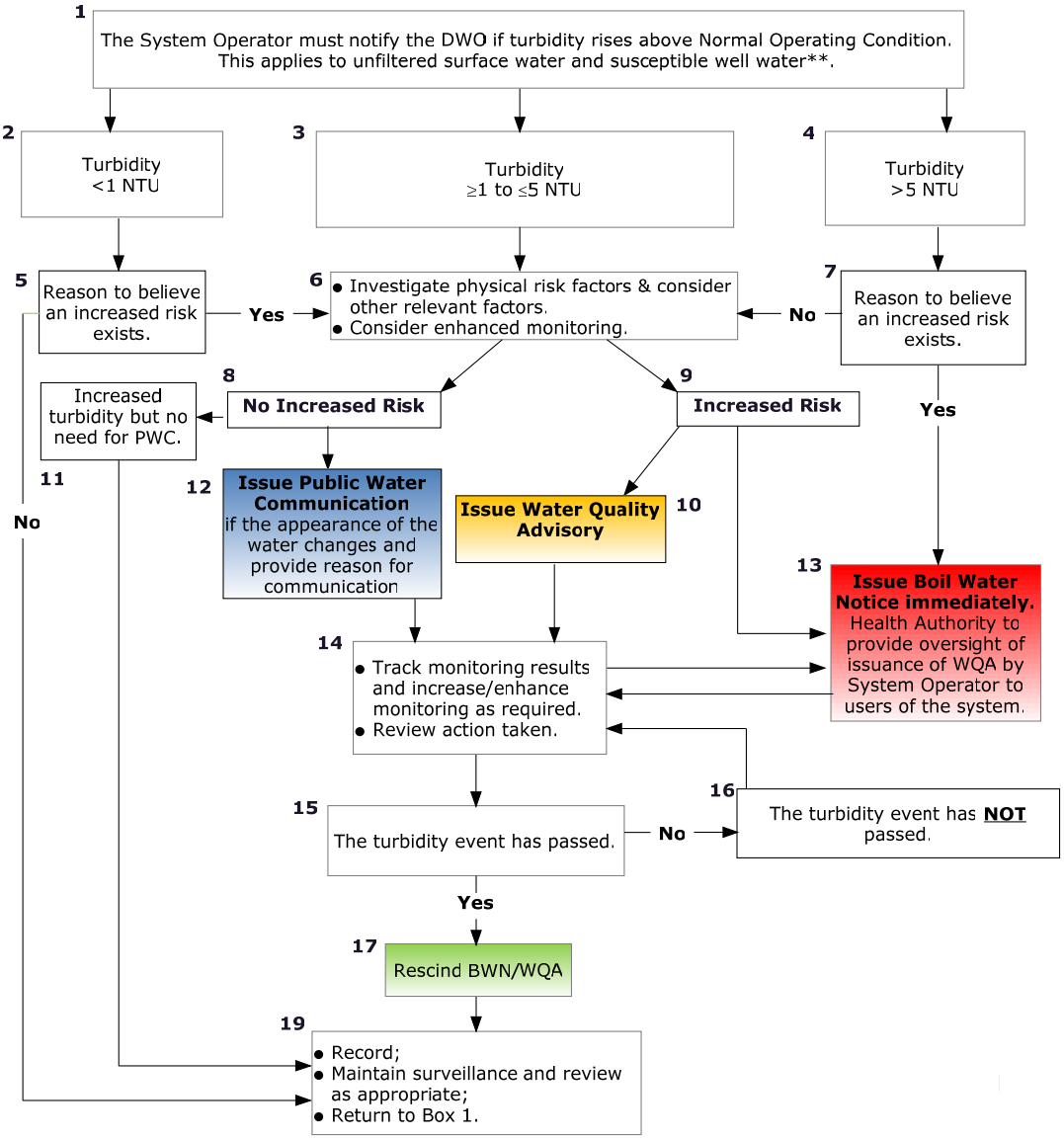
Decision Tree for Responding to a Turbidity Event in Unfiltered* Drinking Water (*Draft 31 Mar 09*)



***In filtered Drinking Water Systems, a spike in post filtration turbidity, not attributable to an instrument malfunction, may indicate a failure in primary treatment. In such cases, a risk assessment should be conducted as outlined in the DWO Guide. For definition of filtration, see Appendix A.**

*******Susceptible well* **refers to ground water that, in the opinion of a drinking water officer, is at risk of containing pathogens [as per Drinking Water Protection Regulation s.5(2)(b)].**

Appendix A: Explanatory Notes to the Decision Tree for Turbidity

This Decision Tree lays out the basic process that should be followed by the local Health Authority [Drinking Water Officer (DWO), Medical Health Officer (MHO)], and System Operators when assessing turbidity events and issuing Advisories or Notices related to those events. The following notes provide an expanded explanation for each of the boxes in the *Decision Tree for Responding to a Turbidity Event in Unfiltered Disinfected Drinking Water*. The numbering below corresponds to the numbering of the decision tree boxes.

Dialogue needs to occur between the DWO and water supplier on the appropriate communication and monitoring with the goal of reaching consensus on the degree of increased health risk associated with the change in turbidity and related considerations as set out in Appendix B. In the absence of consensus the decision rests with the DWO. In an emergency situation, a water supplier may issue a BWN without prior dialogue with the DWO.

Communication with the public is not dependent on the state of the scientific evidence, i.e., communication to users should be occurring under normal circumstances, and not just during water advisories and notices. When advisories or notices are issued, the risk event(s) underlying the turbidity should be communicated and the strength of the scientific evidence presented. In particular, with boil water notices (BWN), the notice should indicate whether sampling evidence indicates the presence of potential pathogens or other evidence relied upon. This may change over the course of an event. A turbidity event indicates a possible threat to drinking water. The onus for providing scientific evidence of the safety of drinking water to human health lies with the water supplier. Failure of the water supplier to provide information to assess the health risk posed by the turbid drinking water may result in the issuance of a water quality advisory (WQA) or BWN at the discretion of a DWO.

Definitions:

- **Boil Water Notice (BWN)** – *Notice provided to water users to boil their water before any use that may involve ingestion of the water.* A BWN infers that an adverse microbiological health risk exists if the water is ingested. A BWN is issued by the system operator on request or order by the Local Health Authority (DWO. The Local Health Authority (DWO) should verify that the BWN has been issued to users of the system.

- **Public Water Communication (PWC)** – *A communication to water users that explains a notable change in the water characteristics.* A PWC usually applies to a change in appearance of the water but does not involve a health risk. The Local Health Authority (DWO) should verify that the PWC has been issued to users of the system.

- **Water Quality Advisory (WQA)** – A water quality advisory should be used where a DWO determines there is some level of risk associated with water use, but the circumstances do not warrant a “Boil Water Notice”; the WQA should specify the nature of the risk, steps that the water supplier is taking and steps that water users may take.. A WQA is issued by the system operator on request or order by the Local Health Authority (DWO). The Local Health Authority (DWO) should verify that the WQA has been issued to users of the system.

- **Filtration** – *A treatment process approved by the Issuing Official (i.e., Health Authority, MHO, DWO, PHE, or EHO) for the removal of particulate matter,* has been granted removal credits for pathogens and is operating as expected.

Box 1. **Decision:** This box represents a situation where the turbidity rises above the Normal Operating Condition for that particular DW system has been noted by the system operator and relayed to the DWO. This box also identifies the type of treatment to which this overall decision process applies – namely unfiltered drinking water. The process to be followed for filtered water is described in the footnote to the decision tree. Three options are available depending upon the measured turbidity, i.e., <1 NTU; ≥1 to ≤5 NTU; and >5 NTU. In addition, ***susceptible well*** refers to ground water that, in the opinion of a drinking water officer, is at risk of containing pathogens. [as per DW Regulation s.5(2)(b)].

Box 2. This box applies when the turbidity level are <1 NTU. In most cases this would likely encompass normal operating levels and no further action would be taken other than maintaining regular surveillance as per Box 18. However, if for some reason the small increase generates some concern to the DWO, Box 2 provides the option to investigate further by initiating some additional monitoring as shown in the decision tree by following the arrows from Box 2→Box 5→Box 6.

Box 3. This box applies when turbidity levels fall in the range of ≥1 to ≤5 NTU. Increases in turbidity that fall in this range need to be investigated further because of the greater potential for adverse health effects.

Box 4. This box applies when turbidity levels are >5 NTU. 5 NTU is typically the approximate level of turbidity that would become visibly noticeable. The actual health risk may depend on a number of factors. For example, one primary factor that needs to be considered is the past history of similar increases for that system and if any adverse health effects have occurred under similar circumstances. Box 4 logically leads to Box 7 where a decision is needed to either assess further or go straight to a BWN.

Box 5. **Decision:** This box needs a decision to determine if there reason to believe an adverse health risk exists even though the turbidity increase is small. This step is necessary to provide the option to investigate further if necessary which leads to Box 6. If there is no reason to believe an adverse health risk exists then the situation goes to situation normal and System Operator maintains surveillance, etc. as per Box 18.

Box 6. **Decision:** This box is eventually fed from all 3 turbidity streams and is the crux where there is a need for further investigation and monitoring regardless of the 3 range options (Boxes 2,3,4). The assessment involves reviewing the physical basis of the increased turbidity and judging if an increased risk (Box 9) is apparent and of sufficient magnitude to justify a Boil Water Notice. Physical and other risk factors are listed in Appendix B to assess risk associated with increased turbidity.

Box 7. **Decision:** This box provides the option to go directly to a Boil Water Notice based on the experience and judgment of the system operator/DWO and to also initiate some additional monitoring (such as for raw water, post-treatment bacteriological testing, distribution system bacteriological testing, operational parameters, disinfectant residuals, illness among users and possibly other parameters). This direct route to a BWN is provided to try to catch an adverse health event before it happens. If there is no past history of adverse health effects with the system, even when the increased turbidity is high and has reached similar magnitudes, the option is provided to bypass the direct route to a BWN via Box 6 that involves a more in-depth assessment that may or may not result in a BWN being issued. In other words the choice keeps all options open. An example of such a situation could be where a landslide of primarily inert non-organic material in the watershed has significantly increased the turbidity in the past but no adverse health effects have been noted or are anticipated.

Box 8. **No Increased Risk** applies to a situation where the DWO has determined there is no increased risk of adverse health effects for users of the system even though there may be detectable changes in water quality with respect to turbidity.

Box 9. .**Increased Risk** applies to a situation where the DWO has determined that there is an increased risk of adverse health effects for users of the system . When risk factors of concern are identified during a turbidity event then a BWN should be issued as per Box 13.

As per Appendix B, an increased risk may also result when the water purveyor does not provide information on the nature of the turbidity event. The assessment of increased risk is at the discretion of the DWO (box 6).

Box 10. . **Issue Water Quality Advisory** if there is uncertainty in the degree of the increased risk to users of the system, i.e., not enough evidence to substantiate that a BWN should be issued and clearly not a situation of 'no increased risk; provide an explanation of the uncertainty.

Box11. This option of not issuing a Public Water Communication may apply for some situations where turbidity has increased, and the DWO has determined there is no increased risk of adverse health effects nor any change in appearance.

Box 12. **Issue Public Water Communication:** A PWC should be issued and system users advised of the reason for the communication when the appearance of the water changes, even if the assessment reveals that there is no increased risk to consumers. A PWC should inform individuals with weakened immune systems of their additional risk and advise them to boil their drinking water.

Box 13. **Issue Boil Water Notice:** This action is fed via three decision routes. Directly via Boxes 4→7→13 based on the reason to believe a health risk exists; by performing a risk assessment and identifying risk drivers of concern (Boxes 6→9→13); and via Box 14 where an increased sampling regime has identified a concern such that a Water Quality Advisory or Public Water Communication needs to be upgraded to a Boil Water Notice. The BWN should be issued by the water supplier and if not the DWO should request or order the water supplier to immediately issue the Boil Water Notice and to verify that it has been issued to users of the system.

Box 14. **Decision:** When a Boil Water Notice, a Water Quality Advisory, or a Public Water Communication has been issued, it is important to track the monitoring results and increase/enhance monitoring as required to determine when the event of concern has passed. It is also important to review decisions on an ongoing basis to ensure that the water supplier has taken appropriate action. It also provides the opportunity to continue monitoring when the turbidity event has not returned to normal via Box 16. Box 14 also provides the option to upgrade from a WQA/PWC to a BWN via the arrow to Box 13 if sampling has shown that the water quality has deteriorated.

Box 15. **Decision:** This box provides two options; (i) to initiate the return to normal operating conditions after monitoring has revealed that the turbidity event has passed; (ii) to continue monitoring as per Box 16.

Box 16. This box feeds back to Box 14 to provide the opportunity to continue monitoring when the turbidity event has not passed. This would keep the WQA/BWN/PWC in effect.

Box 17. When conditions have returned to normal the BWN, PWC or WQA can be rescinded. The Health Authority should provide oversight over the process of rescinding the BWN/WQA/PWN by the System Operator to ensure that users of the system are notified.

Box 18. Turbidity events, causes, and actions taken should be recorded so that they can be reviewed if another event occurs. At this stage, the system should be back to normal operating conditions.

Appendix B: Factors That May Increase the Risk of Human Disease with Rising Turbidity

Physical Risk Factors Associated with Turbidity

1. Turbidity increasing above normal operating condition;
2. Spills (e.g. sewage, agricultural, chemical);
3. Sources of fecal material likely to contain human pathogens, e.g., humans, wild or domestic animals;
4. Changes in hydrological characteristics, e.g., human development, mountain pine beetle, etc.;
5. Organic vs. inorganic source event;
6. Precipitation intensity and anomalies, e.g., the amount and timing of rain, snow, or snowmelt;
7. Treatment risk factors associated with turbidity:
    i. Existing treatment outcomes cannot be maintained e.g., loss of chlorine residual, if chemically disinfected; a decrease in UV dose or lamp failure when disinfected by UV, or a decrease in transmittance;
    ii. A Single disinfection method (e.g., chlorination only) is less effective and may result in higher risk than multiple treatments (e.g., UV + chlorination);

Other Risk Factors That Should be Considered

1. Evidence of illness, or lack of evidence to the contrary
2. Evidence of pathogens in the distribution system, or lack of evidence to the contrary
3. Past history of health concerns.

Absence of Information

1. An increased risk may also result when the water purveyor does not provide information on the nature of the turbidity event. The assessment of increased risk is at the discretion of the DWO (Box 6).