APPENDIX G — GUIDANCE ON POPULATION DENSITY AND SITE SURVEYS

1.0 Background

(1) **General**. In this AC, population density values are used to assess the ground risk portion of the ORA process. In particular, Section 6.0 uses population density values to set the boundaries between different operational ground risk classifications, while Standard Scenario STSC-004 (Appendix D, Section 5.0) uses population density to set boundaries on acceptable locations for the proposed standard operation. This appendix provides additional guidance on where to find these data and how to use them in the context of the ORA or the Standard Scenario.

2.0 Assessment for Unpopulated and Sparsely Populated Areas

(1) **General**. For operations taking place in unpopulated or sparsely populated areas (up to a maximum of 5 or 25 ppl/km^2 respectively), the expectations associated with verifying operational ground risk are generally composed of three items: a "virtual" site survey of population density, an in-person site survey to validate the operational area, and active monitoring of the operational area while the flight operation is in progress. Guidance related to each of these items is provided below. An example of this type of operation can be found in STSC-004 (Appendix D, Section 5.0), under which BVLOS operations are limited to ground areas that are a minimum of 1 km from any area with a population density greater than 5 persons per square km, and a minimum of 2 nautical miles from any area with a population density greater than 25 persons per square km.

(2) **"Virtual" Site Survey**. The primary source of data for the virtual site survey is expected to be the Statistics Canada census data. The data can be downloaded from Statistics Canada for use in separate applications (e.g., Google Earth) or can be accessed directly in graphical format at https://www150.statcan.gc.ca/n1/en/geo. In cases where the main Geography page is unavailable, an alternative link is available at https://www12.statcan.gc.ca/census-recensement/2011/geo/ref/geosearch-georesearche-eng.cfm (note that this link also provides access to archived Census data, and care should be taken to ensure that the most recent available data is being used). Once the Statistics Canada map has been accessed, the display should resemble Figure 21, below. When using population density data for virtual site survey purposes, it is recommended that the lowest granularity of data available be used (Dissemination Areas). To display population density data on the Statistics Canada map, zoom in to the area of interest (Halifax in this example) until the "Displayed boundary" at the lower left of the map shows "Dissemination Areas" as illustrated by the red boarder in Figure 22. The "lock" button can then be pressed (red arrow in Figure 22) to ensure that the Dissemination Area data remains displayed as the map is navigated. The dissemination area(s) near the operational area of interest can then be selected by clicking on the map, which will result in the population information being displayed as shown in Figure 23 (population density highlighted by the red border). As noted above, this virtual site survey provides only an initial assessment for areas of low population density. For example, the population density criteria for STSC-004 is 1km away from areas with 5 persons per square km; thus, if a dissemination area near the intended operation has a population density significantly greater than 5, it is unlikely that the operation will be feasible under STSC-004. However, it may still be possible if the specific geography of the operation and the local population densities permit the 1km from 5 people per square km criteria to be maintained throughout the intended operation. If all dissemination areas within 1km of the operational area have population densities of 5 or less persons per square km, the operation is not automatically acceptable but the operator can proceed to an in-person site survey as described below with reasonable confidence that the operation is feasible. A similar approach can be applied in cases where an operation is planned to be conducted in areas with population densities up to 25 ppl/km^2. An additional layer of virtual site survey may also be conducted using the "Street view" function of Google Maps or Google Earth; Figure 24 provides several examples

of areas that are below 5 persons per square km contrasted with areas that are above 5 persons per square km.

Figure 21 – Statistics Canada Geography tool

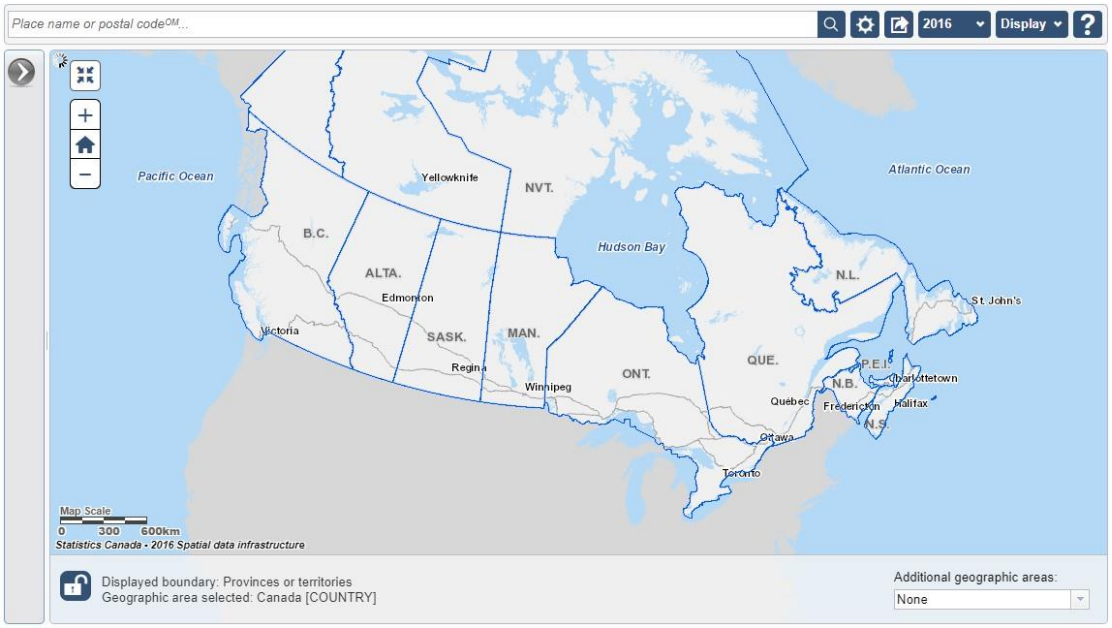

Figure 22 – Map zoomed in to show Dissemination Areas

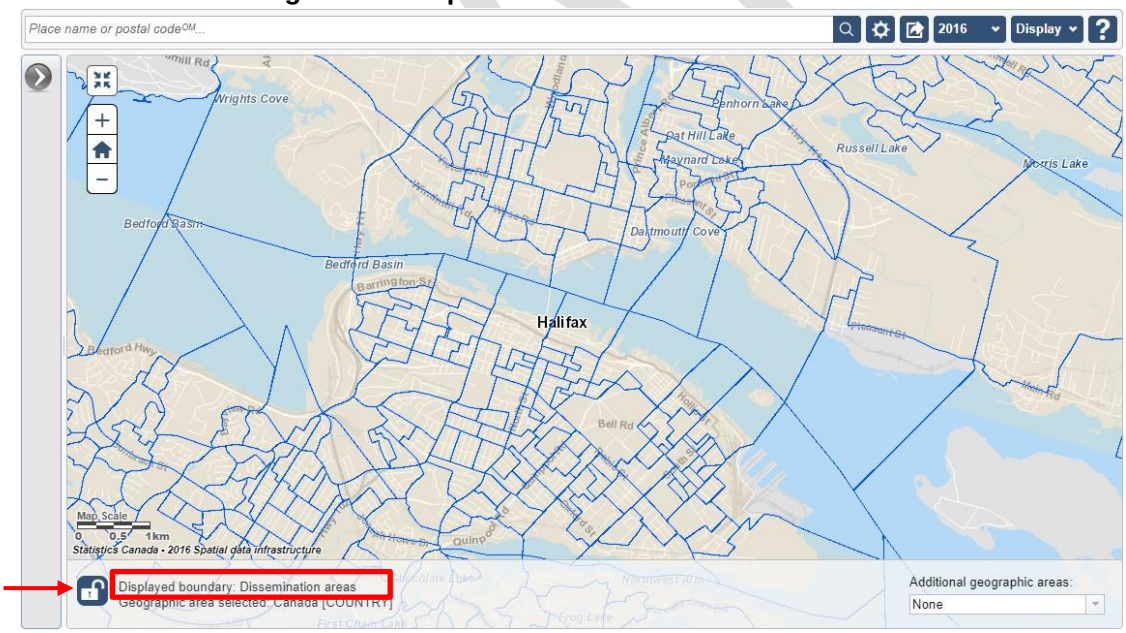

Figure 23 – Display of Population Density Data

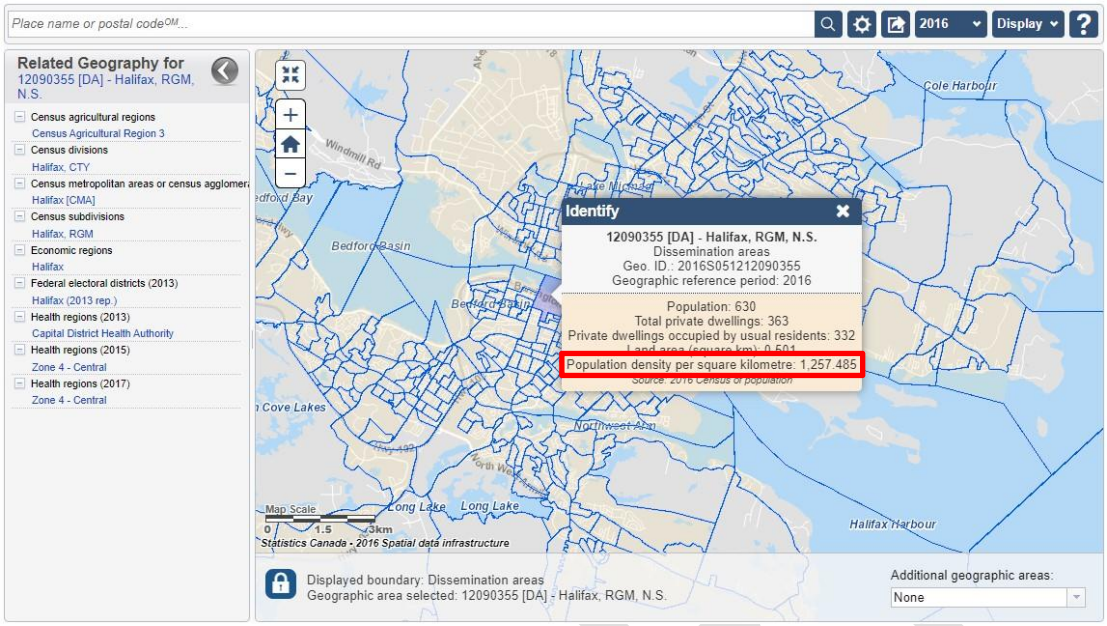

Figure 24 – Sample images of areas with more and less than 5 persons per square km

Less than 5 persons per square km	Between 5 and 25 persons per square km
	
	

Less than 5 persons per square km	Between 5 and 25 persons per square km
	
	

(3) **In-Person Site Survey**. After completing a virtual site survey to assess operational feasibility as described above, the operator must also complete an in-person site survey prior to the operation. For STSC-004, or other operations in areas of low population density, this is required not only to satisfy CAR 901.27, but also to validate that the local population in the operational area satisfies the population density criteria. For example, the site survey should confirm that there are no new built-up areas or changes to city boundaries that would not have been reflected in the most recent census data, and that the operation is planned such that it avoids flight over/near any buildings or areas where people could be expected to be found. This should include assessment of areas that would not be highlighted by the Statistics Canada census (e.g., recreational areas such as campgrounds, beaches, ski hills during wintertime, as well as industrial areas and worksites, etc.).

(4) **Operational Monitoring**. Once the virtual and in-person site surveys have confirmed that the operational area meets the population density criteria, the operation may commence. During the operation, the RPAS operator needs to monitor the area around the aircraft (e.g., using cameras or sensors on the RPA) and adjust operations if evidence is found of sufficient numbers of people on the ground to invalidate the population density criteria. For a case where the site surveys showed an area was clear, but during operations a group of people (e.g., hikers, campers, etc.) were identified in the operational area, the expectation would be for the RPAS operator to handle the situation in the same manner as a traditional aviation pilot who becomes aware of something new creating a hazard to their operation. In the case of STSC-004, the RPAS operator would need to turn around or adjust their flight path to stay 1km away from the group of people.

(5) **Cases where the Virtual Site Survey indicates more than 5 or 25 people per km^2.** As noted above, there may be cases where the population density indicated by the virtual site survey does not reflect the actual number of people in the operational volume. There could be several reasons for this, and in some cases it may be due to the shape and location of the Dissemination Areas calculated by Statistics Canada. Dissemination Areas, especially those in rural areas will often contain an area of clustered population and an adjacent larger unpopulated area. In cases like

this, an operation may be permissible over the adjacent unpopulated area provided the operator takes reasonable measures to ensure that the operational volume, at the time of the operation, does not exceed the number of people per km^2 allowed by the standard scenario. Operator due diligence to ensure the operational area is clear of people may include:

(a) Reliance on natural physical barriers. The operation might take place in an area that is difficult to access. Examples could include bodies of water, mountains, or dense forest.

(b) Reliance on man-made physical barriers. Some operations, for example agricultural spraying, may take place over private property. If the operator, in cooperation with the property owner/manager can take steps to ensure the area is clear of people during the operation, then the operation could be permitted despite the results of the virtual site-survey. In this case, it is expected that the operator would take reasonable precautions to ensure that the area remains clear during the operation. Reasonable precautions could include ensuring that property fencing is intact, and the installation of signage at access points to indicate that the property is private and warning that drone operations might be in progress.

(c) In addition to determining if the operational area is accessible to people, the in-person site survey should determine how the area will be kept clear of people during the operation. Examples of this might include monitoring of access points to the area before and during the flight, or installation of signage where appropriate. Procedures may also be developed to use on board cameras (or other sensors) on board the RPA to ensure that the area remains sufficiently clear of people during the operation. This might even include the use of a second RPAS that is able to monitor for people in the area, in the even that the primary RPAS is not able to perform this function. (e.g. using a second RPAS equipped with a camera to scan for people while the primary RPAS performs the primary mission with a sensor dedicated to that task.)

(d) Strategic location of the base of operation and visual observers. While parts of an operation might be BVLOS, STSC-004 operations will generally commence and conclude with a period of VLOS operation. It's expected that this part of the operation would be conducted in accordance with CAR Part IX VLOS rules, and therefore respect the appropriate distance from people not involved with the operation, maintenance of VLOS, etc. If the operator cannot adequately demonstrate that a small section of the operational volume meets the population density criteria, it may be feasible to design the operation such that flight over those sections is conducted in accordance with Part IX VLOS rules. This might include locating the launch/recovery site in the problematic area or stationing visual observers at that location so that the operation can transition to VLOS in that area.

3.0 Assessment of More Densely Populated Areas

(1) **General**. For operations taking place in areas with a population density above 25 ppl/km^2, the expectations associated with verifying operational ground risk are the same as described in Section 2.0 above, with a few exceptions specific to higher population densities. Guidance related to each of these items is as follows:

(a) Virtual and In-Person Site Surveys. In the case of higher population density areas, it is expected that the virtual site survey will be the primary source of population density data, as in most cases it is not expected that an in-person survey would be able to demonstrate a population density significantly greater than or less than the expected value. However, an in-person site survey is still required to satisfy CAR 901.27, and attention should still be paid to identifying significantly increased areas of ground risk (e.g., actual or potential outdoor gatherings of people).

(b) Operational Monitoring. As in low population density operations, if an area of increased ground risk is identified during an operation, the expectation would be for the RPAS operator to handle the situation in the same manner as a traditional aviation pilot who becomes aware of something new creating a hazard to their operation. For operations being conducted in higher population density areas, the primary difference is determining what constitutes an area of increased ground risk. Since it is generally accepted that operations in areas above 25 ppl/km^2 will involve occasional flight near or over people not involved in the operation, evidence of small numbers of people in the operation is not necessarily problematic. However, it is expected that the operator develop criteria specific to their operational approval for how to identify increased levels of ground risk and when an operation should be suspended or modified as a result.