British Columbia | Ministry of Environment

Technical Guidance 4

Environmental Management Act Authorizations

ANNUAL REPORTING UNDER THE ENVIRONMENTAL MANAGEMENT ACT

A Guide for Mines in British Columbia

Version 1.3

May 2016

Environmental Protection Division

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Acknowledgements

This guide is based on previous annual reporting guidance documents produced by staff in several regions of the BC Ministry of Environment, Environmental Protection Division, and by Les McDonald, R.P. Bio. of Spirogyra Scientific Consulting for the BC Ministry of Environment. A previous draft was edited by Norm Zirnhelt, R.P. Bio. of Cariboo Environmental Quality Consulting Ltd. with review by Environmental Protection Division staff from throughout the province. The present version includes additional edits considerate of review comments provided by the Mining Association of British Columbia in June 2014. The additional edits inclusive of final format changes were compiled by Ed Stockerl, R.P. Bio. of ECS Environmental Compliance Services.

Glossary and Acronyms

Glossary

Approved Water Quality Guidelines:
As per BC Ministry of Environment policy, to proceed with guidelines derivation, certain minimum toxicity and environmental fate data requirements must be met. Once draft guidelines are developed, they have to be approved by the Province before being added to the BC Approved Water Quality Guidelines. These guidelines help define what is clean and safe water in B.C.

BC Water Quality Guidelines (BC WQGs):
A maximum and/or minimum value for a physical, chemical or biological characteristic of water, sediment or biota, applicable province-wide, which should not be exceeded to prevent specified detrimental effects from occurring to a given water use (e.g., aquatic life), under specified environmental conditions. BC's Approved and Working WQGs can be found at the following website: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html

Designated Water Uses:
BC WQGs and Site Specific Water Quality Objectives protect specific designated water uses. These include source drinking water, aquatic life (and their consumers), wildlife, agriculture (livestock watering and irrigation), recreation, aesthetic, and industrial supplies.

Science Based Environmental Benchmarks (SBEBs):
Is a quantifiable receiving environment parameter or attribute developed by qualified professionals through a rigorous scientific process with the intent to guide management decisions and mitigative actions for a regulated activity at a specific location.

Water Quality Objectives (WQOs):
WQOs, also known as Site Specific Water Quality Objectives (SSWGOs), are science-based tools that provide an effective basis for managing aquatic ecosystems. They are based on the BC WQGs and prepared on a site-specific basis, with due regard for the water quality, water uses (including aquatic life), water movement, and waste discharges at a given location. Once approved and signed off by the Assistant Deputy Ministers of the appropriate departments, the WQOs constitute official ministry policy and provide guidance for resource managers to use in protecting water uses in specific water bodies. Where objectives have not been developed, the BC approved WQGs or Working Water Quality Guidelines are used to protect water quality.

Working Water Quality Guidelines:
The Working Water Quality Guidelines bring together guidelines that have not yet been approved by the Province. These guidelines are primarily sourced from the Canadian Council of the Ministers of the Environment (CCME). These working guidelines provide benchmarks for those substances that have not yet been fully assessed and formally endorsed by the Ministry. They will be reviewed by the Ministry on a priority basis for their formal approval and use in British Columbia. BC's Working WQGs can be found at the following website:
http://www.env.gov.bc.ca/wat/wq/BCguidelines/working.html

Acronyms

ARD	Acid Rock Drainage
ASF	Annual Status Form
CCME	Canadian Council of Ministers of the Environment
CEQGs	Canadian Environmental Quality Guidelines
DQO	Data Quality Objective
EMA	Environmental Management Act
EMS	Environmental Monitoring System
GPS	Global Positioning System
MDL	Method Detection Limit
MEM	Ministry of Energy and Mines
ML	Metal Leaching
MOE	Ministry of Environment
PEP	Provincial Emergency Program
QA	Quality Assurance
QC	Quality Control
SSWQO	Site Specific Water Quality Objective
SBEB	Science Based Environmental Benchmark
WQG	BC Approved or Working Water Quality Guideline
WQO	Water Quality Objective

1.0 Introduction

*Environmental Management Act (*EMA) permits for mine projects require annual reporting to the BC Ministry of Environment (MOE). The annual reports, which are public documents, are to include a summary of environmental incidents, tabulated and graphed monitoring data for discharges and the receiving environment, an assessment of the data by a qualified professional, and recommendations as appropriate.

This guidance document summarizes the MOE's expectations for annual reports submitted by mining companies operating in British Columbia. It also recommends a reporting format that makes it easy for the reader to recognize both compliance issues and environmental concerns. Sections 3, 4, and 5 can be used as a guide to developing a table of contents for an annual report. Section 6 details and provides guidance on the submission process.

Annual reports submitted for the 2015 calendar year and onward should follow this document. However, this guidance does not replace or alter the legal requirements of any permit, approval or regulation issued under provisions of the EMA.

2.0 Purpose of the Annual Report

The annual report should summarize the results of all monitoring required under EMA permits. Data assessment should focus on the following:

- compliance with the permit requirements and applicable legislation;
- effects of the permitted activity and any incidents in the environment;
- causes or reasons for non-compliances and effects to the environment;
- corrective action plan to address any identified non-compliance events; and
- recommendations for avoiding future impacts, incidents or non-compliance.

Annual reports help the MOE understand how the permitted discharges and reported changes in the discharge and receiving environment may result in impacts to ecosystems, designated uses and human health. The MOE will use the report to:

- identify whether spills and other incidents have been dealt with in an appropriate manner;
- determine compliance with the permit and/or applicable legislation;
- identify environmental effects or the need for further assessment;
- verify predictions of effects; and
- identify whether the permit adequately protects the environment and whether changes (e.g., permit amendments) may be required.

It is recognized that separate reports may be submitted for permit compliance and receiving environment/biological monitoring, and that the timing of these submissions may vary (e.g. permit reporting may be annual while receiving environment work may be conducted on a biannual basis). While this guidance applies to all EMA permits, separate reports or sections of the annual report, are expected for air, refuse and water / receiving environment. In some cases, a separate biological effects report or water quality report may be required. Appendix A provides an example table of contents for a situation where a separate water quality report is submitted. Permittees are encouraged to discuss deviations from this guidance document with their MOE contact.

3.0 Key Information to be included in the Annual Report

3.1. Compliance

Effluent and process monitoring results should be compared to the applicable permit requirements and limits, which need to be stated clearly in the report. These include, but may not be limited to: monitoring and reporting requirements as per the EMA permit, authorized discharge quantities and qualities, as well as applicable receiving water management levels. The latter would include Approved and Working Water Quality Guidelines (WQGs), Site Specific Water Quality Objectives (SSWQOs), and Science Based Environmental Benchmarks (SBEBs)[1]. A comparison of data to these permit limits and standards requires information to be expressed in the same manner as in the permit. For example, if the discharge limit for a specific parameter is expressed as a loading reported in kg/day, the measured discharge concentration of this parameter and the daily discharge rate should be used to calculate the loading. Discharge limits and receiving water management levels should be listed in the same table/graph as the monitoring data.

All non-compliance events should be highlighted in the report. For authorization holders with annual fees in excess of $20,000, or security in excess of $100,000, the Annual Status Form must be used to summarize compliance status for all authorization clauses. Please see Section 4.7.1 for more detail.

3.2. Spills and other Incidents

The report should include dates, times, descriptions, and a chronology of measures taken for all incidents over the year that resulted in the release of unauthorized effluent and air emissions into the environment or that resulted in non-compliance with the terms of the authorization. These would include, but are not limited to spills, discharges that bypassed authorized treatment works, and unscheduled and emergency releases. Where details of the above information have already been provided to MOE via an earlier spill report to the Provincial Emergency Program (PEP), a brief summary will suffice if the spill incident number assigned by PEP is referenced.

3.3. Management Plan Summaries

Provide a summary of activities that occurred during the reporting year related to applicable management plans in place on site (e.g. flocculant management, calcite management, etc.).

Water balance and modelling predictions should be reported, particularly as it relates to the tailings pond, planned raises, etc. For instance, are volumes in line with what is predicted and is seepage what was expected?

[1] Science Based Environmental Benchmarks are an alternative measurement using a quantifiable parameter or attribute, developed by qualified professionals using site-specific information and with the intent to inform impact assessment to support management decisions when water quality guidelines or site specific water quality objectives cannot be used.

3.4. Environmental Effects

There are numerous tools to determine environmental effects of an activity or discharge. In receiving waters, spatial (upstream versus downstream) and/or temporal (before and after) effects are often assessed. This requires monitoring of the receiving water at various locations. The results of the receiving environment monitoring program in relation to contaminant loadings from discharges are an integral part of the environmental effects assessment and thus the annual report.

The MOE has published contaminant concentration ranges that are considered protective of specific uses/users in the form of standards, objectives and guidelines. In receiving waters, WQGs apply. They are also protective levels in sediment, soil and tissue. The WQGs are based on toxicity information and provide thresholds to which concentrations are considered safe for designated uses, such as human consumption, recreation, aquatic life, wildlife, livestock, irrigation, and industrial use. In some receiving waters, site specific levels have been developed accounting for site specific factors or species composition (e.g. SSWQOs). SSWQOs are based on sound science and have gone through a provincial approval process. For discharge limit or receiving water performance objective established under a permit, the statutory decision maker may also accept other scientifically sound information.

Other impact assessment methods, such as effluent toxicity testing (bioassays) or receiving environment biomonitoring, are also often required under permits.

Monitoring results need to be summarized and impacts assessed in the annual report. All impacts and risks to designated users and ecosystems (e.g. exceedance of a BC Approved or Working WQG, SSWQOs or changes in the benthic invertebrate community due to the discharge) should be clearly identified in the report. Additional guidance regarding data presentation is provided in Appendix B.

3.5. Recommendations

In addition to the information above, the annual report should make recommendations on the following:

- how existing impacts will be resolved or minimized;
- how non-compliance and/or impacts will be avoided in the future;
- whether the monitoring program is still sufficient and effective; and
- how to enhance the monitoring program, if required.

4.0 Reporting Format

The annual report should be submitted to the ministry in electronic format in either Adobe pdf or compatible for the report body, with bookmarks as appropriate for ease of finding each section, and MS Excel or similar for data submission (typically as an appendix). The reporting outline recommended on the following pages will help ensure:

- consistency between reports from mine operations throughout the province;
- that annual report objectives are met; and
- that review by Ministry staff will be efficient and effective in determining existing issues and appropriate actions.

The following subsections (i.e., 4.1 - 4.7) provide an example of the recommended report format and detailed information needs for each subsection. The described format may be used as a basis for developing a table of contents. Additional guidance in this regard is provided in Appendix A. This guidance is most appropriate for a water quality report. However, this format can also be used as a general guide for other annual reporting submissions or for submissions designed to include all annual reporting aspects under a single cover. In this regard, some additional subsections may need to be included as described in Sections 3 and 5. This would be applicable to reporting concerning compliance, air, refuse, and acid rock drainage aspects.

4.1. Executive Summary

Every annual report under a mine permit should include an executive summary which summarizes the most important information for the reader. Since the annual report will be used to determine compliance and environmental risk, it should focus on these areas. For that reason, the following information should be summarized in the executive summary:

- Incidents of permit or regulatory non-compliance:
  - what did the non-compliance involve;
  - when did the non-compliance occur;
  - why did the non-compliance occur;
  - corrective measurements taken to resolve non-compliance;
  - preventive actions adopted to avoid reoccurrence; and
  - description of any additional monitoring/oversight that resulted (if applicable).
- Parameters with upward (or downward) trending concentrations, that approach or exceed BC Approved or Working WQGs, SSWQO, or SBEB in the receiving environment and/or that differ significantly from the background:
  - where was trend identified;
  - which parameter(s) are applicable;
  - how frequently did this occur; and
  - were any biological effects identified?
- It is recommended a summary table of the foregoing be included in the executive summary.

The executive summary should also include production rates over the past year as well as projected production rates and the projected date of mine closure.

4.2. Description of Mine Operation and Discharges

This section should briefly describe the mine activities, as well as authorized and associated discharges (including seepages and runoff). This description should be accompanied by a map showing the location of the mine facilities, activities, pollution control works, discharge points and monitoring sites in relation to sensitive receiving environment features (e.g. water bodies, water user intakes, fish bearing and spawning areas). Sampling sites should be named and clearly marked as surface vs. groundwater sites and summarized in a table. The map should also include topographic information, water collection and diversion system locations, and surface and groundwater flow directions. For larger and complex operations and sampling networks, an overview map plus several detailed maps may be necessary.

The following overviews should also be provided with accompanying rationale:

a) operational changes and progress that occurred over the previous year, including treatment works maintenance, upgrades and reclamation that has the potential to impact water quality (e.g. pit expansions, new waste rock dumps, dam raises, process changes, production changes, etc.); and

b) planned activities for the coming year (e.g. planned construction in a new area which will require a new sediment pond).

4.3. Chemical Reagents and Waste Storage

This section should include an inventory of the following (including changes to reagents if applicable)[2]:

- Hazardous products/reagents stored on site;
- hazardous waste materials stored on site and confirmation whether registered under provisions of the Hazardous Waste Regulation;
- reclaim water volume; and
- remaining storage capacity.

4.4. Incidents

This section should contain a brief description of any incidents releasing effluent (or air emissions) into the environment whether or not they violate the terms of the permit or authorization. These incidents may include process upsets, spills, issues with pollution control works, and bypasses of pollution control works that are required in the permit.

For each incident, the following information should be included:

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[2] As noted in Section 1, while this guidance applies to all EMA permits, separate reports, or sections of the report, are expected for air, refuse, & water/receiving environment. Permittees are encouraged to discuss their particular reporting requirements with their MOE contact.

- type of incident (e.g., spill, process upset)
- date and time of incident;
- location of the incident;
- date and time of incident discovery, who discovered it;
- who was notified about the incident and when (e.g., was it reported to MOE and/or PEP);
- short description of the incident including cause;
- what was done to avoid environmental impacts and rationale for these measures;
- description of any residual impacts; and
- what was implemented to avoid similar incidents in the future (rationale)?

If an incident report had been submitted to the MOE for a specific incident, it should be referenced by report title, report date and submission date. If the incident report provides details of the above information, a brief summary of the incident is sufficient under this section.

4.5. Monitoring

The report must summarize, interpret and discuss the results of all environmental monitoring as required in the associated discharge permit.

4.5.1. Monitoring Program Description

This section should briefly describe the water quality and hydrological monitoring program for effluent, seepage, surface and groundwater for the reporting year. Seasonality of groundwater levels should be assessed, as well as if there are directional changes in the flow. Groundwater contour maps are helpful (seasonal if appropriate). This is very useful to track seepage, understand surface water influences, and determine where groundwater reports to surface water.

The program description should include the following information in a table for each sampling location:

- sample site name (matching the name on the map under Description of Mine Operations and as identified in the permit), and site identifier (i.e., EMS #) assigned in the permit and MOE's Environmental Monitoring System data repository;
- if applicable, sample site description and GPS derived coordinates (in decimal degrees);
- years the site has been sampled;
- sampling frequency;
- parameters measured/analysed;
- sample collection method (e.g., grab, composite, discrete); and
- any deviation of the sampling program from the permit required monitoring and rationale.

4.5.2. Sampling Methodology

Describe all sampling methodologies and equipment used, and note any variations in data collection. Some examples where sampling methodology is critical include:

- groundwater well sampling - purging methods, volumes purged, equipment type (bailer, tubing etc.);
- in-lake sampling – sampling equipment, depths, discrete or composite;
- hydrology program descriptions:
    - methods of flow and meteorological data collection, and sampling frequency,
    - details of monitoring station maintenance and alteration,
    - photographs of the hydrometric stations used for monitoring, and
    - details of the instrumentation used, the manufacturers' rated sensor accuracy and details of calibration;
- field measurement descriptions:
    - types of measurements taken,
    - locations where field measurements are obtained,
    - type of equipment used – name and model of meter or method of data collection, and
    - calibration method and calibration schedule.

Include explanations for any gaps in the data set and provide details with respect to how these gaps can be avoided in the future. Providing the sampling methodology ensures consistency of sampling methods, serves as a record for future samplers, and allows for creation of comparable monitoring programs in the future.

4.5.3. Data Quality Assurance and Quality Control (QA/QC)

Briefly describe the Quality Assurance (QA) measures and procedures used[3].

Indicate which type and how many Quality Control (QC) samples are collected under which conditions and at which frequency.

Provide laboratory Data Quality Objectives (DQOs) used for the monitoring programs and discuss the DQO achievements for (QC) sample results of the method, field and trip blanks as applicable, duplicates or replicates. As well, lab QC results, such as of analytical spikes, surrogate spikes, certified reference samples and split samples should be discussed. Identify instances where DQOs were not achieved. Discuss how these instances were used to ensure only quality data were included into the data set and provide rationale for this approach.

For hydrometric data, using a flow velocity meter, the flow calculation information (including a "worked example") and an accuracy assessment of the goodness of fit of the manual readings to the stage-discharge curve should be included. If the worked example and supportive documentation is presented elsewhere in the report (e.g., in Hydrological section or Appendix), this should be referenced within the QA/QC discussion. Report the residuals as percentage deviations from the curve from each manual gauging and the mean deviation (with standard error) for all manual gauging for that year. Include when staff gauge benchmarks were last checked.

QC sample results should be tabulated with Relative Percent Differences calculated, in an appendix, however they have to be discussed under this section.

[3] See the BC Field Sampling Manual **http://www.env.gov.bc.ca/epd/wamr/labsys/field_man_pdfs/fld_man_03.pdf**

4.5.4. Hydrological and Flow Monitoring Results

If the permit requires discharge flow measurements and/or hydrological monitoring in the receiving environment, flow data should be included in the report.

Discharge flow results should be summarized in an appendix and any exceedance of permitted discharge flow limits identified in the text under this section. This section should also include discussion about the causes for the permit exceedance(s), the potential environmental risks and any corrective and/or preventative measures taken to ensure the cause of the non-compliance is not ongoing and that similar non-compliance situations do not occur in the future.

The receiving water hydrology of the reporting year needs to be plotted in an annual hydrograph that also shows the average annual hydrograph based on available data from flows before mine influence. Hydrometric station records that indicate details with respect to manual gauging should be included in the appendix (i.e. plots of the hydrology information taken from pressure transducers on site, with spot measurements taken with flow meters and v-notch weir or flume estimates, data gaps, and quality assurance checks of the raw data).

4.5.5. Water Quality Monitoring Results

Provide and discuss water quality monitoring results for effluent, seepage, runoff, surface water and groundwater under separate sub-sections. Toxicity test results should be included here or in an Appendix.

It is suggested that all current year's raw water quality data be tabulated in an Appendix and the last 10 years (if available) be provided in a digital format (for MOE to review trends). It is acknowledged that this is site specific[4], and for large data sets, paper plots could be provided for the priority parameters including baseline, then alternate years plotted for example. In circumstances where baseline data is not available or insufficient to allow data comparisons, this limitation should be clearly described in the report.

Summary statistics should be provided in a table and graph format, and highlight values that indicate non-compliance and/or exceedance of safe levels for parameters that:

- show a trend over time and space (e.g., upstream and downstream of a mine activity or discharge);
- exceed permit limits; or
- approach or exceed WQGs, SSWQOs, or SBEBs in the receiving water.

These data summary tables and graphs (where applicable) should be designed to enable an easy comparison of the data to baseline, impact predictions (from the permit application or impact assessment stage), permit limits, WQGs, SSWQOs, SBEBs or permit related site performance objectives. Values that exceed permit limits and safe levels should be clearly highlighted in the table. At the same time, tables should be suitable to enable easy spatial (upstream vs. downstream) and temporal comparison.

[4] The permittee should discuss site specific requirements with the appropriate MOE contact.

Summary statistics should include:

- minimum;
- maximum;
- mean;
- median;
- standard deviation;
- standard error;
- method detection limit; and
- sample size and percent non-detects.

Contaminant concentrations should be graphed in a way that allows comparison of reporting year data to concentrations over the last five years (total of six years) - for example, baseline sampling year(s) and predicted concentrations. Graphing by sampling period (e.g. by month and year) allows for identification of seasonal trends in the last six years. Additional years (i.e., more than 6 years) may be graphed if required to demonstrate seasonal trends. Trend lines and associated regression (R^2) values should be added to show trends over time. The graphs should also include applicable permit limits, WQGs, SSWQOs or SBEBs and should be in colour. Figures 1 and 2 provide examples for graph options that meet the above information requirements. Figure 3 provides an example of an effective means for comparative illustration of temporal and spatial data. Additional guidance related to data presentation and use of regulatory guidelines inclusive of those for groundwater is provided in Appendix B.

To allow proper comparison to previous impact predictions, modelling information for these predictions (such as prediction percentiles) should be provided.

All data tables and graphs should clearly indicate the method detection limit (MDL) and how detection limits that changed throughout the study are being handled. Statistics should be calculated using 0.5 of the MDL. Graphs should equally show that value for all data below the MDL. Note that it is important that MDLs are less than the applicable WQGs or SSWQOs, preferably by at least one order of magnitude.

In order to compare data to chronic guidelines (average or geometric mean guidelines), the average or geometric mean of 5 weekly samples should be calculated as described in the guideline. Values that are less than the detection limit should be graphed as 0.5 of the method detection limit. Since WQGs for most metals are for total concentration, total metals concentrations need to be shown. The exception is aluminum for which dissolved concentration should be graphed. Also, WQGs for iron include criteria for both total and dissolved concentration and therefore dissolved concentration also should be included. Note that dissolved metals concentrations may be graphed where total metals concentrations exceed WQGs and a permittee wants to calculate the percentage of particulate metals available for potential removal by settling.

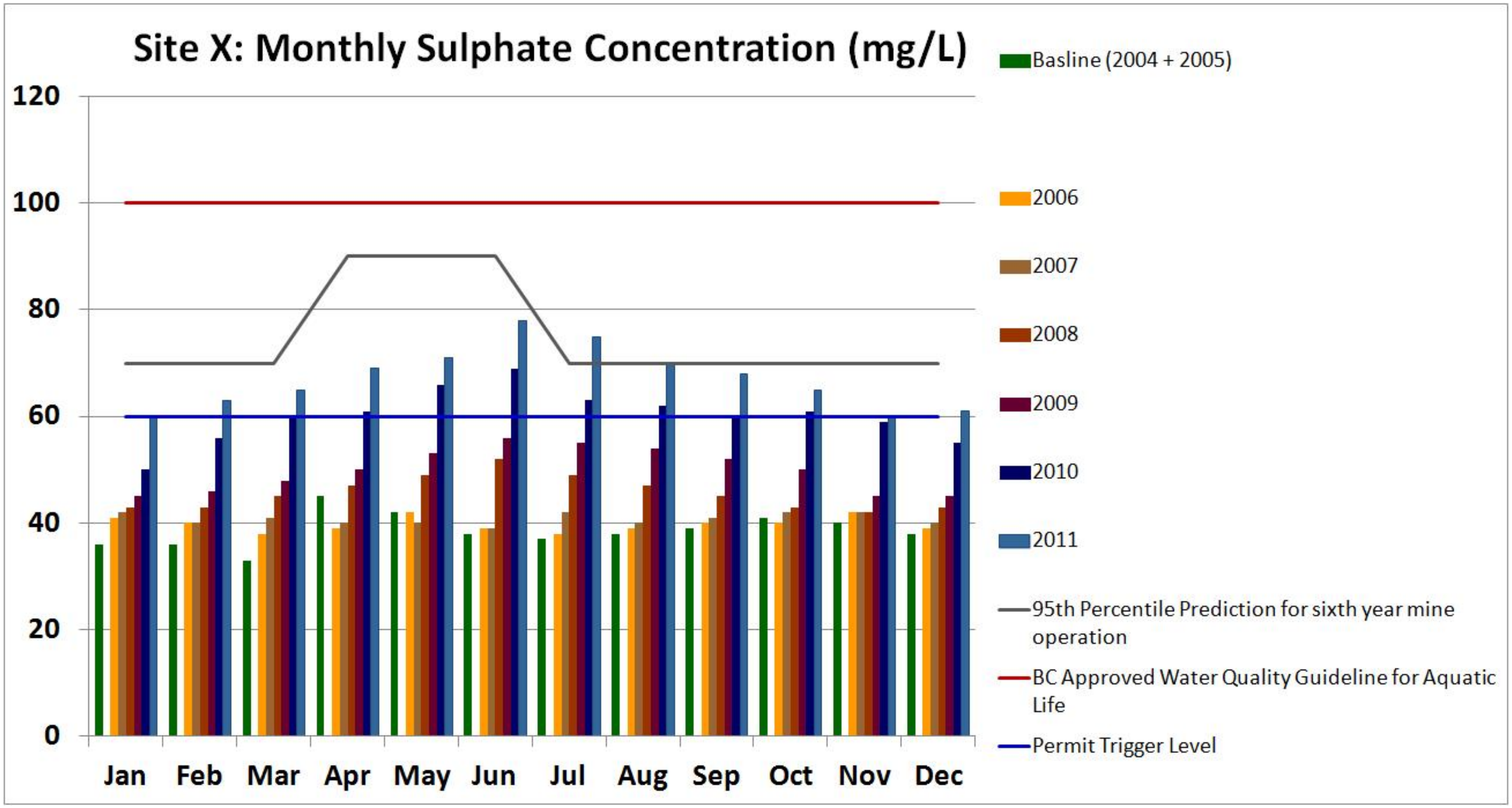


Figure 1: Example of a Graph that allows comparison of monthly data over the last six years to baseline, predicted values, permit limits and/or safe levels. Method Detection Limit: 0.5mg/L

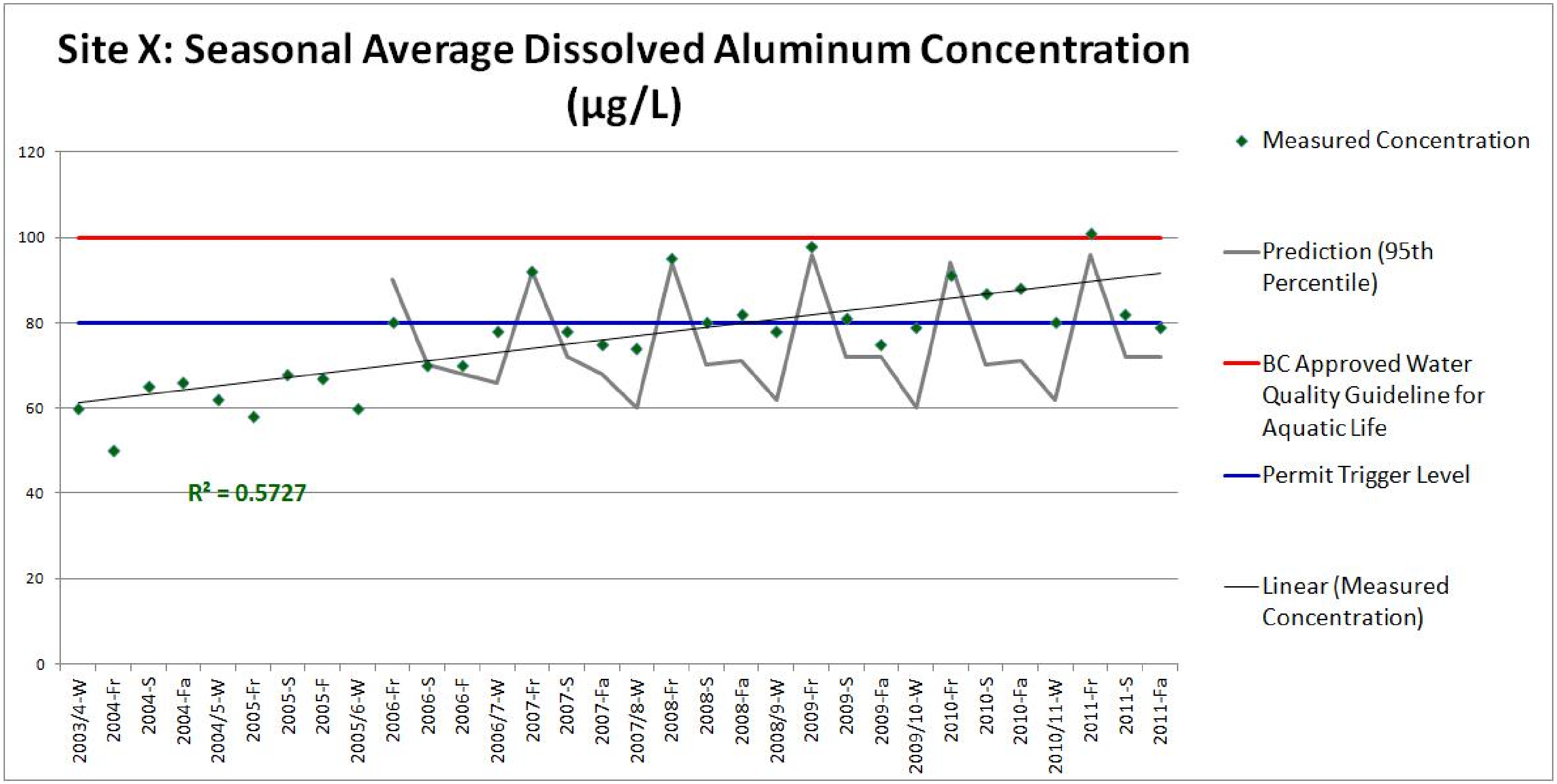
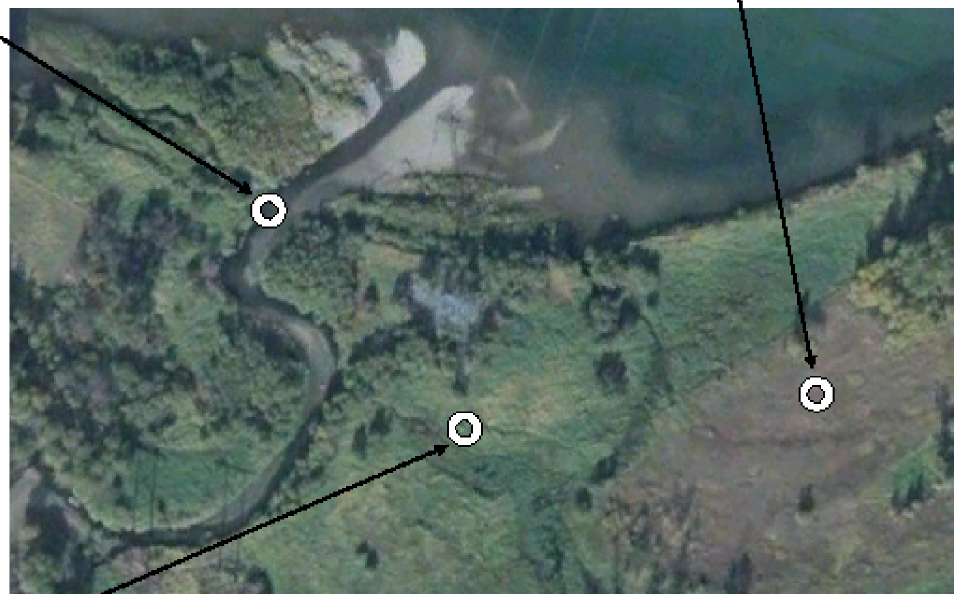


Figure 2: Example of a Graph that allows comparison of seasonal averages over the last six years to baseline (2004/2005), predicted values, permit limits and/or safe levels. Method Detection Limit: 01µ/L)

Winter (W): n=3 (Dec, Jan, Feb), Freshet (Fr): n=5 (5x/30days), Summer Low (S): n=3 (Jun, July, Aug), Fall (Fa): n=3 (Sep, Oct, Nov

Sample ID	Site 01				
Date sampled	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012
Cd (mg/L)	0.15	0.20	0.20	0.11	0.10
Cu (mg/L)	9	8	11	7	9
Pb (mg/L)	0.2	0.2	0.5	0.3	0.4
Ni (mg/L)	0.7	0.6	0.4	0.2	<0.2
Zn (mg/L)	12	12	15	13	16

Sample ID	Site 03				
Date sampled	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012
Cd (mg/L)	0.26	0.35	0.33	0.21	0.20
Cu (mg/L)	13	16	17	15	12
Pb (mg/L)	0.6	0.4	0.4	0.9	0.8
Ni (mg/L)	1.0	1.3	2.0	1.2	1.2
Zn (mg/L)	23	20	20	34	37



Sample ID	Site 02				
Date sampled	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012
Cd (mg/L)	0.22	0.30	0.31	0.24	0.20
Cu (mg/L)	14	14	22	16	15
Pb (mg/L)	0.4	0.4	0.7	0.6	0.4
Ni (mg/L)	1.4	1.2	1.8	1.4	1.3
Zn (mg/L)	18	17	16	22	25

Figure 3: Example of a Graph that allows comparison of temporal and spatial data

4.5.6. Data Interpretation

The discussion should identify any permit limit exceedances, information on why the exceedances occurred, what environmental risk the non-compliance posed, and what was done (or is planned) to deal with the non-compliance (or to avoid such a permit exceedance in the future).

The text should clearly identify the effects of the mine activities and discharges on the receiving water based on temporal and spatial trends as well as a comparison to baseline conditions and changes in discharge volumes or concentrations.

Parameter concentrations in the receiving water that approach (i.e., are above 80% of the guideline) or exceed the safe management levels (WQGs, SSWQOs, SBEBS) or any permitted levels need to be identified. Causes and environmental risks of the exceedances should be discussed and should conclude with recommendations for actions to deal with the identified issues in a way that ensures protection of the environment and of designated water uses.

A comparison of receiving water parameter concentrations to impact predictions (made during the project application/amendment application phase) helps to verify predictions and to identify potential unforeseen issues. Should impact predictions turn out to be significantly lower than measured receiving water parameter concentrations, this section needs to provide planned actions to ensure continuous environmental protection. An assessment should be made of potential cumulative impacts (e.g. additive or synergistic effects).

Data interpretation, conclusions and recommendations should be signed by an appropriate qualified professional.

4.6. Summary and Conclusion

Provide a summary of the major report findings, conclusions and recommendations including proposed program changes and/or permit amendments for the upcoming year.

4.7. Appendices

Include appendices as required and appropriate.

4.7.1. Annual Status Form

Authorization holders with annual fees in excess of $20,000, or security in excess of $100,000, are required to submit an Annual Status Form (ASF) as an appendix to an annual report. The ASF provides a comprehensive review of your authorization's compliance status. The following documents provide instruction and templates for the ASF:

- FAQs[5] (PDF)
- Annual Status Form Template[6] (Macro-enabled XLS)
- Examples[7] (PDF)

5.0 Additional Reporting Requirements - Refuse, Air, Reclamation, Acid Rock Drainage

Note that inclusion of additional sections into the annual report document is expected in order to address reporting requirements pertaining to any other authorizations issued by the Ministry of Environment. This may include air and refuse permits, acid rock drainage and perhaps receiving water environment. Alternatively, the permittee has option to submit separate documents for these aspects.

5.1. Refuse and Air Discharge Permit Summary

A refuse discharge summary should include:

- a site map with refuse discharge locations;
- the annual volume of refuse buried;
- the annual volume of material recovered and recycled;
- the annual sludge disposal volume;
- a description of site maintenance activities; and
- a table detailing how human wildlife interactions and the wildlife issues were avoided.

An air discharge permit summary should include:

- site map with discharge and monitoring locations;
- summary table of air quality monitoring sites, frequencies and parameters;
- compliance summary;
- methodology;
- quality assurance / quality control;
- analysis and interpretation; and
- graphs and data tables as appropriate for data summary.

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[5] http://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/datamart/asf_faq.pdf
[6] http://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/datamart/asf_template_instruction.xlsm
[7] http://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/datamart/asf_examples.pdf

Also include the relevant information for any other authorizations issued by the Ministry of Environment that require annual reporting as a condition of the approval. Additional information may be included in the annual report document or under a separate report submission. This may include reporting related to Approved waste management plans such as land farm treatment of petroleum hydrocarbon contaminated soils.

5.2. Reclamation

A summary of reclamation activities must be submitted to the Ministry of Energy and Mines (MEM). MEM requirements can be found at:

http://www.empr.gov.bc.ca/MINING/PERMITTING-RECLAMATION/Pages/AnnualReporting.aspx

5.3. Acid Rock Drainage and Metal Leaching Programs

Due to the joint assessment of acid rock drainage (ARD) and metal leaching (ML) with the MEM in some regions, studies relevant to the ongoing ARD/ML assessment and data collection may be submitted to the MOE under separate cover.

6.0 Data and Report Submissions

All linked documents are available on the Data and Report Submissions[8] webpage

6.1. Routine Environmental Reporting Submission Mailbox

All annual reports requiring submission to the Ministry should be named according to MOE conventions and sent to the Routine Environmental Reporting Submission Mailbox at EnvironmentalReporting@gov.bc.ca to ensure efficient filing and processing of documents received. Guidelines on how to name the files and email subject lines are available in the online Naming Conventions Guidance Document[9]. For more guidance, please consult the FAQs[10].

8 http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions

9 http://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/datamart/rersm_naming_convention.pdf

10 http://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/datamart/rersm_faq.pdf

6.2. Environmental Monitoring System Data Uploads

All effluent authorizations with annual discharge fees exceeding $20,000 or securities exceeding $100,000, and some larger municipal authorizations related to Liquid and Solid Waste Management plans, as well as all authorizations where upload of effluent monitoring data is currently an authorization condition, must upload the data to the MOE Environmental Monitoring System (EMS). If applicable, please review the following documents for more information.

- FAQs[11] (PDF)
- Step-by-Step Guide[12] (PDF)

For detailed information and instructions on how to upload data to EMS please visit the Environmental Monitoring databases page[13].

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[11] http://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/datamart/ems_faq.pdf

[12] http://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/datamart/ems_step-by-step_guide.pdf

[13] http://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/reporting/environmental-monitoring-databases

APPENDIX A - Example Table of Contents for a Water Quality Report

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APPENDIX B – Data Presentation

Recommendations for Data Presentation

The most common type of monitoring data required under EMA is time-series data, where a fixed location or site is sampled repeatedly over time. Such data are usually presented in table or graph formats. These data can become quite voluminous and statistical summaries are often used to simplify their presentation. To place monitoring data in context, downstream/exposed sites are often compared to upstream/reference sites. Data are also compared to regulatory limits or official guidelines. The following provides some guidance for the proper use of these techniques in describing time-series data.

Regardless of the method used for summarizing and presenting monitoring data, reports must always append the raw data measurements in tabulated form. The most common way this is organized is by having one table for each site with the variables analyzed in rows and the sample dates in columns, variations on this format depend on the nature of the monitoring program. Examples are provided at the end of this appendix. Certificates of Analysis from the analyzing laboratory are sometimes attached to annual reports but this is not necessary. When not appended, some explanation should be included in the report where the Certificates of Analysis can be obtained upon request.

Use of Statistical Summaries

The most common statistic used to describe time-series monitoring data is the mean value which is a representation of the central tendency of a population of numbers. Providing the data are normally distributed, the arithmetic mean is a reasonable representation of the entire set of test results in a single value. It must, however, be accompanied by some additional representation of the distribution (e.g. number of results (n), maximum, minimum and standard deviation). In the report text, a common way to describe a set of values is to report the mean ± one standard deviation. The standard deviation statistic gives an indication of how the data are clustered around the mean. A mean of 10 ± 2 indicates the data are tightly clustered around the mean and that the mean strongly represents all the measurements. A mean of 10 ± 15 indicates the data have a very wide distribution and that the mean poorly represents all the measurements.

Regardless of how the data are manipulated statistically, reports must always include an appendix with the actual calculations, manipulations, or transformations performed on the raw data.

Use of Regulatory Limits and Environmental Guidelines

Comparison of sampling data against regulatory limits is the primary purpose for monitoring. Reporting regulatory limit compliance must be quantitative, noting each incident where limits were exceeded including the magnitude over the limit and any known reasons. In addition to the raw data, compliance summaries are useful and must include some expression of the frequency (e.g., percentage of non-compliant samples) and magnitude of non-compliances. Examples might include highlighting non-compliant results in tables, possibly using different colours for ranges over the limit, or summary tables of non-compliances against the total number of samples and including ranges of magnitudes over the limit.

Variables for which monitoring is required but that do not have regulatory limits should be compared to appropriate environmental guidelines. These guidelines all apply to the "receiving environment", either upstream or downstream of the discharge, and should not be applied to in-plant or pre-discharge sites. For large industries like mines, defining drainages as receiving environment is not always easy. A good rule-of-thumb is if it can be accessed by fish, it is a receiving environment. Always check with the MOE impact assessment biologist to confirm.

Environmental guidelines are often erroneously applied. Guidelines for drinking water are often used, probably under the misconception that these are the most rigorous and protective. Indeed for many variables, the protection of aquatic life is almost always the most sensitive use. Regardless, if drinking water withdrawal is not an existing use on a given waterway, the guidelines for its protection should not be applied.

The hierarchy for correct use of environmental guidelines for groundwater and surface water is as follows:

Groundwater:

1. ***BC Contaminated Sites Regulation*** guidelines (Schedule 6 – Generic Numerical Water Standards) should be used when evaluating groundwater monitoring results for wells located >10 m away from the high water mark of an aquatic receiving environment. Technical Guidance on Contaminated Sites # 15 provides additional information on the application of the Schedule 6 standards to groundwater. (http://www.env.gov.bc.ca/epd/remediation/guidance/technical/pdf/tg15_2013.pdf)

Surface Water:

1. The most current **BC Approved Water Quality Guideline** (http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html). If none have yet been established, use:

2. The most current value in **A Compendium of Working Water Quality Guidelines for British Columbia** (http://www.env.gov.bc.ca/wat/wq/BCguidelines/working.html). If neither of these has yet been established, use:

3. The most current **CCME guideline** (http://ceqg-rcqe.ccme.ca/).

In all cases, the guideline for the most sensitive existing water use for the receiving environment location in question is the one which should be used. For example, the correct total cadmium guideline for a site on a major river with a same-day hardness of 65 mg/L is 0.023 µg/L. This is the CCME guideline for the protection of aquatic life (at the time of writing there are no approved BC guidelines for cadmium) and is represented by the algorithm $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ where the hardness is given as mg/L $CaCO_3$ equivalent. This is the correct guideline to use even if there were a drinking water withdrawal immediately downstream because the CCME drinking water guideline for total cadmium is 5 µg/L, a much higher value and thus a much less sensitive water use.

Time-series Graphing

Discharge permit or regulatory monitoring tests fall into two categories: physical condition measurements (such as temperature or pH) and laboratory analyses of discrete samples (usually to determine the concentration of an element or compound of concern). In both cases, testing for one or more variables is often done at several sites repeatedly over time. Sampling intervals for *in situ* metered physical conditions can be very short (seconds) generating huge quantities of data. Laboratory analyzed samples are rarely taken at intervals shorter than hourly, and once per month is probably the most common sampling frequency.

The data generated by such sampling programs is referred to as “time-series” data, and is best displayed using time-series graphing, where the condition or concentration of the variable is plotted on the y-axis, against time or date on the x-axis. The following, in no particular order, are some guidelines that should be followed when representing regulatory monitoring data using time-series graphs:

1. As a rule, separate time-series graphs should be produced for each variable. Although, two or possibly three variables are sometimes included on one graph if there is a relationship between variables that one wishes to evaluate or illustrate.

2. For one-variable graphs it is common to include several sites (Figure 1). The maximum number of sites depends largely on the “busy-ness” of the graph and would seldom exceed eight or ten. Site selection can sometimes be narrowed by hydraulic relationships (e.g. all sites in a sub-basin).

3. Time-series graphs should be continuous from year-to-year (Figure 2), with each subsequent year’s data added to the previous year’s graph. This is the best way to

evaluate and illustrate developing trends, or the lack thereof.

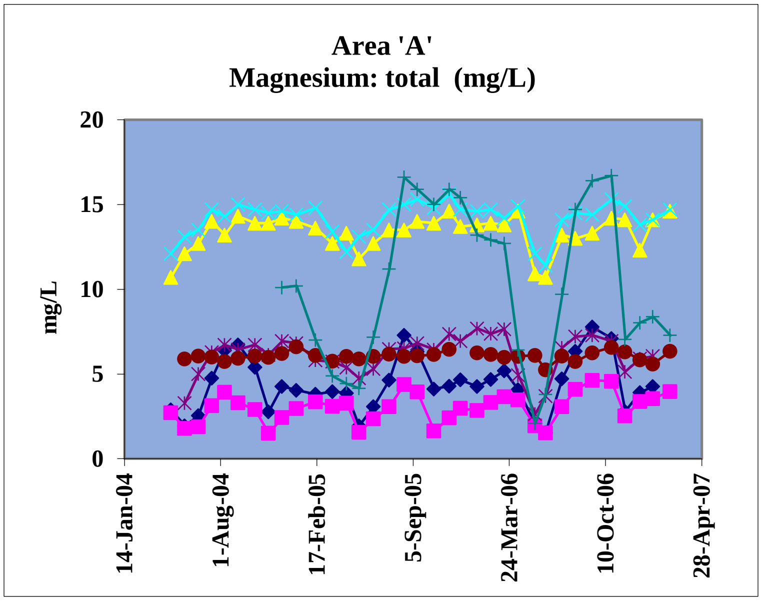


Figure 1. Three years of Total Magnesium sampling on seven different streams in the same vicinity. Some sites are hydraulically connected, i.e., one on a tributary upstream of another (e.g., turquoise x's u/s of yellow triangles) and these details should be explained in the report text.

4. If several graphs are being displayed together on one page for the purposes of comparison, it is imperative that the x- and y-axis be identical in each graph so as not to deceive the eye of the reader (Figure 2).

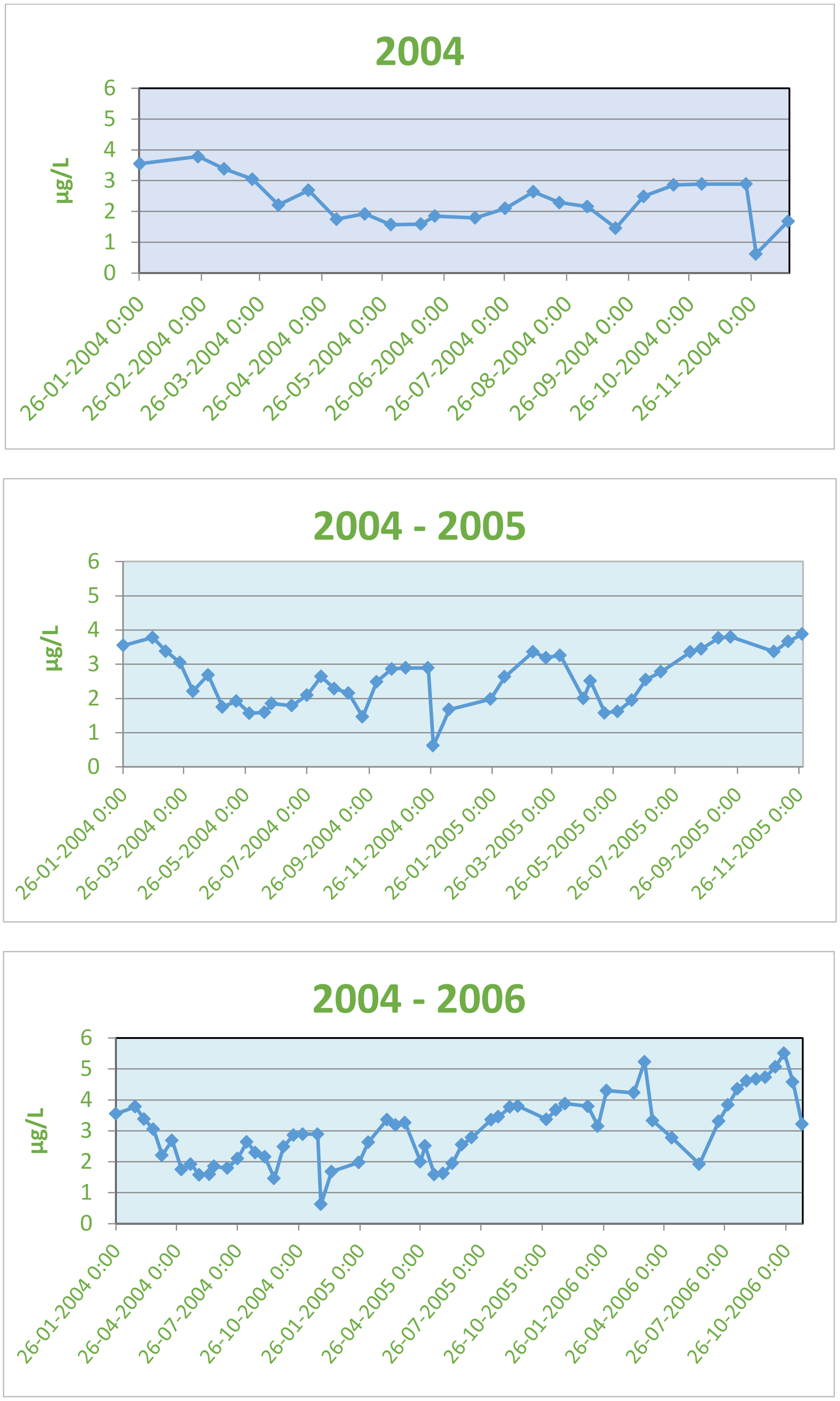
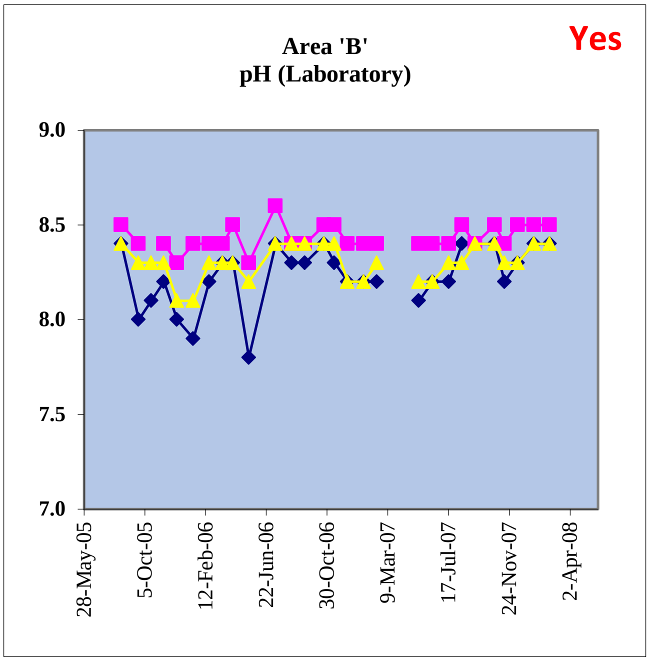


Figure 2. Total Selenium: Elk River at Highway 93, 2004 through 2006. Note y-axis scale is identical in each graph.



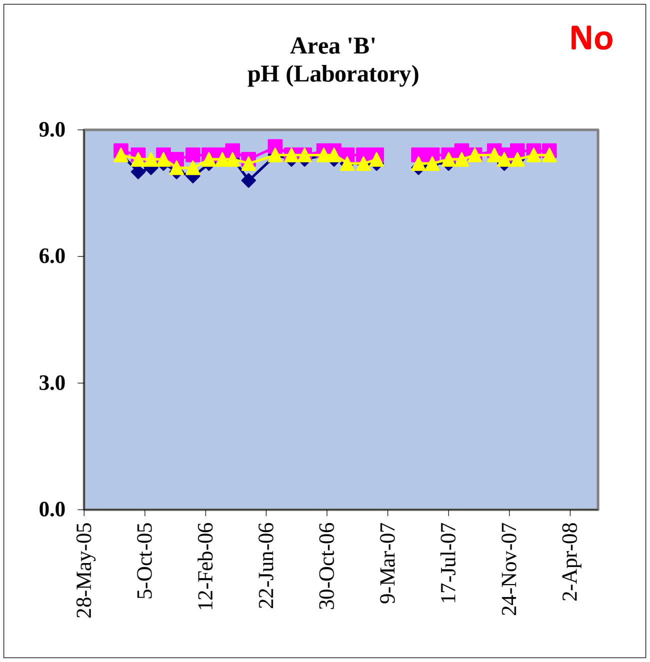
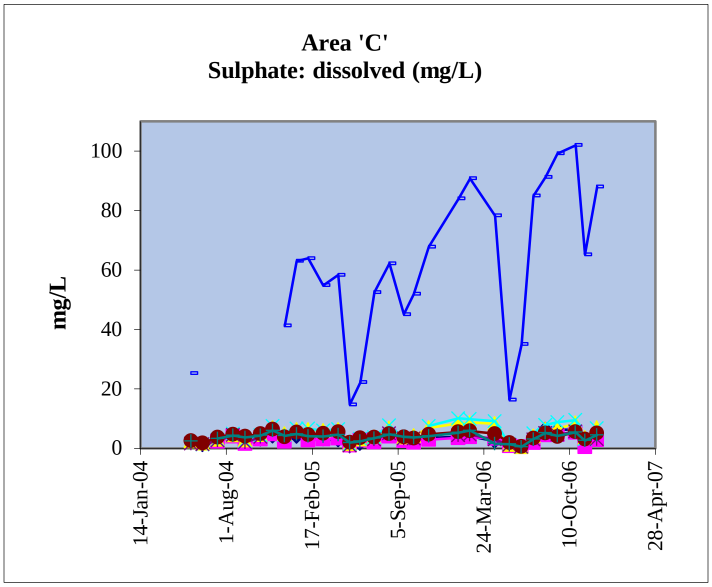


Figure 3. pH at three stream sites measured in discrete samples at the laboratory. Setting the appropriate range for the y-axis scale better illustrates the site differences.

6. Multi-site graphs may require the use of a logarithmic y-axis scale when the range of values between sites is large. Logarithmic graphs also compress the highest values so it may be advisable to include both linear and logarithmic scale graphs (Figure 4).



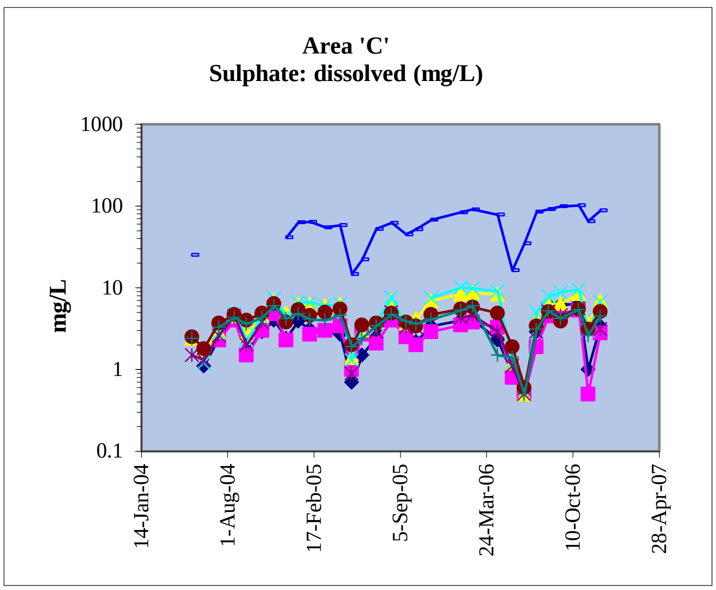


Figure 4. Three years of sulphate sampling from seven sites in the same vicinity. One site has much higher concentrations than the others, adding a log-scale graph shows some separation in the other six sites.

7. It is instructive to include permit limits, regulatory standards, or guidelines on time-series graphs but these should not be used to determine the range of the y-axis scale. A labelled line is useful but should only be included if its value falls in, or is close to, the range of values of the data being graphed (see Figures 5 & 6). If this is not the case, the guideline/limit value should merely be included on the graph in a text box. It is imperative that such limits or guidelines be the most current version and their source be cited.

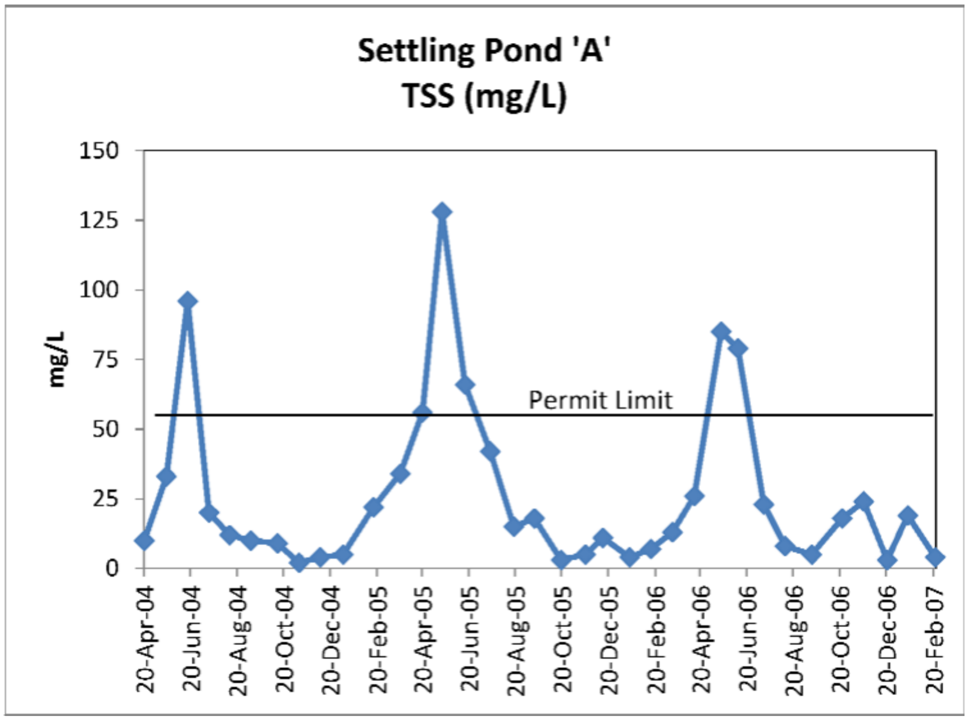
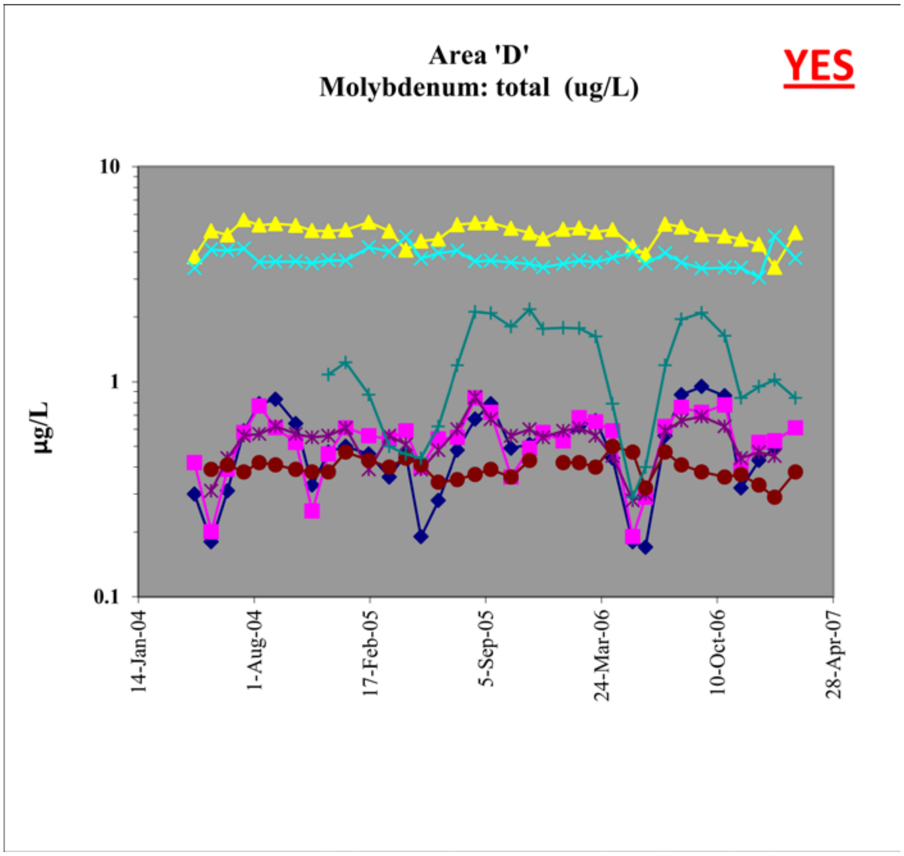


Figure 5. Discharge site with permit limit noted on graph.



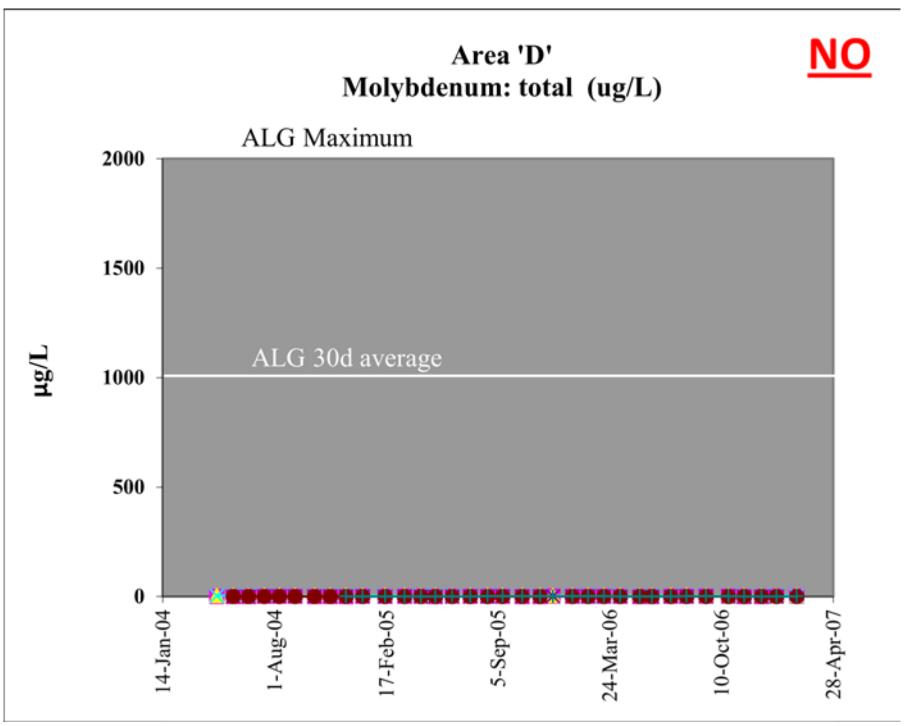


Figure 6. Two examples of the use of guidelines on graphs, the lower graph has a y-axis scale based on guideline values causing all the site comparison detail to be lost. The upper graph is the correct way to present the data and include the guidelines.

8. Guidelines and objectives for metals are often hardness-dependent, changing with the hardness of the water being tested. Further, many guidelines have maximum and 30-day average values. These must be calculated for each sample date, based on the hardness at the site, and plotted along with the variable in question (Figure 7).

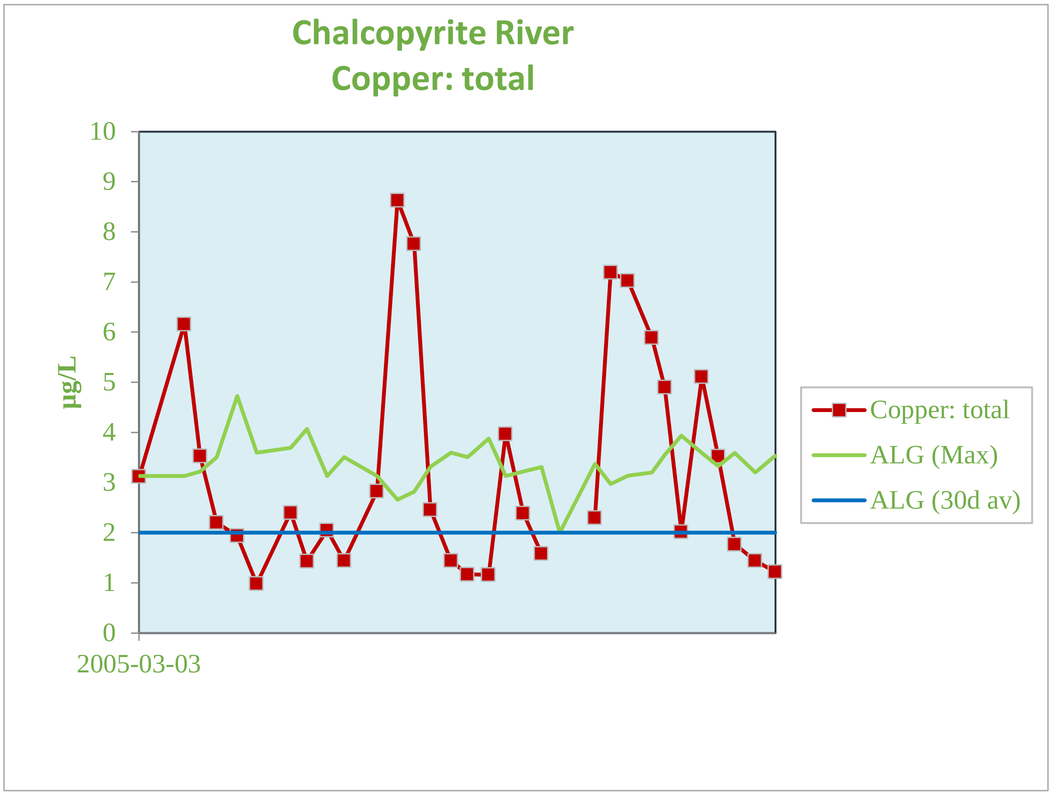


Figure 7. Three years of monthly Total Copper from a river site. The maximum copper guideline for the protection of aquatic life is [0.094(hardness) + 2], where the hardness is reported as mg/L $CaCO_3$. The 30-day average is ≤ 2 µg/L when the average hardness is ≤ 50 mg/L. The hardness at this site varied between 8 and 29 mg/L so the 30-day average guideline was 2 µg/L at all times. The maximum guideline was calculated for each sample from the hardness on that day. This graph shows that the maximum guideline was exceeded in 10 of 32 samples, or 31% of the time. Proper evaluation of the 30-day average guideline requires sampling at least five times in a 30-day period and thus cannot be properly evaluated from these data. Including the 30-day average guideline on the graph is still instructive though the inadequacies of the data must be pointed out.

9. Occasionally the physical location of sample sites changes. As a rule, this will mean a new site is established, which on a graph will start when data gathering on the old site ceases. It may be permissible to join the old and new site data into a single series, if the location change is minor and does not include additional upstream inflow that can be expected to affect the analyte concentration. It is, however, **never** permissible to do this without flagging or labelling this change on graphing following the change.

10. Graphs must also include flags and labels if changes are made to analytical laboratories or methods (particularly those which involve changes in method detection limits), or sampling procedures (e.g., changes in sample preservation).

11. Time-series graphs are of limited value when a large percentage of the data set is censored, i.e., less than (<) the analytical detection limit. As a rough guide, graphs should not be produced if greater than 75% of the data is censored, and a list of such variables should be noted in the report.

12. Graphs are a good method of identifying outlier values (values that are markedly outside of the normal range of results for a particular variable at a site). If graphs are linked to databases and updated as new data becomes available, outliers that are due to lab errors can be caught early enough to have the samples re-tested, thereby correcting the erroneous value(s). If this is not possible, but the cause of the outlier is known, an explanation should be included in the report text. Never allow the outlier value to determine the scale of the y-axis, particularly if this causes a loss of detail to the rest of the data.