WATER MAIN CONSTRUCTION TECHNIQUES

ST. JOHN'S

DEPARTMENT OF PUBLIC WORKS
WATER & WASTEWATER DIVISION

Overview

- Water Main - Materials
- Specifications
- Installation
- Future?

Water Main Materials

Material Types

There are various material types used for water mains, these include:

- Ductile Iron Pipe
- Polyvinyl Chloride (PVC)
- Concrete Steel Cylinder
- Polyethylene

Water Main Specifications

Specifications

Provide information on approved materials, installation methods and typical drawings.

- Department of Municipal and Intergovernmental Affairs – Municipal Water, Sewer and Roads Master Construction Specification Book, Section 02713

- City of St. John's – Specification Book, Section 230

Water Main Specifications

Specifications - Examples

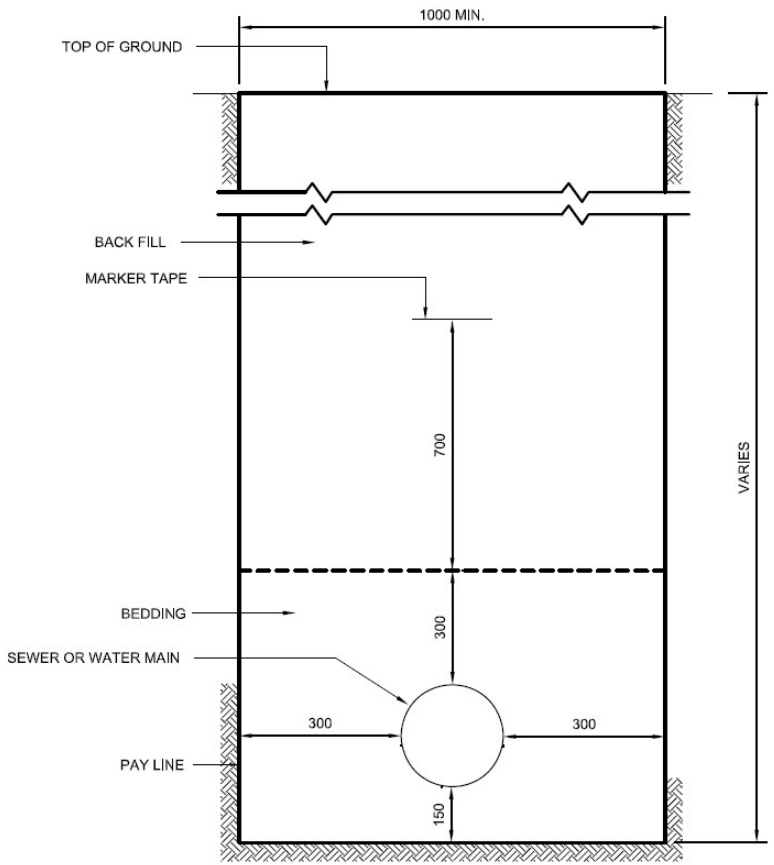
- Approved Pipe Materials
  - Ductile Iron, PVC, Conc. Steel Cylinder
- Pressure Classes of Pipe
  - DI Pipe Class = 350, 250, 200
  - PVC Pipe = DR 14, 18, 21
- Valves
  - Opening Direction, Operating Nut
- Service Pipe
  - Approved Materials and Diameter

Water Main Installation

Pipe Trench

- Excavated to depth specified on drawings, minimum 2 m cover.
- Pipe Bedding
  - Class “B” Material
  - 150 mm Below
  - 300 mm Above
- Marker Tape

Water Main Installation



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Water Main Installation

Pipe Protection

- Debris caps are required on all pipes supplied to CSJ.
- Caps keep debris out of pipes during transportation and installation resulting in lower chance of contamination.
- Required on both bell and spigot ends of pipe

Water Main Installation

Pipe Assembly

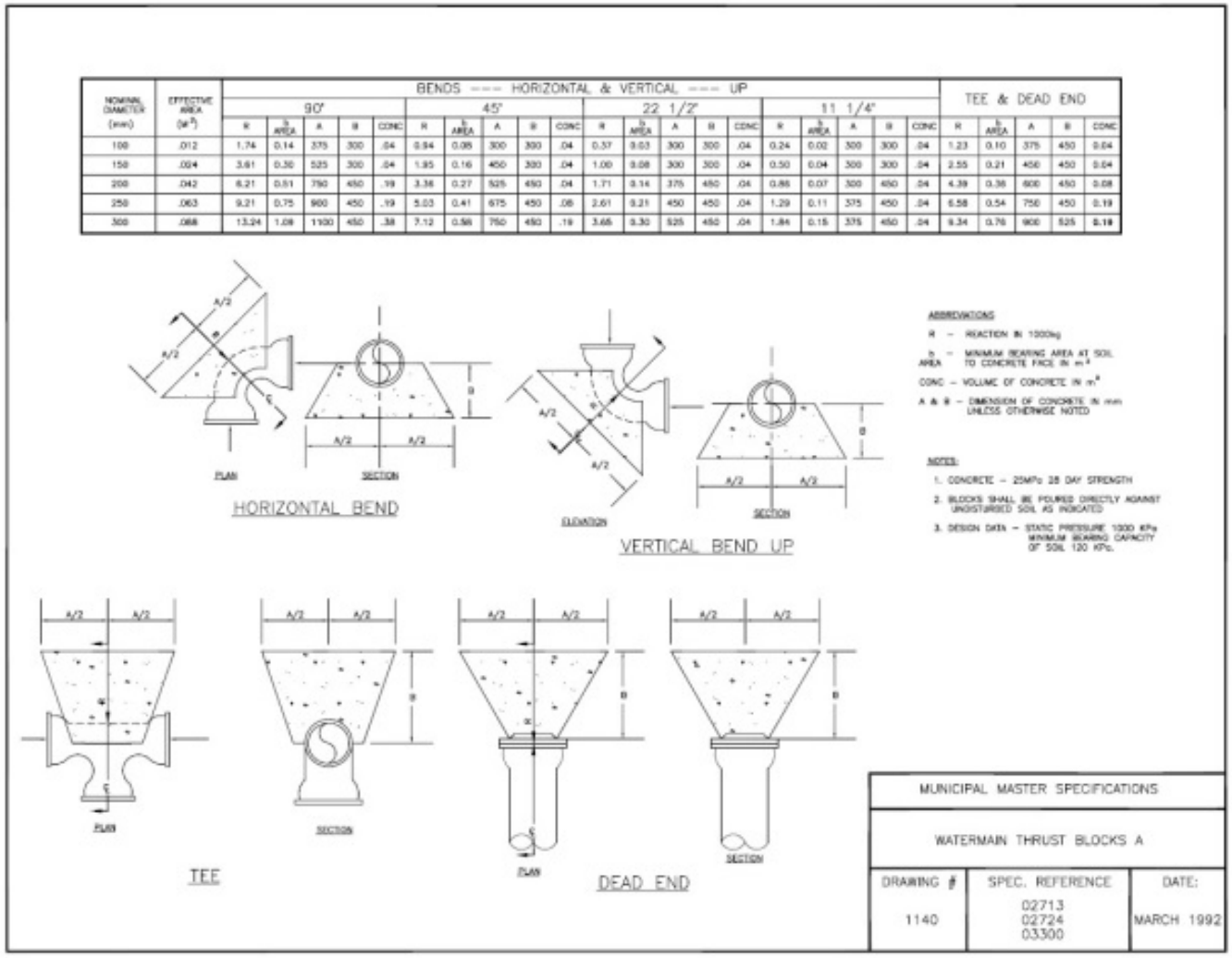
- Pipe laid in trench at design grade and assembled using come-along or pry bar
- However typically pushed together with excavator, there is a risk pushing the pipe into the bell to far and damaging the bell
- On PVC pipe there is a line indicating required insertion depth of pipe.

Water Main Installation

Thrust Blocks

- Required at specified locations such as bends, tees, valves, reducers, end caps.
- Required to be constructed as per Standards Drawings in Specification

Water Main Installation



NOMINAL DIAMETER (mm)	EFFECTIVE AREA (m^2)	BENDS — HORIZONTAL & VERTICAL — UP																				TEE & DEAD END				
		90°					45°					22 1/2°					11 1/4°									
		R	b AREA	A	B	CONC	R	b AREA	A	B	CONC	R	b AREA	A	B	CONC	R	b AREA	A	B	CONC	R	b AREA	A	B	CONC
100	.012	1.74	0.14	375	300	.04	0.94	0.08	300	300	.04	0.37	0.03	300	300	.04	0.24	0.02	300	300	.04	1.23	0.10	375	450	0.04
150	.024	3.61	0.30	525	300	.04	1.95	0.16	450	300	.04	1.00	0.08	300	300	.04	0.50	0.04	300	300	.04	2.55	0.21	450	450	0.04
200	.042	6.21	0.51	750	450	.19	3.38	0.27	525	450	.04	1.71	0.14	375	450	.04	0.86	0.07	300	450	.04	4.39	0.36	600	450	0.08
250	.063	9.21	0.75	900	450	.19	5.03	0.41	675	450	.08	2.61	0.21	450	450	.04	1.29	0.11	375	450	.04	6.58	0.54	750	450	0.19
300	.088	13.24	1.08	1100	450	.38	7.12	0.58	750	450	.19	3.65	0.30	525	450	.04	1.84	0.15	375	450	.04	9.34	0.76	900	525	0.18

HORIZONTAL BEND

VERTICAL BEND UP

ABBREVIATIONS

R – REACTION IN 1000kg

b AREA – MINIMUM BEARING AREA AT SOIL TO CONCRETE FACE IN m^2

CONC – VOLUME OF CONCRETE IN m^3

A & B – DIMENSION OF CONCRETE IN mm UNLESS OTHERWISE NOTED

NOTES:

1. CONCRETE – 25MPa 28 DAY STRENGTH
2. BLOCKS SHALL BE POURED DIRECTLY AGAINST UNDISTURBED SOIL AS INDICATED
3. DESIGN DATA – STATIC PRESSURE 1000 KPa MINIMUM BEARING CAPACITY OF SOIL 120 KPa.

TEE

DEAD END

MUNICIPAL MASTER SPECIFICATIONS		
WATERMAIN THRUST BLOCKS A		
DRAWING #	SPEC. REFERENCE	DATE:
1140	02713 02724 03300	MARCH 1992

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Water Main Installation

Thrust Blocks

- An alternate to thrust blocks is the use of mechanical joint restraints.
- Prior to installation location of joint restraints must be determined by design Engineer. Typically the fitting is restrained plus several lengths of pipe on either side of fitting.
- Two types of restraints:
  - Restraining Gland Ring – Megalug or Megaholder
  - Restraining Joint Restraint

Water Main Installation

Water Main Installation

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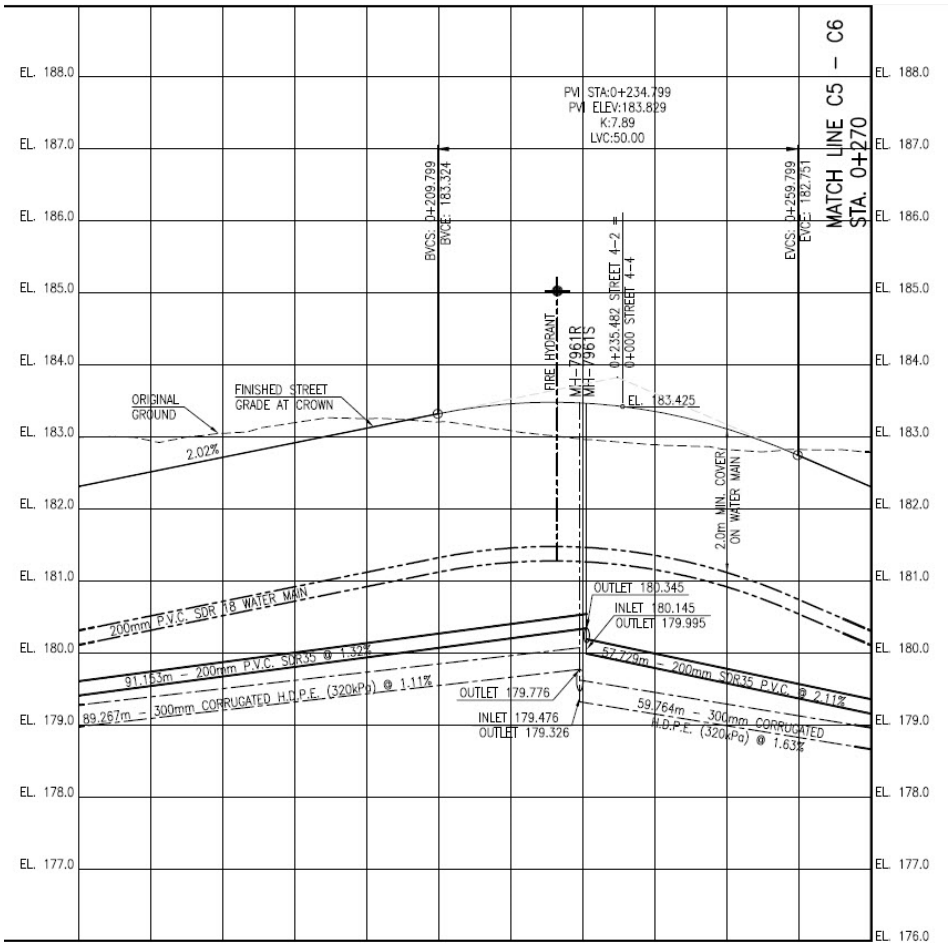
Water Main Installation

Air and Vacuum Release

- The design of a water distribution system must recognize the importance of alleviating air from the system and breaking a vacuum should it form.
- These conditions typically form when a water main is being filled or drained for planned maintenance or during emergencies.
- Air Release can be accomplished by either:
  - Installing a fire hydrant at the high point;
  - Placing a water service at the high point:
  - Installing an Air Release valve at the high point.

Water Main Installation



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Water Main Installation

Corrosion Control

- Metallic components of a water distribution system can experience corrosion.
- Corrosion could be caused by:
  - Soil conditions;
  - Dissimilar materials;
  - Stray current.
- Corrosion control can be accomplished by either:
  - Using non-metallic components;
  - Installing zinc anodes:
  - Wrapping metallic pipe in polyethylene.

Water Main Installation

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Water Main Installation

Service Connections – Ductile Iron

- Direct tapping is permitted up to 25 mm diameter.
- Service greater than 25 mm diameter require service saddle.
- Service connections should be a minimum of 1 m from adjacent service, pipe bell or fitting.
- Direct tap completed using drill and tap bit.
- Tap connection through service saddle completed using shell cutter bit.

Water Main Installation

Water Main Installation

Water Main Installation

Service Connections – PVC

- Direct tapping can but done but not recommended.
- New Construction – use tap tee.
- Tapping to be completed with service saddle.
- Service connections should be a minimum of 1 m from adjacent service, pipe bell or fitting.
- Tap connection through service saddle completed using shell cutter bit.

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Water Main Installation

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Water Main Installation

Testing

- Swabbing or Pigging
- Pressure Test
- Leakage Test
- Chlorination

Water Main Installation

Swabbing / Pigging

- To remove material and debris from lines.

Water Main Installation

Pressure Test

- New water main tested at 150% of normal operating pressure.
- Each section of pipe slowly filled with water and air expelled and tested

Leakage Test

- Conducted concurrently with pressure test.
- Measure quantity of water required to maintain pressure, must not exceed calculated value

Water Main Installation

Chlorination

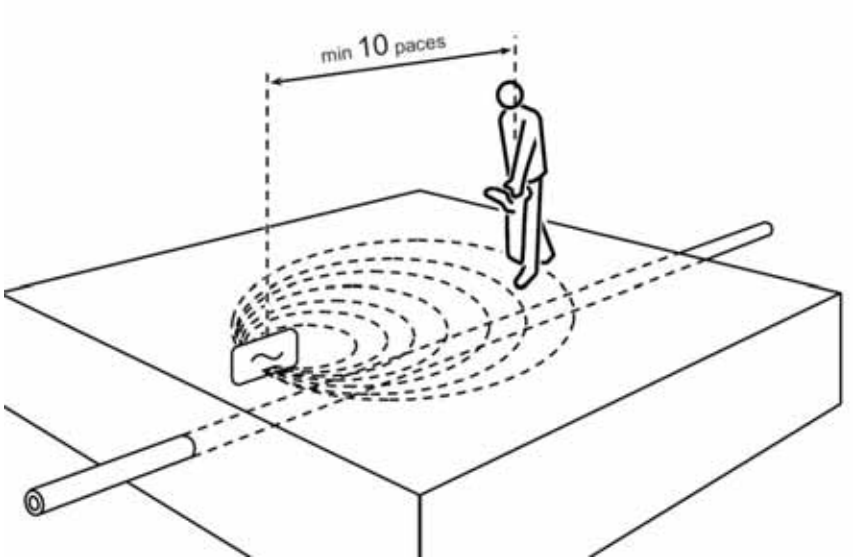
- Chlorine solution added and left for 24 hours.
- Water flushed from line and sample taken.
- Two consecutive samples required to be collected.

Water Main Installation

Tracing / Locating

- Water main material determines type of tracing.
- Metallic material can use be used as a conductor for locating buried infrastructure
- PVC material requires separate method for locating buried infrastructure.

Water Main Installation



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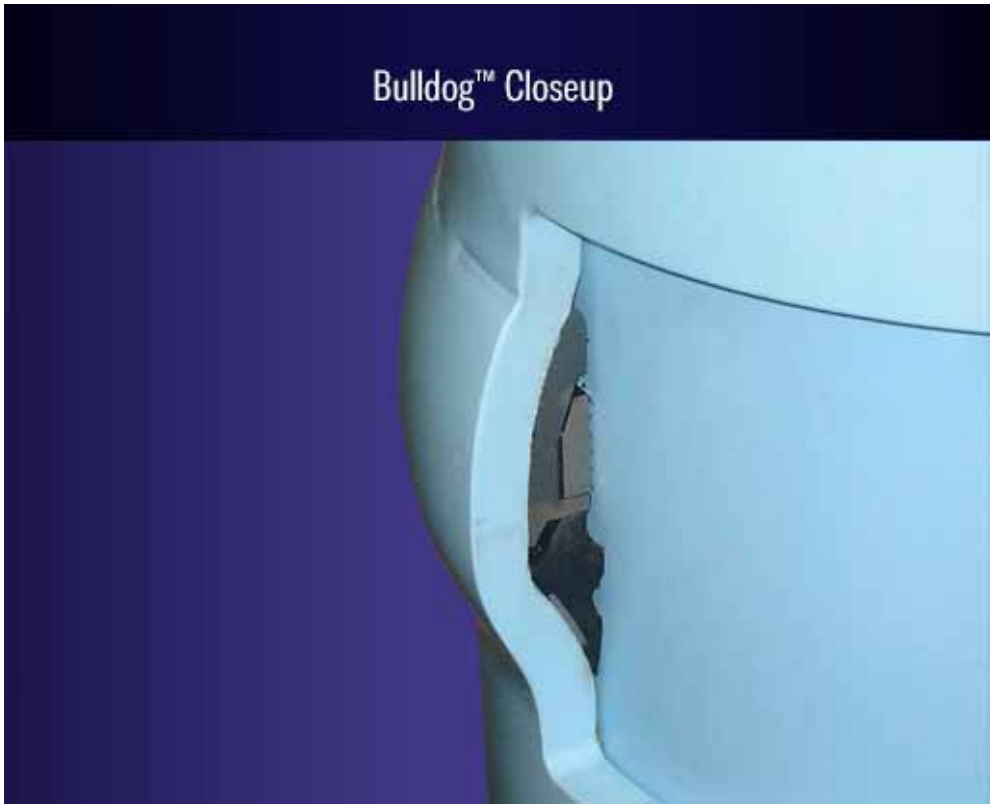
Water Main Installation

	FID	Shape	ID_	MODEL	COMPANY	TYPE	SIZE	MATERIAL	DATE_	DESCRPTN	LATITUDE	LONGITUDE	ALTITUDE	LASTSAVED	NORTHING	EASTING
▸	3468	Point	0000699209	1423-XR/ID Water RFID Ball	CSJ	90 Bend	300mm	PVC		Main	47.569	-52.715	87.315	<Null>	5269963.648	326263.743
	3474	Point	0000959608	1423-XR/ID Water RFID Ball	CSJ	Tee	300mm x 300mm	PVC		Main	47.568	-52.715	88.718	<Null>	5269935.849	326246.997
	3472	Point	0001028297	1423-XR/ID Water RFID Ball	CSJ	90 Bend	200mm	PVC		Main	47.568	-52.715	89.928	<Null>	5269942.162	326241.131
	3477	Point	0001080806	1423-XR/ID Water RFID Ball	CSJ	11.25 Bend	300mm	PVC		Main	47.568	-52.715	88.909	<Null>	5269946.158	326259.548
	3473	Point	0001081236	1423-XR/ID Water RFID Ball	CSJ	Tee	400mm x 300mm	Ductile Iron		Main	47.568	-52.715	88.694	<Null>	5269938.046	326244.195
	3480	Point	0001107373	1423-XR/ID Water RFID Ball	CSJ	Reducer	300mm x 150mm	Ductile Iron		Main	47.568	-52.715	84.992	<Null>	5269954.556	326270.706
	3479	Point	0001109106	1423-XR/ID Water RFID Ball	CSJ	Tee	300mm x 300mm	Ductile Iron		Main	47.568	-52.715	85.22	<Null>	5269954.048	326270.152
	3471	Point	0001109108	1423-XR/ID Water RFID Ball	CSJ	90 Bend	150mm	PVC		Main	47.568	-52.715	86.789	<Null>	5269948.099	326245.62
	3475	Point	0001109120	1423-XR/ID Water RFID Ball	CSJ	Tee	200mm x 300mm	PVC		Main	47.568	-52.715	88.215	<Null>	5269935.243	326247.876
	3476	Point	0001109122	1423-XR/ID Water RFID Ball	CSJ	90 Bend	300mm	PVC		Main	47.568	-52.715	88.349	<Null>	5269933.449	326250.015
	3481	Point	0001109153	1423-XR/ID Water RFID Ball	CSJ	90 Bend	150mm	Ductile Iron		Main	47.568	-52.715	85.91	<Null>	5269961.231	326276.934
	3478	Point	0001109154	1423-XR/ID Water RFID Ball	CSJ	90 Bend	300mm	Ductile Iron		Main	47.568	-52.715	85.41	<Null>	5269951.463	326267.88
	3469	Point	0001109238	1423-XR/ID Water RFID Ball	CSJ	45 Bend	300mm	Ductile Iron		Main	47.568	-52.715	86.6	<Null>	5269958.618	326264.713
	3470	Point	0001109243	1423-XR/ID Water RFID Ball	CSJ	22.50 Bend	300mm	Ductile Iron		Main	47.568	-52.715	86.412	<Null>	5269955.051	326263.016

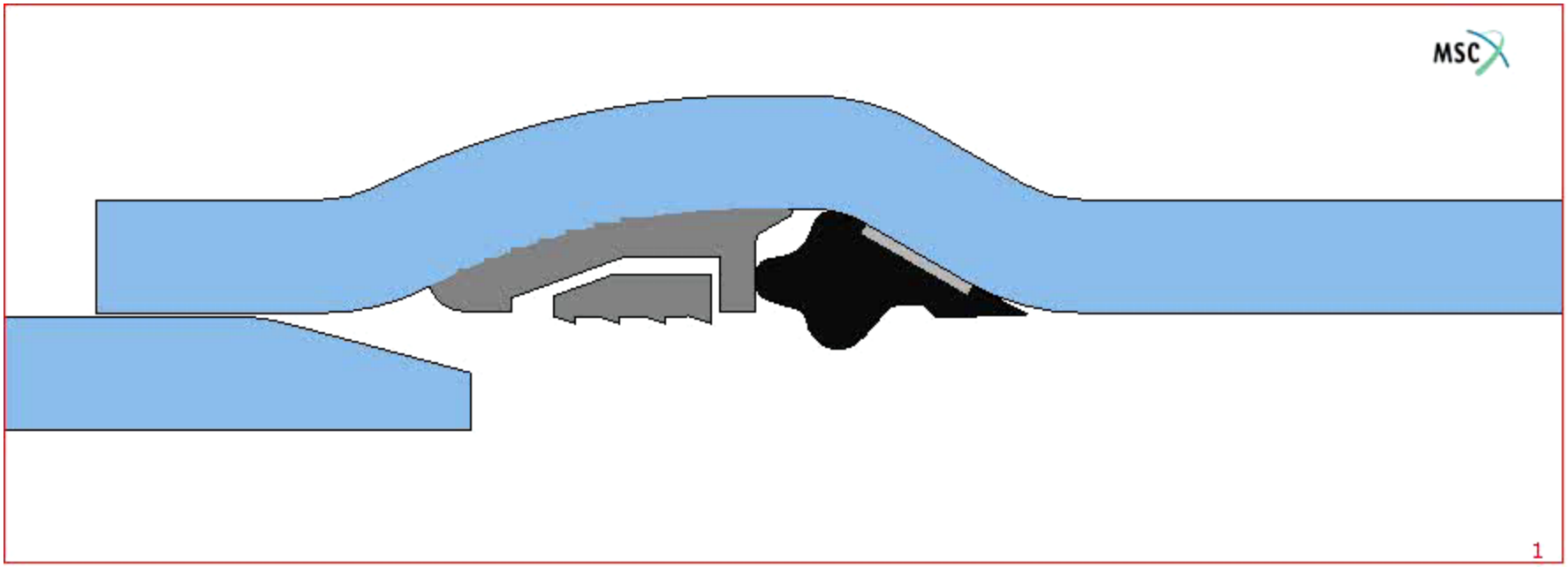
Future Water Main Installation

Internal Joint Restraint

- Current joint restraint system for PVC pipe using external components
- Bulldog joint is an internal joint restraint system.
- No external components therefore no corrosion issues.



Future Water Main Installation



Future Water Main Installation

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Future Water Main Installation

New PVC Material

- Molecularly enhanced PVC – biaxially oriented
- Features:
  - Pipe is lighter therefore it is easier to handle and install.
  - Greater tensile strength
  - Greater impact strength
  - Crack resistance, prevents crack propagation
  - Thinner pipe wall = larger inside pipe diameter resulting in improved flows.

Future Water Main Installation

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Future Water Main Installation

PVC Pipe Assembly

- PVC pipe is supposed to be assembled with pry bars or come-along.
- However typically assembled using excavator bucket – increased risk of damage to pipe.
- Eagle – Claw is a pipe assembly tool

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Future Water Main Installation

Thank You

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