Ontario

Ontario's New Guidance on Groundwater Under the Direct Influence of Surface Water: Shifting the Paradigm to Focus on Treatment Needs

National Water and Wastewater Conference
November 14, 2023

Overview

- Regulatory Framework in Ontario
- Need and Driving Force For Change
- Development of the Guidance Document
- Peer Review and Consultations
- ToR Overview
- Reporting Requirements
- Feedback
- Next Steps

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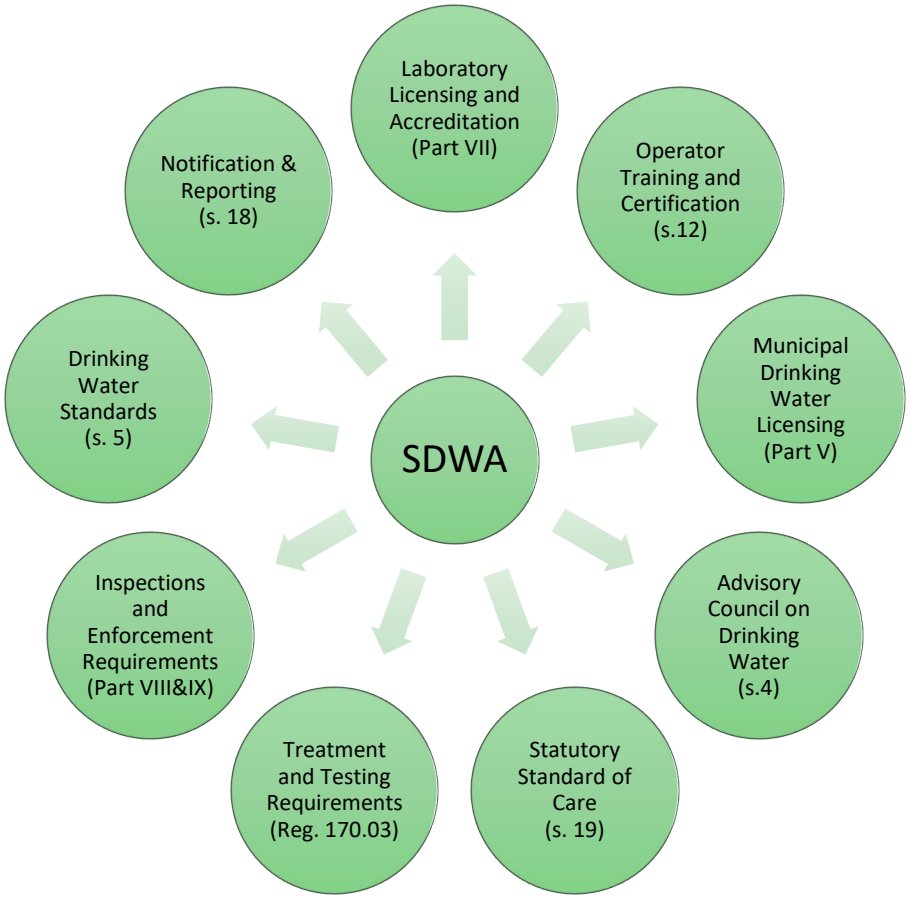
Legislative Framework



Key Regulations

- Drinking-Water Systems (Reg. 170/03)
- Drinking-Water Quality Standards (Reg. 169/03)
- Drinking-Water Testing Services (Reg. 248/03)
- Operator Certification (Reg. 128/04)
- Flushing for Lead - Schools, Private Schools, Day Nurseries (Reg. 243/07)
- Compliance and Enforcement (Reg. 242/05)
- Municipal Residential Systems in Source Protection Areas (Reg. 205/18)

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Regulation 170/03 Schedule 1: What is GUDI?

Systems are deemed GUDI [Section 2(2)] if:

- not a drilled well
- watertight casing does not extend 6 m below ground level
- infiltration gallery
- wells adjacent to surface water:
  - 0.58 L/s < and within 15m from surface water
  - > 0.58 L/s, overburden well within 100 m surface water
  - > 0.58 L/s, bedrock well within 500 m of surface water
- **exhibits evidence of surface water contamination**
- **engineer's/hydrogeologist's report concludes GUDI & includes reasons**

2001 GUDI ToR

Above [Section 2(2)] <u>does not apply</u> if engineer or hydrogeologist makes determination of ground water and not GUDI (requires Director's agreement) [Section 2(3)].

Procedure for disinfection of drinking water allows for GUDI with effective *in-situ* filtration (GUDI WEF).

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PROJECT CHARTER: GUDI Terms of Reference Review

- **2001 GUDI Terms of Reference: old and outdated**
- **No change in legislation - clarification & transparency**
- **Ensure that scarce tax dollars are spent to provide treatment and undertake monitoring, that promotes positive public health outcomes**
- **Update to incorporate most current consensus of science**

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The Original ToR

Two main objectives of the ToR were:

1. To reduce the risk to human health attributable to disease causing microorganisms.

2. To ensure appropriate treatment is provided for subsurface water supplies.

This does not change!

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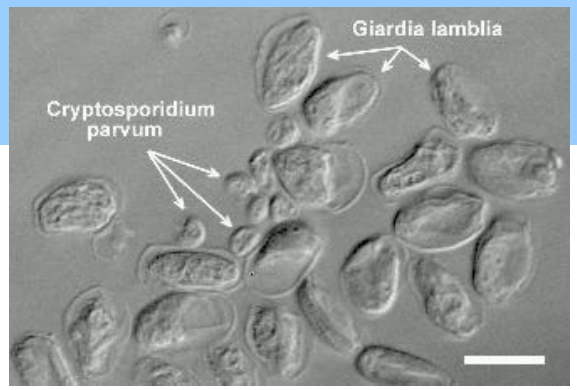
Historical Source Classification	Treatment Requirements	Typical Treatment Equipment
Groundwater	Currently minimum of 2-log inactivation of viruses Moving towards 4-log through DWL renewals and new well permitting	Chlorination
GUDI	4-log inactivation of viruses 3-log removal and inactivation of *Giardia* 2-log removal and inactivation of *Cryptosporidium*	Chemically Assisted Filtration (CAF) or Approved Equivalent (AE) UV irradiation or Ozonation Chlorination
GUDI EF	4-log inactivation of viruses 3-log inactivation of *Giardia* 2-log inactivation of *Cryptosporidium*	UV irradiation or Ozonation

Central treatment questions that we must answer:

When is treatment for protozoan pathogens necessary?
What level of treatment must be provided?



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Opportunity

Opportunity exists to update the ToR and to apply the international scientific community's most current consensus

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Process of Revision

- Collaborative, multi-stakeholder group:
  - Municipal system owners, both large and small
  - Industry consultants
  - Academic experts
  - Cross-divisional ministry staff
- Over 12 presentations (list provided separately) to reach out to the industry to provide an understanding of the draft document
- Facilitated process (Canadian Water Network)
- Led by Aziz and Monica

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Process of Revision

Group
Group Leader/ MECP Liaison

Group #1: Well Integrity and Structural Assessment
Tim Lotimer/ James Pickering

Group #2 Microbiological WQ Evaluation
Tim Walton/ Albert Simhon

Group #3: Assessment of Vulnerability to Contamination by Protozoa
Tammy Middleton/ Cynthia Doughty

Group #4: Physical/ Chemical WQ Assessment & CAF Treatment
Dennis Mutti/ John Minnery

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Process of Revision

Bernadette Conant – CWN - Facilitator

Dave Belanger – City of Guelph – Group 3

Vincent Suffoletta – City of Guelph - Facilitator

Matthew Phillips – City of Guelph – G4 I&C Practical

Kier Taylor – City of Guelph – Group 1

Simon Gautry – AMEC – Group 3

Craig Johnston – Stantec – Group 3

Lloyd Lemon – WSP – Group 3

Jamie Connoly – MOE/MOECC – Group 3

Jennifer Volpato – MOE/MOECC – Group 4

Minnie de Jong – MOE/MOECC – Group 2

Kim Yee – MOE/MOECC – Group 2

George Lai – MOE/MOECC – Group 4

Paul Froese – MOE/MOECC – ADM's Office

Christine Morritt – MOE/MOECC – Group 2

Jim Merritt – MOE/MOECC – ODWAC

Richard Vantfoort – MOE/MOECC – Source Water Protection

Jim Gehrels – MOE/MOECC – Original ToR

Dave Kerr – City of Kawartha Lakes – Small Systems

Gary Houghton – Norfolk County – Small Systems

Tom Renic – Halton Region – Group 4

Eric Hodgins – RMOW – Group 3

Olga Vrentzos – RMOW – Group 1

Al Couch – RMOW – G4 I&C Practical

Dave Rudolph – University of Waterloo – Group 3

Alex Chik – CWN & University of Waterloo - Facilitator

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2012-2013 Peer Review Workshop & Scientific Expert Review Panel*

Dr. Nick Ashbolt* – USEPA, Drinking Water Health and Risk Assessment

Dr. Beniot Barbeau* – Ecole Polytechnique de Montreal

Dr. Mark Borchart USDA-ARS

Dr. Edward Bouwer – John Hopkins University

Dr. Phil Berger – USEPA

Vicki Carmichael – BC Environment

Dr. Jennifer Clancy* – First Female Recipient of AWWA AP Black Award

Dr. Monica Emelko* – University of Waterloo

Dr. Ron Harvey* - USGS

Dr. Steve Hrudey – University of Alberta

Dr. Larry McKay – University of Tennessee

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2012-2013 Peer Review Workshop & Scientific Expert Review Panel*

Stephanie McFayden – Health Canada

Dr. Simon Sihota – Health Canada

Dr. Annie Locas – INRS-IAF

Dr. Pierre Payment - INRS-IAF

Dr. Ray Chittaranjan – University of Hawaii

Dr. Donald Reid – Alberta Environment

Dr. David Rudolph* – University of Waterloo

Dr. Jack Schijven – RIVM Utrecht University

Dr. Jiri Simunek – University of California Riverside

Dr. Marylynn Yates* - University of California Riverside

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2018 Expert Review Panel

Stephanie McFayden – Health Canada

Dr. Jennifer Clancy – ESPRI

Dr. Ron Hofmann, University of Toronto

Dr. Steve Hrudey – University of Alberta, *Emeritus*

Dr. Joan Rose – Michigan State University

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Scientific Principles of the Revised ToR: Reviewed by Expert Panel (2012-2013)

SP1. **Drinking water treatment requirements are based on water quality** and should give consideration to potential changes in water quality, which may be long term or short-lived.

SP2. Major waterborne microbial pathogens include viruses, bacteria and protozoa. **Viruses (as a whole group) require more treatment by disinfection than bacteria.** Therefore, provision of disinfection for viruses typically provides concurrent, comparable or greater disinfection of bacteria. **Protozoa are more difficult to treat than viruses and bacteria by traditional disinfection** with chemical oxidants in particular, *Cryptosporidium* spp. oocysts are not effectively inactivated in this manner.

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Scientific Principles of the Revised ToR: Reviewed by Expert Panel (2012-2013)

SP3. Viruses and bacteria are much more prevalent in the subsurface than protozoa cysts.

SP4. Viral and bacterial pathogens have been the major sources of human waterborne disease associated with subsurface water supplies.

SP5. Essentially all wells have some risk of contamination by viruses; accordingly, **a "minimum level" of disinfection is required for all well-based municipal drinking water systems**.

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Scientific Principles of the Revised ToR: Reviewed by Expert Panel (2012-2013)

SP6. **In Ontario, the majority of public health risk from waterborne pathogens is attributable to fecal contamination** of untreated/inadequately treated water supplies by warm-blooded animals. *Escherichia coli* (*E. coli*) and enterococcus are examples of bacterial indicators of fecal contamination; male-specific F(+) RNA coliphages are viral indicators of fecal contamination and *Giardia* spp. and *Cryptosporidium* spp. are protozoan pathogens of fecal origin. Some, but not all, of the species of these indicators are human pathogens. Because of their association with warm blooded animals, fecal contaminants originate in the near surface (e.g., septic tanks) or above ground.

Scientific Principles of the Revised ToR: Reviewed by Expert Panel (2012-2013)

SP7. **There are no broadly reliable quantitative surrogates for the occurrence (or absence) or fate and transport of human pathogens in water.**

SP8. Unlike bacterial indicators of fecal contamination (e.g., *E.coli*); because of their similarity to enteroviruses (in shape, size, morphology and composition) the presence of viral indicators (e.g. male-specific F(+) RNA coliphage) of fecal contamination in subsurface water supplies is likely the best available indicator of a potential pathway for pathogenic viruses to pass through the subsurface into subsurface water supplies.

Scientific Principles of the Revised ToR: Reviewed by Expert Panel (2012-2013)

SP9. **The presence of photosynthetic pigment-bearing algae and/or diatoms (PBADs) (i.e. pigment-bearing algae and diatoms) is likely the best available indicator of a potential pathway for pathogenic protozoa to pass through the subsurface into well supplies** because some of these organisms (especially when unicellular) are similar to or larger in size than pathogenic *Cryptosporidium* spp. and *Giardia* spp. (oo)cysts and because the presence of photosynthetic pigments suggests relatively rapid travel from above ground to a well.

SP10. **Groundwater age and travel times are not necessarily indicative of pathogen survival and transport in the subsurface.** Further, travel time estimates yield the mean of advective mass, not first arrival. Thus they have limited utility in assessing pathogen risk and advising event based sampling.

Microbiological WQ Evaluation

- ***E. coli*** (already monitored): **an indicator of fecal contamination**
- **Photosynthetic Pigment Bearing Algae and Diatoms (PBADs):**

  an indicator of a rapid subsurface pathway/large enough for protozoan transport

  - Microscopic examination of water in conjunction with the 2012 (or current) US EPA Method 1623.1
  - 50L (maximum of one capsule) of raw ground water examined
  - Recovery assessed using a marine diatom (*Thalassiosira weissflogii*) (6-20 µm x 8-15 µm): size range of *Cryptosporidium/Giardia* (oo)cysts
    - available in Canada
    - not present in freshwater (no background)
    - easily identified (cylindrical glass box), but not confused with other PBADs

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Updated Terminology

<table>
<tr><th colspan="2">Source Water Category</th><th colspan="2">Minimum Required Treatment Level</th></tr>
<tr><th>Existing Term</th><th>Updated Term</th><th>Overall</th><th>Particulate Removal</th></tr>
<tr><td>Groundwater</td><td>Category 1</td><td>4-log virus for new systems and existing systems as determined by MECP</td><td>None</td></tr>
<tr><td>Groundwater Under the Direct Influence of Surface Water (GUDI) With Effective Filtration</td><td>Category 2</td><td rowspan="3">4-log virus
3-log Giardia spp. cysts
2-log Cryptosporidium spp. oocysts
or as mandated by the MECP</td><td>None</td></tr>
<tr><td rowspan="2">GUDI</td><td>Category 3</td><td>Chemically Assisted Filtration (CAF)</td></tr>
<tr><td>Category 3E</td><td>Approved alternative to CAF</td></tr>
</table>

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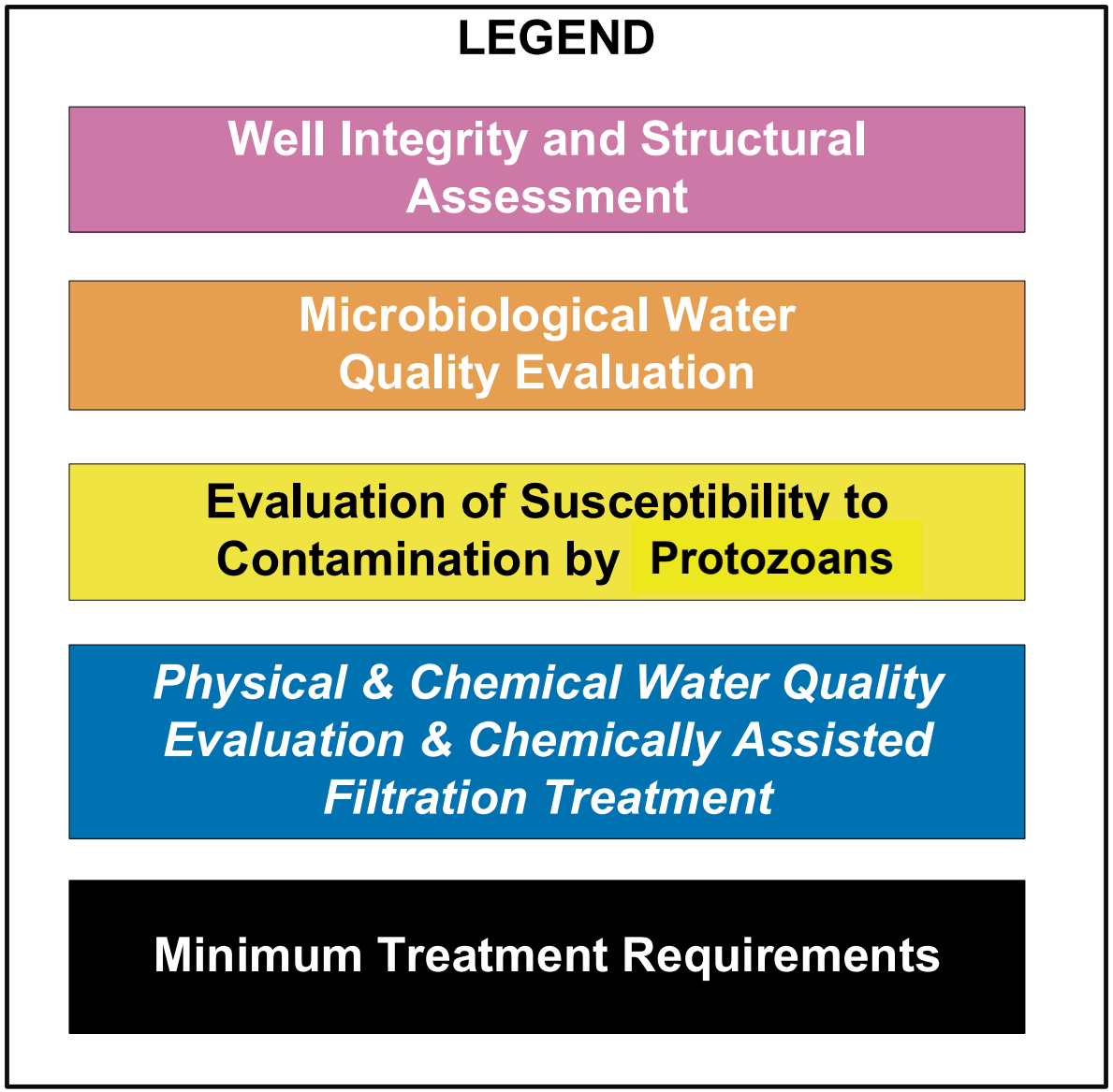
Key Components of New ToR



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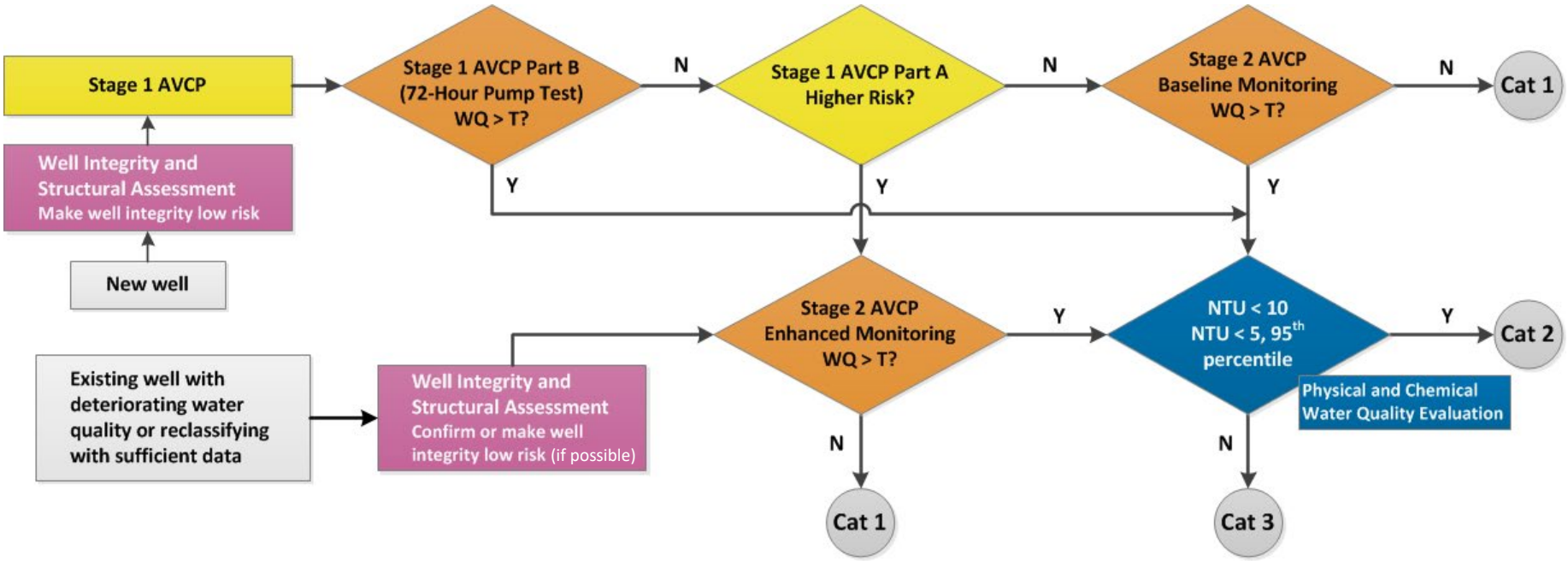
ToR Overview



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ToR Overview

Item	Baseline Monitoring Program	Enhanced Monitoring Program
1. Supply Well	Continuous turbidity measurements (15 min intervals)	Continuous turbidity measurements (15 min intervals)
2. Supply Well	Weekly raw water samples for *E. coli*	Weekly raw water samples for *E. coli*
3. Supply Well	Three (3) samples per year for *Giardia* spp. cysts, *Cryptosporidium* spp. oocysts, and photosynthetic pigment-bearing algae and/or diatoms (PBADs) [1]. Samples should be collected at least 3 months apart and in the following periods: fall, spring recharge, and summer.	Monthly, i.e. twelve (12) samples per year for *Giardia* spp. cysts, *Cryptosporidium* spp. oocysts, and PBADs [1].
4. Wellfield	Pumping rates and water level measurements. Surface water drainage assessment.	

[1] Sampling for these parameters may be discontinued once a potential pathway that is rapid and adequately large for protozoa or similar-sized particles to migrate into the well from above ground or the near surface has been confirmed (i.e., once there are 2 detections of PBADs).

Legend

AVCP – Assessments of vulnerability to contamination by protozoa
NTU – Nephelometric turbidity units
PBADs – Photosynthetic pigment bearing algae and/or diatoms
Crypto – *Cryptosporidium* spp. oocysts
Giardia – *Giardia* spp. cysts
E. coli – *Escherichia coli*
WQ > T – Water quality threshold ≥ 4 *E. coli* + ≥ 2 PBADs OR any *Giardia* or *Cryptosporidium* detected
PFD – Procedure for Disinfection of Drinking Water in Ontario
CAF – Chemically Assisted Filtration
Cat 1 – Category 1, disinfection to achieve treatment levels for groundwater as per PFD.
Cat 2 – Category 2, disinfection to achieve treatment levels for surface water as per PFD. No particulate removal required.
Cat 3 – Category 3, disinfection to achieve treatment levels for surface water as per PFD. CAF or equivalent required.

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Figure A-1: Determining Treatment Requirements for New Wells

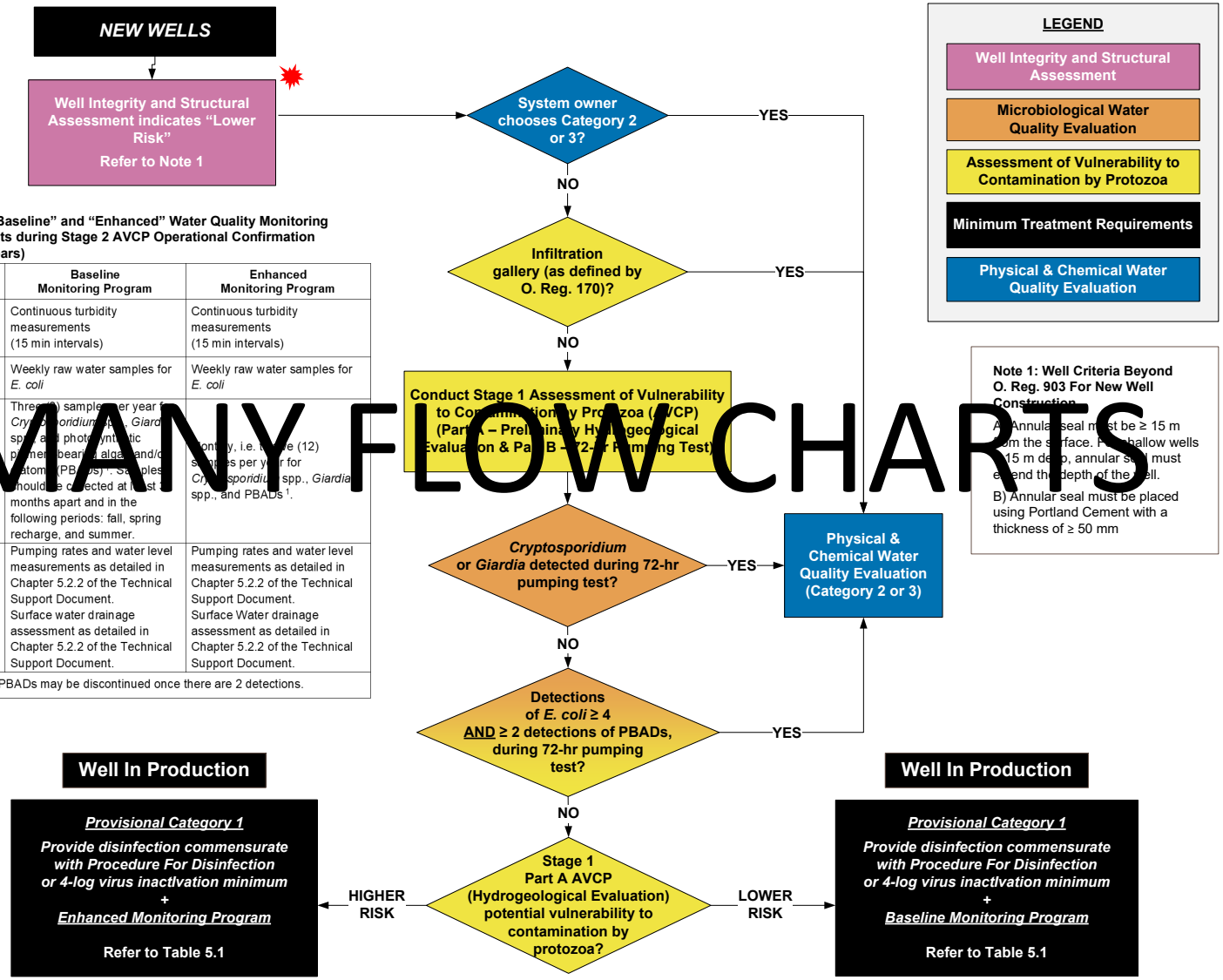

Table 5.1: "Baseline" and "Enhanced" Water Quality Monitoring Requirements during Stage 2 AVCP Operational Confirmation Period (2 Years)

Item	Baseline Monitoring Program	Enhanced Monitoring Program
1. Supply Well	Continuous turbidity measurements (15 min intervals)	Continuous turbidity measurements (15 min intervals)
2. Supply Well	Weekly raw water samples for *E. coli*	Weekly raw water samples for *E. coli*
3. Supply Well	Three (3) samples per year for *Cryptosporidium* spp., *Giardia* spp. and photosynthetic pigment bearing algae and/or diatoms (PBADs)[1]. Samples should be collected at least 3 months apart and in the following periods: fall, spring recharge, and summer.	Monthly, i.e. twelve (12) samples per year for *Cryptosporidium* spp., *Giardia* spp., and PBADs[1].
4. Wellfield	Pumping rates and water level measurements as detailed in Chapter 5.2.2 of the Technical Support Document. Surface water drainage assessment as detailed in Chapter 5.2.2 of the Technical Support Document.	Pumping rates and water level measurements as detailed in Chapter 5.2.2 of the Technical Support Document. Surface Water drainage assessment as detailed in Chapter 5.2.2 of the Technical Support Document.

1: Sampling for PBADs may be discontinued once there are 2 detections.

MANY FLOW CHARTS

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DETAILED FLOW CHARTS FOR:

- Well Integrity and Structural Assessment
  - Determination of High or Low Risk Well
- Determine Treatment Requirements for New Wells
  - Owner can choose higher level of treatment at any time and bypass studies, otherwise …
  - Assessment of Vulnerability to Protozoan Contamination
    - Stage 1 72 hour pump test.
    - Water quality thresholds trigger higher level of treatment
      - Find a *Cryptosporidium* oocyst or *Giardia* cyst
      - ≥ 2 PBADS and ≥ 4 *E. coli*
    - QP makes a determination of high or low risk
      - New well in production, provisional category 1
    - Stage 2 enhanced or baseline monitoring for 2-years
- Physical Chemical Treatment Assessment
  - Is a particulate removal step required; i.e. Category 2 or 3/3E
- Monitoring of Existing Wells In Production
- Challenge Classification
  - Category 2 or 3 to 1, Stage 2 Enhanced AVCP 2-Year Monitoring Period
  - Category 3 to 2, Turbidity Data

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Well Integrity and Structural Assessment

Ontario: protozoa have never been detected in untreated water from a well.
North America: limited detections of protozoa in untreated well water associated with direct contamination from sewage sources (e.g. leaking sanitary sewers) or from faulty well casings near sources of sewage or agricultural contamination.

Well integrity is a critical component of the multi-barrier approach to drinking water protection and complements source protection measures.

- Assessment completed for new wells and existing wells with water quality triggers.
- All wells must comply with Ontario Regulation 903/90 Wells
- Additional assessment to categorize well as low or high risk.
  - Annular seal depth, thickness and material composition (guidance provided on intrusive & non-intrusive methods of investigation).
  - Well casing integrity.
  - Movement of water from uncased portion of well.
- Two more stringent criteria to achieve low risk
  - Annular seal to 15 m
  - Must use Portland Cement

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Assessment of Vulnerability to Contamination by Protozoa (AVCP)

Minimum sampling required to evaluate susceptibility to contamination by protozoa:

NEW WELLS INITIAL PUMP TEST:

- 72 hour pump test
- Higher level of treatment if water quality criteria are exceeded
- Primarily informs level of risk, which informs level of on-going monitoring for provisional category 1 wells.

NEW WELLS 2 YEAR MONITORING PERIOD:

- baseline (3 samples / year for protozoa and PBADs), or
- enhanced (monthly) sampling for protozoa and PBADs, and
- Weekly sampling for *E. coli*.

- Enhanced sampling when:
  - QP designates new well as high risk during hydrogeological evaluation based on evidence of preferential pathways; water table drawdown; temperature, turbidity and conductivity fluctuations > 20%.

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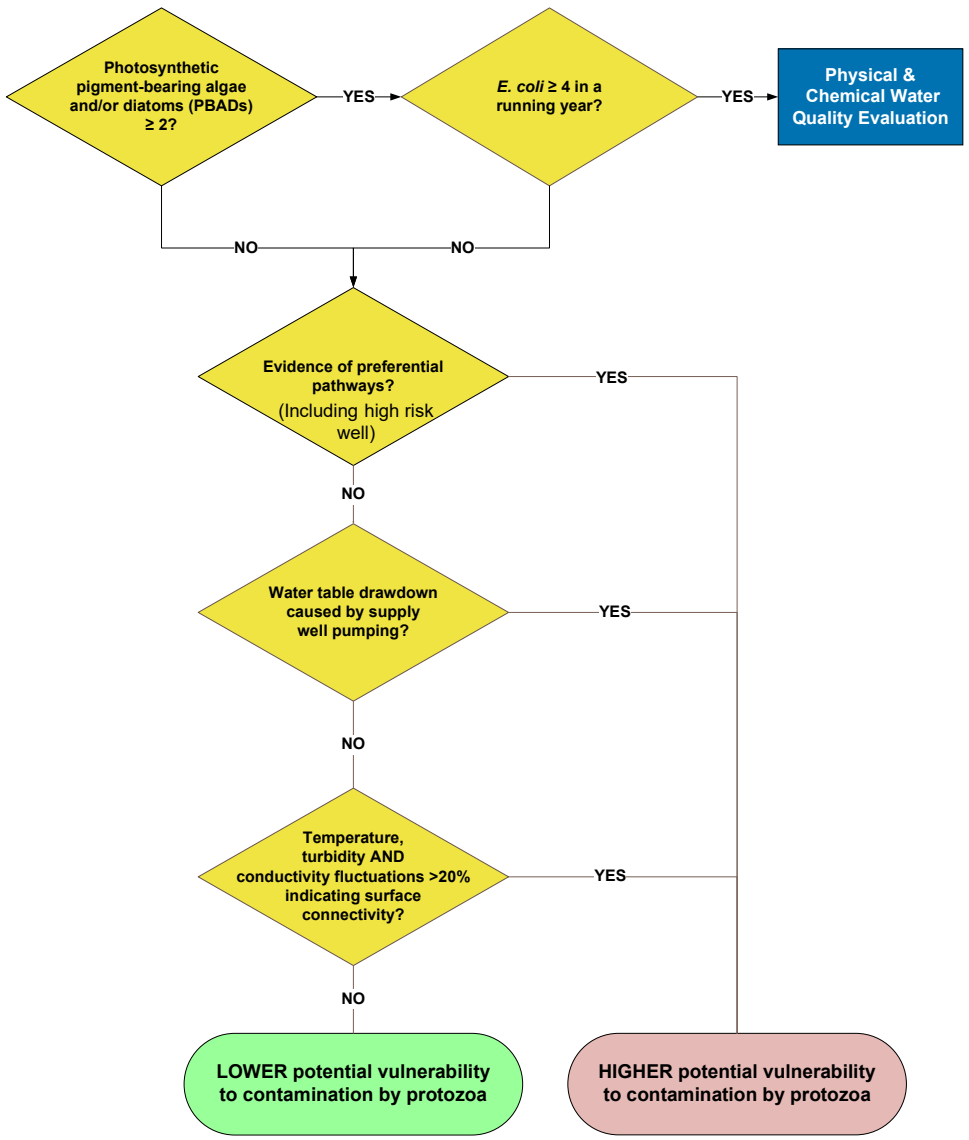
Figure A-6: Assessment of Vulnerability to Contamination by Protozoa (AVCP)
Evidence of Enteric Protozoan Pathway



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Assessment of Vulnerability to Contamination by Protozoa (AVCP)

Principal objective of the GUDI ToR is ***to determine whether a subsurface water supply requires treatment beyond a minimum level of disinfection required to inactivate or remove viruses and bacteria, i.e., whether or not treatment for protozoa is required.***

Treatment for protozoa required if the assessment criteria are met at any time:

a) Evidence of *Cryptosporidium* and/or *Giardia* contamination
(If *Cryptosporidium* and/or *Giardia* are detected)

OR

b) Evidence of both fecal contamination and the presence of an adequately sized or relatively rapid pathway connecting the subsurface and above ground or near surface areas.
(If **water quality threshold** is met: ≥ 4 detections of *E. coli.* during any 12-month running period **AND** ≥ 2 detections of PBADs at any point in time)

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Physical/Chemical WQ Assessment & CAF Treatment

Well classification is also based on whether or not particulate removal is required, i.e., by means of chemically-assisted filtration (CAF) or equivalent.

Particulate removal is required if:

- Particles in the water could harbor pathogens or otherwise hinder the disinfection process.
- If well meets **criterion**: turbidity > 10 NTU in two consecutive samples collected continuously and/or the 95th percentile is > 5 NTU then chemically assisted filtration or approved equivalent required
  - Maximum sample interval is 15 minutes
- PFD has pre-approved equivalents to CAF or director can approve an alternate

Assessed with a minimum of 3 months of continuously collected turbidity data.

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Reporting: AVCP Stage 1 Report

- Part A preliminary hydrogeological evaluation summary report
- Part B pumping test evaluation
- Determination: Provisional Category 1 (lower/higher risk) or Category 2/3.

Reporting: AVCP Stage 2 Report

- Determination: Category 1 (with/without further monitoring) or Category 2/3.
- Prepared at end of 2 year monitoring period or if the assessment criteria met (Cryptosporidium or Giardia detected, or water quality threshold exceeded).
- MECP notification if assessment criteria met during the course of the 2 year monitoring period.

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Comments by Stakeholders

- General support for the science-based approach outlined in the updated ToR
- Positive reception of the emphasis placed upon well integrity and structural assessments to reduce the risk of water quality deterioration
- Support for simple, yet well defined, water quality criteria for determination of when CAF or an approved equivalent is required
- Strong attempt to make documents user-friendly and understandable to system owners and operators

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Next Steps:

- DWL renewals underway to 2026
  - Some aspects of the ToR (4-log virus) continue to be incorporated into updated and new licenses with consultation
  - Ongoing pilots with reclassification as an outcome
- Internal clearance within the Ministry is proceeding well

Thank You!

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