ABMI PHOTO-PLOT

QUALITY CONTROL MANUAL

Alberta Biodiversity Monitoring Institute

Remote Sensing Group

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1. INTRODUCTION

Inventories provide the basis for biodiversity monitoring by offering a baseline for change and trend analyses. ABMI has developed a mapping protocol (described in a germane document entitled ABMI Photo-Plot Interpretation Manual, v2.4.1) for preparing inventories with information on habitat and human footprint[1] characteristics for each of the 1,656 3 by 7 km rectangles (called photo-plots) within which ABMI terrestrial field plots are located. The data format chosen to store these inventories is the ESRI File Geodatabase (FGDB), a spatial data format that is a *de facto* industry standard. The ABMI FGDB (described in a germane document entitled ABMI Photo-Plot Data Model, v2.4.1) contains as many individual **feature datasets**[2] as photo-plots. Each feature dataset consists of 5 **feature classes**[2]:

ABMI_PPLOT – a polygon feature class that act as a metadata container and summary for the rest – comprise the core and buffer boundaries of the photo-plot. It also includes a time stamp to differentiate between the ongoing compilation and future ones (updates and/or remaps).
ABMI_POLYGON – a polygon feature class with all the polygons within the photo-plots.
ABMI_POINT – a multi-point feature class containing points related to polygons.
ABMI_LINE – a multipart polyline feature class that contains all line features.
ABMI_RSFIELD – a point feature class containing points related to field verification of the photo-plot interpretation. **NB**. Not yet implemented in this version.

Standards for any natural resource inventory are required to ensure that the needs of the users are met, and that the data are collected and stored in a consistent manner, greatly facilitating data use and exchanges among the users. ABMI carries out audits to ensure that the defined standards are met and that the interpretation has the high quality required for reliable monitoring. This manual describes in detail the quality control (QC) procedures used in those audits.

2. OBJECTIVES

The audit process will validate the accuracy and quality of the inventory information by reviewing both the interpretation and file geodatabase (FGDB) integrity. Specific objectives include:

[1] Human footprint is the physical extent of areas under human use that either lost their natural cover long ago (e.g., cities, roads, agricultural land) or whose cover is periodically or temporally replaced by resource extraction activities (e.g., forestry, surface mining)]

[2] A feature dataset is a collection of feature classes stored together that share a coordinate system, and that their features fall within a common geographic area. A feature class in turn is a collection of geographic features with the same geometry type (such as point, line, or polygon) and the same attributes. Finally, a feature is a geographic object or phenomenon that can be discretely identified or measured in spatial data collection.

1. To ensure the observance of ABMI photo-plot mapping standards by extensively checking both spatial standards, and attribute integrity and completeness.
2. To evaluate the quality of the interpretation work carried out within a given contract by intensively checking a random subset of photoplots and features.
3. To ensure the desired level of consistency is achieved between interpreters and therefore between different plots.
4. To improve the quality of all aspects of the project through evaluation and feedback.

3. Overview of the Audit Procedure

The audits will consist of two parts: (1) plot-by-plot semi-automated evaluation; and (2) manual evaluation of randomly selected photo-plots:

Part 1 is applied to each and every photo-plot within a contract and is largely based on semi-automated tools that are made available to the interpreters beforehand. Since the interpreters can ascertain on their own the compliance to the particular standards checked through these tools (i.e. by employing them), it is expected that any significant deviance from the standards will be corrected before submitting the photo-plots. Therefore any photo-plot containing errors beyond the rejection cut-off in any of the relevant standards will be immediately returned to the contractor for corrections. Topology standards and the mandatory filling of metadata attributes in the ABMI_PPLOT feature class are also checked during Part 1 audit. Should errors or omissions be found, the photo-plots containing these will be immediately returned for corrections. In the event of one or more photo-plots being returned to the contractor for correction, Part 2 will be delayed until all submitted photo-plots comply with the standards evaluated in Part 1.

Part 2 is applied to only a portion of the photo-plots comprising a contract. A minimum of 25% of the photo-plots completed by the contractors will be randomly selected for audit. The selection will be made so that all individual air photo interpreters who worked on the ABMI photo-plots comprised in a contract will at a minimum have one photo-plot audited. Should the number of interpreters exceed 25% of the photo-plots interpreted as part of a contract, the minimum of one photo-plot per interpreter will be maintained in determining the number of plots selected for audit. To guarantee that each of a contractor's photo interpreters who worked on the contract is selected for audit, it is mandatory that all fillable attributes from the ABMI_PPLOT feature class be completed before submission for audit (hence, this being checked in Part 1 of the audit process). Part 2 will include a thorough assessment of interpretation quality for a randomly selected subset of features in each audited plot, as well as a series of visual checks to be conducted over the photo-plot as a whole. Further details are provided in the sections that follow.

In order to avoid conflicts of interest and allow transparency in the auditing process, photo-plots completed by ABMI staff will be audited by an external contractor, whereas photo-plots completed by an external contractor, will be audited by ABMI staff.

The auditors will prepare a report outlining the evaluation results for all audited photo-plots in the contract. The report will include appendices for each audited photo-plot, containing the corre-

sponding evaluation forms and specific comments where appropriate. This report shall be completed no later than 30 calendar days after the auditor has received the materials for all photo-plots due for submission according to the contract schedule, if all of the photo-plots have passed the Part 1 evaluation. If photo-plots have been returned to the contractor as a result of Part 1 evaluations, this 30-day deadline will begin once all photo-plots have successfully passed this portion of the audit process. If all the audited photo-plots pass the Part 2 audit, the photo-plots for the entire submitted batch will be accepted and payment can proceed.

If the photo-plots that have been audited do not meet the pass criteria outlined in this document, the plots are to be returned to the contractor (or ABMI staff, as appropriate). In this event, the contractor is responsible for ensuring that each interpreter with failed photo-plots:

(1) corrects the reported violations to the standards;

(2) rectifies the interpretation discrepancies noted for the audited features;

(3) reviews the non-audited features and corrects similar, additional inconsistencies or errors based on identified trends; and

(4) reviews all photo-plots completed by that interpreter (i.e., including those not audited in Part 2) before resubmitting for the audit process again.

The contractor or ABMI staff shall resubmit the corrected materials (i.e., a new File Geodatabase in which the revisions have been carried out) no later than 30 calendar days after the notification of the audit results. Once the corrected materials have been returned to the auditor, another audit, not necessarily based on the same photo-plots selected in the previous audit, will be performed. This process will be repeated until the photo-plots pass the audit process. Contractors should be aware that if a photo-plot or batch of photo-plots is returned three times, the contract may be rescinded or the contract price be reduced proportionally to the amount of photo-plots in the batch.

4. Specific Criteria and Standards

The following section lists a set of standards that the interpreted ABMI photo-plots are expected to meet, the compliance to which is checked through a series of individual criteria. These criteria encompass spatial delineation and polygon size constraints, topological rules, constraints regarding the similarity of adjacent features, and the completeness and consistency of feature attributes. Some of these are evaluated through semi-automated procedures (i.e., Part 1 of the audit), while others are assessed through visual inspection (i.e., Part 2 of the audit). More detailed descriptions of each criterion are provided in subsequent sections, and include: (1) a definition of the criterion, or criteria; (2) a description of the procedure to ascertain compliance; (3) the cut-off for rejection the criterion or criteria; and where necessary, (4) other details or observations.

Given that extreme accuracy comes at cost, a 10% tolerance is in general allowed. This means that violations that deviate less than 10% of the value of the standard are as a general rule condoned and not counted as such. The usual rejection cut-off is 1% of the total number of features,

i.e., if for some criterion the proportion of faulty features or instances exceeds 1%, the product will be sent to revision

The following is the list of specific standards enforced through the ABMI Quality Control (QC) procedures:

Topology Standards

- TOPO1. Polygon feature class cannot have gaps (void space).
- TOPO2. Polygons cannot overlap.
- TOPO3. Polygons cannot have detached multi-parts.
- TOPO4. Polygon feature class must be coincident with the ABMI_PPLOT feature class (i.e., the set of polygons must exhaustively cover the buffered photo-plot and not exceed it).
- TOPO5. Lines must not overlap (i.e., be on top of each other). NB. Lines will treated independently of polygon outlines, so no spatial constraints apply between lines and polygons.
- TOPO6. Lines must not self-overlap (i.e., a line may not overlap itself).
- TOPO7. Lines must be contained by the ABMI_PPLOT feature class (i.e., they cannot exceed the buffered photo-plot).
- TOPO8. Multi-point features must not overlap.
- TOPO9. Multi-point features must be properly inside a feature from ABMI_POLYGON (meaning that (i) they should not be placed on top of a polygon outline, and (ii) all points within a multipoint feature must lie inside the same polygon).
- TOPO10. Multi-point features must be contained by the ABMI_PPLOT feature class.

Size Constraints

- SIZE1. There cannot be polygons smaller than 0.5 ha.
- SIZE2. There cannot be polygons smaller than 2 ha representing upland non-forested semi-natural vegetation within forest or agricultural land, or representing upland vegetated areas within settlements; or, there cannot be forested polygons smaller than 2ha where one or more of the adjacent polygons is mixed forest or the same type of forest (deciduous or conifer) as the polygon.
- SIZE3 There cannot be polygons representing linear landscape features (e.g. rivers, roads) that are less than 20 m width on average.
- SIZE4. There cannot be polygons containing some section (such as a protrusion or narrowing) of less than 10 m width.
- SIZE5. There cannot be bridges (a corridor that artificially connects a pocket of some landcover type with a neighbouring polygon of the same type) longer than 20 m.
- SIZE6. There cannot be isolated lines that are less than 50 m long.

NB. The SIZE3 criterion from previous versions of the ABMI3P (5 ha) has been changed in the current version of the protocols, in order to better accommodate interpretation in forested areas.

Spatial Constraints

- SPAT1. There cannot be lines (from ABMI_LINE) running parallel that at some point are less than 5 m apart (if this occurs, one of them has to be artificially offset).
- SPAT2. There cannot be points that are less than 10 m apart.
- SPAT3. The accuracy of hard boundaries (corresponding to clear edges in the image) has to be better than 10m.
- SPAT4. There cannot be polygons where the density of individual points exceeds 2 points/ha.

Adjacency Constraints

- ADJA1. There cannot be forested polygons (i.e., DENSITY = A, B, C, or D) of any size where one or more of the adjacent polygons have the same dominant over- and understory species, the SP1_PER and USP1_PER for each have the same value, the under- and over-story crown closures are less than one class apart, the site height and understory height differ between the two by less than 3 m, the moisture regime corresponds to the same up-land/lowland situation, and (where relevant) that share have the same Green Area wetland type.
- ADJA2. There cannot be adjacent non-forested polygons having the same level-3 land-cover type, the same level-2 land use type(s), and the same infrastructure type.

Standards on Feature Representation

- FEAT1. There cannot be ground features that are easily identifiable in the image and that were not mapped as they should have been according to the interpretation manual (e.g., a neglected dugout).
- FEAT2. There cannot be features whose referent on the ground is not visible in, or cannot be inferred from, the image.
- FEAT3. There cannot be points that (because of the size of the area they represent) could have been mapped as separate polygons.
- FEAT4. There cannot be lines that (because of the width of the ground feature they repre-sent) could have been mapped as polygons.
- FEAT5. There cannot be ground features that are represented as both polygon and line or both polygon and point.

Standards on Attribute Completeness, Consistency and Accuracy

- ATTR1. There cannot be orphan (non-attributed) features, except within the photo-plot buffer.
- ATTR2*. There cannot be features with empty attributes that should have been filled.
- ATTR3. There cannot be inconsistencies in the values of interrelated attributes (e.g. a lake feature with a mesic moisture regime).

- ATTR4. There cannot be invalid values stored in attribute tables (NB. This is ensured by the FGDB domains and the data entry interface).
- ATTR5*. There cannot be disagreements between the contractor and the auditor of: (1) more than one "class interval" in ordinal attributes (e.g. moisture regime, density); (2) greater than 20% in quantitative attributes (e.g. modifier percentage); (3) more than 3 m in height attributes; and (4) more than 20 years in year attributes (e.g., ORIGIN_YR, UORIGIN_YR, MODx_YR).
- ATTR6*. The value selected for a given categorical attribute by the contractor and the auditor must coincide with at least 80% accuracy. It should be noted that higher accuracy is expected in species type and percent attributes (e.g., SPx, SPx_PER with a difference of more than 20%), the White Area upland site type attribute (e.g., WAUL_TY), and the infrastructure type (e.g., INFRA_TY) attribute.

NB1. The auditor may at his/her discretion check only a subset of the criteria listed above. The minimum size of the subset is 50% of the criteria, and the set of selected criteria will be noted in the audit report.

NB2. The Contractor will be provided with a set of automated Quality Control Tools that automatically test compliance to some of these standards. A description of these tools is found in the Appendix.

NB3. Standards marked with an asterisk are evaluated in Part 2 audit.

5. PART 1: PLOT-BY-PLOT SEMI-AUTOMATED EVALUATION

Part 1 of the ABMI photo-plot quality control audit comprises the checking, for compliance to standards, of several criteria related to topology, size, adjacency and attribution. The filling of metadata attributes in the ABMI_PPLOT feature class is also verified. The Part 1 checks are largely completed through semi-automated procedures (i.e., the ABMI QC Tools described in the Appendix). For this reason, and because these tools are provided to the contractor themselves for internal evaluation, these criteria are checked for all photo-plots comprising a contract. It is expected that the contractor employs these tools to ensure the consistent, high quality of their interpretations before the photo-plots are submitted to an external auditor.

Given that extreme accuracy comes at cost, a 10% tolerance is in general allowed with regard to most criteria checked during the audit. This means that violations that deviate less than 10% of the value of the standard are as a general rule condoned and not counted as such. The usual rejection cut-off is 1% of the total number of features, i.e., if for some criterion the proportion of faulty features or instances exceeds 1%, the product will be sent to revision. However, there are criteria for which no errors are allowed. They include the topology standards, and the filling of appropriate metadata in the ABMI_PPLOT feature class.

The following subsections describe the set of criteria that are checked for compliance as part of Part 1 of the ABMI photo-plot audit.

5.1 TOPOLOGY STANDARDS

The following topology rules will be checked, either through ESRI ArcGIS's 'Validate Topology' tool or through manual inspection (where they are not currently available through the ESRI ArcGIS topology rules):

- For the ABMI_POLYGON feature class:
  - TOPO1. Must not have gaps (void space within the photo-plot)
  - TOPO2. Must not overlap (among features of this class)
  - TOPO3. Must not contain unconnected parts (for individual features of this class)
  - TOPO4. Must be covered by ABMI_PPLOT

- For the ABMI_LINE feature class:
  - TOPO5. Must not overlap (among features of this class)
  - TOPO6. Must not self-overlap (among features of this class)
  - TOPO7. Must be covered by ABMI_PPLOT

- For the ABMI_POINT feature class:
  - TOPO8. Must not overlap
  - TOPO9. Must be properly inside a feature from ABMI_POLYGON
  - TOPO10. Must be covered by ABMI_PPLOT

5.2 SIZE CONSTRAINTS

5.2.1 Absolute Minimum Polygon Size (0.5 ha) (ABMI_POLYGON)

Criterion SIZE1A: # of polygons < 0.45 ha
Criterion SIZE1B: # of polygons < 0.25 ha

Rejection cut-off: SIZE1A > 0.01 · Tot#pols OR SIZE1B ≠ 0

NB. Tot#pols, total number of features in the ABMI_POLYGON class

5.2.2 Intermediate Minimum Polygon Size (2 ha) (ABMI_POLYGON)

Criterion SIZE2A: # of polygons < 2 ha for which the LC3 code (inferred by script from the SP fields) of the polygon and of some of its neighbours is one of these combinations:

- FC and FC (both conifer)
- FD and FD (both deciduous)
- FC and FM (conifer and mixedwood), or, FD and FM (deciduous and mixedwood)

Procedure to compute criteria:

1. Set C = 0 and DUPL =0
2. Select ABMI_POLYGON features where AREA < 20,000

3. For each selected feature *i*, if LC3(i) ∈ {'FC','FD', 'FM'}, then do:
    a. Identify the polygons adjacent to *i*
    b. For each adjacent polygon j, do:
        i. C0 = C
        ii. If (LC3(i) = LC3(j)) AND (LC3(i) ≠ 'FM'), then C = C + 1
        iii. If (LC3(i) = 'FM') OR (LC3(j)='FM'), then C = C + 1
        iv. If C0 ≠ C AND AREA(j) < 20,000, then DUPL = DUPL+1

4. SIZE2A = C – DUPL/2

Rejection cut-off: SIZE2A > 0.01 · Tot#pols

NB. DUPL serves to avoid double counting when there adjacent polygons that fulfill the condition and both are < 2ha

Criterion SIZE2B: # of polygons < 2 ha for which the LC2 code of the polygon and of some of its neighbours is one of these combinations:

- (VOU and VTU) or (VOU and VOU), or (VOU and NEL)
- (VTU and NAS) or (VOU and NAS)

Procedure to compute criteria:

1. Set SIZE2B = 0
2. Select ABMI_POLYGON features where AREA < 20,000
3. For each selected feature *i*, if LC2(i) ∈ {'VOU','VTU' }, then do:
    a. Identify the polygons adjacent to *i*
    b. For each adjacent polygon j, do:
        i. If (LC2(i) = 'VOU') AND LC2(i) ∈ {'VOU','VTU','NEL,'NAS'}, then SIZE2B = SIZE2B + 1
        ii. If (LC2(i) = 'VTU') AND LC2(i)= 'NAS', then SIZE2B = SIZE2B + 1

Rejection cut-off: SIZE2B > 0.01 · Tot#pols

5.3 Adjacency Constraints

5.3.1 Minimum Difference Between Adjacent Polygons (ABMI_POLYGON)

Criterion ADJA1: # of forested polygons for which the following conditions are true between the polygon and some of its adjacent neighbours:

- the density (crown closure) for both over- and understory is the same between polygons
- they both have the same SP1 and USP1 codes, and SP1_PER and USP1_PER values
- both site height and understory site height differs by less than 3 metres between polygons
- they both share the same upland/lowland situation
- they both share the same Green Area wetland type (if relevant)

Criterion ADJA2: # of non-forested polygons for which the following conditions are true

between the polygon and some of its adjacent neighbours:

- the level-3 land cover (LC3) is the same
- the level-2 land use(s) is/are the same
- the infrastructure type is the same

Procedure to compute criterion ADJA1:

1. Set C = 0 and DUPL = 0

2. For each selected feature *i*, if LC3(i) ∈ {'FC','FD', 'FM', 'BTXC', 'BFXC', 'BTXN', 'BFXN', 'BTNN', 'BTNI', BTNR', 'FTNN', 'FTNI', 'FTNR', 'FTPN', 'STNN', 'SFNN'}, then do:
   a. Identify the polygons adjacent to *i*
   b. For each adjacent polygon j, do:
      i. C0 = C
      ii. IF Abs(Ord(DENSITY(i) – Ord(DENSITY(j))) ≤ 1, AND
      iii. SP1(i) = SP1(j) AND Abs(SP1_PER(i) – SP1_PER(j)) ≤ 10, AND
      iv. Abs(SITE_HT (i) – SITE_HT (j)) ≤ 3, AND
      v. IF ((MOIST_REG(i) ∈ {'DRY', 'MSC', 'SHG', 'HGC'} AND MOIST_REG(j) ∈ {'DRY', 'MSC', 'SHG', 'HGC'}) OR (MOIST_REG(i) ∈ {'SHD', 'HDC'} AND MOIST_REG(j) ∈ {'SHD', 'HDC'), AND
      vi. IF GAWL_TY(i) = GAWL_TY(j)
      vii. THEN C = C + 1
      viii. If C0 ≠ C AND AREA(j) ≥ 50,000, then DUPL = DUPL+1

3. ADJA1 = C - DUPL/2

Procedure to compute criterion ADJA2:

1. Set C = 0
2. Select ABMI_POLYGON features where LC1 ≠ 'VT'
3. For each selected feature *i* do:
   a. Identify the polygons adjacent to *i*
   b. For each adjacent polygon j, do:
      i. IF (LC3(i) = LC3(j)), AND
      ii. IF (LU1_LEVEL2(i) = LU1_LEVEL2(j)) OR (LU1_LEVEL2(i) = LU2_LEVEL2(j)) OR (LU2_LEVEL2(i) = LU1_LEVEL2(j)) OR (LU2_LEVEL2(i) = LU2_LEVEL2(j)), AND
      iii. IF (INFRA_TY(i) = INFRA_TY(j))
      iv. THEN C = C + 1

4. ADJA2 = C/2

Rejection cut-off: (ADJA1 > 0.01 · Tot#pols) OR (ADJA2 > 0.02 · Tot#pols)

5.4 Standards on Attribute Completeness, Consistency and Accuracy

5.4.1 Orphan Features (ABMI_POLYGON, ABMI_LINE, ABMI_POINT)

Criterion ATTR1: Total # of orphan features (features where all those attributes that are not filled by script are empty or have default values).

Rejection cut-off: ATTR1 > 0

NB. Features completely within the ABMI_PPLOT buffer are not taken into account.

5.4.2 Attribute Inconsistencies (ABMI_POLYGON, ABMI_LINE, ABMI_POINT)

Criterion ATTR3: # of detected inconsistencies between attributes.

Procedure to compute criterion ATTR3:

0. This computation is based on a set of conditional statements that define the valid values for attributes that have dependencies on other attributes. For example, if INFRA_TY is filled, one of LU1_LEVEL2 or LU2_LEVEL2 cannot be 'NU'. The filling of attributes that should always be filled will also be checked (e.g. LU1_LEVEL2 must always be filled). The statements are based on the rules that appear in the Data Dictionary section of the ABMI photo-plot Data Model.
1. For each feature class *k*, for each feature *i* and for each statement *j*, do:
    a. if *j* is not true in *i*, then ATTR3 = ATTR3 +1

Rejection cut-off: ATTR3 > 0.01 · Total number of features considering all feature classes

NB1. When checked through the ABMI QC Tools (see Appendix 3), this attribute is subdivided into ATTR3A (for treed overstory attributes), ATTR3B (for treed understory attributes), ATTR3C (for non-treed vegetated attributes), ATTR3D (for non-vegetated land cover, land use, and infrastructure attributes), and ATTR3E (for status and modifier attributes).

NB2. A text file will be generated from the QC Tools that reports the POLYGON_ID, ARC_ID, or POINT_ID and statement breached for each count.

5.4.3 Invalid Values (ABMI_POLYGON, ABMI_LINE, ABMI_POINT)

ATTR4: # of features containing an invalid value in one or more attributes.

Rejection cut-off: ATTR4 > 0

NB1. This criterion has 0 allowance because this would be an indication that the compulsory data entry tool was not used.

NB2. Note that this is enforced by the FGDB domains and the dropdown list of the data entry interface that all interpreters are expected to use when interpreting ABMI photo-plots.

6. PART 2: MANUAL EVALUATION OF SELECTED PHOTO-PLOTS

Part 2, the second component of the ABMI quality control audit, comprises manual evaluations of size and spatial constraints, feature representation rules, attribute completeness and consistency, and of the interpretation of the photo-plot itself. As these are manual, they will not be performed on every submitted photo-plot. Rather, a 25% random sample, taken from all photo-plots comprised in a contract by the auditor, will be selected for audit by an external auditor. As mentioned in Section 3, if several separate interpreters have completed photo-plots as part of a contract, a minimum of one photo-plot per interpreter will be included in the selection. The random plots will be selected by using a random number generator created in Micorsoft Excel. Each individual interpreter`s plots will be listed in one column. In an adjacent column the random number generator will run and give values ranging between 0 and 1. The auditor will then select the plots required for auditing from the created values of the program. This will be done by sorting the generated values from lowest to highest and identifying the associated photo-plots with those values.

The photo-plot manual evaluation involves two sub-components: (i) a photo-plot-wide check of specific criteria, and (ii) a thorough evaluation of interpretation quality over a subset of features in each selected photo-plot. The following section describes each of these subcomponents in more detail.

6.1 EVALUATING PART 2 COMPLIANCE TO STANDARDS

The following criteria are to be checked as part of the manual evaluations involved in Part 2 of the photo-plot audit, and are performed across the whole of each photo-plot. They chiefly consist of visual scans of the photo-plot, sometimes combined with a series of GIS operations. The suggested visualization scale for initial scans is 1:5000, with closer inspections being performed at scales no finer than 1:1000. The results of these visual checks are to be recorded in an Excel spreadsheet that will be provided to the auditor, wherein the unique ABMI identification numbers (i.e. POLYGON_ID, ARC_ID or POINT_ID) of faulty features are recorded for each criterion, along with a brief description or comments on the violation (e.g. noting that an identified point represents an area large enough to be a polygon, or that a bridge of *x* meters long exists in the identified polygon would be sufficient descriptions).

An accuracy score is calculated based on the Part 2 compliance to standards evaluations, and is used to determine the pass or fail of a particular audited photo-plot. A weighted sum of the total number of features possessing errors or violations is used to calculate this score, where a score of >1.0% is considered unacceptable. If an unacceptable score is determined then the plots will be returned to the interpreter to be corrected. After corrections the interpreter will resubmit the plots to evaluate the compliance to standards again. Further details on these calculations are given in Section 6.3.

6.1.1 Size Constraints

6.1.1.1 Minimum Distance Between Polygon Outlines (ABMI_POLYGON)

Criterion SIZE3+SIZE4: # of polygons violating the Minimum Mapping Width (MMW) standard.

This criterion is visually evaluated through the inspection of polygon outlines at a scale of approximately 1:3000. The auditor should detect and identify in the aforementioned spreadsheet polygons that are narrower than 20 m on average, or that contain sections of width smaller than 10m.

6.1.1.2 Maximum Allowed Bridge (ABMI_POLYGON)

Criterion SIZE5: # of polygons containing unacceptable bridges

Procedure to compute criterion SIZE5:

1. Visualize the ABMI_POLYGON with a solid fill, create a new point shapefile, and place a point in each part of the outline that potentially could be a *bridge* (a corridor that artificially connects a pocket of some landcover type with a neighbouring polygon of the same type).
2. Visualize the ABMI_POLYGON with no fill using the orthophoto as a backdrop, zoom in in each point, and if the narrowing is a bridge and is suspected of being too long, measure it.
3. If the bridge is longer than 22 m, create a new record in the spreadsheet noting down the corresponding polygon, otherwise, remove the point to avoid visiting it again.

6.1.1.3 Minimum Isolated Line Segment Length (ABMI_LINE)

Criterion SIZE6: # of features violating the Minimum Isolated Line Segment Length standard (50 m)

Procedure to compute criterion SIZE6:

1. Convert ABMI_LINE into a single part polyline shapefile
2. Select features in the new shapefile where length < 45 m
3. Note down in the spreadsheet the unique IDs of the original (possibly multipart) features comprised in the set of selected features from the single-part shapefile and the region of the photo-plot in which the violation is found (e.g. NE quadrant, south-central region)

6.1.2 Spatial Constraints

6.1.2.1 Minimum Distance Between Lines (ABMI_LINE)

Criterion SPAT1: # of features violating the Minimum Distance Between Lines (5 m)

Procedure to compute criterion SPAT1:

1. Visualize the ABMI_line feature class with no backdrop. Starting by the NW corner, zoom in at the 1:5,000 scale, and scan systematically the extent of the photo-plot (W to E and N to S), trying to find lines that appear to be too close to each other.
2. For each detected possible violation, zoom in further at around 1:1,000 and measure the shortest distance between the two suspect lines. If they are closer than 4.5 m, note in the spreadsheet the feature ID (i.e., ARC_ID) of the two lines, if they belong to same multi-part feature, or the feature ID of each, if they belong to separate line features.

6.1.2.2 Minimum Distance Between Points (ABMI_POINT)

Criterion SPAT2: # of features violating this standard (10 m separation)

Procedure to compute criterion SPAT2:

1. Create a circular buffer of radius 9 m at each individual point of ABMI_POINT. The result is a polygon shapefile consisting of circles.
2. Select circles that intersect or touch other circles in this shapefile.
3. Select features from ABMI_POINT that have points within the selected circles, and note the corresponding list of unique IDs in the spreadsheet.
4. SPAT2 = (# of selected features in 3)/2

6.1.2.3 Accuracy of Hard Boundaries (ABMI_POLYGON, ABMI_LINE)

Criterion SPAT3: Upper limit of the 95% confidence interval of a random sample of boundary points.

Procedure to compute criterion SPAT3:

1. Create a polyline shapefile with three random features/transects: one traversing the longitudinal borders of the plot, and two traversing the latitudinal borders of the plot (Fig. 3).
2. Put the intersections of these three transects with the ABMI_POLYGON outlines into a point shapefile.
3. Using the orthophoto as a backdrop, remove points corresponding to soft boundaries (not clearly visible in the image). There should be at least 30 points remaining.
4. Add a new field ‘Dist’ to this shapefile table.
5. For each point in the shapefile, measure the shortest distance in meters between the point and the true boundary (i.e., the visible edge in the image) it corresponds to, and store it in the ‘Dist’ field.
6. SPAT3 = mean + 2σ (of the ‘Dist’ field values)

Rejection cut-off: SPAT3 > 10 m

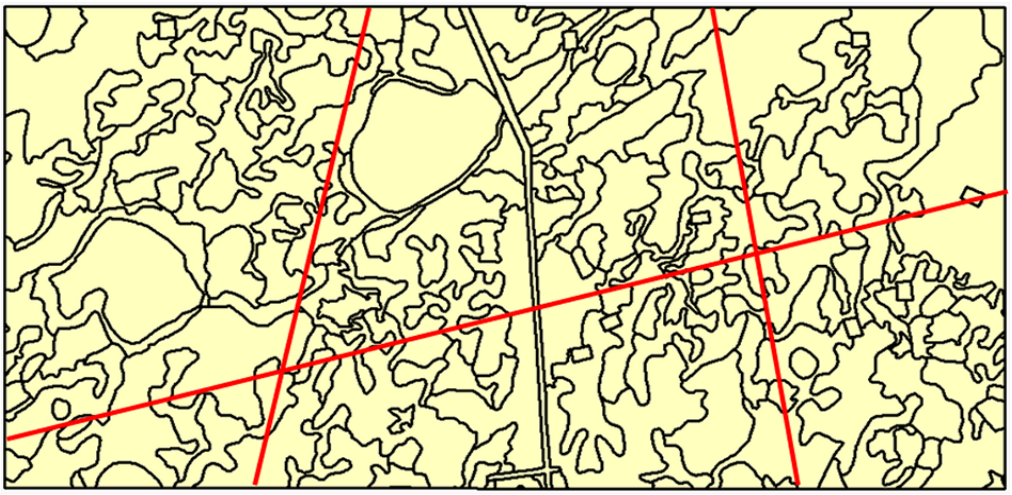


Figure 2. Example of transects for estimating the accuracy of boundary placement

NB1. This procedure is only necessary when the auditor suspects after visual inspection that this standard is consistently violated. In this case, a quantitative estimate of the accuracy of hard boundaries is required.

NB2. If the suspicion is confirmed and the error is greater than 10m, the contractor shall correct the outlines no matter that the other criteria are passed.

6.1.3 Standards on Feature Representation

6.1.3.1 Unmapped Conspicuous Features (ABMI_POLYGON, ABMI_LINE, ABMI_POINT)

Criterion FEAT1A: # of detected unmapped infrastructures (lines and points)
Criterion FEAT1B: # of detected unmapped polygons
Criterion FEAT1C: # of detected unmapped multi-point features other than infrastructures
Criterion FEAT1D: # of detected unmapped linear features other than infrastructures

Procedure to compute the criteria:

1. Visualize the ABMI feature classes populated by the contractor using the orthophoto as a backdrop.
2. Starting by the NW corner, zoom in at the 1:5,000 scale, and scan systematically the extent of the photo-plot (W to E and N to S), trying to find features that are easily identifiable and that have not been mapped and should have according to the interpretation manual.
3. For each detected unmapped feature, note the UTM coordinates of its centroid and a word or two describing the type of feature (e.g., ‘dugout’) in the spreadsheet, specifying which of the above four criteria was involved.

NB1. An unmapped feature that is easily identifiable does not count if there is no clear provision in the Interpretation Manual as of whether it should be mapped or not in this context.

NB2. FEAT1C refers to multi-point features, not to individual points within a multi-point feature.

6.1.3.2 Phantom Features (ABMI_LINE, ABMI_POINT)

Criterion FEAT2: # of delineated features whose referent on the ground is not visible in, or cannot be inferred from, the image

Procedure to compute the criteria:

1. Visualize the ABMI feature classes populated by the contractor using the orthophoto as a backdrop.
2. Starting by the NW corner, zoom in at the 1:5,000 scale, and scan systematically the extent of the photo-plot (W to E and N to S), trying to find lines, points, or small polygons that have no counterpart in the image. Note the detected phantom features in the supplied spreadsheet.

NB. A feature that contains a part (line or point) that is non-existent is counted as a phantom feature. A feature containing several non-existent parts counts as only one phantom feature.

6.1.3.3 Representational Inconsistencies (ABMI_POLYGON, ABMI_LINE, ABMI_POINT)

Criterion FEAT3: # of detected points that should have been mapped as separate polygons
Criterion FEAT4: # of detected lines that should have been mapped as polygons
Criterion FEAT5: # of features that are unduly represented as both polygon and line or both polygon and point.

Procedure to compute the criteria:

1. Visualize the ABMI feature classes populated by the contractor using the orthophoto as a backdrop.
2. Starting by the NW corner, zoom in at the 1:5,000 scale, and scan systematically the extent of the photo-plot (W to E and N to S), trying to find (a) points representing features that are large enough to be represented as polygons; (b) lines representing corridors that are wide enough to be represented as polygons; and (c) features that are represented as both polygon and line or both polygon and point and should not according to the Interpretation Manual.
3. Note the detected inconsistencies in the supplied spreadsheet, indicating to which of the criteria (3, 4, or 5) the feature is contributing.

6.1.3.4 Maximum Number of Points in a Polygon (ABMI_POLYGON, ABMI_POINT)

Criterion FEAT6: # of polygon violating this standard (max 2 points/ha)

Procedure to compute criterion FEAT6:

1. Set FEAT6 = 0

2. Select polygons in ABMI_POLYGON with multi-point features
3. For each selected polygon *i* do:
    a. Count the total number of points adding all multi-point features in i
    b. If Total # points/(Area(i)/10000) > 2.98, then note the polygon ID in the supplied spreadsheet

6.2 EVALUATING INTERPRETATION QUALITY

As explained in Section 3, a thorough evaluation of photo-plot interpretation quality is performed on a subset of features from each of the photo-plots selected for the Part 2 audit. A minimum of 10% of polygons (or a maximum of 30 polygons, if there are more than 300 polygons in total), or a minimum of 20 polygons (if there are less than 200 polygons in total), covering at least 5% of the photo-plot area will be randomly selected by an automated script for an exhaustive check-up. A minimum of 10 % of the multi-point features and 10 % of lines will also be evaluated. The evaluation assesses the completeness and adequacy of the attributes of the selected features. Each error/discrepancy will be assigned a score as a function of the relevance of the attribute, the magnitude of the discrepancy, and the difficulty of its estimation.

The results of the evaluation are used to assess the accuracy of both quantitative attributes (e.g. height, age) and qualitative attributes through an automated analysis of the auditor's results spreadsheet, performed by a script applied as a macro in Microsoft Excel. A second, separate accuracy score will be calculated for interpretation quality, based on the presence and weightings of auditor's disagreements. This score will also be used to determine the pass or fail of an audited photo-plot. Again, further details regarding this accuracy score are provided in Section 6.3.

6.2.1 Assessing the Interpreter's calls

The selected features shall constitute a representative sample of the type of features present in the plot, and should be evenly distributed throughout. No two polygons from the sample should be adjacent. These features, which are selected by a random-systematic algorithm developed by ABMI for this purpose, are subsequently exported to a separate 'subset' File Geodatabase that contains only the selected polygon, line, and point features. The auditing interpreter, will be provided with (1) this subset FGDB, together with the full, original FGDB (to provide context to the selected features); (2) a spreadsheet on which in which to record their evaluation; (3) the aerotriangulated images for the relevant photo-plot(s); and (4) all the auxiliary information that was made available to the contractor. For each sample feature and for each applicable attribute, the value entered by the contractor (or the lack of it) will be assessed by the auditor using softcopy interpretation, and in compliance to ABMI photo-plot standards.

The results of the assessment will be noted down in the evaluation Microsoft Excel spreadsheets provided to the auditor. There is one Excel file per plot with three spreadsheets – one for polygons, points, and lines – each with as many rows as attributes in the feature class, and with three columns per selected feature: one for the interpreter's call, one for the auditor's call (if different), and one for a weight. For each attribute (row in the excel file), the auditor will fill the column 'AUDIT' (auditor's call) only when s/he disagrees with the call made by the interpreter, or when the interpreter didn't enter any value and the auditor feels there should be one. For each feature,

the auditor is asked to provide a weight (in the 'WT' column of the spreadsheet) to the attribute possessing the most serious disagreement according to the weighting guidelines listed below. That is, only one attribute disagreement should be weighted for each feature, but this attribute should represent the disagreement that has the greatest impact on the overall call for the feature in question. In this way, any redundancies caused by disagreements in multiple, related features are eliminated (e.g. all treed understory features, where the auditor and interpreter disagree on whether an understory exists), but the presence of the most serious disagreements are noted. Weights should be given using the following guidelines:

- 0, if the disagreement is not relevant for ABMI and/or NFI purposes or could be explained by two different equally valid interpretations: the auditor's and the air photo interpreter.

- 1, if there is a disagreement between the auditor and interpreter in regards to Moisture Regime, Management Status, Non-Vegetated Class, Non-Vegetated Type, Non-Vegetated Percent (> 20%), Stand Structure, Origin, Origin Year (> 20 years), Density, Height (> 3 m), Non-Treed Woody Percent (≥ 20%), Non-Treed Woody Height (> 3 m), Non-Woody Type, Non-Woody Species, Wetland Type, Modifier(s), or Landuse(s).

- 2, if there is a disagreement between the auditor and interpreter in regards to Species Type, Species Percent (> 20 %), White Area Upland Site Type, or Infrastructure Type.

6.3 Processing Interpretation Audit Results

Two sets of accuracy scores are calculated to evaluate the overall results of the Part 2 compliance to standards checks, and the evaluations of interpretation quality. These are designed to represent a general summary of these results, and provide a means of setting objective thresholds for the pass or fail of an audited photo-plot. Each score is calculated separately, and is subject to a separate rejection threshold. For a photo-plot to pass the Part 2 quality control evaluation, it must obtain a passing score in each of the two Part 2 components – i.e., it must comply to the quality control standards, and meet a certain level of interpretation accuracy. In some instances the auditing process it is likely to pass one component but not the other component. If this occurs then the component that passes will not be subject to resubmission for audit. The component that fails however will have to be corrected and will be resubmitted to audit until it meets the acceptable tolerance for a pass.

6.3.1 Compliance to Standards Accuracy Score

The compliance to standards accuracy score is calculated as the total weighted sum of features containing errors or violations, divided by the total number of all photo-plot features, and multiplied by 100 (i.e., to get a percentage). The results for all polygon, line, and point features are combined. The 'weighted sum' is calculated by giving each checked criterion a weighting, so that more severe violations are weighted more heavily, and summing the equivalent number of weights (per criterion) to the numbers of features containing errors for that particular criterion. Any feature (point, line, or polygon) for which multiple criterion violations are identified are only

counted once in the accuracy score, but must be counted at their highest weighting.

For Example
6.3 (the total weight of all errors)/ 102 (the total number of polygons, lines and points)*100= 6.18 (The compliance to accuracy score).

Table 1 provides a breakdown of the various criterion weights used to calculate the accuracy score.

Table 1. Weighting for Compliance to Standard attributes

Criterion	Weighting
SIZE3 (Minimum Polygon Width)	0.3
SIZE4 (Minimum Corridor Polygon Width)	0.3
SIZE5 (Polygon Bridges)	0.3
SIZE6 (Minimum Isolated Line Segment Length)	0.3
SPAT1(Minimum Distance Between Lines)	0.3
SPAT2 (Minimum Distance Between Points)	0.3
SPAT3 (Accuracy of Hard Boundaries)	0.3
FEAT1A (Unmapped Line and Point Infrastructures)	.5
FEAT1B (Unmapped Polygons)	.5
FEAT1C (Unmapped Points, Non-Infrastructure)	.3
FEAT1D (Unmapped Lines, Non-Infrastructure)	.3
FEAT2 (Phantom Features)	0.3
FEAT3 (Inappropriately Mapped Points, Should Be Polygons)	0.3
FEAT4 (Inappropriately Mapped Lines, Should Be Polygons)	0.3
FEAT5 (Dual Representation)	1.0
FEAT6 (Maximum Points per Hectare in a Polygon)	0.3

A compliance to standards accuracy score of > 1.0% is considered unacceptable, and will result in a ‘failed’ photo-plot that will be returned to the contractor for revisions. The auditor may also fail a plot even if it passes. This would be due to exceptional circumstances where either a combination of problems occurs that are deemed significant or a noticeable trend has emerged that may affect the integrity of the rest of the submitted photo-plots.

6.3.2 Interpretation Accuracy Score

The interpretation accuracy score is calculated as the sum of representative disagreement weights for all audited features in a photo-plot divided by the sum of total features within the photo-plot in question (polygons, lines, and points), subtracted from one (1), and multiplied by 100 to get a percentage. An interpretation accuracy score of < 80.0% is considered unacceptable, and will

result in a ‘failed’ photo-plot that will be returned to the contractor for revisions.

For example: (7 (Errors accumulated in ABMI polygon, ABMI line, and ABMI Point)/ 30 (the number of polygons, lines, and points audited) – 1)*100=76.67% (The accuracy of the photo interpretation for the ABMI Photo-plot).

If an unacceptable interpretation accuracy score is obtained for a photo-plot then the auditor will return the photo-plot and all other photo-plots by that individual for revisions. Once the revisions are corrected and resubmitted the auditor will again randomly audit at least 25% of the photo interpretation of the individuals work. The reason is to ensure that the interpreter will correct any identified trends over all the work he has completed. This will ensure a higher probability that all the interpreters work will be of a high standard. If an acceptable interpretation accuracy score is achieved but, compliance to accuracy score is not achieved then all the photo-plots will be returned to the interpreter. The interpreter will not be audited again on the quality of interpretation but, will be audited again for compliance to standards.

7. QUALITY CONTROL REPORT

The audit process will be summarized in a report that will display the value of each of the included quantitative criteria, which will appear in red when they don’t pass the cut-off. For those failed criteria, more detailed information (as e.g. what features contributed to failure) will be provided in the appendices. In addition, any detected biases will be reported, accompanied of a suggested remedy or improvement. The final section of the report will declare the fail or pass status of the photo-plot, and in the case of failure, the criteria that require action during the revision by the contractor (which would result in a new, revised FGDB to be provided by the contractor). The report will be submitted in pdf format accompanied of the several GIS data that were used/created in the audit. The report shall include the following sections:

1. **Executive summary**. A less than 300 words paragraph summarizing the report, including the final pass/fail decision.
2. **Materials**. Description of the audited materials and any other ancillary information used therein.
3. **Methods**. General overview of the criteria evaluated and the methods used to quantify them, with further detail when they deviate from the procedures put forward in this QC Manual.
4. **Evaluation of the compliance to standards**. Results for those evaluated quantitative criteria related to standards, including the pass/fail status of each one of them.
5. **Evaluation of the interpretation quality**. Results for those evaluated quantitative criteria related to the interpretation itself, including the pass/fail status of each one of them.
6. **Additional comments**. Clarifications on how to interpret some of the previous results, and suggestions to the contractor on how to or correct the detected errors or avoid them in future.
7. **Decision**: Statement of fail or pass, required actions and procedure for revision.
8. **Appendices**: with the detailed result of those scripts that output text, or with the name and

description of the accompanying GIS data produced during QC.

8. Dispute Resolution Process

In rare cases, disputes may arise between the contractor and the auditor in relation to the measured values of the criteria. The contractor may object in writing within 7 calendar days of the date of reception of the Quality Control report, detailing as precisely as possible the reasons of the dispute. The claims will be revised by an independent person designated by ABMI, who will rule the case within the next 14 calendar days, resolution that the parties must accept. This process does not stop or affect the deadlines in section 3.

APPENDIX: ABMI QUALITY CONTROL TOOLS

The following describes the set of Quality Control Tools developed by the ABMI Remote Sensing Group (Jennifer Hird), and updated to the current ABMI photo-plot mapping standards (v2.4.0). These tools are intended to provide interpreters with a series of automated procedures that: (i) automatically fill those ABMI attribute fields that can be inferred from the interpreter's calls (e.g. land cover attributes, wetland hydrodynamic and nutrient regimes, etc.); (ii) test the compliance to a series of required quality standards, and append temporary attribute fields that will hold the output of these quality checks; and (iii) remove the temporary fields.

The ABMI Quality Control Toolbar should automatically be loaded when the provided .mxt file is used as a template for an ArcMap session.

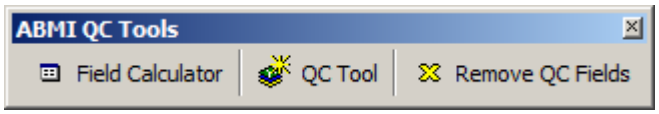
> ***NB.*** *If you are in an editing session you must save your edits and stop the editing session before using these tools.*

ABMI Quality Control Toolbar:

The picture below shows the ABMI Quality Control Toolbar, which contains 3 separate buttons, one for each of the tasks outlined above.

> ***NB.*** *If the toolbar does not appear or was accidentally closed, simply go to View → Toolbars, and click on "ABMI QC Tools". This should place a checkmark next to "ABMI QC Tools" in the menu, and the toolbar should appear.*

ABMI Quality Control Toolbar:



The Field Calculator tool must be run on a File Geodatabase before the QC Tool can be applied – the QC Tool requires that land cover classes and fields be filled before it can fun properly.

ABMI Field Calculator

The ABMI Field Calculator Tool uses a series of scripts to automatically fill a number of attribute fields in the ABMI_POLYGON, ABMI_LINE, and ABMI_POINT feature classes of the ABMI photo-plot File Geodatabases (FGDBs) that can be filled on the basis of attributes previously filled by the interpreter. The list of filled fields is shown in Table 1. For more information on each of these attributes, please see the ABMI Data Model document.

ABMI Field Calculator Tool:

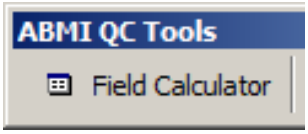


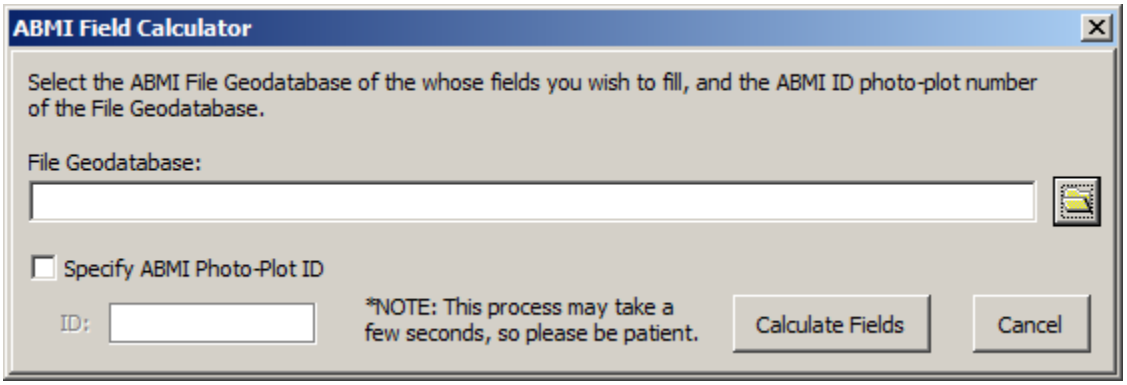
Table 1: Fields filled by the ABMI Field Calculator Tool

ABMI_POLYGON Fields:	ABMI_LINE Fields:	ABMI_POINT Fields:
LC1	LC1	LC1
LC2	LC2	LC2
LC3	LC3	LC3
NV_CLASS	NV_CLASS	NV_CLASS
LU1_LEVEL1	LU1_LEVEL1	LU1_LEVEL1
LU2_LEVEL1	LU2_LEVEL1	LU2_LEVEL1
INFRA_CL	INFRA_CL	INFRA_CL
HYDR_REG	HYDR_REG	HYDR_REG
NUTR_REG	NUTR_REG	NUTR_REG
ABMI_SITE	ABMI_SITE	ABMI_SITE
POLYGON_ID	ARC_ID	POINT_ID
MPT_CNT	ARC_AREA	POLY_NUM
AREA_NET*		PT_CNT
PER_POLY		PT_AREA
		AVG_AREA

**Note: AREA_NET is not yet implemented in this tool.*

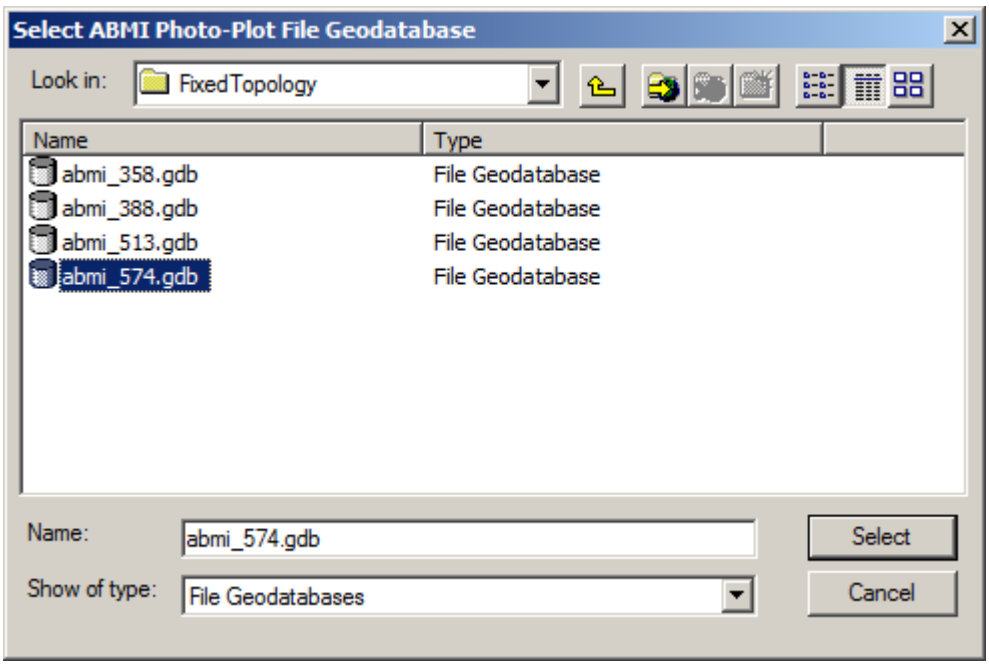
Using the ABMI Field Calculator Tool

Click the "Field Calculator" button on the ABMI Quality Control Toolbar. A dialog box (shown below) appears. The user must provide the path and name of the File Geodatabase and the ABMI photo-plot identification number (i.e. between 1 and 1656) of the photo-plot to which the tool is to be applied.



Click the browse button () on the dialog box. A browse window will appear (see example below). When opened for the first time within the current ArcMap session, the browse window will automatically navigate to the directory and folder in which the first layer or dataset present in the open map document is found. Find the File Geodatabase of interest, select it, and click 'Select'.

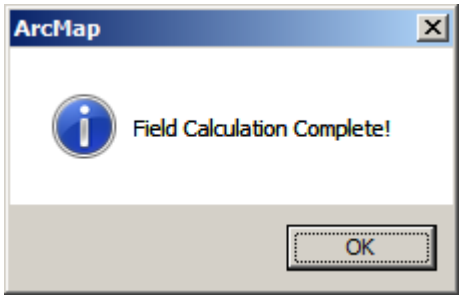
NB. *The browse window is designed to show only FGDBs for the user's selection (i.e. it will not show other types of files, including feature classes). If a File Geodatabase is double-clicked the window will appear blank. If this happens, simply go back up one level in the directory. (Double-clicking a FGDB would normally show the feature dataset(s) or feature class(es) present in the File Geodatabse, but because the browse window that appears here is designed to only show FGDBs, these are not shown).*



Once the File Geodatabase is selected, you should check the box 'Specify ABMI Photo-Plot ID' and type the ABMI photo-plot ID into the 'ID' text box if the photo-plot ID of the FGDB has never been specified, in order to fill the ID fields in each feature class (e.g. ABMI_ID, etc.). If ABMI_ID, etc. have already been filled by a previous application of the Field Calculator tool, you need not enter this information. However, if you do not enter a photo-plot ID and the FGDB does not have one specified, a message box will prompt you to enter an ID. To run the tool, click 'Calculate Fields'.

The tool will begin processing. It may take from a few seconds to up to a minute to process, so please be patient. The mouse pointer will be displayed as an hourglass icon () while the tool runs.

Once the process is complete, a message box (shown below) will pop up, indicating the completion of the field calculation.



ABMI Field Calculator Tool Output

As described above, the ABMI Field Calculator Tool fills particular fields in the ABMI File Geodatabase. Below is an example of the land cover class, ABMI site ID, and polygon ID fields in the ABMI_POLYGON feature class after they have been filled by the tool.

Attributes of abmi_polygon

Landcover 1	Landcover 2	Landcover 3	ABMI ID	Polygon ID	Multipoint Count
VGT	VTU	TUFD	547	5470240	3
VGT	VTU	TUFD	547	5470470	3
VGT	VTU	TUFD	547	5470227	2
VGT	VTU	TUFD	547	5470027	1
VGT	VTU	TUFD	547	5470066	1
VGO	VOW	SONS	547	5470136	1
VGT	VTW	FTNN	547	5470169	1
VGT	VTU	TUFD	547	5470192	1
VGT	VTU	TUFD	547	5470238	1
VGT	VTU	TUFD	547	5470314	1
VGT	VTU	TUFD	547	5470533	1

Record: 0 Show: All Selected Records (0 out of 274 Selected)

NB. *If an attribute table is open while the tool is run, the changes made by the tool to attribute fields will not appear automatically. Close the attribute table and re-open it for the new field values to show.*

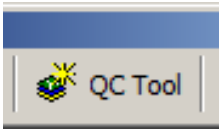
ABMI Quality Control Tool

The ABMI Quality Control Tool tests for the compliance to ABMI standards of a completed photo-plot File Geodatabase. It is meant as a tool to help interpreters test the compliance to standards during internal quality control checks before the final File Geodatabase is submitted to the client. The tool checks a subset of the ABMI standards listed in the Standards Audited for

Quality Assurance section of the ABMI Photo-Plot Interpretation Manual, and provides output in the form of new fields in the relevant feature class as well as (if the user so chooses) a QC Report – a text file containing the same output.

> ***NB.*** *The Quality Control Tool can only be run once the Field Calculator Tool has been applied to a File Geodatabase. Please ensure that the land cover class and other fields are filled properly before running the Quality Control Tool.*

ABMI Quality Control Tool:



Using the ABMI Quality Control Tool

Click the "QC Tool" button on the ABMI Quality Control Toolbar. A dialog box appears (shown below). The user must provide: (i) the File Geodatabase in which he/she wishes to check the standards, (ii) the standards he/she wishes to check, (iii) whether a QC Report should be produced (in text file format), and (iv) if so, the location and filename of the report.

Click the browse button () on the dialog box. A browse window will appear (see example in previous section). When opened for the first time within the current ArcMap session, the browse window will automatically navigate to the directory and folder in which the first layer or dataset present in the open map document is found. Find the File Geodatabase of interest, select it, and click 'Select'.

> ***NB.*** *When a File Geodatabase is selected, a default path (the same folder as the File Geodatabase) and filename are set for the QC report text file automatically. This can be easily changed by manually editing the text in the QC Report text box, or by clicking the browse button (*  *) next to the text box.*

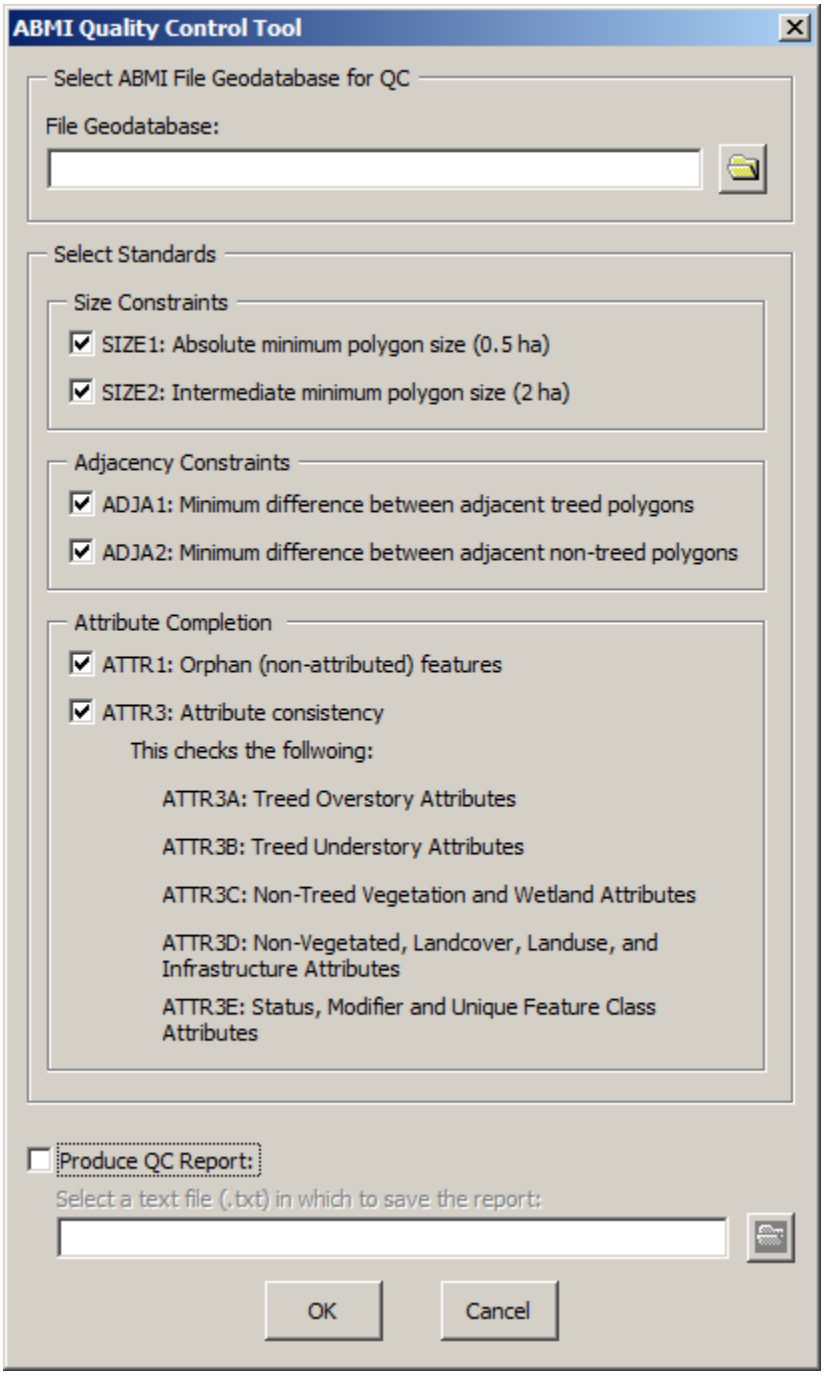
Next, select the standards to be checked from those provided. A full description of each standard is found in the ABMI Photo-Plot Interpretation Manual, and the ABMI QC Manual.

> ***NB.*** *Checks for only 10 quality control criteria/sub-criteria are currently available and implemented in the ABMI Quality Control Tool at this time. More standards will become available for checking in future versions of the tool.*

In order to output a QC Report, click the check box next to 'Produce QC Report'. If this box is left unchecked, a report will not be produced.

> ***NB.*** *The user will only be able to change/set the path and filename of the QC Report if*

'Produce QC Report' is selected.

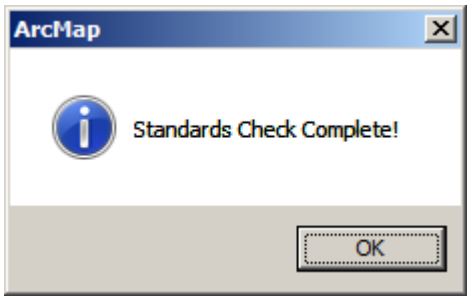


Once the the File Geodatabase and standards to be checked are selected, and if appropriate,

'Produce QC Report' has been checked and the path and filename of the QC report file are satisfactory, click 'OK'. This will begin the tool. Progress bars will appear, indicating the progress of the checking of each standard.

If the 'Cancel' button on a progress bar is clicked while the process is running, the checking of that particular standard is aborted. However, the tool will continue to check the remaining standards.

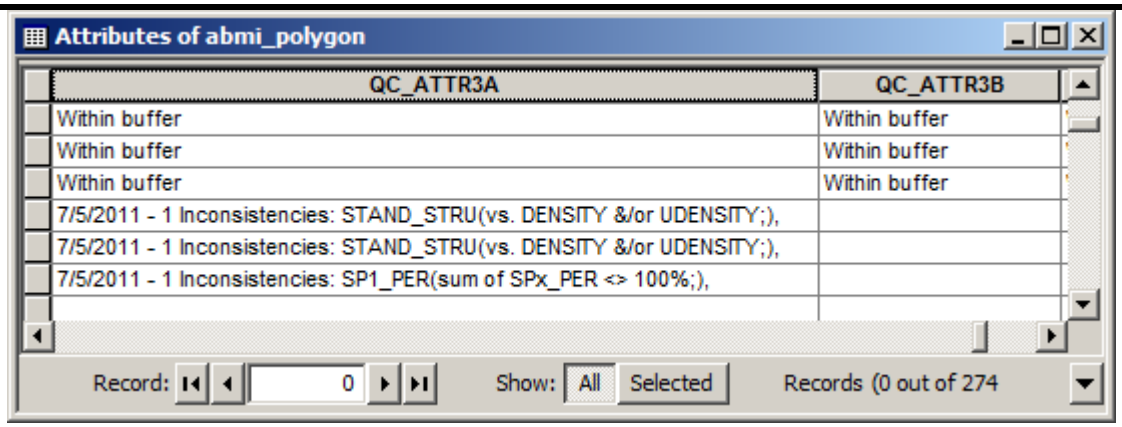
Once the process is complete, a message box (shown below) will appear to indicate the completion of the standards check.



ABMI Quality Control Tool Output

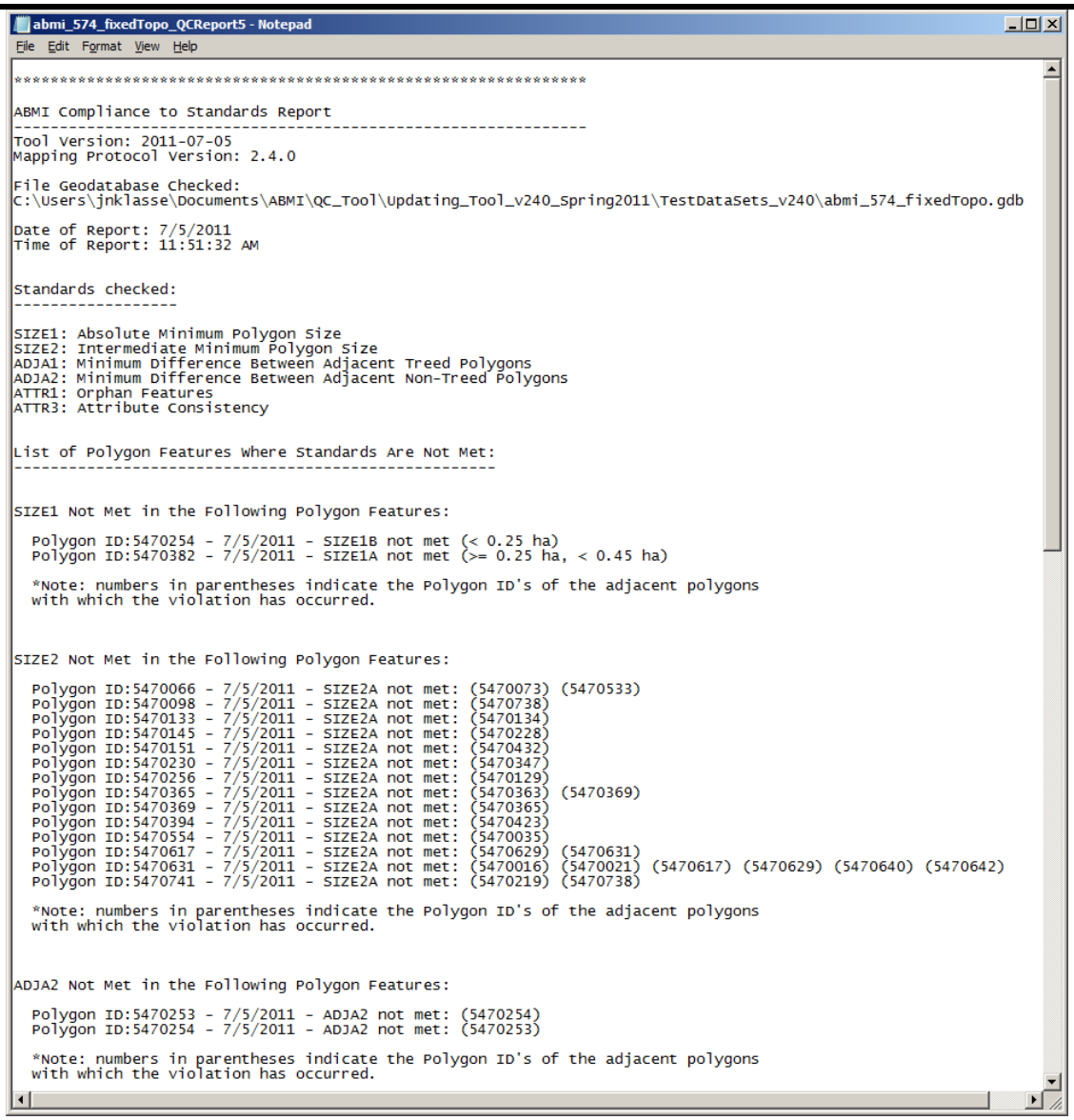
As described above, the ABMI Quality Control Tool provides two types of output to the user. The first is a set of new fields (in the attribute table of the relevant feature class), indicating which features do not meet each standard. Here, a new field is created for each standard being checked, and contains text for each feature that does not meet the standard. This output is automatic, and not optional with the tool. However, the ABMI Quality Control Toolbar also contains a tool that will remove these fields once the user is finished with them (see following section). Below is an example of the 'QC_ATTR3A' field that is created when the ATTR3 standard is checked.

> ***NB.*** *The tool inserts the words "Within buffer" within each QC field of those features that are contained completely within the 100m buffer that surrounds each ABMI photo-plot. These feature are not checked for these criteria (i.e., they do not need to meet these standards). In this situation, no subsequent action is required for the features in question.*



The second output produced by the tool is optional for the user, and comprises QC Report text file listing the contents of each of the temporary quality control fields appended to the attribute table. In other words, it provides a written list of the features that do not meet each of the standards checked by the tool. Below is an example of a QC Report text file. It provides the date and time the tool was run, the File Geodatabase in which standards were checked, the standards that were checked, and the list of features (identified by POLYGON_ID, ARC_ID, or POINT_ID) that do not meet each standard.

> ***NB.*** *If the path and filename selected for the QC Report text file is the same as one that already exists (this can happen easily when using the default path and filename automatically set by the tool), the tool does not overwrite the existing file. Rather, it appends the new QC Report onto the old one in the same file. If this happens, open the text file, go to the end, and scroll up until you find a time stamp, which is the beginning of the new report.*

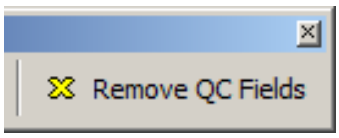


```
abmi_574_fixedTopo_QCReport5 - Notepad
File Edit Format View Help

*****************************************************************

ABMI Compliance to Standards Report
-----------------------------------------------------------------
Tool Version: 2011-07-05
Mapping Protocol Version: 2.4.0

File Geodatabase Checked:
C:\Users\jnklasse\Documents\ABMI\QC_Tool\Updating_Tool_v240_Spring2011\TestDataSets_v240\abmi_574_fixedTopo.gdb

Date of Report: 7/5/2011
Time of Report: 11:51:32 AM


Standards checked:
------------------

SIZE1: Absolute Minimum Polygon Size
SIZE2: Intermediate Minimum Polygon Size
ADJA1: Minimum Difference Between Adjacent Treed Polygons
ADJA2: Minimum Difference Between Adjacent Non-Treed Polygons
ATTR1: Orphan Features
ATTR3: Attribute Consistency


List of Polygon Features Where Standards Are Not Met:
-----------------------------------------------------


SIZE1 Not Met in the Following Polygon Features:

  Polygon ID:5470254 - 7/5/2011 - SIZE1B not met (< 0.25 ha)
  Polygon ID:5470382 - 7/5/2011 - SIZE1A not met (>= 0.25 ha, < 0.45 ha)

  *Note: numbers in parentheses indicate the Polygon ID's of the adjacent polygons
  with which the violation has occurred.


SIZE2 Not Met in the Following Polygon Features:

  Polygon ID:5470066 - 7/5/2011 - SIZE2A not met: (5470073) (5470533)
  Polygon ID:5470098 - 7/5/2011 - SIZE2A not met: (5470738)
  Polygon ID:5470133 - 7/5/2011 - SIZE2A not met: (5470134)
  Polygon ID:5470145 - 7/5/2011 - SIZE2A not met: (5470228)
  Polygon ID:5470151 - 7/5/2011 - SIZE2A not met: (5470432)
  Polygon ID:5470230 - 7/5/2011 - SIZE2A not met: (5470347)
  Polygon ID:5470256 - 7/5/2011 - SIZE2A not met: (5470129)
  Polygon ID:5470365 - 7/5/2011 - SIZE2A not met: (5470363) (5470369)
  Polygon ID:5470369 - 7/5/2011 - SIZE2A not met: (5470365)
  Polygon ID:5470394 - 7/5/2011 - SIZE2A not met: (5470423)
  Polygon ID:5470554 - 7/5/2011 - SIZE2A not met: (5470035)
  Polygon ID:5470617 - 7/5/2011 - SIZE2A not met: (5470629) (5470631)
  Polygon ID:5470631 - 7/5/2011 - SIZE2A not met: (5470016) (5470021) (5470617) (5470629) (5470640) (5470642)
  Polygon ID:5470741 - 7/5/2011 - SIZE2A not met: (5470219) (5470738)

  *Note: numbers in parentheses indicate the Polygon ID's of the adjacent polygons
  with which the violation has occurred.


ADJA2 Not Met in the Following Polygon Features:

  Polygon ID:5470253 - 7/5/2011 - ADJA2 not met: (5470254)
  Polygon ID:5470254 - 7/5/2011 - ADJA2 not met: (5470253)

  *Note: numbers in parentheses indicate the Polygon ID's of the adjacent polygons
  with which the violation has occurred.
```

ABMI Remove Quality Control Fields Tool

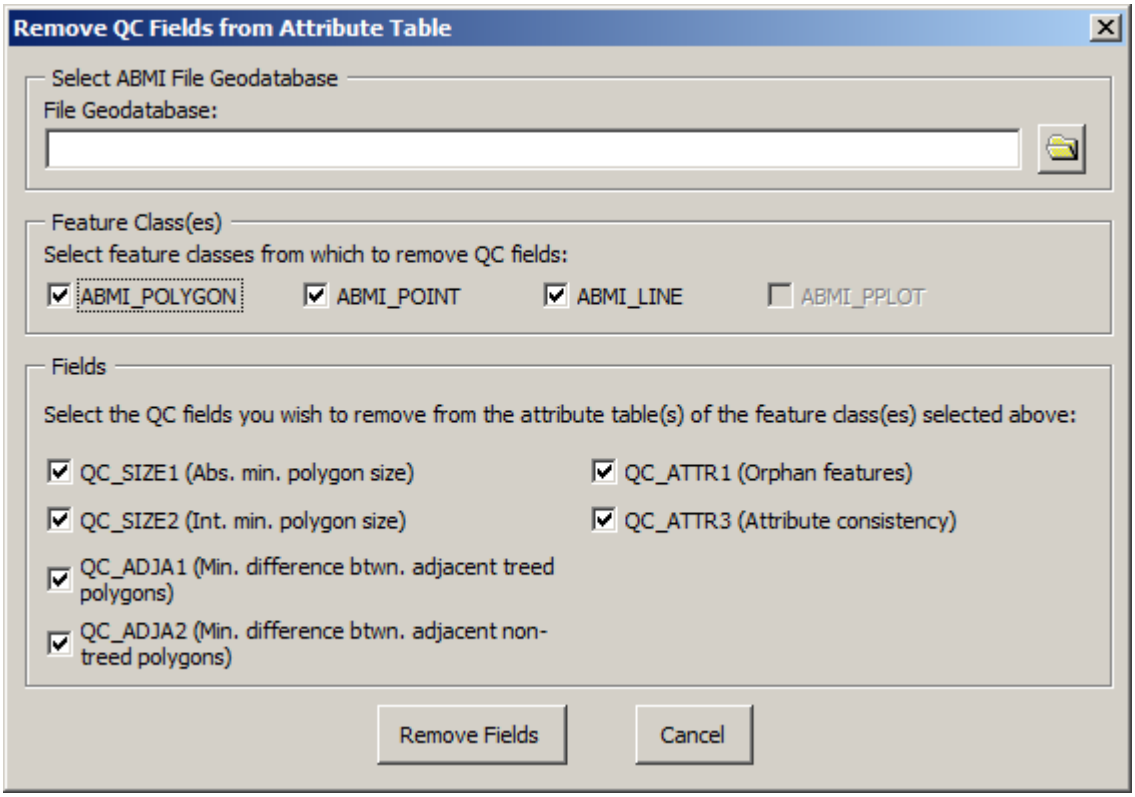
The ABMI Remove Quality Control Fields Tool simply removes the new attribute fields that were created by the ABMI Quality Control tool when the user is finished with them and no longer needs them.

ABMI Remove Quality Control Fields Tool:



Using the ABMI Remove Quality Control Fields Tool

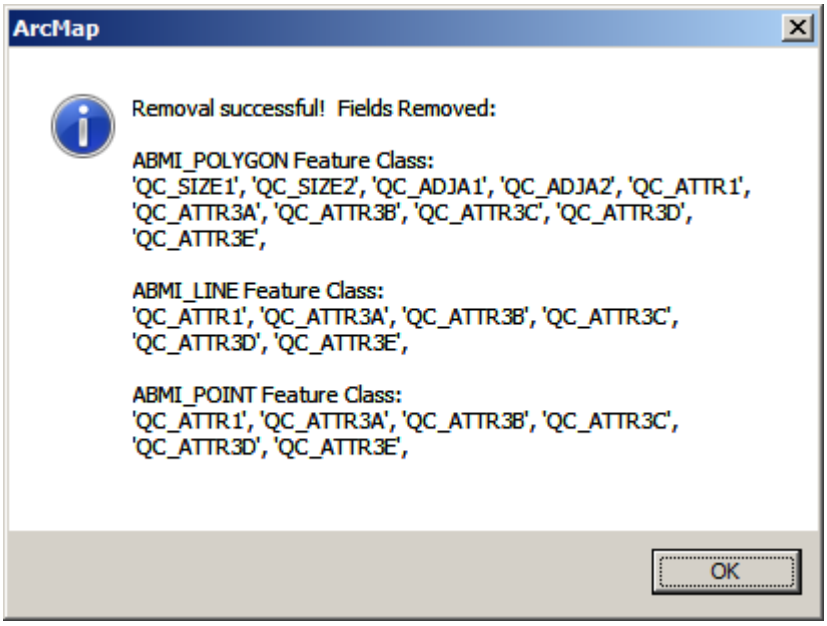
Click on the 'Remove QC Fields' button on the ABMI Quality Control Toolbar. A dialog box appears (shown below). The user must provide the File Geodatabase from which Quality Control fields will be deleted, and the fields to be deleted.



Click the browse button () on the dialog box. A browse window will appear (see example in the Field Calculator Tool section). When opened for the first time within the current ArcMap session, the browse window will automatically navigate to the directory and folder in which the first layer or dataset present in the open map document is found. Find the File Geodatabase of interest, select it, and click 'Select'.

Next, select the Quality Control fields to be deleted, and click 'Remove Fields'.

Once the selected fields have been removed (this should take only a second or two), a message box (shown below) appears that indicates the removal of the selected fields and lists the fields removed.


ArcMap
Removal successful! Fields Removed:
ABMI_POLYGON Feature Class:
'QC_SIZE1', 'QC_SIZE2', 'QC_ADJA1', 'QC_ADJA2', 'QC_ATTR1', 'QC_ATTR3A', 'QC_ATTR3B', 'QC_ATTR3C', 'QC_ATTR3D', 'QC_ATTR3E',
ABMI_LINE Feature Class:
'QC_ATTR1', 'QC_ATTR3A', 'QC_ATTR3B', 'QC_ATTR3C', 'QC_ATTR3D', 'QC_ATTR3E',
ABMI_POINT Feature Class:
'QC_ATTR1', 'QC_ATTR3A', 'QC_ATTR3B', 'QC_ATTR3C', 'QC_ATTR3D', 'QC_ATTR3E',
OK