

1 **Title:** Adaptation and testing of a microscale audit tool to assess liveability using Google Street View:
2 MAPS-Liveability.

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30

31 **ABSTRACT**

32 **Background:** Liveability is a complex, multifaceted concept with various definitions, but with an agreed
33 core set of features (e.g., safety, walkability). Typically, liveability is measured at the macro-level (city or
34 regional-level), and has been used in advocacy by local populations. However, micro-level (street-level)
35 liveability measurements could also/alternatively be used to identify modifiable environmental features
36 impacting health and well-being. To date, no micro-level liveability tools exist. This study investigates the
37 reliability and rater agreement of a new micro-level audit tool designed for use with Google Street View
38 (GSV).

39

40 **Methods:** MAPS-Liveability (GSV), was adapted from the Microscale Audit of Pedestrian Streetscapes
41 (MAPS). This study had two phases: 1) MAPS-Liveability development (rapid literature review identifying
42 core liveability concepts, focus groups confirming liveability concepts and tool adaptation); 2) reliability
43 investigation (researcher agreement). Assessment was made of: total liveability; nine liveability sub-
44 characteristics (e.g., safety, health); and 12 proxy measures of behaviour including active travel (e.g.,
45 bicycle racks, presence of bicycles in racks). Inter-rater reliability and sensitivity to change were assessed
46 by percentage agreement, inter-class correlation coefficients (ICC) and Wilcoxon signed-ranked tests
47 ($p < 0.05$).

48 **Results:** Inter-rater reliability was *excellent* (ICC 0.905-0.968) for total liveability, parked cars and total
49 number of cars (moving/parked); *good* (ICC 0.754-0.885) for health, sustainability, places, number of
50 bicycle racks, bicycle rack capacity, number of bicycles in the racks (time-point 2), cyclists (time-point 2),
51 moving cars (time-point 2) and pedestrians; and *moderate* (ICC 0.550-0.742) for safety, inclusivity,
52 education, traffic/transport, pavements, roads, cyclists (time-point 1), number of bicycles in the racks
53 (time-point 1) and moving cars (time-point 1).

54

55 **Conclusion:** MAPS-Liveability provides a reliable assessment of micro-level liveability features. MAPS-
56 Liveability has excellent inter-rater reliability for total liveability and moderate-excellent inter-rater
57 reliability for liveability attributes and behavioural indicators. GSV at street-level supports safe, large-scale
58 objective data collection, and collection of historical data where primary data is unavailable.

59

60 **KEYWORDS**

61 Liveability, MAPS, street audit, Google Street View, reliability, sensitivity to change

62

63 **1. INTRODUCTION**

64 Liveability is a complex, multi-faceted concept, with varying definitions informed by different theoretical
65 frameworks spanning over twenty years of environmental and health research (Lowe et al., 2013; Giap et
66 al., 2014; Giles-Corti et al., 2014; Valcarcel-Aguiar & Murias, 2019). It is a concept that links public health,
67 urban planning and urban design; and has become a significant focus for policy makers and practitioners,
68 informing their work on infrastructure, construction, health and urban planning (Adam et al., 2017; Higgs
69 et al., 2019; King et al., 2020). By investigating liveability and gaining a greater understanding of the built
70 environment and its characteristics such as accessibility, safety, aesthetics, green and open spaces, we
71 can open up new possibilities for environmental maintenance, regeneration and/or sustainability that can

72 ultimately help lead to improved health and well-being (Adams et al., 2017, Higgs et al., 2019). Such
73 investigations would be considered timely given the United Nations Sustainable Development Goals which
74 calls for cities to be made “inclusive, safe, resilient and sustainable” by 2030 (United Nations, 2018).

75

76 However, despite the upwards trajectory of liveability research over recent decades, there is still
77 currently no standardized and accepted definition of ‘liveability’ (Adam et al., 2017; Higgs et al., 2019;
78 Valcarcel-Aguiar & Murias, 2019). Upon review of the differing definitions, it is apparent that although
79 each has been refined to suit the focus of specific applications, all definitions to varying degrees, include
80 the concepts of safety, health, sustainability, inclusivity, education, sense of place, transport (including
81 walkability), amenities and living standards which relate to health and well-being; and align with key
82 elements of the social determinants of health (Balas, 2004; Lowe et al., 2013; Giap et al., 2014; Giles-Corti
83 et al., 2014; Valcarcel-Aguiar & Murias, 2019).

84

85 Currently, numerous tools exist to audit the environment locally, including the Pedestrian
86 Environment Data Scan (PEDS), the Irvine-Minnesota Inventory, the Analytic Audit Tool, the Systematic
87 Pedestrian and Cycling Environmental Scan (SPACES) and the Revised Block Environmental Inventory (RBI)
88 (Pikora et al., 2002; Brownson et al., 2003; Day et al., 2005; Clifton et al., 2007). These tools were designed
89 with specific dimensions of urban life in mind such as active travel (e.g., PEDS, SPACES) or quality of
90 life/crime prevention (e.g., RBI). Walkable, bikeable, and safe neighborhoods are thought to be more
91 liveable and conducive to better population health and well-being. At present, liveability indicators exist
92 that are routinely used at the macro-scale (e.g., liveable cities) enabling cities to be ranked for investment,
93 policy-making and for impact assessment (Badland et al., 2014; Lowe et al., 2015; Giles-Corti et al., 2016).
94 However, tools combining several aspects of liveability for environmental audits (e.g., trees, cycle lanes,
95 parks) and at lower geographical scales (e.g., neighbourhoods, streets) are not yet well-developed but

96 would be useful in facilitating a more nuanced measurement approach for research (Barton & Grant,
97 2006; Newman, 2006; NSW Department of Health, 2009; San Francisco Department of Public Health,
98 2010; Economist Intelligent Unit, 2011).

99

100 The Microscale Audit of Pedestrian Streetscapes (MAPS) was designed to audit the pedestrian
101 environment and walkability of neighbourhoods (Brownson et al., 2004) and has been adapted over time
102 to provide a broad and inclusive method of assessing destinations, land use, streetscapes, aesthetics and
103 social variables at street-level (Millstein et al., 2013). Therefore, MAPS-Full was an appropriate starting
104 point for developing a liveability assessment tool, providing a better understanding of influencing
105 environmental factors. In addition, it has utility for research, policy and practice regarding environmental
106 attributes that: i) influence health behaviour; ii) reflect the propensity of an area to support physical
107 activity (including walking and cycling); iii) establish how individuals access and interact with and within
108 their environment; iv) provide information regarding better living, socializing and working conditions; v)
109 and can identify the impact of environmental changes on liveability and health and well-being (Astell-Burt
110 et al., 2013; Millstein et al., 2013; Astell-Burt et al., 2014; Giles-Corti et al., 2014).

111

112 Therefore, the objective of this paper is to introduce a modified version of the MAPS, MAPS-
113 Liveability. Our modified version augments it with items that relate to safety, sustainability, health,
114 traffic/transport and roads. Moreover, the rise in programmes, including Google Street view (GSV) that
115 permit remote, retrospective and safe observation of streetscapes without the need for specific expertise,
116 makes a compelling case for designing a tool that is usable for virtual audits (Griew et al., 2013). For this
117 reason, in addition to the modified version of MAPS, we conducted a study to assess the inter-rater
118 reliability of MAPS-Liveability via GSV.

119

120 **2. METHODS**

121 **2.1 Development of the MAPS-Liveability**

122 MAPS-Full was modified by completing the following steps. 1) establishment of a comprehensive list of
123 characteristics that influence liveability via a rapid review of the literature; 2) assessment of MAPS-Full
124 against the list to determine its comprehensiveness; 3) creation of new items to address the areas missing
125 in MAPS-Full to create MAPS-Liveability; and 4) testing the reliability of the new MAPS-liveability tool. The
126 development of MAPS-Liveability followed the adaptation framework outlined by Stewart and colleagues
127 (2012). This included: 1) qualitative research to explore concepts and to review the tool; 2) literature
128 reviews to determine the “adequacy or appropriateness of measures”; and 3) researcher experience and
129 knowledge to provide guidance and the rationale for any proposed tool modifications.

130

131 **2.1.1 MAPS-Full**

132 As stated, MAPS-Full was originally developed from the Analytic Audit Tool to collect data on the
133 pedestrian environment, streetscapes and walkability (Brownson et al., 2004). When the assessment of
134 MAPS-Full was performed to determine its comprehensiveness via literature reviews and qualitative
135 research, we found significant overlap between the liveability characteristics and MAPS-Full (Figure 1)
136 (Stewart et al., 2012). This mapping exercise demonstrated that only eleven additional items were
137 required for MAPS-Liveability (Figure 1).

138

139 MAPS-Full has previously been evaluated for reliability, and the majority of items (75.6%) had
140 moderate or good/excellent reliability (96.1%) (Millstein et al., 2013). Furthermore, MAPS-Full has also
141 been specifically tested for online street view versus field observations, with findings showing that online
142 audits using GSV are valid replacements of field measures when assessing land use (Millstein et al., 2013;

143 Kurka et al., 2016). Therefore, because of the reliability testing and its inclusion of micro-level attributes,
144 it was decided that it only required minimal adaptation to assess liveability.

145

146 **2.1.2 MAPS-Liveability**

147 To adapt MAPS-Full for the purposes of liveability, the content of the original questionnaire was amended,
148 such that: 1) three qualitative open ended questions were added, and 2) twelve proxy indicators of
149 behaviour (including active travel behaviour) were included (Appendix A-B). The proxy indicators of
150 behaviour included: the number of bicycle racks; number of bicycles in the racks; and the number of
151 moving or parked cars. Proxy indicators were added as current methods for tapping into these measures
152 usually rely on household travel surveys which are costly or infrequently performed, usually only providing
153 data at larger geographical scales (e.g., city, county or nationally), and are time intensive and expensive
154 to implement (Goel et al., 2018). In addition, current active travel counts can be inadequate for research
155 purposes as the coverage of cyclist and pedestrian counters (in person or sensors) has been limited, with
156 many of the installed sensors found to be broken or absent during periods when data collection would
157 have been important for research (Goel et al., 2018). Furthermore, other detailed counts relating to
158 cycling such as the number of bicycle racks or bicycle rack capacity, are infrequently assessed, but data
159 relating to their presence is required as inclusion of such cycle infrastructure has been found to encourage
160 cycling (Hull & O'Holleran, 2014).

161

162 When adaptations were complete, the contents of the new 'MAPS-Liveability' tool were sense
163 checked to determine the adequacy, appropriateness and coverage of the measures and it was
164 determined by the research team that MAPS-Liveability was suitable (Table 1) (Stewart et al., 2012).

165

166 **2.1.3 Pilot study**

167 A pilot study was undertaken by two auditors who rated the same streets, at the same point in time, to
168 determine whether the original MAPS-Full data collection protocol was appropriate and feasible for use
169 with the newly developed MAPS-Liveability questionnaire via GSV. The MAPS-Full data collection protocol
170 was implemented on five streets (selected at random within Belfast city centre) with MAPS-Liveability.
171 When both auditors discussed their findings it was determined that only four changes were required to
172 the original MAPS-Full data collection protocol for use with the new MAPS-Liveability tool (Appendix C).

173
174 The four changes included: 1) the audit starting point (i.e. either end of a street rather than at a
175 participant's house); 2) the size of the audit area (i.e. the entire street or a pre-selected route (beginning
176 to end) rather than 0.25 miles); 3) auditing a single complete street/route rather than a segmented
177 street/route (both sides of the street); and 4) the removal of questions relating to sensory perceptions
178 such as noise (Appendix C).

179

180 **2.1.4 Scoring protocol**

181 We developed a new scoring protocol in line with the original protocol for each of the nine characteristics
182 of liveability and for the total liveability score (Appendix D-G) (Cain et al., 2012). Scores for the proxy
183 indicators of behaviour including active travel can also be obtained and quantitatively analyzed (Appendix
184 G).

185

186 **2.2 MAPS-Liveability reliability testing**

187 The current study was performed in Belfast, UK between February and July 2019. The city has seen many
188 changes over the last decade in terms of its micro- and macro-level environment (i.e. cycle lane
189 investment, speed limit reductions to 20mph, pedestrianisation of streets within the city's core,
190 renovation and rejuvenation of amenities and facilities and improvements to public transport). Data were

191 collected at two time points within Belfast city centre, with virtual audits enabling historical data to be
192 collected via GSV. In Belfast city centre, 50 streets (i.e. the entire street as one complete route) were
193 selected at random from those in the city centre. Audit dates for GSV time-point 1, were pre-February,
194 2016; and for time-point 2, July 2019. The mean timeline between each audit was 38 months. Each street
195 was audited at two time-points by two independent auditors (not always the same pair, as there was a
196 pool of seven auditors) using the newly adapted MAPS-Liveability tool and data collection protocol
197 (Appendix H).

198

199 **2.3 Statistical analysis**

200 Statistical analysis was performed using SPSS Data Analysis Version 23 (SPSS Inc.). Spearman's rank
201 correlation coefficients were calculated to establish if there was a relationship between street length
202 (determined by geographical information system mapping, in metres) and audit time (in minutes).
203 Descriptive statistics (mean and standard deviation (SD)) were analyzed and presented, for audit time,
204 street length, each of the nine liveability characteristic scores, total liveability score and the twelve proxy
205 measures of behaviour including active travel behaviour. Inter-class correlation coefficients (ICC) were
206 used to assess how similar scores were between each rater, with a high degree of similarity signifying a
207 high degree of reliability (<0.5 poor, 0.5-0.75 moderate, 0.75-0.90 good and >0.90 excellent (Koo & Li,
208 2016)). One-way random-effects models were implemented, due to the raters being different and
209 randomly selected from a pool of seven raters. ICCs were performed for each liveability characteristic
210 (n=9), total liveability score and proxy measures of behaviour (n=12) as reported by auditor 1 versus
211 auditor 2 (time-point 1 and time-point 2). Regarding sensitivity to change, Wilcoxon signed-rank tests
212 were performed to determine whether the change scores were significantly different between time-
213 points and between auditors for the nine characteristics of liveability, the overall liveability score and the
214 twelve proxy measures of behaviour. Significance was set at $p < 0.05$.

215 **3. RESULTS**

216 **3.1 Results for MAPS-Liveability**

217 Agreement for audit dates (selected on GSV) for time-point 1 was 96% (n=48 of 50) and for time-point 2
218 was 86% (n=43 of 50). Disagreements were due to: auditor error selecting the most appropriate date
219 (n=4); GSV being updated between the time that the two auditors selected the most relevant date (n=2);
220 route discrepancy (n=2); and auditor error when two names were used on one street (n=1). The mean
221 length of time to audit a street at time-point 1 was: 57.8 minutes (*SD*31.0; range 15 -150 minutes) for
222 auditor 1; and 54.6 minutes (*SD*27.1; range 10 - 120 minutes) for auditor 2. At time-point 2 the mean
223 length of time to audit a street was: 37.5 minutes (*SD*21.0; range 15 -120 minutes) for auditor 1; and 37.2
224 minutes (*SD*25.3; range 10 - 120 minutes) for auditor 2. There were no significant differences between
225 auditors for the mean length of time to audit a street ($p>0.05$). However, the length of time between time-
226 point 1 and time-point 2 for each auditor significantly decreased ($p<0.001$). The mean street length was
227 200.4 metres (*SD*131.8; range 20.2 – 616.7 metres), with analysis showing positive correlations between
228 street length and audit time. Longer streets were associated with lengthier audit times (r 0.326-0.547).

229

230 **3.2 Time-point 1: Auditor 1 versus Auditor 2**

231 The ICC for total liveability score was 0.929 (95% CI 0.875-.0959, n=50) and is considered excellent (Table
232 2). For the nine liveability characteristics, three were considered to have good ICC 0.816-0.885 (health,
233 sustainability and places); and six were considered moderate, ranging from ICC 0.598-0.742 (safety,
234 inclusivity, education, traffic/transport, pavements and roads) (Table 2). For the twelve proxy measures
235 of behaviour, the number of parked cars and total number of cars (moving/parked) were considered as
236 excellent (ICC 0.905-0.910) (Table 3). For the number of bicycle racks (whole unit), bicycle rack capacity
237 and the number of pedestrians, the ICCs were considered good (ICC 0.754-0.832) while the ICCs for the
238 number of bicycles in the rack, the number of cyclists and the number of moving cars were considered

239 moderate (ICC 0.585-0.653) (Table 3). The only proxy measures to show poor results were the total
240 number of activities being performed and the presence of static people (ICC -0.216-0.275). Finally, for the
241 two remaining indicators, the data collected was limited due to low counts, which meant that accurate
242 ICCs could not be calculated for the number of individuals exercising (not walking or cycling) and the
243 presence of large groups of people (Table 3).

244

245 **3.3 Time-point 2: Auditor 1 versus Auditor 2**

246 The ICC for the total liveability score was 0.916 (95% CI 0.852-0.952, n=50) and this would be considered
247 as excellent (Table 2). For the nine liveability characteristics, three were considered to have ICCs in the
248 “good” range 0.782-0.812 (health, sustainability and places) and six in the moderate range, ICC 0.550-
249 0.698 (safety, inclusivity, education, traffic/transport, pavements and roads) (Table 2). When compared
250 between auditor 1 versus auditor 2 (time-point 2), the ICC was in the “excellent range” (0.939-0.968) for
251 the number of parked cars and total number of cars (moving/parked) (Table 3). The ICCs were good (0.755-
252 0.878) for the number of bicycle racks (whole unit), bicycle rack capacity, the number of bicycles in the
253 racks, the number of cyclists, the number of moving cars and pedestrians (Table 3). The number of
254 activities being performed being found to result in a poor ICC of -0.319. For the number of individuals
255 exercising (not walking or cycling) the ICC could not be calculated due to low counts. Finally, presence of
256 large groups of people and presence of people static were considered to have moderate to excellent ICCs
257 (ICC 0.700-0.911) however only four streets were included in the analysis (Table 3).

258

259 **3.4 Change time-point 1 to time-point 2: Auditor 1 and Auditor 2 separately (sensitivity to change)**

260 Overall changes were reported by both auditors for the total liveability score and each of the nine
261 characteristics of liveability (Table 2). The greatest change overall between time-point 1 and time-point 2
262 was for the traffic/transport characteristic and for both auditors this change was found to be significant

263 ($p < 0.05$). Overall changes were also reported by both auditors for each of the twelve proxy measures of
264 behaviour including active travel, the change in number of bicycles in the racks and the total number of
265 cars (moving/parked) found by auditor two was significant ($p < 0.05$) (Table 3).

266

267 **3.5 Change time-point 1 to time-point 2: Auditor 1 versus Auditor 2 (inter-rater agreement on sensitivity** 268 **to change)**

269 Using Wilcoxon signed-rank tests (2-tailed), there was no statistically significant differences in the degree
270 of change recorded by the two auditors for total overall liveability score, for each of the nine
271 characteristics of liveability, nor for eleven of the proxy measures of behaviour including active travel
272 ($p > 0.05$) (Tables 2 and 3).

273

274 **4. DISCUSSION**

275 To our knowledge, MAPS-Liveability is the first measure of liveability at the micro level. We have used GSV
276 and a consensus definition of liveability to adapt the existing MAPS-Full tool for the UK context. The
277 current study shows that the new MAPS-Liveability tool can provide researchers, practitioners and policy
278 makers with a reliable measure that can be used to assess liveability and active travel at the street-level
279 with the potential to aggregate scores to a neighbourhood or city level. MAPS-Liveability also provides a
280 method of direct observation online via GSV, an extensive and frequently updated database, which
281 provides a safe, inexpensive and desk-based method of data collection on any location where Google has
282 collected street view data.

283

284 **4.1 Assessing Liveability**

285 When liveability results were reported by two independent auditors the inter-rater reliability for total
286 liveability was considered to be excellent, with each of the nine characteristics of liveability having inter-

287 rater reliability ICC correlations of moderate to good. MAPS-Liveability was also found to be sensitive to
288 change, with both auditors reporting similar score changes over time.

289
290 The greatest change reported from time-point 1 to time-point 2 related to the liveability
291 characteristic of 'traffic/transport'. This finding was to be expected considering the micro- and macro-
292 level built environmental changes (cycle lanes, pedestrianisation, amenity and facility improvements,
293 public transport developments, speed limit reductions) that have been implemented within Belfast city
294 centre over the course of recent years. Consequently, this study showed that MAPS-Liveability can reliably
295 utilize comprehensive liveability data via GSV and detect changes over time. However, we note that some
296 liveability attributes identified in Phase 1, such as anti-social behaviour, signalization at crossings, noise
297 and air pollution, and the pleasantness of a street, could not be assessed via GSV as they required sensory
298 perceptions or finer attention to detail (noted within 4.4 Strengths and limitations).

299

300 **4.2 Proxy indicators of behaviour including active travel behaviour**

301 In addition to the measures of liveability the adapted tool also showed moderate to excellent reliability
302 for the majority of behavioural indicators including travel behaviour via GSV. This is a positive finding as
303 to date measures of active travel are lacking for a number of reasons, including: (i) surveys are usually
304 focused on transport planning as opposed to surveillance; (ii) there is often inadequate coverage of cyclist
305 and pedestrian counters (in person or sensors); (iii) broken sensors are out of action for variable periods
306 of time; and (iv) data are not usually available at the level of the individual but at city or regional level
307 (Goel et al., 2018). Therefore, providing a reliable tool that can assess active travel has the potential to
308 move local, regional and international surveillance and research forward. The current method also
309 provides an indication of cycling in an area and the potential to assess preferred mode of transport (i.e.
310 car, bicycle or on foot) which has been lacking in previously proposed methods (Goel et al., 2018).

311 However, for three of our indicators of behaviour (i.e. presence of large groups of people, presence of
312 static groups and number of individuals exercising (not walking or cycling)), accurate reliability
313 assessments were not possible. The current study took place in Belfast city centre where individuals are,
314 for the most part, transient pedestrians commuting through the city's core for work, shopping or
315 socializing. Infrequently, would there be individuals congregating in large groups, standing still (other than
316 waiting for public transport for instance) or exercising (not walking or cycling). This does not mean that
317 the indicators are unreliable, but rather reliability testing should be performed in other locations and
318 contexts, and at different times of day, to assess the three indicators more fully.

319

320 **4.3 Tool Adaptation**

321 In regards to MAPS-Full, the tool required only minimal content changes, and minor alterations to the
322 data collection protocol for the purpose of auditing the local environment to assess liveability and active
323 travel. The new scoring protocol allowed for total liveability, the nine characteristics of liveability and
324 twelve proxy measures of behaviour including active travel to be assessed. In addition, the adapted tool
325 enabled comparisons to be drawn between streets, collecting data both cross-sectionally and
326 longitudinally to capture change.

327

328 **4.4 Strengths and limitations**

329 Strengths included the comprehensive staged approach that was implemented to develop MAPS-
330 Liveability. In addition, two independent researchers audited 50 streets (at two time-points with a mean
331 timeline of 38 months apart) to provide a comprehensive dataset. Within the current study, GSV enabled
332 researchers to collect historical data and auditors could retrospectively assess liveability and proxy
333 measures of behaviour including active travel. GSV also provides a low cost, efficient and safe method of
334 data collection regardless of the auditor's location (Philips et al., 2017). Having calculated that one street

335 can be audited in 46.7 minutes (mean), this equated to approximately 59 hours (one time-point) or 118
336 hours (two time-points) for the current study. In addition, no time was spent by auditors travelling to a
337 location, nor was there auditor travel costs. Therefore, we feel MAPS-Liveability via GSV may be a feasible
338 replacement for expensive in-person auditing.

339

340 However, GSV does have limitations. When using GSV it is not possible to assess air pollution, noise, or
341 perceived safety, as presence on the street would be required for such assessments. Temporality may be
342 an issue as Google only provides an image for one point in time and does not make available specific
343 information such as exact time of day, day of the week or date. In addition, when assessing transport, an
344 important construct of liveability, and one which would be considered as highly variable across the day, a
345 single point-in-time observation online (via GSV) could be considered insufficient.

346

347 Contemporality can also be a problem as although attempts can be made by the research team to audit
348 in line with the implementation of an intervention or the measurement of another outcome (e.g., health
349 or physical activity), time lapses can occur between GSV images being taken and uploaded and data
350 collection. In addition, the uploading of images to GSV is more frequent in urban areas in comparison to
351 rural areas, which may result in problems for those implementing studies in rural settings. Finally, when
352 using GSV for auditing the presence of street furniture (e.g., bicycle racks) it is not possible for auditors to
353 record those which are not visible, because of obstructions by moving and/or parked vehicles, resulting
354 in the potential for inaccurate counts.

355

356 A limitation of MAPS-Liveability, is that the tool would be considered a presence/absence
357 measure rather than gathering information on the quality of the environment, which may be considered

358 necessary for liveability assessments. Nonetheless, MAPS-Liveability provides researchers, practitioners
359 and policy makers with a useful, reliable and feasible tool for assessing liveability.

360

361 **4.5 Implications for future research**

362 This study was implemented in a UK context where land use mix and density and urban form may differ
363 in comparison to other countries such as the US and Australia. Therefore, given these important
364 contextual differences, further testing regarding reliability and validity of MAPS-Liveability should be
365 conducted in different contexts. Additionally, we implemented this study within a city centre where land
366 use mix could be considered homogeneous across streets (i.e. highly commercial and recreational, with
367 some residential and no agricultural land) and this could artefactually inflate inter-rater reliability.
368 Therefore, it would be useful to test the tool on streets with differing land use mix in future research, for
369 example: other towns and cities across the UK; and in different area types (e.g., rural or suburban areas)
370 to test in heterogeneous environments. In addition, future research could aim to implement MAPS-
371 Liveability to detect change following differing environmental rejuvenation or regeneration interventions.
372 Finally, in regards to GSV, further research could provide a more in depth understanding of the accuracy
373 of date/time stamps when using the software to collect data at differing time-points and to provide
374 guidance for researchers in relation to the reliability of this.

375

376 **5. CONCLUSIONS**

377 MAPS-Liveability provides researchers, policy makers and practitioners with a reliable tool to examine
378 liveability and proxy measures of behaviour including active travel behaviour. MAPS-Liveability enables
379 assessments of micro-level characteristics (such as pavements, bicycle lanes, and softscape features) and
380 active travel. This can inform recommendations for amenity/facility installation, rejuvenation and/or
381 modification.

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385

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390 those of the National Health Service, the NIHR or the Department of Health and Social Care.’

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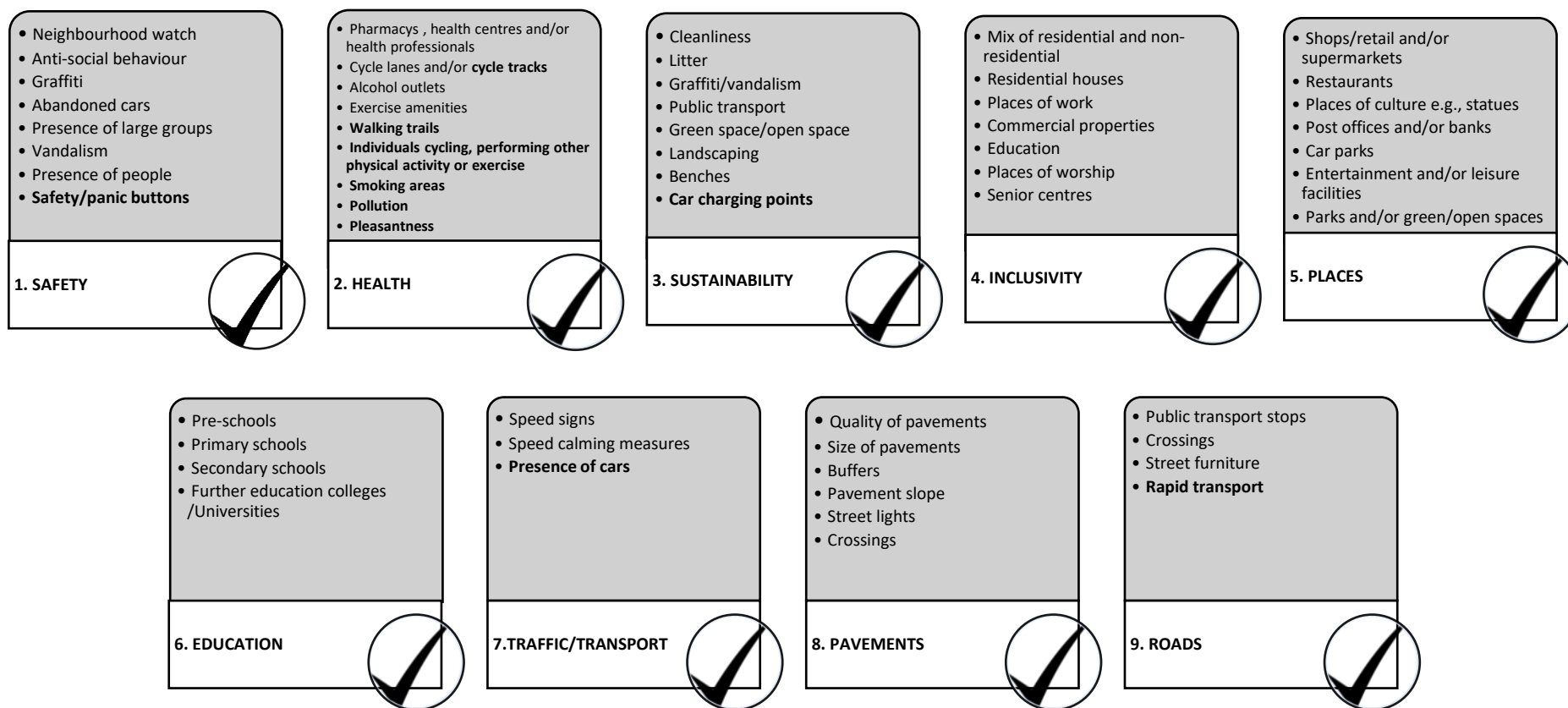
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Figure 1. Overarching characteristics of liveability and the associated attributes



Bold font highlights liveability attributes that were not included within MAPS-Full but were recommended to be added for the purposes of MAPS-Liveability; and standard font highlights the liveability attributes that were already included within MAPS-Full.

Table 1. Summary of liveability characteristics and associated attributes by MAPS-Liveability question

Characteristics	Attributes	MAPS-Liveability question reference
SAFETY	Neighbourhood watch	Aesthetics and social question 6
	Anti-social behaviour	Aesthetics and social questions 6 and 7
	Graffiti/Vandalism	Aesthetics and social questions 6 and 7
	Abandoned cars	Aesthetics and social questions 6 and 7
	Presence of large groups	Behavioural outcomes questions regarding 'Groups' and 'Static people'
	Presence of people	Behavioural outcomes questions regarding 'Groups', 'Pedestrians', 'Exercise', 'Static people' and Aesthetics and social questions 9-12
	Safety/panic button	Aesthetics and social question 6
HEALTH	Pharmacy	Land use/destinations question 5i
	Health centre/professionals	Land use/destinations questions 5k and 5o
	Cycle lanes	Pavements/roads questions 14a and 14ai
	Alcohol outlets	Land use/destinations question 5f
	Exercise amenities	Land use/destinations questions 5z and 5aa-ac
	Walking trails	Land use/destinations question 5e
	Bicycle tracks	Pavements/roads questions 14b and 14bi
	Individuals cycling	Behavioural outcomes question regarding 'Cycling'
	Individuals performing other physical activity or exercise	Behavioural outcomes question regarding 'Exercise'
	Smoking areas	Land use/destinations question 8
SUSTAINABILITY	Cleanliness	Aesthetics and social questions 6 and 7
	Litter	Aesthetics and social questions 6 and 7
	Graffiti/Vandalism	Aesthetics and social questions 6 and 7
	Public transport	Streetscape questions 1 and 2
	Green space/Open space	Land use/destinations questions 5ad and Cul-de-sac question 10c
	Landscaping	Aesthetics and social questions 2 and 5
	Benches	Streetscape question 8
	Car charging points	Streetscape question 8
INCLUSIVITY	Mix of residential and non-residential	Land use/destinations questions 2, 3, 5 and 6
	Residential houses	Land use/destinations question 2
	Places of work	Land use/destinations questions 5 and 6
	Commercial	Land use/destinations questions 5 and 6
	Education	Land use/destinations question 5t
	Places of worship	Land use/destinations question 5s
	Senior centres	Land use/destinations question 5r
PLACES	Shops	Land use/destinations questions 5c, d, f-i, n and 6

	Restaurants	Land use/destinations questions 5a, b, e
	Culture	Land use/destinations question 5p, s and Aesthetics and social questions 1-3
	Post office	Land use/destinations question 5q
	Car parks	Land use/destinations questions 1 and 4
	Bank	Land use/destinations question 5j
	Supermarkets	Land use/destinations questions 5c, g and 6
	Entertainment	Land use/destinations questions 5a, b, e, l, p, x
	Park	Land use/destinations question 5ad
	Leisure facilities	Land use/destinations questions 5y, z, aa-ae
	Green/open space	Land use/destinations questions 5w, y, ab, ad, ae
	Other services	Land use/destinations questions 5 and 6
EDUCATION	Pre-schools	Land use/destinations question 5t
	Primary schools	Land use/destinations question 5t
	Secondary schools	Land use/destinations question 5t
	Further education colleges /Universities	Land use/destinations question 5t
TRAFFIC/TRANSPORT	Speed signs	Streetscape questions 3, 3a, 3b, 4, 5
	Speed calming measures	Streetscape questions 3, 3a, 3b, 4, 5
	Presence of cars	Aesthetics and social questions 6, 7, Pavements and roads question 9 and behavioural outcomes question regarding 'Traffic'
PAVEMENTS	Quality	Pavements/roads questions 1, 5, 8, 9, 12, Crossings question 11 and Cul-de-sac question 4
	Size	Pavements/roads questions 2-4 and 13
	Buffers	Pavements/roads questions 3, 4 and 12
	Slope	Pavements/roads questions 6, 7, Crossings question 6 and Cul-de-sac question 2
	Lights	Streetscape question 6, Crossings question 11 and Cul-de-sac question 5
	Crossings	Crossings questions 1-11 and Streetscape question 9
ROADS	Public transport stops including rapid transport	Streetscape questions 1-2
	Crossings	Crossings questions 1-11 and Streetscape question 9
	Street amenities	Streetscape question 8

Table 2. Descriptive statistics for each liveability characteristic

	Time-point 1						Time-point 2						Change time-point 1 to time-point 2					
	A1 Mean (SD)	n	A2 Mean (SD)	n	ICC A1 vs A2 (95% CI)	n	A1 Mean (SD)	n	A2 Mean (SD)	n	ICC A1 vs A2 (95% CI)	n	A1 Mean (SD)	n	A2 Mean (SD)	n	WSRT (Z score)	n
Safety	10.50 (2.77)	50	10.49 (2.91)	49	0.607 (0.305- 0.778)	49	10.68 (2.61)	50	10.36 (2.97)	50	0.657 (0.397- 0.805)	50	0.18 (0.96)	50	-0.06 (0.97)	49	-1.589	49
Health	8.34 (3.17)	50	8.02 (2.78)	49	0.816 (0.676- 0.896)	49	8.68 (3.61)	50	8.16 (2.80)	50	0.796 (0.642- 0.884)	50	0.34 (1.95)	50	0.16 (1.23)	49	-0.344	49
Sustainability	11.08 (4.67)	50	10.28 (5.36)	50	0.885 (0.798- 0.935)	50	11.38 (4.40)	50	10.59 (4.73)	49	0.812 (0.668- 0.894)	49	0.30 (1.09)	50	0.10 (1.82)	49	-1.531	49
Inclusivity	1.42 (0.84)	50	1.38 (1.03)	50	0.598 (0.297- 0.772)	50	1.44 (0.84)	50	1.43 (0.98)	49	0.550 (0.205- 0.746)	49	0.02 (0.14)	50	0.02 (0.32)	49	0.000	49
Places	13.66 (5.34)	50	13.56 (6.20)	50	0.851 (0.738- 0.915)	50	13.88 (5.57)	50	14.55 (5.77)	49	0.782 (0.616- 0.877)	49	0.22 (1.22)	50	0.71 (3.00)	49	-0.309	49
Education	0.22 (0.47)	50	0.12 (0.33)	50	0.620 (0.333- 0.784)	50	0.24 (0.48)	50	0.10 (0.30)	50	0.620 (0.333- 0.784)	50	0.02 (0.14)	50	-0.02 (0.14)	50	-1.414	50
Traffic/ transport	1.78 (1.34)	50	1.69 (1.58)	49	0.645 (0.373- 0.799)	49	2.88 (1.90)	50	2.55 (2.25)	49	0.664 (0.4.07- 0.810)	49	1.10 (1.15)*	50	0.88 (1.04)*	48	-1.665	48
Pavements	25.68 (5.68)	50	24.38 (8.67)	50	0.741 (0.545- 0.853)	50	25.94 (4.91)	50	25.32 (7.51)	50	0.698 (0.470- 0.828)	50	0.26 (2.27)	50	0.94 (5.08)	50	-0.667	50
Roads	13.34 (3.70)	47	12.67 (6.37)	48	0.742 (0.532- 0.858)	45	13.66 (3.99)	47	13.28 (5.94)	46	0.605 (0.275- 0.786)	43	0.32 (1.71)	47	0.07 (2.71)	46	-0.420	43
Total score	67.22 (16.77)	50	67.54 (18.07)	50	0.929 (0.875- 0.959)	50	69.30 (16.79)	50	69.02 (17.65)	50	0.916 (0.852- 0.952)	50	2.08 (4.05)	50	1.48 (3.70)	50	-1.036	50

*p<0.05; A1: auditor 1; A2: auditor 2; CI: confidence intervals; ICC: intra-class correlations; SD: standard deviation; vs: versus; WSRT: Wilcoxon-sign rank test.

Table 3. Descriptive statistics for each proxy measure of behaviour

	Time-point 1						Time-point 2						Change time-point 1 to time-point 2					
	A1 Mean (SD)	n	A2 Mean (SD)	n	ICC A1 vs A2 (95% CI)	n	A1 Mean (SD)	n	A2 Mean (SD)	n	ICC A1 vs A2 (95% CI)	n	A1 Mean (SD)	n	A2 Mean (SD)	n	WSRT (Z score)	n
No. of bicycle racks	3.16 (4.83)	50	3.52 (6.38)	50	0.832 (0.705- 0.905)	50	3.38 (5.13)	50	3.74 (6.40)	50	0.871 (0.774- 0.927)	50	0.22 (1.09)	50	0.22 (1.56)	50	-0.140	50
No. of bicycles the rack can hold	8.93 (8.34)	27	10.22 (12.00)	27	0.774 (0.493- 0.900)	25	11.07 (10.66)	27	10.48 (11.88)	27	0.878 (0.727- 0.946)	25	2.15 (6.10)	27	0.26 (3.43)	27	-1.682	25
No. of bicycles in the racks (total)	2.74 (4.03)	27	1.74 (2.12)	27	0.585 (0.069- 0.816)	25	2.63 (3.28)	27	2.78 (3.14)	27	0.844 (0.649- 0.931)	25	-0.04 (2.82)	27	1.04* (1.97)	27	-0.849	25
No. of cyclists	0.35 (0.69)	49	0.25 (0.60)	48	0.652 (0.378- 0.806)	47	0.41 (0.73)	49	0.37 (0.78)	49	0.755 (0.565- 0.862)	48	0.06 (0.75)	49	0.13 (0.82)	48	-0.353	47
No. of moving cars	3.76 (5.62)	50	4.83 (8.19)	48	0.653 (0.383- 0.805)	48	3.50 (5.56)	50	3.27 (4.67)	49	0.847 (0.731- 0.914)	49	-0.26 (3.64)	50	-1.50 (5.74)	48	-0.722	48
No. of parked cars	9.04 (11.30)	50	11.33 (13.64)	48	0.905 (0.832- 0.947)	48	8.36 (10.67)	50	9.31 (11.19)	48	0.939 (0.892- 0.965)	49	-0.68 (4.10)	50	-1.92 (6.22)	48	-1.411	48
Total number of cars (moving/parked)	12.80 (14.98)	50	16.17 (17.35)	48	0.910 (0.840- 0.949)	48	11.80 (13.48)	50	12.55 (13.79)	49	0.968 (0.944- 0.985)	49	-1.00 (4.93)	50	-3.44* (7.70)	48	-1.815	48
No. of individuals exercising (not walking or cycling)	0.00 (0.00)	49	0.00 (0.00)	48	-	-	0.02 (0.14)	50	0.00 (0.00)	49	-	-	0.01 (0.14)	49	0.00 (0.00)	48	-1.000	47
Total no. of activities being performed	0.14 (0.50)	49	0.17 (0.48)	47	-0.216 (-1.189- .325)	46	0.18 (0.44)	50	0.25 (0.66)	49	-0.319 (-1.329- 0.255)	49	0.04 (0.41)	49	0.09 (0.35)	47	-0.879	46
No. of pedestrians	28.18 (34.49)	49	38.55 (54.05)	47	0.754 (0.558- 0.864)	46	29.38 (39.53)	50	37.63 (61.41)	49	0.814 (0.671- 0.895)	49	1.80 (28.98)	49	-0.26 (39.77)	47	-1.050	46

Presence of large groups of people	1.23 (1.36)	13	0.25 (0.72)	20	-	-	1.36 (1.28)	14	0.23 (0.53)	22	0.700 (-1.994- 0.980)	4	0.23 (1.69)	13	0.00 (0.86)	20	-0.447	2
Presence of people static	13.31 (14.50)	13	4.05 (10.48)	20	0.275 (-26.917- 0.999)	2	14.29 (14.78)	14	3.55 (5.83)	22	0.911 (0.115- 0.994)	4	2.08 (17.70)	13	-0.70 (7.46)	20	-0.447	2

* $p < 0.05$; A1: auditor 1; A2: auditor 2; CI: confidence intervals; ICC: intra-class correlations; no.: number; SD: standard deviation; vs: versus; WSRT: Wilcoxon-sign rank test.

Appendix A. Changes made to MAPS-Full

As MAPS-Full was developed in the United States of America and the current study is based within the United Kingdom (UK), MAPS-Full was modified by changing English (American) to English (UK) and any American examples were changed to relevant UK examples (Appendix B).

The eleven additional items identified to investigate liveability were added and the list below details these additions:

- 1) 'Safety/panic buttons' added as a sub-response to Section Aesthetics and Social, 6: Which of the following physical disorders are present? "Safety/panic buttons connecting to police".
- 2) Walking trails added as a sub-response to Section Land use/destinations, 6. How many of the following types of non-residential destinations are present? "Public walking trail".
- 3) Bicycle tracks added as a question to Section Pavements/roads, 14b. Is there a marked bicycle track separated from traffic and pedestrians? (yes or no).
14bi. Does the marked bicycle track run for the entire route? (100%, 75-99%, 51-75%, 25-50% or 1-25%).
- 4) Presence of anyone cycling (yes or no) added as a question to Section Aesthetics and Social.
- 5) Presence of anyone performing other physical activity or exercising (not walking or cycling) (yes or no) added as a question to Section Aesthetics and Social.
- 6) Smoking areas added as a sub-response to Section Streetscape, 7: Presence of street amenities? "Smoking areas".
- 7) Car charging points added as a sub-response to Section Streetscape, 7: Presence of street amenities? "Car charging points".
- 8) Rapid transport added as a sub-response to Section Streetscape, 1: Number of public transport stops? "Rapid transport stops".
- 9) Presence of cars – see additional adaptations.
- 10) Pleasantness and 11) Pollution – see phase 1iii.

As a 20mph speed limit intervention and a rapid transport system were implemented within Belfast city centre, specific questions were added (Appendix B).

Several of the MAPS-Full questions did not require complete revisions but rather slight additions to provide clarification for the auditor e.g., when asked about schools, additional guidance was added to also ensure pre-schools, colleges, universities were accounted for (Appendix B).

Twelve proxy indicators of behaviour including active transport behaviour were added as it was felt that not only could MAPS-Liveability be used to assess liveability but it also has the capability to gather specific outcomes and could enable researchers to obtain 'counts'. Therefore the following were added: 1) bicycle racks (as a whole unit); 2) number of bicycle racks (how many bicycles can the rack hold); 3) number of bicycles in each of the racks (total); 4) number of cyclists; 5) number of moving cars; 6) number of parked cars; 7) total number of cars on the road (moving and/or parked); 8) number of individuals exercising (not walking or cycling (e.g., running, jogging, rollerblading etc.)); 9) total number of activities being performed (not walking or cycling); 10) number of pedestrians; 11) presence of large groups or people or groups of people; and 12) presence of static people (presence of people waiting for the bus or talking etc.).

As liveability has been suggested to be a qualitative assessment (Giap et al., 2014) an open text box was added to provide where appropriate a qualitative summary of the area: "any other comments on the street regarding liveability: safety, health, sustainability, inclusivity, places, education, traffic, pavements or roads", "make a note of any temporary street furniture e.g., road works, traffic lights" and "make a comment regarding the weather of the Google Street View at time-point 1 and time-point 2".

Appendix B. Summary of changes made to MAPS-Full

Section	Original MAPS-Full question number	MAPS-Full question	MAPS-Liveability question (italics represents added detail)
Land use/destinations	3	What type of residential uses? <i>Other (mobile home, dormitory)</i>	What type of residential uses? <i>Other (mobile home, dormitory, students)</i>
Land use/destinations	6d	How many of the following types of non-residential destinations are present? <i>Convenience store (may also be a gas station)</i>	How many of the following types of non-residential destinations are present? <i>Convenience store (may also be a petrol station)</i>
Land use/destinations	6f	How many of the following types of non-residential destinations are present? <i>Liquor/alcohol store (primarily sells alcohol, wine bar, strip club)</i>	How many of the following types of non-residential destinations are present? <i>Liquor/alcohol store (primarily sells alcohol, wine bar)</i>
Land use/destinations	6g	How many of the following types of non-residential destinations are present? <i>Big box store (e.g., Home Depot, Best Buy, Sears, Super Walmart, Target)</i>	How many of the following types of non-residential destinations are present? <i>Big box store (e.g., Asda, Tesco, Sainsburys, B&Q)</i>
Land use/destinations	6h	How many of the following types of non-residential destinations are present? <i>Specialty Food Store (e.g., ice cream, candy, bakery)</i>	How many of the following types of non-residential destinations are present? <i>Specialty Food Store (e.g., ice cream, sweets, bakery)</i>
Land use/destinations	6t	How many of the following types of non-residential destinations are present? <i>School</i>	How many of the following types of non-residential destinations are present? <i>School (including pre-school, college and university)</i>
Land use/destinations	6ae	How many of the following types of non-residential destinations are present?	How many of the following types of non-residential destinations are present? <i>Public walking trail</i> <i>0 1 2+</i>
Streetscape	1	Number of public transit stops	Number of public transit stops <i>Rapid transport stops</i>
Streetscape			<i>How many 20mph speed limit signs are along the route?</i> <i>_____ painted on ground _____ sign on a pole _____</i> <i>Other</i> <i>If other, please state _____</i>
Streetscape	3	Special zone speed limits (<i>school, construction</i>) <input type="checkbox"/> Yes _____ mph <input type="checkbox"/> No	Special zone speed limits (<i>school, construction</i>) <input type="checkbox"/> Yes _____ mph <input type="checkbox"/> No <i>Please state _____</i>
Streetscape	4	4. What other street characteristics are present? (specify # of each type) <i>Check all that apply</i> <input type="checkbox"/> Traffic calming (signs, circles, speed tables, speed humps, curb extension) _____ <input type="checkbox"/> Roll-over curbs _____ (if whole segment = 1) <input type="checkbox"/> Drainage ditches _____ (count one side of street) <input type="checkbox"/> Instructional signs for pedestrian's _____ <input type="checkbox"/> Crosswalk signage or other pedestrian signage (for drivers) _____	What other street characteristics are present? (specify # of each type) <i>Check all that apply</i> <input type="checkbox"/> <i>Traffic calming signs</i> _____ <input type="checkbox"/> <i>Traffic calming circles</i> _____ <input type="checkbox"/> <i>Traffic calming speed tables</i> _____ <input type="checkbox"/> <i>Traffic calming speed humps</i> _____ <input type="checkbox"/> <i>Traffic calming curb extension</i> _____ <input type="checkbox"/> Roll-over curbs _____ (if whole segment = 1) <input type="checkbox"/> Drainage ditches _____

		<input type="checkbox"/> None of the Above	<input type="checkbox"/> Instructional signs for pedestrian's _____ <input type="checkbox"/> Crosswalk signage or other pedestrian signage (for drivers) _____ <input type="checkbox"/> None of the Above
Streetscape	7	Presence of street amenities <i>Check all that apply</i> <input type="checkbox"/> Building overhangs that provide shelter from inclement weather in public space (i.e. sidewalks) <input type="checkbox"/> Trash bins (public) <input type="checkbox"/> Benches or other places to sit <input type="checkbox"/> Bicycle racks <input type="checkbox"/> Working drinking fountain <input type="checkbox"/> Working public telephones <input type="checkbox"/> Kiosks or information booths <input type="checkbox"/> None of the Above	Presence of street amenities <i>Check all that apply</i> <input type="checkbox"/> Building overhangs that provide shelter from inclement weather in public space (i.e. pavements) <input type="checkbox"/> <i>Rubbish</i> bins (public) <input type="checkbox"/> Benches or other places to sit <input type="checkbox"/> Bicycle racks <input type="checkbox"/> Working drinking fountain <input type="checkbox"/> Working public telephones <input type="checkbox"/> Kiosks or information booths <input type="checkbox"/> Car charging points <input type="checkbox"/> Smoking areas <input type="checkbox"/> None of the Above
Aesthetics and social	3	Are there observable <u>historic or cultural features</u> along the route (<i>not further than one street segment away from route and can be seen from the route</i>)? <input type="checkbox"/> Yes <input type="checkbox"/> No	Are there observable <u>historic or cultural features</u> along the route (statues, murals etc.)? <input type="checkbox"/> Yes <input type="checkbox"/> No <i>Please state _____</i>
Aesthetics and social	6	Which of the following physical disorders are present? <i>Check all that apply</i> <input type="checkbox"/> Graffiti/tagging (not murals) <input type="checkbox"/> Abandoned cars <input type="checkbox"/> Buildings with broken/boarded windows <input type="checkbox"/> Drug paraphernalia <input type="checkbox"/> Broken glass <input type="checkbox"/> Beer/liquor bottles/cans <input type="checkbox"/> Litter in yards <input type="checkbox"/> Noticeable/excessive litter in street/sidewalk <input type="checkbox"/> Neighborhood watch signs <input type="checkbox"/> Signage for commercial destinations or parks <input type="checkbox"/> None of these	Which of the following physical disorders are present? <i>Check all that apply</i> <input type="checkbox"/> Graffiti/tagging (not murals or street art) <input type="checkbox"/> Abandoned cars <input type="checkbox"/> Buildings with broken/boarded windows <input type="checkbox"/> Drug paraphernalia <input type="checkbox"/> Broken glass <input type="checkbox"/> Beer/liquor bottles/cans <input type="checkbox"/> Litter in yards <input type="checkbox"/> Noticeable/excessive litter in street/sidewalk <input type="checkbox"/> Neighbourhood watch signs <input type="checkbox"/> Signage for commercial destinations or parks <input type="checkbox"/> <i>Safety button connecting to police</i> <input type="checkbox"/> None of these
Aesthetics and social			<i>Presence of anyone cycling?</i> <input type="checkbox"/> Yes <input type="checkbox"/> No
Aesthetics and social			<i>Presence of anyone performing other physical activity or exercising? (not walking or cycling)</i> <input type="checkbox"/> Yes <input type="checkbox"/> No
Walkways / sidewalks (now Pavements / roads)	Changed throughout section	Sidewalk	<i>Pavements</i>
Walkways / sidewalks (now Pavements / roads)	9	Are there <u>temporary obstructions</u> in the sidewalk? (<i>e.g., parked cars, sandwich boards, garbage cans</i>) <input type="checkbox"/> None <input type="checkbox"/> Some <input type="checkbox"/> Many <input type="checkbox"/> No sidewalk	Are there <u>temporary obstructions</u> in the pavement? (<i>e.g., parked cars, sandwich boards, rubbish bins</i>) <input type="checkbox"/> None <input type="checkbox"/> Some <input type="checkbox"/> Many <input type="checkbox"/> No pavement

Walkways / sidewalks (now Pavements / roads)	14	<p>Does the marked bicycle lane run for the entire route?</p> <p><input type="checkbox"/> 100% <input type="checkbox"/> 75-99% <input type="checkbox"/> 51-75% <input type="checkbox"/> 25-50% <input type="checkbox"/> 1-25%</p>
Walkways / sidewalks (now Pavements / roads)	14	<p>Is there a <u>marked bicycle track</u> separated from traffic and pedestrians?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Does the marked bicycle track run for the entire route?</p> <p><input type="checkbox"/> 100% <input type="checkbox"/> 75-99% <input type="checkbox"/> 51-75% <input type="checkbox"/> 25-50% <input type="checkbox"/> 1-25%</p>
Additional qualitative detail		<p>Any other comments on the street regarding liveability: safety, health, sustainability, inclusivity, places, education, traffic, pavements or roads?</p> <p>Please make a noted of any temporary street furniture e.g., road works, traffic lights</p> <p>Please make a comment regarding the weather of the google street view both pre-20mph and post-20mph</p>
Additional count detail		<p>Number of bicycle racks (as a whole unit)</p> <p>Number of bicycle racks (how many bicycles can the rack hold)</p> <p>Number of bicycles in each of the racks (total)</p> <p>Number of cyclists</p> <p>Number of moving cars</p> <p>Number of parked cars</p> <p>Total number of cars on the road (moving and/or parked)</p> <p>Number of individuals exercising (not walking or cycling e.g., running, jogging rollerblading etc.)</p> <p>Type of activities being performed (not walking or cycling e.g., running, jogging, rollerblading etc.)</p> <p>Total number of activities being performed (not walking or cycling)</p> <p>Number of pedestrians</p> <p>Presence of large groups of people or groups of people</p> <p>Presence of people waiting for the bus or talking etc.</p>

Appendix C. Pilot testing of the newly developed MAPS-Liveability.

Following each of the adaptations, a pilot study was implemented to test the newly developed MAPS-Liveability via Google Street View. The data collection procedures were carried out in line with those that were developed for MAPS-Full. Five streets were selected at random and a total of four adaptations were made to the data collection procedures for the purposes of implementing MAPS-Liveability:

1. Location starting point

As liveability may be assessed in a street/area rather than attached to a participant and their participation in a study, it is not always possible to start from an individual's address. Therefore, MAPS-Liveability needs to have the capability of starting at any location. Due to this change, three questions were removed from the Section cul-de-sac:

1) How close is the cul-de-sac or dead-end to the participants' home?

Check one

- On the cul-de-sac
- Adjacent to the cul-de-sac (one or two homes/houses removed from cul-de-sac opening)
- Non-adjacent, but less than 200 feet away
- More than 200 feet away

7) Can most of the cul-de-sac or dead-end area be seen from the participant's home (using the most optimal viewpoint from the home, including higher story windows)?

- Yes No

8) Can most of the cul-de-sac or dead-end area be seen from other homes (using the most optimal viewpoint from the home, including higher story windows)?

- Yes No

MAPS is a tool originally developed in the US where land use and urban form differ in comparison to the UK (Tucker & Gilliland, 2007; Sallis et al., 2016). In the UK, towns and cities are often smaller with mixed and multifunctional land use and also higher levels of land use density. In addition, streets are shorter in terms of the overall length and have fewer and/or smaller segments. Therefore, taking these factors into consideration and previous work which has detailed the need for specific European environmental audit tools (Stockton et al., 2016; Benton et al., 2020). Based on the results of our pilot study, to achieve meaningful assessments of liveability in a European/UK context, changes were required to the length of the assessment area (point 2) and route segments (point 3).

2. Length of assessment area

Therefore, it was decided that MAPS-Liveability would assess the entire street (beginning to end) rather than only 0.25 miles of a route. Alternatively, a second option is to assess the entirety of a pre-established route (e.g., bus station to place of work, or train station to shopping complex). The decision on which option to audit would be dependent on the type of study. However, in the case of the current study, entire streets were audited.

3. Single rather than segmented route

MAPS-Full operates by assessing the route, segments, crossings and if applicable cul-de-sacs. However, similar to point 2 it was felt that liveability cannot be gauged in a restrictive manner so for MAPS-Liveability an entire route should be audited, as one (entire length of the street). By assessing the route as a whole it will provide an overall assessment as opposed to separate segments/crossings which are applicable to the pedestrian streetscape but for the purpose of liveability a broader assessment is required.

4. Removal of questions relating to sensory perceptions (e.g., noise)

During the pilot researchers found it difficult to assess particular characteristics and/or concepts (anti-social behaviour and social disorder) and impossible to answer questions relating to sound, finer details such as signalization at crossings, pollution and the pleasantness of a street (a limitation of using Google Street View). Therefore, two questions (Section: Aesthetics and Social, question 8; Section: Crossings, question 4) and two sub-responses (Section: Crossings, question 3) were removed and questions relating to pleasantness and pollution which were intended to be added following phase 1i-ii could not be added.

Appendix D. Development of a scoring protocol for MAPS-Liveability

Following the completion of MAPS-Full in its original form sub-scores can be obtained for the route, segments crossings, cul-de-sacs (if applicable) and a summed score (Appendix E). This scoring protocol had minimal adaptations to account for the removal and addition of a limited number of questions and sub-responses for MAPS-Liveability (Appendix F).

In addition to the original scoring protocol, it was established during the pilot phase that it may also be beneficial if scores were available and could be assessed for each of the nine characteristics of liveability and a summed total liveability score (Appendix E). If following the adapted liveability scoring and a cul-de-sac is present an additional cul-de-sac score can be obtained via the original MAPS-Liveability scoring protocol.

Furthermore, the adapted survey also enables qualitative data to be obtained, analysed and interpreted by the research team as they see fit and for the purposes of their study; and specific behavioural outcomes to be obtained and quantitatively analysed by the number of counts and yes/no answers (Appendix G).

Appendix E. MAPS-Liveability scoring protocol

MAPS-Liveability	Characteristics	MAPS-Liveability subscale	Liveability attribute scores	Liveability total score (adjusted)
Safety	A6 - Safety buttons (+)	Safety button connecting to police (No = 0, Yes = 1)		
	A6 - Neighbourhood watch (+)	Neighbourhood watch signs (No = 0, Yes = 1)		
	A6 – Physical disorder (+/-)	Graffiti/tagging (not murals or street art) (No = 1, Yes = 0) + Abandoned cars (No = 1, Yes = 0) + Buildings with broken/boarded windows (No = 1, Yes = 0) + Drug paraphernalia (No = 1, Yes = 0) + Broken glass (No = 1, Yes = 0) + Beer/liquor bottles/can (No = 1, Yes = 0)		
	A7 – Physical disorder (-)	Rate the extent of physical disorder (None = 3, A little = 2, Some = 1, A lot = 0)		
	A9-12 - Presence of people (+)	Presence of anyone walking (No = 0, Yes = 1) + Presence of anyone running (No = 0, Yes = 1) + Presence of anyone cycling (No = 0, Yes = 1) + Presence of anyone performing other physical activity or exercising (No = 0, Yes = 1)	21	21
	SS6 - Street lights (+)	Are street lights installed (No = 0, Some = 1 (e.g., overhead street lights on utility poles with wide spacing) or Ample = 2 (e.g., regularly spaced pedestrian lampposts)		
	SS8 – Telephones (+)	Working public telephones (No = 0, Yes = 1)		
	SS8 – Information (+)	Kiosks or information booths (No = 0, Yes = 1)		
Health	P19 – Eyes on the street (+)	Estimate the proportion of street segment that has ground floor or street-level windows within 40 feet of the pavement/walkway (or street if no pavement/walkway) (No windows – 25% = 0 26%-75% = 1 >76% = 2)		
	LU5 - Pharmacy (+)	Pharmacy or drug store (No = 0, Yes = 1)		
	LU5 - Health centre (+)	Health-related professional (No = 0, Yes = 1) + Health or social services (No = 0, Yes = 1)		
	LU5 - Alcohol (-)	Liquor/alcohol store (No = 1, Yes = 0)		
	A9-12 – People performing activity (+)	Presence of anyone walking (No = 0, Yes = 1) + Presence of anyone running (No = 0, Yes = 1) + Presence of anyone cycling (No = 0, Yes = 1) + Presence of anyone performing other physical activity or exercising (No = 0, Yes = 1)		
	SS8 - Smoking areas (-)	(No = 1, Yes = 0)		
	SS8 – Water (+)	Working drinking fountain (No = 0, Yes = 1)		
	SS8 – Bicycle racks (+)	Bicycle racks (No = 0, Yes = 1)	35	31
	LU5 – Leisure facilities (+)	Private indoor (No = 0, Yes = 1) + Public indoor (No = 0, Yes = 1) + Private outdoor (No = 0, Yes = 1) + Public outdoor pay (No = 0, Yes = 1)		
	LU5 – Green & open space (+)	Public park (No = 0, Yes = 1) + Public walking trail (No = 0, Yes = 1) + Community garden (No = 0, Yes = 1)		
	A1-2 – Hardscape & softscape features (+)	Do you observe pleasant hardscape features such as fountains, sculptures or art (public or private (No = 0, Yes = 1) + Do you observe softscape features such as gardens or landscaping (e.g., Public: bodies of water, designated viewpoints; Private: retaining walls, bark, ponds) (No = 0, Yes = 1)		
A5 – Landscaping maintenance	Is landscaping well maintained (0-99% = 0, 100% = 1)			

	A8 – Obstructions to walking (-)	Railroad tracks (No = 1, Yes = 0) + Highway nearby (No = 1, Yes = 0) + Other (No = 1, Yes = 0)		
	P14, 15 – Bicycle lane/use (+)	Is there a marked bicycle lane marked with a lane (No = 0, Yes = 1) + Does the marked bicycle lane run for the entire route (100% = 4; 75-99% = 3; 51-75% = 2; 25-50% = 1; 1-25% = 0) + Is there a marked bicycle track separated from traffic and pedestrians (No = 0, Yes = 1) + Does the marked bicycle track run for the entire route (100% = 4; 75-99% = 3; 51-75% = 2; 25-50% = 1; 1-25% = 0) + Are there any signs indicating bicycle use (No = 0, Yes = 1)		
Sustainability	SS8 – Rubbish bins (+)	Rubbish bins (public) (No = 0, Yes = 1)		
	A6 – Physical disorder (+/-)	Graffiti/tagging (not murals or street art) (No = 1, Yes = 0) + Abandoned cars (No = 1, Yes = 0) + Buildings with broken/boarded windows (No = 1, Yes = 0) + Drug paraphernalia (No = 1, Yes = 0) + Broken glass (No = 1, Yes = 0) + Beer/liquor bottles/can (No = 1, Yes = 0) + Litter in yards (No = 1, Yes = 0) + Noticeable/excessive litter in street/pavement (No = 1, Yes = 0) + Neighbourhood watch signs (No = 0, Yes = 1) + Signage for commercial destinations or parks (No = 0, Yes = 1) + Safety button connecting to police (No = 0, Yes = 1)		
	A7 – Physical disorder (-)	Rate the extent of physical disorder (None = 3, A little = 2, Some = 1, A lot = 0)		
	SS1 - Public transport (+)	If answered 1 or more to SS1a-c (No = 0, Yes = 1 (SS1a or SS1b or SS1c), Yes = 2 (two from SS1a-c) or Yes = 3 (each of SS1a-c))		
	SS8 - Car charging (+)	Car charging points (No = 0, Yes = 1)		
	LU5 – Green & open space (+)	Public park (No = 0, Yes = 1) + Public walking trail (No = 0, Yes = 1) + Community garden (No = 0, Yes = 1)	33	14
	A1-2 – Hardscape & softscape features (+)	Do you observe pleasant hardscape features such as fountains, sculptures or art (public or private) (No = 0, Yes = 1) + Do you observe softscape features such as gardens or landscaping (e.g., Public: bodies of water, designated viewpoints; Private: retaining walls, bark, ponds) (No = 0, Yes = 1)		
	A5 – Landscaping maintenance (+)	Is landscaping well maintained (0% = 0, 1-49% = 1, 50-99% = 2, 100% = 3)		
	SS8 - Benches (+)	Benches or other places to sit (No = 0, Yes = 1)		
	P23-25 – Trees (+)	How many trees exist within 5ft of either side of the pavement/pathway (No pavement/NA = 0, 0-1 trees = 0, 2-10 trees = 1, >11 trees = 2) + How are the trees generally spaced (Irregular or no sidewalk/NA = 0, Evenly = 1) + What percentage of the length of the pavement/walkway is covered by trees, awnings or other overhead coverage (No coverage or no sidewalk/NA and ≤25% = 0, 26%-75% = 1, >75% = 2)		
Inclusivity	LU2 - Mix of residential and non-residential (+)	If answered Yes to any of LU2a-f plus any of LU5 a-ae or LU6 a-c No = 0, Yes = 1)		
	LU2 - Residential houses (+)	Single family homes (No = 0, Yes = 1) + Multi-unit homes (No = 0, Yes = 1) + Apartments or flats (No = 0, Yes = 1) + Apartments/flats above street retail (No = 0, Yes = 1) + Retirement/senior living facility (No = 0, Yes = 1) + Other (No = 0, Yes = 1)	11	11

	LU5 - Places of work/commercial (+)	If answered 1 or 2+ to any of LU5 or LU6 (No = 0, Yes = 1) (excluding LU5v,w,y,ae)		
	LU5 - Education (+)	School (No = 0, Yes = 1)		
	LU5 - Place of worship (+)	Place of worship (No = 0, Yes = 1)		
	LU5 – Senior Centre (+)	Senior Centre (No = 0, Yes = 1)		
Places	LU5 and LU6 - Shops (+)	Grocery/supermarket (No = 0, Yes = 1) + Convenience store (No = 0, Yes = 1) + Big box store (No = 0, Yes = 1) + Specialty food store (No = 0, Yes = 1) + Other retail (No = 0, Yes = 1) + Shopping centre (No = 0, Yes = 1) + Strip mall (No = 0, Yes = 1) + Shopping arcade (No = 0, Yes = 1)		
	LU5 - Restaurants (+)	Fast food restaurant (No = 0, Yes = 1) + Sit-down restaurant (No = 0, Yes = 1) + Café or coffee shop (No = 0, Yes = 1)		
	LU5/A3 - Culture (+)	Library/Museums (No = 0, Yes = 1) + Are there observable historic or cultural features along the route (statues, murals etc.) (No = 0, Yes = 1)		
	LU5 - Post office (+)	Post office (No = 0, Yes = 1)		
	LU1 - Car parks (+/-)	On-street, parallel (No = 0, Yes = 1) – Small lot or garage (<30 spaces) (No = 0, Yes = 1) – Medium to large lot or garage (No = 0, Yes = 1)		
	LU5 - Bank (+)	Bank or credit union (No = 0, Yes = 1)		
	LU5 – Other land use (-)	Warehouse/factory/industrial (No = 1, Yes = 0) + Abandoned building (No = 1, Yes = 0) + Unmaintained lot/field (No = 1, Yes = 0)		
	LU5 - Entertainment (+)	Entertainment (No = 0, Yes = 1) + Casino (No = 0, Yes = 1)	40	33
	LU5 – Green & open space (+)	Public park (No = 0, Yes = 1) + Public walking trail (No = 0, Yes = 1) + Community garden (No = 0, Yes = 1)		
	LU5 - Leisure facilities (+)	Private indoor (No = 0, Yes = 1) + Public indoor (No = 0, Yes = 1) + Private outdoor (No = 0, Yes = 1) + Public outdoor pay (No = 0, Yes = 1)		
	LU5 – Other services (+)	Other service (No = 0, Yes = 1)		
	A4 – Building maintenance (+)	Are the buildings well maintained (0% = 0, 1-49% = 1, 50-99% = 2, 100% = 3)		
	P20-22 Aesthetics (+)	How many different predominant building façade colours exist on the route (No building/NA or 1 color = 0, 2-3 colors = 1, >4 colors = 2) + How many different building accent colours exist on the route (No building/NA or 1 color = 0, 2-3 colors = 1, >4 colors = 2) + How many different predominant building materials exist along the route (No building/NA or 1 color = 0, 2-3 colors = 1, >4 colors = 2)		
Education	LU5 - Schools (+)	School (No = 0, Yes = 1)	2	0
	LU5 – Library/Museums (+)	Library/Museums (No = 0, Yes = 1)		
Traffic/transport	SS1 - Public transport (+)	If answered 1 or more to SS1a-c (No = 0, Yes = 1 (SS1a or SS1b or SS1c), Yes = 2 (two from SS1a-c) or Yes = 3 (each of SS1a-c))		
	SS3-4 - Speed signs (+)	Posted speed limit signs (No = 0, Yes = 1) + 20mph speed limit signs (No = 0, Yes = 1) + special zone speed limit signs (No = 0, Yes = 1)		
	SS5 - Speed calming measures (+)	Traffic calming signs (No = 0, Yes = 1) + Traffic calming circles (No = 0, Yes = 1) + Traffic calming speed tables (No = 0, Yes = 1) + Traffic calming speed humps (No = 0, Yes = 1) + Traffic calming curb extension (No = 0, Yes = 1) + Instructional signs for pedestrian's (No = 0, Yes = 1) + Crosswalk signage or other pedestrian signage (for drivers) (No = 0, Yes = 1)	15	12

	P10-11 – Traffic lanes (-)	Number traffic lanes (1- 4 = 1, >5 = 0) + Is the street predominantly one-way to two-way (One-way = 0, Two-way = 1)		
Pavements	SS8 - Street amenities (+)	Building overhangs that provide shelter from inclement weather in public space (No = 0, Yes = 1) + Rubbish bins (public) (No = 0, Yes = 1) + Benches or other places to sit (No = 0, Yes = 1) + Bicycle racks (No = 0, Yes = 1), Working drinking fountain (No = 0, Yes = 1) + Working public telephones (No = 0, Yes = 1) + Kiosks or information booths (No = 0, Yes = 1) + Car charging points (No = 0, Yes = 1)		
	A6 – Litter in street/pavements (-)	Noticeable/excessive litter in street/pavement (No = 1, Yes = 0)		
	A8 – Obstructions to walking (-)	Railroad tracks (No = 1, Yes = 0) + Highway nearby (No = 1, Yes = 0) + Other (No = 1, Yes = 0)		
	SS6 - Street lights (+)	Are street lights installed (No = 0, Some = 1 (e.g., overhead street lights on utility poles with wide spacing) or Ample = 2 (e.g., regularly spaced pedestrian lampposts)		
	SS9 - Crossings (+)	Mid-segment street crossing where an individual could safely cross (marked by a sign or crosswalk) (No = 0, Yes = 1)		
	P1-2,4, 12 – Pavements (+)	Pavement present (No = 0, Yes = 1) + pavement over 50% of the route (No = 0, Yes = 1) + width of pavement (<3ft = 1, 3-5ft = 2, >5ft = 3, no pavement = 0) + continuous pavement (No = 0, No pavement = 0, Yes = 1) + pavement over 50% of the route (No = 0, Yes = 1) + If no pavement is there any other place to walk that is safe from traffic (Yes = 1, No = 0, N/A pavement present = 1)	42	30
	P3 – Buffers (+)	Buffer present (No = 0, Yes = 1) + buffer over 50% of the route (No = 0, Yes = 1) + how wide is the majority of the buffer (<3ft = 1, 3-5ft = 2, >5ft = 3, N/A = 0)		
	P5 – Pavement quality (-)	Poorly maintained sections of pavement that constitute trip hazards (e.g., heaves, misalignment, cracks, overgrowth): minor – moderate (none = 4, One = 3, A few = 2, A lot = 1, No pavement = 0) + major (none = 4, One = 3, A few = 2, A lot = 1, No pavement = 0)		
	P8-9 – Pavement obstructions (-)	Permanent obstructions (None = 3, Some = 2, Many = 1, No pavement = 0) + temporary obstructions (None = 3, Some = 2, Many = 1, No pavement = 0)		
Roads	SS9, C1, 3-7, 10, 11 - Crossings (+/-)	Mid-segment street crossing where an individual could safely cross (marked by a sign or crosswalk) (No = 0, Yes = 1) + Intersection control (Yield sign = 1 + Stop signs = 1 + Traffic signal = 1 + Traffic circle = 1) + Signalization (Green arrows for dedicated vehicle turn = 1 + Pedestrian walk signals = 1 + Push buttons = 1) + Pre-crossing curb (Ramp lines up w/xing = 1, Ramp doesn't line up = 0, No ramp = 0) + Post-crossing curb (Ramp lines up w/xing = 1, Ramp doesn't line up = 0, No ramp = 0) + Gutters present in crossing (No = 1, Yes = 0) + Other characteristics (Steep slope No = 1, Yes = 0) + Temporary obstructions (No = 1, Yes = 0) + Crossing aids (No = 0, Yes = 1) + Crosswalk treatment (Marked crosswalk No = 0, Yes = 1) + High-visibility striping (No = 0, Yes = 1) + Stop lines on road or additional crosswalk warnings (No = 0, Yes = 1) + Raised crosswalk (No = 0, Yes = 1) + Different material than road (No = 0, Yes = 1) +	41	26

		Features (Specifically identified lanes turning into crossing No = 0, Yes = 1) + Protected refuge islands (No = 0, Yes = 1) + One-way streets through crossing (No = 0, Yes = 1) + Curb extension (No = 0, Yes = 1) + Miscellaneous problems (Lack of lampposts or overhead street lamps No = 1, Yes = 0) + Poor condition of crossing surface (No = 1, Yes = 0) + Poor visibility at corners (No = 1, Yes = 0) + Faded or worn crosswalk markings (No = 1, Yes = 0)		
	A8 – Obstructions to walking (-)	Railroad tracks (No = 1, Yes = 0) + Highway nearby (No = 1, Yes = 0) + Other (No = 1, Yes = 0)		
	P14, 15 – Bicycle lane/use (+)	Is there a marked bicycle lane marked with a lane (No = 0, Yes = 1) + Does the marked bicycle lane run for the entire route (100% = 4; 75-99% = 3; 51-75% = 2; 25-50% = 1; 1-25% = 0) + Is there a marked bicycle track separated from traffic and pedestrians (No = 0, Yes = 1) + Does the marked bicycle track run for the entire route (100% = 4; 75-99% = 3; 51-75% = 2; 25-50% = 1; 1-25% = 0) + Are there any signs indicating bicycle use (No = 0, Yes = 1)		
Overall score	A summed score can be produced for liveability	Safety + Health + Sustainability + Inclusivity + Places + Education + Traffic/Transport + Pavements + Roads (with the exception of those variables that are doubled scored in attributes (only counted once)) (highlighted in grey)	N/A	178

Items not used in scoring protocol but can be dependent on the study aims and objectives: **LU3** (How many non-residential buildings are adjacent to the pedestrian walkway or sidewalk and/or street? 0% = 1 1-33% = 2 34-66% = 3 67-99% = 4 100% = 5 N/A (all residential) = 6 N/A (no walkway) = 7); **LU4** (How many of the non-residential buildings have parking lots or drives between the pedestrian walkway or sidewalk along the street and their entrances? 0% = 1 1-33% = 2 34-66% = 3 67-99% = 4 100% = 5 N/A (all residential) = 6 N/A (no walkway) = 7); **SS5f-g** (What other street characteristics are present? Roll-over curbs, drainage ditches; **SS7** (How many driveways or alleys are there? None, 1-2, 3-5 or 6+; **P6a** (How steep is the pavement at the steepest point in the route (___degrees, no pavement)); **P6b** (How much of the route is at or near this level of steepness? Little 1-25%, some 26-75%, most or all 76-100%, no pavement); **P6c** (If answer to 6(b) is "little" provide a steepness measure that represents the majority of the route ___degrees, no pavement or N/A); **P7** (What is the steepest unavoidable cross-slope that affects walkers? ___degrees, no pavement); **P13** (If no pavement, what is the width of the place on which one could safely walk? (not in possible path of traffic) None, <4ft, >4ft, N/A); **P16** (Are there any signs or structures discouraging skateboard usage Yes, No); **P17** (Is there an informal path (shortcut), not on a cul-de-sac, which connects to something else Yes, No); **P18a/18b** – (Is this a dead-end street Yes, No) Is there a paved or informal path at the end of the cul-de-sac or dead end street that connects to something else (Yes, No, N/A); **P26-28** (What is the smallest building setback from the pavement/What is the largest building setback from the pavement (no building, <10 feet, 10-20 feet, 21-50 feet, 51-100 feet, > 100 feet), What is the average height of buildings, No building, 1-2 stories, 3-5 stories, 6-10 stories, > 10 stories); **C2** (Number of legs at intersection, T-intersection, 4-way intersection, > 4-ways, N/A); **C8** (Bike lane crosses the crossing Yes, No); **C9** (Distance of crossing leg, including all potential parking and turn lanes ___ lanes wide); **C11** (Unanticipated mid-segment crossing, Other ___), **SS2** – Public transport facilities (+).

Appendix F. MAPS-Full Subscales

MAPS-Full section	MAPS-Full existing subscales
Destination and Land use	Residential density subscale Shops subscale Restaurant and entertainment subscale Institutional/services subscale Government services subscale Worship land uses School land uses Public recreation subscale Private recreation subscale Parking land uses (positive) Positive parking subscale Warehouse/factory/industrial uses Abandoned buildings Unmaintained lots and fields Casinos Parking land uses (negative) Positive destinations and land use Negative destinations and land use subscale Overall destinations and land use
Streetscape	Positive streetscapes Positive streetscape subscales (transit tally, posted speed limits, traffic calming, instructional signs, street lights, street amenities, (overhangs, trash bins, benches, bike racks, drinking fountains, public telephones, kiosks, mid-segment crossings) Negative streetscapes Negative streetscape subscale Overall streetscape scale
Aesthetics and social	Positive aesthetics and social elements (hardscape, softscape, landscaping, neighbourhood watch signs, other signage for destinations) Negative aesthetics and social elements Negative aesthetics and social subscale (Negative Aesthetics and Social Subscale: Buildings not maintained, graffiti, abandoned cars, broken/boarded windows, drug paraphernalia, broken glass, litter in yards, extent physical and social disorder, obstructions to walking) Overall aesthetics and social subscale Overall route scale
Pavements	Positive setback and building height Positive pavements Positive pavement subscale Positive buffer Buffer positive subscale Positive bike infrastructure Positive bike infrastructure subscale Positive building aesthetics and design Building aesthetics and design positive subscale Trees positive subscale Informal path or shortcut positive Building height to road width ratio subscale Pavements negative Pavements negative subscale Pavement slope negative Pavement slope negative subscale Negative street design subscale Negative street design subscale Positive segments subscale Negative segments subscale – senior

	Negative segments subscale – child/adult
	Overall segment subscale – senior
	Overall – segment subscale - child
Crossings	<hr/> Crosswalk amenities positive subscale Curb quality/presence Curb quality/presence positive subscale Intersection control and signage positive subscale Road width sum Road width negative subscale Crossing impediments negative Crossing impediments negative subscale Positive crossing subscale Negative crossing subscale Overall crossing <hr/>
Cul-de-sac	Overall cul-de-sac

1 **Appendix G. MAPS-Full scoring protocol adjusted for MAPS-Liveability**

2 **Part 1: Route**

3 **A. Route: Destinations and Land Use**

Item	Item Content	Scoring
Residential Density Subscale		
ResMix	Residential Mix	Apartment over retail only =1 Apts or multi-family only =2 Mixed or other = 3 Single family only = 4 None=0
Res_Density_Mix_recode	Residential density mix recoded (points)	0=commercial 1=single family 2=multi-family only and any other mix 3=apts over retail
Shops subscale		
Shops	Shops subscale score	LU5c + LU5d + LU5f + LU5g + LU5h + LU5i + LU65n + LU6a + LU6b + LU6c
Restaurant and Entertainment Subscale		
Restaur_Ent	Restaurants and Entertainment subscale	LU5a + LU5b + LU5e + LU5l
Institutional/Services Subscale		
Institu_Svc	Institutional/Services subscale	LU5j + LU6k + LU6m
Government Services Subscale		
Govt_Svcs	Government Services subscale	LU5o + LU5p + LU5q+ LU5r
Worship Land Uses		
LU5s	Government or community land use: Place of worship	0=0 1=1 2+ =2
School Land Uses		
LU5t	Government or community land use: School	0=0 1=1 2+ =2
Public Recreation Subscale		
Public_Rec	Public Rec facilities subscale (Community garden, public indoor, public outdoor pay and public park)	LU5y + LU5aa + LU5ac + LU5ad + LU5ae
Private Recreation Subscale		
Private_Rec	Private Rec facilities subscale (private indoor & outdoor)	LU5z + LU5ab
Parking Land Uses (positive)		
LU1b_recode	What parking facilities are present? On-street, parallel, or angled Recoded	No = 0 Yes = 2
Positive Parking Subscale		
Pos_Parking	Positive Parking influences subscale	LU1a + LU1b_rec
Warehouse/Factory/Industrial Uses		
LU5u	Other land use: Warehouse, factory, industrial	0=0 1=1 2+ =2
Abandoned Buildings		
LU5v	Other land use: Abandoned buildings	0=0 1=1 2+ =2
Unmaintained lots and fields		
LU5w	Other land use: unmaintained lots or fields	0=0 1=1 2+ =2
Casinos		

LU5x	Other land use: Casinos	0=0 1=1 2+ =2
Parking Land Uses (negative)		
LU1c	What parking facilities are present? Small lot or garage (< 30 spaces)	No = 0 Yes = 1
Parking Land Uses (negative)		
LU1d_rec	What parking facilities are present? Medium to large lot or garage Recoded.	No = 0 Yes = 2
Positive Destinations and Land Use		
DLU_pos	Destinations and Land Use: Positive subscale	ResMix_recode + Shops + Restaur_Ent + Institu_Svc + Govt_Svc + LU5s + LU5t + Public_Rec + Private_Rec + Pos_Parking
Negative Destinations and Land Use Subscale		
DLU_neg	Negative Destinations and Land Use subscale Casino, abandoned building, unmaintained lot/field, med-large parking lot	LU5u + LU5v + LU5w + LU5x + LU1c + LU1d_rec
Overall Destinations and Land Use		
DLU_Overall	Overall Destinations and Land Use Scale	DLU_pos – DLU_neg

Items from DLU section not used in positive or negative subscales: **LU1** (How is audit information collected? Foot (walked route) = 1 Auto (drove route) = 2 Both = 3); **LU3** (How many non-residential buildings are adjacent to the pedestrian walkway or sidewalk and/or street? 0% = 1 1-33% = 2 34-66% = 3 67-99% = 4 100% = 5 N/A (all residential) = 6 N/A (no walkway) = 7); and **LU4** (How many of the non-residential buildings have parking lots or drives between the pedestrian walkway or sidewalk along the street and their entrances? 0% = 1 1-33% = 2 34-66% = 3 67-99% = 4 100% = 5 N/A (all residential) = 6 N/A (no walkway) = 7).

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B. Route: Streetscape

Item	Item Content	Scoring
Positive Streetscape		
Transit_tally	Transit stop tally that includes amenities (bench, shelter, and timetable)	SS1a + SS1b + SS2_1b + SS2_1c + SS2_1d + SS2_2b + SS2_2c + SS2_2d + SS2_3b + SS2_3c + SS2_3d + SS2_4b + SS2_4c + SS2_4d
Transit_tally_trichot	Transit stop tally. Trichotomized (points: 0, 1, or 2 thru highest)	0 1 2
SS3a_sign	Is there a posted speed limit along the route? Is there a sign or not? No vs. yes	No = 0 Yes = 1
SS3a_pos	Is there a posted speed limit along the route? Regular zone: Speed limit 25 mph or below.	No = 0 Yes, speed limit 25mph or less= 1
SS3b_20mph_painted	How many 20mph speed limit signs are along the route? Painted on the ground	Continuous variable
SS3b_20mph_sign	How many 20mph speed limit signs are along the route? Sign on a pole	Continuous variable
SS3b_20mph_other	How many 20mph speed limit signs are along the route? Other	Continuous variable
SS3b_20mph_other_qual	How many 20mph speed limit signs are along the route? If other, please state	Qualitative
SS4_pos	Is there a posted speed limit along the route? Special zone: Speed limit 25 mph or below.	No = 0 Yes, speed limit 25mph or less= 1
SS5a_dichot	What other street characteristics are present? Traffic calming (signs, circles, speed tables, speed humps, curb). Dichotomized	None = 0 Any = 1

SS5d_dichot	Instructional signs for pedestrians Dichotomized	None = 0 Any = 1
SS5e_dichot	Crosswalk signage or other pedestrian signage (for drivers). Dichotomized	None = 0 Any = 1
SS6_dichot	Are street lights installed? Dichotomized	None = 0 Any = 1
Positive Streetscape Subscales		
Pos_Streetscape	Positive Streetscape subscale: Transit tally, posted speed limits, traffic calming, instructional signs, street lights, street amenities (overhangs, rubbish bins, benches, bike racks, drinking fountains, public telephones, car charging points, kiosks, mid-segment crossings)	Transit_tally_trichot + SS3a_sign + SS3a_pos + SS3b_20mph_painted + SS3b_20mph_sign + SS3b_20mph_other + SS3b_20mph_other_qual + SS5a_dichot + SS5d_dichot + SS5e_dichot + SS6_dichot + SS8a + SS8b + SS8c + SS8d + SS8e + SS8f + SS8g + SS8h + SS9
Negative Streetscape		
SS1a_dichot	Number of public transit stops: Bus stops. Dichotomized none=neg)	None = 1 Any = 0
SS1b_dichot	Number of rapid transit stops: Bus stops. Dichotomized none=neg)	None = 1 Any = 0
SS3a_dichot	Is there a posted speed limit along the route? Regular zone: Speed limit greater than 25 mph. Dichotomized	Lowest through 25= 0 > 25mph = 1
SS5b_dichot	Roll-over curbs (if whole segment = 1) Dichotomized	None = 0 Any (>=1) = 1
SS6_dichot_neg	Are street lights installed? Dichotomized	None = 1 Any (some and ample)= 0
SS7_dichot	How many driveways or alleys are there? Dichotomized	0-5 driveways = 0 6+ driveways = 1
Negative Streetscape Subscale		
Neg_Streetscape	Negative Streetscape subscale	SS1a_dichot + SS1b_dichot + SS3a_dichot + SS5b_dichot + SS6_dichot_neg + SS7_dichot
Overall Streetscape Scale		
Streetscape_Overall	Overall Streetscape Scale	Pos_Streetscape - Neg_Streetscape
Items from the Streetscape section not used in positive or negative subscales: SS1b (Number of public transit stops: senior transit/paratransit #); SS2_1a (Transit stop (#1): Route # text); SS2_2a (Transit stop (#2) Route # text); SS2_3a (Transit stop (#3) Route# text); SS2_4a Transit stop (#4) Route# text); SS5c (Drainage ditches (count one side of street, #)); SS8i (smoking areas).		

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C. Route: Aesthetics and Social

Item	Item Content	Scoring
Positive Aesthetics and Social Elements		
A5_dichot	Is the landscape well maintained? Dichotomized	0-99% = 0 100% = 1
Positive Aesthetics and Social Subscale		
Pos_AesthSoc	Positive Aesthetics and Social Subscale: Hardscape, softscape, landscaping, neighborhood watch signs, other signage for destinations, safety button connecting to police	A1 + A2 + A5_dichot + A6i + A6j + A6k
A9_walking	Presence of anyone walking	No = 0 Yes = 1
A10_running	Presence of anyone running	No = 0 Yes = 1
A11_cycling	Presence of anyone cycling	No = 0 Yes = 1
A12_PA_exercise	Presence of anyone performing other physical activity or exercising (not walking or cycling)	No = 0 Yes = 1
Negative Aesthetics and Social Elements		
A4_dichot_neg	Are the buildings well maintained? Dichotomized	0-99% = 1 100% = 0
A7_dichot	Rate the extent of physical disorder. Dichotomized	None = 0 A little, some or a lot = 1
A8_dichot	Rate the extent of social disorder. Dichotomized	None = 0 A little, some or a lot = 1

Negative Aesthetics and Social Subscale

Neg_AesthSoc	Negative Aesthetics and Social Subscale: Buildings not maintained, graffiti, abandoned cars, broken/boarded windows, drug paraphernalia, broken glass, litter in yards, extent physical and social disorder, obstructions to walking.	A4_dichot_neg + A6a + A6b + A6c + A6d + A6e + A6g + A7_dichot + A8_dichot + A8a + A8b
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Overall Aesthetics and Social Subscale

AesthSoc_Overall Overall	Overall Aesthetics and Social Subscale	Pos_AesthSoc - Neg_AesthSoc
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Overall Route Scale

Route_Overall	Overall Route Scale	DLU_Overall + Streetscape_Overall + AesthSoc_Overall
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Items from the Aesthetics and Social section not used in positive or negative subscales: A3 (Are there observable historic or cultural features along the route? No = 0 Yes = 1); A4_dichot (Is the building well maintained? Dichotomized 0-99% = 0 100% = 1); A9c (Other obstructions to walking: Other No = 0 Yes = 1); A6f (Beer/liquor bottles/cans No = 0 Yes = 1); A6h (Noticeable/excessive litter in street/sidewalk No = 0 Yes = 1).

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Part 2: Segments

(Note: There are multiple segments possible per route; S1 indicates the first segment, for which the variables and subscales are listed below. For subsequent segments, use S2, S3, etc. for naming variables and subscales. **There is only one route per segment – S1**)

A. Positive Subscales Item

Item	Item Content	Scoring
Positive Setback and Building Height		
S1_26	What is the smallest building setback from the sidewalk?	No building = 1 <10 feet = 2 10-20 feet = 3 21-50 feet = 4 51-100 feet = 5 >100 feet = 6
S1_27	What is the largest building setback from the sidewalk/walkway?	No building = 1 <10 feet = 2 10-20 feet = 3 21-50 feet = 4 51-100 feet = 5 >100 feet = 6
S1_26_27_Opts	Either setback (S1_26, S1_27) >50 ft and no building.	No = 0 Yes = 0
S1_26_27_1point	All other combinations of S1_26 and S1_27	No = 0 Yes = 1
S1_26_27_2points	Both setbacks (S1_26 and S1_27) 10-20 ft. or one setback <10 ft and one setback 10-20 ft.	No = 0 Yes = 2
S1_26_27_3points	Both setbacks (S1_26 and S1_27) <10 ft.	No = 0 Yes = 3
S1_26_27_points	Smallest and largest setback scores combined	S1_26_27_Opts + S1_26_27_1point + S1_26_27_2points + S1_26_27_3points
S1_28_trichot	What is the average height of buildings? Trichotomized.	No building and 0-2 stories = 0 3-5 stories = 1 6-10 stories = 2 10+stories = 3
Positive Building Height and Setbacks Subscale		
PosBldgHtSetbks_S1	Positive Setbacks/Bldg. Height: Positive subscale	S1_26_27_points + S1_28_trichot
Positive Sidewalk		
S1_2_recode	What is the width of the majority of the sidewalk? Recoded	<3 feet = 2 3-5 feet = 2 >5 feet = 3 No sidewalk= 0
S1_12a_recode	If no sidewalk, is there any other place to walk that is safe from traffic? Unpaved pathway (goat path); Recoded	Recoded No = 0 Yes = 1 NA/Sidewalk=0
S1_12b_recode	If no sidewalk, is there any other place to walk that is safe from traffic? Street shoulder; Recoded	No = 0 Yes = 1 NA/Sidewalk=0
S1_12c_recode	If no sidewalk, is there any other place to walk that is safe from traffic? Buffer; Recoded	No = 0 Yes = 1 NA/Sidewalk=0
S1_12_sum	Combination of 12a; 12b; 12c	No/ NA to 12a, 12b & 12c (no alternative walking path)= 0 Yes to 12a or 12b or 12c (alternative walking path) = 1

Positive Sidewalk Subscale		
Sidewalk_Pos_S1	Sidewalk and sidewalk alternative (combined) presence and width (#s 1, 2, 12): S1_2_recode+s1_12_sum	No sidewalk = 0 Any path = 1 Narrow sidewalk(<5 ft) = 2 Wide sidewalk (>5) = 3
Positive Buffer		
S1_3a_recode	Is there a buffer present? Recoded	No sidewalk = 0 No = 0 Yes = 1
S1_3b_dichot	How wide is the majority of the buffer? Dichotomized.	No sidewalk = 0 0-3 feet = 0 >3 feet = 1
Buffer Positive Subscale		
Buffers_Pos_S1	Buffers: Positive subscale	S1_3a_recode + S1_3b_dichot
Positive Bike Infrastructure		
S1_14a_recode	Is there a marked bicycle lane marked with a line or a raised curb? Recoded	No = 0 Yes = 2
S1_14ai_bicycle_lane	Does the marked bicycle lane run for the entire route?	100% = 4; 75-99% = 3; 51-75% = 2; 25-50% = 1; 1-25% = 0
S1_14b_recode	Is there a marked bicycle lane marked with a line or a raised curb? Recoded	No = 0 Yes = 2
S1_14bi_bicycle_track	Does the marked bicycle track run for the entire route?	100% = 4; 75-99% = 3; 51-75% = 2; 25-50% = 1; 1-25% = 0
Bike Infrastructure Positive Subscale		
Bike_Infra_S1	Bike Infrastructure: Positive subscale	S1_14a_recode + S_14ai_bicycle_lane + S1_14b_recode + S1_14bi_bicycle_track + S1_15
Positive Building Aesthetics and Design		
S1_19_trichot	Proportion of street segment w/windows within 40 feet of sidewalk/walkway (or street): Trichotomized	No windows – 25% = 0 26%-75% = 1 >76% = 2
S1_20_trichot	How many different predominant building façade colors exist? Trichotomized	No building/NA or 1 color=0 2-3 colors=1 >4 colors=2
S1_21_trichot	How many different building accent colors? Trichotomized	No building/NA or 1 color=0 2-3 colors=1 >4 colors=2
S1_22_dichot	How many different predominant building materials? Dichotomized	No building/NA or 1 material=0 >2=1
Building Aesthetics & Design Positive Subscale		
BldAesthDes_S1	Building Aesthetics & Design: Positive subscale	S1_19_trichot + S1_20_trichot + S1_21_trichot + S1_22_dichot
Trees Positive		
S1_23_trichot	How many trees exist within 5 feet of either side of the sidewalk/pathway? Trichotomized	No sidewalk/NA = 0 0-1 trees = 0; 2-10 trees = 1 >11 trees = 2
S1_24_recode	How are the trees generally spaced? Recoded	Irregular or no sidewalk/NA= 0 Evenly = 1
S1_25_trichot	What percentage of sidewalk/walkway is covered by trees/other overhead coverage? Trichotomized	No coverage or no sidewalk/NA and ≤25% = 0 26%-75% = 1 >75% = 2
Trees Positive Subscale		
Trees_S1	Trees: Positive subscale	S1_23_trichot + S1_24_recode + S1_25_trichot
Informal Path or Shortcut Positive (single item, not a subscale)		
S1_17	Is there an informal path (shortcut), not on a cul-desac which connects to something else?	No = 0 Yes = 1
Building Height to Road Width Ratio Subscale		
BldgHt_RdWdthSetbk_R atio_S1	Building Height: Road Width+ Setback Avgs. Ratio	S1_28_feet/RdWdth_plus_Setbk_avg_S1
BldgHt_RdWdthSetbk_R atio_Scores_S1	Scores for the above ratio.	Lowest - .499 = 0 .50 - .999 = 1 1.0 - 1.999 = 3 2.0 - 2.999 = 2 3.0 – Highest = 1
RdWdth_plus_Setbk_avg_S1	Road width (in feet) plus setback averages	S1_10_feet + S1_26_27_feetmid_avg

S1_28_feet	Average building height –recalculated in feet (using midpoint of response option ranges). (Top of the ratio.)	No building = 0 1-2 stories = 18 3-5 stories 48 6-10 stories = 96 >10 stories = 144
S1_10_feet	How many traffic lanes are present? Recalculated in feet.	1 = 12 2 = 24 3 = 36 4 = 48 5 = 60 6 = 72 7+ = 84
S1_26_feetmid	Smallest building setback from the sidewalk, calculated using the midpoint of response option ranges.	No building = 0 <10 feet = 5 10-20 feet = 15 21-50 feet = 35 51-100 feet = 75 >100 feet = 100
S1_27_feetmid	Largest building setback from the sidewalk, calculated, using the midpoint of response option ranges.	No building = 0 <10 feet = 5 10-20 feet = 15 21-50 feet = 35 51-100 feet = 75 >100 feet = 100
S1_26_27_feetmid_avg	Average smallest and largest setback midpoints (S1_26 and 27). (Part of the bottom of the ratio.)	Calculated numeric range

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21 **Part B. Segments: Negative Subscales**

Sidewalk Negative

S1_4_recode	Is the sidewalk continuous within the segment? Recoded	No = 1 Yes = 0
S1_5a_dichot	Are there poorly maintained sections of the sidewalk that constitute trip hazards? Minor- moderate; Dichotomized	0-1 = 0 A few or a lot = 1
S1_5b_dichot	Are there poorly maintained sections of the sidewalk that constitute trip hazards? Major; Dichotomized	0-1 = 0 A few or a lot = 1
S1_8_dichot	Are there permanent obstructions in the sidewalk? Dichotomized	None = 0 Some or many = 1
S1_9_dichot	Are the temporary obstructions in the sidewalk? Dichotomized	None = 0 Some or Many = 1

Sidewalk Negative Subscale

Sidewalk_Neg_S1	Sidewalk : Negative subscale	S1_4recode + S1_5a_dichot + S1_5b_dichot + S1_8_dichot + S1_9_dichot
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Sidewalk Slope Negative

S1_6a_dichot_S	How steep is the sidewalk at the steepest point in the segment? Dichotomized. [For seniors]	0-6.88 = 0 6.89-highest = 1
S1_6a_dichot_C	How steep is the sidewalk at the steepest point in the segment? Dichotomized. [For children/adults]	0-6.88 = 0 6.89-highest = 1
S1_6b	How much of the segment is at or near this level of steepness (follow-up question to S1_6a)?	Little (1-25%) = 1 Some (26-75%) = 2 Most or all (76-100%) = 3 No sidewalk = -777
S1_6c	If answer to 6(b) is "Little," provide a steepness measure that represents the majority of the segment	#
S1_6c_recode_S	If answer to 6(b) is "Little," steepness measure majority of the segment: Recoded. [For seniors] If answer to 6(b) is not "Little" there is not a separate measure of the steepness of the majority of the segment, steepness measure from s1_6a_dichot_S is recoded here.	0-3.43 = 0 3.44 - 6.88 = 1 6.89 - 8.99 = 2 8.99 – Highest = 3
S1_6c_recode_C	If answer to 6(b) is "Little," steepness measure majority of the segment: Recoded. [For children/adults] If answer to 6(b) is not "Little" there is not a separate measure of the steepness of the majority of the segment, steepness measure from s1_6a_dichot_S is recoded here.	0-6.88 = 0 6.89 - 8.99 = 1 8.99 – Highest = 2

S1_7_recode_S	What is the steepest unavoidable cross-slope that affects walkers? Recoded. [For seniors]	0 - 1.14 = 0 1.15 - 2.28 = 1 2.29 - 3.43 = 2 3.44 – Highest = 3
S1_7_recode_C	What is the steepest unavoidable cross-slope that affects walkers? Recoded. [For children/adults]	0 - 2.28 = 0 2.29 - 3.43 = 1 3.44 – Highest = 2
Sidewalk Slope Negative Subscale		
Sidewalk_Neg_Slope_S	Seniors Slope: Negative subscale	S1_6a_dichot_S + S1_6c_recode_S + S1_7_recode_S Sidewalk
Sidewalk_Neg_Slope_C	Children Slope: Negative subscale	S1_6a_dichot_C + S1_6c_recode_C + S1_7_recode_C
Negative Street Design Subscale		
S1_10_dichot	How many traffic lanes are present? Dichotomized	1-4 lanes = 1 >5 lanes = 2
S1_11_recode	Is the street predominantly one-way or two-way? Recoded	One-way = 1 Two-way = 0
Negative Street Design Subscale (Note: this subscale is not included in the overall negative sum; it can be calculated and used separately if desired.)		
Neg_Street_Des_S1	Street Design: Negative subscale	S1_10_dichot + S1_11_dichot
Positive Segments Subscale		
Segments_Pos_S1	Sum of positive segment subscales	PosBldgHtSetbks_S1 + Sidewalk_Pos_S1 + Buffers_Pos_S1 + Bike_Infra_S1 + BldgAesthDes_S1 + Trees_S1 + S1_17 + BldgHt_RdWdthSetbk_Ratio_Scores_S1
Negative Segments Subscale - Senior		
Segments_Neg_Senior	Sum of negative segment subscales, for seniors	Sidewalk_Neg_S1 + Sidewalk_Neg_Slope_S_S1
Negative Segments Subscale – Child/Adult		
Segments_Neg_Child	Sum of negative segment subscales, for youth/adults	Sidewalk_Neg_S1 + Sidewalk_Neg_Slope_C_S1
Overall Segments Subscale - Senior		
Overall_Segment_Senior	Overall segment score for seniors	Segments_Pos_S1Segments_Neg_Senior_S1
Overall Segments Subscale - Child		
Overall_Segment_Child	Overall segment score for youth/adults	Segments_Pos_S1Segments_Neg_Child_S1

Items from Segments section not used in positive or negative subscales: S1_6b (How much of the segment is at or near this level of steepness (follow-up question to S1_6a)? Little (1-25%) = 1 Some (26-75%) = 2 Most or all (76-100%) = 3 No sidewalk = -777); S1_13 (If no sidewalk, what is the width of the place on which one could safely walk? None = 1 <4 feet = 2 ≥4 feet = 3 N/A = -777); S1_16 (Are there any signs or structures discouraging skateboard usage? No = 0 Yes = 1); S1_18a (Is this a dead-end street? No = 0 Yes = 1); S1_18b (Is there a paved or informal path at the end of the cul-de-sac or dead-end street which connects to something else (follow-up question to S1_18a)? No = 0 Yes = 1 N/A = -777).

25 Part 3: Crossings

(Note: There are multiple crossings possible per route; C1 indicates the first crossing, for which the variables and subscales are listed below. For subsequent crossings, use C2, C3, etc. for naming **There may be multiple crossings on a route however questions should be answered for the overall route.**)

28 A. Positive Subscales Item

Item	Item Content	Scoring
Crosswalk Amenities Positive Subscale		
CrosswalkAmenities_C1	Crosswalk amenities: Positive subscale (Crossing aids, marked crosswalk, high visibility striping, stop lines or crosswalk warnings, raised crosswalk, different material than road, protected refuge islands, curb extensions).	C1_7c + C1_8a + C1_8b + C1_8c + C1_8d + C1_8e + C1_11c + C1_11e
Curb Quality/Presence		
C1_5a_positive	Pre-crossing curb - option 1: Ramp lines up with crossing. Recoded	Ramp lines up w/xing = 1 Ramp doesn't line up = 0 No ramp = 0
C1_5b_positive	Post-crossing curb - option 1: Ramp lines up with crossing. Recoded	Ramp lines up w/xing = 1 Ramp doesn't line up = 0 No ramp = 0
Curb Quality/Presence Positive Subscale		

Curb_Qual_C1	Curb Quality and Presence Subscale	C1_5a_positive + C1_5b_positive
Intersection Control and Signage Positive Subscale		
IntsectCtrlSign_C1	Intersection Control/Signage: Positive subscale (Yield signs, stop signs, traffic signal, traffic circle, green arrows for turn lane, pedestrian walk signals, push buttons, countdown signal, audible walk signal, lanes turning into right crossing, lanes turning into left crossing, one way streets through crossing)	C1_1a + C1_1b + C1_1c + C1_1d + C1_3a + C1_3b + C1_3c + C1_3d + C1_3e + C1_11a + C1_11b + C1_11d

29

30 **Part b: Crossings: Negative Subscales**

Road Width Sum		
C1_10_trichot	Distance of crossing leg, including all potential parking and turn lanes. Trichotomized	1 – 2 = 0 3 – 4 = 1 5 – Highest = 2
Road Width Negative Subscale		
Road_Width_C1	Same as trichotomized road (crossing) width	C1_10_trichot
Crossing Impediments Negative		
C1_5a_negative	Pre-crossing curb-option 3: No ramp. Recoded	Ramp lines up w/xing = 1 Ramp doesn't line up = 0 No ramp = 0
C1_5b_negative	Post-crossing curb-option 3: No ramp. Recoded	Ramp lines up w/xing = 1 Ramp doesn't line up = 0 No ramp = 0
Crossing Impediments Negative Subscale		
Cross_Imped_C1	Crossing impediments: Negative subscale (no ramp pre- and post-crossing curb, gutters, steep slope or cross-slope, temporary obstructions, poor visibility at corners, faded or worn crosswalk markings)	C1_5a_negative + C1_5b_negative + C1_6 + C1_7a + C1_7b + C1_12c + C1_12d
Positive Crossing Subscale		
PosCrossChars_C1	Positive Crossing	CrosswalkAmenities_C1 + CurbQual_C1 + IntsectCtrlSign_C1
Negative Crossing Subscale		
NegCrossChars_C1	Negative Crossing	Road_Width_C1 + Cross_Imped_C1
Overall Crossing		
OverallCrossScore_C1	Overall Crossing Scale	PosCrossChars_C1 – NegCrossChars_C1
<p>31 Items from Crossings section not used in positive or negative subscales: C1_2 (Number of legs at intersection T-intersection = 1 4-way = 2 >4-way = 3); C1_4 (Crosswalk timing # of seconds No crosswalk = -777 No signal = -778); C1_5a_opt2 (Pre-crossing curb-option 2: Ramp doesn't line up with crossing Ramp does not line up = 1); C1_5b_opt2 (Post-crossing curb-option 2: Ramp doesn't line up with crossing Ramp does not line up = 1); C1_9 (Bike lane crosses the crossing? No = 0 Yes = 1); C1_12a (Misc problems: Lack of lampposts or street lamps No = 0 Yes = 1); C1_12b (Misc problems: Poor condition of crossing surface No = 0 Yes = 1); C1_12e (Misc problems: Unanticipated mid-segment crossing No = 0 Yes = 1); C1_12f (Misc problems: Other No = 0 Yes = 1); C1_12f1 ("other" reason (if above is applicable)).</p>		

31
32
33
34

35 **Part 4: Cul-De-Sacs**

36 (Note: There may be multiple cul-de-sacs (CdS) per route; D1 indicates the first cul-de-sac, for which the variables and subscale are listed below. For subsequent cul-de-sacs, use D2, D3, etc., for naming.)

Item	Item Content	Scoring
D1_1_dichot	How close is cul-de-sac or dead-end to participant's home? Dichotomized.	On the CdS = 1 Adjacent = 1 <200 feet away = 0 >200 feet away = 0
D1_1_dichot	How big is cul-de-sac at its largest diameter? Dichotomized.	<50 feet = 0 51-100 feet = 1 101-200 feet = 1 >200 feet = 1
D1_2a_dichot	What is incline/grade of cul-de-sac at its steepest point? Dichotomized.	0 thru 6.88 = 1 6.89 thru highest = 0

D1_2b_dichot	What is incline/grade of street at opening to cul-desac? Dichotomized.	0 thru 6.88 = 1 6.89 thru highest = 0
D1_4_dichot	For paved part, how smooth is pavement? Dichotomized.	Not smooth = 0 Somewhat smooth = 0 Mostly smooth = 0 Very smooth = 1
D1_5_sum	Total amenities: basketball hoops + skateboard features + streetlights + pedestrian or safety signage	#
D1_5_sum_trichot	Total amenities: sum: Trichotomized	0 = 0 1 = 2 >1 = 2
D1_7_recode	Is parking allowed in the area? Recoded.	No = 1 Yes = 0

Overall CulDeSac

OverallCdSScore_D1	Sum of following items all items except 4, 9, 10, 12 (closeness to participant's home, largest cul-de-sac diameter, incline/grade at steepest point, smooth pavement, total amenities, visibility of cul de sac area from participant's home, visibility of cul de sac area from other homes, parking allowed)	D1_1_dichot + D1_1_dichot + D1_2a_dichot + D1_2b_dichot + D1_4_dichot + D1_5_sum_trichot + D1_7 + D1_8 + D1_11_recode
--------------------	---	--

Items not used in cul-de-sac score: D1_3 (What %age of cul-de-sac is paved? <25% = 1 25-50% = 2 51-75% = 3 >75% = 4); D1_5e1 (What amenities exist at opening to or in cul-de-sac? Other #); D1_5e2 (What amenities exist at opening to or in cul-de-sac? Other (describe) Text); D1_6 (Number of driveways that enter into the cul-de-sac #); D1_10 (Is there an island in the cul-de-sac? No = 0 Yes = 1); D1_8a (Is there access through the end of the cul-de-sac to another public street or area? No = 0 Yes = 1); D1_9b1 (If yes: what type of access? Formal path No = 0 Yes = 1); D1_9b2 (If yes: what type of access? Informal path No = 0 Yes = 1); D1_9b3 (If yes: what type of access? Informal, no path No = 0 Yes = 1); D1_10c1 (If yes: what is on the other side? Another street No = 0 Yes = 1); D1_10c2 (If yes: what is on the other side? A recreation or play area No = 0 Yes = 1); D1_10c3 (If yes: what is on the other side? Open space No = 0 Yes = 1); D1_10c4 (If yes: what is on the other side? Commercial or retail area No = 0 Yes = 1); D1_10c5 (If yes: what is on the other side? Other No = 0 Yes = 1).

*Highlighted text shows changes that were made to the tool.

55 **Appendix H. MAPS-Liveability**

Date of audit	
Auditor	
Street name	
Start time	
End time	
Google maps date	

56

57 **Section: Land use/destinations**

58 **Count both sides of the street**

59

60 1. What parking facilities are present?

61 *Check all that apply*

- 62 None
- 63 On-street, parallel or angled parking
- 64 Small lot or garage (< 30 spaces)
- 65 Medium to large lot or garage

66

67 2. What types of residential uses?

68 *Check all that apply*

- 69 Single family houses
- 70 Multi-unit homes (duplex, 4-plex, terrace)
- 71 Apartments or flats
- 72 Apartments/flats above street retail
- 73 Retirement/senior living facility
- 74 Other (mobile home, dormitory, students)
- 75 None

76

77 3. How many of the non-residential buildings are
78 adjacent to the pedestrian pavement and/or street?
79 *(Adjacent to pavement and street means that there
80 is not a yard, parking lot or other space blocking
81 entrances between the sidewalk and the building)*

- 82 0%

83

- 1-33%
- 34-66%

84

- 67-99%
- 100%

85

- N/A (all residential buildings)

86

- N/A (no pedestrian walkway/pavement)

87

88 4. How many of the non-residential buildings have
89 parking lots or drives between the pedestrian
90 walkway or pavements along the street and their
91 entrances?

92

- 0%

93

- 1-33%
- 34-66%

94

- 67-99%
- 100%

95

- N/A (all residential buildings)

96

- N/A (no pedestrian walkway/pavements)

97

98 5. How many of the following types of non-
99 residential destinations are present? (Do not double
100 count.)

101

102 **Food-related land uses**

103 a. Fast food restaurant (*national or local chain,*
104 *primarily sells burgers, fried chicken, pizza, or*
105 *“Americanized” Mexican, Chinese, etc.)*

106

- 0
- 1
- 2+

107

b. Sit-down restaurant

108

- 0
- 1
- 2+

109

c. Grocery/supermarket

110

- 0
- 1
- 2

111

d. Convenience store (*may also be a petrol station*)

112

- 0
- 1
- 2+

113

e. Café or coffee shop

114

- 0
- 1
- 2+

115

f. Liquor/alcohol store (*primarily sells alcohol, wine*
116 *bar, pub*)

117

- 0
- 1
- 2+

118

g. Big box store (*e.g., Asda, Tesco, Sainsburys, B&Q*)

119

- 0
- 1
- 2+

120

h. Specialty Food Store (*e.g., ice cream, sweets,*

121 *bakery*)

122

- 0
- 1
- 2+

123

124 **Retail and service oriented land uses**

125

i. Pharmacy or drug store

126

- 0
- 1
- 2+

127

j. Bank or credit union

128

- 0
- 1
- 2+

129

k. Health-related professional (*e.g., chiropractor,*
130 *Dr. office*)

131

- 0
- 1
- 2+

132

l. Entertainment (*e.g., movie theatre, arcade*)

133

- 0
- 1
- 2+

134

m. Other service (*e.g., salon, lawyer, accountant,*
135 *estate agent, laundry/dry cleaner, commercial*
136 *mailing service*)

137

- 0
- 1
- 2+

138

n. Other retail (*e.g., books, clothing, hardware,*
139 *video rental*)

140

- 0
- 1
- 2+

141

142 **Government or community land use**

143

o. Health or social services (*e.g., hospital, health*
144 *department, community action agency,*
145 *police/fire stations, city hall, etc.)*

146

- 0
- 1
- 2+

147

p. Library/Museums

148

- 0
- 1
- 2+

149

q. Post office

150

- 0
- 1
- 2+

151

r. Senior center

152

- 0
- 1
- 2+

153

s. Place of worship (*e.g., church, synagogue,*
154 *convent, mosque, etc.)*

155

- 0
- 1
- 2+

156

t. School (including pre-, college and university)

157

- 0
- 1
- 2+

158

159 **Other land use**

160

u. Warehouse/factory/industrial

- 161 0 1 2+
- 162 v. Abandoned building
- 163 0 1 2+
- 164 w. Unmaintained lot/field
- 165 0 1 2+
- 166 x. Casino
- 167 0 1 2+
- 168
- 169 **Recreational land use**
- 170 y. Community garden
- 171 0 1 2+
- 172 z. Private indoor (e.g., commercial gyms, dance clubs)
- 173
- 174 0 1 2+
- 175 aa. Public indoor (community centers)
- 176 0 1 2+
- 177 ab. Private outdoor (e.g., private golf course, commercial outdoor recreation)
- 178
- 179 0 1 2+
- 180 ac. Public outdoor pay (e.g., pool)
- 181 0 1 2+
- 182 ad. Public park
- 183 0 1 2+
- 184 ae. Public walking trail
- 185 0 1 2+
- 186 6. Shopping Centers
- 187 *Check all that apply*
- 188 Shopping centre
- 189 Strip mall (strip of shops with parking in front)
- 190
- 191 Shopping Arcade
- 192 None of the above
- 193
- 194 **Section: Streetscape**
- 195 ****Count both sides of the street****
- 196 1. Number of public transport stops
- 197 *If NO stops, skip to 3.*
- 198 (a) Bus stops _____

- 199 (b) Rapid transport stops _____
- 200 (c) Senior transit/paratransit _____
- 201
- 202 2. What is available at each transit stop?
- 203 *Only count benches that users could be easily identified by bus drivers as waiting to ride the bus.*
- 204
- 205
- 206 Route # _____
- 207 Bench Covered Shelter Timetable
- 208
- 209 Route # _____
- 210 Bench Covered Shelter Timetable
- 211
- 212 Route # _____
- 213 Bench Covered Shelter Timetable
- 214
- 215 Route # _____
- 216 Bench Covered Shelter Timetable
- 217
- 218 3. Is there a posted speed limit along the route?
- 219 *If multiple, select the highest*
- 220 Regular
- 221 Yes 3a) {0, No}..._____ mph No
- 222
- 223 3b. How many 20mph speed limit signs are along the route?
- 224 _____painted on ground _____ sign on a pole
- 225
- 226 _____Other
- 227
- 228 If other, please
- 229 state _____
- 230
- 231 4. Special zone speed limits (school, construction)
- 232 Yes _____ mph No
- 233 Please
- 234 state _____
- 235
- 236 5. What other street characteristics are present?
- 237 (specify # of each type)

- 238 *Check all that apply*
- 239 Traffic calming signs _____
- 240 Traffic calming circles _____
- 241 Traffic calming speed tables _____
- 242 Traffic calming speed humps _____
- 243 Traffic calming curb extension _____
- 244 Roll-over curbs _____ (if whole segment = 1)
- 245
- 246 Drainage ditches
- 247 Instructional signs for pedestrian's _____
- 248 Crosswalk signage or other pedestrian signage (for drivers) _____
- 249
- 250 None of the Above
- 251
- 252 6. Are street lights installed?
- 253 None
- 254 Some (e.g., overhead street lights on utility poles with wide spacing)
- 255
- 256 Ample (e.g., regularly spaced pedestrian lampposts)
- 257
- 258
- 259 7. How many driveways or alleys are there? Count only one side of the street.
- 260 *(Count only alleys that are wide enough to be used by cars or other vehicles that could impede pedestrian traffic.)*
- 261
- 262
- 263
- 264 None 1-2 3-5 6+
- 265
- 266 8. Presence of street amenities
- 267 *Check all that apply*
- 268 Building overhangs that provide shelter from inclement weather in public space (i.e. pavements)
- 269
- 270 Rubbish bins (public)
- 271 Benches or other places to sit
- 272 Bicycle racks
- 273 Working drinking fountain
- 274 Working public telephones
- 275 Kiosks or information booths
- 276 Car charging points
- 277

- 278 Smoking areas
 279 None of the Above
 280
 281 9. Presence of any mid-segment street crossing,
 282 where an individual could safely cross (marked by
 283 sign or crosswalk)?
 284 Yes No
 285
 286 **Section: Aesthetics and Social**
 287 ****Count both sides of the street****
 288
 289 1. Do you observe pleasant hardscape features,
 290 such as fountains, sculptures, or art (public or
 291 private)?
 292 Yes No
 293
 294 2. Do you observe softscape features such as
 295 gardens or landscaping (e.g., *Public: bodies of*
 296 *water, designated viewpoints; Private: retaining*
 297 *walls, bark, ponds*)?
 298 Yes No
 299
 300 3. Are there observable historic or cultural features
 301 along the route (statues, murals etc.)?
 302 Yes No
 303 Please
 304 state _____
 305
 306 4. Are the buildings well maintained?
 307 0% 1-49% 50-99% 100%
 308
 309 5. Is landscaping well maintained?
 310 0% 1-49% 50-99% 100%
 311
 312 6. Which of the following physical disorders are
 313 present?
 314 *Check all that apply*
 315 Graffiti/tagging (not murals or street art)
 316 Abandoned cars

- 317 Buildings with broken/boarded windows
 318 Drug paraphernalia
 319 Broken glass
 320 Beer/liquor bottles/cans
 321 Litter in yards
 322 Noticeable/excessive litter in
 323 street/sidewalk
 324 Neighborhood watch signs
 325 Signage for commercial destinations or
 326 parks
 327 Safety button connecting to police
 328 None of these
 329
 330 7. Rate the extent of physical disorder (*question 6*)
 331 (*e.g., litter, graffiti, broken glass, abandoned cars*)
 332 None
 333 A little (physical/social disorder is present)
 334 Some (disorder is very noticeable)
 335 A lot (disorder is overwhelming)
 336
 337 8. Other obstructions to walking
 338 *Check all that apply*
 339 Railroad tracks (must obstruct walkway)
 340 Highway nearby (within one segment
 341 from walkway)
 342 Other: _____
 343 None
 344
 345 9. Presence of anyone walking?
 346 Yes No
 347
 348 10. Presence of anyone running?
 349 Yes No
 350
 351 11. Presence of anyone cycling?
 352 Yes No
 353
 354 12. Presence of anyone performing other physical
 355 activity or exercising? (not walking or cycling)
 356 Yes No

- 357 **Section: Pavements / Roads**
 358 **Type: Residential / Commercial (circle)**
 359
 360 1. Is a pavement present?
 361 Yes No Over 50% of the route
 362
 363 2. What is the width of the majority of the
 364 pavement?
 365 < 3 ft. 3-5 ft. > 5 ft. No
 366 pavement
 367
 368 3. (a) Is there a buffer present?
 369 Yes No Over 50% of the route
 370 (b) How wide is the majority of the buffer?
 371 < 3 ft. 3-5 ft. > 5 ft. N/A
 372
 373 4. Is the pavement continuous within the route?
 374 Yes No No sidewalk Over 50%
 375 of the route
 376
 377 5. Are there poorly maintained sections of the
 378 pavement that constitute trip hazards? (*e.g.,*
 379 *heaves, misalignment, cracks, overgrowth*)
 380 a. Minor - moderate
 381 None One A few A lot No
 382 pavement
 383
 384 b. Major
 385 None One A few A lot No
 386 pavement
 387
 388 6. (a) How steep is the pavement at the steepest
 389 point in the route? (*Excluding heaves*)
 390 _____ degrees No pavement
 391
 392 (b) How much of the route is at or near this level of
 393 steepness?
 394 Little (1-25%) Some (26-75%)

395 Most or All (76-100%) No pavement
 396 (c) If answer to 6(b) is "Little," provide a steepness
 397 measure that represents the majority of the
 398 route _____ degrees No pavement
 399 N/A
 400
 401 7. What is the steepest unavoidable cross-slope that
 402 affects walkers? _____ degrees No
 403 pavement
 404
 405 8. Are there permanent obstructions in the
 406 pavement?
 407 (e.g., telephone poles, trees, café tables, shrubs,
 408 basketball hoops)
 409 None Some Many No
 410 pavement
 411
 412 9. Are there temporary obstructions in the
 413 pavement?
 414 (e.g., parked cars, sandwich boards, rubbish bins)
 415 None Some Many No
 416 pavement
 417
 418 10. How many traffic lanes are present (include all
 419 lanes that traffic can use; choose most
 420 predominant)?
 421 1 2 3 4 5 6 7+
 422
 423 11. Is the street predominantly one-way or two-
 424 way?
 425 1-way 2-way
 426
 427 12. If no pavement, is there any other place to walk
 428 that is safe from traffic?
 429 Yes
 430 Unpaved pathway (goat path)
 431 Street shoulder
 432 Buffer
 433 No

434 N/A pavement present
 435
 436 13. If no pavement, what is the width of the place
 437 on which one could safely walk? (*Not in possible*
 438 *path of traffic*)
 439 None < 4 ft. ≥ 4 ft. N/A
 440
 441 14a. Is there a marked bicycle lane marked with a
 442 line?
 443 Yes No
 444
 445 14ai. Does the marked bicycle lane run for the
 446 entire route?
 447 100% 75-99% 51-75%
 448 25-50% 1-25%
 449
 450 14b. Is there a marked bicycle track separated from
 451 traffic and pedestrians?
 452 Yes No
 453 14bi. Does the marked bicycle track run for the
 454 entire route?
 455 100% 75-99% 51-75%
 456 25-50% 1-25%
 457
 458 15. Are there any signs indicating bicycle use (share
 459 the road, etc.)?
 460 Yes No
 461
 462 16. Are there any signs or structures discouraging
 463 skateboard usage?
 464 Yes No
 465
 466 17. Is there an informal path (shortcut), not on a
 467 cul-de-sac, which connects to something else?
 468 Yes No
 469
 470 18a. Is this a dead-end street?
 471 Yes No
 472

473 18b. Is there a paved or informal path at the end of
 474 the cul-de-sac or dead end street that connects to
 475 something else?
 476 Yes No N/A
 477
 478 19. Estimate the proportion of street segment that
 479 has ground floor or street-level windows within 40
 480 feet of pavement/walkway (or street if no
 481 pavement/walkway)
 482 1-25% 26-50% No
 483 windows
 484 51-75% 76-100%
 485
 486 20. How many different predominant building
 487 façade colors exist on the route? (*Count both sides*
 488 *of the street*)
 489 1 2-3 4-6 >6 N/A
 490
 491 21. How many different building accent colors exist
 492 on the route? (*Count both sides of the street*)
 493 1 2-3 4-6 >6 N/A
 494
 495 22. How many different predominant building
 496 materials (e.g., brick, concrete, steel, wood) exist
 497 along the route? (*Count both sides of the street*)
 498 1 2-3 4-6 >6 N/A
 499
 500 23. How many trees exist within 5 feet of either side
 501 of the pavement/pathway (can be in buffer or
 502 setback; also count trees that are more than 5 feet
 503 away if they provide shade for the
 504 pavement/pathway)?
 505 0 or 1 2-5 6-10 11-20 21+ N/A
 506
 507 24. How are the trees generally spaced?
 508 Evenly spaced Irregularly spaced N/A
 509

- 510 25. What percentage of the length of the
511 pavement/walkway is covered by trees, awnings or
512 other overhead coverage?
- 513 1-25% 25-50% No coverage
514 51-75% 76-100% N/A
515
- 516 26. What is the smallest building setback from the
517 pavement?
- 518 No building <10 feet 10-20 feet
519 21-50 feet 51-100 feet >100 feet
520
- 521 27. What is the largest building setback from the
522 pavement/walkway?
- 523 No building <10 feet 10-20 feet
524 21-50 feet 51-100 feet >100 feet
525
- 526 28. What is the average height of buildings? (*Count*
527 *both sides of the street*)
- 528 No building 1-2 stories 3-5 stories
529 6-10 stories >10 stories
530

531 Crossings

532 **How many crossings on the route?** _____

533 Answer for overall route

534 1. Intersection control

535 *Check all that apply*

- 536 Yield signs
537 Stop signs
538 Traffic signal
539 Traffic circle
540 N/A – Unanticipated mid-segment
541 crossing
542 None of the Above
543

544 2. Number of legs at intersection

545 *Check one*

- 546 T-intersection
547 4-way intersection
548 > 4-ways

549 N/A

550

551 3. Signalization

552 *Check all that apply*

- 553 Green arrows for dedicated vehicle turn
554 Pedestrian walk signals
555 Push buttons
556 None of the Above
557

558 4. (a) Pre-crossing curb (*Even if there is no marked*
559 *crosswalk, there is still a crossing*)

560 *Check one*

- 561 Ramp lines up with crossing
562 Ramp does not line up with crossing
563 No ramp
564

565 (b) Post-crossing curb

566 *Check one*

- 567 Ramp lines up with crossing
568 Ramp does not line up with crossing
569 No ramp
570

571 5. Gutters present in crossing

572 *Within possible path of crossing pedestrians*

573 Yes No
574

575 6. Other characteristics of crossing

576 *Check all that apply*

- 577 Steep slope or steep cross-slope at
578 intersection
579 Temporary obstructions
580 Crossing aids (e.g., flags)
581 None of the Above
582

583 7. Crosswalk treatment

584 *Check all that apply*

- 585 Marked crosswalk
586 High-visibility striping
587 Stop lines on road or additional crosswalk
588 warnings

589 Raised crosswalk

590 Different material than road

591 None of the Above
592

593 8. Bike lane crosses the crossing?

594 Yes No
595

596 9. Distance of crossing leg, including all potential
597 parking and turn lanes

598 _____ lanes wide
599

600 10. Features

601 *Check all that apply*

- 602 Specifically identified lanes **turning into**
603 **crossing**
604 Right turn Left turn
605 Protected refuge islands
606 One-way streets **through crossing**
607 Curb extension
608 None of the Above
609

610 11. Miscellaneous problems

611 *Check all that apply*

- 612 Lack of lampposts or overhead street
613 lamps
614 Poor condition of crossing surface
615 Poor visibility at corners
616 Faded or worn crosswalk markings
617 Unanticipated mid-segment crossing
618 Reason: _____
619 Other: _____
620 None of the Above
621

622 Cul-de-sac

623 **Complete only if street comes to a dead end – Cul-**
624 **de-sac**

625 In order for the cul-de-sac or street dead-end to be
626 rated, it must open out, widen or bulbs out.
627

628 1. How big is the cul-de-sac or dead-end at
629 its largest diameter?
630 *Check one*
631 ≤ 50 feet
632 51 – 100 feet
633 101 – 200 feet
634 > 200 feet
635

636 2. What is the incline/grade of the:
637 Cul-de-sac or dead-end at its steepest point:
638 ___ degrees
639 Street at the opening to the cul-de-sac or dead-
640 end: ___ degrees
641

642 3. What percentage of the cul-de-sac or
643 dead-end is paved?
644 *Check one*
645 <25%
646 25-50%
647 51-75%
648 > 75%
649

650 4. For the paved part of the cul-de-sac or
651 dead-end, how smooth is the pavement?
652 *Check one*
653 Not smooth at all – a lot of bumps or
654 cracks
655 Somewhat smooth – a few major bumps
656 or cracks
657 Mostly smooth – minor bumps or cracks
658 Very smooth – few or no bumps or cracks
659

660 5. What amenities exist at the opening to or
661 along the cul-de-sac or dead-end portion
662 of the street?
663 *Check all that apply*
664 Basketball hoops _____ number
665 Skateboard features (e.g., ramps) _____
666 number

667 Streetlights _____ number
668 Pedestrian or other safety signage (e.g.,
669 children at play)
670 Other; describe _____
671 _____
672 None of the Above
673

674 6. _____ driveways enter into the cul-de-
675 sac or dead-end area?

676 7. Is parking allowed (not prohibited) in the area?
677 Yes No
678

679 8 (a). Is there access through the end of the cul-de-
680 sac or dead-end street to another public street or
681 area?
682 Yes No If no, done with section.
683

684 9 (b). If yes, what type of access?
685 *Check all that apply*
686 Formal: A planned formal path with a
687 paved, marked or deliberate surface.
688 Informal: An informal path that is
689 unpaved, not marked and could be
690 considered a shortcut.
691 Informal, no path
692

693 10 (c). If yes, what is on the other side?
694 *Check all that apply*
695 Another street
696 A recreation or play area (can be part of a
697 school)
698 Open space
699 Commercial or retail area
700 Other
701 _____
702
703
704

705 Qualitative open ended questions

706 1) Any other comments on the street regarding
707 liveability: safety, health, sustainability, inclusivity,
708 places, education, traffic, pavements or roads:
709

710

711

712

713 2) Please make a note of any temporary street
714 furniture e.g., road works, traffic lights:
715

716

717 3) Please make a comment regarding the weather of
718 the google street view at both time-point 1 and time-
719 point 2:
720
721
722
723

724 **Proxy indicators of behaviour including**
 725 **active transport**
 726

	Outcomes	Count	Total for the route
Cycling	Number of bicycle racks (as a whole unit)		
	Number of bicycle racks (how many bicycles can the rack hold)		
	Number of bicycles in each of the racks (total)		
	Number of cyclists		
Traffic	Number of moving cars		
	Number of parked cars		
	Total number of cars on the road (moving and/or parked)		
Exercise	Number of individuals exercising (not walking or cycling e.g., running, jogging rollerblading etc.)		
	Type of activities being performed (not walking or cycling e.g., running, jogging, rollerblading etc.)		
	Total number of activities being performed (not walking or cycling)		

727

	Outcomes	Count	Total for the route
Pedestrians	Number of pedestrians		
Groups	Presence of large groups of people (>4) congregating together (count as whole groups)		
Static people	Presence of people on their own or in small groups (2-3 people) waiting for the bus etc.		