table 1, by plugging or blocking of flow, or by pumping and bypassing of flow as specified.

TABLE 1	
Maximum Depth of Flow for TV Inspection	
Nominal Pipe Diameter	**Maximum Depth of Flow**
6”-10”	15% of pipe diameter
12”-24”	20% of pipe diameter

3.05 INSPECTION REQUIREMENTS

A. Access: OWNER and/or the ENGINEER shall have access to observe monitor and other operations at all times.

B. DVD Commentary: Record and edit the following information using WinCam or equal: narrative of location, direction of view, maintenance access structure numbers, pipe diameter and material, date, time of inspection, and location of laterals and other key features.

1. DVD shall visually display this information at beginning and end of each maintenance access structure-to-maintenance access structure pipe segment.

2. DVD between maintenance access structures shall visually display length in feet from starting point of given segment.

C. Storm sewer Identification: DVD and inspection documentation shall include storm sewer line and maintenance access structure identifiers shown on Drawings.

D. Image Perspective: Camera image shall be down center axis of pipe when camera is in motion.

1. Provide 360-degree sweep of pipe interior at points of interest, to more fully document existing condition of storm sewer.

2. Points of interest may include, but are not limited to the following: defects, cracks, voids, connections, encrustations, mineral deposits, debris, sediment, and any location determined not to be clean or part of an improper liner installation, and defects in liner that include, but are not limited to bumps, folds, tears, and dimples.

3. Cabling system employed to transport camera and transmit its signal shall not obstruct camera's view.

E. Storm sewer Reach Length: Physically measure and record length of each storm sewer reach from centerline of its terminal maintenance access structures.

F. Inspection Rate: Camera shall be pulled through storm sewer in either direction, but both inspections are to be in same direction. Maximum rate of travel shall be 30 feet (9 m) per minute when recording.

G. If during television operation, television camera will not pass safely through entire storm sewer line section being investigated, CONTRACTOR shall, at no additional cost to OWNER, set up equipment so that inspection can be performed from opposite (downstream) maintenance access structure. Where an obstruction is encountered and a reverse set up is required, the distance shall be entered into the log and verbally noted on the DVD video from which maintenance access structure the measurements are being made. If under the reverse set-up the camera again fails to pass through the entire storm sewer line section, inspection shall be considered complete. All obstructions in the storm sewer segment that prohibit passage of the television camera shall be immediately reported to the ENGINEER by CONTRACTOR referencing location and nature of the obstruction. No rehabilitation work shall proceed until CONTRACTOR receives direction from OWNER regarding removal of the obstruction.

H. Should CONTRACTOR's televising equipment become lodged in any storm sewer line, it shall be removed by CONTRACTOR at his expense. This shall include, if necessary, excavation and repair of the storm sewer, underground utility repairs, backfilling and surface restoration. CONTRACTOR shall re-televise any line segment in which his equipment became lodged after said equipment has been removed to demonstrate to the OWNER that no damage exists as a result of his televising operations.

I. Should bypass pumping or other form of sewage flow control be required by/of CONTRACTOR to facilitate storm sewer line televising, CONTRACTOR shall be solely responsible for providing all labor, equipment and materials necessary to control the flow of sewage in and/or around storm sewer segment(s) being televised.

3.04 EVALUATION PROCEDURES

A. To evaluate if sags exist in the sanitary storm sewer pipe, water must be introduced into the pipe section to be televised. Pump/Add approximately 750 gallons of water into the terminal MAS or first upstream MAS to be cleaned and inspected. This volume of water can be modified based on the run of sanitary storm sewer pipe to be televised with the approval of the ENGINEER or OWNER (for example 10 to 50 gallons for a smaller section of pipe).

B. Once the cleaning nozzle reaches the upstream MAS, the water is to be turned off and then allow 15 minutes for the water introduced into the sanitary storm sewer pipe section to flow down before the line is televised.

3.07 FIELD QUALITY CONTROL

A. OWNER and/or the ENGINEER will review DVDs and logs to ensure compliance with requirements listed in this specification.

B. If storm sewer line, in sole opinion of OWNER and/or the ENGINEER, is not adequately clean, it shall be recleaned and the storm sewer line inspected by CONTRACTOR at no additional cost.

C. Quality Assurance: Submit one example DVD of previous storm sewer inspection work that shows operational and structural defects in storm sewers, complete with audio commentary and inspection log(s). Prior to submittal, finalize the DVD to prevent re-recording.

1. DVD and inspection logs will be reviewed to determine if quality of TV image is acceptable, and if defects were properly identified and documented.

2. Modify equipment and/or inspection procedures to achieve report material of acceptable quality.

3. Do not commence work prior to approval of report material quality by OWNER and/or the ENGINEER. Upon acceptance, report material shall serve as standard for remaining work.

D. Inspection Logs: Unless otherwise indicated, submit inspection logs that include the following as a minimum:

1. Project title

2. Name of BCWWS Project

3. Time of day

4. Zone atlas map number

5. Maintenance access structure to maintenance access structure pipe section

6. Upstream maintenance access structure number.

7. Downstream maintenance access structure number.

8. Pipe segment length

9. Pipe material

10. Line size

11. Compass direction of viewing

12. Direction of camera's travel

13. Pipe depth

14. Operator name

15. Tape counter reading at beginning and end of each maintenance access structure to maintenance access structure pipe segment.

16. Closest street address and street name on which storm sewer is located

17. Location (start and end counter distances in feet from the beginning maintenance access structure's centerline) and description of obstructions, structural defects, missing pieces of pipe, longitudinal and/or circumferential cracking, joint deterioration-including open and/or offset joints, ovality, leakage or evidence thereof, corrosion, erosion, break-in connections, protruding connections, mineral

deposits, roots, previous repairs, grease/fats/oil deposits on pipe walls, sags, and other abnormalities with respect to the storm sewer's condition with counter distance in feet from the beginning maintenance access structure's centerline.

E. DVDs: Submit completed DVDs after cleaning. Prior to submittal, finalize the DVD to prevent re-recording. DVDs must be readable with standard viewing software such as Windows Media Player, and if a specific program is needed please submit for preapproval.

F. Maintain copy of all inspection documentation (DVDs, databases, and logs) for duration of Work and warranty period.

G. Digital Photographs: Digital format JPEG on standard CD or DVD photographs of all problems, severe defects or atypical observations shall be taken by CONTRACTOR or upon request of OWNER.

3.08 MEASUREMENT AND PAYMENT

A. Measurement and payment will be based on actual quantities installed as more specifically discussed and described in SECTION 01025 of MEASUREMENT AND PAYMENT.

- END OF SECTION -

SECTION 02761 PAVEMENT MARKING

PART 1 – GENERAL

1.01 STANDARD SPECIFICATIONS

A. When referenced in this section, Standard Specifications shall mean Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition. All Pavement Markings and Signage shall conform to the Broward County Traffic Engineering Division (BCTED) Standards, latest revision.

1.02 SUBMITTALS

A. The Contractor shall submit all products used for pavement markings in accordance with the Section entitled “Submittals”.

1.03 DELIVER, STORAGE, AND PROTECTION

A. Packaging and Labeling: All coatings and traffic marking materials shall be shipped in strong containers plainly marked with the weight in pounds per gallon, the volume of coatings and traffic marking materials content in gallons, the color, user information, date of manufacture, LOT, batch and DOT code number. Each batch manufactured shall have a unique number. A true statement of the percentage composition of the pigment, the proportion of pigment to vehicle, and the name and address of the manufacturer, also shall be shown. The label shall warn the user of any special handling or precautions of the material, as recommended by the manufacturer. Any package not so marked will not be accepted for use under these Specifications.

B. Storage: Any coatings and traffic marking materials which, although inspected and approved at the point of manufacture, hardens or livers in the containers so that it cannot be readily broken up with a paddle to a smooth, uniform painting consistency, will be rejected. All materials shall have a container storage life of one year from date of manufacture. Any coatings and traffic marking materials not acceptable for proper application will be rejected, even though it conforms to these Specifications in all other respects.

C. Mixing: All paints except aluminum shall be delivered to the project completely mixed, and ready to be used without additional oil or thinner. Gasoline shall not be used for thinner under any circumstances.

PART 2 – MATERIALS

2.01 PAINT

A. Color: White, yellow, or blue traffic striping meeting the requirements of BCTED and the Standard Specifications.

B. Homogeneous, easily stirred to smooth consistency, with no hard settlement or other objectionable characteristics during a storage period of 6 months.

2.02 THERMOPLASTIC STRIPING

A. White or yellow thermoplastic striping material meeting the requirements of BCTED and the Standard Specifications.

2.03 RAISED REFLECTIVE MARKERS

A. Metallic or nonmetallic, or prismatic reflector type, of permanent colors retaining color and brightness under action of traffic.

B. Rounded surfaces presenting a smooth contour to traffic. The minimum area of each reflective face shall be 2-1/2 inches squared.

C. Marker and adhesive epoxy in accordance with ASTM D4280

D. Markers shall meet the requirements of BCTED and the Standard Specifications.

2.04 GLASS SPHERES

A. Glass spheres shall be of a composition designed to be highly resistant to traffic wear and to the effects of weathering.

B. In accordance with AASHTO M247, Type I with moisture resistant coating or a formulation specified by the traffic striping material manufacturer and the BCTED and the Standard Specifications.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

A. Cleaning:

1. Thoroughly clean surfaces to be marked before application of pavement marking material.
2. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water or a combination of these methods.
3. Completely remove rubber deposits, surface laitance, existing paint markings, and other coatings adhering to pavement with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion.
4. Scrub areas of old pavement affected with oil or grease with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application.
5. Surfaces shall be completely free of dry dirt and ice, and dry of water at the time of application of any of the materials specified herein.
6. Oil-Soaked Areas: After cleaning, seal with cut shellac to prevent bleeding through the new paint.
7. Reclean surfaces when Work has been stopped due to rain.
8. Existing Pavement Markings:
   a. Remove existing pavement markings that may interfere or conflict with newly applied marking patterns, or that may result in a misleading or confusing traffic pattern.
   b. Do not apply thermoplastic markings over existing preformed or thermoplastic markings.
   c. Perform grinding, scraping, sandblasting or other operations so finished pavement surface is not damaged.

B. Pretreatment for Early Striping: Where early striping is required on rigid pavements, pretreat with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride.

C. New Concrete Pavement:

1. Allow a minimum cure time of 30 days before cleaning and marking.
2. Clean by either sandblasting or water blasting to the following results:
   a. No visible evidence of curing compound on peaks of textured concrete surface.
   b. No heavy puddled deposits of curing compound in valleys of textured concrete surface.
   c. Remaining curing compound is intact, with loose and flaking material completely removed.
   d. Peaks of textured pavement surface are rounded in profile and free of sharp edges and irregularities.
3. Allow a minimum drying time of 24 hours after water blasting before applying thermoplastic markings.

3.02 ALIGNMENT FOR MARKINGS

A. The Contractor shall be responsible for all measurements, reference points and marks, string lining, and any other steps required in establishing pavement marking locations and alignment. On tangents and on curves up to 1 degree, the alignment of the marking shall not deviate from the string line by more than 1 inch. On curves exceeding 1 degree, the maximum permissible deviation shall be 2 inches. All alignment width and location shall conform to the details shown on the Drawings.

3.03 PAINT APPLICATION

A. General:

1. Thoroughly mix pigment and vehicle together prior to application, and keep thoroughly agitated during application.
2. Do not add thinner.
3. Apply only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Maintain paint temperature within these same limits.
4. Apply only when surface is dry.
5. Do not apply when conditions are windy to the point of causing overspray or fuzzy line edges.
6. New Asphalt Pavement: Allow a minimum pavement cure time as recommended by the manufacturer before applying paint.
7. Provide guide lines and templates to control paint application.
8. Take special precautions in marking numbers, letters, and symbols.
9. Sharply outline edges of markings and apply without running or spattering.

B. Rate of Application:

1. Reflective Markings:
   a. Paint: Apply evenly, 105 plus or minus 5 square feet per gallon.
   b. Glass Beads: Apply uniformly, 6 plus or minus 0.5 pounds of glass spheres per gallon of paint.
2. Nonreflective Markings: Apply paint evenly to pavement surface at a rate of 105 plus or minus 5 square feet per gallon.
3. On new pavement or new asphalt surface treatments, apply two coats of paint at a uniform rate of 210 square feet per gallon.

C. Drying:

1. Provide maximum drying time to prevent undue softening of bitumen and pickup, displacement, or discoloration by traffic.

2. If drying is abnormally slow, discontinue painting operations until cause is determined and corrected.

3.04 THERMOPLASTIC MARKING APPLICATION

A. Following specified surface preparation, prime and apply marking and glass beads to provide a reflectorized strip as shown on Drawings.

B. The material shall be applied to the pavement by the extrusion method only, wherein one side of extrusion shaping die is the pavement and the other sides are formed by suitable equipment for heating and controlling the flow of the material.

C. Application Temperatures:

1. Pavement Surface: Minimum 40 degrees F and rising.
2. Thermoplastic: Minimum 375 degrees F, maximum 425 degrees F.

D. Primer:

1. On portland cement concrete and existing asphalt pavements, apply epoxy resin primer/sealer according to the thermoplastic manufacturer's recommendations.
2. All primer/sealer to dry prior to applying thermoplastic.

E. Thermoplastic Marking:

1. Extrude in a molten state, free of dirt or tint. at a thickness of 0.10 to 0.15 inch for lane lines and 0.07 to 0.10 inch for edge or other lines in accordance with FDOT Design Standards.
2. Apply centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator.
3. Apply special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable, extrusion-type applicator.

F. Glass Bead Application:

1. Immediately after marker application, mechanically apply such that the beads are held by and imbedded in the surface of the molten material.
2. Application Rate: One pound per 20 square feet of compound.

G. Cool completed marking to ambient temperature prior to allowing vehicular traffic.

3.05 INSTALLATION OF RAISED REFLECTIVE MARKERS

A. Apply markers to the bonding surface using bituminous adhesives only.

B. Apply the adhesive to the binding surface (not the marker) so that 100 percent of the bonding area of the marker will be covered.

C. Align markers carefully, projecting no more than 3/4-inch above level of pavement. Reflective face of the marker shall be perpendicular to a line parallel to the roadway centerline. Do not install markers over longitudinal or transverse joints of the bonding surface.

D. Spacing: As shown on the Drawings or as required by BCTED.

E. Immediately remove excess adhesive from the bonding surface and exposed surface of the marker.

F. Use only a mineral spirits meeting Federal Specifications TT-T-291 to remove adhesive from exposed faces of markers.

3.06 GLASS BEAD APPLICATION

A. Apply immediately following application of paint.

B. Use evenly distributed, drop-on application method.

C. Rate: 10 pounds per gallon of paint.

3.07 PROTECTION

A. The Contractor shall erect adequate warning signs and/or provide sufficient number of flagmen, and take all necessary precautions for the protection of the materials and safety of the public.

B. Protect surfaces from disfiguration by paint spatters, splashes, spills, or drips.

3.08 CLEANUP

A. Remove paint spatters, splashes, spills, or drips from Work and staging areas and areas outside of the immediate Work area where spills occur.

- END OF SECTION -

SECTION 02771 CONCRETE CURB AND SIDEWALK

PART 1 – GENERAL

(NOT USED)

PART 2 – MATERIALS

2.01 EXPANSION JOINT FILLER

A. 1/2-inch thick, preformed asphalt-impregnated, expansion joint material meeting AASHTO M153 Type I, II, or III, or AASHTO M213, or cellulose fiber types meeting the requirements of AASHTO M213, except the asphalt content is acceptable provided they contain minimum of 0.2 percent copper pentachlorophenate as a preservative and 1 percent water proofing wax.

2.02 CONCRETE

A. Ready-mixed meeting ASTM C94, Option A, with compressive strength of 3,000 psi at 28 days.

B. Maximum Aggregate Size: 1-1/2 inch.

C. Slump: 2 to 4 inches.

2.03 CURING COMPOUND

A. Liquid membrane-forming, clear or translucent, suitable for spray application and meeting ASTM C309, Type 1.

PART 3 – EXECUTION

3.01 FORMWORK

A. Lumber Materials:

1. 2 inch dressed dimension lumber, or metal of equal strength, straight, free from defects that would impair appearance or structural quality of completed curb and sidewalk.
2. 1 inch dressed lumber or plywood may be used where short-radius forms are required.

B. Metals: Steel in new undamaged condition.

C. Setting Forms:

1. Construct forms to shape, lines, grades, and dimensions.
2. Stake securely in place.

D. Bracing:

1. Brace forms to prevent change of shape or movement resulting from placement.
2. Construct short-radius curved forms to exact radius.

E. Tolerances:

1. Do not vary tops of forms from gradeline more than 1/8 inch when checked with 10-foot straightedge.
2. Do not vary alignment of straight sections more than 1/8 inch in 10 feet.

3.02 PLACING CONCRETE

A. Excavate to the required depth, place and compact limerock base rock as specified in the Contract Documents. Compact directly under the area and 1 foot beyond each side of the sidewalk and curb.

B. Prior to placing concrete, remove water from excavation and debris and foreign material from forms.

C. Place concrete as soon as possible, and within 1-1/2 hours after adding cement to mix without segregation or loss of ingredients, and without splashing.

D. Place, process, finish, and cure concrete in accordance with applicable requirements of ACI 304, and this section. Wherever requirements differ, the more stringent shall govern.

E. To compact, vibrate until concrete becomes uniformly plastic.

F. All edges shall be smooth and rounded.

3.03 CURB CONSTRUCTION

A. Construct ramps at pedestrian crossings in compliance with FDOT and PROWAG minimum standards. Standards apply to work in the City's Rights of Way.

B. Expansion Joints: Place at maximum 20-foot intervals and at the beginning and end of curved portions of curb, and at connections to existing curbs. Install expansion joint filler at each joint.

C. Gutter minimum slope shall be 0.33% unless otherwise approved by the City.

D. Curb Facing: Do not allow horizontal joints within 7 inches from top of curb.

E. All gutters and curb and gutters shall have a minimum 4" think limerock "curb pad" LBR 100.

F. Contraction Joints:

1. Maximum 10-foot intervals in curb.
2. Provide open joint type by inserting thin, oiled steel sheet vertically in fresh concrete to force coarse aggregate away from joint.
3. Insert steel sheet to full depth of curb.
4. Remove steel sheet with sawing motion after initial set has occurred in concrete and prior to removing front curb form.
5. Finish top of curb with steel trowel and finish edges with steel edging tool.

G. Front Face:

1. Remove front form and finish exposed surfaces when concrete has set sufficiently to support its own weight.
2. Finish formed face by rubbing with burlap sack or similar device to produce uniformly textured surface, free of form marks, honeycomb, and other defects.

3. Remove and replace *defective* concrete.
4. Apply curing compound to exposed surfaces of curb upon completion of finishing.
5. Continue curing for minimum of 5 days.

H. Backfill curb with earth upon completion of curing period, but not before 7 days has elapsed since placing concrete.

1. Backfill shall be free from rocks 2 inches and larger and other foreign material.
2. Compact backfill firmly.

3.04 SIDEWALK CONSTRUCTION

A. Thickness:

1. 4 inches thick minimum, 6 inches thick at driveways, extended two feet beyond drive on both sides

B. Connection to Existing Sidewalk:

1. Remove old concrete back to an existing contraction joint.
2. Clean the surface.
3. Apply a neat cement paste immediately prior to placing new sidewalk.

C. Expansion Joints: Place at maximum 20-foot intervals, at adjacent curb expansion joint, where sidewalk ends at curb, and around posts, poles, or other objects penetrating sidewalk. Install expansion joint filler at each joint.

D. Contraction Joints:

1. Provide transversely to walks at locations opposite contraction joints in curb.
2. Dimensions: 3/16-inch by 1-inch weakened plane joints.
3. Construct straight and at right angles to surface of walk.

E. Finish:

1. Broom surface with fine-hair broom at right angles to length of walk and tool at edges, joints, and markings.
2. Ensure that the surface variations are not more than ¼ inch under a 10-foot straightedge, or more than 1/8 inch on a 5-foot transverse section.
3. Mark walks transversely at 5 foot intervals, or in pattern shown on Drawings, with jointing tool; finish edges with rounded steel edging tool.
4. Apply curing compound to exposed surfaces upon completion of finishing.
5. Protect sidewalk from damage and allow to cure for at least 7 days.

F. Curb Ramps:

1. All curb ramps and detectable warnings shall comply with the current FDOT Index 304 and the Accessibility Guidelines for Pedestrian Facilities in the Public Right-of- Way by the United States Access Board.

- END OF SECTION -

SECTION 02772 ASPHALT PAVEMENT

PART 1 – GENERAL

1.01 STANDARD SPECIFICATIONS

A. When referenced in this Section, Standard Specifications shall mean Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition.

1.02 QUALITY ASSURANCE

A. Qualifications:

1. Independent Testing Laboratory: In accordance with ASTM E329.
2. Asphalt concrete mix formula shall be prepared by an approved certified independent laboratory under the supervision of a certified asphalt technician.

1.03 SUBMITTALS

A. The Contractor shall submit its proposed formula for the asphaltic concrete paving for review in accordance with the Section entitled “Submittals”.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Do not apply asphalt materials or place asphalt mixes when ground temperature is lower than 10 degrees C (50 degrees F), or air temperature is lower than 4 degrees C (40 degrees F). Measure ground and air temperature in shaded areas away from heat sources or wet surfaces.

B. Moisture: Do not apply asphalt materials or place asphalt mixes when application surface is wet.

PART 2 – MATERIALS

2.01 MATERIALS

A. Prime Coat: Cut-back asphalt, Grades RC-70 or RC-250 meeting the requirements of the Standard Specifications.

B. Tack Coat: Emulsified asphalt, Grade RS-2, SS-1, or SS-1H meeting the requirements of the Standard Specifications. The bituminous material shall be heated to a suitable consistency as directed by the City.

C. Sand (Blotter Material): Clean, dry, with 100 percent passing a 4.75 mm (No. 4) sieve, and a maximum of 10 percent passing a 75 mm (No. 200) sieve.

2.02 ASPHALT CONCRETE MIX

A. General:

1. Mix formula shall not be modified except with the written approval of City.
2. Source Changes:
   a. Should material source(s) change, establish a new asphalt concrete mix formula before the

new material(s) is used.
b. Perform check tests of properties of the plant-mix bituminous materials on the first day of production and as requested by City to confirm that properties are in compliance with design criteria.
c. Make adjustments in gradation or asphalt content as necessary to meet design criteria.

B. Asphalt Concrete: Type SP meeting the requirements of the Standard Specifications.

C. Composition: Hot-plant mix of aggregate, mineral filler, and paving grade asphalt cement. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the mix formula.

D. Aggregate:

1. The aggregate shall meet the requirements of the Standard Specifications.
2. Mineral Filler shall meet the requirements of the Standard Specifications

E. Asphalt Cement: Paving Grade AC-30 meeting the requirements of the Standard Specifications.

PART 3 – EXECUTION

3.01 GENERAL

A. Traffic Control: Minimize inconvenience to traffic, but keep vehicles off freshly treated or paved surfaces to avoid pickup and tracking of asphalt.

B. Driveways: Repave driveways from which pavement was removed. Leave driveways in as good or better condition than before start of construction.

3.02 LINE AND GRADE

A. Provide and maintain intermediate control of line and grade, independent of the underlying base to meet finish surface grades and minimum thickness.

B. Shoulders: Construct to line, grade, and cross-section shown.

3.03 PREPARATION

A. Prepare subgrade as specified in the Contract Documents.

B. Existing Roadway:

1. Modify profile by grinding, milling, or overlay methods as approved, to provide meet lines and surfaces and to produce a smooth riding connection to existing facility.
2. Resurface entire roadway following adjustment of base and asphalt grades.
3. Paint edges of meet line with tack coat prior to placing new pavement.

C. Thoroughly coat edges of contact surfaces (curbs, manhole frames) with emulsified asphalt or asphalt cement prior to laying new pavement. Prevent staining of adjacent surfaces.

3.04 PAVEMENT APPLICATION

A. General: Place asphalt concrete mixture on an approved, prepared base in conformance with this Section.

B. Cold Milling

1. Milling of existing asphalt pavement shall be at the depth and location as indicated on the Construction Drawings or as directed by the City.
2. The milled surface shall be reasonably smooth and free of excessive scarification marks, gouges, ridges, continuous grooves, or other damage. The milled pavement surface shall be thoroughly cleaned of all loose aggregate particles, dust, and other objectionable material by the use of power brooms, power blowers, power vacuums or other means.
3. The Contractor shall coordinate the adjustment of maintenance access structures, meter boxes, drainage inlets, and valve boxes with the milling operation.
4. All milled material shall become the property of the Contractor and shall be disposed of off-site or used in conformance with the Contract Documents, or for utilization as Reclaimed Asphalt Pavement, in conformance with the specification provided above, as approved by the City.

C. Prime Coat:

1. Heat cut-back asphalt between 100 degrees F and 150 degrees F prior to application.
2. Apply uniformly to clean, dry surfaces. Avoiding overlapping of applications.
3. Do not apply when moisture content of upper 3 inches of base exceeds optimum moisture content of base, or if free moisture is present.
4. Application Rate: Minimum 0.1 gallons per square yard of surface area.
5. Remove or redistribute excess material.
6. Allow a minimum of 5 full days for curing of primed surface before placing asphalt concrete.

D. Tack Coat:

1. Apply uniformly to clean, dry surfaces. Avoiding overlapping of applications.
2. Do not apply more tack coat than necessary for the day's paving operation.
3. Touch up missed or lightly coated surfaces and remove excess material.
4. Application Rate:
   a. Minimum 0.05 gallons to maximum 0.12 gallons of asphalt (residual if diluted emulsified asphalt) per square yard of surface area.
   b. Apply at rate, within range specified, sufficient to assure good bonding, but not so heavy that surplus asphalt flushes into asphalt concrete being placed.

E. Pavement Mix:

1. Prior to Paving:
   a. Sweep primed surface free of dirt, dust, or other foreign matter.
   b. Patch holes in primed surface with asphalt concrete pavement mix.
   c. Blot excess prime material with sand.
2. Place asphalt concrete pavement mix in lifts as shown.
3. Compacted Lift Thickness:
   a. Minimum: Twice the maximum aggregate size, but in no case less than 1 inch. Minimum thickness for Type SP-9.5 is 1.0 inches.
   b. Maximum: 4 inches.
4. Total Compacted Thickness: Per Contract Documents.

5. Apply such that meet lines are straight and edges are vertical.
6. Collect and dispose of segregated aggregate from raking process. Do not scatter material over finished surface.
7. Joints:
   a. Offset edge of each layer a minimum of 6 inches so joints are not directly over those in underlying layer.
   b. Offset longitudinal joints in roadway pavements, so longitudinal joints in wearing layer coincide with pavement centerlines and lane divider lines.
   c. Form transverse joints by cutting back on previous day's run to expose full vertical depth of layer.
8. Succeeding Lifts: Apply tack coat to pavement surface between each lift.
9. After placement of pavement, seal meet line by painting a minimum of 6 inches on each side of the joint with cut-back or emulsified asphalt. Cover immediately with sand.

F. Compaction:

1. Roll until roller marks are eliminated and compacted to 100 percent of the laboratory compacted mixture.
2. Joint Compaction:
   a. Place top or wearing layer as continuously as possible.
   b. Pass roller over unprotected end of freshly laid mixture only when placing of mix is discontinued long enough to permit mixture to become chilled.
   c. Cut back previously compacted mixture when Work is resumed to produce a slightly beveled edge for full thickness of layer.
   d. Cut away waste material and lay new mix against fresh cut.

G. Tolerances:

1. General: Conduct measurements for conformity with crown and grade immediately after initial compression. Correct variations immediately by removal or addition of materials and by continuous rolling.
2. Completed Surface or Wearing Layer Smoothness:
   a. Uniform texture, smooth, and uniform to crown and grade.
   b. Maximum Deviation: 1/8 inch from lower edge of a 12-foot straightedge, measured continuously parallel and at right angle to centerline.
   c. If surface of completed pavement deviates by more than twice the specified tolerances, remove and replace wearing surface.
3. Transverse Slope Maximum Deviation: ¼ inch in 12 feet from the rate of slope shown.
4. Finished Grade:
   a. Perform a field differential level survey on a maximum 50-foot grid and along all grade breaks.
   b. Maximum Deviation: 0.02 foot from the grade shown.

H. Seal Coat:

1. General: Apply seal coat of paving grade or emulsified asphalt to finished surface at longitudinal and transverse joints, joints at abutting pavements, areas where the asphalt concrete was placed by hand, patched surfaces, and other areas as directed by the City.
2. Preparation:
   a. Maintain surfaces that are to be sealed free of holes, dry, and clean of dust and loose material.

b. Seal in dry weather and when the temperature is above 35 degrees F.

3. Application:
   a. Fill cracks over 1/16 inch in width with an asphalt-sand slurry or approved crack sealer prior to sealing.
   b. When sealing patched surfaces and joints with existing pavements, extend minimum 6 inches beyond edges of patches.

3.05 PAVEMENT OVERLAY

A. Preparation:

1. Remove fatty asphalt, grease drippings, dust, and other deleterious matter.
2. Surface Depressions: Fill with asphalt concrete mix, and thoroughly compact.
3. Damaged Areas: Remove broken or deteriorated asphalt concrete and patch as specified in Article Patching.
4. Portland Cement Concrete Joints: Remove joint filler to minimum 1/2 inch below surface.

B. Application:

1. Tack Coat: As specified in this Section.
2. Place and compact asphalt concrete as specified in Article Pavement Application.
3. Place first layer to include widening of pavement and leveling of irregularities in the surface of the existing pavement.
4. When leveling irregular surfaces and raising low areas, the actual compacted thickness of any one lift shall not exceed 2 inches.
5. The actual compacted thickness of intermittent areas of 120 square yards or less may exceed 2 inches, but not 4 inches.
6. Final wearing layer shall be of uniform thickness, and meet grade and cross-section as shown.

3.06 PATCHING HOT MIX ASPHALT

A. Preparation:

1. Remove damaged, broken, or unsound asphalt concrete adjacent to patches. Trim to straight lines exposing smooth, sound, vertical edges.
2. Prepare patch subgrade as specified in the Contract Documents.

B. Application:

1. Patch Thickness: 3 inches or thickness of adjacent asphalt concrete, whichever is greater.
2. Place asphalt concrete mix across full width of patch in layers of equal thickness.
3. Spread and grade asphalt concrete with hand tools or mechanical spreader, depending on size of area to be patched.

C. Compaction:

1. Roll patches with power rollers capable of providing compression of 200 to 300 pounds per linear inch. Use hand tampers where rolling is impractical.
2. Begin rolling top course at edges of patches, lapping adjacent asphalt surface at least 1/2 the roller width. Progress toward center of patch overlapping each preceding track by at least 1/2 the width of roller.
3. Make sufficient passes over entire area to remove roller marks and to produce desired finished surface.

D. Tolerances:

1. Finished surface shall be flush with and match grade, slope, and crown of adjacent surface.
2. Tolerance: Surface smoothness shall not deviate more than plus 1/4 inch or minus 0 when a straightedge is laid across patched area between edges of new pavement and surface of old surfacing.

3.07 FIELD QUALITY CONTROL

A. General: Provide services of an approved certified independent testing laboratory to conduct tests.

B. Field Density Tests:

1. Perform tests from cores or sawed samples.
2. Measure with properly operating and calibrated nuclear density gauge.
3. Maximum Density: In accordance with ASTM D2041, using a sample of mix taken prior to compaction from the same location as the density test sample.

C. Testing Frequency:

1. Quality Control Tests:
   a. Asphalt Content, Aggregate Gradation: Once per every 500 tons of mix or once every 4 hours, whichever is greater.
   b. Mix Design Properties, Measured Maximum (Rice's) Specific Gravity: Once every 1,000 tons or once every 8 hours, whichever is greater.
2. Density Tests: Once every 500 tons of mix or once every 4 hours, whichever is greater.

- END OF SECTION -

SECTION 02820 FENCE SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the privacy aluminum fence system defined herein at Victoria Park Stormwater Pump Station in Fort Lauderdale, Florida.

1.02 RELATED WORK

A. Section 02300 - Earthworks

B. Division 03 - Concrete

1.03 SYSTEM DESCRIPTION

A. The manufacturer shall supply a steel framework Trac system design manufactured by FenceTrac™ or approved equal. The system shall include all components (i.e., all necessary components, posts, gates and hardware) required.

1.04 QUALITY ASSURANCE

A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.05 REFERENCES

A. ASTM International

1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
3. ASTM D523 - Test Method for Specular Gloss.
4. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
5. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
6. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
7. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
8. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
9. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.

1.06 SUBMITTAL

A. The manufacturer's submittal package shall be provided prior to installation.

1.07 PRODUCT HANDLING AND STORAGE

A. Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

PART 2 - MATERIALS

2.01 MANUFACTURER

A. The commercial ornamental steel fence system shall conform to FenceTrac standard system with Aluminum style filler materials supplied by FenceTrac or approved equal. FenceTrac is manufactured in Tulsa, OK. Contact: 918-794-8722; info@fencetrac.com

2.02 MATERIAL

A. Steel material for fence framework, when galvanized prior to forming, shall conform to the requirements of ASTM A924/A924M, with a minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft^2 (275 g/m^2), Coating Designation G-90.

B. Steel material for posts, when galvanized prior to forming, shall conform to the requirements of ASTM A924/A924M, with a minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.60 oz/ft2(183 g/m2), Coating Designation G-60.

C. Material for the Top and Bottom Tracs shall be 18 Ga. steel. Material for the Post Mount and Vertical-H Tracs shall be 18 Ga. steel. The cross-sectional shape of the rails shall conform to the manufacturer's roll-formed U-channel design. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

2.03 FABRICATION

A. All fence framework shall be pre-cut to specified lengths. The Post Mount Tracs shall be pre-drilled for attachment to the posts.

B. The manufactured steel framework and posts shall be subjected to a multi-stage pretreatment cleaning and coating process. Starting with the pre-rinse and wash process for good adhesion, followed by oven drying in preparation for powder coat application, then adding an electrostatic spray application of a thermosetting Polyester-TGIC powder coat finish. The total coating shall be a minimum thickness of 3 mils (0.0762mm). The color shall be (specify Black, Bronze, White or Beige). The coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.

C. Completed sections shall be capable of supporting appropriate wind speeds according to ASCE 7-22 for Commercial/Industrial designed systems only. Residential applications will vary and wind speed testing can be calculated for an additional cost if necessary. Panels without special ornamentation or custom additions on top shall be biasable up to a 45% change in grade.

PART 3 - EXECUTION

3.01 PREPARATION

A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.02 FENCE INSTALLATION

A. Fence post shall be spaced according to FenceTrac installation instructions or Submittal drawings. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence sections shall be attached to posts with self-tapping screws supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36” (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The 02300 Earthworks and 03300 Cast-In-Place Concrete sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application. Alternative materials on posts are also possible with the FenceTrac system, additional contact may be necessary to complete special post installations.

3.03 FENCE INSTALLATION MAINTENANCE

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. FenceTrac spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-FenceTrac parts or components will negate the manufactures’ warranty.

3.04 GATE INSTALLATION

A. Gate posts shall be spaced according to the manufacturers’ gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers’ gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer’s recommendations.

3.05 CLEANING

A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

Table 1 – Minimum Sizes for FenceTrac Posts			
Fence Posts (Steel)	Panel Height		
2-1/2" x 16 Ga.	Up to & Including 6' Height for Residential Applications		
2-1/2" x 14 Ga.	Up to & Including 6' Height for Residential Applications		
2-1/2" x 12 Ga.	Up to & Including 8' Height for Residential Applications		
3" x 12 Ga.	Up to & Including 8' Height for Commercial Applications		
4" x 12 Ga.	Up to & Including 8' Height for Commercial Applications		
4" x 11 Ga.	Up to & Including 10' Height for Commercial Applications		
Gate Leaf	Gate Height		
	Up to & Including 6'	Over 6' Up to & Including 8'	Over 8' Up to & Including 10'
Up to 4'	2-1/2" x 14Ga.	3" x 12 Ga.	4" x 11 Ga.
4'1" to 6'	3" x 12Ga.	3" x 12 Ga.	4" x 11 Ga.
6'1" to 8'	4" x 11 Ga.	4" x 11 Ga.	6" x 3/16"

Table 2 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance minimum 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

- END OF SECTION -

SECTION 02900 LANDSCAPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish, install, establish and maintain landscaping as indicated in the Contract Documents.
2. The allowable Contract Time is two separate phases called Installation Period and Establishment Period. The Installation Period precedes the Establishment Period and is the allowable Contract Time minus the two-year Establishment Period.
3. Failure to complete the installation and establishment of the landscaping within allowable Contract Time will result in liquidated damages being assessed and withheld in accordance with the General Conditions.
4. The two-year Establishment Period will begin when plants have been installed and accepted by the Engineer regardless of the duration of the time used for the Installation Period.

B. Related Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.

C. Completely coordinate with work of other trades.

1.02 SUBMITTALS

A. See Section 01300 for requirements for the mechanics and administration of the submittal process.

PART 2 – PRODUCTS

2.01 GRADE STANDARDS AND CONFORMITY WITH TYPE AND SPECIES

A. Only use nursery grown plant materials purchased from Florida based Nurseryman Stock that comply with all required inspection, grading standards, and plant regulations in accordance with the latest edition of the Florida Department of Agriculture's "Grades and Standards for Nursery Plants."

B. Unless otherwise specified, minimum grade for all plants is Florida No. 1. All plants must be the specified size and grade at the time of delivery.

C. Use only plants that are true to type and species, free of fungal infection and disease and ensure that the plants not specifically covered by Florida Department of Agriculture's "Grades and Standards for Nursery Plants" conform in type and species with the standards and designations in general acceptance by Florida nurseries.

Submit a list of nurseries where plants are tagged for the work document including contact information and location. The Engineer and Contractor may visit the nursery sites to inspect representative samples of plant material and lock tag the example plants. Prior to planting, provide the Engineer with a certification from the supplying nursery that all plant materials have been purchased from Florida based Nurseryman Stock.

D. A minimum of two plants of each species on each shipment must be shipped with tags stating the botanical nomenclature and common name of the plant. Should discrepancies arise between botanical nomenclature and common name, the botanical name will take precedence.

Root Ball Sizes for Field Grown Palms			
Palm Type	**Overall Height**	**Root Ball Radius from Trunk**	**Root Ball Depth**
Sabal Palm*	N/A	Per Florida Grades & Standards	Per Florida Grades & Standards
Coconut Palm	N/A	Per Florida Grades & Standards	Per Florida Grades & Standards
Queen Palm	N/A	24”	24”
All Other Field Grown Palms	< 15’ OA	12”	18”
	15’ – 25’ OA	16”	24”
	26’ – 30’ OA	18”	30”
	30’	24”	36”

* Sabal palms (Sabal palmetto) specified as being “Regenerated Palms” as shown on the Plant Schedules shall be minimum Florida no. 1 grade unless noted otherwise. The root ball width shall be, at a minimum, equal to twice the diameter of the trunk as measured at the base. The root balls shall have new, regenerated, round-tipped roots that have emerged from the root initiation zone. Roots shall be whitish-yellow in color, have tapered ends and be present on all sides of the root ball.
To qualify as “Regenerate Palms,” sabal palms shall have been placed in containers or be contained within “plastic fabric or film material”, or approved equal, after field harvesting and during the root regeneration period. They shall
have a minimum of three fully expanded new fronds that have not been pruned. Fully expanded new fronds shall meet the minimum requirements to be considered “excellent leaves”, as defined by the glossary of terms in the latest edition of the Florida Department of Agriculture and Consumer Services Grades and Standards for Nursery Plants – Palms and Cycads.

2.02 INSPECTION AND TRANSPORTING

A. Move nursery stock in accordance with all Federal and State regulations and accompany each shipment with the required inspection certificates. Submit inspection certificates to the Engineer.

2.03 WATER

A. Water may be obtained from any approved source. The water shall be free of any substance which might be harmful to plant growth. Effluent water shall meet all Federal, State, and local requirements.

2.04 MULCH

A. Use of cypress mulch is prohibited.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Layout:

1. The location of plants as shown on the work document, are approximate. At no cost to the Owner, the final locations may be adjusted to accommodate unforeseen field conditions or to comply with safety setbacks and requirements.
2. Mark proposed mowing limits, planting beds and individual locations of trees and palms as shown in the Contract Documents for the Engineer’s review, prior to excavation or planting.
3. Make no changes to the layout, materials or any variations of plant materials from the Contract

Documents without the Engineer's written approval.

B. Soil Drainage:

1. All planting holes and beds must drain sufficiently prior to installing any plants. Immediately notify the Engineer of drainage or percolation problems before plant installation.

C. Planting:

1. Meet the requirements of the Contract Documents.

D. Repair and Restoration:

1. Repair and restore existing areas disturbed by installation, establishment or maintenance activities. Where new turf is required to restore and repair disturbed areas, sod shall be sufficiently thick to secure a dense stand of live turf. Sod shall be live, fresh, and uninjured at the time of planting. It shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all handling. It shall be planted within 48 hours after being cut and kept moist from the it is cut until it is planted.

E. Disposal of Debris:

1. Remove and dispose of all debris and excess material generated from the installation of plants at the end of each day's work and in compliance with all Federal, State and Local laws and ordinances.

F. Reporting:

1. Certify monthly on a form provided by the Owner, Landscape Monthly Inspection Form, that the plants have been installed and are being established and maintained in accordance with the Contract Documents.

G. Establishment Plan:

1. Not less than 45 days prior to the scheduled completion of the installation, submit an Establishment Plan and Inspection Plan to the Engineer for review and comment. Installation will be considered complete only when the Establishment Plan has been accepted by the Engineer. Specifically describe the methods, activities, materials and schedule to achieve establishment of plants. Acceptance of the Establishment Plan is not a release from responsibility for the overall establishment and maintenance of the planting area as required in the Contract Documents; perform any supplemental activities, in addition to the Establishment Plan, that may be required to adequately establish and maintain the planting area.

H. Installation Completion:

1. To allow time for scheduling inspection of installation, provide the Engineer with seven calendar days advance notice of completion of installation of all plants. Upon completion of installation of plants, certify on a form provided by the Owner, "Contractor Certification of Installation" that the landscaping has been installed and is being established in accordance with the Contract Documents.

3.02 ESTABLISHMENT

A. Establishment Period:

1. The establishment period is defined as the entire two years after installation of all plants and incidental landscaping. The establishment period will begin upon acceptance by the Engineer of the Establishment Plan and the complete installation of landscaping.

B. During the establishment period:

1. Keep all plants undamaged, free of pests and disease, properly hydrated and nourished, supported to grow and maintain form and general appearance of the plants specified in the Contract documents and the Establishment Plan.
2. Keep all plants pruned to maintain plant health, clear visibility of signs, traffic signals, safe sight distance at intersections and driveways, safe and operational horizontal and vertical clearance from roadways, sidewalks, utilities, light poles, traffic control signals and devices, toll equipment and facilities, mechanical equipment, fences, walls and drainage structures, and to provide unobstructed access. Pruning shall conform to ANSI A300 Part 1 Standards. Pruning shall be performed by an International Society of Arboriculture (ISA) Certified Arborist or person with documentation of equivalent or greater expertise. Prior to performing pruning activities provide proof of the individual's active arborist certification or other credential to the Engineer for approval.
3. Keep the individual plant locations and planting beds free of litter, debris, excess material and undesirable vegetation.
4. Keep landscape bed edges correctly located and trimmed, and the mulch groomed and replenished as specified in the Contract Documents.
5. Operate and maintain all components of any irrigation system when installed as part of the Contract.
6. Remove staking and guying from all fully established plants unless otherwise directed by the Engineer.
7. Continue any mowing and litter pick up of the turf areas as depicted and specified in the Contract Documents.

C. Inspection and Reporting Requirements:

1. Beginning the first month of the establishment period, inspect and certify at a monthly interval on the Owners's "Landscape Monthly Inspection Form" that the landscaping is being established per the Contract Documents.
2. In addition, at quarterly intervals, beginning within 90 days of the establishment period start date, provide a Registered Landscape Architect to perform inspections of the landscaping and document the findings in a signed and sealed report. Information in the inspection report shall include, as a minimum, the following:
   a. Date of inspection
   b. Description of project
   c. Location of inspection
   d. Weather conditions
   e. Condition of plants - identify by species, location, and number of plants that are no longer the specified minimum grade.
   f. Condition of plant beds and adjoining areas (including mulch, turf, edges of planting beds, weeds, and staking and guying), if applicable
   g. Condition and operation of the irrigation system, if applicable
   h. Contractor's response, action, and schedule
   i. Other comments

j. Signature and seal of Landscape Architect

3. Submit the monthly inspection form and the quarterly inspection report to the Engineer within seven calendar days after performing the inspection.

3.03 REMEDIAL WORK

A. Perform all necessary remedial work at no cost to the Owner. Use replacement plants of the same species and planting medium as the plant being replaced and as specified in the Contract Documents. Replacement plant size must match the size of the adjacent grown-in plants of the same species and variety which may be larger than the initially installed size. The establishment time for replacement plants shall be remaining establishment period or 90 days after date of replacement installation acceptance, whichever is greater. Approval of remedial work does not relieve the Contractor from continuing responsibility under the provisions of this Section.

B. At the end of the Work Document period, when all contract requirements are met, the Engineer will release the Contractor from further remedial work.

3.04 METHOD OF MEASUREMENT

A. Installation:

1. The quantity to be paid will be the quantity of plants or trees installed.

B. Establishment:

1. The quantity to be paid will be in equal monthly payments for plants or trees maintained during the establishment period.

3.05 BASIS OF PAYMENT.

A. Price and payment will be full compensation for all work and materials specified in this Section, including all ancillary work and materials necessary to meet the contract requirements.

B. Payment during the Installation Period:

1. The Contractor must make a request for payment by submitting an invoice, based on the amount of work completed. The Contractor's invoice must consist of the following:
   a. Contract Number, Financial Project Identification Number, Invoice Number, Invoice Date and the period that the invoice represents.
   b. The basis for arriving at the amount of the progress invoice including approximate quantities of work completed on each Work Document, less payments previously made and less an amount previously forfeited.
   c. Contract Summary showing the percentage of dollar value of completed work based on the present Contract amount and the percentage of days used based on the present Contract Days.
   d. Payment will be made in accordance with the total unit price for each item listed in the Bid Price Proposal after applying the Bid Factor to three decimal places.

- END OF SECTION -

SECTION 02911 SOIL PREPARATION

PART 1 – GENERAL

1.01 SEQUENCING AND SCHEDULING

A. Rough grade areas to be planted or seeded prior to performing Work specified under this Section.

1.02 APPLICABLE STANDARDS AND SPECIFICATIONS

A. Comply with the following standards and specifications for all materials, methods, and workmanship unless otherwise noted:

1. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.
2. City of Fort Lauderdale Code of Ordinances.

PART 2 – PRODUCTS

2.01 TOPSOIL

A. General: Uniform mixture of 50 percent sand and 50 percent muck in a loose friable condition, free from objects larger than 1-1/2 inches maximum dimension, and free of subsoil, roots, grass, other foreign matter, hazardous or toxic substances, and deleterious material that may be harmful to plant growth or may hinder grading, planting, or maintenance.

B. Textural Amendments: Amend as necessary to conform to required composition.

C. Source: Import topsoil if onsite material fails to meet specified requirements or is insufficient in quantity.

2.02 SOURCE QUALITY CONTROL

A. Topsoil Analysis/Testing: Performed by county or state soil testing service or approved certified independent testing laboratory.

B. Should soil tests prove the topsoil to alkaline or above the accepted minimum for salt content, the topsoil shall be removed and replaced by acceptable material at Contractor’s expense.

PART 3 – EXECUTION

3.01 SUBGRADE PREPARATION

A. The subgrade shall be 4 inches lower than finished grade with 2 inches of topsoil added to sod areas.

B. Scarify subgrade to minimum depth of 6 inches where topsoil is to be placed.

C. Remove stones over 2-1/2 inches in any dimension, sticks, roots, rubbish, and other extraneous material.

D. Limit preparation to areas which will receive topsoil within 2 days after preparation.

3.02 TOPSOIL PLACEMENT

A. Topsoil Thickness:

1. Sodded Areas: 2 inches.
2. Planting Beds: 6 inches.

B. Do not place topsoil when subsoil or topsoil is excessively wet or otherwise detrimental to the Work.

C. Mix soil amendments with topsoil before placement or spread on topsoil surface and mix thoroughly into entire depth of topsoil before planting or seeding.

D. Uniformly distribute to within 1/2-inch of final grades. Fine grade topsoil eliminating rough or low areas and maintaining levels, profiles, and contours of subgrade.

E. Remove stones exceeding 1-1/2 inches, roots, sticks, debris, and foreign matter during and after topsoil placement.

F. Remove surplus subsoil and topsoil from site. Grade stockpile area as necessary and place in condition acceptable for planting or seeding.

- END OF SECTION -

SECTION 02920 SODDING

PART 1 – GENERAL

1.01 DEFINITIONS

A. Maintenance Period: Begin maintenance immediately after each area is planted (sod) and continue for a period of 8 weeks after all planting under this Section is completed.

B. Satisfactory Stand:

1. Grass or section of grass that has:
   a. No bare spots larger than 3 square feet.
   b. Not more than 10 percent of total area with bare spots larger than 1 square foot.
   c. Not more than 15 percent of total area with bare spots larger than 6 square inches.

1.02 DELIVERY, STORAGE, AND PROTECTION

A. Sod:

1. Do not harvest if sod is excessively dry or wet to the extent survival may be adversely affected.
2. Harvest and deliver sod only after laying bed is prepared for sodding.
3. Roll or stack to prevent yellowing.
4. Deliver and lay within 24 hours of harvesting.
5. Keep moist and covered to protect from drying from time of harvesting until laid.

1.03 WEATHER RESTRICTIONS

A. Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.04 SEQUENCING AND SCHEDULING

A. Prepare topsoil as specified in the Contract Documents, before starting Work of this Section.

B. Complete Work under this section within ten (10) days following completion of soil preparation.

C. Notify City at least three (3) days in advance of:

1. Each material delivery.
2. Start of planting activity.

D. Planting Season: Those times of year that are normal for such Work as determined by accepted local practice. At a minimum, Contractor shall avoid planting in January or February.

1.05 MAINTENANCE SERVICE

A. Contractor: Perform maintenance operations during maintenance period to include:

1. Watering: Keep surface moist.

2. Washouts: Repair by filling with topsoil, and replace sodded areas.
3. Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3 1/2 inches.
4. Re-sod unsatisfactory areas or portions thereof immediately at the end of the maintenance period if a satisfactory stand has not been produced, at which time maintenance period shall recommence.
5. Re-sod during next planting season if scheduled end of maintenance period falls after September 15.

PART 2 – MATERIALS

2.01 FERTILIZER

A. Commercial, uniform in composition, free-flowing, suitable for application with equipment designed for that purpose. Minimum percentage of plant food by weight.

B. Mix:

1. Nitrogen: Sixteen.
2. Phosphoric Acid: Four.
3. Potash: Eight.

2.02 SOD

A. Unless a particular type of sod is called for, sod may be of either St. Augustine Floritam, or Seashore Paspalum, in accordance with the following:

1. Use St. Augustine Floritam where an irrigation system is in place. If original sod being replaced is St. Augustine Floritam, replacement sod shall match.
2. Seashore Paspalum sod will be used in areas prone to salt water flooding.

B. Strongly rooted pads, capable of supporting own weight and retaining size and shape when suspended vertically from a firm grasp on upper 10 percent of pad.

1. Grass Height: Normal.
2. Strip Size: Supplier's standard, commercial size rectangles.
3. Soil Thickness: Uniform; 1-inch plus or minus 1/4-inch at time of cutting.
4. Age: Not less than 10 months or more than 30 months.
5. Condition: Healthy, green, moist; free of diseases, nematodes and insects, and of undesirable grassy and broadleaf weeds. Yellow sod, or broken pads, or torn or uneven ends will not be accepted
6. Any netting contained within the sod shall be certified by the manufacturer to be bio-degradable within a period of 3 months from installation.

PART 3 – EXECUTION

3.01 PREPARATION

A. Grade Areas to Smooth, Even Surface with Loose, Uniformly Fine Texture:
   1. Roll and rake, remove ridges, fill depressions to meet finish grades.
   2. Limit such Work to areas to be planted within immediate future.
   3. Remove debris, foreign material and stones larger than 1 1/2 inches diameter, and other objects that may interfere with planting and maintenance operations.

B. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry off before seeding. Do not create muddy soil.

C. Restore prepared areas to specified condition if eroded or otherwise disturbed after preparation and before planting.

D. Limit preparation to those areas that can be sodded within 72 hours after preparation.

3.02 FERTILIZER

A. Apply evenly over area in accordance with manufacturer's instructions. Mix into top 2 inches of top soil.

B. Application Rate: 20 pounds per 1,000 square feet (1,000 pounds per acre).

3.03 SODDING

A. Do not plant dormant sod, or when soil conditions are unsuitable for proper results.

B. Pre-wet the area prior to placing sod. Lay sod to form solid mass with tightly fitted joints; butt ends and sides, do not overlap:

   1. Stagger strips to offset joints in adjacent courses.
   2. Work from boards to avoid damage to subgrade or sod.
   3. Tamp or roll lightly to ensure contact with subgrade; work sifted soil into minor cracks between pieces of sod, remove excess to avoid smothering adjacent grass.
   4. Complete sod surface true to finished grade, even, and firm.

C. Fasten sod on slopes to prevent slippage with wooden pins 6 inches long driven through sod into subgrade, until flush with top of sod. Install at sufficiently close intervals to securely hold sod.

D. Water sod with fine spray immediately after planting. During first month, water daily or as required to maintain moist soil to depth of 4 inches.

3.04 FIELD QUALITY CONTROL

A. Eight weeks after sodding is complete and on written notice from Contractor, City will, within 15 days of receipt, determine if the sod has been satisfactorily established.

B. If the sod is not satisfactorily established, Contractor shall replace the sod and repeat the requirements of this Section.

- END OF SECTION -

SECTION 03100 CONCRETE FORMWORK

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall design and furnish all materials for concrete formwork, bracing, and supports and shall design and construct all falsework, all in accordance with the provisions of the Contract Documents.

1.02 RESPONSIBILITY

A. The design and engineering of the formwork as well as safety considerations are the responsibility of the Contractor.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 03200 - Concrete Reinforcement

C. Section 03300 - Cast in Place Concrete

D. Section 03315 - Grout

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

1. Codes and Standards

    a. The Building Code, as referenced herein, is the Florida Building Code (FBC).

2. Government Standards

    a. PS 1U.S. Product Standard for Concrete Forms, Class I.

3. Commercial Standards

    a. ACI 347 Recommended Practice for Concrete Formwork.

    b. ACI 318R Building Code Requirements for Reinforced Concrete.

    c. ACI 350Code Requirements for Environmental Engineering Concrete Structures

1.05 QUALITY ASSURANCE

A. The variation from established grade or lines shall not exceed 1/4 inch in 10 feet and there shall be no offsets or visible bulges or waviness in the finished surface. All tolerances

shall be within the "Suggested Tolerances" specified in ACI 347. The Contractor shall grind smooth all fins and projections between formwork panels as directed by the Engineer.

B. Curved forms shall be used for curved and circular structures that are cast-in-place. Straight panels will not be acceptable for forming curved structures.

PART 2 – PRODUCTS

2.01 FORM MATERIALS

A. Except as otherwise expressly accepted by the Engineer, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:

1.	Footing sides	-	Construction grade Hem Fir or Douglas Fir
2.	Walls	-	Steel or plywood panel
3.	Columns	-	Steel, plywood or fiber glass
4.	Roof and floor Slabs	-	Plywood
5.	All other work	-	Steel panels, plywood or tongue and groove lumber

B. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:

1. Lumber shall be Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS I for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8 inch thick.

2.02 PREFABRICATED FORMS

A. Form materials shall be metal, wood, plywood, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall be an acceptable type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

2.03 FORMWORK ACCESSORIES

A. Exterior corners in concrete members shall be provided with 3/4 inch chamfers. Re entrant corners in concrete members shall not have fillets unless otherwise shown.

B. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form tie fasteners having a circular cross section, shall not exceed 1 1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.

C. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. At locations where removable taper ties are acceptable, a preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Greenstreak Group, Inc., or approved equal. Friction fit plugs shall not be used.

D. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "Bug Holes" in cast-in-place concrete.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms and falsework, shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantially, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete.

C. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8 inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent

loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1 1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean outs shall be as acceptable to the Engineer.

D. Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory affect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

3.02 EARTH FORMS

A. All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1 inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

3.03 FOOTINGS, SLAB EDGES AND GRADE BEAMS

A. Provide wood side forms for all footings, slab edges and grade beams.

3.04 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.05 INSERTS, EMBEDDED PARTS AND OPENINGS

A. Embedded Form Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for in Section 03350 entitled "Concrete Finishes". Wire ties for holding forms will not be permitted. No form tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1 inch back from the formed face or faces of the concrete.

3.06 FORM CLEANING

A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined

as surfaces which are permanently exposed to view. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.07 FORMWORK TOLERANCES

A. Formwork shall be constructed to insure that finished concrete surfaces will be in accordance with the tolerances listed in ACI 347.

1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown in the Drawings:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation from the level or from the grades shown on the Drawings	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation from the plum	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation in the thickness of slabs and walls	Minus 1/4 inch; Plus 1/2 inch
Variation in the locations and sizes of slab and wall openings	Plus or minus 1/4 inch

3.08 FORM REMOVAL

A. Remove top forms on sloping surfaces of concrete as soon as removal operations will not allow the concrete to sag. Perform any needed repairs or treatments required on sloping surfaces at once, and follow immediately with the specified curing.

B. The Contractor shall be responsible for the removal of forms and shores. Forms or shores shall not be removed before test cylinders have reached the specified minimum 28-day compressive strength for the class of concrete specified in Section 03300 entitled "Cast-in-Place Concrete", nor sooner than listed below:

1. Grade beam side forms - 3 days

2. Wall forms - 3 days

3. Column forms - 3 days

4. Beam and girder side forms - 3 days

5. Beam bottoms and slab forms/shores - 14 days

3.09 MAINTENANCE OF FORMS

A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms

shall be thoroughly cleaned. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the Contractor shall perform the oiling at least two weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

- END OF SECTION -

SECTION 03200 CONCRETE REINFORCEMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, fabricate and place all concrete reinforcing steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete and shall perform all appurtenant work, including all the wires, clips, supports, chairs, spacers, and other accessories and special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion, all in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 03100 - Concrete Formwork

C. Section 03300 - Cast in Place Concrete

D. Section 03315 - Grout

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of these specifications, all Work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

1. Codes and Standards

    a. The Building Code, as referenced herein, is the Florida Building Code (FBC).

2. Commercial Standards

    a. ACI 315 Details and Detailing of Concrete Reinforcement.

    b. CRSI Concrete Reinforcing Steel Institute Manual of Standard Practice

    c. ACI SP66 ACI Detailing Manual

    d. ACI 305 Hot Weather Concreting

    e. ACI 318 Building Code Requirements for Reinforced Concrete.

    f. ACI 350 Code Requirements for Environmental Engineering Concrete Structures

    g. WRI Manual of Standard Practice for Welded Wire Fabric.

    h. ASTM A 1064 Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

i. ASTM A 615 Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

1.04 SUBMITTALS

A. The Contractor shall furnish shop bending diagrams, placing lists, and Drawings of all reinforcing steel prior to fabrication in accordance with the requirements of the Section 01300 entitled, "Submittals." The Contractor shall submit detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66) for all reinforcing steel. These drawings shall be made to such a scale as to clearly show joint locations, openings, the arrangement, spacing and splicing of the bars. Where opening sizes are dependent on equipment selection the Contractor shall indicate all necessary dimensions to define steel lengths and placing details.

B. Details of the concrete reinforcing steel and concrete inserts shall be submitted by the Contractor at the earliest possible date after receipt by the Contractor of the Notice to Proceed. Said details of reinforcing steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop Drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.

C. Where mechanical couplers are shown on the Drawings to be used to splice reinforcing steel, the Contractor shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop Drawings which show the location of each coupler with details of how they are to be installed in the formwork.

D. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.

E. Requests to use splices not shown on the Drawings.

F. Requests to use mechanical couplers along with manufacturer’s literature on the mechanical couplers with instructions for installation, and certified test reports on the coupler’s capacity.

G. Proposed supports for each type of reinforcing.

H. Certification that all installers of dowel adhesives are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.

I. International Code Council-Evaluation Services Evaluation Services Report (ICC-ES ESR) for dowel adhesives.

J. Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

A. Installer Qualifications for Drilled-In Rebar: Drilled-in rebar shall be installed by an Installer with at least three years of experience performing similar installations. Installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process for drilled-in anchors, to include but not be limited to the following:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Rebar doweling preparation and installation.

5. Proof loading/torquing.

C. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.

D. Inspections of the adhesive dowel system may be made by the Engineer or other representatives of the City in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspection of products and anchor holes prior to injection, installation, and proof testing.

PART 2 – PRODUCTS

2.01 REINFORCEMENT

A. All reinforcing steel for all reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement, and shall be manufactured in the United States. All reinforcing steel shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on the Drawings.

2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings; provided, that welded wire fabric with longitudinal wire of W9.5 size wire shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only. All welded wire fabric reinforcement shall be galvanized.

B. Field welding of reinforcing steel will not be allowed.

C. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORY MATERIALS

A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcing during concrete placement. Wire bar supports shall be plastic protected (CRSI Class 1).

B. Tie Wire: Galvanized 16 gauge annealed type.

C. Concrete blocks (dobies), used to support and position reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Concrete blocks shall only be used bottom mat of reinforcing steel for slabs on grade.

2.03 MECHANICAL COUPLERS

A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.

C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.

D. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece shall be provided by the coupler manufacturer.

2.04 DOWEL ADHESIVE SYSTEM

A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.

B. All holes shall be drilled in accordance with the manufacturer’s instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes ,if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer requirements.

C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer’s instructions prior to installation of adhesive and reinforcing bar.

D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.

E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer's instructions.

F. Embedment Depth:

1. The embedment depth of the bar shall be as show on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on "SET-XP" by Simpson Strong-Tie Co. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer's ICC-ES ESR.

3. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer's ICC-ES ESR.

G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.

H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete, must comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report. The adhesive system shall be "Epcon System C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Injection Adhesive Anchor System" as manufactured by Hilti, Inc. "SET-XP" as manufactured by Simpson Strong-Tie Co. or "Pure 110+ Epoxy Adhesive Anchor System" by DeWalt. Fast-set epoxy formulations shall not be acceptable.

I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

2.05 FABRICATION

A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings, and the fabricating details shall be prepared in accordance with ACI 315 and ACII 318, except as modified by the Drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1 1/2 inch for No. 3 bars, 2 inch for No. 4 bars, and 2 1/2 inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the minimum thickness, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.

B. The Contractor shall fabricate reinforcing bars for structures in accordance with bending diagrams, placing lists, and placing Drawings. Said Drawings, diagrams, and lists shall be prepared by the Contractor as specified under Section entitled "Submittals," herein.

C. Fabricating Tolerances: Bars used for concrete reinforcing shall meet the following requirements for fabricating tolerances:

1. Sheared length: + 1 inch

2. Depth of truss bars: + 0, 1/2 inch

3. Stirrups and ties: + 1/2 inch

4. All other bends: + 1 inch

2.06 MINIMUM REINFORCEMENT

A. Unless otherwise shown on the Drawings or in the absence of the steel being shown, the minimum cross sectional area of reinforcing steel in the direction of principal reinforcement shall be 0.0033 times the gross concrete area of all concrete members.

B. Unless otherwise shown on the Drawings or in the absence of the steel being shown, the minimum cross sectional area of temperature reinforcing steel (reinforcing steel perpendicular to the principal reinforcing steel) shall be as follows:

1. 0.0020 times the gross concrete area in slabs of non-water-bearing structures.

2. 0.0015 times the gross concrete area vertically in walls of non-water-bearing structures.

3. 0.0025 times the gross concrete area horizontally in walls of non-water-bearing structures.

4. 0.0050 times the gross concrete area in slabs of water-bearing structures

5. 0.0030 times the gross concrete area vertically in walls of water-bearing structures.

6. 0.0050 times the gross concrete area horizontally in walls of water-bearing structures.

7. Temperature steel shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

PART 3 – EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.

C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.02 PLACEMENT

A. Reinforcing steel shall be accurately positioned as shown on the Drawings, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcing steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.

B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

D. Bars additional to those shown on the Drawings which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.

E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.

F. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer. Reinforcing bars shall not be cut to place electrical, plumbing or mechanical conduits, piping, ducts, etc. without the expressed written approval of the Engineer of Record.

G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat, and supporting the reinforcing mat in the plane shown on the Drawings.

H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

I. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1 1/3 times the maximum size of the coarse aggregate, nor less than one inch.

J. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.

K. In columns, the clear distance between longitudinal bars shall be not less than 1 1/2 times the bar diameter, nor less than 1 1/2 times the maximum size of the coarse aggregate, nor less than 1 1/2 inches.

L. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

M. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer.

N. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318, Section 12.15.1 for a class B splice.

O. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

P. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

Q. Reinforcing shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field bent except as shown on the Drawings or specifically permitted by the Engineer.

R. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.

S. All adhesive dowel installations in the horizontal or overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CRSI per ACI 318-11 9.2.2. Current AAI Certificates must be submitted to the Engineer of Record for approval prior to commencement of any adhesive anchor installations.

T. Adhesive Dowel Testing

1. At all locations where adhesive dowels are shown on the Drawings, at least 5 percent of all adhesive dowels installed shall be tested to the value indicated on the Drawings, with a minimum of one tested dowel per group. If no test value is indicated on the Drawings but the installed dowel is under direct tension, the Contractor shall notify the Engineer to verify the required test value.

2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.

3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the State of Florida. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.

4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.

5. Proof testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

3.03 CLEANING AND PROTECTION

A. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

B. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and, if necessary recleaned.

- END OF SECTION -

SECTION 03290 JOINTS IN CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall construct all joints in concrete at the locations shown on the Drawings. Joints required in concrete structures are of various types and will be permitted only where shown on the Drawings, unless specifically accepted by the Engineer.

B. Construction joints, expansion joints, contraction joints and control joints shall be provided at the locations shown and formed in accordance with the details shown on the Drawings.

C. Waterstops shall be provided where shown on the Drawings, and in all waterbearing joints in hydraulic structures.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 - Concrete Formwork

B. Section 03200 - Concrete Reinforcement

C. Section 03300 - Cast in Place Concrete.

D. Section 03315 - Grout

E. Section 03350 - Concrete Finishes

F. Section 03370 - Concrete Curing

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the following documents to the extent that the provisions therein are not in conflict with the requirements of this Section.

1. Federal Specifications:

    a. TT S 00227E(3) Sealing Compound, Elastomeric Type, Multi component (For Caulking, Sealing, And Glazing Buildings And Other Structures).

2. U.S. Army Corps of Engineers Standard Specifications

    a. CRD C572

3. Commercial Standards:

    a. ASTM C 920 Specification for Elastomeric Joint Sealants.

    b. ASTM D 624 Test Method for Rubber Property Tear Resistance.

c. ASTM D 638 Test Method for Tensile Properties of Plastics.

d. ASTM D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

e. ASTM D 747 Test Method for Apparent Bending Modules of Plastics by Means of a Cantilever Beam.

f. ASTM D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

g. ASTM D 2240 Test Method for Rubber Property Durometer Hardness.

1.04 TYPES OF JOINTS

A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called construction joint. Unless noted otherwise, all joints in water bearing structures shall be provided with a waterstop of the shape specified herein or shown on the Drawings.

B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4 1/2 inches from the joint; which is provided with a sleeve type dowel, to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided when specified on the Drawings.

C. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours, the joint shall be formed as detailed on the Drawings. This space is obtained by placing a preformed joint filler against the first pour, which acts as a form for the second pour. Unless noted otherwise, all expansion joints in water bearing members shall be provided with a 9-inch wide waterstop. Preformed joint filler shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material. The space so formed shall be filled with a joint sealant material as specified herein. The joint sealant shall be isolated from the filler using a bond breaker.

D. Control Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions shown on the Drawing, is formed or saw cut in the concrete. This groove shall be filled with a joint sealant.

1.05 SUBMITTALS

A. Waterstops: Prior to production of the material required under this contract, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be furnished under this contract. The balance of the material to be used under this contract shall not be produced until

after the Engineer has reviewed the qualification samples. The samples shall be delivered to a location on site indicated by the Engineer.

B. Joint Sealant: Prior to ordering the sealant material, the Contractor shall submit to the Engineer for the Engineer's review, sufficient data to show general compliance with the requirements of the Contract Documents.

C. Contractor shall submit product data sheets of all materials proposed under this section.

D. Shipping Certification: The Contractor shall provide written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. Contractor certificates are not acceptable.

E. The Contractor shall submit placement Shop Drawings showing the location and type of all joints for each structure.

F. For sawcut contraction joints submit documentation indicating the following:

1. Proposed method of sawcutting indicating early entry or conventional sawing.

2. Description of how work is to be performed including equipment to be utilized, and curing methods.

3. Description of alternate method in case of time constraint issues or failure of equipment.

1.06 QUALITY ASSURANCE

A. Waterstop

1. Review: It is required that all waterstop field joints shall be subject to review inspection, and no such work shall be scheduled or started without having made prior arrangements with the Engineer to provide for the required reviews. Not less than 24 hours' notice shall be provided to the Engineer for scheduling such reviews.

2. All field joints in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review, and all faulty material shall be removed from the site and disposed of by the Contractor at its own expense.

3. The following defects represent a partial list of defects which shall be grounds for rejection:

a. Offsets at joints greater than 1/16 inch or 15 percent material thickness, at any point, whichever is less.

b. Exterior crack at joint, due to incomplete bond, deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.

c. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16 inch or 15 percent of material thickness at any point, whichever is less.

d. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2 inch in 10 feet.

e. Porosity in the welded joint as evidenced by visual inspection.

f. Bubbles or inadequate bonding which can be detected with pen knife test. (If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)

1.07 GUARANTEE

A. The Contractor shall provide a two year written guarantee of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the City, at no additional cost to the City, any such defective areas which become evident within said two year guarantee period.

PART 2 – PRODUCTS

2.01 PVC WATERSTOPS

A. General: Waterstops shall be extruded from an elastomeric polyvinylchloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. The Contractor shall obtain from the waterstop manufacturer and shall furnish to the Engineer for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD C572 and listed in Paragraph C. below.

B. Multi Rib Waterstops: All PVC waterstops shall be of Multi rib construction of the following types:

1. Expansion Joints and Control Joints: 9-inches by 3/8-inch minimum thickness, ribbed center bulb. Waterstops for expansion joints and control joints shall be Style 738 by Greenstreak or equal .

2. All other Construction Joints: 6-inches by 3/8-inch minimum thickness, flat ribbed. Waterstops for all construction joints shall be serrated style 732 by Greenstreak or equal .

3. Install Waterstops as shown as manufactured structures .

4. T-type Waterstops installed against existing concrete shall be Style 609 by Greenstreak, or equal. Compatible batten bars and anchor bolts shall be supplied by the same manufacturer .

5. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field .

6. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.

C. Waterstop Testing Requirements: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

	Value	**ASTM Std.**
Tensile Strength-min (psi)	1750	D 638, Type IV
Ultimate Elongation-min (percent)	350	D 638, Type IV
Low Temp. Brittleness-Max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	400	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638, Type IV
Effect of Alkalies (CRD-C572)		
Ultimate Elongation-min (percent)	300	D 638, Type IV
Change in Weight (percent)	+0.25/-0.10	----
Change in Durometer, Shore A	+5	D 2240
Finish Waterstop		
Tensile Strength-min (psi)	1400	D 638, Type IV
Ultimate Elongation-min (percent)	280	D 638, Type IV

2.02 CHEMICAL RESISTANT WATERSTOPS

A. General: Waterstops shall be manufactured from thermoplastic elastomeric rubber material. The synthetic rubber shall be provide a high resistance to acids, bases, alcohols, oils, solvents or chemicals. No reclaimed material shall be used. The Contractor shall obtain from the waterstop manufacturer and furnish to the Engineer for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements outlined herein. Waterstop connections shall be heat welded. All waterstop corners, intersections, and directional changes shall be miter cut, heat welded, factory fabricated. Only straight butt splices shall be allowed in the field.

B. Multi-Rib Waterstops: All chemical resistant waterstops shall be of multi-rib construction. Waterstops for expansion joints shall be 9”x3/16” ribbed with a center bulb. Waterstops for construction joints shall be 6”x3/16” ribbed with a center bulb. Chemical resistant waterstops shall be Westec Type TPE-R synthetic rubber, manufactured by Westec Barrier Technologies, St. Louis, MO, or equal.

C. Waterstop Physical Properties: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property	**Value**	**ASTM Std.**
Tensile Strength	1800 psi	D-412
Ultimate Elongation	450%	D-412
100% Modulus	1000 psi	D-412
Shore A Hardness	85 units ± 5 units	D-2240
Brittle Point	-70°F	D-746
Ozone Resistance	450 pphm passed	D-1171

D. Weathering Performance: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property	**Value**	**ASTM Std.**
Tensile Strength (% Retention)	87%	D-412
Ultimate Elongation (% Retention)	84%	D-412
Shore A Hardness (units change)	7 units	D-2240

E. Chemical Resistance Properties: When tested in accordance with ASTM D-471 after 166 hours of full immersion at 73.4oF (23oC), the waterstop material shall meet or exceed the following requirements:

(Continued on Next Page)

Fluid	Physical Property	Value
Sulfuric Acid 98%	Ultimate Elongation	77% Retention
	Ultimate Tensile	82% Retention
	100% Modulus	108% Retention
	Hardness Change Shore A	-1 Unit
	Weight Change	2.1%
Sodium Hydroxide 50%	Ultimate Elongation	101% Retention
	Ultimate Tensile	107% Retention
	100% Modulus	104% Retention
	Hardness Change Shore A	-4 Unit
	Weight Change	-0.1%

2.03 HYDROPHILIC WATERSTOPS

A. Hydrophilic waterstops shall be designed to expand and seal under hydrostatic conditions. At construction joints, the waterstops shall be Adeka Ultraseal MC 2010 M for wall/slab thickness greater than 9 inches, and Adeka Ultraseal KBA-1510FF for wall/slab thickness less than 9 inches or equal. At expansion joints, the waterstops shall be Adeka Ultraseal KM-3030M or equal.

B. Plate fabrications used to plug flow channels for future expansion or otherwise to close wall openings shall be caulked using hydrophilic waterstops designed for the application. Caulking agents shall be Adeka Ultraseal P201 or equal.

2.04 JOINT SEALANT

A. Joint sealant shall comply with Section 07920 entitled “Sealants and Caulking”.

2.05 EXPANSION JOINT MATERIAL

A. Preformed expansion joint material shall be non-extruding, and shall be one of the following types:

1. Type I – Sponge rubber, conforming to ASTM D1752, Type I
2. Type II – Cork, conforming to ASTM D1752, Type II
3. Type III – Self-expanding cork, conforming to ASTM D1752, Type III
4. Type IV – Bituminous fiber, conforming to ASTM Designation D1752

2.06 BACKER ROD

A. Backer rod shall comply with Section 07920 entitled “Sealants and Caulking”.

2.07 BOND BREAKER

A. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Hunt Process 225 TU as manufactured by Hunt Process Co., Santa Fe Springs, CA; Select Cure CRB as manufactured by Select Products Co., Upland, CA; or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.08 CONTRACTION JOINT INSERTS

A. Contraction joint inserts shall be Transverse-Control Joints by Greenstreak Plastic Products or equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Unless otherwise shown on the Drawings, waterstops of the type specified herein shall be embedded in the concrete across joints as shown. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The Contractor shall take suitable precautions and means to support and protect the waterstops during the progress of the Work and shall repair or replace at its own expense any waterstops damaged during the progress of the Work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.

B. When any waterstop is installed in the concrete on 1 side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 14 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.02 CONSTRUCTION JOINTS

A. Construction joints shall be as shown on the Drawings. Otherwise, Contractor shall submit description of the joint and its location to Engineer for approval.

B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

C. Unless noted otherwise on the Drawings, maximum Maximum1 distance between horizontal joints in slabs and vertical joints in walls shall be 45' 0". For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25’-0” unless noted otherwise on the Drawings1.

D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.

E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.

F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

3.03 EXPANSION JOINTS

A. Size and location of expansion joints shall be as shown on the Drawings.

B. All expansion joints in water-bearing structures shall have a center-bulb type waterstop. All expansion joints below grade in walls or slabs which enclose an accessible area shall have a center-bulb type waterstop.

3.04 CONTRACTION JOINTS

A. Location of contraction joints shall be as shown on the Drawings.

B. Contraction joints shall be formed either by sawcutting or with contraction joint inserts as specified in paragraph 2.08, A. Sawcutting of joints will not be permitted unless specifically approved by the Engineer.

C. If approved by the Engineer, sawcutting of contraction joints in lieu of forming shall conform to the following requirements:

1. Joints shall be sawed as soon as the concrete can support foot traffic without leaving any impression, normally the same day as concrete is placed and in no case longer than 24 hours after concrete is placed.

2. Curing shall be performed using wet curing methods as indicated in Section 03370 – Concrete Curing. Curing mats, fabrics or sheeting materials shall remain in place to the extent possible while cutting of joint is being performed. Curing materials shall only be removed as required and shall be immediately reinstalled once cutting of the joint has been completed.

3. Depth of joint shall be as shown on the drawings or noted in these specifications. At locations where the joint cannot be installed to full depth due to curbs or other stopping points hand tools shall be used to complete joints.

4. Saw cut joints shall meet the requirements of ACI 224.3, Section 2.8, Jointing Practice.

3.05 SPLICES IN PVC WATERSTOPS

A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:

1. The material not be damaged by heat sealing.

2. The splices have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.

3. The continuity of the waterstop ribs and of its tubular center axis be maintained.

B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.

C. All joints in waterstop involving more than 2 ends to be joined together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be factory fabricated with not less than 24-inch long strips of material beyond the joint. Upon being inspected and accepted, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24 inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

3.06 JOINT CONSTRUCTION

A. Setting PVC Waterstops: In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support the waterstops during the progress of the Work and to insure the proper imbedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.

B. In placing PVC waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise shown, all waterstops shall be held in place with light wire ties on 12 inch centers which shall be passed through the hog rings or grommets, and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.

C. Joint Location: Construction joints, and other types of joints, shall be provided where shown on the Drawings. When not shown on the Drawings, maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45-feet, and maximum distance between vertical and horizontal joints for earth or water retaining walls shall be 25-feet, unless noted otherwise. The location of all joints, of any type, shall be submitted for review by the Engineer.

D. Joint Preparation: Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise shown

on the Drawings, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 – Cast in Place Concrete.

E. Adequate means shall be provided for anchoring the waterstop in concrete. Waterstops shall be positioned so that they are equally embedded in the concrete on each side of the joint.

F. Sealant application shall be in accordance with the manufacturer's printed instructions. The surfaces of the groove for the sealant shall not be coated. Concrete next to waterstops shall be placed in accordance with the requirements of Section entitled, "Cast in Place Concrete."

G. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. All sealant shall cure at least 7 days before the structure is filled with water.

H. All sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations. Before work is commenced, the crew doing the Work shall be instructed as to the proper method of application by a representative of the sealant manufacturer.

I. Thorough, uniform mixing of 2 part, catalyst cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, the Contractor shall arrange to have the crew doing the Work carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.

J. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the Work hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re sealed with the specified joint sealant. All costs of such removal, joint treatment, re sealing, and appurtenant work shall be at the expense of the Contractor.

3.07 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.

B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.

C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no

concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.

E. Type 1 joint sealant shall be used in all expansion and contraction joints in concrete, except where Type 7 or Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.

F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.

G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

- END OF SECTION -

SECTION 03300 CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Provide all labor, equipment, materials, and services necessary for the manufacture, transportation, and placement of all plain and reinforced concrete work, as shown on the Drawings or as required by the Engineer.

B. The requirements in this section shall apply to the types of concrete listed below. See Article 2.11 for concrete mix design and properties of concrete.

1. Class A1 Concrete: Normal weight structural concrete to be used in all structures qualifying as environmental concrete structures designed in accordance with ACI 350 including any structures containing water. Class A1 concrete shall have a mandatory admixture that meets ASTM C-1582 to inhibit chloride corrosion of reinforcing steel bars.

2. Class A2 Concrete: Normal weight structural concrete in all structures other than environmental concrete structures as described above, and for all sidewalks and pavement. Class A2 concrete shall have a mandatory admixture that meets ASTM C-1582 to inhibit chloride corrosion of reinforcing steel bars.

3. Class A3 Concrete: Normal weight structural concrete to be used where specifically called for on Contract Drawings or areas where specifically requested by Contractor and approved by Engineer. Class A3 concrete is identical to Class A2 concrete except that coarse aggregate specified in Article 2.08 below shall be Size #8 in accordance with ASTM C33. Class A3 concrete shall have a mandatory admixture that meets ASTM C-1582 to inhibit chloride corrosion of reinforcing steel bars.

4. Class A4 Concrete: Normal weight structural concrete used where concrete is indicated to be placed underwater (tremie concrete). Class A4 concrete shall have a mandatory admixture that meets ASTM C-1582 to inhibit chloride corrosion of reinforcing steel bars.

5. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

6. Flowable Fill: Lean concrete proportioned without the use of coarse aggregate primarily for use as pipe backfill. Flowable fill shall be utilized only at locations indicated on the Drawings.

7. Grout is specified in Section 03315 – Grout.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittals

B. Section 03100 – Concrete Formwork

C. Section 03200 – Concrete Reinforcement

D. Section 03250 – Concrete Accessories

E. Section 03290 – Joints in Concrete

F. Section 03350 – Concrete Finishes

G. Section 03370 – Concrete Curing

H. Section 03315 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code

2. ACI 214 – Guide to Evaluation of Strength Test Results of Concrete

3. ACI 301 – Specifications for Structural Concrete

4. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete

5. ACI 305 – Specification for Hot Weather Concreting

6. ACI 306 – Standard Specification for Cold Weather Concreting

7. ACI 309R – Guide for Consolidation of Concrete

8. ACI 318 – Building Code Requirements for Structural Concrete and Commentary

9. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

10. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field

11. ASTM C 33 – Standard Specification for Concrete Aggregates

12. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

13. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

14. ASTM C 88 – Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate

15. ASTM C 94 – Standard Specification for Ready-Mixed Concrete

16. ASTM C 114 – Standard Test Method for Chemical Analysis of Hydraulic Cement

17. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

18. ASTM C 138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

19. ASTM C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete

20. ASTM C 150 – Standard Specification for Portland Cement

21. ASTM C 157 - Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete

22. ASTM C 172 – Standard Practice for Sampling Freshly Mixed Concrete

23. ASTM C 192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

24. ASTM C 231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

25. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete

26. ASTM C 295 – Standard Guide for Petrographic Examination of Aggregates for Concrete

27. ASTM C 457 – Standard Test Method for Microscopical Determination of the Air-Void System in Hardened Concrete

28. ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete

29. ASTM C 595 – Standard Specification for Blended Hydraulic Cements

30. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

31. ASTM C 989 – Standard Specification for Slag Cement for Use in Concrete and Mortars

32. ASTM C 1012 – Standard Test Method for Length Change of Hydraulic Cement Mortars Exposed to a Sulfate Solution

33. ASTM C 1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

34. ASTM C 1157 – Standard Performance Specification for Hydraulic Cement

35. ASTM C 1260 – Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)

36. ASTM C 1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

37. ASTM C 1579 – Standard Test Method for Evaluating Plastic Shrinkage Cracking of Restrained Fiber Reinforced Concrete (Using a Steel Form Insert)

38. ASTM C 1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

39. ASTM C 1609 – Standard Test Method for Flexural Performance of Fiber Reinforced Concrete (Using Beam with Third-Point Loading)

40. ASTM C 1778 – Standard Guide for Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300 – Submittals.

1. Sources of all materials and certifications of compliance with specifications for all materials.

2. Certified current (less than 6 months old) chemical analysis (mill test report) of the Portland Cement or Blended Cement to be used. The chemical analysis must include the equivalent alkali content of the Portland Cement or Blended Cement. For Type IL cement, submit updated cement mill test reports every 6 months while active concrete work is being performed.

3. Certified current (less than 1 year old) chemical analysis of fly ash or slag cement to be used.

4. Aggregate test results showing compliance with required standards, i.e., sieve analysis, potential reactivity, aggregate soundness tests, petrographic analysis, mortar bar expansion testing, etc.

5. Manufacturer's data on all admixtures stating compliance with required standards and are compatible with one another. Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to Mix design review by the Engineer.

6. Concrete mix design for each class of concrete specified herein.

7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein.

8. Drying shrinkage test results from trial concrete mixes.

1.05 QUALITY ASSURANCE

A. Tests on materials used in the production of concrete shall be required as specified in Part 2 – Products. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the City.

B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the City.

C. Field quality control tests, as specified in Article 3.11, unless otherwise stated, will be performed by a materials testing consultant supplied by the Contractor at no additional cost to the City. The Contractor shall be pay for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field-Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

1.06 CONCRETE COORDINATION CONFERENCE

A. At least 35 days prior to the start of the concrete construction schedule, the Contractor shall conduct a meeting at the site. The purpose of the meeting is to review the proposed concrete mix designs, to discuss the proposed approaches and procedures for mixing, transporting, placing, testing, finishing, and curing of all aspects of concrete work to ensure the concrete construction is performed in accordance with the Specifications, and to clarify roles of the parties involved. The Contractor shall send a concrete coordination conference agenda to all attendees 20 days prior to a mutually agreed upon date for the conference.

B. As a minimum the agenda shall include:

1. Concrete Materials and Mix Designs

2. Inspection Responsibilities

3. Concrete Sampling and Testing Specification Requirements
4. Cylinder Storage and Transportation
5. Acceptance/Rejection Responsibility and Authority for Fresh Concrete
6. Concrete finishing
7. Concrete Curing
8. Test Report Distribution
9. Miscellaneous Items

C. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Contractor's superintendent
2. Engineer
3. City's representative (if they chose to attend)
4. Laboratory retained for trial batching and construction quality control testing for the concrete.
5. Any subcontractors involved in placing, finishing, and curing of concrete
6. Concrete supplier
7. Concrete pumping subcontractor (if pumping is being proposed)

D. Minutes of the meeting shall be recorded, typed, and printed by the Contractor and distributed to all attendees and any other concerned parties within five days of the meeting.

PART 2 – PRODUCTS

2.01 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.02 or 2.03, respectively.

2. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

3. Portland Cement shall also meet performance requirements of ASTM C 1157.

4. Portland cement shall contain no more than 0.60 percent alkalies. The term "alkalies" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide (Na20 + 0.658 K20). These oxides shall be determined in accordance with ASTM C 114.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement), Type IS (Portland Slag Cement), or Type IL (Portland Limestone Cement) conforming to ASTM C 595.

2. Type IP cement shall be an inter-ground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.

3. Type IS cement shall be an inter-ground blend of Portland Cement and slag cement in which the slag cement constituent is between 30% and 40% of the weight of the total blend.

4. Type IL cement shall be an inter-ground blend of Portland Cement and limestone in which the limestone constituent is between 5% and 15% of the weight of the total blend.

5. Fly ash, slag cement, and limestone used in the production of blended cements shall meet the requirements of Articles 2.02, 2.03, and 2.04 respectively.

6. Cements meeting ASTM C 1157 shall not be used in manufacture of blended cements.

7. Blended cement shall meet the Physical Requirements of Tables 2 and 3 of ASTM C 595 including the requirements for high sulfate resistance in Table 3 as tested per ASTM C1012.

C. Different types of cement shall not be mixed, nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.02 FLY ASH

A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618. Fly ash shall be considered as a supplemental cementitious material.

B. For fly ash to be used in the production of Type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.

C. The percentage of fly ash shall also be set to meet the mean mortar bar expansion requirements in provisions of Article 2.07.G.2. Where fly ash is used, the minimum fly ash content shall be 15%.

D. For Type A1 concrete as required for use in environmental concrete structures, i.e., process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

2.03 SLAG CEMENT

A. Slag cement shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.

B. The percentage of slag cement shall also be set to meet the mean mortar bar expansion requirements in provisions of Article 2.07.G.2. Where Slag Cement is used, the minimum Slag Cement content shall be 30%, and the maximum Slag Cement content shall be 40%.

C. For Type A1 concrete as required for use in environmental concrete structures, i.e., process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

D. Additional slag cement shall not be included in concrete mixed with Type IS or IP cement.

2.04 PORTLAND LIMESTONE CEMENT (TYPE IL)

A. Portland Limestone Cement (Type IL) cement shall meet the requirements of ASTM C 595.

B. Limestone used for blended cement Type IL shall be naturally occurring and meet the requirements of ASTM C 33.

C. Fly ash or slag cement shall be used with Type IL cement to meet requirements for durability, ASR resistance, sulfate resistance, and use for environmental structures, as specified herein.

2.05 CONCRETE ALKALI LOADING

A. The alkali loading of concrete is the Portland Cement equivalent alkali content multiplied by the Portland Cement content of the mix in pounds per cubic yard divided by 100. The Portland Cement equivalent alkali content shall be included in the certified chemical analysis of the Portland Cement.

B. Means of evaluating alkali loading of concrete and proportioning constituents of concrete to minimize alkali loading of content shall also conform to the guidelines of ASTM C1778.

2.06 WATER

A. Water used for mixing concrete shall be clear, potable, and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts, and other impurities.

B. Water shall not contain more than 100 PPM chloride.

C. Water shall not contain more than 500 PPM dissolved solids.

D. Water shall have a pH in the range of 4.5 to 8.5.

E. Water shall meet requirements of ASTM C 1602.

2.07 AGGREGATES

A. All aggregates used in normal weight concrete shall conform to ASTM C 33.

B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.

C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel, or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.

D. For Class A3 concrete, coarse aggregate shall be Size #8 in accordance with ASTM C33.

E. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.

F. Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.

G. Aggregates shall be obtained from pits acceptable to the Engineer, shall be non reactive, and shall conform to the FBC and ASTM C 33.

H. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

2.08 ADMIXTURES

A. Admixtures containing intentionally added chlorides shall not be used.

B. Air entraining admixture shall be added to all concrete unless noted otherwise. The air entraining admixture shall conform to ASTM C 260. The admixture proposed shall be selected in advance so that adequate samples may be collected, and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.

C. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set, and enhancing durability. Admixtures permitted shall confirm to the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.

1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are “Eucon Series” by the Euclid Chemical Company, “Master Pozzolith Series or Master Polyheed Series” by Master Builders Solutions, and “Plastocrete Series” by Sika Corporation.

2. High range water reducer shall conform to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at the batch plant and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured, and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day’s operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are “Eucon 37” or Plastol 5000 by the Euclid Chemical Company, “Master Rheobuild 1000 or Master Glenium Series” by Master Builders Solutions, and “Daracem 100 or Advaflow Series” by W.R. Grace.

3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year’s duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are “MasterSet AC 534 or

MasterSet FP 20" by Master Builders Solutions, "Accelguard 80/90 or NCA" by the Euclid Chemical Company and "Daraset" by W.R. Grace.

4. A retarding admixture may be used be used when air temperature at time of placement is expected to be consistently above 90 degrees Fahrenheit and where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type B or D. Acceptable products are "Eucon NR or Eucon Retarder 100" by the Euclid Chemical Company, "MasterSet R Series or MasterSet DELVO Series" by Master Builders Solutions, and "Plastiment" by Sika Corporation.

5. Workability Retaining Admixture shall conform to ASTM C 494, Type S. The admixture shall retain concrete workability without affecting time of setting or early-age strength development. Acceptable products are "MasterSure Z 60" by Master Builders Solutions, ViscoFlow-2020 by Sika Corporation, PLASTOL AMP-X3 by Euclid Chemical Company, or equal.

D. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.

E. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

1. Certification: Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to Mix design review by the Engineer.

2.09 CONCRETE MIX DESIGN

A. The proportions of cement, aggregates, admixtures, and water used in the concrete mixes shall be based on laboratory trial mixes in conformance with ACI 301. Trial mixes shall also conform to Article 3.01 of this Specification. Trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.

1. Compressive Strength (28-Day)

Concrete Class A1, A4	4,500 psi (min.), 6500 psi (max.)
Concrete Class A2, A3	4,500 psi (min.), 6000 psi (max.)
Concrete Class B	3,000 psi (min.), 5000 psi (max.)

2. Water/cementitious materials ratio, by weight

	Maximum	Minimum
Concrete Class A1, A4	0.42	0.39
Concrete Class A2, A3	0.45	0.39
Concrete Class B	0.50	0.39

3. Slump range

   a. 4" nominal unless high range water reducing admixture is used.

   b. 9” max if high range water reducing admixture is used.

   c. 10.5” max if self-compacting concrete additive is used for tremie mix design.

4. Air Content

Concrete Class A1, A2, A3, A4	3% ±1.5%
Concrete Class B	3% Max (non-air-entrained)

PART 3 – EXECUTION

3.01 TRIAL MIXES

A. Trial mixes shall be used to confirm the quality of a proposed concrete mix in accordance with ACI 301. An independent qualified testing laboratory designated and retained by the Contractor shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batches shall be prepared using the aggregates, cement, supplementary cementitious materials, and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the City.

B. The independent testing laboratory shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and density (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. ". If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the City. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.

3.02 SHRINKAGE TESTS

A. Concurrent with the trial batch requirements stated in Article 3.01, the testing laboratory shall perform drying shrinkage tests for the trial batches as specified herein. Shrinkage testing is only required for concrete to be used for environmental concrete structures (Class A1).

B. Fabricate, cure, dry, and measure specimens in accordance with ASTM C157 modified as follows.

1. Remove specimens from molds at an age of 23 hours ± 1 hour after trial batching.

2. Place specimens immediately in water at 70 ^{o}F ± 3 ^{o}F for at least 30 minutes.

3. Measure within 30 minutes thereafter to determine original length, then submerge in saturated lime water at 73 ^{o}F ± 3 ^{o}F.

4. At age seven days, measure to determine expansion, expressed as a percentage of original length. This length at age seven days shall be the base length for drying shrinkage calculations (zero days' drying age).

5. Store specimens immediately in a humidity-controlled room maintained at 73 ^{o}F ± 3 ^{o}F and 50 percent ± 4 percent relative humidity for the remainder of the test.

6. Make and report separately measurements to determine shrinkage expressed as base length percentage for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

C. Compute the drying shrinkage deformation for each specimen as the difference between the base length (at zero days' drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation for the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage for any specimen departs from the average test age for that test by more than 0.0004 inch, disregard the results obtained

from that specimen. Report results from the shrinkage test to the nearest 0.001 percent of shrinkage. Take compression test specimens in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered part of the normal compression tests for the project.

D. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.036 or 0.042 percent, respectively. Use a mix design for construction that has first met the trial batch shrinkage requirements.

E. If the trial batch specimens do not meet both the strength and shrinkage requirements, revise the mix designs and/or materials and retest.

3.03 PRODUCTION OF CONCRETE

A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready-mix concrete plant or from a site mixed plant. In selecting the source for concrete production, the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.

B. Ready-Mixed Concrete

1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.

2. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as

water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

5. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed within the time requirements stated in Article 3.04 of this Section.

6. Every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:

   a. Date and truck number

   b. Ticket number

   c. Mix designation of concrete

   d. Cubic yards of concrete

   e. Cement brand, type, and weight in pounds

   f. Weight in pounds of fine aggregate (sand)

   g. Weight in pounds of coarse aggregate (stone)

   h. Air entraining agent, brand, and weight in pounds and ounces

   i. Other admixtures, brand, and weight in pounds and ounces

   j. Water, in gallons, stored in attached tank

   k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio

   l. Water, in gallons, used (by truck driver)

   m. Time of loading

   n. Time of delivery to job (by truck driver)

7. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.

8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to inspection at the batching plant by the Engineer.

C. Site Mixed Concrete

1. Site Mixed Concrete shall only be used where specifically approved by the Engineer.

2. Scales for weighing concrete ingredients shall be accurate when in use within ±0.4 percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.

3. Operation of batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances:

a.	Cement, fly ash, or slag cement	± 1 percent
b.	Water	± 1 percent
c.	Aggregates	± 2 percent
d.	Admixtures	± 3 percent

4. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.

5. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within the specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance therewith.

6. Mixers with a rated capacity of one cubic yard or larger shall conform to the requirements of the Plant Mixer Manufacturers' Division of the Concrete Plant Manufacturers' Bureau.

7. Except as provided below, batches of one cubic yard or less shall be mixed for not less than one minute. The mixing time shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.

8. Shorter mixing time may be permitted provided performance tests made in accordance with of ASTM C 94 indicate that the time is sufficient to produce uniform concrete.

9. Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three-quarters of the required mixing time shall take place after the last of the mixing water has been added.

10. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixer blades shall be replaced when they have lost 10 percent of their original height.

11. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if recommended by the manufacturer.

12. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.

13. Addition of retarding admixtures shall be completed within one minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Retarding admixtures shall not be used unless approved by the Engineer.

14. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C 94.

3.04 CONCRETE PLACEMENT

A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.

B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures required.

C. On horizontal joints where concrete is to be placed on hardened concrete, flowing concrete containing a high range water reducing admixture or cement grout shall be placed with a slump not less than 8 inches for the initial placement at the base of the wall. Concrete or cement grout shall meet all strength and service requirements specified herein for applicable class of concrete. This concrete shall be worked well into the irregularities of the hard surface.

D. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.

E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix meeting all specified requirements.

F. Concrete shall be conveyed as rapidly as practical to the point of deposit by methods which prevent the separation or loss of the ingredients. The concrete shall be deposited so that additional handling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates unless workability-retaining admixtures are included and approved by the Engineer. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.10 of this Section.

G. Where concrete is conveyed to position by chutes, a continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.

H. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds.

I. Placing of concrete shall be regulated so the pressure caused by the wet concrete shall not exceed that used in the design of the forms.

J. All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable hopper heads. Tremies shall be of variable lengths so the free fall shall not exceed five (5) feet, and enough tremies shall be placed in the form to ensure the concrete remains level.

K. When placing concrete which will be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.

L. Concrete shall be placed to thoroughly embed all reinforcement, inserts, and fixtures.

M. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. Concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.

N. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.

O. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. Vibration shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration shall not be continued in any one location to the extent that pools of grout are formed.

P. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall ensure that each layer is placed while the previous layer is soft or plastic, so the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.

Q. To prevent featheredges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.

R. In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge. The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators to ensure complete filling under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Contractor shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and water stops, and/or any proposed deviations from the stated requirements to the Engineer for review and approval.

S. Concrete shall not be placed during rains sufficiently heavy or prolonged to prevent washing of mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

3.05 PLACING FLOOR SLABS ON GROUND

A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete