

	Location/Activity	Observations / Risk Scoring Notes	Hazard	Hazardous Event	Preventive Control Measure	Monitoring Procedures	Response	Recommended Actions	Lead	Likelihood	Severity	Detectability	Risk Score	CCP	Critical Control Limits
2	Fire Lines to Buildings (various locations)	Detectability - Worst case	Chemical	Backflows from fire lines	Backflow By-law. Installation of backflow preventers required by building permit process	Annual inspection of all private backflow preventers required by the Town	Follow Emergency Response procedure or specific SOPs	Enforce backflow by-law. Continue to implement backflow prevention and cross-connection program	SE	3	3	5	11	No	n/a
9	Private Hydrants and Service Connections Tampering (various locations)	n/a	Chemical, Biological, Radiological	Vandalism/terrorism. Illegal connection to system through hydrant or service connection	n/a	n/a	Follow Emergency Response procedure or specific SOPs	Develop Emergency Response Procedure specific to this hazardous event, modify by-law to include backflow prevention device installation and premise isolation requirement. For new ICI, develop solutions with Building, Engineering and Fire Depts. to resolve this threat. Advise Fire Dept. to monitor the use of private fire hydrants and to enforce the Water Use by-law	SE	1	5	5	11	No	n/a
19	Severe Risk ICI Service Connections	2009 Backflow program implementation stage phase 1 - 60% compliance	Chemical, Biological, Capacity	Backflows from severe risk ICI customers with no backflow prevention. - e.g. Laidlaw Industrial car storage and garages, Markham Stouffville Hospital, funeral homes)	Backflow prevention program: survey of ICI and high risk customers. Installation of backflow preventers required by building permit process	Annual inspection of all private backflow preventers required by the Town	Follow Emergency Response procedure or specific SOPs	Map hotspots in Town. Make information available on mobile systems	IMS	2	4	5	11	No	n/a
13	Interconnections with Region of York / Toronto Water - Low Chlorine	Detectability - Assumes part of the weekly sampling program.	Biological	Low chlorine residual in water from source (less than 0.25 mg/L)	n/a	York Region monitoring chlorine residual at pumping stations and reservoirs. York advises the Town (SOP exists but not necessarily followed)	Flush upon detection. Isolate if possible. Boil Water Advisory	Connect to York's and Toronto's SCADA. York Region Communication SOP19 in place. Design and implement supply point monitoring system. Increase frequency and locations of testing	SE	3	4	3	10	No	n/a
15	Interconnections with Region of York / Toronto Water - High Chlorine	Severity - Assumes the slug is coming from the Region of York / City of Toronto and will affect the entire pressure zone. Detectability - Assumes chlorine residual monitoring would not detect the slug.	Chemical	High chlorine content in water from slug due to superchlorination of mains	n/a	n/a	Flush upon detection. Close valves (isolate). Notify the Region of York. Drinking Water Advisory	Connect to York's and Toronto's SCADA. York Region Communication SOP19 in place. Design and implement supply point monitoring system. Increase frequency and locations of testing	SE	2	4	4	10	No	n/a
23	Valves & Hydrants operation - transients	n/a	Chemical, Biological, Capacity	Transients due to abnormal operation of valves and hydrants	System valves only operated by Town. SOPs to operate	n/a	Follow Emergency Response procedure or specific SOPs	Pilot transient analysis to improve understanding of system transients	SE	3	3	4	10	No	n/a
14	Source Water Quality Deficiency (except Chlorine)	To become CCP once monitoring locations implemented.	Chemical, Biological, Radiological	Deficient water quality in the water from source. Change in chemical composition (e.g. pH) of source water (water coming from Toronto / York)	Treated water quality is being continuously tested at the source and at the reservoirs	Lead sampling program. Chlorine residual sampling	Follow Emergency Response procedure or specific SOPs	Design and implement supply point monitoring system	SE	1	4	4	9	No	n/a
18	Private System Mains	n/a	Chemical, Biological, Capacity	Break in private system. Deficient disinfection/cleaning	Work instruction developed for private WM breaks, WW Operators to inform York Region Public Health	n/a	Follow Emergency Response procedure or specific SOPs	Consider requirement to install backflow preventers on water services for all condominiums/private developments. Meeting with York Region Public Health to ensure Public Health is aware it is their responsibility, not the Town. Map all private systems with greater than 6 residential units and provide info to MOE	O&M	2	3	4	9	No	n/a
20	Moderate / Low Risk Multiple Residential Service connections	n/a	Chemical, Biological, Capacity	Backflows from residential customers with no backflow prevention. (e.g. Condominium Developments)	Installation of backflow preventers required by building code	Annual inspection of all private backflow preventers required by the Town	Follow Emergency Response procedure or specific SOPs	Track these customers through the phase 3 of the Backflow Prevention Program	SE	2	3	4	9	No	n/a
24	Mainline Valves (various locations)	n/a	Chemical, Biological, Capacity	Unauthorized use of valves by contractors creating dead ends	During the 4 years exercising cycle of valves, check status (open/close) is correct	n/a	Follow Emergency Response procedure or specific SOPs	Review valve exercising frequency with AWWA standard	O&M	3	2	4	9	No	n/a
25	Watermains (in contaminated sites -e.g. landfills, chemical depots, gas stations, sewage )	n/a	Chemical, Biological, Capacity	Introduction of contaminants due to negative pressures. Hydrocarbon permeation into PVC pipes	n/a	n/a	Follow Emergency Response procedure or specific SOPs	Map hotspots in Town. Make it available on mobile systems	IMS	2	3	4	9	No	n/a
26	Critical Watermain Supply (various locations) for critical customers	Detectability - Assumes Town is notified by the customer.	Capacity	Loss of supply to critical customers (e.g. Hospitals, IBM, Novapharm, airport)	n/a	n/a	Follow Emergency Response procedure or specific SOPs	Map critical customers in Town. Make information available on mobile systems. Develop Emergency Response Procedure	O&M	3	4	2	9	No	n/a
28	Inadequate draw of water from Watermains (various locations)	Detectability - Part of the operator flushing/sampling program.	Biological	Existing system high water age, stagnant water at dead ends, and inadequate frequency of flushing,	Dead end flushing program	Residual reading at dead ends	Flushing to restore chlorine residual	Identify high water age areas and develop mitigation program	SE	4	2	3	9	Yes	See Critical Control Points Table
29	Adverse Water Quality Notification - Watermains	Severity - Could lead to a drinking water advisory.	Chemical, Biological	Notification of adverse water quality results	Flushing program	Sampling occurs daily at different sampling points throughout the system	In the case of low chlorine, flush watermain at hydrant until chlorine residual level is restored. May lead to issuing a boil water advisory. Regulatory sampling is completed	Follow SOP16b Adverse Water Quality ...	O&M	3	3	3	9	Yes	See Critical Control Points Table
1	Air valves	Detectability - Submerged air valves will be found during O&M inspections however the hazardous event will only be found by chance.	Chemical, Biological, Capacity	Negative pressure in system causing the introduction of contaminated water via submerged air valves	Venting of air valves as close to ground as possible	Air valves are inspected once a year as part of O&M program. Flush valves and vents, inspected annually	Follow Emergency Response procedure or specific SOPs	Ensure all air valves are identified, and vented properly	O&M	2	3	3	8	No	n/a

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3	Flushing Stations - Malfunction	Severity - If stations are checked often enough, the failure of the flushing station will not lead to any significant effects on the water quality.	Biological	Failure of automatic flushing stations	Batteries changed twice a year at DST change	Flushing stations checked once a month.	Follow Emergency Response procedure or specific SOPs	n/a	O&M	3	2	3	8	No	n/a
7	Hydrant - Accidental Contamination	Severity - Assumes there is no malicious intent. Detectability - Assumes the hydrant user does not notify the Town.	Chemical, Biological	Accidental contamination thru unapproved connection to system through hydrant	Permitting process includes the installation of backflow preventers and meters	Backflow preventers are inspected annually by certified tester	Follow Emergency Response procedure or specific SOPs	n/a	O&M	2	2	4	8	No	n/a
8	Hydrant- Bi-directional Flushing	Detectability - The presence of turbidity and colour would be reported by customers who are not directly affected by the valve closure.	Chemical, Biological	Bi-directional flushing at hydrants during watermain break repair causing adverse water quality	SOPs for watermain break repairs implemented. Customers notified water disruption and asked to reduce water usage	Chlorine residual sampling	Follow Emergency Response procedure or specific SOPs	Uni-directional flushing program	SE	4	2	2	8	No	n/a
16	Design Issue in New Development Infrastructure	Detectability - Assumes the incorrect sizing of the infrastructure is not identified until there is a problem with chlorine residuals.	Capacity, Biological	Infrastructure incorrectly sized	Waterworks DWWP Approval process implemented to ensure proper water analysis data received and reviewed. Uni-directional flushing in new sub-divisions prior to 80% occupancy	n/a	Flushing and chlorine residual sampling at problem areas identified	Develop standard for minimum flow (80% occupancy flow)	SE	3	3	2	8	No	n/a
17	Pressure Reducing Valve (PRV) Failure	Detectability - Problem would be reported by the customers immediately. Severity - Could affect an entire pressure zone.	Chemical, Biological, Capacity	Improper PRV function or failure in open or closed position	Preventive maintenance once a year. Currently install valve position indicators and pressure gauges on all PRVs	n/a	Follow Emergency Response procedure or specific SOPs	Implement DMA for early warning	SE	2	4	2	8	No	n/a
21	Temporary/Surface Bypass Watermains	Detectability - Even though the operators are present they will not be aware of the hazardous event which will only be found by chance.	Chemical, Biological	Bleeder installed on the end of bypass line. Potential for cross connections if negative pressures in the system	Install vacuum breaker on bleeder and double check valve on source	n/a	Follow Emergency Response procedure or specific SOPs	Map active temporary by-pass locations in Town. Make information available on mobile systems	INF	1	3	4	8	No	n/a
27	Easement Watermain Breaks (various locations)	Detectability - Assumes the break cannot be found. The response to the hazardous event is the same as any major watermain break.	Chemical, Biological, Capacity	Watermain break under creek or ravine	n/a	n/a	SOPs in place for watermain repair	Implementation of DMA and leak detection program. Develop specific leak detection program for locations where leak is hard to identify	SE	1	3	4	8	No	n/a
6	Hydrant Usage	n/a	Chemical, Biological, Capacity	Fire department causing sustained negative pressure at high points in the system when using hydrants at lower elevations, or causing a high flow in a small diameter watermain	Fire Dept. developed SOP and training to report hydrant use by Fire Dept. to Waterworks	n/a	Follow Emergency Response procedure or specific SOPs	Evaluate areas of vulnerabilities in the system. Review and verify Fire Dept. SOP is in place and in practice. Set up meeting with Fire Dept. to continue discussion with this issue	O&M	2	3	2	7	No	n/a
10	Improper Pump Operation	Detectability - Region of York Operator daily rounds.	Chemical, Biological, Capacity	Transients due to abnormal operation of pumps at pumping stations. i.e. Bayview and Markham Pumping Stations, Milliken and Thornhill Pumping Stations	Region of York pumps have surge protection	n/a	Follow Emergency Response procedure or specific SOPs	To be connected to Toronto and York's SCADA data exchange. Discuss pumping station operation with Toronto Water and Region of York to identify ways to mitigate event. Obtain Toronto and York Region SOP for Operators detection of pump transient and Risk analysis results	SE	2	3	2	7	No	n/a
12	Reservoir Tampering	Detectability - Assumes security alarm would be activated.	Chemical, Biological, Capacity, Radiological	Vandalism/terrorism. System compromised at reservoirs. i.e. Markham and North Markham Reservoirs, Milliken and Bayview Reservoirs. Emergency at one of the reservoirs during high demands (e.g. break-in, security alarm activated)	Entry alarms on reservoir hatches security system. City of Toronto and York Region have conducted a vulnerability study and implemented upgrades based on recommendations. Flows can be redirected from the different sources	York/Toronto monitors reservoirs/pumping stations on SCADA	Region of York's SOP-19 for communication with Markham	Communicate security concerns to York Region. York Region Communications SOP19 in place. Develop Emergency Response Procedure. To be connected to Toronto and York's SCADA data exchange. Obtain Toronto and York Region's Risk Analysis Results for review	SE	1	5	1	7	No	n/a
22	Backflow Prevention Failure on temporary/surface bypass watermains	n/a	Chemical, Biological	Backflow prevention failure during superchlorination of temporary watermain	SOPs for commissioning	Inspector present. Sampling before opening valves to connect to system	Follow Emergency Response procedure or specific SOPs	Revise SOP and approval process for by-pass hook up to ensure that each back flow prevention device is tested within a year.	INF	2	3	2	7	No	n/a
30	Other Utility Break near Watermain	Detectability - Operator rounds. Reported by customer. Severity - Major watermain supplying a critical customer or pressure zone.	Biological, Capacity	Sewer break under/over watermain causing it to collapse and break or introduce contamination. Watermain break caused by 3rd party construction (i.e. gas utility breaks watermain when working on the gas line)	Asset management programs (CCTV inspection every five years)	Follow SOP for high risk watermain break	SOPs in place for watermain repair	n/a	O&M	1	4	2	7	No	n/a
4	Operator Competence	n/a	Chemical, Biological, Capacity	Lack of trained operators (operators do not know the system comprehensively)	Comprehensive training program. Annual competence assessment from PMR	n/a	Follow Emergency Response procedure or specific SOPs	Ongoing training to provide complete knowledge of system. Complete system description and map of hotspots	O&M	3	2	1	6	No	n/a
5	Staffing Compliment (Strikes or Emergencies)	n/a	Chemical, Biological, Capacity	Lack of trained and qualified staff during strike or emergency i.e. pandemic	Markham has sufficient staff to maintain regulatory operations during emergency	n/a	Expand responsibilities of existing contractors. Town has developed a pandemic plan.	Maintain minimum staffing complement with ongoing training	O&M	2	3	1	6	No	n/a
31	New Watermain Commissioning	Detectability - Sample results	Biological	Improper disinfection during commissioning of new water infrastructure	SOP for New Development Process	n/a	Follow Emergency Response procedure or specific SOPs	n/a	SE	2	3	1	6	No	n/a

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11	Loss of Supply Power	Detectability - Assumes pump status is on SCADA. Severity - Storage available in system. Manageable distribution operation.	Chemical, Biological, Capacity	Loss of power supply at Pumping Stations or other facilities	Backup power plus system storage back feed	York Region monitors water supply levels on SCADA	SOP to get pumps back in service. Can reroute flows from other sources	To be connected to Toronto and York's SCADA data exchange. Modelling to determine alternative ways of supplying in case of emergencies. Push for installation of stand-by power	SE	2	1	1	4	No	n/a