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1. Overview

1.1 Delivery File Format
Ecopia's Building Footprints will be delivered in a Shapefile vector format with polygon geometry.

1.2 Accuracy
Ecopia Building Footprints are a polygonal representation of the geometric footprint of each building in a specific area of interest, as visible from geospatial imagery. Ecopia Building Footprints will reflect the spatial detail of each building discernable from the source geospatial imagery.

The interpretation of buildings in geospatial imagery can be a subjective process. As such, a number of examples have been provided in Section 3 to detail the expected geometric representations for particular scenarios.

Ecopia’s Building Footprints shall adhere to the thresholds stated in Section 2. A sampling methodology has been detailed in section 1.3 to capture conformance thresholds for elements of quality that cannot be measured across the entire population of the output.

1.3 Quality Assurance Threshold Testing
Ecopia has defined a number of quality assurance thresholds which represent the quality of Ecopia Building Footprints. Some of these quality assurance thresholds are not feasible to verify against the entire dataset. And, in order to ensure the quality of the data for aspects that cannot be globally verified, the following sampling methodology will be applied:

For every 1,000km$^2$, an area of 50km$^2$ will be selected at random to represent a sample site. For each sample area, a manual analyst will assess all polygons in the Ecopia Building Footprint vector layer to ensure adherence to the thresholds stated in Section 2.
2. Quality Assurance Assessment of Building Footprint Capture

Table 1 summarizes the criteria and thresholds used to validate the quality of Ecopia Building Footprints. The following sub-sections detail the definition and assessment method for each measurement.

<table>
<thead>
<tr>
<th>Measure Name</th>
<th>Threshold</th>
<th>Sample/All Polygons</th>
</tr>
</thead>
<tbody>
<tr>
<td>False Negatives</td>
<td>&lt;=5%</td>
<td>Sample</td>
</tr>
<tr>
<td>False Positives</td>
<td>&lt;=5%</td>
<td>Sample</td>
</tr>
<tr>
<td>Valid Interpretation</td>
<td>&gt;=95%</td>
<td>Sample</td>
</tr>
<tr>
<td>Valid Geometry</td>
<td>100%</td>
<td>All Polygons</td>
</tr>
<tr>
<td>Minimum Area</td>
<td>100%</td>
<td>All Polygons</td>
</tr>
</tbody>
</table>

2.1 False Negatives

- **Definition**: The count of buildings that were missed represented as a percentage of the total buildings that were supposed to be captured.

- **Assessment method**: For each sample area, a manual analyst identifies any buildings from the source imagery with a geometric area $\geq 10m^2$ that were not captured in the Ecopia Building Footprint vector. The number of buildings missed is to be represented as a percentage of the total buildings that were supposed to be captured.

2.2 False Positives

- **Definition**: A count of the excess buildings that were wrongfully captured represented as a percentage of the total buildings that were supposed to be captured.

- **Assessment method**: For each sample area, a manual analyst identifies any buildings from the source imagery that should not have been captured as part of the Ecopia Building Footprint vector. The count of excess buildings will be represented as a percentage of the total buildings that were supposed to be captured.
2.3 Valid Interpretation

- **Definition:** The number of polygons in the Ecopia Building Footprint vector considered to be a reasonable representation of the underlying building as visible from the source imagery (as per the guidelines in Section 3), represented as a percentage of the total buildings captured in the Ecopia Build Footprint vector.

- **Assessment method:** For each sample area, a manual analyst will assess each building polygon and determine whether it is a reasonable representation of the underlying building as visible from the source imagery. The total count of those building geometries deemed representative within the sample sites are to be represented as a percentage of the total buildings delivered in the Ecopia Building Footprint vector.

2.4 Minimum Area

- **Definition:** A count of buildings with a geometric area measuring >= 10m² represented as a percentage of the total buildings delivered in the Ecopia Building Footprint vector.

- **Assessment method:** An automated script will be run to count the buildings with a geometric area of >= 10m². To calculate this measure, extracted polygons will be mapped with an equal area projection. The number of valid buildings is to be represented as a percentage of the total buildings delivered in the Ecopia Building Footprint vector.

2.5 Valid Geometry

- **Definition:** A count of the buildings with geometry that is valid represented as a percentage of the total buildings delivered in the Ecopia Building Footprint vector. A building polygon is consider to have valid geometry if:
  - It does not overlap with other building polygons;
  - It does not contain any spikes;
  - It does not contain lines that are intersected with each other;
  - It does not contain multiple polygons.

- **Assessment method:** An automated script will be run to count valid building geometries. A manual analyst will then go through each of the building geometries that have been detected as invalid by the automated script and confirm the correctness of the detection. The number of valid buildings is to be represented as a percentage of the total buildings delivered in the Ecopia Building Footprint vector.
3. Guidelines for Ecopia Building Footprint Capture

The following rules should be used for capturing buildings in general:

- Building Footprint corners that fall between 80° - 100° should be made 90°. This will be conducted on a best effort basis.

- The correct capture of a building Footprint is defined as a vector covering 90% to 110% of the foundation of the building visible in the source imagery. Figure 1 shows an example of a building captured with acceptable coverage.

- When buildings are partially covered by shadows or vegetation, the correct location of building Footprint will be inferred using prior knowledge (ie. the knowledge that buildings normally have parallel lines, symmetrical designs, etc.). Figure 2 shows a correct example of capturing obstructed buildings.

- Buildings under construction should be captured. Figure 3 shows a correct example.

(a) Original imagery  (b) Correct capture of building.

Figure 1. Capture of unobstructed buildings.
Figure 2. Capture of obstructed buildings.

Figure 3. Capture of buildings under construction
3.1 Single-family buildings

The following rules should be used for capturing single-family buildings:

- Primary building structures should be captured as separate polygons. Adjoining buildings will be captured as a single polygon and may be separated according to visual features such as fence lines or different roof colors (see Figure 4).
- Extension, sunrooms, balconies, patios, and annexes should be captured as part of the primary building structure (see Figure 5).
- Permanent buildings structures such as sheds and greenhouses, not attached to the primary building structure, but larger than 10m$^2$ should be captured as individual buildings (see Figure 6).
- Non-permanent objects such as, caravans and trampolines should not be captured as buildings (see Figure 7).
- Inner courtyards within buildings should be captured if resolution of imagery allows (see Figure 8).

![Figure 4. Capture of adjoining single family buildings](image-url)
(a) Raw imagery.  
(b) Correct capture of patios.

**Figure 5.** Capture of patios.

(a) Raw imagery.  
(b) Correct capture of small sheds.

**Figure 6.** Capture of small sheds.
Figure 7. Caravans and trampolines should not be captured.

Figure 8. Capture of buildings with inner courtyards.
3.2 Townhouses
Adjoining townhouses should not be separated. Figure 9 shows a correct example of capturing townhouses. Townhouses are to be distinguished from adjoining single family houses by the pattern of their repeated “cookie cutter” geometry, size, shape, and color.

(a) Raw image.  
(b) Correct capture of townhouses.

Figure 9. Capture of townhouses.
### 3.3 Commercial buildings

The following rules should be used for the capture of commercial buildings:

- Multi-floor buildings should be captured at their base (see Figure 10 for example)
- Adjoining commercial buildings should be separated. Visual features such as color, texture or parcel data (if available) can be used to infer the separation. However, each building must have a reasonable street-entrance point (see Figure 11)

![Figure 10. Capture of high-rise buildings.](image)
3.4 **Farmland**

Following rules should be used for capturing buildings in farmland areas:

- Hay bales should not be captured (see Figure 12)
- Water tanks should be captured. Minimum size is 16.5m² (see Figure 13)
- Greenhouses should be captured (see Figure 14)
Figure 13. Capture of water tanks.

(a) Raw image.  (b) Correct capture of water tanks.

Figure 14. Capture of green houses.

(a) Raw image.  (b) Correct capture of greenhouses.