Case Study on the Development of Canada's National Hydrological Service's Quality Management System

Prepared by
Ted R. Yuzyk
Chris Thomson
Jean-Francois Cantin

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1. Canada's NHS - Water Survey of Canada

The Water Survey of Canada (WSC) was formally established in 1908 to address potential water quantity issues along the Canada/United States border and growing irrigation demands in the western prairies. Its mandate was to collect standardized water quantity measurements (discharge and water level) on a systematic basis for Canada's waterways. Over the years, WSC's hydrometric network development has been guided by a myriad of national legislation and evolving requirements from many interests for water quantity data in Canada.

In 1971, the WSC became an integral part of the newly-formed Department of Environment Canada (EC). An important milestone in its development as a truly national monitoring program came when cost-sharing agreements were signed in 1975 with all of Canada's 10 provinces in an effort to harmonize and standardize water quantity data collection. WSC became the primary data collector of hydrometric data for nine of the provinces; except for Quebec, where a provincial agency collects the data and makes these data available to the WSC.

In the early 2000s, negotiations were initiated to update and revise the 1975 cost share agreement with all the provinces and territories. The primary focus for the new agreement was to have a more equitable costing arrangement that incorporated the full costs for operating a hydrometric station. Canada also formally recognized the devolution of powers to its 3 northern territories around this time. Since then, new agreements have been signed with 6 of the provinces and the 3 territories. Negotiations are still ongoing with the remaining 4 provinces to sign off on the new agreement, but in the interim they are collaborating under the terms and conditions of the new agreement.

Another important milestone for WSC came in the early 1990s when the program was realigned under the Meteorological Service of Canada (MSC), also part of EC. This organizational change enabled Canada to establish an integrated National Meteorological and Hydrological Service (NMHS), which it has in place today. This, in turn, has resulted in the unified implementation of the ISO framework within the NMHS.

Today, the hydrometric network stands at some 2,700 active stations. The stations are categorized according to interest: federal (fully federally funded), partnered (shared funding between federal and provincial/territorial) and provincial or territorial (fully funded by a province or territory). Figure 1 shows the national distribution of these stations and the associated interest. These stations meet a wide range of needs, for example: flood forecasting**;** emergency response; infrastructure design; environmental monitoring and research; improving economic efficiency in the agriculture, hydroelectricity and transportation sectors; modelling and forecasting of water flows and levels; water allocation; understanding climate change; and recreational uses of waterways.

Some 1800 of these 2,700 stations have data available on a near real time basis. Since 2000, new technologies have been introduced to determine discharge, and the network operations are changing accordingly.

The standard mechanical meter (*i.e.*, Price Current meter) is being replaced across the network with a variety of hydro-acoustic instrumentation (*e.g.*, Acoustic Doppler Current Profilers, Acoustic Velocity Meters) being supplied by different international manufacturers (*e.g.*, TRDI, Sontek, etc.). In the last10 years the use of the mechanical meters in the network has dropped from about 95% to 30%.

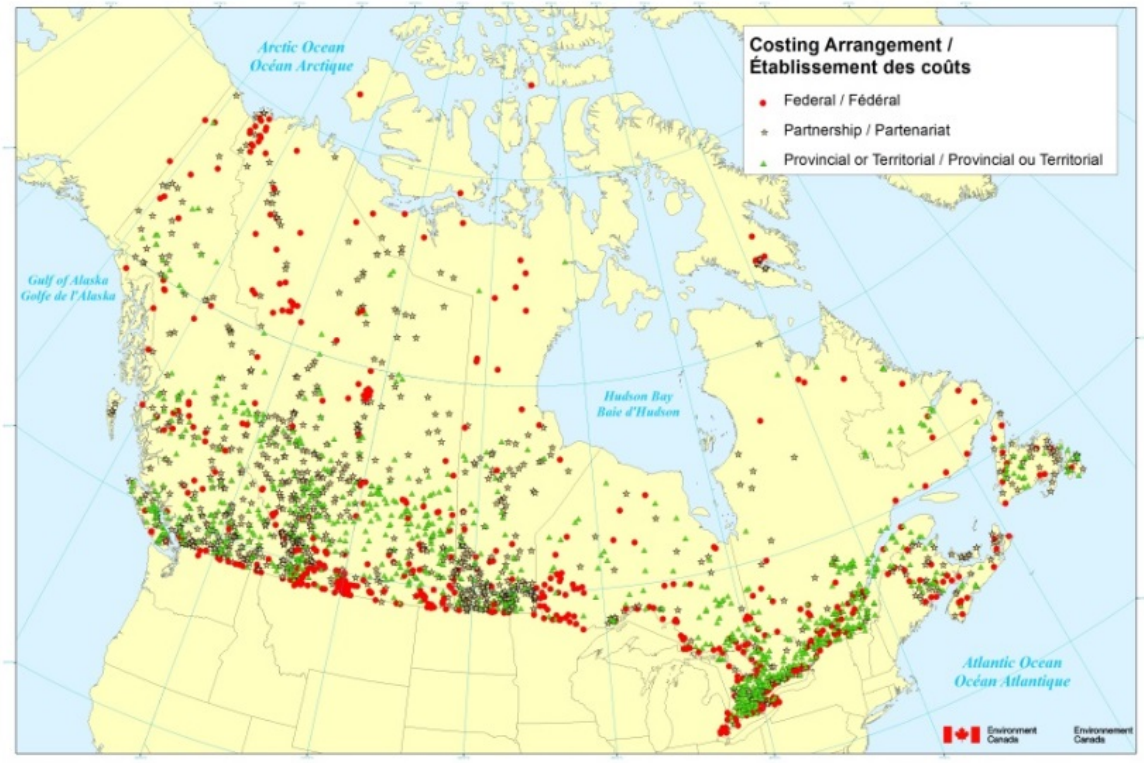


Figure 1: Canada's Hydrometric Network in 2015.

There is about 250 staff that helps to deliver Canada's national water monitoring program. Some 20 individuals are located in headquarters in Ottawa and the rest are associated with the 7 main district offices that are located across Canada. Close to 90% of the staff are technical staff (*i.e.*, technologists, technicians) and the remainder are professional staff (*i.e.*, engineers and physical scientists). The operating budget for the program in 2015 was around $36M (CDN$).

As noted earlier, the WSC is the primary operator of the national hydrometric network that addresses federal and provincial/territorial needs. To manage this network there is a National Administrators Table (NAT) that meets annually. Essentially all the provinces and territories, are represented and the meeting is chaired by the Director of WSC. This body is

responsible for setting policy to guide the effective and efficient management of the national hydrometric program.

Much of the hydrometric data for Canada are stored in the national hydrometric database – HYDAT, and are readily and freely accessible to the public http://wateroffice.ec.gc.ca/ . Besides the 2,700 active stations, there are data for an additional 5,500 stations that have been discontinued over time.

2. Brief History of Quality Management in the WSC

Over its history the WSC has developed operating manuals, standardized procedures and training materials to ensure that the hydrometric data were being collected and processed in a nationally consistent manner. It is important to note that there has also been significant collaboration with the United States Geographical Survey (USGS) that has resulted in considerable similarity in how these two countries collect and process hydrometric data.

In the 1980s, the WSC implemented an internal Quality Assurance Program (QAP), which had regular auditing of data collection and computation procedures. In addition, the WSC implemented a progressive career development program for its hydrometric technicians, to ensure that they received consistent, scheduled, on-the-job training and development in the areas of hydrometric data measurement, computations and analyses. The WSC also completed a series of procedural manuals that explicitly described the standards and methods for measuring, collecting, computing, and publishing hydrometric data.

By the late 1990s the QAP was expanded into a broader Quality Assurance Management System (QAMS). This was in direct response to consultations with the provinces and territories that wanted a quality management system that clearly documented the procedures to follow and that: attained the stated performance standards; permitted regular auditing for adherence to the procedures and standards; would be defensible against challenges; would be more flexible for incorporating new standards and procedures; and would allow the clients of the program to use the data with confidence.

In the early 2000s, the WSC began to more fully explore the implementation of the ISO 9001 framework. This coincided with efforts by the MSC to apply many of the elements of ISO 9001 framework to their aviation routine meteorological report (METAR) observations. In 2002 some funding was secured to move forward with adapting the QAMS to more closely follow the structure outlined in the ISO 9001:2000 Quality Management System (QMS).

The WSC proceeded to hire a number of external consultants to help it move forward. In 2002, all the cost share partners were interviewed to determine their expectations with regards to ISO 9001:2000 Standard implementation. A number of potential concerns were raised with implementation, but there was general support for moving forward. Another

consultant prepared the conceptual design of the QMS for WSC in 2002 and undertook a gap analyses in 2003 to determine where more attention would be required in implementing an ISO 9001 framework.

In 2003, attention was focused on establishing an agreed upon set of general quality principles and supporting policies that would be instrumental for guiding the hydrometric QMS. Focus was also put on developing key documents similar to those used by ISO.

Orientation sessions were then held and training was provided to all the water staff so that everyone had a good understanding of their roles and responsibilities with regards to implementing the new QMS framework.

In 2004, the first internal (hydrometric) audits were conducted with help from an external contractor (Real Alternatives Inc.). They were conducted on the WSC headquarters and one district office. These audits focussed on the application of ISO 9001:2000 Standard. As these were only trial audits, the focus was on identifying "Opportunities for Improvement" (OFIs) and familiarizing the organization with the audit process. Some 26 OFIs were identified and considerable feedback was received from the staff on the audit process.

Around 2005 the decision was made by senior management at Canada's NMHS to move forward with implementing ISO in an integrated manner for its meteorological and hydrological programs. This was done to ensure efficiencies and the uniform application of the ISO Standard across the NMHS.

In 2007, a series of external audits were conducted on a number of areas within the NMHS against the 9001:2000 ISO Standard. Hydrometric monitoring was not specifically audited at this time. This subsequently led to the first ISO certification through TÜV SÜD (America) for Canada's NMHS.

In 2009, external audits resulted in the recommendation for recertification based on ISO 9001:2008 Standard. These audits clearly covered the hydrometric monitoring activities. Only one minor non-compliancy was identified and five OFIs. In 2010, the NMHS was recertified under the new Standard with Kiwa INTERNATIONAL CERT Zertifizierung GmbH.

The next three year cycle of semi-annual external audits began in 2011 with a review for recertification scheduled for 2014. In 2014, hydrometric monitoring was extensively audited. The NMHS was then recertified through TRC (The Registrar Company) until 2016, when they will be reviewed against the new ISO 9001:2015 Standard. This Standard is now available, and WSC is proceeding with its recertification.

These various external audits have noted that the WSC's hydrometric monitoring program continues to improve with each audit cycle; and there is a mature QMS now in place. More

insight and details on the implementation of the ISO framework will be covered in following sections.

3. Primer on ISO 9001:2015 - QMS

3.1 Overview

The International Standard for QMS has been continuously revised over the years with the most current being the Fifth Edition, ISO 9001:2015. WSC has started the recertification process and has 3 years, or until 2018, to comply with the new Standard.

The new Standard has been modified, as has been the case with every edition, in an effort to make it more effective. One important change to note is that the clause sequence has changed and the clauses do not align with ISO 9001:2008 numbering order. This will have implications for document numbering as they relate to specific clause numbers. Some other changes and improvements include:

- better integration with other business activities.
- enhancement of the process approach and the Plan-Do-Check-Act cycle.
- decentralization of the system and spread of responsibilities for the QMS throughout the organization.
- greater involvement of the top management in the QMS.
- introduction of risk-based thinking in the QMS.
- more emphasis on performance monitoring.

For reference purposes, the quality principles are:

- *Customer focus,*
- *Leadership,*
- *Engagement of people,*
- *Process approach,*
- *Improvement,*
- *Evidence-based decision making,*
- *Relationship management.*

Application of these principles is seen as being fundamental to implementing and maintaining a successful QMS.

The new Standard is comprised of 10 main clauses with multiple sub-clauses under each that provides further direction:

1. Scope,
2. Normative references,

3. Terms and definitions,
4. Context of the organization,
5. Leadership,
6. Planning,
7. Support,
8. Operation,
9. Performance evaluation,
10. Improvement.

The Standard applies what it refers to as the **Plan-Do-Check-Act** (PDCA) cycle, where:

Plan - establishes the objectives of the system and its processes, and the resources needed to deliver results in accordance with customer's requirements and the organization's policies, and identify and address risks and opportunities;

Do - implements what was planned;

Check - monitors and (where applicable) measures processes and the resulting products and services against policies, objectives, requirements and planned activities, and report results;

Act – takes actions to improve performance, as necessary.

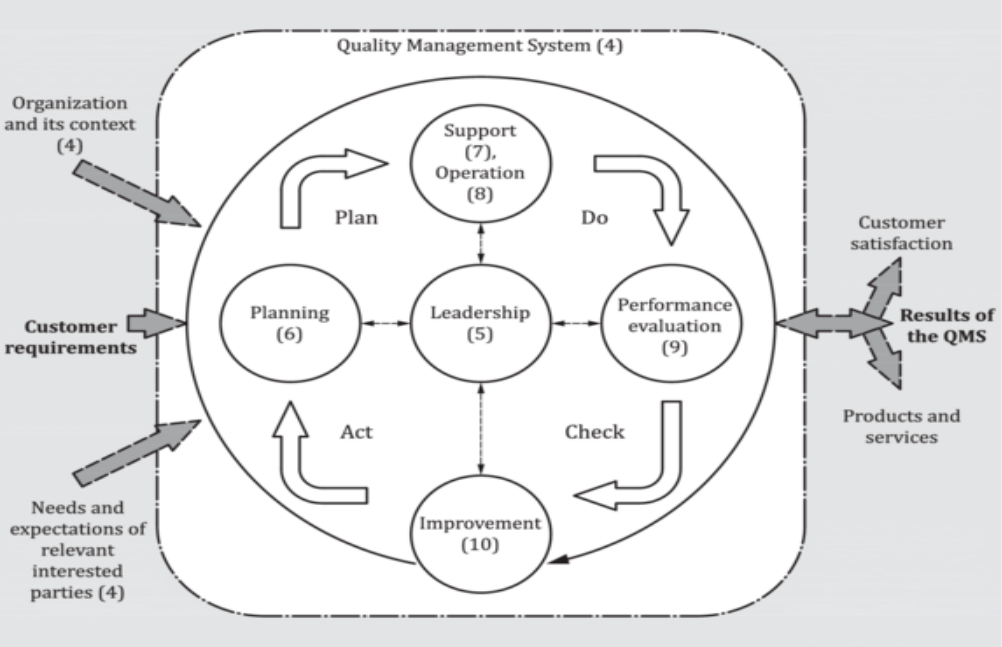


Figure 2: ISO QMS Plan-Do-Check-Act Cycle

Note: Numbers in brackets refer to the clauses in the International Standard
Source: ISO 9001:2015 Quality Management Systems – Requirements (Fifth Edition)

3.2 Key Elements of an ISO QMS

A short description of key elements or activities under each of the key main clauses is described here to make it clear what is required of a NHS. The first three clauses: scope (1); normative references (2), links to the suite of other ISO documents; and terms and definitions (3) are self-explanatory and require no further explanation or perspective.

4. Context of the organization: This clause basically sets the stage for the NHS to reflect on their particular work, the organizational structure, work flow, internal and external relationships and determine the scope and level of commitment *(*which in this case study is ***hydrometric data collection and production***) that it is prepared to make in regards to adopting the ISO QMS framework.

5. Leadership: For this clause the focus is on ensuring that the top management in the NHS is fully supportive and engaged in promoting this important initiative. A key activity here is the development and communication of a ***quality policy*** for the NHS.

6. Planning: The key focus with this clause is setting ***quality objectives*** or goals for which the organization measures its achievements. Nested under these quality objectives are specific performance metrics and targets the NHS establishes to monitor and report on how well the organization is doing.

7. Support: Management must also ensure that everyone in the NHS understands their roles and responsibilities and are supported and have the resources they require in delivering on the QMS. This clause also addresses competencies of the staff and ensuring that they have the proper skill sets through training, and the tools they require to effectively and safely do their work. Proper documentation and in particular ***document and record control*** is seen as critical to ensuring success and is captured under this clause.

8. Operation: This clause focusses on establishing a ***quality manual*** that provides the blueprint for the hydrometric data collection and production and that clearly describes all the processes and support services required in delivering the final product, which is quality assured/quality controlled (QA/QC) hydrometric data. The quality manual in this case is more of a system that clearly links all the core processes and common support processes with their respective required documentation: forms; standard operating procedures; and other relevant documents.

9. Performance evaluation: This involves undertaking ***internal audits*** to assess whether the QMS is working effectively and identifying ***opportunities for improvement***, ways that will help make the QMS function better. This information, in turn, is shared with top management and the organization on a periodic basis so that everyone is apprised of the state of compliancy in the NHS.

10. Improvement: This final clause deals with the need for follow-up and ensuring corrective actions are taken to address non-conformities and actions are taken to address opportunities for improvements. It promotes the concept of ***continual improvement*** in implementing the QMS in the NHS.

In terms of compliancy or certification, regular ***external audits*** are conducted twice a year over a three year cycle. More significant issues, identified through external audits, are referred to as ***non-conforming actions*** and will require corrective actions be taken to ensure compliancy with the Standard and obtain or retain ISO certification.

3.3 ISO QMS Documentation Framework

There are four levels of documentation that make up an ISO QMS. All these documents are maintained as part of the QMS, with considerable attention paid to version control. The figure below shows the hierarchy of documentation that will be required for the NHS's QMS.

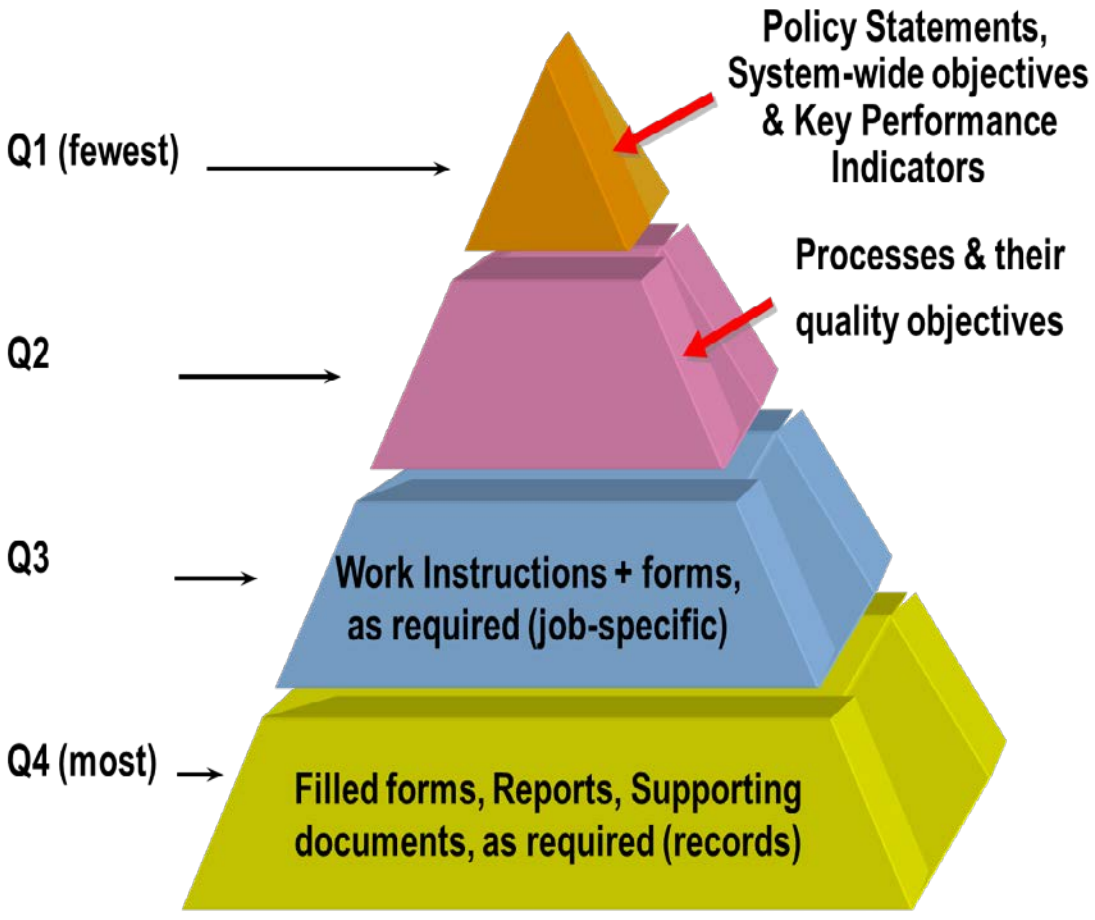


Figure 3: Hierarchy of QMS Documentation Required by the ISO Standard

4. Implementation of the ISO QMS Framework

4.1 Canada's Scope of QMS Activities

It has been about 15 years since the WSC began exploring the ISO framework to now where it has a mature QMS in place and functioning well. As noted earlier, WSC is part of Canada's NMHS (along with the Meteorological Service of Canada) and as such its QMS is nested within that of the broader organization.

Figure 4 depicts the complete QMS process for the NMHS, which covers the full range of activities. WSC's mandate, however, is limited to only the monitoring activity.

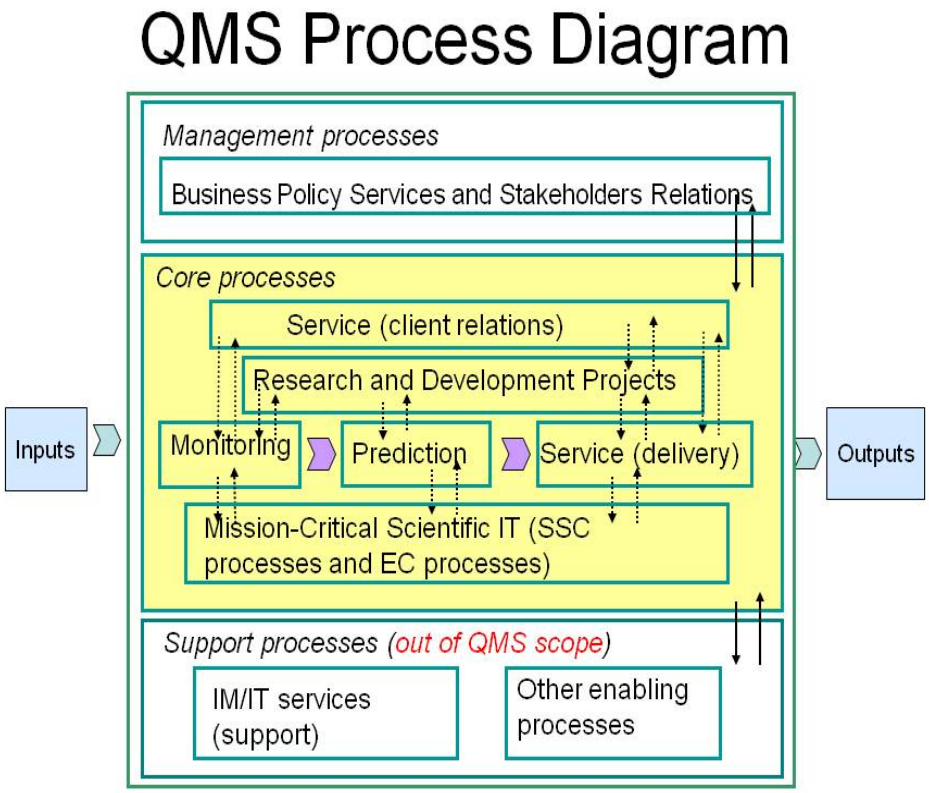


Figure 4: Canada's NMHS Scope of QMS Activities

The hierarchy of ISO documentation (Levels Q1-Q4) required for a comprehensive QMS are managed and controlled by the NMHS through a Quality Management Office (QMO). This, in turn, ensures rigour and consistency in the application of the ISO Standard to all its products and services. Appendix A describes how the various levels of documents are managed and controlled as part of the system.

4.2 Canada's Quality Policy

As noted, the Q1 Level captures policy-related QMS processes. Developing a Quality Policy is seen as being fundamental. This makes it clear that the organization (*i.e.*, top management and staff) is committed to the implementation and continuous improvement of a QMS in an effort to provide quality products and services. The NMHS has developed the following quality policy.

Quality Policy for the NMHS:

We, in Environment Canada (EC) and Shared Services Canada (SSC),work together to provide meteorological, hydrological and environmental data, predictions, information and related services to enable Canadians to make informed decisions on changing weather, water and climate conditions.*

*We commit to service excellence in meeting all requirements (statutory, clients, partners and stakeholders) in conformity to ISO 9001:2008**, management principles based on best practices and the departments' code of conduct, including:*

Providing guidance, training, tools, and resources to our employees;

Defining and improving our internal and external products and services through engagement with our employees, partners, stakeholders and clients; and

Ensuring value for Canadians by maintaining a sustainable work environment that continually improves our process efficiency and effectiveness through excellence, innovation and relevance.

* Scope is limited to those functions and activities within EC and SSC that contribute to the delivery of weather, water and environmental information and services to Canadians.

** This will be updated to ISO 9001:2015 after the organization is recertified under the new Standard.

4.3 Canada's Quality Objectives and Performance Indicators

Also important is to establish quality objectives or overarching goals. These tend to be general in nature and could be applicable to any organization that is providing information, products and services. For Canada's NMHS they are:

- To ensure a sustainable organization through effective management of risks, of operational and human resources, and of employee engagement and performance.

- To achieve internal and external client, partner and stakeholder satisfaction.

- To ensure service enhancements are based on internal and external client, partners and stakeholders requirements, on scientific and technological excellence, on innovation, and on the principle of value for money.

- To foster a continuously learning organization by supporting continuous learning in our staff, and to facilitate continuous improvement in the efficiency and effectiveness of internal processes and operations.

Work is on-going to define/refine key performance indicators for the NMHS to measure and track the following: stakeholder satisfaction, business process effectiveness, knowledgeable and sustainable workforce, innovation in the organization, sustainable infrastructure and engagement.

4.4 WSC's Specific Quality Objectives and Performance Indicators

To compliment these broader higher-level quality objectives, the WSC developed three quality objectives that focus on hydrometric data collection and production and the associated performance metrics for each of them (these quality objectives are considered Q2 Level documentation).

1. Canadians have reliable and timely access to hydrometric data and information from across Canada:

i. WSC will conduct acquisition, production and dissemination activities to provide hydrometric data (water level and/or discharge) for all WSC-operated hydrometric stations, such that:
   a) For real-time enabled stations, 100% of provisional hydrometric data are available via the internet within 3 hours of occurrence.
   b) 100% of approved hydrometric data from a calendar year are submitted for dissemination within 4 months of the end of that calendar year.

ii. Routine requests for data and information products are answered within five working days.

iii. The monitoring network collects and interprets water resources data for 80% of the Canadian landscape. *(This is based on a water quantity indicator currently being developed and evaluated by the WSC. The indicator assesses how well Canada's 25 major drainage basins are being monitored to adequately characterize the flow regime in the basin. The indicator incorporates three criteria: gauging density, percentage gauged area and number of people per hydrometric gauging station. At least 2 out of 3 criteria need to be met in order to classify the basin as adequately characterized. In 2011, a total of 11 basins were assessed to be adequately characterized based on this indicator with the long-term*

goal being 20, which represents 80% of these major basins.)

2. A credible, sustainable national hydrometric monitoring program is maintained and supported:

i. A competent workforce is in place.
   a) A staffing strategy, outlining the required number of technicians and water resource professionals, is:
      1. developed
      2. reported upon annually
      3. updated annually

   (Once the staffing strategy is finalized, reporting will include a brief summary of the annual report and updates.)

   b) Hydrometric technicians in the Apprenticeship or Professional Training Program (HT-APTP) receive training and promotion as per the training program.

ii. Potential program improvements are identified based on analysis of annual feedback from the following groups:
   a) National Administrators Table
   b) National Hydrometric Program Coordinators Committee
   c) Data users

iii. Regular audits are conducted according to the audit schedule for:
   a) ISO Quality Management Office (QMO) audits
   b) Internal field and office audits

iv. Corrective actions are taken within the prescribed timeframe for:
   a) Corrective and Preventative Action Request (CPAR)
   b) Opportunity for Improvement (OFI)
   c) Non-Conformance

3. The national hydrometric program is well managed according to established international operational criteria:

i. The hydrometric network is managed according to life-cycle management principles, and as such, a life-cycle management plan is:
   a) developed
   b) reported upon annually
   c) updated annually

   (Once the life-cycle management plan is finalized, reporting will include a brief summary of the annual report and updates.)

ii. 100% of active cableways are inspected:
   a) before use

b) annually
c) every 5 years by a qualified engineer

iii. For each province and territory, the "Hydrometric Monitoring Sites, Operating Standards and Output Products" (Schedule C) and the "Contributions by the Parties" (Schedule D) of the Cost Sharing Agreement for Water Quantity Surveys are approved by June 30 of the fiscal year.

iv. For each province and territory, Annual Reports (Cost Share Reports) under the Cost Sharing Agreement for Water Quantity Surveys are completed by the December 31 of the following fiscal year.

v. Operations are adjusted according to partner requirements and resource availability. *(The WSC is currently developing and evaluating a number of efficiency indicators, but this is still a work in progress. One promising indicator focusses on the cost per dataset to assess cost effectiveness of the monitoring and is referred to as the hydrometric costing index. It incorporates the program costs, weighting based on level of effort required for a type of station and data completeness.)*

4.5 Quality Manual: WSC's Core Processes

Figure 5 describes the specific activities that the WSC is responsible for under its QMS. The six boxes highlighted in yellow are the core processes that WSC monitors and reports on as part of their quality manual. They are:

Stakeholder requirements - The purpose of this process is to identify new or changed stakeholder requirements and subsequent development or update of a plan for a design, process, procedure or methodology to address those requirements.

Design and development - This process provides a new, changed or acquired off the shelf design, process, procedure, methodology or technology that addresses a new or changed stakeholder expectation/need. It produces an operations-ready (*i.e.*, validated) system from a new or changed design, process, procedure, methodology or technology.

Implementation - This process involves implementation of an existing, new, changed or acquired off the shelf design, process, procedure, methodology or technology as validated by the design and development process.

Data acquisition - This process is to collect data and make them available for further processing. This is the initial step towards provision of information to clients and stakeholders. This process occurs after the stakeholder requirements have been defined, and if required, the design and development has been completed and implemented as required, and an operational work plan has been developed and approved.

Data production - This process produces hydrometric data and metadata to national

standards.

Delivery and dissemination - This process is to transfer provisional and approved hydrometric data and metadata to the national database and to make them available to stakeholders.

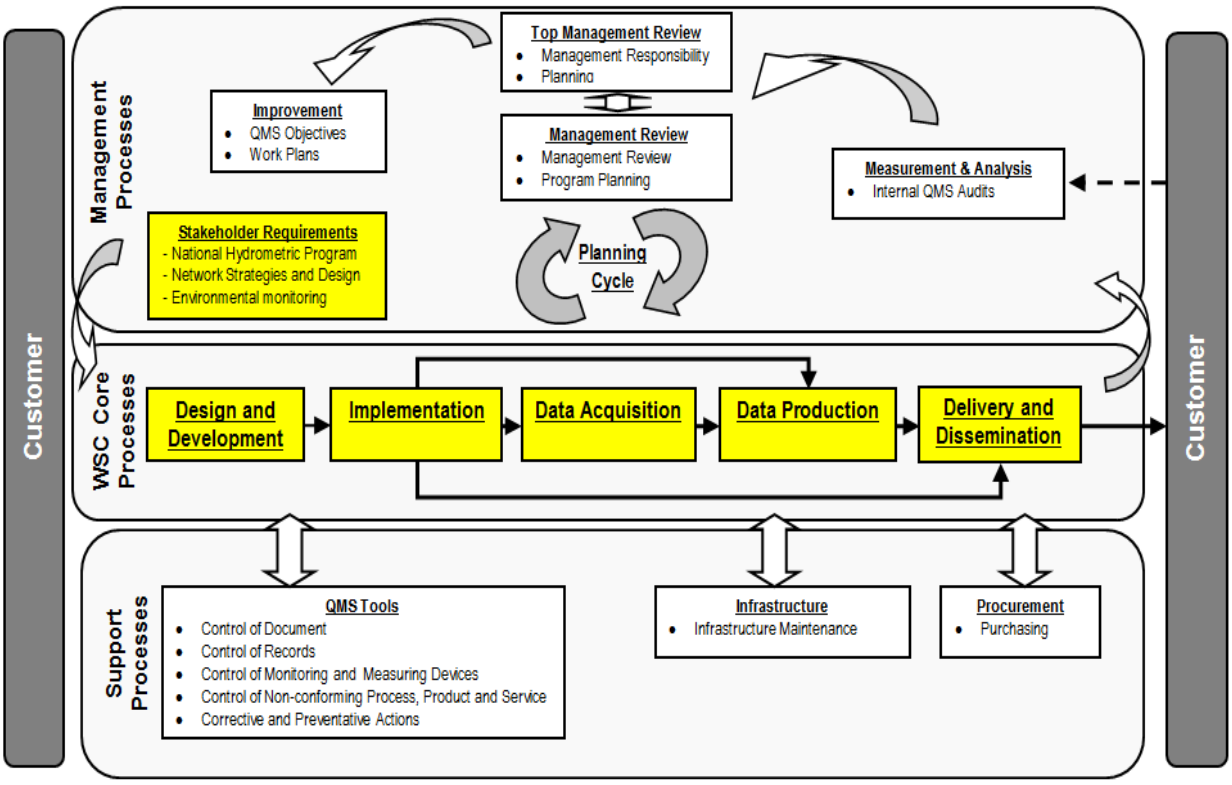


Figure 5: Canada's NHS Core QMS Processes

For more detail on what is covered in each of the core processes, please refer to the QMS process (Q2 Level) documentation found in Appendix B. These 6 core processes make up the QMS Manual that the WSC is directly responsible for updating.

The QMS process (Q2 Level) documentation follows a defined format. Each document covers the process purpose and scope and has a "Turtle" diagram. The "Turtle" diagram provides the key information that is important from an auditing perspective, which is:

- inputs,
- outputs,
- special process requirements,
- human resources,
- materials and equipment,
- linked processes/documents,
- associated records.

Also included is a: process flow chart; supplemental information that is linked to the steps in the flow chart; a table of definitions covering any terms or acronyms that are used; and finally, the history of any changes that have been made to the document. A process owner, which in this case is the Director of WSC, is responsible for signing and dating any changes made to the document and ensures document control.

4.6 Quality Manual: Common Processes with the NMHS

There are also is another eight (Q2 Level) processes that are common to all the products and services provided by the NMHS. The manager of the QMO is responsible for document control of these common processes. They are:

Control of Documents - The purpose of this process is to identify, develop, implement, maintain and control the documentation that defines and supports the quality management system in an efficient and effective manner. All applicable documents shall be identified and controlled in such a manner so as to ensure current versions are available to the functions or personnel to which they apply.

Control of Records - The purpose of this process is to ensure that records which have been identified as evidence supporting the QMS are identified and controlled. This process shall define record identification, storage, protection, retrieval, retention and disposal in order to provide records that remain legible, readily identifiable and retrievable.

Control of Monitoring and Measurement Devices - This procedure is to establish a common frame of reference on which Network and Life Cycle managers can base detailed control instructions to manage monitoring and testing of equipment.

Management of Non-conforming Process, Product and Service - The purpose of this document is to guide and direct the management of non-conforming process and product within the NMHS QMS. This pertains to three clauses in the ISO 9001:2008 Standard that deal with: monitoring and measurement of process; monitoring and measurement of product; and control of non-conforming product.

Corrective and Preventive Actions - The purpose of this procedure is to ensure that there is an investigation and determination of the root cause of: repetitive non-conforming products or services; individual non-conformances that have serious or potentially serious consequences; non-conformances identified through audit findings; and operational performance that is below target or expectations. Opportunities for improvement to the quality management system are identified, analyzed and implemented as appropriate. Actions are implemented to correct problems and prevent recurrence. Actions are monitored and verified for effectiveness.

Infrastructure Maintenance - The purpose of this procedure is to ensure that: infrastructure and equipment that is critical for the delivery of the NMHS products and services is identified and appropriate maintenance activities are defined: specified activities are identified, planned, conducted and recorded; and responsibilities and

qualifications for persons performing these activities are determined.

Purchasing/Contracting - The purpose of this procedure is to ensure that: requirements for acquiring goods and services are clearly defined and communicated to suppliers and contractors; received goods and services meet specified requirements; and suppliers and contractors are evaluated and selected based on their ability to meet requirements and provide best value.

Internal Audits - The purpose of this procedure is to ensure that: internal quality management system audits are defined, planned, scheduled and conducted; the NMHS's activities are reviewed for compliance with predefined processes; and the ISO Standard and non-compliance and opportunities for improvement to the management system are identified; and the responsible managers are informed.

Please refer to Appendix C for the common processes QMS documentation that is essential for developing a complete Quality Manual, as required by the ISO Standard.

4.7 Quality Manual: Other QMS Documentation Specific to WSC

Q3 Level and Q4 Level Documentation

As noted earlier, there are still two more levels (Q3 and Q4) of documentation that makes up the complete ISO 9001 QMS. Q3 Level documents are the work instruction level documents that provide detailed guidance in performing a specific activity. Forms (blank forms, checklists, templates) are considered a unique subset of Q3 Level work instruction documentation. There are currently 10 approved forms available on-line in WSC's QMS Operational Library (Appendix D).

Also included as Q3 material are Standard Operation Procedures (SOPs) that provide detailed guidance on carrying out an activity. The WSC has 20 SOPs that address specific activities related to their QMS core processes (Appendix D). These documents are updated on an as required basis with the latest version available on-line in the WSC QMS Operational Library.

Appendix E provides an example of standardized form (Q3) used by WSC for collecting a discharge measurement: Hydrometric Survey Notes – Mid-Section Method (qFOR-NA023-02-2015).

Q4 documents are records that provide evidence or results of an activity or event, such as a completed form. An example of this is provided in Appendix F and is for the Hydrometric Mid-Section Method (qFOR-NA023-02-2015).

Training for Hydrometric Technicians

The majority of WSC's staff is comprised of technologists who are responsible for collecting and processing hydrometric data. On entering the program the technical staff must complete a structured training program, which is based on required competencies, referred to as the

Hydrometric Technician - Apprenticeship or Professional Training Program (HT-APTP). They become qualified ***technologists*** upon completing the HT-APTP.

There is a suite of lesson packages that must be completed under five key themes by the hydrometric technician in order to achieve the required competencies. The five key themes are:

1) Health and Safety
2) Station Operations
3) Data Acquisition
4) Data Production
5) Data Delivery and Review

For a complete list of the lesson packages, see Appendix G. To complete the training program requires a minimum of 3.5 years. For more information on the program and learning objectives for each lesson package, one can refer to the SOP for this activity (*i.e.*, qSOP-NA018-02-2014).

Contributed Hydrometric Data

As described earlier in the report, the WSC is the primary operator of the National Hydrometric Program (NHP), but some hydrometric data are also collected and contributed to the national database (*i.e.*, HYDAT) by the provinces/territories and hydroelectric agencies. An operator refers to any agency that routinely collects hydrometric data. A policy (Appendix H) was established by the National Administrators Table (NAT) in 2007 that addresses contributed hydrometric data and is incorporated into the NHS QMS Manual. It states that:

1. Any hydrometric operator that has implemented, and is compliant with, a QMS that is accepted by the NHP may contribute hydrometric data and information directly to the NHP. No additional reviews or inspections of these data and information will be required.

2. All other hydrometric operators must submit their hydrometric data and information to a hydrometric operator that has a NHP accepted QMS for their approval. The process for approving submitted data shall include quality assurance audits that will examine:
   - the approaches used to collect and produce data and information to ensure that those approaches can achieve the accuracy requirements of the NHP National Standards;
   - the processes and procedures applied to ensure the appropriate approaches are used and are applied correctly;
   - the associated documentation including hydrometric station operation records; and
   - the format in which the data and information is being submitted to ensure that it is acceptable for ingestion by the NHP.

This policy ensures that all the data in HYDAT have been subjected to the principles and practices of a formal QMS before they are accepted.

5. Value of ISO 9001 QMS for the WSC

A number of staff, managers and the Director of WSC were interviewed to get their perspective on the success of ISO 9001 implementation and what have been the benefits for the organization:

- The overall consensus is that the implementation has been successful, recognizing that there are always some growing pains in adopting any new framework for an organization. The WSC prior to ISO 9001 implementation did already have a fairly structured QMS in place and therefore the transition to an ISO 9001 QMS was less challenging because of much of the documentation was already available.

- Since 2004, WSC has worked on better defining and refining its QMS processes, compiling and updating the required documents and constructing its QMS manual as prescribed by ISO 9001. This has resulted in more comprehensive and up-to-date documentation and probably more so than if it had not adopted the ISO 9001 QMS.

- Application of the framework has added a higher degree of rigour to the program's documentation and has led to streamlining and more consistency in all aspects of national program delivery.

- WSC has embraced the quality principles, as identified on Page 7, in the context of continuous improvement in the program. There have been significant strides within the organization over the years in understanding the value of applying an ISO 9001 QMS and the benefits that it brings to the organization.

- Program management has also found that the quality objectives (described on Pages 13-14) help contribute to a better understanding of the state or health of the program and help to address departmental reporting requirements.

- Although there are added costs with implementing an ISO 9001 QMS the WSC managers believe that the benefits exceed these costs. These benefits include enhanced data integrity and a more effective and efficient national hydrometric program.

- All the partners, represented at NAT, have encouraged and been supportive of WSC adopting the ISO 9001 QMS and its becoming certified. This is viewed as a positive step for the national hydrometric program as it provides authoritative recognition that a robust QMS is in place to assure the quality of the hydrometric data that the partners and a broad range of data users rely upon.

6. Lessons Learned in Implementing an ISO 9001 QMS

Some of the lessons learned are:

- From the beginning of the process, top management was fully engaged. This active engagement provided the leadership required to ensure that the organization fully embraced ISO 9001 QMS implementation and adopted a culture of continuous improvement.

- WSC spent a considerable amount of time and effort particularly at the beginning to educate and train staff on ISO 9001 QMS implementation that was fundamental to its successful implementation. It is important to engage everyone in the organization to ensure everyone's commitment.

- A significant amount of time was spent on developing the core processes documents, the QMS Q2 documents. These QMS documents are pivotal to showing how the organization functions and delivers on its key activities. These documents are particularly important from an audit perspective. These documents are now reviewed on annual basis to ensure that they are up-to-date even though changes at this stage in the QMS evolution tend to be minimal.

- A clear example of the importance of a Q2 document relates to a case in the early years of QMS implementation where a contractor was required to produce a limited number of ice rods for WSC based on the organization's specifications. The *Design and Development* process document was not explicitly followed resulting in a defective batch of ice rods. Subsequently, future technology development projects have gained from the lessons learned from the ice rods example and closely adhere to the *Design and Development* QMS document.

- There is a considerable amount of program documentation, so much so that the organization must determine what is really essential to be monitored in the ISO 9001 QMS. For instance, there are only two WSC specific policy documents: contributed hydrometric data policy and a policy on the use of hydro-acoustic technologies in WSC operations. In terms of forms and standard operating procedures (Q3 documents), the WSC has selected 10 national forms and 20 standard operating procedures to be maintained in WSC's QMS operational electronic library. These are reviewed on a regular basis.

- During the QMS implementation period there was a major shift in data collection with the move away from hand-written paper forms to electronic entry completed forms.

This work greatly benefited as it adhered to the ISO 9001 QMS framework that was fully in place by then.

- It is important that staff use the most up-to-date information and documentation on procedures in undertaking their work. There is a tendency for staff to print and refer to paper copies for convenience purposes which can be problematic as documents are constantly being updated. The footer at the bottom of each QMS document page clearly states - ***Read Only Copy – See intranet for latest revision***. This is now becoming more engrained in the staff over time to check on line when referring to any documentation.

7. Lessons Learned from ISO 9001 Certification

Some lessons learned through certification are:

- The WSC has 7 district offices and another 20 smaller sub-offices. Approximately 9 of these are audited each year. The staff is required to be trained in the audit process, and it takes about 1 day to complete an audit for each office and document the findings. This is a significant, but worthwhile investment by the organization. The WSC uses this opportunity to cycle staff through this process so that everyone becomes more knowledgeable on the ISO QMS and the workload is distributed throughout the organization.

- Semi-annual external audits are conducted over a 3-year period based on a representative number of offices. This in turn establishes whether the organization is complying with the current ISO Standard. In 2016 the WSC will begin the process to ensure compliance and obtain certification under the new ISO 9001:2015. The WSC finds that these audits keeps the organization focussed and wards off any complacency.

- WSC has been certified under two previous ISO Standards so this is the third time for certification. The organization is now very knowledgeable about the audit process and has a mature QMS in place. It has learned that with each subsequent certification that the process is becoming less onerous.

- During the last 3-year audit cycle (2012-2015) the audits identified a number of areas requiring improvement. These are identified and tracked on the corrective and preventative action request (CPAR) form. Three opportunities for improvement (OFIs) were raised during these audits. These typically are suggestions on how to improve on a particular activity. These OFIs are given careful consideration, but do not impact upon certification. An example of one of the OFIs identified in a 2014 audit:

  "There is an opportunity to set criteria for when a Hydrometric Service R&D Project might warrant a post mortem analysis. For the *Q2-700-056 Design and Development*

process, there is an opportunity for the exploration of the criteria for certain types of projects that might warrant some sort of variance analysis or post mortem analysis to be incorporated within the overall project plan so that not only is the technical content in innovation going to emerge at the end of the project but also more efficiency in project planning and project execution." (this relates to ISO 9001:2008 Clause: 8.5.1 Continual Improvement).

This resulted in incorporating the post mortem concept into the *Q2-700-056 Design and Development* process document in early 2015.

- Non-conforming actions, if not addressed, can impact certification. During this last cycle, there were 4 non-conforming actions identified that needed to be addressed in order to obtain recertification. An example of one of the non-conforming actions identified in a 2014 audit:

  "Evidence shows that the quality objectives have not been reviewed since 2011 and no performance indicators have been measured since then. No measurement of quality objectives is available for 2012 and the last update of the document "Objectives for quality monitoring" was performed on 2011-06-09. In addition, it is shared with other processes, so no record of evidence shows the last update for the hydrometric process." (relates to ISO 9001: 2008 Clause: 5.4.1 - top management shall ensure that quality objectives, including those needed to meet requirements for product are established at relevant functions and levels within the organization. The quality objectives shall be measurable and consistent with the quality policy).

  This was addressed with the establishment of a revised suite of quality objectives and their associated performance metrics (outlined on Pages 13-15) in 2015.

  Depending on the nature of the required corrective actions, their resolution and verification by external audits typically are completed and resolved within a year. WSC has learned that it is important to address these identified issues in a timely manner so as not to impact on certification.

8. Contact and Access to Canada's QMS Documentation

Canada's QMS Manual utilizes "ECollab" (a version of Microsoft's proprietary Sharepoint software) and is currently behind a firewall. The Quality Management Office (QMO) is responsible for housing and maintaining all of the QMS information on the internal "ECollab" website.

Any requests for information relating to WSCs QMS should be directed to Canada's National Hydrological Adviser:

Dr. Alain Pietroniro
Director, Water Survey of Canada
373 Sussex Drive, 1st Floor LaSalle Academy
Ottawa, Ontario, K1A 0H3, Canada

Phone Number: (306) 975-4394

Email: al.pietroniro@canada.ca

Key Documents

International Organization for Standardization, (2015). *ISO 9001:2015 Quality Management Systems - Requirements (Fifth Edition)*.

World Meteorological Organization. (2013). *Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services (2013 Edition).*

World Meteorological Organization, (2011). *A Practical Guide for the Implementation of a Quality Management System for National Meteorological and Hydrological Services (Version 10*

Appendices

Appendix A: Canada's NMHS - QMS Manual: Documentation Convention

Appendix B: Canada's NHS - QMS Manual: Core Processes

B1: Stakeholder Requirements
B2: Design and Development
B3: Implementation
B4: Data Acquisition
B5: Data Production
B6: Delivery and Dissemination

Appendix C: Canada's NMHS - QMS Manual: Common Support Processes

C1: Control of Documents
C2: Control of Records
C3: Control of Monitoring and Measuring Devices
C4: Management of Non-conforming Process, Product and Service
C5: Corrective and Preventative Actions
C6: Infrastructure Maintenance
C7: Purchasing
C8: Internal Audits

Appendix D: List of Forms and Standard Operating Procedures

Appendix E: Q3 Example of a Form (qFOR-NA023-02-2015), Hydrometric Survey Notes - Mid-Section Method

Appendix F: Q4 Example of Completed Form (qFOR-NA023-02-2015), Hydrometric Survey Notes - Mid-Section Method

Appendix G: HT-APTP Training Requirements

Appendix H: Hydrometric Contributed Data Policy

Appendix A: Canada's NMHS – QMS Manual: QMS Documentation Convention

Document Title: **Document Format and Revisions**		*Document Owner:* **Manager, Quality Management Office**	
Document Level: **Work Instruction**	*Reference No.:* **Q3-423-01**	*Revision:* **8A**	*Page:* **1 of 7**

1.0 PURPOSE

The purpose of this work instruction is to provide detailed guidance to the document formatting and revision conventions used by MSC and WSC in controlling QMS documents.

2.0 SCOPE

This instruction applies to all internally generated documentation which is controlled within the QMS.

3.0 RESPONSIBILITY

Staff - all MSC and WSC employees are responsible to understand and follow the guidance provided in this work instruction.

4.0 DEFINITIONS

Level 1 QMS Document – a top level quality policy document which provides quality commitments and reference to how the commitments are achieved.

Level 2 QMS Document – a process description which defines the resources to manage and the required steps of a process identified within the quality management system.

Level 3 QMS Document – a work instruction level document describing a specific activity. A Form Template is also considered a Level 3 document, because it provides guidance on information that is to be collected and recorded.

Level 4 QMS Document – these are records providing evidence or results of an activity or event (example – a filled-in form).

Internal Documents – Internal documents are created and maintained internally.

External Documents – External documents are not generated internally, but influence the work of process owners by providing guidance, direction, or otherwise regulating process owner activities.

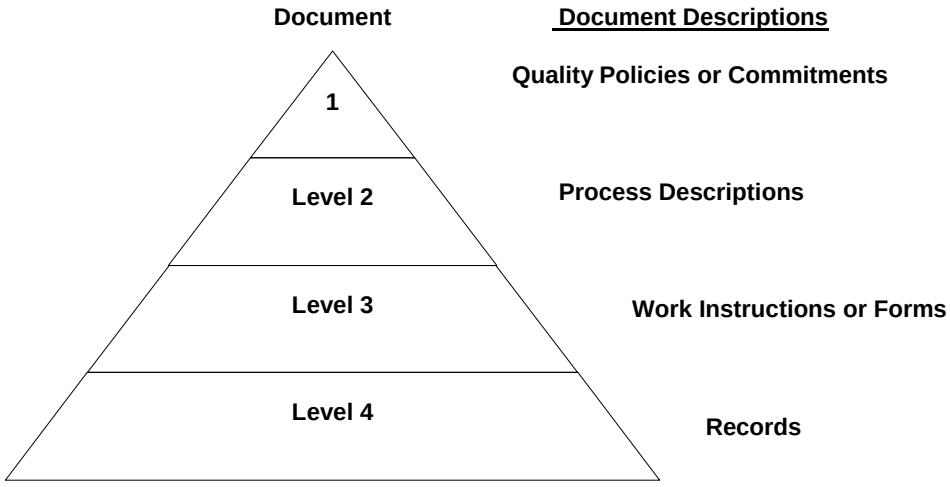
5.0 RELATED DOCUMENTATION

Q2-423-01 – Control of Documents
QF-423-01 – Document Control List Template
QF-423-05 – Q2 Documentation Form Template (QMO document is being revised to reflect each program maintains their own specific Form Template)
QF-423-06 – Q3 Documentation Form Template (QMO document is being revised to reflect each program maintains their own specific Form Template)

WORK INSTRUCTIONS

6.1 QMS Document Organization

Below is an illustration of the QMS documentation hierarchy used.



6.1.1 Level 1 QMS Document: Quality Policy

Quality Policy level documents state quality commitments and provide direction to how these commitments are achieved. This level of QMS documentation is generally developed by the Quality Management Office (QMO) and approved by senior management. All level 1 documents will have a header and footer format similar to the one used for level 2 documentation. The Quality Policy is reviewed annually at the year-end management review. Q1 level documents are reviewed once per ISO certification.

6.1.2 Overarching: Level 2 QMS Document

Process Description level documents define at a high level the required steps and resources for managing a process identified within the quality management system. This level of documentation is generally developed and approved by the function with overall responsibility for the particular process. All level 2 documents will follow the format provided in Form Template QF-423-05. For all overarching Level 2 QMS documents, the Process Owner (PO) will ensure that a systematic review is performed at a frequency appropriate to the document in question, at a minimum this review is to be performed once a year, for both internally or externally generated documents.

6.1.3 Q2 "Underlying": Level 2 QMS Document

It is a more detailed process description which defines the resources to manage and the

required steps of a process identified within the quality management system. This level of document generally links to, or supports, an overarching process. For all underlying Level 2 QMS documents, the Process Owner (PO) will ensure that a systematic review is performed at a frequency appropriate to the document in question, at a minimum this review is to be performed once a year, for both internally or externally generated documents.

Process Descriptions should limit their section lengths to the following guidelines when possible.
Section One – Recommendation: 1 page
Section Two – Recommendation: 3 pages
Section Three – Recommendation: 2 pages

6.1.4 Level 3 Work Instructions

Work Instruction level documents provide detailed guidance in performing a specific activity. Work instructions may be internally generated documents (including text, signage, pictures and forms) or externally generated documents. Forms are a unique variety of level 3 documents and are described in a following section.

Whenever feasible, internally generated work instructions will incorporate the header and footer document control format described for level 2 documents.

Externally generated documents will need to be identified by revision for document control purposes.

See the Q3 Documentation Form Template, QF-423-06. Insert your own information in the identified areas in the Q3 Documentation Form Template.

6.1.5 Level 3 Forms

Forms templates (blank forms, checklists, templates) are considered a unique subset of level 3 work instruction documents. Forms will display at a minimum at descriptive title and the form number and revision number on each page. Other required information will be recorded on the Document Control List.

6.1.6 Level 4 Records

Records provide evidence that certain actions have been taken or that certain events have occurred. For example, a completed form for process reviews is a record of that the process review has indeed occurred. Records are controlled using a Record Management Table (see the Q2-424-01 process on Control of Records).

6.2 Reference Number Descriptions

Reference numbers will be assigned to each document with the following conventions.

First Group – will be the letter **'Q'** for quality followed by; a **'1'** for Policy level documents, a **'2'** for Process Description level documents, a **'3'** for Work Instruction level documents, or an **'F'** for Form Templates (a subset of level 3 documentation). A **'4'** can be used for records, where it is useful to catalogue them using the same system.

Second Group – will be a reference number that links the document to the corresponding requirements of the ISO 9001:2008 QMS Standard. Q2 Documents submitted to the QMO by process owners will be assigned a 3-digit number tied to the section of the ISO 9001:2008 standard that best applies to the process as a whole within the QMS (e.g. 400, 500, 600, 700 or 800)

Third Group – will be a three digit sequential number for documents under the same first two groups.
Process owners, who generate Q3 and QF documents that are not directly controlled by the QMO (for example, for non-common processes) are encouraged to use a similar type reference numbering system wherever practical. The QMO will not be assigning or managing reference numbers for non-common process Q3 and QF documents and it will be left to the process owner to manage their specific reference numbering scheme.

6.3 Header Information

Information to be provided in specific fields of the Form Template header is provided in this subsection.

National Meteorological and Hydrological Service- QMS Manual

Document Title:		*Document Owner:*	
Document Level:	*Reference No.:*	*Revision:*	*Page:* **# of # (<Current page> of <Total>)**

Document Title – states a descriptive name for the document. The title should be specific and detailed enough to clearly identify it to primary users of the document and to aid in avoiding potential confusion among similarly named documents in use in other processes.

Document Owner – states the person responsible for the document

Document Level – describes where the document fits into the QMS document hierarchy

Reference Number – a unique reference number for each document; please refer to a following section for a detailed description of this numbering convention

Revision – describes the current status (draft, approved or obsolete) of the version of the document you are viewing; please refer to a following section for details on these conventions. For all controlled documents, the Process Owner (PO) will ensure that a systematic review is performed at a frequency appropriate to the document in question, at a minimum this review is to be performed **once a year**, for both internally or externally generated documents.

NOTE: If the PO identifies a requirement for a new document or changes to an existing document, the Document Development Process is initiated. A record of decisions for the document review process is retained. This record of decision may be from a management review that included documentation.

Page – provides the current page and total number of pages in the document

6.3.1 Footer Information

Information to be provided in specific fields of the Form Template footer is provided in this subsection.

Approval Authority:	*Approved by:*	*Date:*

Read Only Copy – See intranet for latest revision – **http*//***_____
Approval Authority – states the Function that has authority to approve the document for use

Approved by – the name of the approval

Date – the date (yyyy-mm-dd) this revision received approval. These three elements are only necessary on page 1 of the document.

Read Only Copy – a statement informing users that only copies of documents found on the server are controlled and should be checked to ensure latest version. It must be indicated on every page.

http: - provides location of controlled copy of document

6.4 Revision Conventions

A document state is reflected in the 'Revision' box of the document. There are three possible states:

Draft - The document is being written or reviewed. The author may publish in-progress copies of the document in order to collect feedback on the content of the document before entering the next phase.

Approved - The document has been approved by the designated approval authority. This status confirms approval of the content of the document, and its use in the context of its defined purpose.

Not currently in use – The designated approval authority and the Quality Management Office (QMO) have agreed to put the document "on hold" because the document, while not currently in effect, could be re-activated in the future.

Obsolete – This version of the document has been replaced or cancelled and is no longer valid. This version of the document will be moved to the archive.

6.4.1 Document Revision Number

A revision number shall appear in the document. The revision number shall follow this model:

For the **Draft** state, from 1Dv01 to 99Dv99.

For the **Approved** state, from 1A to 99A.

For the **Not currently in use** state, from 1N to 99N.

For the **Obsolete** state, 1X to 99X.

The number prior to the letter that indicates the revision of a particular document (e.g., 2Dv05, represents the fifth draft version of the second revision of a document).

6.4.2 Archiving of old versions

If there is a previous version of the new document, the older version will be archived. If the Process Owner decides to delete a document, a record of the deletion, including the reason, is produced and stored as per the Control of Records procedure (Q2-424-01).

Note: Before deleting a document, the Process Owner or his or her delegate must ensure the Department has received the necessary disposal authority from Library and Archives Canada. If the Department does not have authority to dispose of the document, it cannot be deleted (though it can be

removed from ECollab or the Intranet. Instead, it must be archived until such time as the necessary disposition authority has been obtained.

6.4.3 Document History

All documents at levels 1, 2 and, where feasible, 3 will include document history information as described below.

6.4.4 Date information

For documents shall be based on the following format: yyyy-mm-dd.

6.4.5 Approval (optional)

This optional section identifies the approval person and function for the document as well as the date on which it was approved (this information also appears in the footer of the first page). The information for this section is maintained for the current revision only.

6.4.6 History of Changes

The list of relevant changes in the content shall appear at (or near) the end of the document. This list shall identify each revision of the document. This information shall be maintained over the life of the document for historical control. Enough detail shall be provided to meaningfully distinguish the current revision from the previous revision.

The dates shall be associated with the revisions to determine which version of the document was in effect when a particular event occurred.

This section may also be used to provide evidence that a document was reviewed as per Process Q2-423-01, even though it was not modified during this review (in such a case, the state and revision number would remain the same as before).

Detailed History of Changes

Date	State	Initials	Description of Changes
2006-08-15	Approved	JCM	The document is initiated.
2006-08-02	Draft	EAB	• Document title notes. • 6.2 reference numbering changes • 6.4 removal of author and reviewer in document history
2008-04-24	Approved	EM	• Document title notes. • 6.2 reference numbering changes • 6.4 removal of author and reviewer in document history
2009-08-28	Approved	DL	Revised to recognize 2008 version of standard
2011-01-07	Approved	PT	Document owner changed, new manager of the QMO. Footnote added to reflect that although Water Survey transferred to the ES Board in 2010, it remains within the scope of the QMS. Clarification of certain sections.
2011-06-07	Approved	PT	Added “Not currently in use” (“N”) under Section 6.3 as an identification for documents that are not currently used,

Date	State	Initials	Description of Changes
			but could be used again in the future. Added Section 6.1.5 on Records. Other modifications consequent to those above.
2013-01-11	Draft	LCD	Added the document QF-423-06 to the process, added information to section 6.1.3, section 6.1.3.1 for the Revision, section 6.1.4 for the document QF-423-06, added the sections 6.3.2 and 6.4.1 to the process and other minor changes.
2013-01-18	Draft	LCD	Added information about the Q3 Documentation Form Template, QF-423-06, section 6.1.4.
2013-02-01	Approved	AB	Approval
2014-01-23	Approved	AB	Approval
2015-06-10	Draft	VM	Specified review frequency for Q1 and overarching Q2 documents
2015-06-10	Approved	AB	Approval

Manager, QMO		**2015-06-10**

Read Only Copy – See intranet for latest revision

Appendix B: Canada's NHS – QMS Manual: Core Processes

Appendix B1: Stakeholder Requirements

Document Title: **Stakeholder Requirements**		*Process Owner:* **Director, Water Survey of Canada**	
Document Level: **Process Description**	*Reference No.:* **Q2-700-058**	*Revision:* **6A**	*Page:* **1 of 5**

1.0 SECTION ONE – INTRODUCTION

1.1 Purpose:

The purpose of this process is to identifying new or changed stakeholder requirements and subsequent development or update of a plan for a design, process, procedure or methodology to address those requirements.

1.2 Scope:

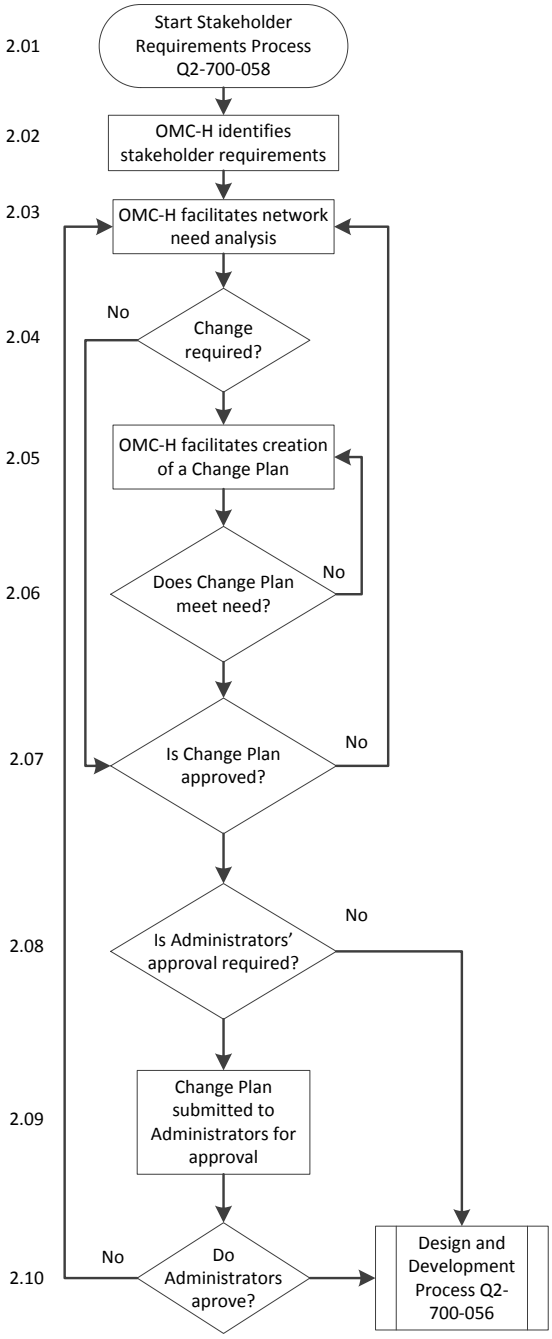
This process includes identification of requirements and development and approval of a Change Plan.

1.3 Information 'Turtle'

Inputs:	**Outputs:**
♦ Provincial/Territorial requirements (Hydrometric agreements) ♦ Departmental requirements ♦ International/inter-jurisdictional requirements ♦ Other stakeholder requirements ♦ Quality Assurance Program Audit Report ♦ Recommendations of Sub-Committees (e.g. NetOpS - Network Operations, DCS – Data Control ♦ CPARs, OFIs and Non-conforming products reports ♦ Monitoring Strategies Division input ♦ Website feedback ♦ User feedback from surveys and workshops	♦ Direct correspondence/Reports ♦ Schedule C from Cost Shared Agreement ♦ Regional Memorandum of Understandings ♦ Change plan
Special Process Requirements: ♦ N/A	**Process Metrics:** ♦ Number of stakeholder requirements gathered ♦ Number of change plans created that meet needs and are approved ♦ Correct representation of what the stakeholder requires, captured in Schedule C and agreed upon at a Coordinators Committee meeting (minutes)

Human Resources: ♦ National Hydrometric managers ♦ Members of the Administrator and Coordinating committees ♦ Members of OMC-H ♦ Support staff	**Materials & Equipment:** ♦ Computer and Office equipment
Linked Processes / Documents: ♦ Monitoring Strategies & Data Management Division (MSDM) ♦ Environmental monitoring ♦ Q2-423-01 Control of Documents ♦ Q2-424-01 Control of Records ♦ Q2-830-01 Control of Non-conforming Product	**Associated Records:** ♦ Scientific Reports/Products ♦ Minutes of meetings ♦ Schedule C ♦ Schedule D ♦ Annual cost shared report

2.0 SECTION TWO – PROCESS FLOWCHART



3.0 SECTION THREE – SUPPLEMENTAL INFORMATION

3.1 Process Notes

2.01 Inputs to this stage include Hydrometric agreements, Stakeholder requirements and Statutory requirements, information from committees and related reports.

2.02 Stakeholder requirements identified through minutes of various meetings (OMC-H, NAT, DCS, NetOpS), website feedback, User workshop and surveys as required. Responses to CPAR and the Nonconforming Products process may also identify requirements.

2.03 OMC-H may assign work to sub-committee, outside consultant, or complete it themselves as appropriate. The task entails the comparison of existing network deliverables against the needs identified by stakeholders. A typical analysis includes information about provincial, federal and partner stations with input from NHP and OMC-H. Input from Monitoring Strategies Division is included**.** They will assess data, equipment, methodologies, and procedures gaps in conducting spatial and temporal analysis of the network (i.e. where and when a station should exist, which equipment should be installed, which procedures should be used, etc.).

2.04 OMC-H determines if a change is required.

2.05 OMC-H facilitates the creation of a Change Plan. Facilitation may include work assignments to project lead, sub-committees, outside consultants, or completion by themselves as appropriate. While the analysis in step 2.03 identifies the gaps, the Change Plan restates these gaps into new or changed requirements/deliverables. This is a preliminary plan to guide and direct the next phases such as Design & Development. This plan is a high-level approach to HR and funding requirements, operational issues (etc.) to be investigated.

2.06 OMC-H reviews the Change Plan to determine if needs are met. The review may include utilizing expertise outside the coordinating committee if appropriate. The change plan will be refined until completed.

2.07 If the needs are met, the plan is approved by OMC-H.

2.08 OMC-H reviews the needs for approval by the Administrators.

2.09 OMC-H submits the plan to Administrators if deemed necessary.

2.10 The Administrators of the hydrometric cost-shared agreement may approve the change plan (go to the Design and Development Process), may reject the change plan (return to box 2.02), or may terminate the process altogether

3.2 Definitions

Term	Definition
Administrator	The individual named by a party to a hydrometric agreement to represent the needs and interests of that party and to approve the activities undertaken under that agreement.
Client	A person, body or agency.
Coordinating Committee	A body created by the Administrators of a hydrometric agreement to plan and manage the activities under that agreement so as to meet the needs of the stakeholders.
CPAR	Corrective or Preventive Action Report
DCS	Data Control Sub-Committee
FOpS	Field Operations Sub-Committee
Hydrometric	Of or related to measurements and calculations of the velocity, discharge, volume and other physical parameters of surface waters and surface water bodies.
NAT	National Administrators Table. A body made of all named Administrators.
Network	A collection of hydrometric monitoring sites that provide spatial and temporal information in accordance with specified parameters.
OFI	Opportunity for Improvement
OMC-H	Body made of the Program Director, all regional WSC managers and National representatives, to plan and manage the operational activities as to meet the needs of the stakeholders.
Project Lead	Could be any of the following; an individual, sub-committee, working group or task group.
Stakeholder	Stakeholders are individuals or organizations (including clients) who are the direct recipients of product or service, or may have an interest in the work and policies (for example, hydrometric agreement administrators, clients, data users, recreational users, etc.).

4.0 SECTION FOUR – DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Description of Changes
1Dv01	Oct 15, 2004	NHP QMS	QMS documents developed under NHP QMS. Documents were used to develop MSC-WSC ISO
1DV02	March, 2007	First Draft	Reformatted and edited to fit MSC-WSC ISO project requirements
1DV03	Jun 04, 2008	Pending Review by WSC Core Team	Reformatted and edited to fit MSC-WSC ISO project requirements
1Dv04	Jun 12, 2008	Issued for review & approval	Reviewed by OMC-H, approved by Director
1A	June 18, 2008	Approved	Draft 1Dv04 approved to 1A
2Dv01	Jul 10, 2008	Pending review by WSC Core Team	Refining document using input from internal audit, staff training and others
2Dv02	Aug 07, 2008	Pending review by WSC Core Team	Refining document
2Dv03	Aug 19, 2008	Issued for review & approval	Reviewed by OMC-H, approved by Director
2A	Aug 28, 2008	Approved	Draft 2Dv03 approved to 2A
3A	Jun 7, 2010	Approved	References to OP and OPSC altered
4A	Jun 5, 2012	Approved	Reviewed with minor organizational changes
5A	Dec 18, 2013	Approved	Reviewed with minor organizational changes
6D	Feb 12, 2015	Reviewed	Reviewed with minor changes.
6A	March 9, 2015	Approved	

B2: Design and Development

Document Title: **Design and Development**		*Process Owner:* **Director, Water Survey of Canada**	
Document Level: **Process Description**	*Reference No.:* **Q2-700-056**	*Revision:* **6A**	*Page:* **1 of 5**

1.0 SECTION ONE - INTRODUCTION

1.1 Purpose

This process provides a new, changed or acquired off the shelf design, process, procedure, methodology or technology that addresses a new or changed stakeholder expectation/need. It produces an operations-ready (i.e., validated) system from a new or changed design, process, procedure, methodology or technology.

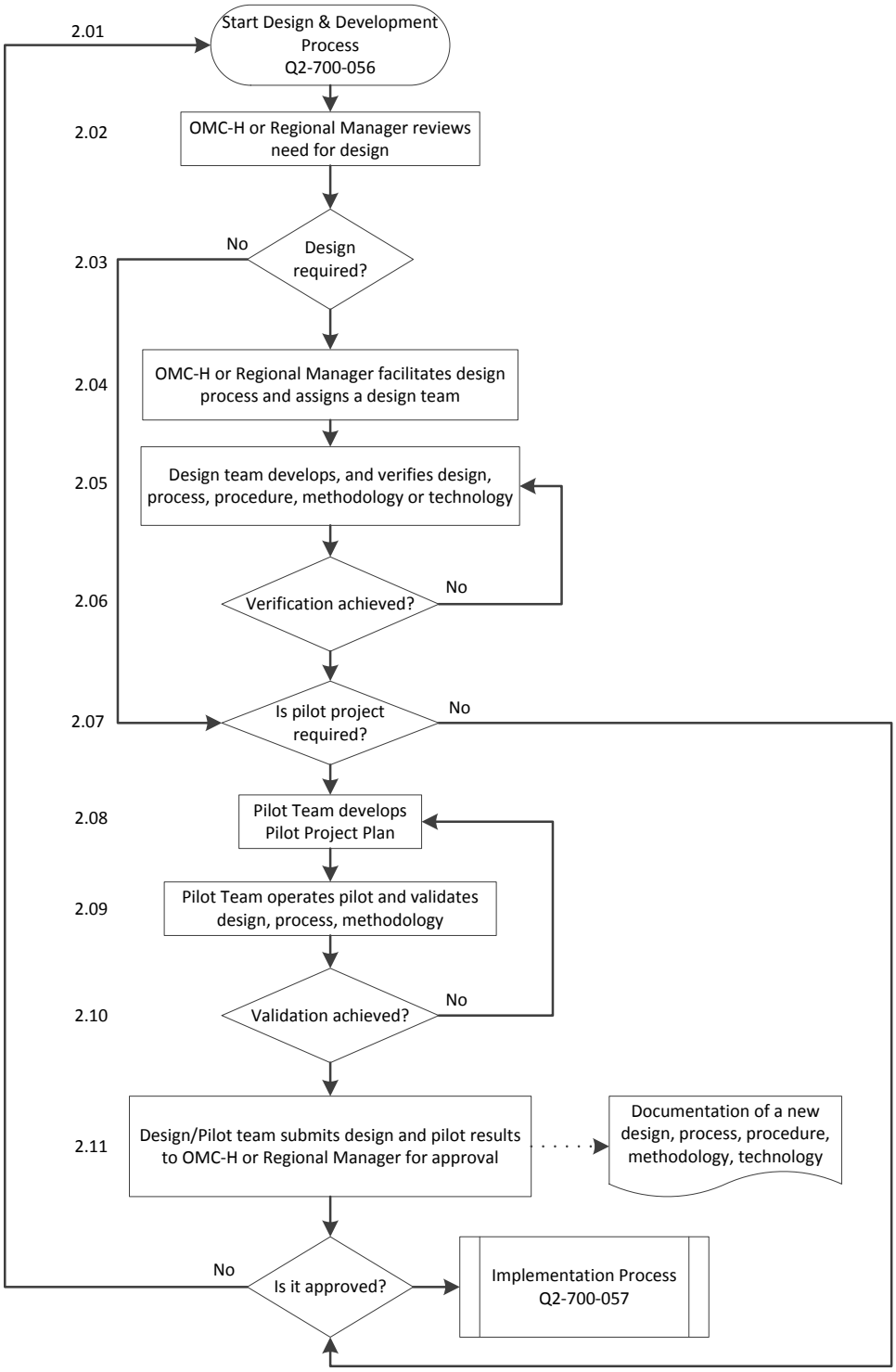
1.2 Scope

This process defines, the steps design and pilot teams must take in order to design a solution to satisfy a change or new need. This process outlines the need for a new design and the steps for development and validation of the solution.

1.3 Information 'Turtle'

Inputs: • Output from Stakeholder Requirements Process (Q2-700-058), including Change Plan • National Standards • Quality Assurance Program Audit Report • Information about existing designs, processes, procedures, methodologies, technologies	**Outputs:** ♦ Documentation of a new design, process, procedure, methodology, technology ♦ Approved field and office technologies
Special Process Requirements: ♦ N/A	**Process Metrics:** • Design fulfills needs as per requirements • Design is deemed acceptable for operational use by OMC-H or Regional Manager
Human Resources: ♦ Staff inventory: composition of the staff includes engineers, hydrologists, physical scientists, technologists and support staff ♦ OMH-C, Regional Manager	**Materials & Equipment:** ♦ Field and office equipment ♦ Station facilities and infrastructures ♦ Testing tools
Linked Processes / Documents: • CSB and SSC processes • Q2-423-01 Control of Documents • Q2-424-01 Control of Records • Q1-600-01 Resource Management • Q2-760-01 Control of Monitoring & Measuring Devices • Q2-740-01 Purchasing	**Associated Records:** • Scientific/engineering Reports & Products • National Standard Operating Procedures • Specifications and Drawings • Validation and verification reports • Decision documents from OMC-H, Regional Management meetings • Decision documents from Design and Pilot Team meetings

2.0 SECTION TWO – PROCESS FLOWCHART


2.01
Start Design & Development Process Q2-700-056
2.02
OMC-H or Regional Manager reviews need for design
2.03
No
Design required?
2.04
OMC-H or Regional Manager facilitates design process and assigns a design team
2.05
Design team develops, and verifies design, process, procedure, methodology or technology
2.06
Verification achieved?
No
2.07
Is pilot project required?
No
2.08
Pilot Team develops Pilot Project Plan
2.09
Pilot Team operates pilot and validates design, process, methodology
2.10
Validation achieved?
No
2.11
Design/Pilot team submits design and pilot results to OMC-H or Regional Manager for approval
Documentation of a new design, process, procedure, methodology, technology
No
Is it approved?
Implementation Process Q2-700-057

3.0 SECTION THREE – SUPPLEMENTAL INFORMATION

3.1 Process Notes

2.01 Start of the Design and Development Process.

2.02 A review of the design, process, procedure, methodology or technology needs is carried out by the OMC-H or the regional Manager. The review may include work assignments to sub-committees, task groups or outside consultants.

If the design, process, procedure, methodology or technology needs can be satisfied within existing designs, processes, procedures methodologies or technologies then proceed to the pilot project (step 2.05). Alternately, the needs may identify the requirements for a new or change to the design, process or technology, procedure, methodology or technology invoking a design process. The reviewer also defines indicators for verification of the design.

2.03 The OMC-H or the regional Manager facilitates the design process by assigning a Design Team that may include sub-committees, WSC regional offices task groups or outside consultants. In some instances, the design process may include the use of, or integration with, IT infrastructures, in which case CSB/SSC process will be called upon to participate and/or deliver related components. The Design Team develops the design.

2.04 The Design Team verifies any design changes or new design, process or technology, procedure, methodology or technology. The verification ensures that the design outputs have met the input requirements.

2.05 The Design Team assesses if a pilot project is required and if required assembles a Pilot Team. The Pilot Team may be the same as the Design Team, a sub-set of the Design Team or composed of new members. If a pilot project is not necessary, proceed to the Implementation Process (Q2-700-057).

2.06 The Pilot Team prepares a pilot plan which details the design installation and validation criteria in an operational setting.

2.07 The Pilot Team, with the help of regional representatives, operates the pilot in an operational environment and identifies implementation requirements (training, user's guide, installation guides, etc.) and gaps. This activity is critical in preparing for successful implementation (Implementation Process Q2-700-057).

2.08 The Pilot Team reviews results and validates the solution. Validation is required to ensure that the resulting design, process, procedure, methodology or technology is capable of meeting the requirements for the specified application or intended use (ex; demonstration of performance).

2.09 Once the validation criteria are met, the Design/Pilot Team submits the design and validation results to the OMC-H or the regional Manager for their approval.

2.10 OMC-H or the regional Manager may approve the new/changed design, process, procedure, methodology or technology so the implementation process may begin, may

reject the results (go back to box 2.01) or may terminate the process altogether.

3.2 Definitions

Term	Definition
Administrator	The individual named by a party to a hydrometric agreement to represent the needs and interests of that party and to approve the activities undertaken under that agreement.
Client	A person, body or agency.
Coordinating Committee	A body created by the Administrators of a hydrometric agreement to plan and manage the activities under that agreement so as to meet the needs of the stakeholders.
Hydrometric	Of or related to measurements and calculations of the velocity, discharge, volume and other physical parameters of surface waters and surface water bodies.
Operational Staff	Individuals within an operating party that conduct activities
Network	A collection of hydrometric monitoring sites that provide spatial and temporal information in accordance with specified parameters.
OMC-H	Body made of all regional WSC managers and National representatives to plan and manage the operational activities as to meet the needs of the stakeholders.
Project Lead	Could be any of the following; an individual, sub-committee, working group or task group
Stakeholder	Stakeholders are individuals or organizations (including clients) who are the direct recipients of product or service, or may have an interest in the work and policies, (for example, hydrometric agreement administrators, clients, data users, recreational users, etc.)

4.0 SECTION FOUR – DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Description of Changes
1Dv01	Oct 15, 2004	NHP QMS	QMS documents developed under NHP QMS. Documents were used to develop MSC-WSC ISO
1Dv02	March, 2007	First Draft	Reformatted and edited to fit MSC-WSC ISO project requirements
1Dv03	Jun 04, 2008	Pending Review by WSC Core Team	Reformatted and edited to fit MSC-WSC ISO project requirements
1Dv04	Jun 12, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
1A	Jun 18, 2008	Approved	Draft 1Dv04 approved to 1A
2Dv01	Jul 10, 2008	Pending review by WSC Core Team	Refining document using input from internal audit, staff training and others
2Dv02	Aug 07, 2008	Pending review by WSC Core Team	Refining document
2Dv03	Aug 19, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
2A	Aug 28, 2008	Approved	Draft 2Dv03 approved to 2A
3A	Jun 6, 2010	Approved	OP and OPSC references altered.
4A	Jun 5, 2012	Approved	Reviewed with minor revisions
5A	Dec 18, 2013	Approved	Reviewed and approved
6D	February 12, 2015	Reviewed	Reviewed with minor revisions
6A	March 9 2015	Approved	

B3: Implementation

Document Title: **Implementation Process**		*Process Owner:* **Director, Water Survey of Canada**	
Document Level: **Process Description**	*Reference No.:* **Q2-700-057**	*Revision:* **6A**	*Page:* **1 of 6**

1.0 SECTION ONE - INTRODUCTION

1.1 Purpose

This process involves of implementation of an existing, new, changed or acquired off the shelf design, process, procedure, methodology or technology as validated by the Design and Development process (Q2-700-056).

1.2 Scope

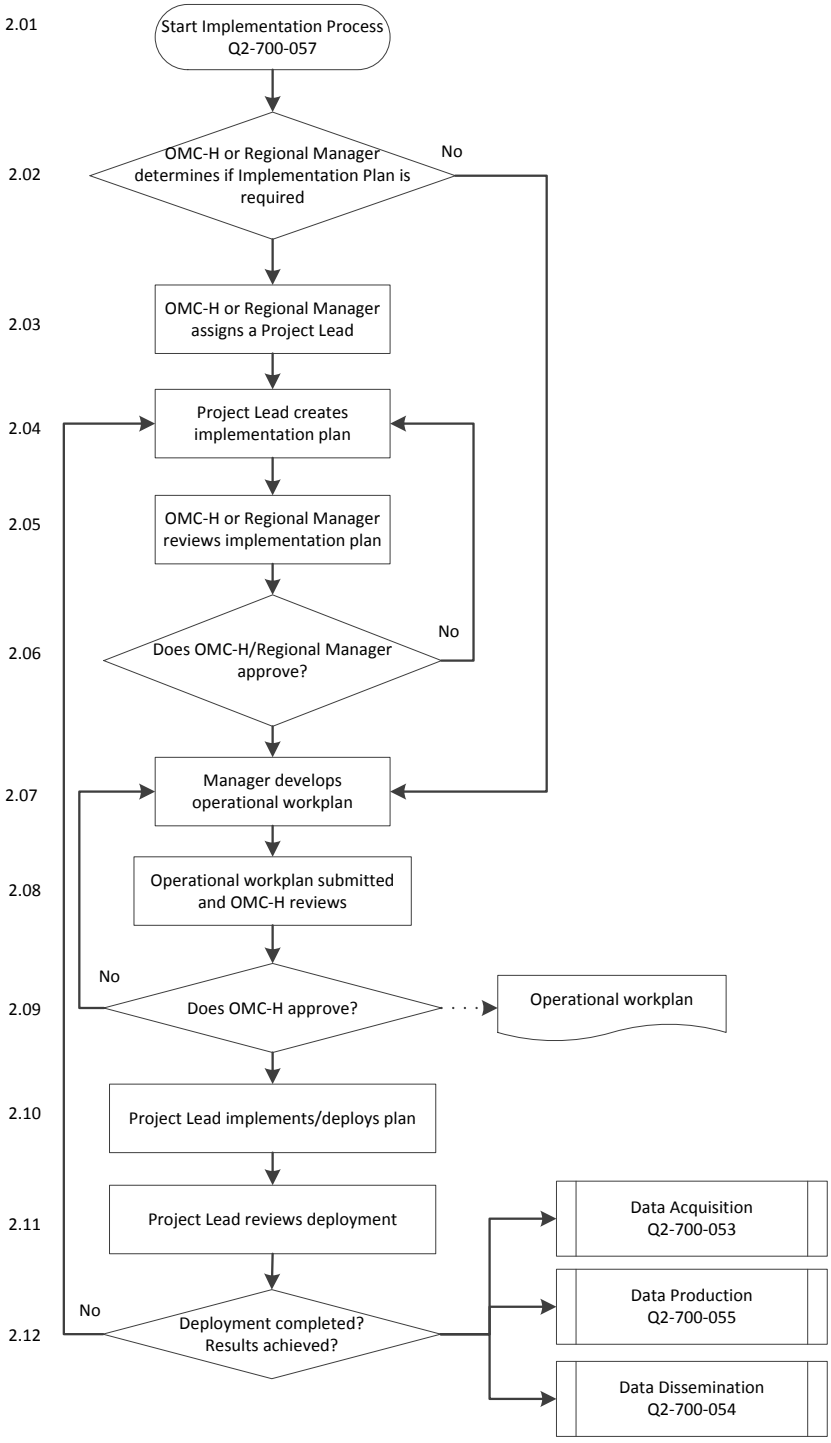
The scope of this process includes the development of the implementation plan and operationalizing the implementation plan. An implementation plan may include a detailed schedule, identification of resources required, transition requirements, mitigation of impacts, purchasing. An operational work plan for on-going operation is also developed in this process.

1.3 Information 'Turtle'

Inputs: • Documentation of a new design, process, procedure, methodology or technology • Approved field and office technologies • Advice, service, etc. from other Environment Canada Branches, and Shared Services Canada • Output from Design & development process Q2-700-056 • Quality Assurance Program Report	**Outputs:** • Deployed operational system • Operational work plan
Special Process Requirements: • N/A	**Process Metrics:** • Technologies implemented as per timelines defined by the implementation plan • Technologies made operational as per timelines defined by the operational work plan
Human Resources: • Staff inventory: composition of the staff includes engineers, hydrologists, physical scientists, technologists and support staff • OMC-H	**Materials & Equipment:** • Field and office equipment

Linked Processes / Documents:	Associated Records:
o CSB and SSC • Q2-423-01 Control of Documents • Q2-424-01 Control of Records • Q1-600-01 Resource Management • Q2-830-01 Control of Non-conforming Products • Q2-850-01 Corrective and Preventative Actions • Q2-760-01 Control of Monitoring & Measuring Devices • Q2-630-01 Infrastructure Maintenance • Q2-740-01 Purchasing	• Operational work plan • Implementation Plan • Implementation records • Review results

2.0 SECTION TWO – PROCESS FLOWCHART



3.0 SECTION THREE – SUPPLEMENTAL INFORMATION

3.1 Process Notes

2.01 Start of the Implementation Process Q2-700-057.

2.02 OMC-H considers the type and magnitude of the new/existing validated technology and decides if a formal implementation plan is required. In the event where an implementation plan is not required, an operational work plan is prepared for regular monitoring operations

2.03 Formal assignment of the implementation task to a Project Lead.

2.04 Project Lead may direct or coordinate a team to create a plan for. Lead may gather input from other Branches in the form advice, service, etc. Project plan may include detailed scheduling, cost benefit analysis, risk assessment study, impact assessment and mitigation, transition phase requirements, allocation/request for resources (funding, PY), life cycle management and assessment criteria. The plan must also address the needs for the development and delivery of user's guides, training material/session, reference documents, (etc.).

The creation of the plan may require input from SSC/CSB processes for projects involving IT infrastructures.

2.05 Implementation plan is reviewed by OMC-H or regional Manager for approval. The plan may be approved, rejected (go back to step 2.04) or terminated altogether.

2.07 If an implementation plan is not required or has been approved by the OMC-H or regional Manager, an operational work plan is prepared by the Regional Manager. The operational work plan may include station visit/maintenance/upgrade requirements, allocation/request for resources (funding, PY), etc.

If the creation of the operational plan involves IT infrastructures, it may require input from SSC/CSB process.

2.08 Once completed, the operational work plan will be submitted to OMC-H for their review.

2.09 OMC-H will either approve (go to step 2.10) or reject (go back to 2.07) the operational work plan.

2.10 Project Lead (with team) performs all tasks to deploy the operational work plan. Such tasks e.g. a) using appropriate levels of purchasing process to acquire material, b) assigning work to individual, working group, regional staff or consultant to deliver on each study or assessment, c) communicating with appropriate staff and regional reps for scheduling, training, d) coordinating construction of infrastructures and the installation of equipment, e) ensuring that the operational plan and life cycle principles are in place for on-going monitoring, (etc.).

If the implementation or operational plan includes the use or integration with IT infrastructures and SSC/CSB processes, they will be called upon to participate and/or deliver.

2.11 Project lead (with team) reviews deployment (monitors progress, making reviews and adjustments as necessary until the project is completed). Implementation information/records are gathered to document the deployment, such as as-built drawing, training logs, calibration records, database updates, etc.

2.12 Success is measured according to a set of criteria defined in the implementation and operational plan (equipment test, software tests, training effectiveness validation). If positive, the output goes to the next applicable process based on the type of technology/project. If negative, go back to step 2.05, the project may also be terminated altogether.

3.2 Definitions

Term	Definition
Administrator	The individual named by a party to a hydrometric agreement to represent the needs and interests of that party and to approve the activities undertaken under that agreement.
Client	A person, body or agency.
Coordinating Committee	A body created by the Administrators of a hydrometric agreement to plan and manage the activities under that agreement so as to meet the needs of the stakeholders.
Hydrometric	Of or related to measurements and calculations of the velocity, discharge, volume and other physical parameters of surface waters and surface water bodies.
OMC-H	Body made of all regional WSC managers and National representatives to plan and manage the operational activities as to meet the needs of the stakeholders.
Operational Staff	Individuals within an operating party that conduct activities.
Project Lead	Could be any of the following; an individual, sub-committee, working group or task group.
Stakeholder	Stakeholders are individuals or organizations (including clients) who are the direct recipients of product or service, or may have an interest in the work and policies, (for example, hydrometric agreement administrators, clients, data users, recreational users, etc.)

4.0 SECTION FOUR – DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Description of Changes
1Dv01	Oct 15, 2004	NHP QMS	QMS documents developed under NHP QMS. Documents were used to develop MSC-WSC ISO
1DV02	March, 2007	First Draft	Reformatted and edited to fit MSC-WSC ISO project requirements
1DV03	Jun 04, 2008	Pending Review by WSC Core Team	Reformatted and edited to fit MSC-WSC ISO project requirements
1Dv04	Jun 12, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
1A	Jun 18, 2008	Approved	Draft 1Dv04 approved to 1A
2Dv01	Jul 10, 2008	Pending review by WSC Core Team	Refining document using input from internal audit, staff training and others
2Dv02	Aug 07, 2008	Pending review by WSC Core Team	Refining document
2Dv03	Aug 19, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
2A	Aug 28, 2008	Approved	Draft 2Dv03 approved to 2A
3A	Jun 7, 2010	Approved	References to OP and OPSC altered
5A	Dec 18,2013	Approved	Organizational name changes, process remains unchanged
6D	February 12, 2015	Reviewed	Reviewed with minor revisions
6A	March 9, 2015	Approved	

B4: Data Acquisition

Document Title: **Data Acquisition**		*Process Owner:* **Director, Water Survey of Canada**	
Document Level: **Process Description**	*Reference No.:* **Q2-700-053**	*Revision:* **5A**	*Page:* **1 of 5**

1.0 SECTION ONE - INTRODUCTION

1.1 Purpose

The purpose of this process is to collect data and make it available for further processing. This is the initial step toward provision of information to clients and stakeholders. This process occurs after the stakeholder requirements have been defined, and if required, the design and development has been completed and implemented as required, and an operational work plan has been developed and approved.

1.2 Scope

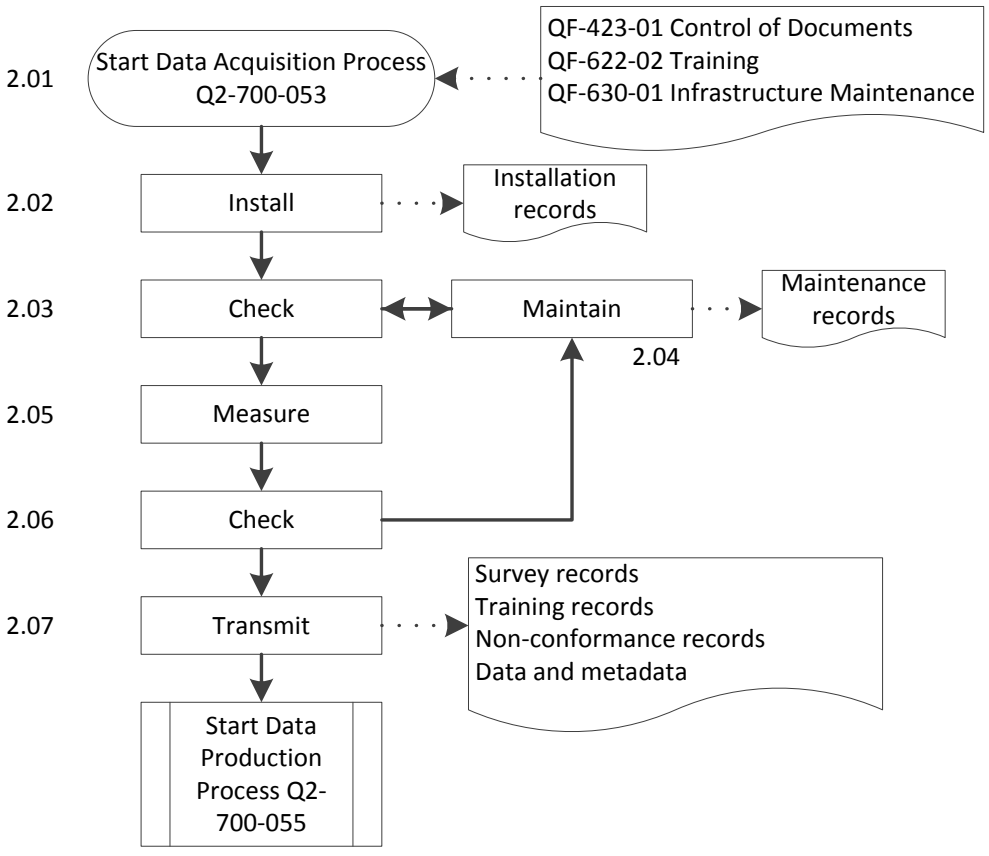
This procedure applies to: discrete data, collected via field measurements and observations; and time-series data, automatically acquired and transmitted.

1.3 Information 'Turtle'

Inputs: • National Standard Operating Procedures • Quality Assurance Program Audit Reports • Non-Conformance Reports • Results from Implementation process (Q2-700-057): technologies are in place and ready for operation, and an operational work plan is available.	**Outputs:** • Installation records • Maintenance records • Survey records • Non-Conformance Reports • Data and metadata
Special Process Requirements: • HT-APTP trained staff	**Process Metrics:** • # stations installed • # of station visits • time from occurrence to transmission for time-series data
Human Resources: • Staff inventory: engineers, hydrologists, • Staff inventory: engineers, hydrologists, physical scientists, supervisors, technologists and support staff	**Materials & Equipment:** • Field and office equipment/infrastructures
Linked Processes / Documents: • Manufacturer's manuals • IT infrastructure processes of CSB	**Associated Records:** • Training records

and SSC • Q2-423-01 Control of Documents • Q2-424-01 Control of Records • Q1-600-01 Resource Management • Q2-830-01 Management of Non-conforming Process, Product and Service • Q2-850-01 Corrective and Preventative Actions • Q2-760-01 Control of Monitoring & Measuring Devices • Q2-630-01 Infrastructure Maintenance • Q2-740-01 Purchasing	

2.0 SECTION TWO – PROCESS FLOWCHART



3.0 SECTION THREE – SUPPLEMENTAL INFORMATION

3.1 Process Notes

2.01 Data Acquisition Process Q2-700-053 starts. All activities are conducted according to National Standard Operating Procedures (SOPs). Quality Assurance Program Audits determine compliance with National SOPs.

2.02 Operational Staff install the technologies and infrastructures of hydrometric stations according to National Standard Operating Procedures for installation and operational work plans. For stations that have already been installed, this process begins at step 2.03.

2.03 Operational Staff check station health and environmental parameters.

2.04 Operational Staff take preventive and corrective action according to national Standard Operating Procedures. Maintenance may include resets, calibrations, validations, application of corrections.

2.05 Operational Staff measure hydrometric parameters according to national Standard Operating Procedures through field visits for discrete data, and through automated processes for time-series data. The discrete data will be used in the Data Production Process Q2-700-055 to check, validate and correct the model and time-series data.

The hydrometric parameters measured at a station, and the measurement schedule (frequency, duration) is outlined in operational work plans.

2.06 Operational Staff check data and survey notes for completeness and correctness according to National Standard Operating Procedures before transmission.

2.07 Operational Staff transmit hydrometric parameters to databases. This transmission occurs either manually, or through automated processes. CSB and SSC operate and maintain most of the IT infrastructures and software used to transmit and store hydrometric parameters.

3.2 Definitions

Term	Definition
Administrator	The individual named by a party to a hydrometric agreement to represent the needs and interests of that party and to approve the activities undertaken under that agreement.
Client	A person, body or agency.
Coordinating Committee	A body created by the Administrators of a hydrometric agreement to plan and manage the activities under that agreement so as to meet the needs of the stakeholders.
Corporate Services Branch (CSB)	The Branch of Environment Canada responsible for the provision of select IT products and services (complimentary to Shared Services Canada products and services).
Databases	HYDAT: The archive of daily hydrometric data and associated statistics that have been approved as meeting national standards. HYDEX: The database containing metadata for the hydrometric stations listed in HYDAT. Production databases: Databases used by computational software to process and store data.
HT-APTP	Hydrometric Technologist - Apprenticeship or Professional Training Program. Extensive apprenticeship training provided to all new technologists via standardized modules and delivery methods to ensure competencies.
Hydrometric Data and Metadata	Data and metadata related to measurements and calculations of the level, velocity, discharge, volume and other physical parameters of surface waters and surface water bodies.
Operational Management Committee – Hydrometric (OMC-H)	Committee responsible for the national management of the Water Survey of Canada.
Operational Staff	Individuals within an operating party that conduct activities.
Network	A collection of hydrometric monitoring sites that provide spatial and temporal information in accordance with specified parameters.
Operating Party	Body or agency conducting activities.
Project Lead	Could be any of the following; an individual, sub-committee, working group or task group.
Quality Assurance Program Audits	During the Quality Assurance Program Audits, Water Survey of Canada experts review field installations and office work of Operational Staff and Supervisors. Offices are audited on a regular basis according to a schedule. Audit results are an input to core processes, providing feedback to staff, ensuring compliance to with Standard Operating Procedures, and identifying opportunities for improvement.
Shared Services Canada (SSC)	The Federal Government entity responsible for the provision of select IT products and services (complimentary to Corporate Services Branch products and services).
Stakeholder	Stakeholders are individuals or organizations (including clients) who are the direct recipients product or service, or may have an interest in the work and policies, (for example, hydrometric agreement administrators, clients, data users, recreational users, etc.).

4.0 SECTION FOUR – DOCUMENT HISTORY

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1DV03	Jun 04, 2008	Pending review by WSC Core Team	Reformatted and edited to fit MSC-WSC ISO project requirements
1Dv04	Jun 12, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
1A	Jun 18, 2008	Approved	Draft 1Dv04 approved to 1A
2Dv01	Jul 10, 2008	Pending review by WSC Core Team	Refining document using input from internal audit, staff training and others
2Dv02	Aug 07, 2008		Refining document
2Dv03	Aug 19, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
2A	Aug 28, 2008	Approved	Draft 2Dv03 approved to 2A
3A	May 18, 2010	Approved	Organizational updates References to OP and OPSC altered
4D	May 3, 2013	Issued for review and approval	
4A	May 8, 2013	Approved	
5D	December 8, 2014	Issued for review and approval	Updated entire process, including definitions.
5A	March 9, 2015	Approved	

B5: Data Production

Document Title: **Data Production**		*Process Owner:* **Director, Water Survey of Canada**	
Document Level: **Process Description**	*Reference No.:* **Q2-700-055**	*Revision:* **5A**	*Page:* **1 of 5**

1.0 SECTION ONE - INTRODUCTION

1.1 Purpose

The purpose of this process is to produce hydrometric data and metadata to national standards.

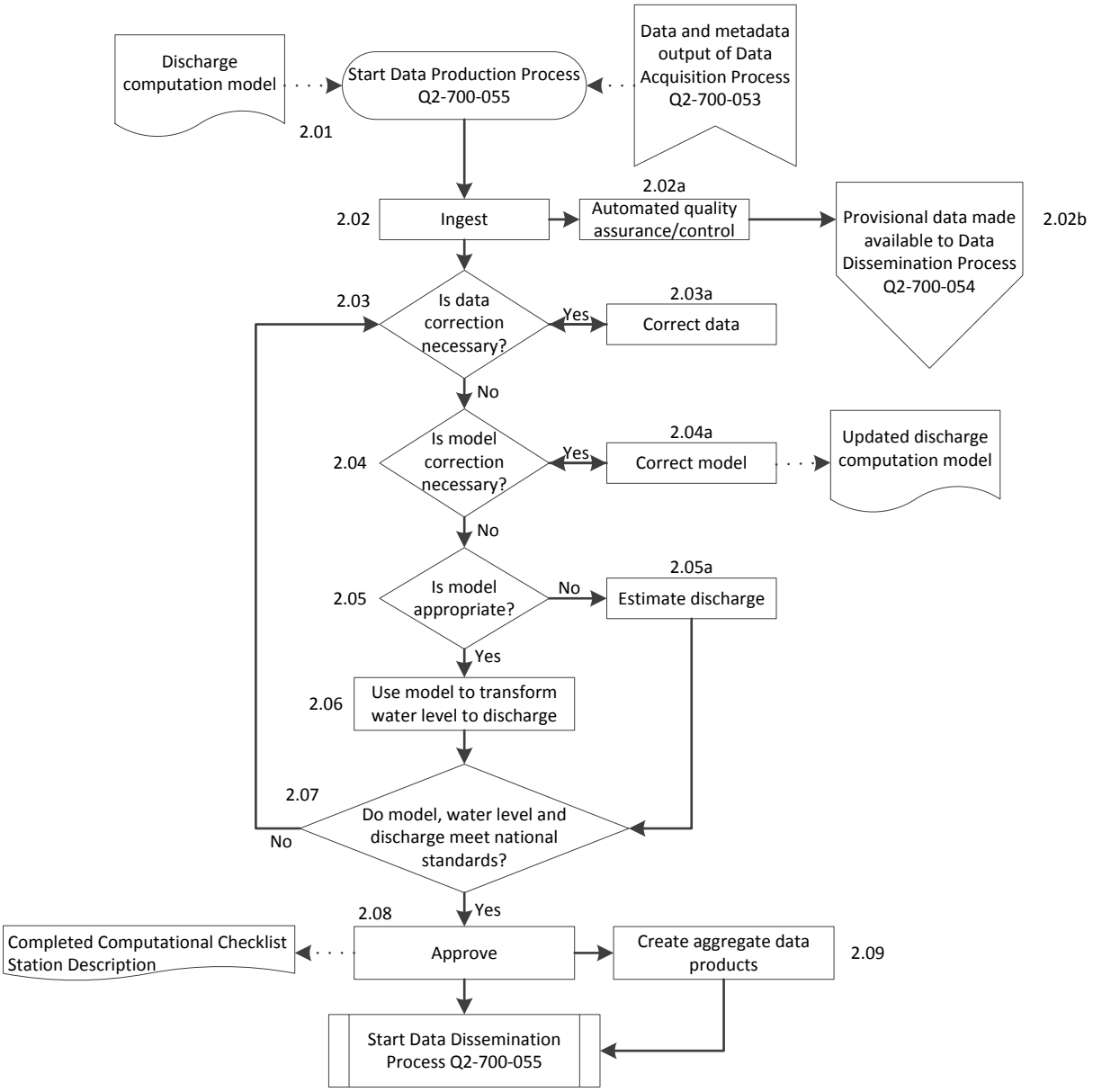
1.2 Scope

This process applies to hydrometric discrete and time-series data and metadata which is provided for the Dissemination process.

1.3 Information 'Turtle'

Inputs: • Data Acquisition process output • Operational work plans • National Standard Operating Procedures • Computation Checklist • Discharge computation models • Quality Assurance Program (QAP) Audit Report • Non-conforming Products Reports	**Outputs:** • Computation Checklist Record • Approved Hydrometric Data • Provisional Hydrometric Data • Metadata • Updated discharge computation models • Station Description
Special Process Requirements: ♦ HT-APTP Trained staff	**Process Metrics:** • Time between ingest and approval • Time between ingest and completion of automated procedures to make provisional hydrometric data available to Dissemination process
Human Resources: o Staff inventory: includes engineers, hydrologists, physical scientists, supervisors, technologists and support staff	**Materials & Equipment:** • Field and office technologies/infrastructures
Linked Processes / Documents: • IT infrastructure processes of CSB and SSC • Q2-700-062 Overarching Monitoring • Q2-423-01 Control of Documents • Q2-424-01 Control of Records • Q1-600-01 Resource Management • Q2-830-01 Management of Nonconforming Process, Product and Service • Q2-850-01 Corrective and Preventative Actions	**Associated Records:** • Training records

2.0 SECTION TWO – FLOW CHART



3.0 SECTION THREE – SUPPLEMENTAL INFORMATION

3.1 Process Notes

2.01 Data and metadata (output from the Data Acquisition process) are available and Data Production starts. A discharge computation model for a station may be available from previous iterations of this process for data from that station, and the model may be updated through this process. All activities are conducted according to National Standard Operating Procedures (SOPs). Quality Assurance Program Audits determine compliance with National SOPs.

2.02 During the ingest process, time-series data from automatic transmission are automatically arranged according to the database structure by software. Discrete and time-series data transmitted manually are manually added to the databases by Operational Staff.

2.02a&b Time-series data undergo automated quality control procedures and are made available as Provisional data to the Data Dissemination process. This quality control procedure may apply a pre-determined correction to the data before it is passed on for Dissemination.

2.03 Operational Staff reviews data for validity to begin production process. This step is conducted according to National SOPs. Operational Staff determine if data are valid by checking for completeness and abnormalities in the time series and computations.

2.03a If the data are not valid and correction is necessary, Operational Staff will correct the data. This may involve replacement of missing or corrupt raw data, or adjustments based on field measurements. Non-repairable data do not continue in this process and are disregarded.

2.04 If the data are valid and correction is not necessary, Operational Staff determine if discharge computation model correction is necessary according to National SOPs.

2.04a If discharge computation model correction is necessary, Operational Staff correct it according to National SOPs. An output of this step is an updated discharge computation model.

2.05 If discharge computation model correction is not necessary, Operational Staff determine if the discharge computation model is appropriate according to National SOPs.

2.05a If the discharge computation model is not appropriate, discharge is estimated according to National SOPs.

2.06 If the discharge computation model is appropriate, Operational Staff use it to transform water level to discharge through a computational transformation according to National SOPs.

2.07 Approvers (Operational Supervisors) examine the discharge computation model, water level and computed or estimated discharge to determine if they meet national standards. They review interpretations, decisions and production methodologies that were applied by the Operational Staff during the steps 2.03 and 2.04. This review includes examination of results for consistency throughout a geographic area. If data do not meet national standards, Approvers return the products to Operational Staff for further examination and corrections.

2.08 If data meet national standards, Approvers approve the discharge computation model, water level and discharge. Final approved documents such as the Computational Checklist and Station Description are identified as tracked records. Approver assembles data and metadata that has been approved and provides it to Data Control staff to begin the Data Dissemination Process (Q2-700-054).

2.09 Data Control or Approver generates aggregate data products from approved data, and provides it for the Data Dissemination Process (Q2-700-054).

3.2 Definitions

Term	Definition
Administrator	The individual named by a party to a hydrometric agreement to represent the needs and interests of that party and to approve the activities undertaken under that agreement.
Aggregate data products	Computed from a set of unit data, these are daily, monthly or annual means.
Approver	Qualified person assigned the responsibility of validating and approving that hydrometric data has been collected and computed in accordance with National Standards and Procedures. Usually referred to as an Operational Supervisor.
Corporate Services Branch (CSB)	The Branch of Environment Canada responsible for the provision of select IT products and services (complimentary to Shared Services Canada products and services).
Data Control	Work unit responsible for transferring approved hydrometric data from an operating party into the national databases.
Discharge computation model	Mathematical model used to compute discharge from measured hydrometric data. Discharge computation models commonly used are stage-discharge rating curves, but other models such as stage-fall, dilution and index velocities may be used.
HT-APTP	Hydrometric Technician - Apprenticeship or Professional Training Program. Extensive apprenticeship training provided to all new technologists via standardized modules and delivery methods to ensure competencies.
Databases	HYDAT: The archive of daily hydrometric data and associated statistics that have been approved as meeting national standards. HYDEX: The database containing metadata for the hydrometric stations listed in HYDAT. Production databases: Databases used by computational software to process and store data.
Hydrometric Data and Metadata	Data and metadata related to measurements and calculations of the level, velocity, discharge, volume and other physical parameters of surface waters and surface water bodies.
Network	A collection of hydrometric monitoring sites that provide spatial and temporal information in accordance with specified parameters.
Operational Staff	Individuals within an operating party that conduct activities.
Operating Party	Body or agency conducting activities.
Shared Services Canada (SSC)	The Federal Government entity responsible for the provision of select IT products and services (complimentary to Corporate Services Branch products and services).
Stakeholder	Stakeholders are individuals or organizations (including clients) who are the direct recipients of product or service, or may have an interest in the work and policies, (for example, hydrometric agreement administrators, clients, data users, recreational users, etc.).
Quality Assurance Program Audits	During the Quality Assurance Program Audits, Water Survey of Canada experts review field installations and office work of Operational Staff and Supervisors. Offices are audited on a regular basis according to a schedule. Audit results are an input to core processes, providing feedback to staff, ensuring compliance to with Standard Operating Procedures, and identifying opportunities for improvement.

4.0 SECTION FOUR – DOCUMENT HISTORY

Detailed History of Changes

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1DV03	Jun 04, 2008	Pending review by WSC Core Team	Reformatted and edited to fit MSC-WSC ISO project requirements
1Dv04	Jun 12, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
1A	Jun 18, 2008	Approved	Draft 1Dv04 approved to 1A
2Dv01	Jul 10, 2008	Pending review by WSC Core Team	Refining document using input from internal audit, staff training and others
2Dv02	Aug 07, 2008	Pending review by WSC Core Team	Refining document
2Dv03	Aug 19, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
2A	Aug 28, 2008	Approved	Draft 2Dv03 approved to 2A
3A	Jun 6, 2010	Approved	References to OP and OPSC altered
4D1	May 3,2013	Issued for review & approval	
4A	May 8, 2013	Approved	
5D	Dec 8, 2015	Issued for review and approval	Updated entire process, including definitions
5A	March 9, 2015	Approved	

Approval Authority:	*Approved by:*	*Date:*
Director, Water Survey of Canada		**2015-03-09**

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B6: Data Delivery and Dissemination

Document Title: **Data Delivery and Dissemination**		*Process Owner:* **Director, Water Survey of Canada**	
Document Level: **Process Description**	*Reference No.:* **Q2-700-054**	*Revision:* **5A**	*Page:* **1 of 5**

1.0 SECTION ONE - INTRODUCTION

1.1 Purpose

The purpose of this process is to transfer provisional and approved hydrometric data and metadata to national databases and to make it available to stakeholders.

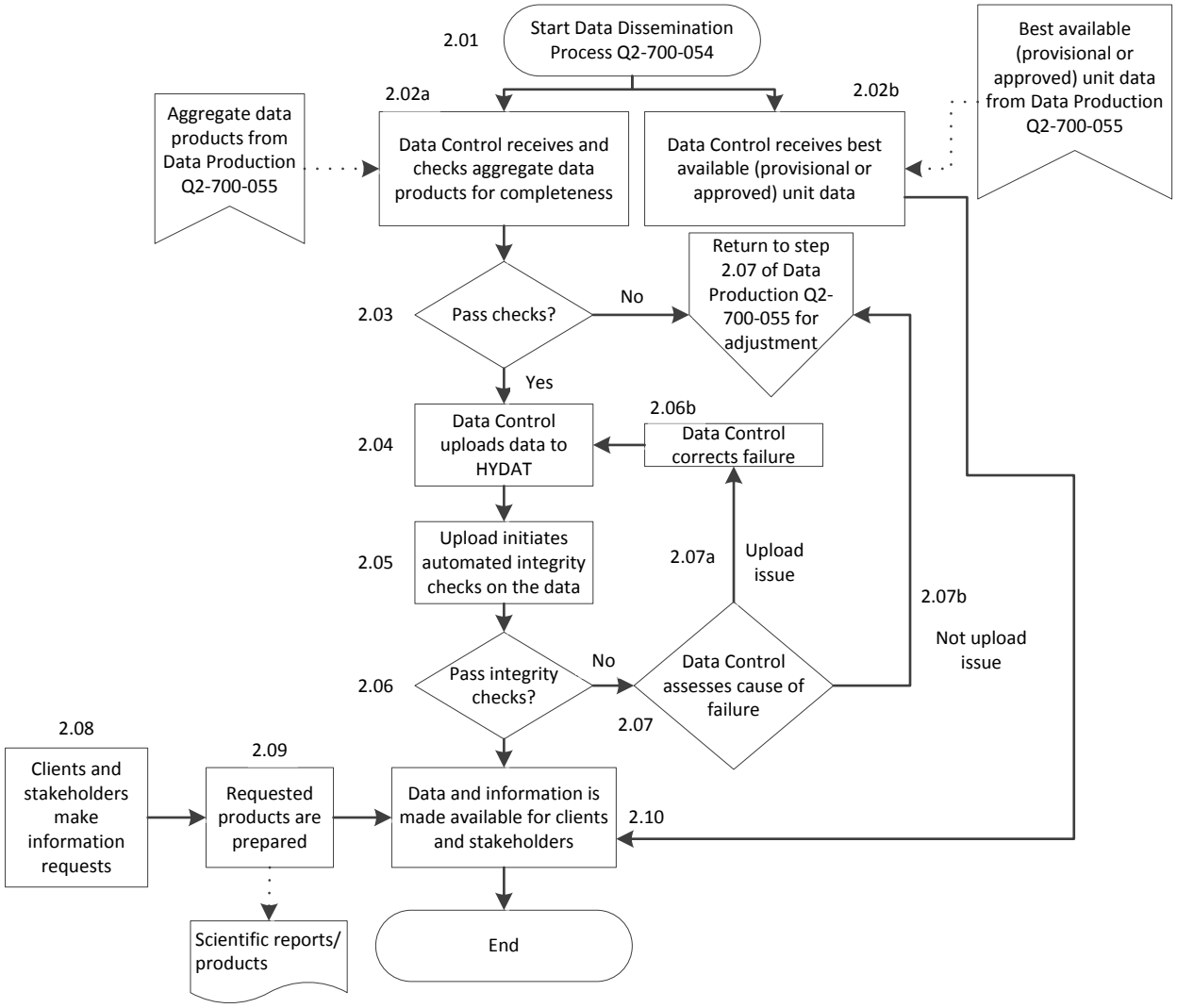
1.2 Scope

This process applies to approved and provisional hydrometric data and metadata from the Data Production process.

1.3 Information 'Turtle'

Inputs:	**Outputs:**
• Outputs of Data Production process (Q2-700-055) • Operational work plan • Quality Assurance Program Audit Report • Client and stakeholder information requests	• Approved hydrometric data and metadata • Provisional hydrometric data and metadata • Aggregate hydrometric data products • Direct correspondence
Special Process Requirements: • N/A	**Process Metrics:** • Response time to information requests • Time between receipt of best available unit data and dissemination on the web (poll running time) • Time between receipt of aggregate data products and dissemination on the web
Human Resources: • Staff inventory: engineers, hydrologists, physical scientists, data control staff, technologists and support staff • Database administrators • IT staff	**Materials & Equipment:** • Field and office equipment • Data system infrastructures
Linked Processes / Documents: • IT infrastructure processes of CSB and SSC • Q2-700-062 Overarching Monitoring • Q2-423-01 Control of Documents • Q2-424-01 Control of Records • Q1-600-01 Resource Management	**Associated Records:** • Scientific Reports/Products

2.0 SECTION TWO – PROCESS FLOWCHART



3.0 SECTION THREE – SUPPLEMENTAL INFORMATION

3.1 Process Notes

2.01 Hydrometric Data Dissemination Process Q2-700-054 starts. All activities are conducted according to National Standard Operating Procedures (SOPs). Quality Assurance Program Audits determine compliance with National SOPs.

2.02a Data Control receives approved aggregate data products from step 2.09 of the Data Production process.

2.02b Data Control receives best available unit data from step 2.02b of the Data Production process and those are automatically disseminated on the web (step 2.10 of Data Dissemination).

2.03 Data Control performs completeness checks on aggregate data. Data failing completeness checks is returned to step 2.07 of the Data Production process for the Approver to direct adjustments.

2.04 Data Control submits complete aggregate data products to the central databases administered by CSB. This process is conducted according to National SOPs.

2.05 CSB receives aggregate data and runs automated integrity checks, outlined in National SOPs.

2.06 Data failing checks are returned to Data Control to assess the reason for failure. Data passing integrity checks are provided for dissemination on the web.

2.07 Data Control assesses the cause of failure.

2.07a If the failure is related to upload, Data Control corrects the failure.

2.07b If the failure is not related to upload, Data control returns the data to step 2.07 in the Data Production process.

2.08 Requests for information are received by NIRT and Data Control.

2.09 Data Control may prepare products, e.g. create provisional aggregate data products, compile data, obtain models and determine instantaneous peaks and extremes.

2.10 CSB disseminates data on the web. Information to respond to requests from stakeholders and clients is disseminated either on the web, via email or over the phone by either NIRT or Data Control.

3.2 Definitions

Term	Definition
Administrator	The individual named by a party to a hydrometric agreement to represent the needs and interests of that party and to approve the activities undertaken under that agreement.
Aggregate data products	Computed from a set of unit data, these are daily, monthly or annual means.
Best available data	At any given time, any piece of data that is the best quality and confidence available. Changes or improvements to that data are applied as new information becomes available.
Client	A person, body or agency.
Data Control	Work unit responsible for transferring approved hydrometric data from an operating party into the national databases.
Databases	HYDAT: The archive of daily hydrometric data and associated statistics that have been approved as meeting national standards. HYDEX: The database containing metadata for the hydrometric stations listed in HYDAT. Production databases: Databases used by computational software to process and store data.
Hydrometric Data and Metadata	Data and metadata related to measurements and calculations of the level, velocity, discharge, volume and other physical parameters of surface waters and surface water bodies.
Network	A collection of hydrometric monitoring sites that provide spatial and temporal information in accordance with specified parameters.
NIRT	The National Inquiry Response Team receives client inquires at Environment Canada. NIRT may respond to information requests, or pass them on to Data Control.
Stakeholder	Stakeholders are individuals or organizations (including clients) who are the direct recipients of product or service, or may have an interest in the work and policies (e.g., hydrometric agreement administrators, clients, data users, recreational users, etc.).
Quality Assurance Program Audits	During the Quality Assurance Program Audits, Water Survey of Canada experts review field installations and office work of Operational Staff and Supervisors. Offices are audited on a regular basis according to a schedule. Audit results are an input to core processes, providing feedback to staff, ensuring compliance to with Standard Operating Procedures, and identifying opportunities for improvement.
Unit data	Data that are the direct result of observations, estimation or modelling at the frequency of recording; not aggregated (e.g. averaged).

4.0 SECTION FOUR – DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Description of Changes
1Dv01	Oct 15, 2004	NHP QMS	QMS documents developed under NHP QMS. Documents were used to develop MSC-WSC ISO
1DV02	March, 2007	First Draft	Reformatted and edited to fit MSC-WSC ISO project requirements
1DV03	Jun 04, 2008	Pending review by WSC Core Team	Reformatted and edited to fit MSC-WSC ISO project requirements
1Dv04	Jun 12, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
1A	Jun 18, 2008	Approved	Draft 1Dv04 approved to 1A
2Dv01	Jul 10, 2008	Pending review by WSC Core Team	Refining document using input from internal audit, staff training and others
2Dv02	Aug 07, 2008	Pending review by WSC Core Team	Refining document
2Dv03	Aug 19, 2008	Issued for review & approval	Reviewed by OMC-H, approved by OP Lead
2A	Aug 28, 2008	Approved	Draft 2Dv03 approved to 2A
3A	Jun 7, 2010	Approved	References to OP and OPSC altered.
4D	May 3, 2013	Issued for review and approval	
4A	May 8, 2013	Approved	
5D	Dec 8, 2014	Issued for review and approval	Updated entire process, including definitions
5A	March 9, 2015	Approved	

Appendix C: Canada's NMHS – QMS Manual: Common Support Processes

Appendix C1: Control of Documents

Titre du document / Document Title **Control of documents**		*Titulaire du document / : Document Owner:* **Manager, Quality Management Office**	
Niveau de document / Document Level: **Process description**	*N° de référence / Reference No.:* **Q2-423-01**	*Révision :* **8A**	*Page :* **1 of 5**

1.0 SECTION ONE - INTRODUCTION

1.1 Purpose

The purpose of this process is to identify, develop, implement, maintain and control the documentation that defines and supports the quality management system in an efficient and effective manner. All applicable documents shall be identified and controlled in such a manner to ensure current versions are available to the functions or personnel to which they apply.

1.2 Scope

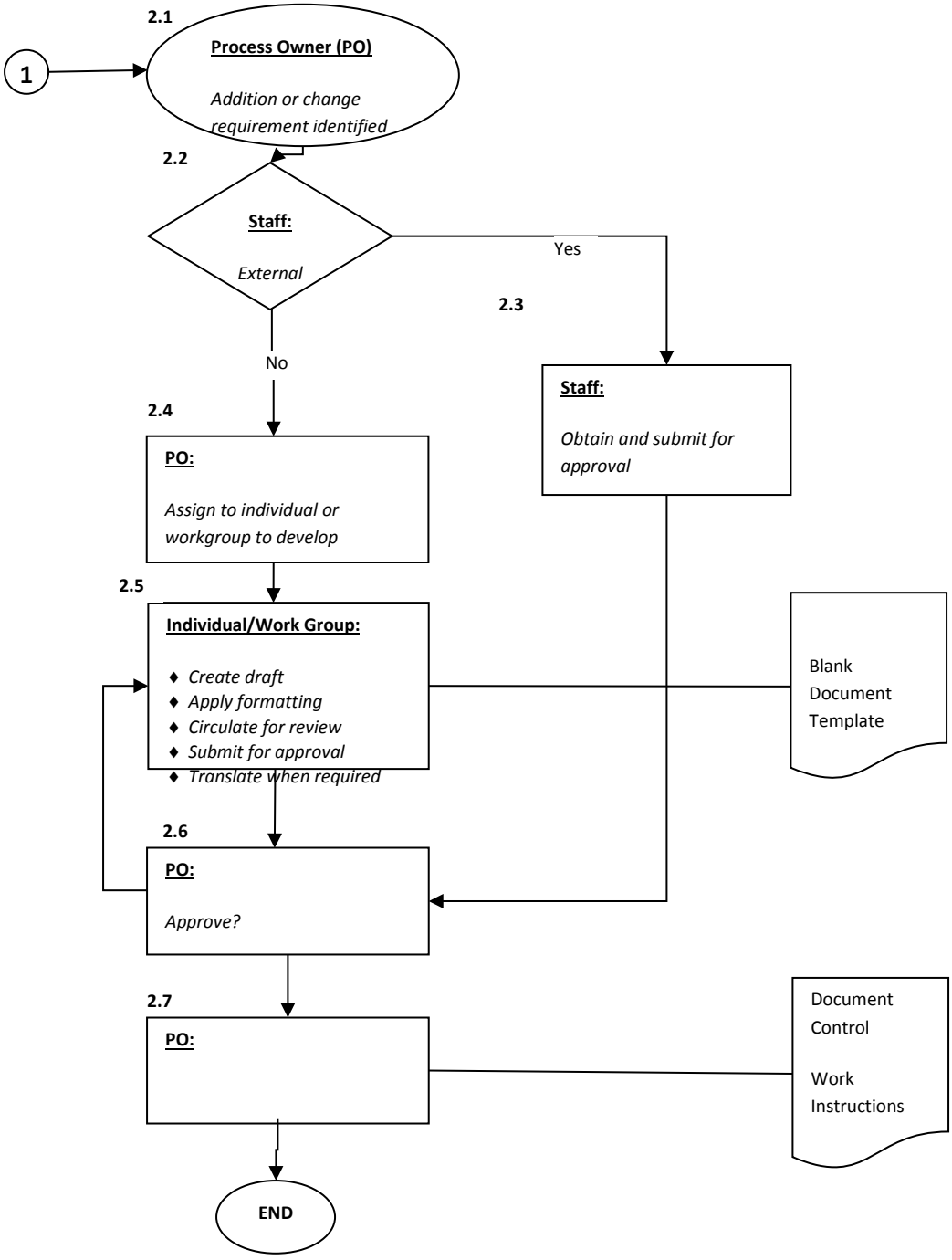
This procedure applies to all internal and external documentation that are determined to support the business of MSC-WSC.

1.3 Information 'Turtle'

Inputs: ♦ Internal documents ♦ External documents	**Outputs:** ♦ Correct versions of controlled documents available at required points of use
Process Requirements: ♦ Internal document repository. ♦ User training ♦ Information management training	**Process Metrics:** ♦ Audit findings pertaining to, or with a root cause associated with, improperly controlled documents or managed.
Human Resources: ♦ QMO Manager (or delegate) ♦ All process owners ♦ IT and IM support staff	**Materials & Equipment:** ♦ Intranet ♦ Computers ♦ Printers

2.0 SECTION TWO – PROCESS FLOWCHARTS

Document development process



PROCEDURAL NOTES

2.1 Process is initiated with the identified need for document support for the business. This may be for a new document or a change to current documentation.

2.2 Is the required documentation to be provided by an external source or is it to be developed internally?

2.3 Staff member is to obtain relevant version of the document and submit to PO (Process Owner) for approval for use.

2.4 PO tasks individual or workgroup to develop the required scope of documentation.

2.5 For guidance on document format and revisions, refer to the referenced work instruction document (Q3-423-01), as well as to document template QF-423-05, for detailed instructions. Translate when required.

2.6 PO to decide whether to approve document or not.

2.7 Document Control functions will be exercised as per Q3-423-01. The Document Control List (when control is not automated) is modified accordingly. The PO is responsible for ensuring that staff requiring access to documents has access to the latest revision and are notified of changes. This includes notification of documents deleted from the QMS system.

3.0 SECTION THREE – SUPPLEMENTAL INFORMATION

3.1 Procedural Responsibility

Staff - any EC employee

Process Owner (PO) - A term indicating that there is an individual that has overall accountability for the process. That individual's name shall appear in the header as "Document Owner". Elsewhere in the process, he/she will be referred to generically as "Process Owner" (PO). It is incumbent on personnel involved in coordinating and/or developing QMS documentation to confirm the name of the process owner.

Work Group - EC employee(s) tasked with a specific document generation

Doc. Control - EC employee responsible for document control in a given QMS Process

Controlled - A term applicable to any document necessary to follow processes covered by this QMS. This means that the content of the document may only be adjusted by an authorized authority and that only currently approved versions of documents are available to users of these documents.

NOTE: In the above instance the word "document" is used to refer to an input document such as a procedure, instruction or preformatted form. (Note: once a preformatted form is completed it is now a "record" for the purpose of this definition. Records are managed via the "Records Control" procedure—Q2-424-01).

3.2 Definitions

Q1 Level 1 QMS Document – a top-level quality policy document which describes WES (including Water Survey of Canada) quality commitments, in light of ISO 9001 and Treasury Board requirements. Reference: Documents Control Work Instruction, Q3-423-01

Q2 Overarching: Level 2 QMS Document - a process description which provides a macro description of major processes and their interrelationship. Reference: Documents Control Work Instruction, Q3-423-01.

Q2 "Underlying": Level 2 QMS Document - a more detailed process description which defines the resources to manage and the required steps of a process identified within the quality management system. Reference: Documents Control Work Instruction, Q3-423-01.

Level 3 QMS Document - a work instruction level document describing a specific activity. Reference: Documents Control Work Instruction, Q3-423-01.

Level 4 QMS Document - these are records providing evidence or results of an activity or event (example – a filled-in Form). Reference: Documents Control Work Instruction, Q3-423-01.

Internal Documents - Internal documents are created and maintained internally.

External Documents - External documents are not generated internally, but influence the work of WES/Water Survey programs by providing guidance, direction, or otherwise regulating activities.

4.0 SECTION FOUR - DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Initials	Description of Changes
1A	2006-12-15	Approved	AM	Draft changed to Approved 1A
2A	2007-05-16	Approved	JSC	Revisions following audit/PO meeting (French translation, document review)
3Dv01	2010-01-03	Draft	MG	Add notes designed to guide QMO office in updating document to incorporate the concept of ECollab.
3Dv02	2010-03-01	Draft	MG	Added some baseline line rules for terminology and file naming conventions and general rules regarding updating of documents—resulting from February 22-23 2010 meeting. Also cleaned up my previous guidance notes
3A	2010-03-22	Approved	EM	Draft changed to Approved 3A
4A	2010-12-03	Approved	PT	New QMO Manager. No other change.
5D	2011-02-10	Draft	DL/PT	Document revised to ensure that it reflects all WES/WSC documentation procedures rather than just ECollab; clarification of notes and other matters concerning archiving or documents.
5A	2012-06-20	Approved	PT	Approval of version 5Dv3 (minor changes from one sub-version to the next).
6Dv01	2013-01-11	Draft	LCD	Document revised to ensure that it reflects all WES/WSC documentation procedures; clarification of notes and other matters concerning document; reduced the flowchart from 3 pages to 1 page; removed a big part that didn't reflect the recent updates of QMS.
6Dv02	2013-01-18	Draft	LCD	Changed the format of the flowchart.
6A	2013-01-31	Approved	AB	Approval
7Dv01	2014-01-20	Draft	EH	Corrected links to Intranet and ECollab, corrected the titles of documents in section 1.3 to match those in ECollab, reformatted the process flowchart.
7A	2014-01-21	Approved	AB	Approval
8A	2015-04-20	Approved	AB	Reviewed and maintain status quo, process subject to change due to release of ISO 9001:2015 standard. Proposal to potentially merge with *Q2-424-01 Control of Records* common process.

Approval Authority: **Manager, QMO**	*Approved by:*	*Date:* **2015-04-20**

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C2: Control of Records

Document Title: **Control of Records**		*Process Owner:* **Manager, Quality Management Office**	
Document Level: **Process Description**	*Reference No.:* **Q2-424-01**	*Revision:* **8A**	*Page:* **1 of 5**

1.0 SECTION ONE - INTRODUCTION

1.1 Purpose

The purpose of this process is to ensure that records which have been identified as evidence supporting the QMS are identified and controlled. This process shall define record identification, storage, protection, retrieval, retention and disposal in order to provide records that remain legible, readily identifiable and retrievable.

1.2 Scope

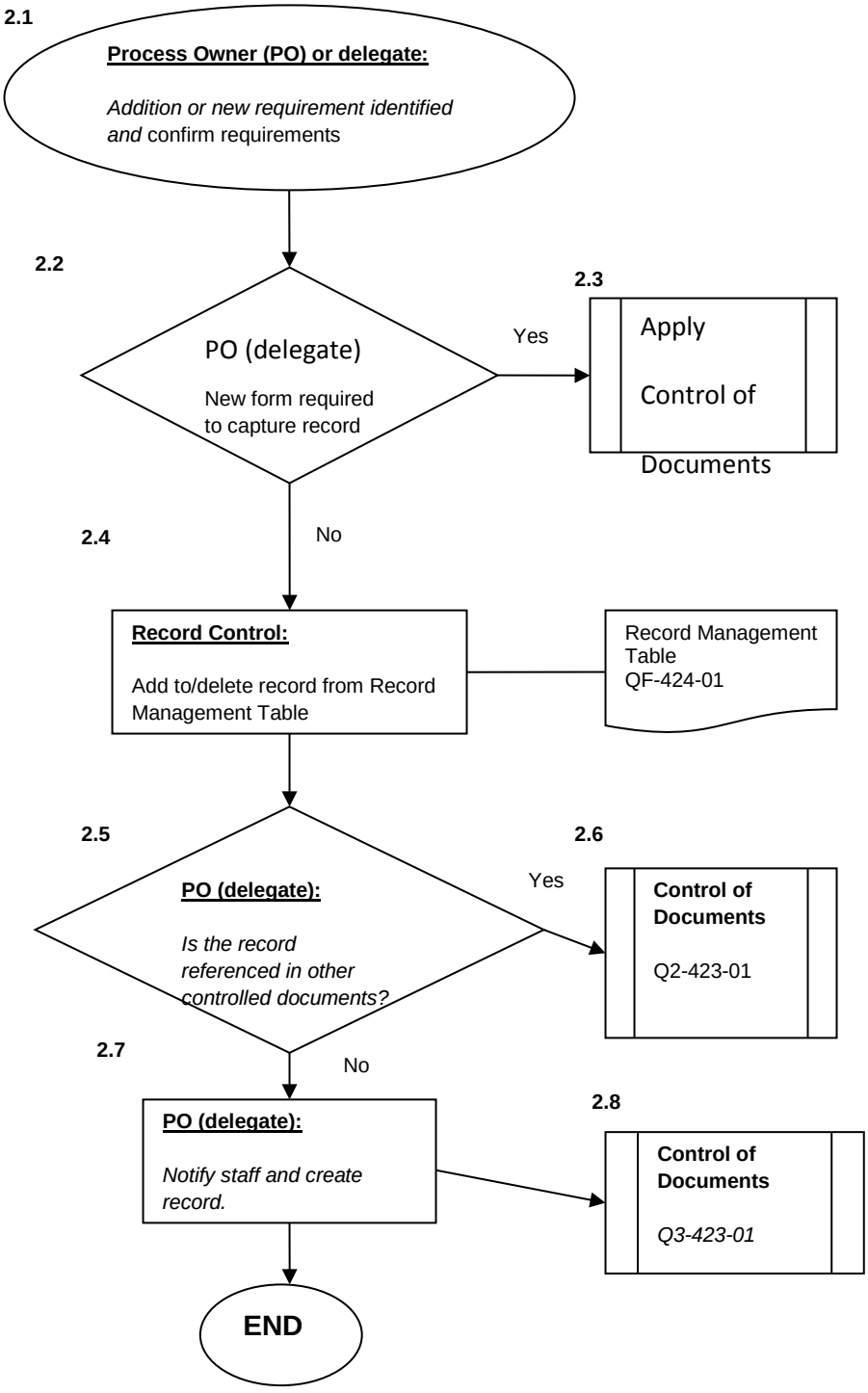
This procedure applies to all records that have been identified as evidence supporting the QMS.

1.3 Information 'turtle'

Inputs: ♦ Identified QMS records ♦ Changes to requirements for records	**Outputs:** ♦ Controlled records (secure, retrievable—electronic or hard copy)
Process Requirements: ♦ IT Infrastructure-ECollab	**Process Metrics:** ♦ Each process owner or delegate reviews his/her Record Management Table (QF-424-01) annually. ♦ Audit findings pertaining to uncontrolled or non-retrievable, records. (Target is 0 such findings.)
Human Resources: ♦ Process owners (PO)	**Materials & Equipment:** ♦ Computers ♦ Physical storage location (if applicable) ♦ Archives
Linked Processes / Documents: ♦ Q1-400-01, section 4.2.4 ♦ Q2-423-01, Control of Documents ♦ QF-424-01, Record Management Table Form Template ♦ All overarching and underlying processes ♦ Q3-423-01, Document Format and Revisions ♦ QF-423-05, Q2 Documentation Form Template ♦ QF-423-06, Q3 Documentation Form Template	**Associated Records:** ♦ Record Management Table ♦ Review decision record ♦ Records in ECollab; and

2.0 SECTION TWO – PROCESS FLOWCHART

Record Development Process



Procedural Notes

2.1 Process is initiated with the identified need for record support for the QMS. This may be for a new record or changes to an existing record. Process Owner (PO) or delegate confirms that record contains appropriate information and its association with the target process and is also responsible for determining the appropriate protection, retention time, back-up and retrieval requirements of any appropriate controlled record.

2.2 If a new form is required to enter the record then the Control of Document process should be initiated to create and control the form.

2.3 New Form Template will be developed following the Control of Documents process (Q2-423-01).

2.4 Record control staff will collect and record the required information for a new record on the process' Record Management Table (QF-424-01). Each process is responsible for its own Master List of Records.

2.5 PO or delegate verifies whether the record is referenced in other controlled documents. Process owner or designate revises the appropriate levels of documentation (i.e. process description, relevant work instruction) to reference the information collection, recording and reporting activities associated with record.

2.6. PO or delegate is responsible to ensure that staff requiring access to records has access to the latest revision and are notified of all record control procedures. This includes notification of records deleted from the Record Management Table. A new record is created. PO or delegate will ensure that a systematic review is performed at a frequency appropriate to the record in question. The review will assess the continuing requirement for the record and determine if changes are required to the form, recording procedures, or the retention time.

2.7. If the PO or delegate decides to delete a record, the Record Management Table (QF-424-01) shall be revised.

Remark: Environment does not yet have authorization from Library and Archives Canada (LAC) to delete documents and records that pertain to activities that are specific to the department. This means that a record that is no longer useful (whose retention period has expired) must be archived until the department obtains from LAC the authorization to dispose of the record.

2.8 If the PO or delegate identifies a requirement for a new record or changes to an existing record, the Document Development Process is initiated. A record of decisions for the record review process shall be created. Ensure that all related links or references to the record have been updated in all related procedures or instructions. Retention and archival of electronic records are managed through ECollab. All information must be stored in accordance with information management guidelines and policies. A record of decisions for the record review process shall be created. Reference: Q3-423-01, Document Format and Revisions.

3.0 SECTION THREE - SUPPLEMENTAL INFORMATION

3.1 Procedural Responsibility

Staff - any EC employee

PROCESS OWNER (PO) - Individual responsible for the process or designate

Record Control - employee responsible for the QMS document control for a given process

3.2 Definitions

Quality Management System (QMS) Record – document stating results achieved or providing evidence of activities performed

4.0 SECTION FOUR - DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Initials	Description of Changes
1A	2006-12-15	Approved	AM	Draft changed to Approved 1A
2Dv01	2007-05-17	Draft	EB/AM	Revisions following audit/PO meeting (French translation, document review)
2A	2007-05-23	Approved	JSC	Draft changed to Approved 2A
3Dv01	2010, 01,03	Draft	MG	Added some suggested changes to guide Irina for changes required to reflect ECollab.
3A	2010-03-22	Approved	EM	Draft changed to approved 3A
4A	2011-03-22	Approved	PT	Process owner changed. No other change.
5A	2012-06-21	Approved	PT	Added a remark to Procedural Note 2.11 regarding authorization to dispose, plus a few minor corrections
6Dv01	2013-01-23	Draft	LCD	Added the document Q3-423-01, QF-423-05, QF-423-06 to this process. Document revised to ensure that it reflects all MSC/WSC documentation procedures; clarification of notes and other matters concerning documents; reduced the flowchart from 2 pages to 1 page; removed a big part that didn't reflect the recent updates of QMS.
6Dv02	2013-01-25	DRAFT	LCD	Minor changes in the section "Information Turtle". Organized the Procedural Notes.
6A	2013-01-31	Approved	AB	Approval
7Dv01	2014-01-27	Draft	EH	Updates to ECollab links and changes to connectors in flowchart.
7A	2014-01-27	Approved	AB	Approval
8A	2015-04-20	Approved	AB	Reviewed and maintain status quo, process subject to change due to release of ISO 9001:2015 standard. Proposal to potentially merge with Q2-423-01 Control of Documents common process.

Approval Authority: **Manager, QMO**	*Approved by:*	*Date:* **2015-04-20**

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C3: Control of Monitoring and Measuring Devices

Document Title: **Control of Monitoring and Measuring Devices**		*Document Owner:* **Manager, Quality Management Office**	
Document Level: **Process Description**	*Reference No.:* **Q2-760-01**	*Revision:* **6A**	*Page:* **1 of 6**

1.0 SECTION ONE – INTRODUCTION

1.1 Purpose

This procedure is to establish a common frame of reference on which Network and Life Cycle Managers can base detailed control instructions to manage monitoring and test equipment.

1.2 Scope

This procedure applies to all monitoring and measurement devices that are used to provide evidence of products or services conforming to determined requirements. Management considerations for these devices include:

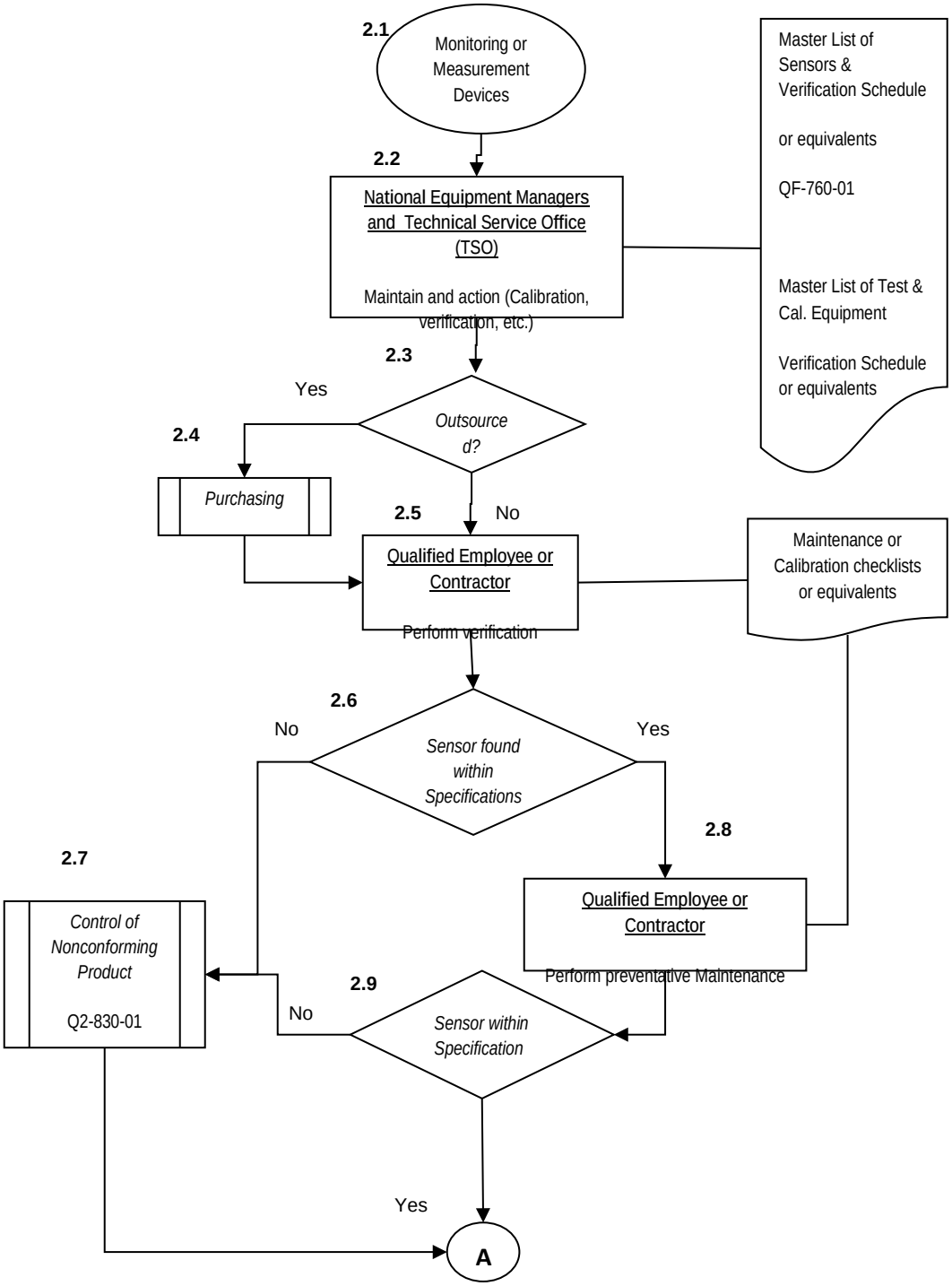
- Assuring equipment is protected during handling maintenance and storage;
- Identification of calibration status;
- Safe guarding to preclude unauthorized adjustments;
- Scheduling to assure than, when necessary for valid results, equipment is calibrated or verified at specified intervals against measurement standards traceable to international or national standards, or if no standard exists, the basis for the calibration / verification is documented;
- Activities are identified, planned, conducted and recorded;
- Responsibilities and qualifications for persons performing activities is determined.

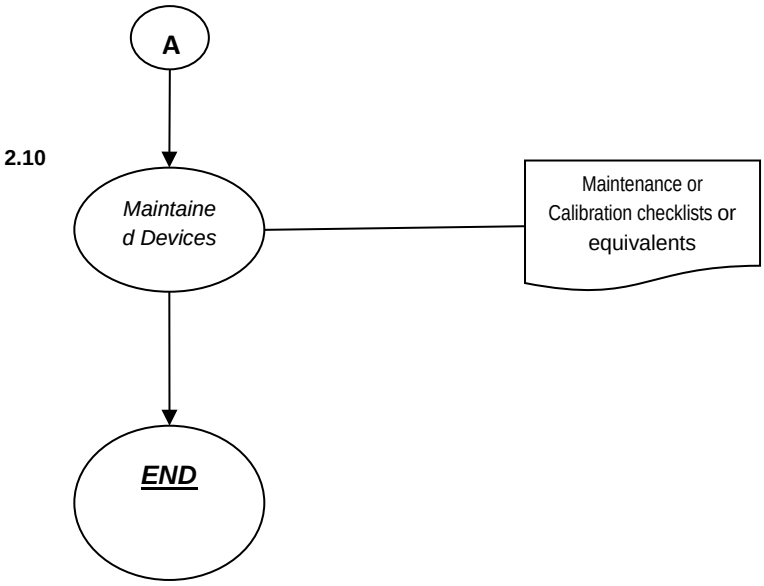
1.3 Information 'Turtle'

Inputs: ♦ Critical process equipment ♦ Critical monitoring devices	**Outputs:** ♦ Maintained equipment ♦ Calibrated monitoring devices
Process Requirements: ♦ Will vary according to equipment of process	**Process Metrics:** ♦ Percentage of calibrated equipment according to process schedule
Human Resources: ♦ Qualified Employees	**Equipment:** ♦ Calibration instruments
Linked Processes / Documents: ♦ Q1-600-01, section 6.3	**Associated Records:** ♦ Master Schedules

♦ Q2-740-01, Purchasing/Contracting ♦ Q2-830-01, Management of Non-conforming process, product and service ♦ QF-760-01, Monitoring & Measurement Device Master Schedule Form or equivalents ♦ QF-760-02, Calibration & Verification Record Form or equivalents ♦ Referenced Work Instructions	♦ Device Calibration Records

2.0 SECTION TWO - PROCESS FLOWCHART





PROCEDURE NOTES

2.1 Monitoring and measuring devices are categorized into two groups, one is the sensors that monitor environmental parameters and the other is the Test & Calibration Equipment that are used to check the sensors.

2.2 Devices are added to the Test & Calibration Equipment Master List and Verification Schedule or equivalents. All applicable fields are completed for each device, including a unique identification or reference number, any traceable standard, reference to work instructions (or approved supplier) and specified frequency of activity. The equipment manager reviews the Master Schedule to determine which devices are due for calibration or verification activities.

2.3 If the activity is to be outsourced the purchasing process will be followed to ensure a qualified, approved supplier is used.

2.4 *Purchasing-Contracting Process* Q2-740-01.

2.5 Calibration and verification tasks that are performed internally will be conducted only by qualified contractors or personnel in accordance with instructions.

2.6 If maintenance personnel find that equipment does not meet specified performance standards, *Management of Nonconforming process, product and service* (Q2-830-01) must be followed.

2.7 Management of Nonconforming process, product and service. Device is not released until the nonconformity is dealt with including the requisite preventative maintenance actions.

2.8 Equipment is maintained according to the preventative maintenance schedule.

2.9 If equipment does not meet specified performance standards after verification of performance, *Management of Nonconforming process, product and service* must be followed.

2.10 Equipment managers are responsible to ensure the Equipment Records and Master Schedules are updated following completed activities. When the controlled devices are found to be in compliance with their standards and specifications, they are considered in a controlled state.

3.0 SECTION THREE - SUPPLEMENTAL INFORMATION

3.1 Procedural Responsibilities

National Equipment Manager - any employee who is responsible for a piece of equipment that has been identified as QMS critical process, monitoring or verification equipment for a network at a national level. (e.g., Life Cycle Managers)

Qualified Employee - any employee that has been trained or otherwise approved to perform specific maintenance or calibration activities.

Technical Service Office (TSO) Manager - any employee who is responsible for a piece of equipment that has been identified as QMS critical process, monitoring or verification equipment for a network at a regional level.

3.2 Definitions

Equivalent(s) - contains the same information as required on the referenced forms

TSO – Technical Service Office (or equivalent)

4.0 SECTION FOUR - DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Initials	Description of Changes
1A	2006-12-15	Approved	EAB	Draft changed to Approved 1A
2Dv01	2009-11-25	Draft	MG	Adjust purpose and ad “Life Cycle Manager” to 3.1
2A	2010-03-31	Approved	EM	Draft changed to Approved 2A
3A	2011-04-08	Approved	PT	Process owner changed. No other change.
4Dv01	2013-01-25	Draft	LCD	Added information in Process Requirements, Process Metrics and updated the information about the Human Resources. Updated the name of the document Q2-830-01. Added ``or equivalents`` the documents QF-760-01 and QF-760-02. Reduced the flowchart and updated the Procedure Notes.
4Dv02	2013-02-04	Draft	LCD	Reduced the flowchart and updated the Procedure Notes. Minor changes.
4A	2013-02-06	Approved	AB	Approval
5Dv01	2014-01-30	Draft	EH	Corrected the title of linked processes/documents, changed some links in the Flow Chart, corrected link to ECollab.
5A	2014-01-30	Approved	AB	Approval
6A	2015-04-20	Approved	AB	Reviewed and maintain status quo, process subject to change due to release of ISO 9001:2015 standard. Proposal to potentially merge with Q2-630-01 Infrastructure Maintenance common process.

C4: Management of Nonconforming Process, Product and Service

Document Title: **Management of non-conforming process, product and service**		*Document Owner:* **Manager, Quality Management Office**	
Document Level: **Process description**	*Reference No.:* **Q2-830-01**	*Revision:* **10A**	*Page:* **1 of 5**

1.0 Purpose

The purpose of this document is to guide and direct the management of non-conforming process and product within the MSC-WSC quality management system. This relates to the following clauses of the ISO 9001:2008 Standard and the MSC-WSC QMS.

8.2.3 – monitoring and measurement of process
8.2.4 – monitoring and measurement of product
8.3 – control of nonconforming product

This document also provides guidance on the relationship of these three requirements to clauses 8.5.2 and 8.5.3 regarding corrective and preventive actions.

Note that the term “product” also includes outputs that are generally referred as services in the day-to-day terminology of the MSC-WSC community.

2.0 BACKGROUND

The ISO 9001 standard requires the monitoring and measurement of both process and product.

The Standard requires that the organization:

a) Monitor and measure product characteristics at different stages of product realization to verify that requirements have been met.

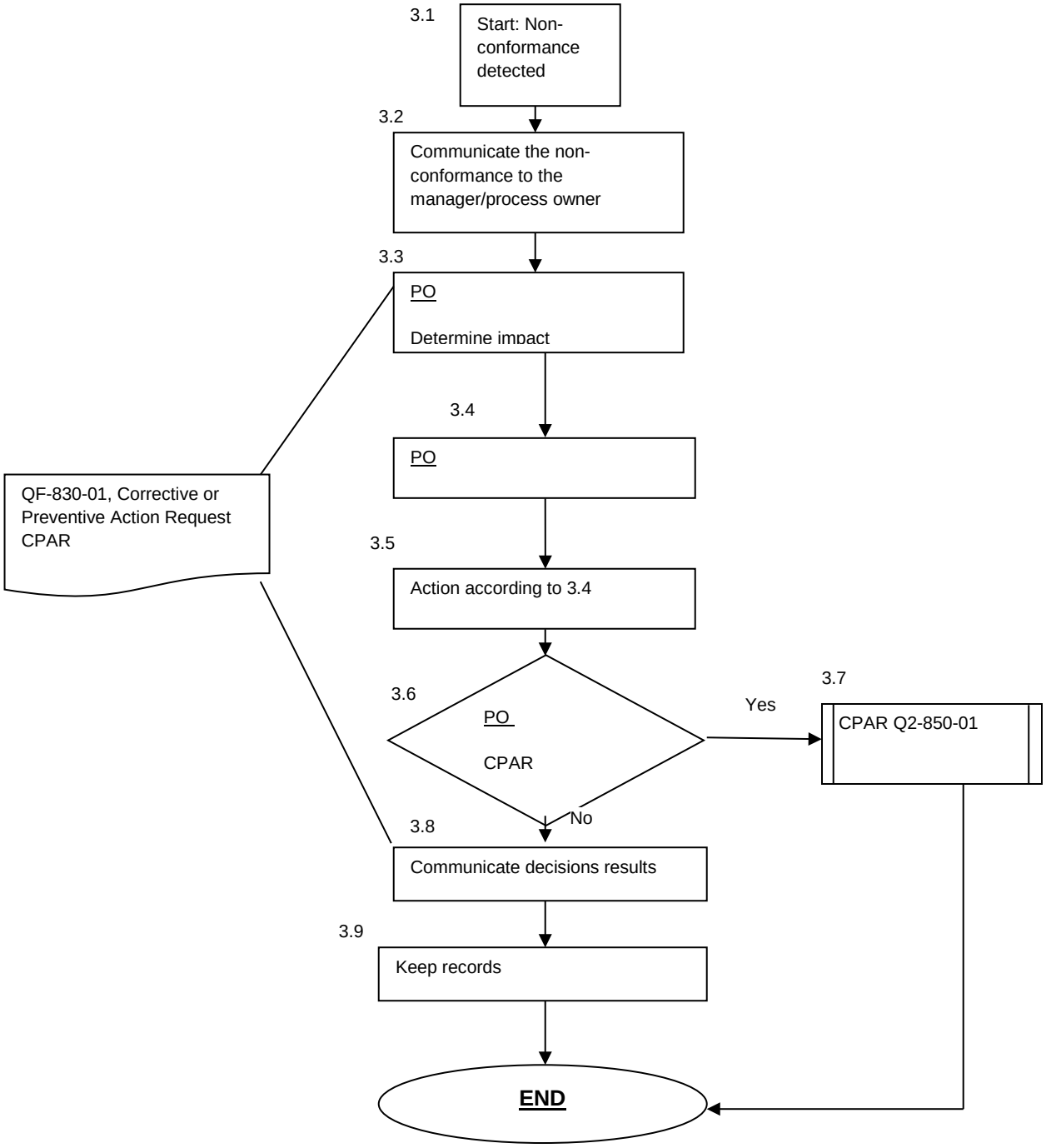
b) Maintain evidence that acceptance criteria have been met.

c) Deliver the product only after planned arrangements have been completed.

d) Control product that does not meet requirements and keep records.

See Section 4 for the definition of non-conformance.

3.0 QMS REQUIREMENTS FOR NON-CONFORMANCE TRACKING – Process Flowchart



Procedure notes:

Each MSC-WSC process must take the following steps to ensure that it meets the requirements of the MSC-WSC quality management system and by extension, complies with the ISO 9001 standard:

3.1 Non-conformance (NC) detected and logged.
3.2 Communicate the non-conformance to the manager/process owner
3.3 The PO has to determine the impact of the nonconformance, and the importance of it.
3.4 The PO has to determine the course of actions between 7 choices and document justification:
1-Do nothing
2-Accept the non-conformance and release
3-Correct the non-conformance
4-Monitor the non-conformance
5-Inform the appropriate process owner
6-Escalate to CPAR
7-Initiate an opportunity for improvement
3.5 Implement the decision taken in 3.4.
3.6. The PO has to determine if CPAR is required.
3.7 If yes, the PO has to follows the corrective and preventive actions request process. See Q2-850-01.
3.8 The PO communicates decisions results including to the NC originator.
3.9 The PO has to keep records of decisions.

4.0 SUPPLEMENTAL INFORMATION

Non-conformance definition: A non-conformity occurs when we don't fulfill a requirement. Product requirements are specified in many ways e.g. contracts, memoranda of agreement, service level agreements, government regulations, and internal service standards/charters. Nonconformities also occur when we have formally documented a process or procedure and then don't follow it e.g. process descriptions documented for major WES activities and standard operating procedures established to control those activities.

Most statements of requirements don't specify perfection - they allow tolerances that balance costs with needs. For example, automatic weather stations can't operate without failure 100% of the time and it isn't feasible to instantly bring them into service when they do fail. Performance agreements with customers set tolerances that recognize those realities. WES is in non-compliance when it exceeds those tolerances and this in turn constitutes a nonconforming product. This statement, however, does not preclude the need to identify and manage individual non-conformances.

Important points to consider when a non-conformance occurs:

a) Identify the outputs that the process produces.
b) Identify the activities that the process follows to produce those outputs.
c) Determine what constitutes a non-conformity with respect to outputs and processes i.e. what criteria apply when deciding whether the output or process meets specified requirements?
d) Assess how information about non-conformities is currently managed; determine if the nonconformities are consistently identified and if so, whether there is related information concerning actions taken in response; determine whether the information is retrievable in a form that provides evidence of records of non-conformities and that enables further analysis.
e) Assess how nonconformities are prioritized for action. Determine if procedures are required to ensure that high-priority issues receive appropriate levels of staff and management attention.
f) Identify the gap between the information needed and the information currently available using existing practices.
g) Develop a solution to minimize the gap.

These steps represent an idealized solution and managers need to recognize pragmatic concerns when implementing them:

a) Solutions need to make business sense. It may not be reasonable or cost-effective to track all products and processes – the choice is a matter of managerial discretion. Managers should, however, be prepared to explain their decisions in the context of a business case and risk analysis.
b) Many WES activities use operational processes to monitor their products. These are typically software-based processes and include logs and problem tickets. The resulting databases often include entries that are true nonconformities but these entries are often mixed in with ones related to scheduling, task management, etc. It may be more feasible to retain legacy practices – perhaps with some enhancement – than to redesign the process to optimize nonconformity tracking. The Non-conformity Report Form (QF-830-02) or equivalent is often a useful tool for supplementing legacy practices to meet the full requirements of the MSC-WSC QMS.

To meet the minimum expectations of the QMS, the tracking mechanism must:

a) Address the major product offerings and operating processes.
b) Facilitate prioritization of critical issues.
c) Facilitate data analysis to identify trends.
d) Provide evidence of compliance to the WES QMS requirements.

5.0 SECTION RELATIONSHIP BETWEEN CPARs AND NON-CONFORMITIES

In most processes, individual nonconformities are a fact of life and the operational systems deal with them on a routine basis. Some non-conformities, however, have the potential to significantly impact on the production process and on users. In other cases, frequent and related non-conformities – while not individually serious – may indicate a more serious underlying problem.

It may be possible to deal with even serious non-conformities at the working and supervisory levels. In other cases, senior managers may need to become involved but the solution lies within the authority and resources available to those managers. In such cases, procedures established to manage nonconforming product and process are often sufficient to address problem resolution.

The Corrective and Preventive Action Request (CPAR) process (QF-850-01) comes into effect when these procedures do not bring the required results. Examples include cases where:

- A manager may not have enough authority or resources to take action and therefore requires support from peers and/or superiors.
- A manager receives from an internal supplier services that do not comply with standards or requirements.
- A manager is responsible for monitoring process or product but does not have the necessary authority to take actions required to resolve the problems detected through that process.

The CPAR process functions at two levels. The first is through the Non-conformity Report (NCR) (QF-830-02) or equivalent whereby the existence and nature of a problem are communicated to an appropriate person in the organization. When the NCR does not adequately resolve the issue, the full CPAR process comes into effect. This two-level process helps to avoid unnecessary administrative overhead and provides a document trail that is useful in communicating and understanding the issues.

In summary, non-conformance management and the CPAR process are not separate or parallel. The former includes the processes of identifying non-conformities to requirements, applying remedial actions, and analyzing the data for trends and systematic problems. The CPAR process follows sequentially in those cases where more senior levels of management need to be brought into play.

6.0 DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Initials	Description of Changes
1A	2006-12-15	Approved	EM	Draft changed to Approved 1A
2Dv01	2007-08-08	Draft	EM	Amendment in response to registration audit and CPAR 98
2A	2007-09-04	Approved	JSC	Amendment in response to registration audit and CPAR 98
3A	2008-06-25	Approved	JV	Process revised in response to CPAR 98. Process now allows for the use of equivalents to forms used to record and track non-conformances, including electronic forms.
4A	2009-08-30	Approved	DL	Revised to resolve CPAR 214
5A	2009-09-28	Approved	EM	Service added to title. NC report reference number corrected and tied to NC process. New reference number QF-830-02
6A	2010-11-22	Approved	PT	Change in document owner(no other change)
7A	2012-06-21	Approved	PT	Minor corrections
8Dv01	2013-04-19	Draft	LCD	Document revised to ensure that it reflects all MSC/WSC documentation procedures; clarification of notes and other matters concerning documents; added the flowchart; removed a big part that didn't reflect the recent updates of QMS. Added the procedure notes.
8Dv02	2013-04-22	Draft	LCD	Clarification of notes and other matters concerning documents; updated the flowchart and the procedure notes. Added Section 5.
8Dv03	2013-04-25	Draft	LCD	Clarification of notes and other matters concerning documents; updated the flowchart and the procedure notes. Minor changes.
8A	2013-04-25	Approved	AB	Approved.
9Dv01	2014-04-03	Draft	EH	Changed link to latest version
9A	2014-04-03	Approved	AB	Approved
10A	2015-04-20	Approved	AB	Reviewed and maintain status quo, process subject to change due to release of ISO 9001:2015 Standard. Proposal to potentially merge with Q2-850-01 Corrective and Preventive Actions common process.

Approval Authority:	*Approved by:*	*Date:*
Manager, QMO		**2015-04-20**

Read Only Copy – See intranet for latest revision

C5: Corrective and Preventative Actions

Document Title: **Corrective and Preventive Actions**		*Document Owner:* **Manager, Quality Management Office**	
Document Level: **Process Description**	*Reference No.:* **Q2-850-01**	*Revision:* **10A**	*Page:* **1 of 6**

1.0 INTRODUCTION

1.1 Purpose

The purpose of this procedure is to ensure that:

- There is an investigation and determination of the root cause of:
  - Individual non-conformances that have serious or potentially serious consequences
  - Non-conformances identified through audit findings
  - Operational performance that is below target or expectations
- Opportunities for improvement to the quality management system are identified, analyzed and implemented as appropriate.
- Actions are implemented to correct problems and prevent recurrence
- Actions are monitored and verified for effectiveness

1.2 Scope

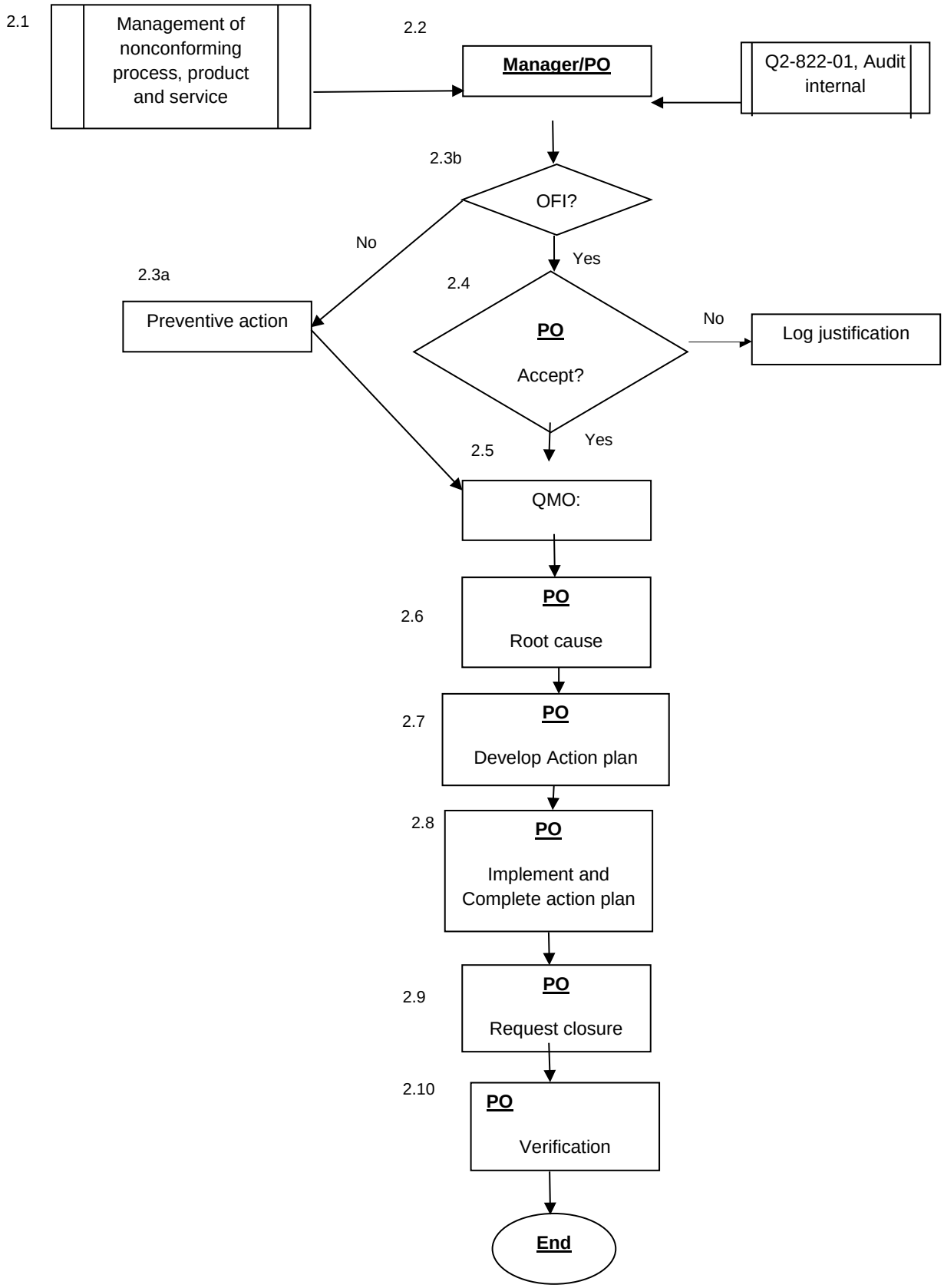
This procedure applies to all products, processes and services that may affect the quality of MSC-WSC products.

1.3 Information 'Turtle'

Inputs:	**Outputs:**
♦ Evidence of Nonconforming products or services (form QF-830-02 or equivalents) ♦ Audit Reports ♦ Performance data/reports ♦ Opportunity for improvement ♦ Results of reviews (Q2 – management) ♦	♦ Applied correction ♦ System improvement
Process Requirements: ♦ Identify and determine root cause ♦ Identify opportunities for improvement ♦ Correct problem and prevent reoccurrence ♦ Monitor actions for effectiveness	**Process Metrics:** ♦ Planned actions completed on schedule ♦ Volume of repeat problems ♦ Discernable operational improvements as indicated by individual process metrics ♦ Time to closure; follow up on actions.
Human Resources: ♦ Employee	**Equipment:** ♦ QMS ECollab

♦ Quality Management Office (QMO) manager and staff ♦ Process owners	
Linked Processes / Documents: ♦ Q1-800-01, Measurement, Analysis and Improvement ♦ Q1-500-01, Management Responsibility ♦ Q2-423-01, Control of Documents ♦ Q2-424-01, Control of Records ♦ Q2-830-01, Management of nonconforming process, product and service ♦ Q2-822-01, Internal QMS Audits ♦ QF-850-01, Corrective or Preventive Action Request (CPAR) form ♦ QF-830-02 – Non-conformity Report form ♦ QF-500-01 Standing Agenda Management Review (over-arching process meetings) with action register ♦ QF-500-02 Standing Agenda Management Review (Program Committee meetings) with action register	**Associated Records:** ♦ Filled Corrective or Preventive Action Request (CPAR) forms ♦ CPAR Log (ECollab) ♦ Nonconformity Report forms

2.0 PROCESS FLOWCHART



PROCEDURE NOTES

2.1 After a non-conformance (NC) was detected, process Q2-822-01 (Internal audit) has been triggered.

2.2 A non-conformance is identified from the process Q2-830-01 or from an audit (Q2-822-01) as needing a CPAR. It is sent to the process owner and/or manager.

2.3 2.3a - Corrective action is taken after nonconformities are identified. Preventive action is taken when a potential or future nonconformity is identified as a result of the analysis of records and other relevant sources of information.

2.3b - Issues that do not represent non-conformances may represent opportunities for improvement (OFIs). OFIs generally have a supporting business case written to the level of detail appropriate to the opportunity identified.

2.4 The PO has to accept OFI or not.

2.5 The non-conformance is identified and is entered the CPAR system. The statement of NC must always begin with a brief description of the condition expected and then followed by the condition found. The QMO clearly reviews the criteria that has been contravened and confirms that the issue is in fact a nonconformance (versus an opportunity for improvement).

2.6 The PO or delegate conducts an analysis to find the root cause of the identified NC or OFI. The management of the root cause analysis, remedial action and review are all facilitated by ensuring a clear focus of attention to the issue at hand.

2.7 The PO or delegate develops an action plan to correct the immediate NC and eliminate the root cause. The manager responsible for addressing the issues identified in the CPAR shall discuss potential approaches and solutions with others who share related responsibilities. The responsible manager shall decide the best course of action based on the nature of the issue. After the responsible manager has approved the proposed actions, this information shall be recorded on Section 2 of the CPAR form and the form is sent to the QMO.

2.8 It is the responsibility of the PO to implement monitor and update the action plan and to communicate progress to the QMO. The QMO regularly monitors the progress of the CPAR to determine if the action plan(s) is/are falling behind the established timeline and alerts the responsible manager accordingly. Action plans that are progressing are reflected in the CPAR tracking mechanism as in progress.

2.9 After the responsible manager determines that actions have been completed satisfactorily, this information is recorded on Section 3 of the CPAR form and the form is sent to the QMO to request that the CPAR be closed.

2.10 The QMO (or delegated representative) verifies whether the completed actions have satisfactorily addressed the problem and its root cause. If the QMO determines that the actions were not sufficient, it shall co-ordinate with the affected managers to develop a more appropriate solution. If the QMO is satisfied that the issue has been resolved,

The CPAR is closed by completing the form Section 4 of the CPAR report shall be completed.

3.0 SUPPLEMENTAL INFORMATION

3.1 Definitions

Non-conformance (NCF): - A non-conformance is a product, service or process that does not comply with defined requirements.

Corrective Action: A corrective action eliminates or mitigates the cause of a detected nonconformity or other undesirable situation. Where appropriate, actions plans may address two stages:

1) Short term actions to correct or mitigate the immediate problem
2) Longer term actions that address the root cause.

Root cause: When deficiencies have been found, the managers should propose action to eliminate them but not before establishing the root cause which has caused the immediate cause that has been identified. Anyone can perform the analysis to find the cause of the problem.

Opportunity for Improvement (OFI): An opportunity for improvement seeks to improve the effectiveness of the management system and/or reduce the risk of a potential nonconformance.

Preventive Action Request (PAR): A preventive action seeks to eliminate the cause of a potential or future nonconformity or other undesirable potential situation.

Corrective or Preventive Action Request form (CPAR) : Form used for Corrective Action Requests, Opportunities for Improvement and Preventive Action Requests.

Management Review (MR): Various management reviews are held, including QMS Steering Committee, Director General over-arching process reviews, and program committee reviews. The purpose is to review the various elements of the QMS, as required by the ISO standard, and to report on the health of the system.

Action Register (AR): Issues can be recorded and tracked via a management review action register, rather than through the CPAR process.

Quality Management Office (QMO): The office responsible for overseeing the Quality Management System.

Director General (DG): Owner of over-arching process.

Process Owner (PO): in the context of this document, manager that ensures that corrective actions are determined, planned and implemented.

4.0 DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Initials	Description of Changes
1A	2006-12-15	Approved	EM	Draft changed to approved 1A
2A	2007-11-01	Approved	EM	Changes in response to CPAR 97
3A	2009-08-28	Approved	DL	Approved
4A	2009-09-28	Approved	EM	Minor revisions to reflect NC form QF-830-02
5Dv01	2010-01-11	Draft	EM	Emphasize timeliness (resulting from CPAR-RMCP230
5Dv02	2010-01-13	Draft	MG	Recognize Senior Management level approach to CAPA via management meetings. Also build escalation procedure and reflect correct CPAR responsibility in concert with "Option 2" from Jan 8, QMS Steering Committee output, item 4.
5Dv03	2010-03-01	Draft	MG	To add box to flow chart 2.6 indicating consultative process involved when raising an NC. Text at 2.6 description also edited in section 3. Process now matches instructions on QF-850-01.
5Dv04	2010-03-31	Draft	EM	Dv03 changes accepted; additional definitions and comments added.
5A	2010-04-08	Approved	EM	Draft changed to 5A
6A	2011-04-08	Approved	PT	Process owner changed, new manager of QMO. No other change.
7A	2011-06-24	Approved	PT	Correction to Linked Documents in the Turtle table: obsolete references to Q1-830-01 and Q1-850-01 replaced by Q1-500-01 and Q1-800-01. Updated references to CPAR log to reflect use of ECollab.
8Dv01	2013-04-19	Draft	LCD	Document revised to ensure that it reflects all WES/WSC documentation procedures; clarification of notes and other matters concerning documents: reduced and recreated the flowchart; removed a big part that didn't reflect the recent updates of QMS. Changes in the procedure notes.
8Dv02	2013-04-22	Draft	LCD	Clarification of notes and other matters concerning documents; reduced and recreated the flowchart. Updated the Procedures notes, removed a big part that didn't reflect the recent updates of QMS. Added the definition of a root cause.
8Dv03	2013-04-25	Draft	LCD	Clarification of notes and other matters concerning documents; updated the flowchart. Updated the Procedures notes, changed the definition of a root cause.
8A	2013-04-25	Approved	AB	Approved.
9Dv01	2014-04-03	Draft	EH	Correction of link to ECollab and formatting of flowchart
9A	2014-04-03	Approved	AB	Approval
10A	2015-04-20	Approved	AB	Reviewed and maintain status quo, process subject to change due to release of ISO 9001:2015 standard. Proposal to potentially merge with Q2-830-01 Management of nonconforming process, product and service common process

Approval Authority: **Manager, QMO**	*Approved by:*	*Date:* **2015-04-20**

C6: Infrastructure Maintenance

Document Title: **Infrastructure Maintenance**		*Document Owner:* **Manager, Quality Management Office**	
Document Level: **Process Description**	*Reference No.:* **Q2-630-01**	*Revision:* **6A**	*Page:* **93 of 4**

1.0 SECTION ONE – INTRODUCTION

1.1 Purpose

The purpose of this procedure is to ensure that:

- Infrastructure and equipment that is critical for the delivery of MSC-WSC products and services is identified and appropriate maintenance activities are defined.
- Specified activities are identified, planned, conducted and recorded
- Responsibilities and qualifications for persons performing these activities are determined

1.2 Scope

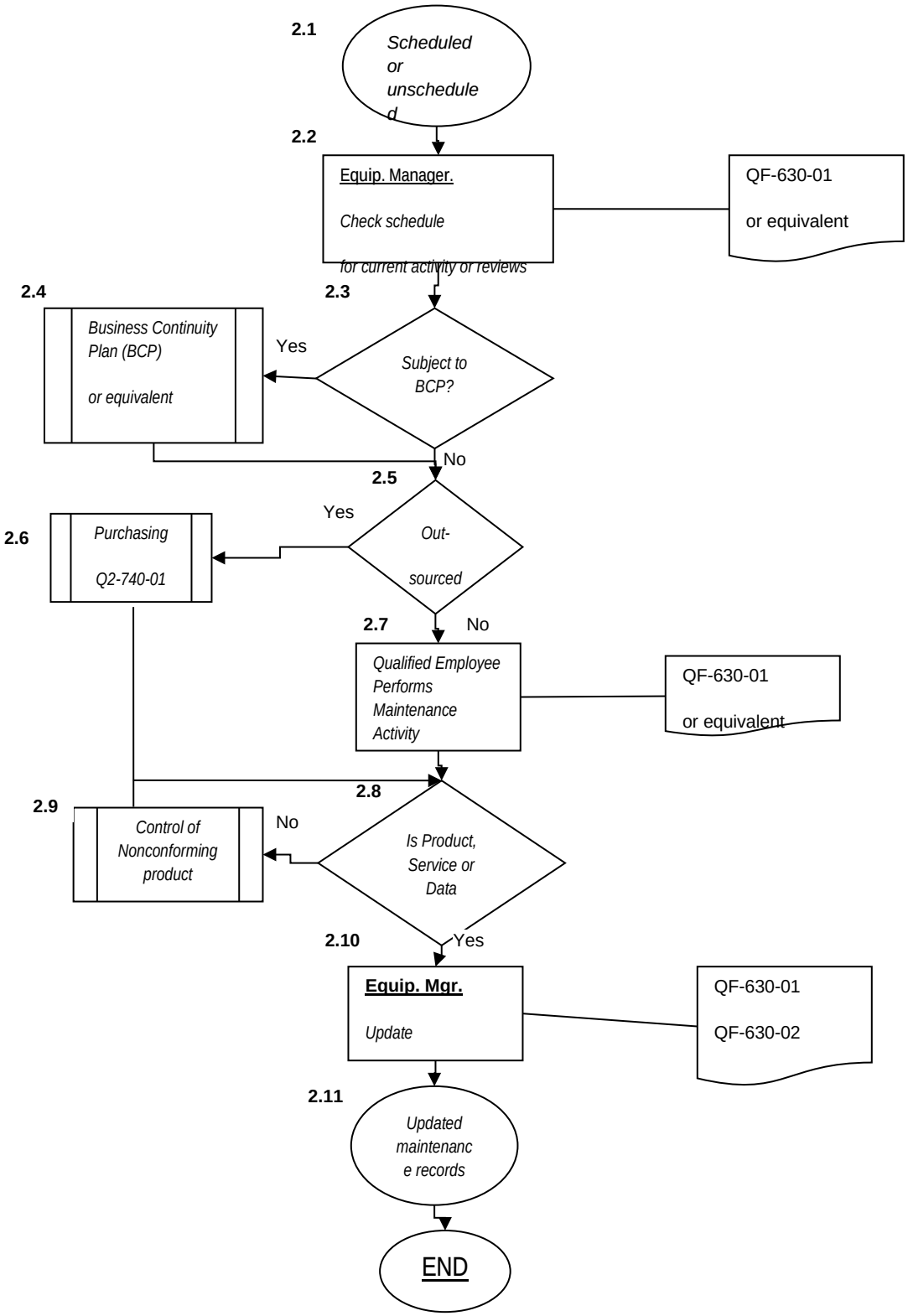
This procedure applies to buildings, workspaces, utilities, process equipment and supporting services required to meet MSC-WSC product or service requirements.

1.3 Information 'Turtle'

Inputs: ♦ Critical process equipment ♦ Critical infrastructure ♦ Schedule ♦ Non-conformances ♦ Preventive Maintenance Plan	**Outputs:** ♦ Maintained equipment ♦ Maintained infrastructure
Process Requirements: ♦ Identified third party supplier	**Process Metrics:** ♦ Associated non-conformance reports ♦ Unplanned equipment downtime incidents
Human Resources: ♦ Maintenance competency	**Equipment:** ♦ Maintenance tools
Linked Processes / Documents: ♦ Q1-600-01, section 6.3 ♦ Q2-740-01, Purchasing/Contracting ♦ Q2-830-01, Management of non-conforming process, product and service ♦ QF-630-01, Preventative Maintenance Plan ♦ QF-630-02, Maintenance Record	**Associated Records:** ♦ Maintenance schedules ♦ Maintenance records

♦ Referenced Work Instructions ♦ Business Continuity Plan (BCP)	

2.0 SECTION TWO - PROCESS FLOWCHART



PROCEDURE NOTES

2.1 Refers to Preventive Maintenance (PM) plans for critical process equipment and infrastructure at each activity. Critical process equipment and infrastructure should be identified during individual activity Process Mapping development and recorded or referenced in the Process Description (section 1.3 - under 'Materials & Equipment'). PM Plans should be recorded on Form Template QF-630-01 or in another format that contains the equivalent information. PM plans may also be updated through the technical review process. Unscheduled maintenance refers to infrastructure that requires maintenance due to unforeseen disruptions or failures / non-conformance.

2.2 Critical equipment managers are responsible to check the PM Plan, ensuring equipment receives scheduled inspection or maintenance activities. In the case of unforeseen disruptions or failures the impact of the "problem" is assessed.

2.3 The decision to as to whether to implement a Business Continuity Plan (BCP) or equivalent has to be considered.

2.4 Implement the BCP, Q2-500-002.

2.5 If the activity is to be outsourced the purchasing process will be followed to ensure a qualified, approved supplier is used.

2.6 Follow the purchasing process, Q2-740-01.

2.7 Inspection and maintenance tasks that are performed internally will be conducted only by competent persons and in accordance with any identified instructions.

2.8 If product does not meet specified performance requirements, the *Management of nonconforming process, product and service*, process will be followed.

2.9 Follow the *Management of nonconforming process, product and service* process.

2.10 Critical equipment managers are responsible to ensure the equipment record and PM plan are updated following completed activities.

2.11 Updated maintenance records.

3.0 SECTION THREE - SUPPLEMENTAL INFORMATION

3.1 Procedural Responsibilities

Equipment Manager - any WES employee who is responsible for a piece of equipment that has been identified as QMS critical process, monitoring or verification equipment

Qualified Employee – any WES employee that has been trained or otherwise approved to perform specific maintenance or calibration activities.

3.2 Definitions

Equivalent(s) - contains the same information as required on the referenced forms.

BCP - Business Continuity Plan.

4.0 SECTION FOUR - DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Initials	Description of Changes
1Dv01	2006-07-27	Draft	BBC	The document is initiated.
1Dv02	2006-08-08	Draft	BBC	First meeting revisions.
1Dv03	2006-08-10	Draft	BBC	Second meeting revisions.
1Dv04	2006-09-09	Draft	JK	Third meeting revisions.
1Dv05	2006-11-09	Draft	EAB	revisions
1Dv06	2006-11-09	Draft	EAB	revisions
1Dv07	2006-12-05	Draft	EAB	Process review and employee suggestions
1A	2006-12-15	Approved	EAB	Draft to Approved 1A
2A	2010-05-06	Approved	PT	Updated to remove reference to OP and change reference to Business Resumption by Business Continuity
3A	2012-06-20	Approved	PT	Indicated new process owner, plus corrected a few typos.
4Dv01	2013-02-08	Draft	LCD	Document revised to ensure that it reflects all WES/WSC documentation procedures; clarification of notes and other matters concerning documents; reorganize the flowchart; Add information in *Process Requirements.*
4Dv02	2013-04-11	Draft	LCD	Document revised. Added the reference number Q2-740-01 and made minor changes.
4Dv03	2013-04-11	Draft	LCD	Changed the format of the flowchart.
4A	2013-04-11	Approved	AB	Approved.
5Dv01	2014-04-03	Draft	EH	Changed arrows in flowchart.
5A	2014-04-03	Approved	AB	Approved.
6A	2015-04-20	Approved	AB	Reviewed and maintain status quo, process subject to change due to release of ISO 9001:2015 standard. Proposal to potentially merge with Q2-760-01 Control of Monitoring and Measuring Devices common process.

C7: Purchasing/Contracting

Document Title: **Purchasing/Contracting**		*Document Owner:* **Manager, Quality Management Office**	
Document Level: **Process Description**	*Reference No.:* **Q2-740-01**	*Revision:* **8A**	*Page:* **1 of 6**

1.0 SECTION ONE – INTRODUCTION

1.1 Purpose

The purpose of this procedure is to ensure that:

- The requirements for acquiring goods and services are clearly defined and communicated to suppliers and contractors
- Received goods and services meet specified requirements
- Suppliers and contractors are evaluated and selected based on their ability to meet requirements

1.2 Scope

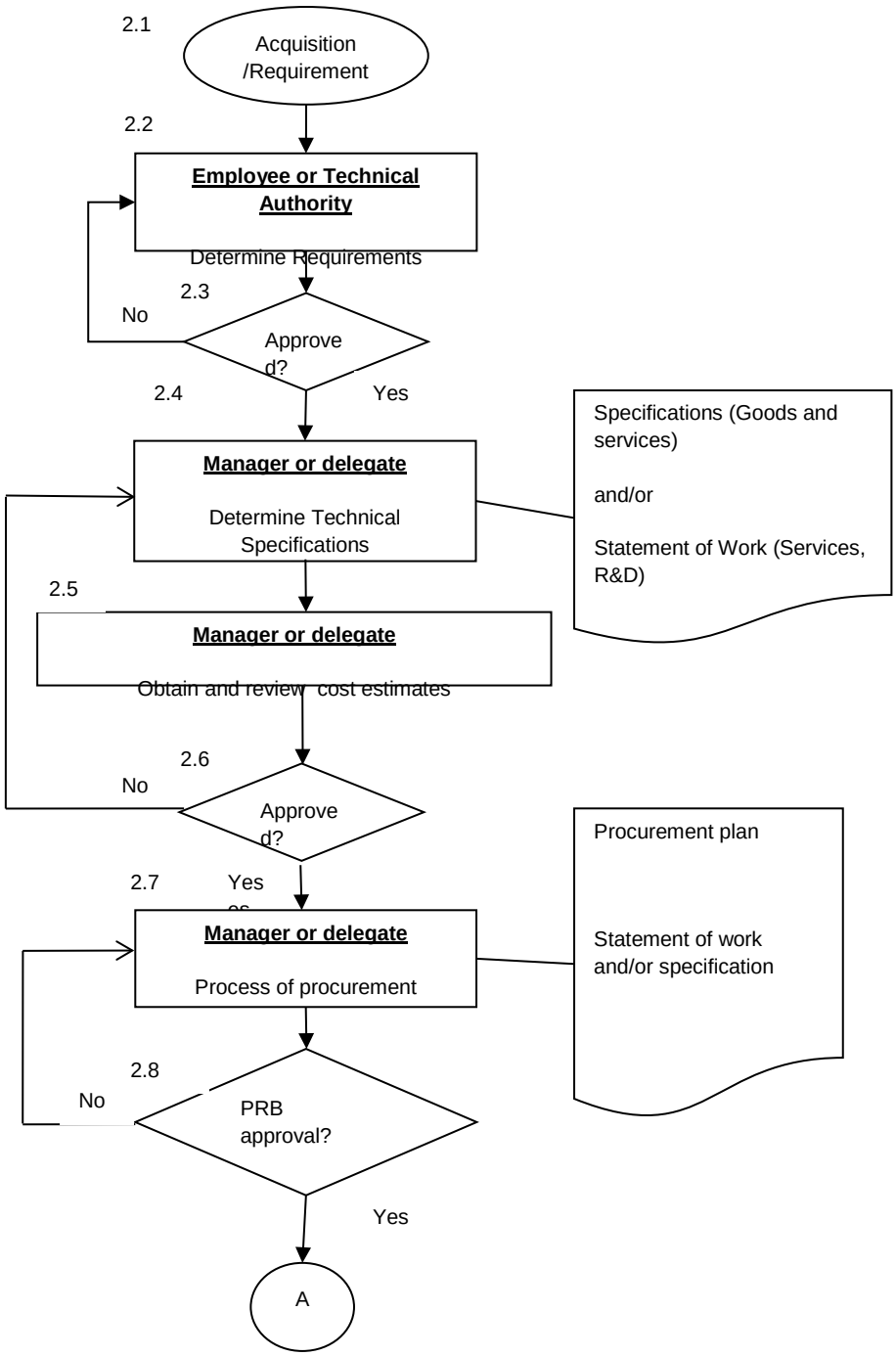
This procedure applies to purchased goods and services that directly affect the organization's ability to achieve its product requirements and deliver its programs.

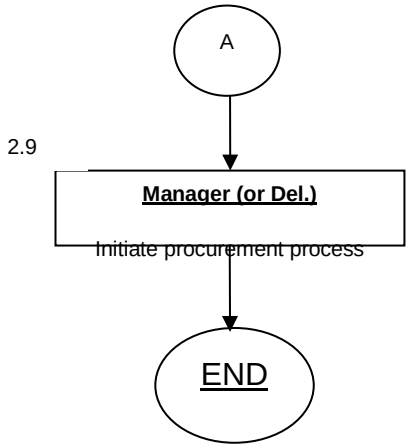
1.3 Information 'Turtle'

Inputs: ♦ Acquisitions affecting quality	**Outputs:** ♦ Acceptable goods, services and R&D contracts ♦ Acceptable suppliers and contractors
Process Requirements: ♦ Defined requirements for goods and services ♦ Approved suppliers and contractors ♦ Receiving verification	**Process Metrics:** ♦ Acquisition is conducted by an enabling organization or department that is outside of QMS. Random audits of contracts above a certain threshold to evaluate compliance with statement of work submitted
Human Resources: ♦ Employees ♦ Process owner or delegate ♦ Procurement specialist ♦ Receiving inspectors ♦ Technical Authority on the contract ♦ Responsible for Monitoring the contract	**Equipment:** ♦ N/A
Linked Processes / Documents: ♦ Q1-700-01, section 7.4 ♦ Q2-423-01, Control of Documents	**Associated Records:** ♦ Specifications (goods and services) ♦ Requisition for Goods and Services

♦ Q2-424-01, Control of Records ♦ Q2-830-01, Management of non-conforming process, product and service ♦ Procurement Review Board (PRB) Website - http://intranet.ec.gc.ca/acemd-dgbage/default.asp?lang=En&n=E35BAC5A-1 ♦ PWGSC SOI web site - http://soi.pwgsc.gc.ca/app/index.cfm?fuseaction=prg.MAIN&srch=&altlang=-e ♦ Specifications and Statement of Work ♦ PWGSC Requisition for Goods and Services – form 9200 ♦ Environment Canada Requisition for Goods – form 1851 ♦ PWGSC Standard Acquisition Clauses and Conditions - https://buyandsell.gc.ca/policy-and-guidelines/standard-acquisition-clauses-and-conditions-manual ♦ Environment Canada Requisition for Services – form 1884 ♦ PWGSC Contract Form – created by PWGSC ♦ Environment Canada Contract Form – Merlin format (created by procurement specialist) ♦ EC Acquisition Card ♦ EC Local Purchase Order Authority Books	♦ Contract or purchase document ♦ Supplier and contractor evaluation results ♦ Receiving Record

2.0 SECTION TWO - PROCESS FLOWCHART





PROCEDURE NOTES

2.1 Acquire goods or services that directly affect the organization's ability to achieve its product requirements or deliver its services.

2.2 The requirement(s) may be a result of strategic planning, routine replacements or items required urgently for operational purposes. Delegates may include employees with approval authority as specified in Specimen Signature Record (SSR).

2.3 Decision to approve or reject.

2.4 The technical specifications that already exist must be reviewed for their relevance to the current procurement. Where details are outdated or missing that piece of technical information must be updated and approved by the appropriate Technical Authority. If no specification exists, create one from a basic description of product technical requirements. These technical requirements or SOW must be approved by the appropriate Technical Authority.

2.5 Cost estimates should be acquired using appropriate methods. For small procurements, estimates for two or more suppliers may suffice. For larger or more complex procurements, it may be necessary to initiate processes such as price and availability requests through PWGSC.

2.6 The manager may determine that the estimated cost exceeds available resources or does not represent good value. Specifications should be reviewed to determine whether changes are appropriate.

2.7 Proceed with procurement/acquisition. In accordance with policies and procedures established both internally by EC and by central agencies such as PWGSC, the manager determines an appropriate procurement plan. This may range from a credit card or standing offer purchase through to a major procurement administered through PWGSC. For complex purchase actions, the manager shall prepare a formal procurement plan document, in consultation with procurement specialists. The manager shall prepare procurement documents in accordance with procedures specified by EC or central agencies.

2.8 Refer to the PRB Website on whether the purchase requires a PRB submission. http://intranet.ec.gc.ca/acemd-dgbage/default.asp?lang=En&n=E35BAC5A-1 If no PRB approval is required, proceed to step 2.9.

2.9 Initiate procurement action. Evaluate bids, proposals, and estimates in accordance with the procurement plan. Select the vendor/contractor or recommend acceptance in accordance with EC and central agency policies and procedures. Where the procurement is considered to directly affect the organization's ability to deliver its products or services, document how the supplier/contractor was evaluated and chosen. Award contract or recommend contract award in accordance with EC and central agency policies and procedures. Verify that the received goods or services comply with contractual requirements. If goods or services do not comply, interact with the vendor in accordance with EC and central agency policies and procedures. Assess vendor/contractor performance. Consideration factors include price, timeliness, produce/service compliance to specifications, post-sales support, and user feedback. Maintain record of vendor/contractor performance for goods and services that directly affect the organization's ability to deliver its products or services.

3.0 SECTION THREE - SUPPLEMENTAL INFORMATION

3.1 Procedural Responsibilities

Employee or Technical Authority – identifies need for good, service, contract
Manager – Line or Results manager
Environment Canada - Procurement Specialist
PWGSC – Procurement Specialist

3.2 Definitions

PRB: Procurement Review Board
SOI: Standing Offer Index
SOW: Statement of work
PWGSC: Public Works and Government Services Canada
RFP: Request for proposal

4.0 SECTION FOUR - DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Initials	Description of Changes
1A	2006-12-15	Approved	EM	Draft changed to 1A
2A	2008-06-25	Approved	JV	Process updated as a result of CPAR 113. Supplier evaluation is now clearly indicated in 2.16 of flowchart.
3Dv01	2010-03-12	Draft	JC	Updated
3A	2010-03-22	Approved	EM	Draft changed to 3A
4A	2010-12-03	Approved	PT	Owner changed, new QMO manager. No other change.
5A	2012-06-21	Approved	PT	Correction to name of Q2-830-01 process.
6Dv01	2013-02-04	Draft	LCD	Document revised to ensure that it reflects all MSC/WSC documentation procedures; clarification of notes and other matters concerning documents; reduced the flowchart; removed a big part that didn't reflect the recent updates of QMS.
6A	2013-02-06	Approved	AB	Approval
7Dv01	2014-02-03	Draft	EH	Updated ECollab link and PWGSC website
7A	2014-02-03	Approved	AB	Approval
8A	2015-04-20	Approved	AB	Reviewed and maintain status quo, process subject to change due to release of ISO 9001:2015 standard. Complete re-write planned to include SAP– HRG– Procurement–Travel–Finance processes.

C8: Internal Audit

Document Title: Internal QMS Audits		*Document Owner:* Manager, Quality Management Office	
Document Level: Process Description	*Reference No.:* Q2-822-01	*Revision:* 10A	*Page:* 1of 4

1.0 SECTION ONE – INTRODUCTION

1.1 Purpose

The purpose of this procedure is to ensure that:

- Internal quality management system audits are defined, planned, scheduled and conducted.
- MSC-WSC's activities are reviewed for compliance with predefined processes and the ISO 9001:2008 standard.
- Noncompliance and opportunities for improvement to the management system are identified and responsible managers are informed.

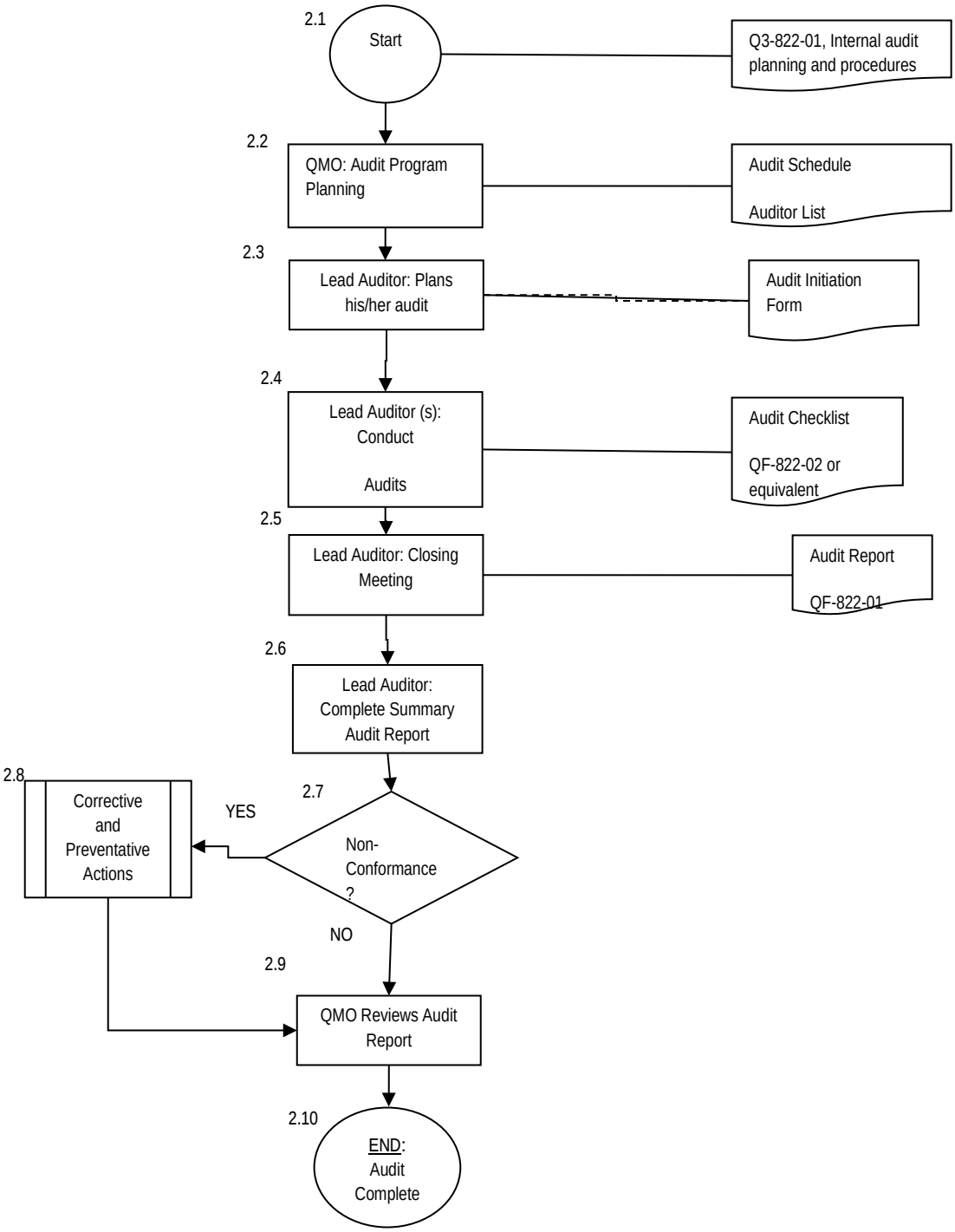
1.2 Scope

This procedure applies to the internal auditing of all elements of MSC-WSC's Quality Management System. All elements and all sites will be audited at least once per registration cycle.

1.3 Information 'Turtle'

Inputs: ♦ Scheduled QMS internal audits	**Outputs:** ♦ QMS audit reports
Process Requirements: ♦ N/A	**Process Metrics:** ♦ Compliance with schedule including the number of audits conducted
Human Resources: ♦ Qualified Auditors ♦ Sufficient number of responsible persons ♦	**Equipment:** ♦ ArcGIS
Linked Processes / Documents: ♦ QF-822-01, Audit report ♦ Auditor Availability List form ♦ Audit Schedule ♦ QF-822-02, Audit Checklist form ♦ QF-822-03, Audit Initiation form ♦ Q3-822-01, Internal audit planning and procedures ♦	**Associated Records:** ♦ Audit Reports ♦ CPAR ♦ Audit Schedule ♦ Databases ArcGIS

2.0 SECTION TWO - PROCESS FLOWCHART



PROCEDURE NOTES

2.1 The audit plan is established by the Quality Management Office. The auditors follow Q3-822-01 through the process.

2.2 Quality Management Office establishes an audit schedule in consultation with the process owner, and assigns a lead auditor for the various audits in the plan schedules the audit and informs the Process Owner once posted on ECollab.

2.3 Lead Auditor prepares for audit. QF-822-03 sent to Process Owner with copy to ISO mailbox .Lead Auditor conducts audit activities and records findings and evidence on audit checklist or equivalent. Gather evidence and summarize the audit findings.

2.4 Lead Auditor conducts a closing meeting with auditee representatives, presenting the audit findings.

2.5 Lead Auditor drafts the audit report for QMO review.

2.6 Lead Auditor makes recommendation to QMO if any of the findings require a Corrective and Preventative Actions Report by providing related evidence; QMO initiates the CPAR if necessary.

2.7 Corrective and Preventive Actions process is triggered, Q2-850-01.

2.9 Quality Management Office reviews the audit report and findings.

2.10 Audit completed.

3.0 SECTION THREE – SUPPLEMENTAL INFORMATION

Procedural Responsibilities

QMO - Staff in the Quality Management Office.

Lead Auditor - Employee assigned by the QMO to lead a team of internal auditors.

Process Owner - Person who is responsible for the process being audited.

Definitions

CPAR – Corrective or Preventive Action Request
QMS – Quality Management System

4.0 SECTION FOUR – DOCUMENT HISTORY

Detailed History of Changes

Rev#	Date	State	Initials	Description of Changes
1Dv01	2006-10-02	Draft	BBC	The document is initiated.
1Dv02	2006-11-17	Draft	JSC	Document is revised following review by BBC and JSC
1A	2006-12-20	Approved	EAB	Draft changed to approved 1A
2Dv01	2007-04-28	Draft	EM	Draft changes in response to pre-assessment audit
2Dv02	2007-05-09	Draft	EM	Draft changes in response to Quality Management Office review
2Dv-03	2007-05-15	Draft	EM	Draft changes in response to Quality Management Office review
2A	2007-05-24	Approved	JSC	Draft changed to approved 2A
3A	2008-05-02	Approved	EM	Changes to reflect QF-822-03, Audit Initiation Form
4A	2009-08-28	Approved	DL	Revised to recognize 2008 version of standard
5A	2010-05-26	Approved	EM	Updated to remove reference to OP and correct document owner
6A	2011-04-08	Approved	PT	Updated to update document owner; no other change.
7Dv01	2013-04-11	Draft	LCD	Document revised to ensure that it reflects all MSC/WSC documentation procedures; reorganization of the flowchart; removed a big part that didn't reflect the recent updates of QMS.
7A	2013-04-17	Approved	AB	Approval.
8Dv01	2014-04-08	Draft	Eh	Modified arrows in Flowchart to fit ISO9001 guidelines, updated dates and revision number
8A	2014-04-08	Approved	AB	Approval
9A	2014-06-26	Approved	AB	Corrected typos
10A	2015-04-20	Approved	AB	Reviewed and maintain status quo, process subject to change due to release of ISO 9001:2015 standard.

Approval Authority:	*Approved by:*	*Date:*
Manager, QMO		**2015-04-20**

Read Only Copy – See intranet for latest revision

Appendix D: List of Forms and Standard Operating Procedures

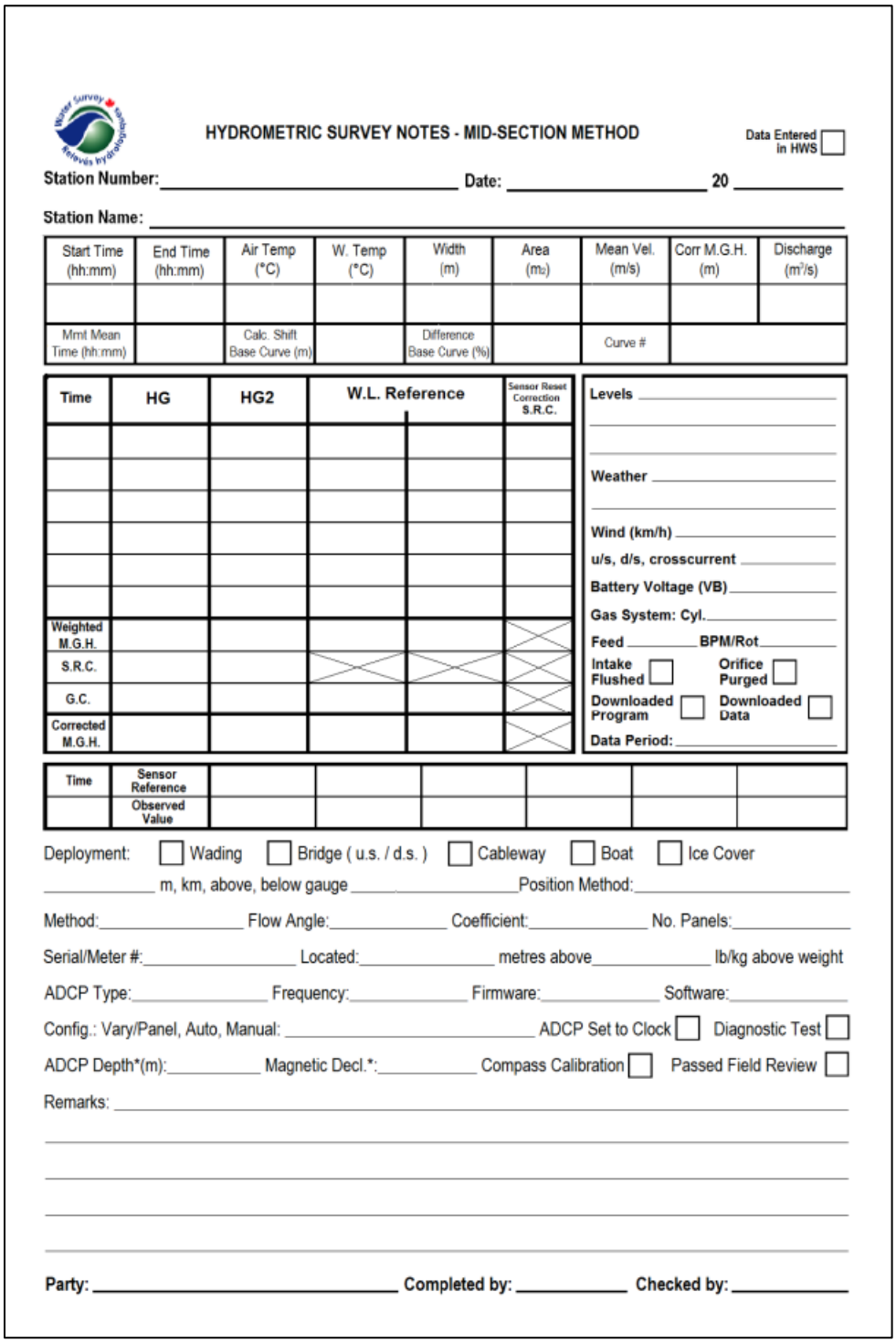
Forms Available in the WSC QMS Operational Library

Date	Title	Form Number
2003	Quality Assurance Program Field Audit	qFOR-NA005-01-2003
2014	Quality Assurance Program Office Audit	qFOR-NA004-04-2014
2014	Computational Checklist	qFOR-NA008-02-2014
2014	Three Wire Levelling	qFOR-NA022-01-2014
2014	HT- APTP Progression Notes Booklet	qFOR-NA025-01-2014
2015	WSC Internal Training Certificate Template	qFOR-NA006-01-2015
2015	Hydrometric Survey Notes – Mid-Section	qFOR-NA023-02-2015
2015	Hydrometric Survey Notes – Moving Boat	qFOR-NA024-02-2015
2015	Review and Promotion Committee Submission	qFOR-NA026-01-2015
2015	ADCP Beam Alignment Test	qFOR-NA027-01-2015

Standard Operating Procedures Available in the WSC QMS Operational Library

Date	Title	Document Number
1981	Hydrometric Field Manual - Measurement of Streamflow	qSOP-NA007-01-1981
1983	Hydrometric Field Manual - Measurement of Stage	qSOP-NA008-01-1983
1985	Procedural Guide for International Gauging Stations	qSOP-NA020-01-1985
2004	WSC Station Locations	qSOP-NA023-01-2004
2005	Hydrometric Field Manual - Levelling	qSOP-NA005-02-2005
2010	Station Naming Conventions	qSOP-NA003-03-2010
2011	Water Survey Approved SHEF codes	qSOP-NA034-02-2011
2012	Hydrometric Manual - Data Computations	qSOP-NA037-00-2012
2013	Operator Accreditation - Determining Discharge with ADCP	qSOP-NA016-03-2013
2013	ADCP Discharge Measurement by Moving Boat	qSOP-NA038-01-2013
2013	Computing AVM Discharge with Flowcal	qSOP-NA044-01-2013
2014	Hydrometric Technician - Apprenticeship or Professional Training Program HT - APTP	qSOP-NA018-02-2014
2014	Interim Procedures for M9 and S5	qSOP-NA040-03-2014
2014	File Naming Conventions	qSOP-NA017-06-2014
2014	Instructions for the Completion of Hydrometric Survey Notes	qSOP-NA042-02-2014
2015	Under-ice discharge measurements using ADCPs	qSOP-NA041-03-2015
2015	Mid-section open water measurements using ADCPs	qSOP-NA046-01-2015
2015	Measuring Discharge with FlowTracker ADV	qSOP-NA022-04-2015
2015	WSC Cableway Management Procedures	qSOP-NA045-02-2015
2015	HYDAT Application Upload	qSOP-NA047-01-2015

Appendix E: Q3 Example of a Form (qFOR-NA023-02-2015), Hydrometric Survey Notes - Mid-Section Method



HYDROMETRIC SURVEY NOTES - MID-SECTION METHOD

Data Entered in HWS ☐

Station Number: _____ Date: _____ 20 _____

Station Name: _____

Start Time (hh:mm)	End Time (hh:mm)	Air Temp (°C)	W. Temp (°C)	Width (m)	Area (m_2)	Mean Vel. (m/s)	Corr M.G.H. (m)	Discharge (m^3/s)
Mmt Mean Time (hh:mm)		Calc. Shift Base Curve (m)		Difference Base Curve (%)		Curve #		

Time	HG	HG2	W.L. Reference		Sensor Reset Correction S.R.C.
Weighted M.G.H.					
S.R.C.					
G.C.					
Corrected M.G.H.					

Levels _____

Weather _____

Wind (km/h) _____

u/s, d/s, crosscurrent _____

Battery Voltage (VB) _____

Gas System: Cyl. _____

Feed _____ BPM/Rot _____

Intake Flushed ☐ Orifice Purged ☐

Downloaded Program ☐ Downloaded Data ☐

Data Period: _____

Time	Sensor Reference						
	Observed Value						

Deployment: ☐ Wading ☐ Bridge (u.s. / d.s.) ☐ Cableway ☐ Boat ☐ Ice Cover

_____ m, km, above, below gauge _____ Position Method: _____

Method: _____ Flow Angle: _____ Coefficient: _____ No. Panels: _____

Serial/Meter #: _____ Located: _____ metres above _____ lb/kg above weight

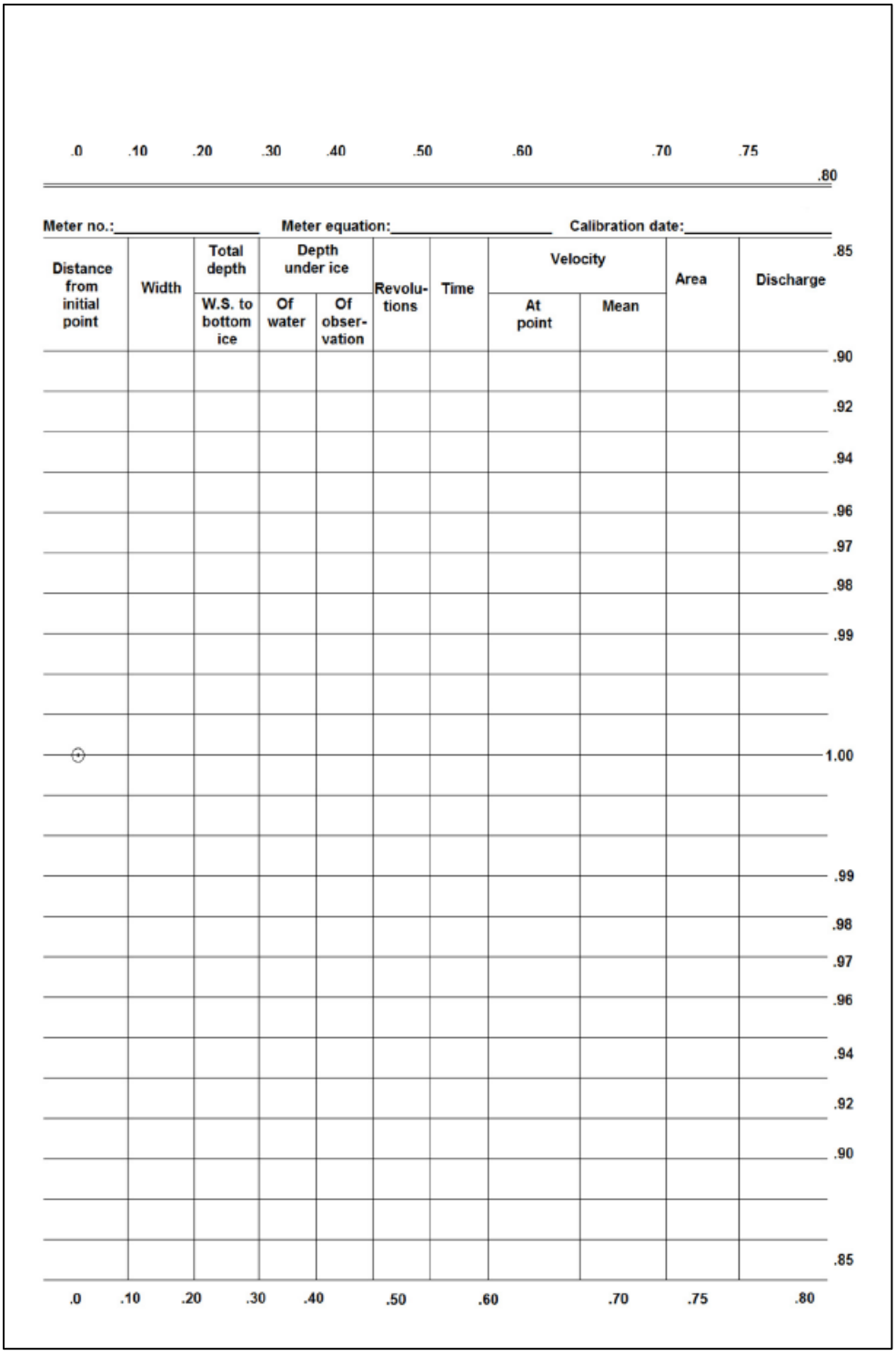
ADCP Type: _____ Frequency: _____ Firmware: _____ Software: _____

Config.: Vary/Panel, Auto, Manual: _____ ADCP Set to Clock ☐ Diagnostic Test ☐

ADCP Depth*(m): _____ Magnetic Decl.*: _____ Compass Calibration ☐ Passed Field Review ☐

Remarks: _____

Party: _____ Completed by: _____ Checked by: _____


.0 .10 .20 .30 .40 .50 .60 .70 .75 .80
Meter no.:
Meter equation:
Calibration date:
Distance from initial point
Width
Total depth
W.S. to bottom ice
Depth under ice
Of water
Of obser-vation
Revolu-tions
Time
Velocity
At point
Mean
Area
Discharge
.85 .90 .92 .94 .96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92 .90 .85
.0 .10 .20 .30 .40 .50 .60 .70 .75 .80

LEVEL NOTES

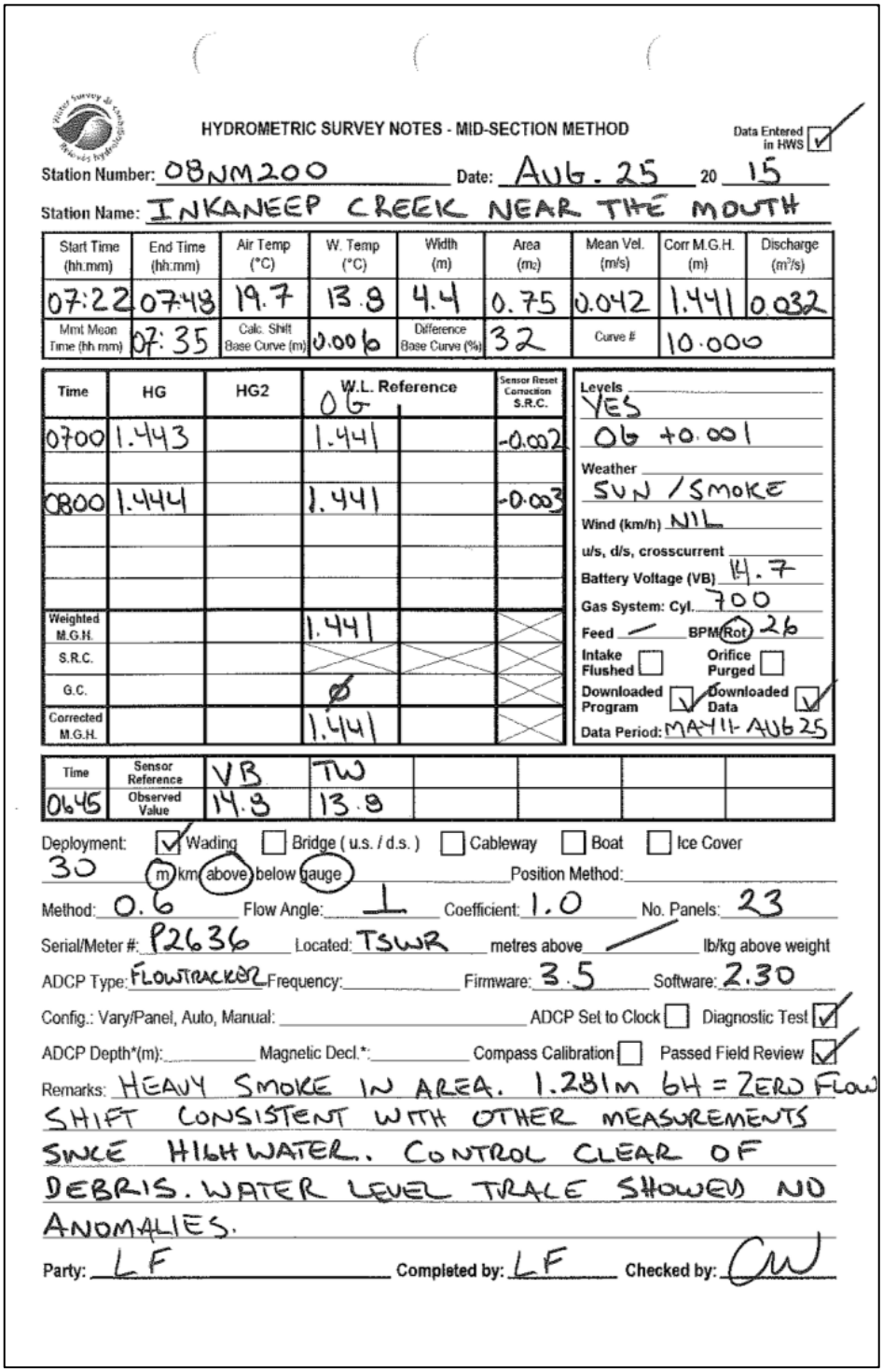
STATION	B.S.	HT. INST.	F.S.	ELEVATION	

SKETCHES

FIELD REVIEW Pass ☐		Review Yes	Check Yes	Review Comments	Review Applies To : C = Current Meter F = FlowTracker A = ADCP
Passed All Instrument QAQC?	C F A	☐	☐		
Software Input Same as Notes?	C F A	☐	☐		
Diff in ADCP and Water T < 2°C?	F A	☐	☐		
Signal to Noise Ratio > 4?	F	☐	☐		
Flow Angles Accounted for?	C F	☐	☐		
Exposure Time / Location > 40 s?	C F A	☐	☐		
Valid Ensembles / Panel > 30?	A	☐	☐		
No Boundary or Spike Problem?	F	☐	☐		
Bed Contour as Expected for Site?	C F A	☐	☐		
Ice/Slush Depth as Expected?	C F A	☐	☐		
Velocity Profile Suitable?	C F A	☐	☐		
# Panels > 20?	C F A	☐	☐		
No Panel Q > 10%?	C F A	☐	☐		

Notes on Site Conditions Affecting Measurement Quality:

Appendix F: Q4 Example of a Completed Form (qFOR-NA024-02-2015), Survey Notes – Mid-Section Method



HYDROMETRIC SURVEY NOTES - MID-SECTION METHOD

Data Entered in HWS ☑

Station Number: 08NM200 Date: AUG. 25 20 15

Station Name: INKANEEP CREEK NEAR THE MOUTH

Start Time (hh:mm)	End Time (hh:mm)	Air Temp (°C)	W. Temp (°C)	Width (m)	Area (m^2)	Mean Vel. (m/s)	Corr M.G.H. (m)	Discharge (m^3/s)
07:22	07:48	19.7	13.9	4.4	0.75	0.042	1.441	0.032
Mmt Mean Time (hh:mm)	07:35	Calc. Shift Base Curve (m)	0.006	Difference Base Curve (%)	32	Curve #	10.000	

Time	HG	HG2	W.L. Reference (OG)		Sensor Reset Correction S.R.C.
0700	1.443		1.441		-0.002
0800	1.444		1.441		-0.003
Weighted M.G.H.			1.441		
S.R.C.					
G.C.			∅		
Corrected M.G.H.			1.441		

Levels YES
OG +0.001

Weather SUN / SMOKE

Wind (km/h) NIL

u/s, d/s, crosscurrent

Battery Voltage (VB) 14.7

Gas System: Cyl. 700

Feed — BPM (Rot) 26

Intake Flushed ☐ Orifice Purged ☐

Downloaded Program ☑ Downloaded Data ☑

Data Period: MAY 11 - AUG 25

Time		VB	TW				
0645	Sensor Reference						
	Observed Value	14.9	13.9				

Deployment: ☑ Wading ☐ Bridge (u.s. / d.s.) ☐ Cableway ☐ Boat ☐ Ice Cover

30 (m) km above below gauge Position Method:

Method: 0.6 Flow Angle: 1 Coefficient: 1.0 No. Panels: 23

Serial/Meter #: P2636 Located: TSWR metres above lb/kg above weight

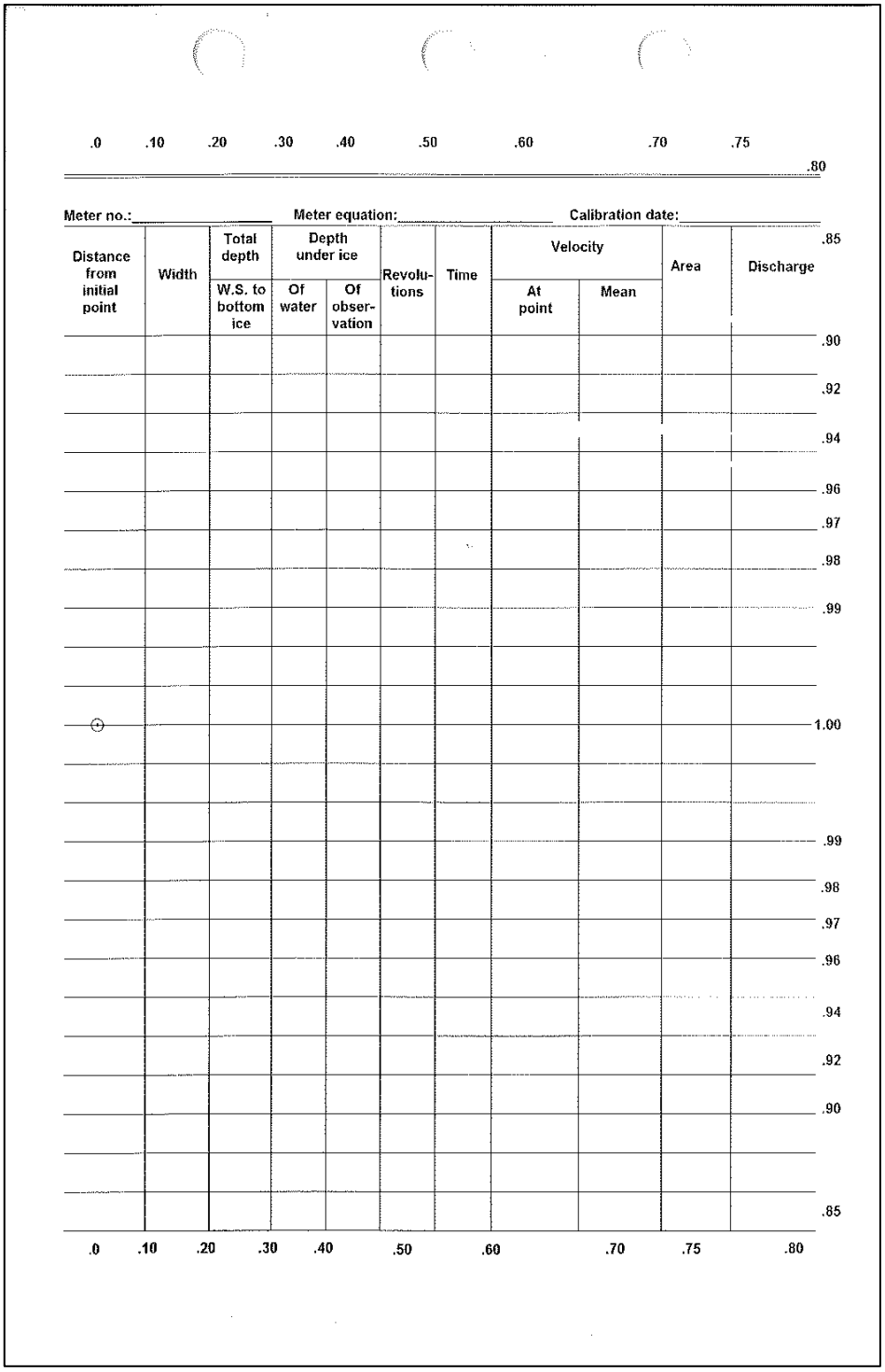
ADCP Type: FLOWTRACKER Frequency: Firmware: 3.5 Software: 2.30

Config.: Vary/Panel, Auto, Manual: ADCP Set to Clock ☐ Diagnostic Test ☑

ADCP Depth*(m): Magnetic Decl.*: Compass Calibration ☐ Passed Field Review ☑

Remarks: HEAVY SMOKE IN AREA. 1.281m GH = ZERO FLOW SHIFT CONSISTENT WITH OTHER MEASUREMENTS SINCE HIGH WATER. CONTROL CLEAR OF DEBRIS. WATER LEVEL TRACE SHOWED NO ANOMALIES.

Party: LF Completed by: LF Checked by: CW



Note: Not required as this measurement was collected by electronic means

LEVEL NOTES

STATION	B.S.	HT. INST.	F.S.	ELEVATION	
BM2	1.260	4.700	—	3.440	CONTROL
BM1	0.310	4.506	0.504	4.196	
BM298	1.525	4.252	1.779	2.727	
OG(TOP)	2.301	4.302	2.251	2.001	
BM2	—	—	0.863	3.439	
				0.001 m	CLOSURE

SKETCHES

BM2 3.440 CONTROL – PLUG IN WING WALL

BM1 4.195 BOLT – POWER POLE

BM298 2.729 PIPE BM

F

FIELD REVIEW Pass ☑		Review Yes	Check Yes	Review Comments	Review Applies To (C = Current Meter, F = FlowTracker, A = ADCP)
Passed All Instrument QAQC?	CFA	☑	☑		
Software Input Same as Notes?	CFA	☑	☑		
Diff in ADCP and Water T < 2°C?	FA	☑	☑		
Signal to Noise Ratio > 4?	F	☑	☑	20.2 dB	
Flow Angles Accounted for?	CF	☑	☑		
Exposure Time / Location > 40 s?	CFA	☑	☑	40 S AVERAGED INT.	
Valid Ensembles / Panel > 30?	A	☐	☐		
No Boundary or Spike Problem?	F	☑	☑		
Bed Contour as Expected for Site?	CFA	☑	☑	MEAS. SECTION STABLE	
Ice/Slush Depth as Expected?	CFA	☐	☐		
Velocity Profile Suitable?	CFA	☑	☑		
# Panels > 20?	CFA	☑	☑	24	
No Panel Q > 10%?	CFA	☑	☑	8.9% MAX	

Notes on Site Conditions Affecting Measurement Quality:

LOW WATER, USED MINIMUM PANEL WIDTHS.
MAJORITY OF FLOW ON RIGHT SIDE.
SOFT BED.

Appendix G: HT-APTP Training Requirements

8.1 Progression Notes Booklet

User Guidance and Summary of Learning Objectives

Private Property of: _____

Candidates should help gather evidence in support of their progression within the Hydrometric Technician - Apprenticeship or Professional Training Program (HT-APTP). These Progression Notes (logs) were designed for this purpose. Refer to the HT-APTP documentation for details on Lesson Packages and associated learning objectives.

Once complete, these records are private and must be stored adequately until required by your supervisor. Completed logs should include:

- The targeted learning objective
- The work location, date and party involved
- A general description of activities and work performed
- Comments from the candidate on their experience and performance
- Comments from the senior technologist on candidate's experience and performance
- The candidate and senior technologist signatures

Refer to the example included to learn how to capture the required information.

A single log should only contain details for experiences related to a single learning objective. If work performed at any given time provides experience for more than one learning objective, multiple logs should be completed, one for each objective.

During the HT-APTP, several logs should be completed for each learning objective in order to demonstrate progression and a sufficient variety of experiences towards it. For example, candidates should separately and more than once demonstrate the application of standard procedures during FlowTracker, Price Current Meter, and ADCP measurements. Coordinate your learning and documentation efforts with your supervisor to target learning objectives that will benefit most from it.

Summary of Lesson Packages and Associated Learning Objectives

Section 1. Health and Safety

Training should have been received for the following Lessons Packages:

- ***Introduction to OHS standards***
- ***Ergonomics***
- ***Standard First Aid / CPR / AED***
- ***Wilderness First Aid***
- ***Wildlife Awareness and Safety***
- ***Wilderness Survival***
- ***Swift Water Safety***
- ***Boat Operator Practical Training***
- ***Pleasure Craft Operator Card***
- ***Small Vessel Operator Proficiency***
- ***MED A3***
- ***Ice Surface Safety***
- ***Confined Space Entry – Stilling Wells***
- ***Fall Protection***
- ***Fixed Wing Aircraft Safety***
- ***Helicopter Safety***
- ***Restricted Radio Operator Certification***
- ***Underwater Egress Training for Aircraft***
- ***All-Terrain Vehicle Safety***
- ***Snowmobile Safety***
- ***Defensive Driving***
- ***Skid Control***
- ***Trailer Safety***
- ***Winch Safety***
- ***Cableway Safety***
- ***Canadian Firearms Safety Course***
- ***Possession and Acquisition License (PAL)***
- ***EC Non-Enforcement Firearms Level 2***
- ***Chainsaw and Brush-Cutter Safety***
- ***Ice Auger Safety***
- ***Transportation of Dangerous Goods***
- ***WHMIS***

Section 2. Station Operations

Lesson 2.1 Water Survey Program

A. Organizational profile
B. Nature of the work performed
C. Water Survey of Canada documentation
D. Information produced and provided
E. Communication responsibilities

Lesson 2.2 Gauging Stations

A. Purpose of a gauging station
B. Station infrastructure
C. Station data collection and storage
D. Stream flow controls
E. Station records
F. Station operating schedule

Lesson 2.3 Logistics

A. Station visit prioritization
B. Trip planning
C. Equipment preparation
D. Safety call-in procedures

Lesson 2.4 Vehicles

A. Vehicle policies
B. Permits and authorizations
C. Maintenance
D. Code of conduct

Lesson 2.5 Basic Electricity and Electronics

A. Basic electricity theory
B. Station Electric and electronic parts
C. Operational techniques
D. Troubleshooting techniques
E. Risk management

Lesson 2.6 Quality Management Systems

A. Quality management systems
B. Quality management responsibilities
C. Quality management documentation

Lesson 2.7 Hydrometric Site Selection

A. Canadian hydrology
B. Site selection criteria
C. Office investigation procedures
D. Field reconnaissance procedures
E. Site selection analysis

Lesson 2.8 Construction

A. Administrative requirements
B. Site basic infrastructure

Lesson 2.9 Station Management

A. Station description
B. Station documentation systems
C. Station work planning

Lesson 2.10 Cableway Operations

A. Preliminary inspections
B. Use of cableways

Lesson 2.11 International Requirements

A. Cooperative agreements
B. International stations
C. International procedures
D. International work logistics

Section 3. Data Acquisition

Lesson 3.1 Datum References

A. Determination of Datum
B. Benchmark operations
C. Datum documentation
D. Benchmark installation and maintenance

Lesson 3.2 Levelling

A. Types of levelling equipment
B. Equipment operation and maintenance
C. Procedures
D. Defining levelling results
E. Determination of gauge corrections
F. Documentation of results

Lesson 3.3 Data Loggers

A. Types of data loggers
B. Installation and maintenance
C. General functionalities
D. Validation and calibration
E. Communication and telemetry

Lesson 3.4 Diagnostic & Environmental Data

A. Station diagnostics data
B. Environmental conditions
C. Documentation of results

Lesson 3.5 Stage

A. Discrete value measurements
B. Types of automated stage sensors
C. Time series measurements
D. Field corrections
E. Documentation of results

Lesson 3.6 Discharge

A. Measurement method
B. Types of discharge measurement sensors
C. Equipment maintenance
D. Deployment preparation
E. Measurement procedures
F. Marginal conditions
G. Post-measurement procedures

Lesson 3.7 Index Velocity

A. Types of in-situ velocity sensors
B. Time series measurements
C. Field maintenance

Section 4. Data Production

Lesson 4.1 Continuous Data Production

A. Production cycles
B. Data systems architecture

Lesson 4.2 Data Entry

A. Station information
B. Data entry processes
C. Data entry administration

Lesson 4.3 Corrections

A. Purpose of corrections
B. Application
C. Extrapolations
D. Documentation requirements

Lesson 4.4 Model Development

A. Modelling theory
B. Development
C. Extrapolations
D. Validation
E. Corrections

Lesson 4.5 Estimation

A. Estimation theory
B. Estimation procedures

Lesson 4.6 Data Approval

A. Approval responsibilities
B. Approval procedures
C. Documentation requirements

Section 5. Data Delivery and Review

Lesson 5.1 Data Delivery

A. Products
B. Dissemination
C. Requests

Lesson 5.2 Data Review

A. Causes
B. Procedures

Hydrometric Technician Training Progression Notes:
(Completed Example of qFOR-NA025-01-2014)

Objective: 3.3.1		**Page #:** 1 of 1
Location	**Date**	**Party**
Graham Creek near Nepean	August 20, 2013	Pat Trainee and Judy Senior

Description of Activity / Work Performed:

In response to faulty stage data coming from the Graham Creek station via telemetry, Judy the Senior Tech and I visited the site to determine what was causing the inaccuracies.

Candidate/Senior Technologist Comments:

-I quickly determined that the water level in the stilling well was considerably lower than the creek's stage. I flushed the intake pipes, which were full of sediment. After allowing water to flow back into the well, the water level in the well accurately reflected the creek's water level.

-Pat accurately determined the cause of the inaccurate stage data, and addressed the issue by flushing the well.
-Pat should have taken more actions to reduce the risk of this problem happening again soon. He could have removed accumulated sediments from the bottom of the well, and clean the intake pipes themselves (I suggested to extend the intake pipes further into the creek, away from loose sediments that seem to plug the intakes.)
-Pat needs more exposure to station maintenance in general so that he can learn what to look for, and what to do to fix it.

Candidate Signature: Pat Trainee

Senior Technologist Signature: Judy Senior

Appendix H: Contributed Hydrometric Data Policy

Document Title: **National Hydrometric Program Contributed Data Policy**		*Document No.:* **qPOL-PA001-02-2009**
Revision: **1A**		*Page:* **Page 120 of 121**

Revision History

Ver#	Date	Initials	Description/Rationale of Changes
Dv1	Sept 20, 2007	NHPCC	National Hydrometric Program Coordinators Committee (NHPCC) submits document to National Administrators Table (NAT) for approval.
1A	Sept 20, 2007	NAT	National Administrators Table (NAT) approves document

Purpose - This policy is intended to address the needs of the National Hydrometric Program (NHP) partners and clients by enabling the acceptance of data and information into the national data set while protecting the integrity of these national data holdings.

Scope - This policy applies;

- to all parties offering hydrometric data and information to the NHP; and,
- to real-time, current and archive-ready hydrometric data and information.

Background:

Hydrometric data are of great value to those involved in environmental and resource management, research and investigation. The value of this data is maximized when it is 'defensible as meeting or exceeding stated and accepted levels of accuracy. The challenge to the producers of hydrometric data is that the "correct value" is unknown and, therefore, unavailable for comparison to their product. However, hydrometric operators are able to provide 'defensible' data values by the application of devices and procedures for which the accuracy can be estimated (standardized approaches).

The application of quality measures will assist hydrometric operators to consistently provide defensible data. Quality control measures are applied to do such things as test the calibration of measuring devices, repeat measurements that fall beyond tolerance, or have staff check each other's work for errors. Quality assurance measures, such as audits, are applied to ensure that the established standardized approaches are being followed at all times. Quality management measures are applied to ensure that the standardized approaches are providing the desired results.

Hydrometric operators also must be able to provide appropriate documentation (metadata) of their approaches and quality measures to allow the end user to determine whether the data and information can be used for their purpose.

NHP Objective:

The NHP is committed to supplying hydrometric data and information products that meet its stated National Standards. The NHP will ensure that all hydrometric data and information that it offers to its partners and clients has had appropriate quality measures applied through the collection, production and presentation steps.

NHP Approach:

Commencing January 1, 2011, the NHP requires that any activities conducted on its behalf be performed or approved by a hydrometric operator that has implemented a quality management system (QMS) that has been accepted by the NHP. NHP activities include:

a) design and development of standards, procedures or monitoring systems;
b) collecting, verifying or computing data or information;
c) providing archive management; or,
d) providing data and information services

NHP Contributed Data Policy:

1. Any hydrometric operator that has implemented, and is compliant with, a QMS that is accepted by the NHP may contribute hydrometric data and information directly to the NHP. No additional reviews or inspections of these data and information will be required.

2. All other hydrometric operators must submit their hydrometric data and information to a hydrometric operator that has a NHP accepted QMS for their approval. The process for approving submitted data shall include quality assurance audits that will examine:
    - the approaches used to collect and produce data and information to ensure that those approaches can achieve the accuracy requirements of the NHP National Standards;
    - the processes and procedures applied to ensure the appropriate approaches are used and are applied correctly;
    - the associated documentation including hydrometric station operation records; and,
    - the format in which the data and information is being submitted to ensure that it is acceptable for ingestion by the NHP.

    The frequency and sample size of these audits may vary dependent upon the producer's past history of providing hydrometric data and information and the volume of data being submitted. The hydrometric operator submitting data and information is responsible to compensate the hydrometric operator that conducts the audits.