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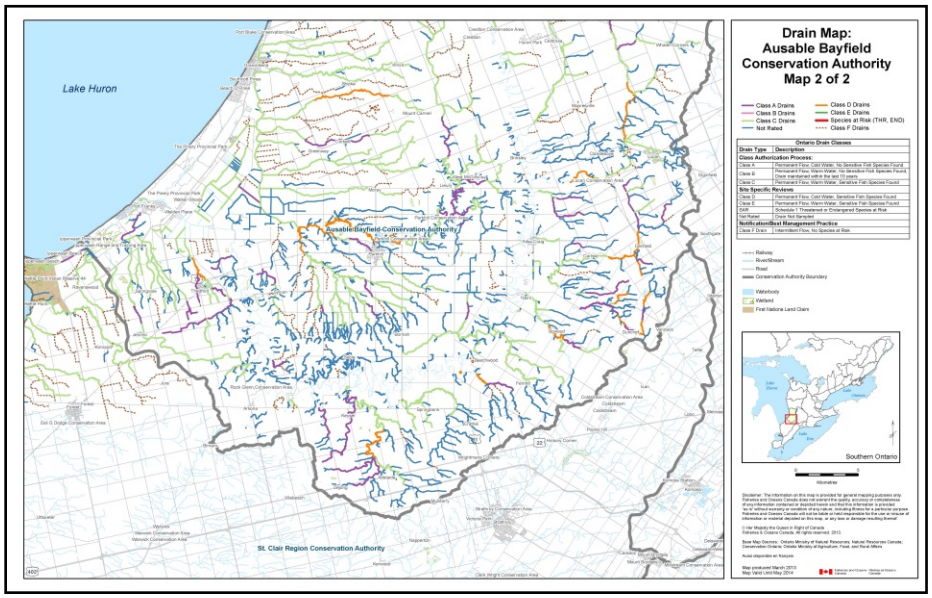
Central and Arctic Region

Canadian Science Advisory Secretariat
Science Advisory Report 2013/061

ADVICE ON THE STANDARDIZED DATA COLLECTION METHODS IN SUPPORT OF A CLASSIFICATION PROTOCOL FOR THE DESIGNATION OF WATERCOURSES AS MUNICIPAL DRAINS



Example of a drain classification map.

Context

Agricultural watercourses in Ontario have been designated as municipal drains. To streamline regulatory processes for maintenance works, these watercourses are classified based on temperature, permanency of flow, and fish species present. Currently, maintenance works on three drain types require a site-specific review by Fisheries and Oceans Canada (DFO) including Types D and E drains. These drain types contain sensitive fish species or may have species at risk (SAR) present and/or mapped critical habitat [includes fishes and/or mussels that are listed as Threatened or Endangered under the Species at Risk Act *(SARA)]. These three drain types are more sensitive to municipal drain maintenance works, which typically involve dredging the bottom of the drain and removing excess sediment. Drain types D and E are classified based on temperature and fish data that have been collected in the field. SAR presence is determined by using the Species at Risk Maps, or by detecting species at risk during fish sampling. If either source indicates the presence of SAR, then a SAR class will be applied.*

DFO Science has been asked to create sensitive species criteria and to provide a classification protocol that will be used to create the sensitive fish species list. In addition, DFO Science has been asked to review the resulting list of sensitive species to ensure that no sensitive species have been omitted and non-sensitive species are not included. Furthermore, a sampling protocol has been created to describe how temperature, flow, and fish data should be collected for the purposes of determining municipal drain classification.

This Science Advisory Report is from the July 11, 2013 science review of standardized data collection methods in support of municipal drain classification sampling protocol. Additional publications from this meeting will be posted on the DFO Science Advisory Schedule as they become available.

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SUMMARY

- Watercourses designated as municipal drains are currently classified based on temperature, permanency of flow and fish species present. Proper drain classification is imperative to ensure that appropriate mitigation is used during drain maintenance works.
- Information related to drain segmentation, as well as sampling protocols to determine temperature, permanency of flow and fish species present to ensure that drains are properly classified is provided.
- Advice on sensitive species criteria, as well as a classification method to determine whether a species should be classified as 'Sensitive' or 'Tolerant' is discussed. Following the proposed classification criteria, all fish species in Ontario were classified as either 'Sensitive' or 'Tolerant' [refer to Appendix 1 of Mandrak and Bouvier (2014)].
- Guidance is also provided on proper vouchering techniques, including both preserved vouchers, as well as digital vouchers. A list detailing vouchering requirements for all species in Ontario is provided [refer to Appendix 2 of Mandrak and Bouvier (2014)].

BACKGROUND

Rural watercourses in Ontario have been designated as municipal drains under the *Drainage Act, 1990*. These rural watercourses are classified into a number of categories to facilitate the review and approval of drain maintenance activities with respect to fishes and fish habitat. This is done under a Class Authorization Process developed by Fisheries and Oceans Canada (DFO) pursuant to the federal *Fisheries Act, 1985*. Full details on the process are outlined in the document: Agricultural Drain Maintenance in Southern Ontario – Guidance to Meeting Requirements of the *Fisheries Act* (DFO 2002).

The presence of top predators in a watercourse historically determined whether a site-specific review and Fisheries Act Authorization was required. It was deemed that this approach may not be appropriate and rather a list of sensitive species be created, which would better align with DFO's Risk Management Framework. The Risk Management Framework uses species sensitivity to determine risk level and whether an Authorization is the appropriate regulatory tool to be used. This report will summarize the review of a sensitive species classification method and resulting list of sensitive and tolerant species. Furthermore, this report will provide a standardized sampling protocol for the collection of temperature, flow and fish data for the purposes of determining municipal drain classification in Ontario. Knowledge gaps are summarized and should be updated as these gaps are addressed through future research.

The following types of data are required to support the drain classification process (Figure 1; Table 1):

- drain location/extent;
- sensitive fish species present;
- flow characteristics (permanent or intermittent); and,
- water and air temperature (summer).

In some cases, information may already be available to allow classification of a municipal drain. Prior to conducting field surveys, it is important to determine if fish, flow, and temperature data exist for the drain in question.

The Ontario Ministry of Natural Resources (OMNR), DFO, municipalities, and the local Conservation Authority should determine if they have the required data. Sources of data would include the OMNR Aquatic Resource Area layers, which may identify known spawning areas in drains and adjacent flooded riparian areas for species such as Northern Pike (*Esox lucius*). In

addition, the DFO Species at Risk Maps should be used to identify systems that may contain SAR. Records inputted in the creation of the SAR maps have been verified for accuracy and have been determined to be valid records. If the SAR maps indicate that a SAR is present in the drain, a site-specific visit may be required to verify that the current habitat is suitable for the SAR.

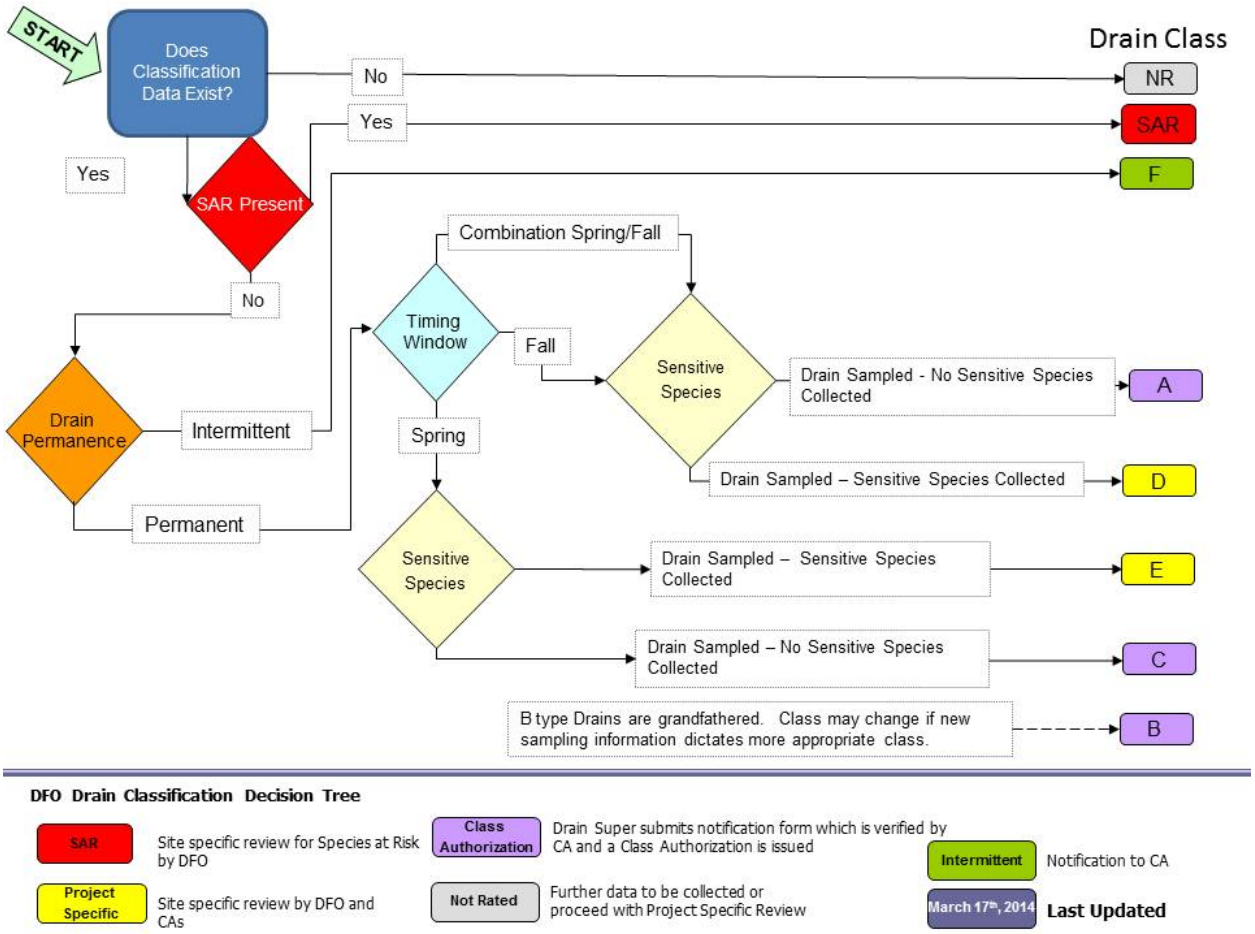

Figure 1. The agricultural drain classification process. The decision tree may result in a drain classification of SAR (endangered or threatened species at risk present), NR (not rated), or Class A to F.

Table 1. Summary of key characteristics of each drain classification.

TYPE	Flow	Spawning Period	Species	Time Since Last Clean-out	Authorization
A	Permanent	Fall or Combination Spring / Fall	No sensitive fish species present	N/A	Class A
B*	Permanent	Spring	Sensitive species present	Less than 10 years	Class B
C	Permanent	Spring	No sensitive species present	N/A	Class C
D	Permanent	Fall or Combination Spring / Fall	Sensitive species present	N/A	Project specific
E	Permanent	Spring	Sensitive species present	N/A	Project specific
F	Intermittent	N/A	N/A	N/A	None required (work done in dry or low flow)
Not Rated	Unknown	Unknown	Unknown	Unknown	Site specific or assess drain
SAR	N/A	N/A	Species at risk present	N/A	Site specific

* Note: No new Class B drains will be assigned, and any existing Class B drains will not change classification unless new data becomes available to support the reclassification to Class A, C, D, or SAR. Time since last clean out is no longer collected as part of the Drain Classification Project as per a decision made by the Drainage Action Working Group in 2010.

Areas that require drain classification will be prioritized by the local municipality or Conservation Authority based on current needs and concerns in the area. Priority areas might include:

- Areas with no existing data;
- Drains within which maintenance work is proposed in the near future, but at least a year away; and,
- Drains where the presence of sensitive fish species or habitat (e.g. spawning habitat, coldwater seeps) is suspected.

ASSESSMENT

Sampling procedure

The extent of the drain should be determined on the Ontario Ministry of Agriculture, Food and Rural Affairs/DFO/Conservation Authority drains layer. Any given drain will be comprised of one or more segments, each of which may be classified independently. A drain segmentation layer does not currently exist; therefore, segmentation will be based on the sampling procedures outlined below. In the absence of a drain segmentation layer, it is recommended, for ease of access and delineation, that road crossings be the basis for potential segmentation. To assist in potential future segmentation projects, basic characteristics should be recorded upstream of the road crossing. These characteristics should include drain name, latitude, longitude, date, maximum stream width, maximum depth, water temperature, air temperature, riparian cover, adjacent land use, and intermittency.

It is necessary to sample away from the road crossing to avoid the hydrological influence of the road crossing. Where access to the drain is available, the first site should be placed where the channel morphology becomes uniform. The intent of the habitat sampling is to determine changes in hydrology along the drain for segmentation purposes. If sampling was only to occur

at road crossings, these data may falsely lead one to believe that the channel is uniform throughout the entire drain segment (from downstream road crossing to upstream road crossing) when, in reality, the drain segment may differ between road crossings. If access to the drain upstream of the road crossing is not available, the measurements should be taken at the road crossing. It should be noted that changes in surficial geology may occur along a drain segment and may be used to alter the drain segmentation. For example, coldwater seeps, moraines, or isolated pools upstream from the road crossing should be noted, and may be used to create a break in the drain segmentation layer. In addition, impassable barriers within the drain should be used to create a break in the drain segmentation layer.

Flow determination

Each watercourse must be classified as either "permanent" or "intermittent". Permanent systems flow year round, or are consistently wet. If a watercourse continues to flow (in an average year), or is consistently wet, during the dry summer months, it should be considered permanent. Intermittent systems flow continuously for only a portion of the year, or are consistently dry, during the summer months. If a watercourse flows during brief periods (usually during the spring and/or fall), or for brief periods following storm events during the summer months, or has a defined channel but is dry for at least three months of the year, it should be considered intermittent. If the watercourse is categorized as an intermittent system, but habitats are present within the drain where there are known sensitive species, the drain cannot be considered intermittent. If the flow is determined to be intermittent, the collection of fish and temperature data are not required as the drain will be automatically receiving an F classification.

The permanency of the watercourse can be determined in a number of ways, including a review of historical data and existing information (1), application of published methods (2), the use of water-level loggers (3), the use of temperature loggers (4), or regular site visits with georeferenced photographic evidence (5).

1. Documentation of existing information obtained from Conservation Authority, OMNR, or DFO records (e.g. drainage reports, fisheries reports, watershed reports). This includes flow data/water depth of the drain collected at monthly intervals throughout the open-water period, supported by georeferenced photographs and dated field notes. Consideration must be given to the amount of precipitation received immediately prior to observation, or during the sampling year. Local weather statistics (e.g., from Environment Canada) should be reviewed if there are any concerns regarding abnormalities during observation periods. Such data will indicate if the drain, from that point upstream, is intermittent, but will not provide information on the segment(s) downstream.
2. Applying the methods outlined in the, "*The Stream Permanency Handbook for South-Central Ontario*" (Irwin et al. 2013), or methods included in the *"Evaluation, Classification and Management of Headwater Drainage Features Guidelines"* (TRCA 2013). Such an assessment will indicate if the drain, from that point upstream, is intermittent, but will not provide information on the segment(s) downstream.
3. Water-level loggers placed at the bottom end of a drain segment for a minimum of three months during the open-water period (May-June-July, or June-July-August; Irwin et al. 2013). As intermittency is most likely to occur as summer progresses, loggers are to be deployed during this time (i.e., early July – end of August). This will indicate if the drain, from that point upstream, is intermittent, but will not provide information on the segment(s) downstream.
4. Temperature loggers at the bottom end of a drain segment in an area of greatest water depth, for a minimum of three months during the open-water period (May-June-July, or

June-July-August; Irwin et al. 2013). As intermittency is most likely to occur as summer progresses, it would be best if the loggers were deployed during this time. As water temperature is generally lower and varies diurnally less than air temperature, a thermograph of the data can be compared to data from a local weather station to determine if the temperature logger was exposed, to assess intermittency. This will indicate if the drain, from that point upstream, is intermittent, but will not provide information on the segment(s) downstream.

5. Bi-weekly site visits during the months of May, June, July and August with georeferenced photographic evidence demonstrating that the watercourse is dry. This information can be obtained from reliable sources (e.g., Drainage Superintendents, municipal staff, landowners, local residents), provided it is verified with georeferenced, photographic evidence. Such data will indicate if the drain, from that point upstream, is intermittent, but will not provide information on the segment(s) downstream.

Temperature

If not intermittent, each watercourse must be classified as “coldwater”, “coolwater”, or “warmwater”. The relationship between water temperature, air temperature, and thermal classification has long been established (Stoneman and Jones 1996) and recently evaluated and refined (Chu et al. 2009). Other thermal classification methods have been developed that use longer-term thermal data or fish assemblage data (e.g., Wichert and Lin 1996; Lyons et al. 2009); however, they require much more data collection than the method outlined below. In particular, fish assemblage-based methods require sufficient sampling effort to collect a large proportion of the species present, which would be typically greater than effort required to detect a sensitive species (see below).

The following procedures are to be used to take standardized water and air temperature measurements. These are largely derived from the DFO/OMNR Habitat Management Series publication, “*A Simple Method to Determine the Thermal Stability of Southern Ontario Trout Streams*” and an evaluation of this method by Chu et al. (2009). Further guidance is available in Section 5 Module 1 of the Ontario Stream Assessment Protocol (Stanfield 2010).

- The sampling should take place from **July 1 to August 31**. Prior to, and after, these dates, overnight cooling of streams does not allow adequate separation of the thermal categories.
- Sample on days when maximum air temperatures have reached **at least 24.5°C** (Chu et al. 2009). Sample only when the previous 2-3 days are relatively similar in daily maximum air temperature (i.e., less than 5^{o}C warmer or cooler). For example, sampling would not occur on a 25°C day that was preceded by two days of 32°C or 20°C temperatures. This bias can occur when waiting for a day that is finally ‘hot enough”, or when a cold front moves in during the morning or early afternoon on a day scheduled for sampling.
- Water temperature sampling should not occur if it has rained in the three days prior to sampling, as rain events will alter water temperature.
- Take water temperature measurements between 16:00 and 18:00 h, which represent the maximum daily water temperature. Temperatures can be measured using a hand-held thermometer, a temperature logger, or minimum-maximum thermometer placed at the site before 16:00 h and removed and checked for maximum water temperature after 18:00 h. The temperature should be taken in the main flow of the stream, where waters are well mixed. Deployment methods from Jones and Allin (2010) should be used if temperature loggers are being used. All data points should be recorded (date, time and location of water temperature recordings, dates of maximum air temperatures, and devices used to

record temperature) so that drain class determination may be automated and reviewed at a later date.

- Obtain the maximum air temperature for the day of sampling. This is **not** a measure of the air temperature at 16:00 h. Daily air temperature maximums are available from Environment Canada weather stations. Locate the weather station closest to the stream site being sampled. Alternatively, a reliable temperature recording device (e.g., HOBO temperature logger) or minimum-maximum thermometer can be placed at a nearby, shaded location in the morning and checked at the end of the day (after 18:00 h).
- Using the nomogram shown in Figure 2 below, plot the maximum air temperature against the 16:00-18:00 h water temperature. Determine the location of your data point on the nomogram as belonging to the coldwater, coolwater, or warmwater category.
- It is recommended that the first temperature measurements be done in the drain at the road crossing farthest downstream, then at the road crossing farthest upstream. If the thermal classification is the same at both sites, then the thermal classification of the drain segment(s) between those sites should be considered the same. If the thermal classification is different, then temperature measurements should be taken at the road crossing halfway up the drain and iteratively upstream and downstream until the extents of the thermal classes across the drain segments is determined.
- To increase the accuracy of the site classification, several measurements should be taken on different days, particularly if the water temperature is close to the boundary between thermal categories (e.g., within ± 2°C).

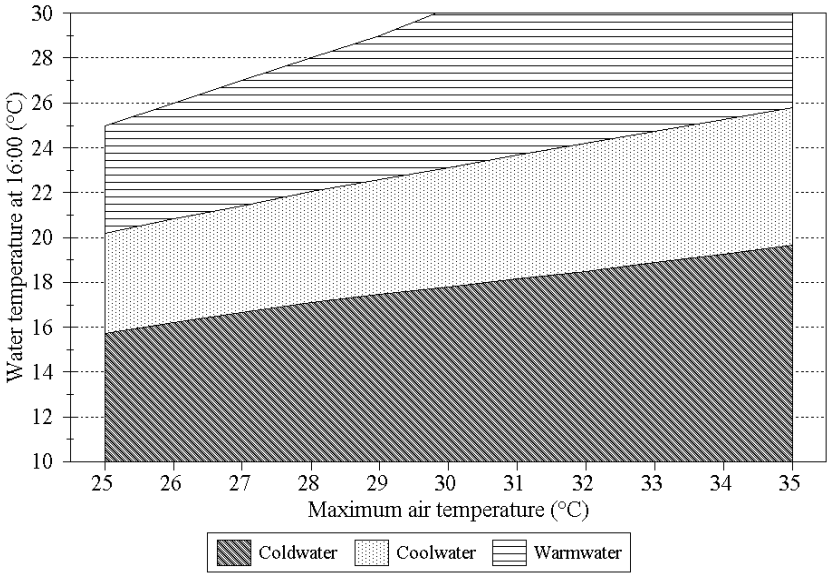

Figure 2. Nomogram used to determine thermal classification using maximum daily summer water and air temperatures (from Stoneman and Jones 1996).

Fish sampling

If the watercourse is not intermittent, then the occurrence of sensitive species must be determined [see Appendix 1 of Mandrak and Bouvier (2014) for a complete list of sensitive and tolerant species]. As indicated above, field investigation may not always be necessary to obtain information about the fish assemblage present in the drain. OMNR, DFO, and the local Conservation Authority should be contacted to determine if they have the required data. The Royal Ontario Museum and Canadian Museum of Nature should be contacted to determine if

they have any collections records for the drains in question. Fish sampling is necessary if there are no existing data, or if there is an expectation that the fish assemblage composition may have changed since the last time of sampling.

If fish sampling is required, the gear and effort to be used depends on the nature of the drains and objective of the sampling (e.g., sensitive species vs. whole assemblage). Wadeable sampling can be undertaken in habitats with water depths of less than 1.2 m (1 m for electrofishing) if the substrate is free from tripping hazards and firm enough for wading to occur. Non-wadeable sampling would be required where these conditions are not met.

In both wadeable and non-wadeable habitats, seining and electrofishing are considered the most efficient, readily available, sampling gears. However, seining may not be the most effective sampling method in habitat where debris, boulders or other obstacles are present. Electrofishing is not effective in habitats with high turbidity (>10 NTU) or low conductivity (<100 µS) or high conductivity (> 600 µS). Detailed descriptions of the dimensions and use of these gears can be found in Bonar et al. (2009). Electrofishing should only be undertaken by trained and certified individuals. Electrofishing training is offered through the Institute for Watershed Science or may be available through your local Conservation Authority. Although seining and electrofishing are the preferred sampling techniques, if it is not feasible to apply these techniques due to the limitations described above, sampling may be accomplished with the use of fyke nets or trap nets.

An OMNR scientific collector permit is required for all fish sampling. Additionally, a federal Species at Risk Act *(SARA) permit is required if a SARA-listed species is* ***present*** *and a provincial ESA permit is required if an ESA-listed species is* ***targeted*****.** Depending on the objective, fish sampling can be conducted in a number of ways.

1. If the objective is to determine if sensitive species are present, then the whole fish assemblage does not need to be sampled. The following procedure is recommended.
    a. It is recommended that conventional site identification methods (e.g., Ontario Stream Assessment protocol; Stanfield 2010) be used; although it may not always be feasible to use this approach in drains as these methods rely on the presence of crossovers that are often not present in drain systems. When it is not possible to use conventional site identification methods, a site can be defined as 10 times wetted width (m) or 40 m, whichever is greater.
    b. It is recommended that the first fish sampling site be located in the drain upstream of the road crossing farthest downstream. The second fish sampling site should be located in the drain above the road crossing farthest upstream. If sensitive species are found at both sites, then sensitive species should be considered to be present through the drain. If sensitive species are found at only one site, or at neither site, then fish sampling should be conducted at the road crossing halfway up the drain and iteratively upstream and downstream until the extent of sensitive species occurrence across the drain segments is determined. Sampling should only occur between road crossings if permission is granted.
    c. If electrofishing, the site should be sampled using a minimum of three passes at each site. Once three passes have been completed, process fish. **If a sensitive species is caught in the first three passes, then no further sampling is required. Otherwise, sampling should continue**. Complete one pass at a time, processing fish after each pass until no new species have been caught in three consecutive passes or a sensitive species is caught, whichever comes first. The site should be sampled in an upstream direction, ensuring adequate coverage of different habitats moving from bank to bank if possible, at a rate of 2-5 $s{\cdot}m^2$. Fishes

should be identified and field sheet completed after the first three passes, and then after each subsequent pass. Photographic documentation or vouchers should be kept for every species collected (see Appendix 2 of Mandrak and Bouvier 2014 for a detailed account of proper vouchering techniques, both preserved and digital vouchers).

d. If seining, the site should be sampled using a minimum of three sampling events at each site (i.e., one sampling event represents a seining survey across the entire site length, and may constitute multiple hauls). A seine net with a mesh size of 3 mm (1/8") should be used. **If a sensitive species is caught in the first three sampling events, then no further sampling is required. Otherwise, sampling should continue** until no new species have been caught in three consecutive sampling events or a sensitive species is caught, whichever comes first. The site should be sampled in a downstream direction, sampling different habitats if possible. Fishes should be identified and field sheet completed after the first three sampling events, and then after each subsequent sampling event. Photographic documentation or vouchers should be kept for every species collected (see Appendix 2 of Mandrak and Bouvier 2014 for a detailed account of proper vouchering techniques, both preserved and digital vouchers).

e. If fyke or trap netting, the site should be sampled using three nets. The three nets should be set at the same time and remain for 24-h at each site. A net with a mesh size of 6 mm should be used. **If a sensitive species is caught in the first 24-h net sets, then no further sampling is required. Otherwise, sampling should continue** until no new species have been caught in three consecutive net sets or a sensitive species is caught, whichever comes first. Fishes should be identified and field sheet completed after each net is fished. Photographic documentation or vouchers should be kept for every species collected (see Appendix 2 of Mandrak and Bouvier 2014 for a detailed account of proper vouchering techniques, both preserved and digital vouchers).

NOTE: As many sensitive species have low detection probabilities, a minimum of three sampling events (e.g., a single pass, a single night of a net set) at each site is required for all gear types, as detection is unlikely to occur after a single sampling event. In addition, a minimum of three sampling events at each site will allow for additional detection analyses of sensitive species, allowing for a refinement of this protocol. Also, detection probability is known to vary by gear type, habitat characteristics, and abundance of the target species. The above protocol is meant to provide guidelines that are suitable for a majority of sensitive species. Sensitive species-specific detection probability estimates would allow for a refinement of the protocol but are currently not available.

2. If the objective is to determine the composition of the whole fish assemblage [e.g., for general survey purposes, or to determine thermal classification based on fish composition (e.g., Wichert and Lin 1996)], established, existing protocols should be used (e.g., Ontario Stream Assessment Protocol; Stanfield 2010). Smith and Jones (2005) provides guidance on the number of passes required at a site to detect all species present, and the number of sites required to be sampled to determine the whole fish assemblage in a watershed (e.g., drain). Whole fish assemblage sampling should be conducted at randomly selected sites and, ideally, species accumulation curves will be calculated during the sampling to guide total effort required. Note that effort required for such sampling is dependent upon the effort required to detect the rarest species at the site or in the watershed and, therefore, will be substantially greater than the effort required to sample more common species (e.g., sensitive, but not rare, species).

3. If the objective is to determine the presence of a SAR, Portt et al. (2008) provides guidance on the gear and effort required to detect fish SAR. Dextrase et al. (2014) provides further guidance on the effort required for a subset of fish SAR. Sampling should target the preferred habitat of the target fish SAR. Although it is dependent on the level of site occupancy and abundance, the effort required for fish SAR sampling may be greater than the effort required to sample more common species (e.g., sensitive, but not rare, species).

Sources of Uncertainty

There is a need to incorporate and consider species that are listed (Special Concern, Threatened or Endangered) under the *Endangered Species Act*, *2007* (ESA) but not listed under the federal SARA when completing the initial screening for fish SAR, such as Redside Dace, *Clinostomus elongatus*, Black Redhorse, *Moxostoma duquesnei*, and Cutlip Minnow, *Exoglossum maxillingua*. The DFO Species-at-Risk maps do not currently include information for species listed under the ESA, but not under the SARA.

A drain segmentation layer for Ontario based on landscape features and hydrology is required to better inform municipal drain classification, and sampling requirements. In addition, a landscape model to predict intermittency should be applied to the drain segmentation layer.

To classify a drain segment as permanent or intermittent we suggested the use of temperature loggers to determine level of intermittency (see method 4 in Flow Determination section). This method should be evaluated empirically to determine its accuracy in determining drain permanency.

The temperature sampling protocols described in this report were created for watercourses in southern Ontario. The protocols may not be applicable to watercourses in northern Ontario, which are subject to a different thermal regime. A temperature sampling protocol for northern Ontario should be created to enable proper watercourse designations. Ideally, a landscape model to predict thermal class should be created, and applied to a drain segmentation layer. Once validated, this would eliminate the need to complete independent temperature sampling when classifying a watercourse as a municipal drain.

Additional studies are required to determine the amount of effort required by gear type to detect either a specific species, or a sensitive species in drains. Effort by gear type should also be investigated to determine the sampling effort required to detect the whole fish assemblage in drains. Predictive models of sensitive species occurrence in drain segments could be created, and once validated could help inform which drains have a higher likelihood of containing sensitive species.

CONCLUSIONS

Sampling protocols provided in this report should be used when classifying watercourses as municipal drains. Additional studies to refine the proposed sampling protocols have been identified and could be referred to when considering future research needs. The peer-reviewed sensitive species list provided in Appendix 1 of Mandrak and Bouvier (2014) should be used as a reference when determining whether a species is considered ‘Sensitive’ or ‘Tolerant’. This list should be updated following new listing decisions, and when new research on species sensitivity and tolerance, specifically in relation to turbidity and water quality tolerances, becomes available. Guidance on fish identification and vouchering provided in Appendix 2 of Mandrak and Bouvier (2014) should be followed when completing fish surveys, as proper vouchering of both preserved specimens and digital vouchers is essential to ensure watercourses are properly classified.

SOURCES OF INFORMATION

This Science Advisory Report is from the July 11, 2013 Science review of standardized data collection methods in support of a municipal drain classification sampling protocol. Additional publications from this meeting will be posted on the DFO Science Advisory Schedule as they become available.

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MPO. 2014. Conseils relatifs aux méthodes normalisées de collecte de données à l'appui du protocole de classification visant la désignation de cours d'eau en tant que drains municipaux. Secr. can. de consult. sci. du MPO, Avis sci. 2013/061.