SLD 8a Risk Assessment Table

	Location/Activity	Hazard	Hazardous Event	Consequence	Preventive Control Measure	Monitoring Procedures	Response	Likelihood	Severity	Detectability	Risk Score	CCP?	Critical Control Limits	Observations / Risk Scoring Notes	Recommended Actions
2	Fire Lines to Buildings (various locations)	Chemical	Backflows from fire lines	Potential introduction of contaminants.	Backflow By-law. Installation of backflow preventers required by building permit process.	Annual inspection of all private backflow preventers required by the Town.	n/a	3	3	5	11	No	n/a	Detectability - Worst case	Enforce backflow by-law. Initiate cross-connection program. Map locations with fire lines.
9	Hydrants and Service Connections Tampering (various locations)	Chemical, Biological, Radiological	Vandalism/terrorism. Illegal connection to system through hydrant or service connection	Potential introduction of contaminants.	n/a	n/a	n/a	1	5	5	11	No	n/a	n/a	Develop Emergency Response Procedure.
19	Severe Risk ICI Service Connections	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)	Potential introduction of contaminants.	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.	n/a	2	4	5	11	No	n/a	2009 Backflow program implementation stage phase 1.	Map hotspots in Town. Make information available on mobile systems.
6	Hydrant Usage	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	Backflow into the system leading to a potential introduction of contaminants.	n/a	n/a	n/a	3	3	4	10	No	n/a	n/a	Establish SOP with Fire Department. Develop training/awareness for Fire Department on their effect on water system. Evaluate areas of vulnerabilities in the system.
13	Interconnections with Region of York / Toronto Water - Low Chlorine	Biological	Low chlorine residual in water from source (less than 0.25 mg/L)	Potential for biological contamination.	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.	3	4	3	10	No	n/a	Detectability - Assumes part of the weekly sampling program.	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.
15	Interconnections with Region of York / Toronto Water - High Chlorine	Chemical	High chlorine content in water from slug due to superchlorination of mains	Customers affected by high chlorine levels.	n/a	n/a	Flush upon detection. Close valves (isolate). Notify the Region of York. Drinking Water Advisory.	2	4	4	10	No	n/a	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.	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.
16	Design Issue in New Development Infrastructure	Capacity, Biological	Infrastructure incorrectly sized	Little draw from system causing low chlorine residual.	Town reviews all new infrastructure developments and ensures proper design prior to issuing permit.	n/a	Flushing and chlorine residual sampling at problem areas identified.	3	3	4	10	No	n/a	Detectability - Assumes the incorrect sizing of the infrastructure is not identified until there is a problem with chlorine residuals.	n/a
23	Valves & Hydrants operation - transients	Chemical, Biological, Capacity	Transients due to abnormal operation of valves and hydrants	Potential introduction of contaminants due to back siphoning. Breaking off of tubercles / biofilm (low chlorine residual).	System valves only operated by Town. SOPs to operate.	n/a	n/a	3	3	4	10	No	n/a	n/a	Purchase and install high frequency pressure gauges to detect transients.
1	Air valves (various locations - e.g. Kennedy Rd. & 14th Ave)	Chemical, Biological, Capacity	Negative pressure in system causing the introduction of contaminated water via submerged air valves	Potential introduction of contaminants.	Venting of air valves as close to ground as possible.	Air valves are inspected once a year as part of O&M program.	n/a	2	3	4	9	No	n/a	Detectability - Submerged air valves will be found during O&M inspections however the hazardous event will only be found by chance.	Ensure all air valves are identified, and vented properly.
14	Source Water Quality Deficiency (except Chlorine)	Chemical, Biological and Radiological	Deficient water quality in the water from source. Change in chemical composition (e.g. pH) of source water (water coming from Toronto / York)	Potential for chemical and microbiological contamination. Dissolved lead in water from leaded joints and lead gaskets.	Treated water quality is being continuously tested at the source and at the reservoirs.	Lead sampling program. Chlorine residual sampling.	n/a	1	4	4	9	No	n/a	To become CCP once monitoring locations implemented.	Design and implement supply point monitoring system.
18	Private System Mains	Chemical, Biological, Capacity	Break in private system. Deficient disinfection/cleaning	Potential introduction of contaminants.	n/a	n/a	n/a	2	3	4	9	No	n/a	n/a	Consider requirement to install backflow preventers on water services for all condominiums/private developments. Require private owners notify Public Health in the event of a watermain break.
20	Moderate / Low Risk Multiple Residential Service connections	Chemical, Biological, Capacity	Backflows from residential customers with no backflow prevention. (e.g. Condominium Developments)	Potential introduction of contaminants.	Installation of backflow preventers required by building code.	Annual inspection of all private backflow preventers required by the Town.	n/a	2	3	4	9	No	n/a	n/a	n/a
24	Mainline Valves (various locations)	Chemical, Biological, Capacity	Unauthorized use of valves by contractors creating dead ends	Low chlorine residual. May generate transients leading to breaks and negative pressures.	n/a	n/a	n/a	3	2	4	9	No	n/a	n/a	During exercising of valves, check status (open/close) is correct.
25	Watermains (in contaminated sites -e.g. landfills, chemical depots, gas stations, sewage)	Chemical, Biological, Capacity	Introduction of contaminants due to negative pressures. Hydrocarbon permeation into PVC pipes	Potential introduction of contaminants.	n/a	n/a	n/a	2	3	4	9	No	n/a	n/a	Map hotspots in Town. Make it available on mobile systems.
26	Critical Watermain Supply (various locations) for critical customers	Capacity	Loss of supply to critical customers (e.g. Hospitals, IBM, Novapharm, airport)	Emergency situation affecting critical customers.	n/a	n/a	n/a	3	4	2	9	No	n/a	Detectability - Assumes Town is notified by the customer.	Map hotspots in Town. Make information available on mobile systems. Develop Emergency Response Procedure.
28	Inadequate draw of water from Watermains (various locations)	Biological	High Water Age, Stagnant water at dead ends, and inadequate frequency of flushing, or from phased New Development Build-out	Low chlorine residuals.	Dead end flushing program.	Residual reading at dead ends.	Flushing to restore chlorine residual.	4	2	3	9	Yes	See Critical Control Points Table	Detectability - Part of the operator flushing/sampling program.	New developments should be included as part of the flushing/sampling program at least in the first few months of commissioning to determine flushing/sampling program requirements (if any).
29	Adverse Water Quality Notification - Watermains	Chemical, Biological, Radiological	Notification of adverse water quality results	Potential for contamination.	Sampling done throughout the system.	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.	3	3	3	9	Yes	See Critical Control Points Table	Severity - Could lead to a drinking water advisory.	n/a

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3	Flushing Stations - Malfunction	Biological	Failure of automatic flushing stations	Low chlorine residuals.	n/a	Flushing stations checked once a month. Batteries changed twice a year.	n/a	3	2	3	8	No	n/a	Severity - If stations are checked often enough, the failure of the flushing station will not lead to any significant effects on the water quality.	n/a
7	Hydrant - Accidental Contamination	Chemical, Biological	Accidental contamination using legal/permitted connection to system through hydrant	Potential introduction of contaminants.	Permitting process includes the installation of backflow preventers and meters.	n/a	n/a	2	2	4	8	No	n/a	Severity - Assumes there is no malicious intent. Detectability - Assumes the permitted hydrant user does not notify the Town.	Develop Emergency Response Procedure.
8	Hydrant- Bi-directional Flushing	Chemical, Biological, Capacity	Bi-directional flushing at hydrants during watermain break repair causing adverse water quality	Breaking off of tubercles / biofilm causing a reduced chlorine residual.	SOPs for watermain break repairs. Customers notified of valve closure, and before flushing, and told not to drink the water during the repair period.	Chlorine residual sampling.	n/a	4	2	2	8	No	n/a	Detectability - The presence of turbidity and colour would be reported by customers who are not directly affected by the valve closure.	n/a
17	Pressure Reducing Valve (PRV) Failure	Chemical, Biological, Capacity	PRV failure in open or closed position	Negative pressures, loss of water supply, creation of dead ends, watermain breaks.	Preventive maintenance once a year.	n/a	n/a	2	4	2	8	No	n/a	Detectability - Problem would be reported by the customers immediately. Severity - Could affect an entire pressure zone.	Installation of pressure monitoring at critical areas.
21	Temporary/Surface Bypass Watermains	Chemical, Biological	Drain valve left open on bypass line. Potential for cross connections if negative pressures in the system	Potential introduction of contaminants.	n/a	n/a	n/a	1	3	4	8	No	n/a	Detectability - Even though the operators are present they will not be aware of the hazardous event will only be found by chance.	Map active temporary by-pass locations in Town. Make information available on mobile systems.
27	Easement Watermain Breaks (various locations)	Chemical, Biological, Capacity	Watermain break under creek or ravine	Rerouting of water system causing scouring of tubercles / biofilm. Low chlorine residuals.	n/a	n/a	SOPs in place for watermain repair.	1	3	4	8	No	n/a	Detectability - Assumes the break cannot be found. The response to the hazardous event is the same as any major watermain break.	Implementation of Management Areas
10	Improper Pump Operation	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	Low/negative pressures, breaking off of tubercles / biofilm. Reduced chlorine residual.	York pumps have surge protection.	n/a	n/a	2	3	2	7	No	n/a	Detectability - Operator daily rounds.	Discuss pumping station operation with Toronto Water and Region of York to identify ways to mitigate event.
12	Reservoir Tampering	Chemical, Biological, Capacity, Radiological	Vandalism/terrorism. System compromised at reservoirs. i.e. Markham and North Markham Reservoirs, Milliken and Bayview Reservoirs, Milliken and Wooten Way Towers. Emergency at one of the reservoirs during high demands (e.g. break-in, security alarm activated)	Potential introduction of contaminants. Reduced water supply to Town.	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.	York's SOP-19 for communication with Markham.	1	5	1	7	No	n/a	Detectability - Assumes security alarm would be activated.	Communicate security concerns to York Region. York Region Communications SOP19 in place. Develop Emergency Response Procedure.
22	Backflow Prevention Failure on temporary/surface bypass watermains	Chemical, Biological	Backflow prevention failure during superchlorination of temporary watermain	Customers affected by high chlorine levels.	SOPs for commissioning.	Inspector present. Sampling before opening valves to connect to system.	n/a	2	3	2	7	No	n/a	n/a	Test backflow preventers are working before installing. Require certification of backflow prevention equipment from manufacturer.
30	Other Utility Break near Watermain	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)	Watermain breaks. Loss of supply to area.	Asset management programs (CCTV inspection every five years).	n/a	SOPs in place for watermain repair.	1	4	2	7	No	n/a	Detectability - Operator rounds. Reported by customer. Severity - Major watermain supplying a critical customer or pressure zone.	n/a
4	Operator Competence	Chemical, Biological, Capacity	Lack of trained operators (operators do not know the system comprehensively)	Increased vulnerability to loss of supply and/or introduction of contaminants.	Comprehensive training program.	n/a	n/a	3	2	1	6	No	n/a	Detectability - Assumes problem is recognized already.	Ongoing training to provide complete knowledge of system. Complete system description and map of hotspots.
5	Staffing Compliment (Strikes or Emergencies)	Chemical, Biological, Capacity	Lack of trained and qualified staff during strike or emergency i.e. pandemic	Increased vulnerability to loss of supply and/or introduction of contaminants.	Markham has sufficient staff to maintain regulatory operations during emergency.	n/a	Expand responsibilities of existing contractors. Town has developed a pandemic plan.	2	3	1	6	No	n/a	n/a	Maintain minimum staffing complement with ongoing training.
31	New Watermain Commissioning	Biological	Improper disinfection during commissioning of new water infrastructure	Potential for microbiological contamination.	SOP for New Development Process	n/a	n/a	2	3	1	6	No	n/a	Detectability - Sample results	n/a
11	Loss of Supply Power	Chemical, Biological, Capacity	Loss of power supply at Pumping Stations or other facilities	Potential for low/negative pressures.	Backup power plus system storage backfeed	York Region monitors water supply levels on SCADA.	SOP to get pumps back in service. Can reroute flows from other sources.	2	1	1	4	No	n/a	Detectability - Assumes pump status is on SCADA. Severity - Storage available in system. Manageable distribution operation.	Modelling to determine alternative ways of supplying in case of emergencies. Push for installation of stand-by power.