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POLYTECHNIQUE MONTRÉAL

affiliée à l'Université de Montréal

**Évaluation des opportunités et des barrières à l'implantation d'une
planification urbaine axée sur l'accessibilité aux destinations**

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Mémoire présenté en vue de l'obtention du diplôme de *Maîtrise ès sciences appliquées*

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Ce mémoire intitulé :

Évaluation des opportunités et des barrières à l'implantation d'une planification urbaine axée sur l'accessibilité aux destinations

présenté par **Frédéric COURNOYER**

en vue de l'obtention du diplôme de *Maîtrise ès sciences appliquées*

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RÉSUMÉ

À travers le monde et en Amérique du Nord particulièrement, les réseaux de transport sont planifiés pour permettre à la population de se déplacer rapidement en parcourant de longues distances. Ces réseaux, souvent développés en priorisant les infrastructures automobiles, ne permettent pas à toutes les populations d'accéder facilement aux destinations importantes pour eux. Toutefois, depuis un certain temps, le milieu de la recherche insiste sur l'idée que la facilité de se rendre à destination (accessibilité) est plus importante pour la population que le fait de se déplacer (mobilité). Ainsi, planifier pour l'accessibilité implique avant tout de faciliter l'accès de la population aux destinations qui leur sont d'intérêt. Les impacts sur la société de ce changement de paradigme vers l'accessibilité incluent, entre autres, la réduction des émissions de gaz à effet de serre, la réduction des coûts pour entretenir les systèmes de transports, la réduction des inégalités sociales ainsi que la réduction de la sédentarité chez la population.

Nonobstant un consensus en recherche sur les avantages d'une planification basée sur l'accessibilité, son intégration en pratique demeure limitée. Des barrières techniques, institutionnelles et politiques à une intégration systématique de l'accessibilité ont été identifiées dans des études précédentes. Par conséquent, les documents de planification en transport et en aménagement du territoire priorisent généralement les indicateurs de mobilité et non des mesures d'accessibilité. En pratique, bien que des stratégies liées à l'accessibilité, comme la densification et la mixité des activités gagnent en popularité, les indicateurs d'accessibilité sont encore peu utilisés pour guider la planification de projets en transport ou en aménagement.

Ce mémoire cherche donc à évaluer les opportunités et les barrières à l'implantation d'une planification urbaine axée sur l'accessibilité aux destinations. Deux sous-objectifs de recherche ont été développés :

- 1- Évaluer l'intégration de l'accessibilité dans les plans d'aménagement et de transport, en comparant les différences entre types d'organisations et paliers gouvernementaux;
- 2- Identifier les facteurs facilitant ou limitant l'utilisation d'indicateurs d'accessibilité par des professionnels en transport et en aménagement.

En vue de répondre au premier sous-objectif de recherche, 40 documents de planification produits par des organisations et agences œuvrant en planification des transports et en aménagement du territoire au Canada ont été collectés. Ceci inclut des documents produits par des villes, des agences

de transport en commun et des organisations métropolitaines de planification des transports, entre autres. Un cadre d'analyse, formé de 20 questions, a été développé pour évaluer l'intégration de l'accessibilité dans les documents de planification récoltés. Les résultats montrent que la majorité des documents définissent des objectifs pour faciliter l'accessibilité aux destinations, mais peu incluent des indicateurs ou des cibles d'accessibilité chiffrés. Les résultats varient fortement selon le type d'organisations qui publient le document. Les villes, autant dans des documents d'aménagement, de transport, ou intégrant les deux, obtiennent les résultats les plus élevés. À l'opposé, les agences de transport en commun obtiennent les résultats les plus faibles. Parmi les dix documents des agences de transport en commun, aucun n'inclut d'indicateurs d'accessibilité. Par ailleurs, au sein même du territoire de certaines municipalités, les résultats ne sont pas homogènes et cohérents entre différentes organisations. Ceci implique qu'une municipalité peut définir des cibles d'accessibilité qui seront différentes de celles définies par l'organisme de planification métropolitaine. Des incohérences entre la vision, les objectifs et les indicateurs des plans sont également relevées.

Pour atteindre le deuxième sous-objectif, une méthodologie basée sur des ateliers participatifs avec des arrondissements et services de la Ville de Montréal a été développée. La méthodologie repose sur trois ateliers participatifs qui cherchent respectivement à (1) codévelopper des indicateurs d'accessibilité en fonction des besoins de l'arrondissement, (2) codévelopper des scénarios de transport et d'aménagement du territoire et (3) évaluer les barrières et les opportunités pour l'implantation d'indicateurs d'accessibilité dans la planification urbaine. Un total de trois études de cas ont été réalisées avec : (1) l'arrondissement de LaSalle, (2) l'arrondissement de Montréal-Nord et (3) l'arrondissement Côte-des-Neiges–Notre-Dame-de-Grâces et le Service de l'urbanisme et de la mobilité de la Ville de Montréal. Dans le cadre des trois études de cas, les professionnels rencontrés ont préféré définir des indicateurs d'accessibilité faciles à communiquer et à calculer, au détriment d'indicateurs plus complexes qui leur ont été présentés. Après avoir mobilisé les indicateurs, les professionnels ont identifié quelques barrières limitant ce changement de paradigme, incluant le manque d'intérêt de la classe politique pour des changements structurels à long-terme et la ségrégation des responsabilités et pouvoirs en transport et en aménagement. Toutefois, les professionnels ont également souligné plusieurs opportunités pour ces indicateurs, comme pour confirmer des connaissances existantes, pour planifier de nouveaux développements résidentiels et pour simuler l'impact de projets de transport.

Les résultats et conclusions de ce mémoire contribuent au bassin de littérature sur les conditions permettant de favoriser une planification du territoire et des transports basée sur l'accessibilité aux destinations. Les connaissances développées peuvent être mobilisées par le milieu pratique pour favoriser le changement de paradigme vers l'accessibilité. Pour le milieu de la recherche, les principaux résultats communs aux deux articles de ce mémoire sont que : (1) le milieu de la pratique développe un intérêt grandissant pour les indicateurs d'accessibilité, (2) le milieu de la pratique préfère les indicateurs d'accessibilité simples, (3) les municipalités et les arrondissements sont des organisations propices à la planification axée sur l'accessibilité, (4) il y a un manque de cohérence entre les organisations œuvrant à différentes échelles au sein d'une même municipalité et (5) le milieu politique est un acteur à mobiliser pour favoriser un changement de paradigme vers l'accessibilité. Ces résultats sont cohérents avec le bassin de littérature sur l'accessibilité qui s'était majoritairement intéressé à des cas d'études européens. En somme, ce projet de recherche vient développer de nouvelles connaissances pour favoriser une planification des transports et du territoire basée sur l'accessibilité.

ABSTRACT

Across the world, and particularly in North America, transportation networks are planned to allow the population to move quickly over long distances. These networks, often developed by prioritizing automobile infrastructure, do not allow everyone to easily access destinations that are important to them. However, for some time now, the research community has emphasized the idea that the ease of reaching destinations (i.e., accessibility) is more important for the population than the act of moving itself (i.e., mobility). Thus, planning for accessibility primarily involves facilitating the population's access to destinations of interest to them. Along with addressing social inequalities, a shift towards planning for accessibility has been linked with other societal challenges such as the reduction of greenhouse gas emissions, the reduction of costs to maintain transportation systems, and the reduction of sedentary behavior among the population.

Notwithstanding a research consensus on the advantages of accessibility-based planning, its integration in practice remains limited. Technical, institutional, and political barriers to the systematic integration of accessibility have been identified in previous studies. Consequently, transportation and land-use planning documents generally prioritize mobility indicators rather than accessibility measures. In practice, although strategies related to accessibility, such as densification and the mixing of activities, are gaining popularity, accessibility indicators are still rarely used to guide the planning of transportation or land-use projects.

This thesis therefore seeks to assess the opportunities and barriers to the implementation of urban planning focused on accessibility to destinations. Two research sub-objectives were developed:

- 1- Assess the integration of accessibility in land-use and transportation plans, by comparing differences across types of organizations and levels of government;
- 2- Identify the factors facilitating or limiting the use of accessibility indicators by professionals in transportation and land-use planning.

To address the first research sub-objective, 40 planning documents produced by organizations and agencies involved in transportation and land-use planning in Canada were collected. This includes documents produced by cities, public transit agencies, and metropolitan transportation planning organizations, among others. An analytical framework, composed of 20 questions, was developed to assess the integration of accessibility in the collected planning documents. The results show that

the majority of documents define objectives to facilitate accessibility to destinations, but few include quantified accessibility indicators or targets. The results vary significantly depending on the type of organization that publishes the document. Cities, whether in land-use, transportation, or integrated documents, obtain the highest scores. In contrast, public transit agencies obtain the lowest scores. Among the ten documents from public transit agencies, none includes accessibility indicators. Furthermore, within the same territory of certain municipalities, results are not homogeneous and consistent across different organizations. This implies that a municipality may define accessibility targets that differ from those defined by the metropolitan planning organization. Inconsistencies between the vision, objectives, and indicators of the plans are also observed.

To achieve the second sub-objective, a methodology based on participatory workshops with boroughs and departments of the City of Montreal was developed. The methodology relies on three participatory workshops that respectively aim to (1) co-develop accessibility indicators based on the needs of the borough, (2) co-develop transportation and land-use scenarios, and (3) assess barriers and opportunities for the implementation of accessibility indicators in urban planning. A total of three case studies were conducted with: (1) the borough of LaSalle, (2) the borough of Montréal-Nord, and (3) the borough of Côte-des-Neiges–Notre-Dame-de-Grâce and the City of Montreal’s Urban Planning and Mobility Department. Within the three case studies, the professionals consulted preferred to define accessibility indicators that are easy to communicate and calculate, at the expense of more complex indicators that were presented to them. After mobilizing the indicators, the professionals identified several barriers limiting this paradigm shift, including the lack of interest from the political class in long-term structural changes and the fragmentation of responsibilities and powers in transportation and land-use. However, professionals also highlighted several opportunities for these indicators, such as confirming existing knowledge, planning new residential developments, and simulating the impact of transportation projects.

The results and conclusions of this thesis contribute to the body of literature on the conditions that enable planning of land-use and transportation based on accessibility to destinations. The knowledge developed can be mobilized by practitioners to support the paradigm shift toward accessibility. For the research community, the main results common to both articles of this thesis are that: (1) practitioners are showing growing interest in accessibility indicators, (2) practitioners

prefer simple accessibility indicators, (3) municipalities and boroughs are organizations conducive to accessibility-based planning, (4) there is a lack of coherence among organizations operating at different scales within the same municipality, and (5) the political sphere is a key actor to mobilize in order to promote a paradigm shift toward accessibility. These results are consistent with the body of literature on accessibility, which has mostly focused on European case studies. In sum, this research project contributes new knowledge to support transportation and land-use planning based on accessibility.

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LISTE DES SIGLES ET ABRÉVIATIONS

ARTM	Autorité régionale de transport métropolitain
BRT	Bus rapid transit
CIPQAY	Combined Index of Park Quality and Accessibility for Youth
CMA	Census metropolitan area
GTFS	General Transit Feed Specification
LTS	Level of traffic stress
OSM	OpenStreetMap
PUM 2050	Plan d'urbanisme et de mobilité 2050 de la Ville de Montréal
QNH	Quartier Namur-Hippodrome
REQ	Registre des entreprises du Québec
SUM	Service de l'urbanisme et de la mobilité de la Ville de Montréal
STM	Société de transport de Montréal
TOD	Transit oriented development
VKT	Vehicle kilometers traveled

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CHAPITRE 1 INTRODUCTION

1.1 Mise en contexte

L'aménagement du territoire et la planification des systèmes de transport sont étroitement liés (Gallez et al., 2015). La manière dont le territoire est développé, au gré des réglementations de zonage, de densité et de mixité, impacte directement le développement des systèmes de transport et les habitudes de déplacement de la population (Cervero & Kockelman, 1997; Gallez et al., 2015). À l'inverse, le développement des transports influence le développement urbain; un exemple étant le lien documenté entre l'expansion du réseau routier et l'étalement urbain (Barrington-Leigh & Millard-Ball, 2015). En Amérique du Nord, le territoire est peu dense et les usages sont largement ségrégés, c'est-à-dire qu'on retrouve des quartiers uniquement résidentiels et d'autres avec des commerces et des emplois (Newman & Kenworthy, 1996). Ces conditions favorisent l'utilisation de l'automobile, alors que les distances élevées compliquent l'utilisation de modes actifs et que le transport en commun est rarement compétitif, en termes de temps et de coûts, avec l'automobile (Banister, 2008).

Cette approche à la planification des transports cherche à maximiser la mobilité de la population, qu'on définit comme la facilité de se déplacer (Levine et al., 2012). Toutefois, une dichotomie existe entre cette vision et les besoins de la population (Levine et al., 2019). En effet, se déplacer n'est pas un besoin autotélique, c'est-à-dire une activité qu'on effectue pour elle-même, mais bien dérivée d'un autre besoin, celui d'atteindre des destinations d'intérêt (Levine et al., 2012). Toutefois, ce besoin réel n'est pas systématiquement intégré dans la planification des transports (Levine et al., 2019).

L'accessibilité aux destinations est le concept qu'on définit qu'on la possibilité de rejoindre des destinations d'intérêt (Geurs & van Wee, 2004; Handy, 2020) et qui est ainsi directement lié aux besoins des populations. L'accessibilité inclut quatre composantes : le transport, l'aménagement du territoire, l'individu et la temporalité (Geurs & van Wee, 2004).

Plusieurs types de mesures d'accessibilités sont définies en recherche (El-Geneidy & Levinson, 2006; Geurs & van Wee, 2004; Marwal & Silva, 2022). Les mesures les plus répandues en recherche et en pratique sont les mesures basées sur la localisation (*location-based measures*), qui évaluent l'accessibilité à partir d'origines. Parmi ce groupe, on retrouve les mesures d'opportunités

cumulatives qui représentent le nombre de destinations accessibles sous un seuil de temps ou de distance (El-Geneidy & Levinson, 2006), comme le nombre d'épiceries accessibles en quinze minutes de marche. Les mesures gravitaires, un autre type de mesures basées sur la localisation, sont basées sur une pondération des destinations selon leur distance avec l'origine. De cette manière, les destinations à proximité ont un plus grand poids (Kapatsila et al., 2023).

Depuis quelques décennies, le milieu de la recherche appelle à un changement de paradigme pour prioriser l'accessibilité aux destinations dans la planification des transports (Handy, 2020). Cette approche devrait permettre de réduire certaines externalités, comme les émissions de GES, les problèmes de santé et les coûts pour maintenir les infrastructures automobiles (Badoe & Miller, 2000; Banister, 2011), associées aux pratiques actuelles en planification des transports. Ultimement, une planification basée sur l'accessibilité permettrait à la population d'accéder facilement aux destinations qui leur sont d'intérêt. Ce paradigme permettrait d'intégrer la planification du territoire et des transports pour développer des communautés complètes, où les modes actifs et collectifs sont prioritaires (Banister, 2008).

1.2 Problématique

Nonobstant la recherche récente sur l'accessibilité, comme le développement de nouvelles mesures et le fait que le concept ait été mis de l'avant il y a plus d'une soixantaine années, son intégration en pratique demeure limitée (Boisjoly & El-Geneidy, 2017a, 2017b; Siddiq & Taylor, 2021; Silva et al., 2017). Les raisons expliquant cet écart entre la recherche et la pratique peuvent être classées en trois grandes catégories : techniques, institutionnelles et politiques. D'un point de vue technique, concrètement, les professionnels en aménagement et en transport n'ont parfois pas accès aux données, aux compétences et/ou aux connaissances nécessaires pour calculer des indicateurs d'accessibilité (Silva et al., 2017). Au niveau institutionnel, une barrière notable concerne la segmentation des mandats et des responsabilités des organisations en aménagement et en transport (Silva et al., 2017). Comme mentionné précédemment, les transports et le territoire sont souvent planifiés en vase clos (Gallez et al., 2015), ce qui rend difficile l'intégration de l'accessibilité qui cherche à considérer conjointement ces deux domaines. Au niveau politique, ce changement de paradigme impliquerait également des modifications structurelles à la façon de concevoir les transports et le territoire, ce qui contraste avec des enjeux plus tangibles pour la population, comme la congestion (Handy, 2020; Straatemeier & Bertolini, 2008).

Ce changement de paradigme peut être porté de deux manières complémentaires, d’abord dans les documents de planification stratégique, mais également à travers la planification de projets en transport et en aménagement. Plusieurs études ont évalué l’intégration de l’accessibilité dans des documents de planification (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025). Toutefois, ces études se sont intéressées à évaluer un seul type de plan, comme un plan de transport régional, sans considérer la pluralité d’organisations concernées par l’accessibilité. En effet, il y a un besoin d’évaluer l’intégration horizontale de l’accessibilité, c’est-à-dire entre des organisations œuvrant au même palier gouvernemental, mais ayant des rôles et objectifs différents, comme la Société de transport de Montréal et la Ville de Montréal. De plus, comme montré précédemment en recherche (Hull, 2008), il existe également un manque de coordination verticale entre différents paliers de gouvernement.

D’autres études ont réalisé des projets en collaboration avec des acteurs du milieu pratique pour évaluer de quelles manières les indicateurs d’accessibilité peuvent être utilisés par des professionnels en urbanisme et en transport (Hull et al., 2012; Pönkänen et al., 2025; Silva et al., 2017, 2019; Straatemeier & Bertolini, 2020). Toutefois, ces études de cas se sont majoritairement déroulées en Europe et il existe un besoin de comprendre comment ces résultats se transposeraient dans des contextes différents. En effet, plusieurs villes où se sont déroulés ces projets, comme Munich et Madrid (Silva et al., 2017), possèdent des caractéristiques urbaines et des systèmes de transport plus propices à la planification basée sur l’accessibilité en comparaison du contexte nord-américain.

1.3 Objectifs de recherche

L’objectif principal de ce projet de recherche est d’évaluer les opportunités et les barrières à l’implantation d’une planification urbaine axée sur l’accessibilité aux destinations. Les sous-objectifs associés sont :

- 1- Évaluer l’intégration de l’accessibilité dans les plans d’aménagement et de transport, en comparant les différences entre types d’organisations et paliers gouvernementaux;
- 2- Identifier les facteurs facilitant ou limitant l’utilisation d’indicateurs d’accessibilité par des professionnels en transport et en aménagement.

Le premier sous-objectif porte sur l’analyse de 40 plans d’aménagement et de transport provenant d’organisations œuvrant dans dix des plus grandes villes canadiennes. Un cadre d’analyse, incluant

20 questions portant sur les quatre composantes de l'accessibilité (transport, aménagement, individu, temporalité) ainsi que sur la vision du plan et les indicateurs a été développé pour évaluer l'intégration de l'accessibilité dans les documents de planification de villes canadiennes. À partir des thèmes identifiés, une analyse qualitative a été réalisée pour évaluer spécifiquement leur intégration dans les documents stratégiques. À ma connaissance, cette analyse est la première à s'intéresser à l'intégration de l'accessibilité entre différents paliers de gouvernement (analyse verticale) et différents types d'organisations (analyse horizontale). Les résultats contribuent à la littérature en permettant d'identifier de quelle manière l'accessibilité est considérée au sein de municipalités où plusieurs documents de planification sont en vigueur et d'évaluer comment les différents types de plans l'abordent. Le cadre d'analyse peut être appliqué à d'autres contextes dans des projets de recherches futurs.

Le deuxième sous-objectif vise à identifier les facteurs facilitant ou limitant l'utilisation d'indicateurs d'accessibilité par des professionnels en transport et en aménagement. Récemment, la littérature a souligné le besoin de comprendre comment opérationnaliser l'accessibilité en pratique (Silva & Larsson, 2019). Plusieurs études sur le sujet ont été réalisées en Europe (voir Hull et al. (2012)), mais aucune en Amérique du Nord, à ma connaissance. De nouveaux projets sont ainsi requis pour développer des connaissances dans des contextes socio-économiques et urbains distincts. Pour atteindre ce deuxième sous-objectif, une méthodologie basée sur la réalisation de trois ateliers participatifs avec des professionnels en transport et en urbanisme à Montréal est développée. Le processus est celui de la recherche collaborative : des connaissances pertinentes à la littérature sont produites à la suite d'une collaboration avec des professionnels et ces professionnels profitent de la démarche qui peut les outiller dans leur travail (Morrisette, 2013). Trois études de cas sont planifiées avec (1) l'arrondissement de LaSalle, (2) l'arrondissement de Montréal-Nord, (3) le Service de l'urbanisme et de la mobilité de la Ville de Montréal et l'arrondissement Côte-des-Neiges–Notre-Dame-de-Grâces. À travers ces ateliers participatifs, des indicateurs d'accessibilité sont définis, en collaboration avec les professionnels rencontrés. Les opportunités et les barrières à leur utilisation sont ensuite évaluées à l'aide de groupes de discussion, d'observation et de données générées par les participants.

1.4 Plan du mémoire

Ce mémoire suit la structure d'un mémoire par articles. Ce premier chapitre sert d'introduction et contient les objectifs de recherche de ce projet de maîtrise.

Le deuxième chapitre présente une courte revue de littérature pour soutenir les revues de littérature détaillées qui sont présentées dans les deux articles de ce mémoire.

Le troisième chapitre aborde la démarche de ce projet de recherche, incluant quatre phases distinctes : (1) définition du projet, (2) analyse de plans d'aménagement et de transport, (3) études de cas et (4) synthèse des résultats.

Les chapitres 4 et 5 présentent les deux articles de ce mémoire. Le premier article, en lien avec le premier objectif de recherche de ce mémoire, s'intitule : « Beyond buzzwords: evaluating the integration of accessibility goals and indicators in land use and transportation policy documents », publié dans le journal *Transport Policy* le 17 février 2026. Cet article a été rédigé par l'auteur de ce mémoire, en collaboration avec les professeurs Geneviève Boisjoly, Owen Waygood et Kevin Manaugh, ainsi qu'avec les étudiants au doctorat Maxwell Francis White et José Arturo Jasso Chávez.

Le deuxième article, en lien avec le deuxième objectif de recherche, s'intitule « Accessibility in action: Participatory planning workshops with land use and transport practitioners in Montreal, Canada ». Celui-ci a été réalisé en collaboration avec la directrice et le co-directeur de recherche de l'auteur de ce mémoire et soumis au *Journal of Urban Mobility* le 12 mars 2026 pour publication dans un numéro spécial.

Le sixième chapitre inclut une synthèse des résultats de ce mémoire et une discussion de la contribution des deux articles à la recherche en transport et en urbanisme. Les connaissances développées pour une implantation plus systématique de l'accessibilité en pratique sont également mises de l'avant.

Le septième chapitre sert de conclusion à ce mémoire, en résumant la méthodologie employée, les connaissances principales développées, les limites ainsi que des pistes de recherche futures.

CHAPITRE 2 REVUE DE LITTÉRATURE

La revue de littérature détaillée de ce projet de maîtrise sera présentée dans les deux articles scientifiques (voir Chapitres 4 et 5). Dans les deux articles, une revue de littérature générale sur l'accessibilité, incluant une description de ses composantes et des mesures existantes est présentée. Ensuite, des revues de littérature spécifiques aux objectifs des articles sont également présentées. Dans ce chapitre, un bref aperçu de l'accessibilité et des résumés des revues de littérature des articles sont présentés.

Dans le cadre de ce mémoire, l'accessibilité est définie comme la possibilité d'atteindre des destinations d'intérêt et on y associe quatre composantes : le transport, l'aménagement du territoire, l'individu et la temporalité (Geurs & van Wee, 2004). La composante du transport implique les différents modes de transports disponibles et leurs coûts monétaires et en temps. Ces derniers sont utilisés pour atteindre des destinations spatialement réparties sur le territoire. Ces déplacements sont également réalisés selon les préférences, les besoins et les contraintes individuels. Finalement, l'accessibilité varie temporellement selon la disponibilité de certains modes de transport, comme le transport en commun, et les heures d'ouverture des destinations, comme des commerces ou des services.

Par sa nature, l'accessibilité est un concept qui intègre à la fois la planification des transports et l'aménagement du territoire. Alors qu'historiquement les transports étaient planifiés pour répondre à des objectifs de mobilité, définie comme la facilité de se déplacer, l'accessibilité conjugue mobilité et proximité (Levine et al., 2019). De cette façon, on cherche à faciliter les déplacements de la population tout en priorisant la proximité entre lieux de résidence et destinations d'intérêt. Des concepts qui gagnent en popularité depuis quelques années, comme la ville des 15 minutes (Silva et al., 2025) et les aménagements axés sur le transport en commun (Papa & Bertolini, 2015) sont fondés sur l'accessibilité. En effet, ces derniers ont en commun cet objectif de planifier selon l'accessibilité, en développant des milieux de vie denses et en proposant une mixité d'usages. Une planification urbaine basée sur l'accessibilité pourrait être synonyme de nombreuses externalités positives pour notre société, comme une diminution des coûts associés aux infrastructures routières, une réduction de la production de gaz à effet de serre et la réduction de la sédentarité (Banister, 2008).

En plus de nombreuses études produites par le milieu de la recherche sur l'accessibilité et ses composantes, la littérature s'est également intéressée au développement d'indicateurs d'accessibilité. Bien que les définitions varient, on retrouve généralement quatre types de mesures basées sur (Geurs & van Wee, 2004) : la localisation, l'infrastructure, la personne ou l'utilité. Une brève description des mesures basées sur la localisation sera réalisée, considérant qu'elles sont les plus populaires auprès des professionnels et des décideurs politiques (Boisjoly & El-Geneidy, 2017a). Ces mesures représentent l'accessibilité à partir d'une unité géographique pour évaluer la connexion entre des origines, souvent des lieux de résidence, et des destinations d'intérêt (Geurs & van Wee, 2004). Parmi ce groupe de mesures, on retrouve les mesures d'opportunités cumulées qui représentent, pour chaque unité géographique donnée, le nombre de destinations accessibles sous un seuil de temps ou de distance. Il est également possible d'associer un poids aux destinations pour les pondérer selon leur distance avec l'origine; ces mesures sont définies comme des mesures gravitaires (Kapatsila et al., 2023). On retrouve également des mesures de compétitivité qui permettent de considérer l'offre et la demande de certaines destinations dans les calculs d'accessibilité (Geurs & van Wee, 2004).

Dans la section 4.2 (article 1), la revue de littérature met en lumière trois études spécifiques qui ont analysé l'intégration d'objectifs et de mesures d'accessibilité dans des documents de planifications produits par des organismes en aménagement du territoire et en planification des transports (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025). Les informations présentées incluent d'abord la méthode d'analyse, soit un cadre d'analyse quantitatif (Proffitt et al., 2019; Tuffour et al., 2025) ou la récolte de données qualitatives (Boisjoly & El-Geneidy, 2017a). La revue indique que le concept d'accessibilité est rarement défini comme « la possibilité d'atteindre des destinations » et la majorité des documents de planification ne contiennent pas d'indicateurs ou de cibles d'accessibilité. Une lacune a été identifiée dans ces trois études spécifiques (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025) : seulement un type de plans est analysé, ce qui ne permet pas de comparer l'intégration de l'accessibilité dans des plans produits par différents types d'organisations. Les informations récoltées à travers cette revue de littérature ont également permis de concevoir la méthodologie de ce premier article.

La revue de littérature du deuxième article (section 5.2) couvre plus spécifiquement les études qui ont évalué l'intégration de l'accessibilité dans des contextes de planification des transports et d'aménagement du territoire. Ces études sont séparées en deux catégories : (1) les sondages et (2)

les projets en collaboration avec des acteurs du milieu pratique. D'abord, plusieurs études ont développé des entrevues et des sondages pour évaluer les opportunités et les barrières à l'implantation de l'accessibilité en pratique (Boisjoly & El-Geneidy, 2017b; Rowangould et al., 2024; Siddiq & Taylor, 2021). Ces études ont identifié des barrières techniques, institutionnelles et politiques. Ensuite, d'autres études ont effectué des ateliers participatifs avec des acteurs du milieu de la pratique (Hull et al., 2012; Pönkänen et al., 2025; Silva et al., 2017, 2019; Straatemeier & Bertolini, 2020). L'objectif de ces études était de développer des indicateurs d'accessibilité et d'ensuite évaluer leur application en pratique. Ce bassin de littérature s'est majoritairement concentré sur le contexte européen et de nouvelles études sont requises pour évaluer les opportunités et les barrières à la planification basée sur l'accessibilité dans des contextes socio-économiques et urbains distincts. Cette revue de littérature et la lacune identifiée ont appuyé la méthodologie développée pour atteindre le deuxième sous-objectif de recherche de ce mémoire.

CHAPITRE 3 DÉMARCHE MÉTHODOLOGIQUE

Cette section présente la démarche méthodologique définie dans le cadre de ce projet pour atteindre les objectifs mentionnés ci-dessus. Le projet s'est déroulé en quatre phases (Figure 3.1) : (1) définition du projet, (2) analyse de plans d'aménagement et de transport (article 1), (3) études de cas (article 2) et (4) synthèse des résultats.

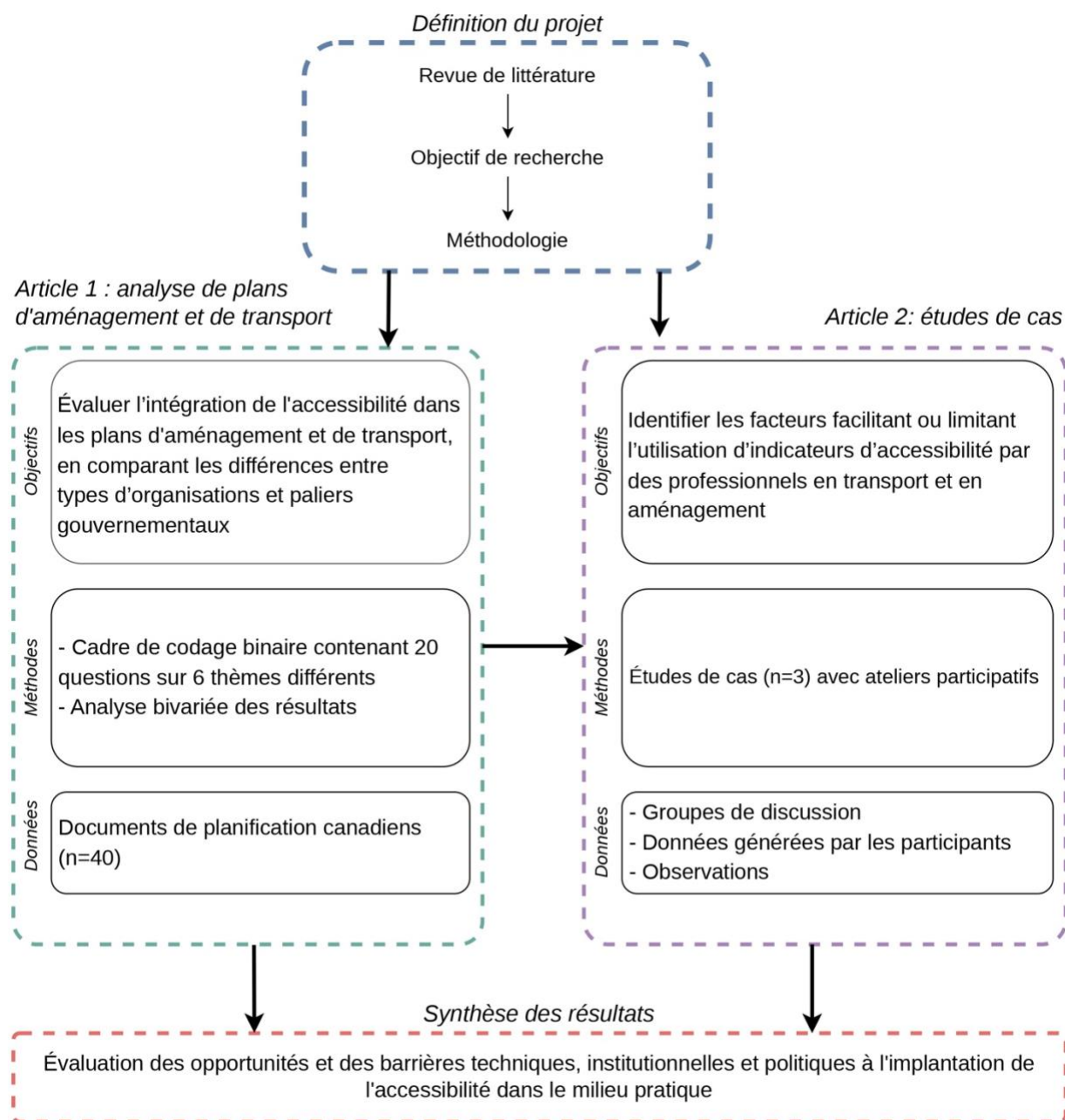


Figure 3.1 Démarche du projet de recherche

3.1 Définition du projet

Ce travail de recherche a d'abord débuté par une revue de littérature pour définir des objectifs de recherche répondant spécifiquement à des lacunes dans la littérature. Des lectures sur l'accessibilité ont permis à l'auteur de ce mémoire d'identifier qu'en dépit du nombre croissant d'études sur l'accessibilité, le concept demeure marginal dans le milieu pratique (Handy, 2020). Les lectures de documents de planification comme le *Plan d'urbanisme et de mobilité 2050* (PUM 2050) de la Ville de Montréal et le *Plan stratégique de développement 2025-2034* de l'ARTM ont été réalisées pour identifier si l'accessibilité y était abordée. Deux observations dérivées de ces lectures sont que : (1) l'accessibilité n'est pas systématiquement intégrée dans les documents de planification en transport et en aménagement à Montréal et (2) la Ville de Montréal a établi une vision claire dans le PUM 2050 pour intégrer l'accessibilité dans les processus de planification et de prise de décisions.

Concernant ce premier constat, une revue de littérature des articles ayant évalué l'intégration de l'accessibilité dans les documents de planification a été réalisée. Il y avait d'abord un manque de connaissances sur le niveau d'intégration de l'accessibilité dans les documents de planification au Canada. De plus, la littérature s'était uniquement intéressée à un type de plan et à un niveau spatial dans une même étude (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025). C'est ainsi que le premier sous-objectif de ce mémoire a été défini, soit d'évaluer comment l'intégration de l'accessibilité varie entre des documents de planification produits par des organisations de différents types et œuvrant à niveaux paliers gouvernementaux.

Ensuite, cette revue de littérature a permis d'identifier plusieurs études ayant développé des projets en collaboration avec des professionnels du milieu pratique (Hull et al., 2012; Silva et al., 2019; Straatemeier & Bertolini, 2008, 2020). Réaliser des ateliers participatifs avec des professionnels en urbanisme et en transport permet d'évaluer comment ces acteurs s'approprient les outils d'accessibilité et quelles sont les barrières pratiques, institutionnelles et politiques à leur implantation (Straatemeier & Bertolini, 2008). Peu d'études se sont intéressées à cette question et aucune en Amérique du Nord, à ma connaissance. Considérant la démarche entamée dans le PUM 2050 envers le développement d'une vision centrée sur l'accessibilité, la Ville de Montréal semblait être l'organisation appropriée pour atteindre le deuxième sous-objectif de recherche de ce mémoire : identifier les facteurs facilitant ou limitant l'utilisation d'indicateurs d'accessibilité par

des professionnels en transport et en aménagement. Ces études de cas permettent de confirmer ou d'infirmer les résultats de la littérature, en s'intéressant à la Ville de Montréal, qui présente des caractéristiques différentes des villes où les études précédentes s'étaient déroulées.

Ces deux phases permettent donc d'analyser l'intégration de l'accessibilité dans les documents de planification et ensuite au sein du milieu de la pratique en transport et en urbanisme. Ces deux approches sont complémentaires, considérant que la recherche passée a identifié qu'une meilleure intégration de l'accessibilité dans les documents de planification est un facteur déterminant pour l'intégration en pratique (Boisjoly & El-Geneidy, 2017b)

3.2 Analyse de plans d'aménagement et de transport (Article 1)

Cette deuxième phase a permis d'atteindre le premier sous-objectif de ce mémoire avec la publication de l'article : « Beyond buzzwords: evaluating the integration of accessibility goals and indicators in land use and transportation policy documents ». La méthodologie de cet article se base sur un cadre d'analyse adapté de l'étude de Proffitt et al. (2019). Le cadre initial contenait 14 questions et aucune d'entre elles n'évaluait les composantes temporelles et de l'aménagement du territoire de l'accessibilité. La première étape a consisté à adapter ce cadre en se basant sur la littérature pour évaluer ce qu'un document de planification devrait contenir pour intégrer de manière exhaustive l'accessibilité. Le cadre final contient 20 questions classées en six catégories : (1) définition et vision de l'accessibilité, (2) transport, (3) aménagement du territoire, (4) individu et équité, (5) temporalité et (6) indicateurs. Les questions sont sous format binaire, c'est-à-dire qu'on évalue si le plan inclut ou non un élément en lien avec l'accessibilité. Chaque document obtient donc un score final de 0 à 20.

Ce cadre a ensuite été utilisé pour analyser 40 documents de planification du territoire ou des transports au Canada. D'abord, dix villes canadiennes ont été sélectionnées en choisissant les neuf plus peuplées et une dixième, Halifax, pour avoir un échantillon incluant les provinces maritimes. Tous les documents de planification du territoire et des transports effectifs dans ces villes ont été collectés en ligne pour être évalués. Ensuite, le cadre d'analyse a été appliqué par l'auteur de ce mémoire à chaque document.

En plus des superviseurs de l'auteur de ce mémoire, deux étudiants aux cycles supérieurs ainsi que le superviseur de l'un de ceux-ci ont contribué à l'écriture de ce premier article. Les étudiants aux cycles supérieurs ont utilisé le cadre d'analyse pour valider les résultats et réduire la subjectivité

associée avec la méthodologie déployée. Tous les coauteurs ont ensuite relu l'article avant la soumission finale.

Un résultat important de la phase 2 concerne le niveau d'intégration élevé de l'accessibilité dans le PUM 2050 de la Ville de Montréal, ce qui a largement influencé le design de la phase 3. Dans le document, il est mentionné qu'il faut planifier le territoire et les transports pour « que tous les Montréalais et les Montréalaises aient un accès suffisant aux ressources du quotidien, peu importe leur quartier de résidence, le moment de la journée, leur statut socioéconomique ou leurs capacités individuelles » (Ville de Montréal, 2024). Ce constat est directement analogue au concept d'accessibilité. On peut également observer que le document est axé sur l'accessibilité avec quatre cibles chiffrées : (1) la ville des 15 minutes, (2) l'accès aux centres d'emplois, (3) l'accès aux parcs et (4) l'accès aux bibliothèques.

3.3 Études de cas (Article 2)

Les résultats de la phase 2 indiquent que la Ville de Montréal et ses arrondissements sont un contexte propice à l'implantation de l'accessibilité comme outil de planification. Alors, dans cette troisième phase, une méthodologie axée sur trois ateliers participatifs a été développée pour atteindre le deuxième sous-objectif de recherche de ce mémoire. Considérant que cette étape impliquait de collaborer avec des professionnels, un certificat d'éthique a été obtenu. En collaboration avec le Service de l'urbanisme et de la mobilité (SUM) de la Ville de Montréal, des arrondissements potentiellement intéressés par cette démarche de recherche ont été contactés à l'hiver 2025 par courriel. Trois études de cas ont été réalisées auprès des organisations suivantes : (1) l'arrondissement de LaSalle, (2) l'arrondissement de Montréal-Nord, (3) le SUM et l'arrondissement Côte-des-Neiges–Notre-Dame-de-Grâces pour le projet Namur-Hippodrome. Ces arrondissements ont été choisis pour représenter des territoires ayant un développement urbain et des systèmes de transport variés. Les arrondissements de LaSalle et de Montréal-Nord font face à des défis semblables, comme la prédominance d'infrastructures automobiles et une offre de transport en commun insuffisante au sein de leur quartier. On peut également leur diagnostiquer un manque de commerces et de services de proximité. À l'opposé, le projet Namur-Hippodrome implique le développement d'un nouveau quartier sur le site de l'ancien Hippodrome de Montréal, à quelques pas de la station de métro Namur. À terme, le quartier accueillera des milliers de logements, ainsi qu'une diversité de services et de commerces. Un total de 16 professionnels ayant

des emplois variés au sein de leur arrondissement ou de la Ville de Montréal, incluant des ingénieurs en mobilité, des conseillers en aménagement, et des conseillers au développement économique sont rencontrés.

Pour chacune des trois études de cas, durant la première rencontre, un sujet d'analyse et des indicateurs d'accessibilité reliés sont définis selon les besoins actuels de l'arrondissement. Des cartes et des indicateurs d'accessibilité sont produits à la suite de cette première rencontre et présentés lors du deuxième atelier avec les professionnels. Le deuxième atelier sert à la création de scénarios en transport ou en urbanisme pour évaluer les impacts sur l'accessibilité. Lors du troisième atelier, les nouveaux indicateurs d'accessibilité sont présentés pour évaluer les gains d'accessibilité et donner suite aux scénarios modélisés. C'est également lors de cette rencontre qu'un retour est fait sur le processus des ateliers participatifs. Ces trois ateliers sont réalisés pour chacune des études de cas ($n=3$), ce qui implique un total de neuf ateliers participatifs. Les dates des ateliers sont présentées dans le Tableau 3.1, puis l'auteur de ce mémoire était accompagné de ses superviseurs et de membres de son laboratoire de recherche pour l'appuyer.

Tableau 3.1 Dates des études de cas

	Atelier #1	Atelier #2	Atelier #3
LaSalle	5 juin 2025	10 juillet 2025	14 octobre 2025
Montréal-Nord	11 juin 2025	17 juillet 2025	22 octobre 2025
Namur-Hippodrome	14 juillet 2025	28 octobre 2025	1 ^{er} décembre 2025

À travers les ateliers participatifs, tous les calculs d'accessibilité sont réalisés par l'auteur de ce mémoire avec le progiciel r5r et les cartes sont produites avec le logiciel QGIS. La première étape consiste à récolter les données nécessaires aux calculs sous la forme de quatre ensembles de données (voir Tableau 3.2) : réseau, origines, fichiers pour le transport en commun (si applicable) et destinations. Un code dans le langage de programmation R est ensuite produit pour nettoyer et traiter les données en vue des calculs d'accessibilité. Ce nettoyage automatisé permet d'exclure les destinations selon des critères définis en collaboration avec les professionnels rencontrés. À titre d'exemple, le nettoyage de la base de données des épiceries implique de retirer les commerces

fermés et tous ceux qui sont considérés comme des commerces alimentaires, mais qui ne permettent pas de faire une épicerie complète, comme les dépanneurs ou les épiceries spécialisées. D'autres sources de données (p. ex. OSM et REQ) et outils (p.ex. Google Maps) sont également utilisées pour corroborer cette première étape de nettoyage. Les sources de données complémentaires permettent d'identifier des lacunes avec les sources de données principales et les outils permettent de vérifier manuellement les propriétés des destinations. Dans le cadre des études de cas, les professionnels rencontrés ont choisi de définir des indicateurs d'accessibilité basés sur la localisation. Ces derniers impliquent de calculer l'accès aux destinations à partir d'une unité géographique (Geurs & van Wee, 2004), c'est-à-dire le lot résidentiel dans le cadre de cette étude. Les équations 3.1 et 3.2 permettent de calculer des indicateurs d'opportunités cumulées, un type de mesure basée sur la localisation.

$$A_i = \sum_j O_j f(C_{ij}) \quad (3.1)$$

$$f(C_{ij}) = \begin{cases} 1 & \text{if } C_{ij} \leq t \\ 0 & \text{if } C_{ij} > t \end{cases} \quad (3.2)$$

avec A_i qui représente le nombre de destinations accessibles pour le lot résidentiel i , O_j le nombre de destinations au point j , et $f(C_{ij})$ la fonction qui retourne 1 si le temps de déplacement C_{ij} est plus faible qu'un certain seuil t ou 0 s'il est plus haut.

Les destinations, présentées dans le Tableau 3.2, sont choisies selon les besoins et les priorités des arrondissements rencontrés. À la suite des calculs, les données d'accessibilité sont importées dans QGIS pour produire des cartes d'accessibilité dans l'objectif d'identifier des variations spatiales au sein des quartiers étudiés. D'autres détails sur les calculs d'accessibilité sont disponibles dans la section 5.4.4.

En ce qui a trait à la collecte de données, des groupes de discussions sont réalisés durant les trois ateliers pour évaluer les connaissances des professionnels sur l'accessibilité, leur perception du processus de recherche collaborative et leur vision sur les opportunités et barrières pour l'utilisation d'indicateurs d'accessibilité dans la planification urbaine. En plus des groupes de discussions, les autres sources de données récoltées incluent des observations réalisées par l'équipe de recherche et des données générées par les participants, comme des notes sur les cartes et indicateurs présentés.

À l'issue des ateliers participatifs avec les trois arrondissements, les données récoltées sont combinées dans un fichier texte pour les évaluer sous l'optique des questions de recherche définies. Les rencontres sont enregistrées et leur transcription est ajoutée audit fichier texte. Finalement, une analyse qualitative, suivant une approche déductive, des données est réalisée.

Tableau 3.2 Données récoltées pour le calcul des indicateurs d'accessibilité

Données	Source	Geométrie / type de fichier
<i>Réseau</i>		
Réseau routier	BBBike (Schneider, 2025)	Polylignes / .pbf
<i>Origines</i>		
Lots résidentiels	Ministère des Affaires municipales et de l'Habitation (Ministère des Affaires municipales et de l'Habitation, 2022)	Polygones / .shp
<i>Fichiers pour le transport en commun</i>		
General Transit Feed Specification (GTFS)	Société de transport de Montréal (Société de transport de Montréal, 2025)	Format GTFS
<i>Destinations</i>		
Écoles	Ministère de l'Éducation et Ministère de l'Enseignement supérieur (Ministère de l'Éducation et Ministère de l'Enseignement supérieur, 2017)	Points / .shp
Garderies	Ministère de la Famille (Ministère de la Famille, 2019)	Points / .csv
Parcs	Ville de Montréal (Ville de Montréal, 2019)	Polygones / .csv
Pharmacies	OpenStreetMap (OpenStreetMap contributors, 2025)	Points / .geojson
Épiceries	Ville de Montréal (Ville de Montréal, 2017)	Points / .shp
Hôpitaux	Ministère de la Santé et des services sociaux (Ministère de la Santé et des services sociaux, 2020)	Points / .shp
Commerces	OpenStreetMap (OpenStreetMap contributors, 2025)	Points / .geojson
Équipements collectifs	Ville de Montréal (Ville de Montréal, 2021)	Points / .shp

3.4 Synthèse des résultats

Pour conclure ce mémoire, les résultats des phases 2 et 3 ont été conjugués pour identifier des opportunités et des barrières à l'implantation d'une planification urbaine basée sur l'accessibilité. Cinq résultats communs aux deux articles ont été identifiés, ce qui démontre la complémentarité des deux approches. L'analyse de plans d'aménagement et de transport (article 1) a permis d'évaluer l'intégration actuelle de l'accessibilité dans les pratiques de différents types d'organisations. Les études de cas (article 2) ont ensuite permis de valider les résultats de la phase précédente, notamment en ce qui a trait aux indicateurs d'accessibilité et à l'implantation de l'accessibilité dans différentes organisations.

CHAPITRE 4 ARTICLE 1 : BEYOND BUZZWORDS: EVALUATING THE INTEGRATION OF ACCESSIBILITY GOALS AND INDICATORS IN LAND USE AND TRANSPORTATION POLICY DOCUMENTS

TRANSPORT POLICY – En ligne le 16 février 2026

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Abstract

Accessibility, defined as the ease of reaching destinations, is often framed as a paradigm shift in land use and transport planning. However, while widely known in research as a cornerstone of sustainable urban and transport systems, this concept has yet to be realized in planning practice. Many studies have assessed the integration of accessibility in policy documents, to evaluate the current state of practice and identify barriers to implementation. Yet, no study that looked at the

integration of accessibility in policy documents has assessed accessibility across documents published by different organization types and government levels. This study addresses this gap by examining how different documents define accessibility, whether they distinguish it from mobility, and the degree to which accessibility objectives are supported by indicators. We assessed 40 Canadian documents from land use and transport planning authorities, municipalities, and transit agencies using a 20 binary questions structured content analysis framework complemented by a qualitative content analysis. We find that municipal documents score higher than documents produced by transit agencies, especially in recent years. Further, the highest accessibility score (90%) is obtained by a municipal integrated land use and transport plan. In contrast, no transit agency document scored above 50% nor includes accessibility indicators. Many documents also reveal inconsistencies between stated objectives, governance structures, and implementation pathways. This research highlights the growing consideration of accessibility in policy documents, but there remains a need for all organizations involved in the planning of land use and transportation systems to better define accessibility indicators.

Keywords: accessibility, policy, transport, land use, planning, paradigm shift

4.1 Introduction

Mobility has dominated the planning of transportation systems and the transportation aspects of land use planning for decades, often focusing on facilitating high volumes of motor vehicle traffic (Banister, 2008). This planning approach has overlooked, and made it more difficult to address, what people need from transport and land use systems: access to destinations (Handy, 2020). While mobility focuses on movement, accessibility prioritizes the ease of reaching destinations of interest for all individuals (Geurs & van Wee, 2004). To facilitate the ease of reaching destinations, accessibility-based planning fosters the integration of transport systems with land use developments, typically prioritizing sustainable modes of transport (Handy, 2020). This paradigm centres human needs, contributes to sustainable cities, and mitigates the negative externalities of transport systems (Banister, 2008; Handy, 2020).

Accessibility has gained increasing attention in research. One stream of research has focused on how to measure accessibility, using transport and land use data. A variety of measures have been developed by researchers to compare accessibility of places and populations (e.g., Páez et al. (2012)), to evaluate the impact of transportation projects (e.g., Pereira et al. (2019)), to assess equity (e.g., El-Geneidy et al. (2016); Grisé et al. (2019)), and to model transport behaviour (e.g., Mehdizadeh and Kroesen (2025)). Despite this trend, land use and transport planning practices have been slow to adopt accessibility-based approaches.

Therefore, research has more recently focused on investigating the state of accessibility in practice. Many studies have assessed policy documents to evaluate the integration of concepts related to accessibility, namely, equity (Manaugh et al., 2015; Smith et al., 2025), active transportation (Magalhães et al., 2022), the last-mile problem (Bista et al., 2021) and the interaction between land use and transportation (Lopes et al., 2020). Three studies have specifically assessed the integration of accessibility in transport or integrated development plans, focusing on one type of document (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025). This suggests a gap in the literature, as accessibility planning involves different levels of governance and different sectors. To the authors' knowledge, no study has (i) compared the integration of accessibility into different types of documents (e.g., land use planning, transportation planning, transit, mobility) and (ii) assessed multiple documents applicable within the same municipality.

To address these gaps, this study seeks to (i) evaluate the integration of accessibility in land use and transport policy documents, (ii) compare how accessibility is considered across different organization types (i.e., land use planning authorities, transportation planning authorities, municipalities, and transit agencies), (iii) and across different government levels (i.e., municipal, metropolitan, and provincial), and (iv) evaluate how consistently accessibility is addressed within each municipality. To achieve this, we first develop a quantitative content analysis coding framework to assess the integration of accessibility using 20 binary questions classified into six categories: definition, transport component, land use component, individual component, temporal component, and indicators. A total of 40 documents from Canadian municipalities, land use planning authorities, transportation planning authorities, and transit agencies are assessed and compared with this framework. Second, through a qualitative content analysis, key segments from the documents are analyzed. The quantitative and qualitative results provide insights for researchers and planning authorities to support the integration of accessibility into policy documents.

4.2 Literature review

4.2.1 Accessibility

Accessibility is a central indicator for integrated land use and transport planning (Handy, 2020; Levine, 2020), since accessibility directly responds to the needs of individuals, and higher levels of accessibility have been associated with higher participation in activities (Tao et al., 2022) and well-being (Forster et al., 2023; Makarewicz & Németh, 2018). Accessibility comprises four components: individual, transport, temporal, and land use components (Geurs & van Wee, 2004).

Accessibility can be measured in different ways, and these measures are categorized in four main groups: infrastructure-based (i.e., network performance), location-based (i.e., opportunity counts), person-based (i.e., individual constraints), and utility-based (i.e., perceived benefit) (Geurs & van Wee, 2004). In practice, location-based measures are the most common and usually consider the number or quality of destinations accessible from an origin (Boisjoly & El-Geneidy, 2017b). The simplest version of these, the cumulative-opportunity measures, counts the number of opportunities accessible within a specific cost threshold (e.g., travel time, distance, or monetary) (El-Geneidy & Levinson, 2006). The gravity-based measures avoid the definition of such threshold by weighting opportunities according to their travel cost, with closer opportunities contributing

more than distant ones (El-Geneidy & Levinson, 2006). Another possibility is to measure the travel time to the nearest destination (i.e., minimum travel cost) (Papa et al., 2016). A challenge resides in the choice of accessibility indicators, since the most theoretically-sound measures are often the hardest to communicate and operationalize (Boisjoly & El-Geneidy, 2017a). Past research has identified a strong correlation between gravity-based and cumulative-opportunity measures, justifying the use of the latter considering their ease of operationalization and communication (Kapatsila et al., 2023). As such, in planning practice, with few exceptions, only the cumulative-opportunity measures are used (Boisjoly & El-Geneidy, 2017a; Papa et al., 2016).

Researchers have also identified a variety of transport and land use factors supporting accessibility. Increasing sustainable accessibility can be attained with new transport services, but also with land use improvements. Key elements of accessibility include mixed-use development (close destinations require shorter trips), density of population (reduces trip length and encourages active transportation), and multiple transport mode options (mode choice is rationalized) (Banister, 2008; Gil Solá et al., 2018). These elements are parts of transit-oriented development (TOD), which aims to concentrate the development of residences, jobs and commerce (i.e., destinations) around a structured public transport network. This integrated land use and transport strategy directly improves the local accessibility (through opportunities surrounding TODs) and regional accessibility (through long-distance opportunities with public transport) of residents (Papa & Bertolini, 2015).

A further dimension of accessibility research concerns its role in measuring how benefits (i.e., outcomes) of new land use or transportation projects are distributed across population groups. Researchers have developed a range of equity-oriented frameworks targeted at the distribution of accessibility including sufficientarian (i.e., everyone should reach a minimum acceptable level) and egalitarian (i.e., unjust disparities between groups should be reduced) approaches (Rowangould et al., 2024). From a practical perspective, planners increasingly rely on tools to evaluate who benefits from accessibility improvements, to avoid relying on the traditional cost-benefit analysis conducted in transportation planning. These new methods include multi-criteria decision analysis (te Brömmelstroet et al., 2016) and scenario-based frameworks (Hull et al., 2012) to compare accessibility changes and their equity implications.

4.2.2 Accessibility in planning

In the last decade, many studies have assessed the shift from a mobility to an accessibility paradigm in transport and land use planning. Studies have typically employed three methods: (i) interviewing or surveying practitioners to identify the best practices and barriers to implementation (Boisjoly & El-Geneidy, 2017b; Gil Solá et al., 2018; Rowangould et al., 2024) (ii) evaluating the integration of accessibility tools in planning practice (Papa et al., 2016; te Brömmelstroet et al., 2016) and (iii) analyzing strategic documents to evaluate the integration of accessibility in transport policy (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025). Particularly relevant to this study is the COST Action TU1002, a European initiative that aimed to evaluate and improve the usability of accessibility tools in planning (see Hull et al. (2012); Silva et al. (2019)).

Through interviews and surveys with planners from the Global North, researchers have identified multiple barriers (e.g., technical, political, organizational) practitioners face when trying to implement accessibility. Even though they value the concept as highly relevant for planning land use and transport systems, they face many challenges (Rowangould et al., 2024). From a technical perspective, practitioners often lack the necessary knowledge (e.g., accessibility theory, accessibility computation methods) to implement relevant accessibility indicators into their land use and transport analyses (Boisjoly & El-Geneidy, 2017b). Even when encouraged to generate accessibility indicators, the lack of data, in terms of quality and quantity, and appropriate software can be a limitation (Boisjoly & El-Geneidy, 2017b; Rowangould et al., 2024). Moreover, they often lack the time to overcome these barriers through training (Rowangould et al., 2024), since they have other tasks to fulfill and the implementation of accessibility is not a priority. In line with this, due to the limited staff and technical resources available, practitioners often prioritize measures required by government agencies, such as reducing congestion in the United States context (Rowangould et al., 2024). In some instances, individuals have implemented accessibility indicators in their organization's practice on their own initiative (Boisjoly & El-Geneidy, 2017b). These previous studies looked at the use of accessibility instruments by different organizations, but not how it was integrated in the strategic documents of said organizations.

Studies have also assessed the integration of the accessibility concept and its indicators in plans from transport and land use governmental agencies (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025). Boisjoly and El-Geneidy (2017a) assessed 32 documents from transport

agencies in Asia, Australia, Europe and North America using a qualitative content analysis method. Results show that most documents discuss accessibility, but the concept is rarely defined and sometimes used as a buzzword. This gap leads to a low presence of accessibility indicators and targets. Some accessibility objectives are also associated with measures unrelated to accessibility. Accordingly, the authors conclude that a shift towards accessibility planning is observable, but the lack of accessibility indicators impedes a full transition to decision-making based on accessibility rather than mobility.

Proffitt et al. (2019) quantitatively assessed the integration of accessibility in Regional Transportation Plans published by 42 Metropolitan Planning Organizations in the United States. The authors developed a content analysis coding framework, and the plans were scored using a binary (yes, no) scoring approach. The framework evaluated if the plans focused on mobility or accessibility. The authors observe that few documents include a working definition of the accessibility concept or accessibility performance measures, which was mirrored by findings by Boisjoly and El-Geneidy (2017a). Conversely, reducing congestion (a measure of mobility) is still defined as the primary objective in the plans.

Building on the Proffitt et al. (2019) study, Tuffour et al. (2025) assessed the mobility to accessibility paradigm shift in Ghana. This study, one of the few from the Global South, analyzed 52 development plans from metropolitan areas, municipalities, and districts, as well as the National Transportation Policy framework. Results showed that a majority of documents do not define accessibility, and most use the accessibility and mobility terms interchangeably. Differences in accessibility scores are also observed between the different assembly (i.e., government) levels. On average, metropolitan documents scored the highest, followed by municipal, and district assemblies. As found in previous research (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019), a gap exists between the vision presented in the Ghanaian documents and the defined indicators.

The lack of accessibility integration in policy documents is often accompanied by governance misalignment. To promote accessibility-based planning, the concept of accessibility must be understood and articulated through actions that are logically connected to goals (Pei et al., 2010), while being measured by indicators (Gudmundsson, 2003). This is especially challenging given the multiple levels of sectors and governance involved when considering accessibility (Rode & da Cruz, 2018). First, there exists a discrepancy between organizations planning transport and those

responsible for urban development (Tremblay-Racicot, 2023). Second, the lack of coordinating efforts to promote accessibility at different government levels, namely local and regional accessibility has been identified by past research (Handy, 2020). Findings show that local governments have typically focused on place-based projects and higher levels have focused on larger scale movements projects (Veeneman & Mulley, 2018). Due to this mismatch between governance levels, there can be inconsistent application and lack of coordination between authorities.

While the accessibility paradigm involves actors from every government level and different planning sectors (land use, transport and transit planning), little is known about how accessibility is integrated across these different levels and sectors. Addressing this gap in the literature is instrumental in supporting accessibility-based planning, given that the mismatch between scales has been identified as a barrier to the accessibility paradigm shift (Handy, 2020; Levine et al., 2019). Past research has assessed accessibility integration in planning documents, but only in one type of document (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025).. Since roles and responsibilities of organizations vary, it is expected that these empirical findings are limited in scope considering they do not assess the variability between distinct document types. Moreover, by evaluating one document per city, these past studies also neglect the numerous documents in effect in each municipality, and how they jointly (or not) integrate accessibility. This study, therefore, contributes to filling this gap by assessing and comparing a variety of policy documents across and within municipalities. It first identifies differences in the integration of accessibility between organizations (e.g., municipalities, transit agencies, metropolitan planning organizations). Second, it assesses how different organizations overseeing the same city integrate accessibility in their planning processes. In doing so, this analysis offers a more comprehensive understanding of the factors hindering the paradigm shift in policy documents, while identifying promising avenues for researchers and planners.

4.3 Context and methods

4.3.1 The Canadian context

In Canada, land use and transportation responsibilities are shared between the federal, provincial, metropolitan, municipal and local governance levels. Each level has its competencies and scope of

action. In addition to the governmental actors, public transport is also administered by distinct entities (i.e., transit agencies).

The provincial governments administer highways and roads while controlling some transportation and land use legislation. They also support local transport projects through funding programs (Tremblay-Racicot, 2023), and they have created metropolitan transport agencies such as Metrolinx (Ontario) and the Autorité régionale de transport métropolitain (ARTM; Quebec) in large metropolitan regions. The power of these regional or metropolitan agencies varies by province as they are intermediary governance bodies. They often coordinate land use and transport planning across municipalities. Some metropolitan organizations oversee the integration of public transport services from different agencies and manage fare systems.

In contrast, a primary competency of municipalities is the planning of active transportation networks (Tremblay-Racicot, 2023). Most Canadian municipalities have published active transportation master plans to guide the development of the cycling and walking networks. Funding for these projects may come from higher levels of government, but ultimately, municipalities are responsible for their development. Even though most municipalities do not directly manage public transport, they can fund a large share of the operating subsidies of transit agencies (Tremblay-Racicot, 2023). Municipalities are also responsible for a majority of local roads.

4.3.2 Policy documents

In this study we collected 40 documents published by organizations at the provincial, metropolitan and municipal levels from 10 of the most populous municipalities in Canada, as done by Cui et al. (2020). Documents were collected from six provinces representing distinct geographical and cultural contexts: British Columbia, Alberta, Manitoba, Ontario, Quebec, and Nova Scotia. Note that documents from federal agencies and municipal boroughs/wards were not analyzed as their policies and competencies provide only limited consideration of accessibility. Moreover, not all Canadian cities have a structure composed of municipal boroughs with distinct planning groups. Table 4.1 summarizes the distribution of organizations included in this study. We sampled 27 documents from 10 municipalities (at the municipal level), 11 documents from 7 metropolitan areas (census metropolitan areas, CMAs), and two provincial documents produced in two provinces. Municipalities and metropolitan areas were selected based on population size and geographic distribution. Thus, the nine most populous metropolitan areas were selected as well as the 14th

(Halifax) (Statistics Canada, 2022, 2026), to include the eastern provinces, as done in previous Canadian studies (see Cui et al. (2020); Higgins et al. (2025)). For each selected municipality, all land use and transportation documents in effect were collected.

Table 4.1 Distribution and sampling of documents collected for this study¹

	Municipal	Metropolitan (CMA)	Provincial
Total number of entities in Canada	5162	41	10
Number of entities sampled	10	7	2
Number of documents collected	27	11	2
% of the population	48	48	26

Documents were grouped into six categories based on the issuing organization and focus: land use planning authorities, transportation planning authorities, municipalities (integrated land use and transport documents), municipalities (land use documents), municipalities (transport documents) and transit agencies. The 40 documents collected are presented in Table 4.2, organized by municipality. In addition to the organization and document names, the year of publication, the government level of the organization and the document type are also presented.

The differences in organization types also reflect the distinct legal mandates and planning responsibilities of each organization (Tremblay-Racicot, 2023). Metropolitan agencies are responsible for planning and coordinating regional transportation and land use. This influences how they approach accessibility, which is typically at a larger scale, assessing regional integration, and multimodality. Municipalities, on the other hand, hold authority over land use and transportation planning (Tremblay-Racicot, 2023). They frame accessibility through certain legal mandates, namely zoning, the distribution of services, and active mobility infrastructure. In the Canadian context, public transit agencies oversee service operations. They were included in the study, as they may not currently have the possibility to influence urban development, but accessibility indicators can still inform and contribute to public transport decision-making. Accessibility outcomes depend on both land use interventions and transportation services. Transit

¹ Le pourcentage de la population est calculé selon le nombre d'habitants des entités considérées par rapport au total canadien. Au niveau municipal, par exemple, les 10 municipalités considérées représentent 48% de la population. Par contre, au niveau provincial, seulement les provinces du Québec et de la Nouvelle-Écosse, avec des documents à Montréal/Québec et Halifax respectivement sont analysés, ce qui donne un total de 26% de la population canadienne.

agencies influence the latter through service design and network planning. Increasing accessibility could be a strategy for transit agencies to increase ridership, as shown by previous research (Merlin et al., 2021).

Table 4.2 Land use and transport policy documents examined in this study (n=40)

Organization name	Document name	Year	Government level	Document type
1. Calgary Metropolitan Region Board	Growth Plan (Calgary Metropolitan Region Board, 2022)	2022	Metropolitan	Land use planning authorities
2. City of Calgary	Municipal Development Plan (City of Calgary, 2024)	2024	Municipal	Municipalities (land use documents)
3. City of Calgary	Calgary Transportation Plan 2020 (City of Calgary, 2020)	2020	Municipal	Municipalities (transport documents)
4. Calgary Transit	RouteAhead: A Strategic Plan for Transit in Calgary (2023) (Calgary Transit, 2023)	2023	Municipal	Transit agencies
5. Edmonton Metropolitan Region Board	Edmonton Metropolitan Region Board Growth Plan (Edmonton Metropolitan Region Board, 2017)	2017	Metropolitan	Land use planning authorities
6. Edmonton Metropolitan Region Board	Integrated Regional Transportation Master Plan (Edmonton Metropolitan Region Board, 2021)	2021	Metropolitan*	Transportation planning authorities
7. City of Edmonton	Edmonton City Plan (City of Edmonton, 2020)	2020	Municipal	Municipalities (land use documents)
8. City of Edmonton	Transportation Master Plan (City of Edmonton, 2009)	2009	Municipal	Municipalities (transport documents)
9. City of Edmonton	Edmonton Transit Strategy (City of Edmonton, 2017)	2017	Municipal	Transit agencies
10. Halifax Regional Municipality	Regional Municipal Planning Strategy (Halifax Regional Municipality, 2014)	2014	Metropolitan*	Land use planning authorities

Table 4.2 Land use and transport policy documents examined in this study (n=40) (suite)

11. Government of Nova Scotia	Choose how you move: Sustainable Transportation Strategy (Government of Nova Scotia, 2013)	2013	Provincial	Transportation planning authorities
12. City of Halifax	Integrated Mobility Plan (City of Halifax, 2017)	2017	Municipal	Municipalities (transport documents)
13. Halifax Transit	Moving Forward: Together Plan (Halifax Transit, 2014)	2014	Municipal	Transit agencies
14. City of Hamilton	Urban Hamilton Official Plan (City of Hamilton, 2013)	2013	Municipal	Municipalities (land use documents)
15. City of Hamilton	Transportation Master Plan (City of Hamilton, 2022)	2022	Municipal	Municipalities (transport documents)
16. City of Hamilton	Ten Year Local Transit Strategy (City of Hamilton, 2015)	2015	Municipal	Transit agencies
17. Communauté métropolitaine de Montréal (Montreal Metropolitan Community)	Plan métropolitain d'aménagement et de développement (Communauté métropolitaine de Montréal, 2012)	2012	Metropolitan	Land use planning authorities
18. Autorité régionale de transport métropolitain (ARTM; Montreal Regional Metropolitan Transport Authority)	Plan stratégique de développement du transport collectif 2025-2034 (Autorité régionale de transport métropolitain, 2024)	2024	Metropolitan	Transportation planning authorities
19. Ministère des Transports et de la Mobilité durable (Quebec Ministry of Transport)	Politique de mobilité durable – 2030 (Ministère des Transports et de la Mobilité durable, 2018)	2018	Provincial	Transportation planning authorities
20. Ville de Montréal (City of Montreal)	Plan d'urbanisme et de mobilité 2050 (Ville de Montréal, 2024)	2025	Municipal	Municipalities (integrated land use and transport documents)

Table 4.2 Land use and transport policy documents examined in this study (n=40) (suite)

21. Société de transport de Montréal (Montreal transit agency)	Plan stratégique organisationnel 2030 (Société de transport de Montréal, 2023)	2023	Municipal	Transit agencies
22. Exo	Plan stratégique organisationnel 2021-2027 (Exo, 2021)	2021	Metropolitan	Transit agencies
23. City of Ottawa	Official Plan (City of Ottawa, 2022)	2022	Municipal	Municipalities (land use documents)
24. City of Ottawa	Transportation Master Plan Policies and TMP Capital Infrastructure Plan (City of Ottawa, 2023)	2023	Municipal	Municipalities (transport documents)
25. OC Transpo	Transit Services Five-Year Roadmap (OC Transpo, 2019)	2019	Municipal	Transit agencies
26. Communauté métropolitaine de Québec (Quebec City Metropolitan Community)	Bâtir 2031 : Le Plan métropolitain d'aménagement et de développement du territoire de la Communauté métropolitaine de Québec (Communauté métropolitaine de Québec (CMQ), 2013)	2013	Metropolitan	Land use planning authorities
27. Ville de Québec (City of Quebec)	Schéma d'aménagement et de développement (Ville de Québec, 2019)	2019	Municipal	Municipalities (land use documents)
28. Ville de Québec (City of Quebec)	Plan de mobilité durable (Ville de Québec, 2011)	2011	Municipal	Municipalities (transport documents)
29. Réseau de transport de la Capitale (Quebec City transit agency)	Plan stratégique 2018-2027 du RTC (Réseau de transport de la Capitale (RTC), 2018)	2018	Municipal	Transit agencies
30. Metrolinx	2041 Regional Transportation Plan (Metrolinx, 2018)	2018	Metropolitan	Transportation planning authorities

Table 4.2 Land use and transport policy documents examined in this study (n=40) (suite)

31. Ontario Ministry of Transportation	Connecting the GGH: A Transportation Plan for the Greater Golden Horseshoe (Ontario Ministry of Transportation, 2022)	2022	Metropolitan**	Transportation planning authorities
32. City of Toronto	Official Plan (City of Toronto, 2024)	2024	Municipal	Municipalities (land use documents)
33. Toronto Transit Commission	2024-2028 Corporate Plan (Toronto Transit Commission, 2024)	2024	Municipal	Transit agencies
34. Metro Vancouver	Metro 2050: Regional Growth Strategy (Metro Vancouver, 2022)	2022	Municipal	Land use planning authorities
35. Translink	Transport 2050 (Translink, 2022)	2022	Metropolitan	Transportation planning authorities
36. City of Vancouver	Vancouver Plan (City of Vancouver, 2022)	2022	Municipal	Municipalities (land use documents)
37. City of Vancouver	Transportation 2040 Plan (City of Vancouver, 2012)	2012	Municipal	Municipalities (transport documents)
38. City of Winnipeg	OurWinnipeg 2045 (City of Winnipeg, 2022)	2022	Municipal	Municipalities (land use documents)
39. City of Winnipeg	Transportation Master Plan: 2050 (City of Winnipeg, 2024)	2024	Municipal	Municipalities (transport documents)
40. Winnipeg Transit	Winnipeg Transit Master Plan (Winnipeg Transit, 2021)	2021	Municipal	Transit agencies

(*): Regional and metropolitan are terms used interchangeably. These documents were classified as “metropolitan” documents.

(**): This document was published by the Ontario Ministry of Transportation (provincial) but only discusses the Toronto region, known as the Greater Golden Horseshoe (GGH). It was classified as “provincial” since it was published by a provincial agency.²

² À noter que ce plan est finalement considéré comme un plan « métropolitain » et que la note au bas du tableau ne s'applique plus.

4.3.3 Content analysis framework

To evaluate the integration of accessibility in the policy documents, we used a content analysis framework adapted from Handy (2005) and Proffitt et al. (2019) and tailored to the Canadian context and the study objectives. The content analysis framework is presented in Table 4.3. The initial framework includes four categories (definition, goals, project selection, and indicators) with a total of 14 questions. The adapted framework consists of six categories (definition and vision of accessibility, transport component, land use component, individual and equity component, temporal component, and indicators) with a total of 20 questions. The goals section from the Proffitt et al. (2019) study was dissected into the four accessibility components found in Table 4.3. Questions for the land use and temporal components were added, as questions in the initial framework only evaluated the transport and individual components. The rationale behind the design of each question is presented in Table 4.3 and discussed in the next subsections. Questions in gray were added to the framework or substantially modified compared to the Proffitt et al. (2019) framework, whereas questions in white were kept identical.

The framework questions were also classified as means, societal outcomes or representing the accessibility shift (i.e. accessibility-based planning) as shown in Figure 4.1. This conceptual diagram was developed based on the content of the book *From Mobility to Accessibility* (Levine et al., 2019). Levine et al. (2019) argue that accessibility-based planning should not be conflated with possible means to achieve it, or outcomes of this shift. For instance, question #16 (on the definition of an indicator measuring accessibility to destinations) is inherently accessibility-based planning (i.e., the accessibility shift). A municipality, transport, or land use agency planning to increase the number of destinations accessible by its population would be, by definition, planning based on accessibility. However, other questions, such as question #8, assess possible means to attain accessibility-based planning: Do any of the goals promote or rely on mixed-use development in neighborhoods? As such, past research has argued that dense neighborhoods can promote “proximity-centred accessibility” (Silva et al., 2023). It is not considered accessibility-based planning, since increased density and proximity can degrade mobility, and thus, in some instances, reduce accessibility (Levine et al., 2019). The same logic applies to the societal outcomes of accessibility-based planning, which are not equivalent to the accessibility shift. These include VKT

reductions (question #15) and equity improvements (question #12). It is expected that accessibility-based planning would reduce transport-related inequities, but equity improvements could still be achieved with mobility-based planning. Conversely, accessibility improvements could also increase transport-related inequities depending on their socio-spatial distribution.

This classification results in respectively, 4, 10, and 6 questions for the means to achieve accessibility, accessibility-based planning (shift), and societal outcomes. Most questions classified as accessibility-based planning are found in the accessibility definitions and accessibility indicators (7/10), as expected, while questions evaluating means or outcomes of accessibility-based planning are spread across the different categories. Questions #10 and #11 were categorized as accessibility-based planning, since their framing involves the evaluation of accessibility disparities. While they also relate to equity outcomes, the focus is on the accessibility improvements.

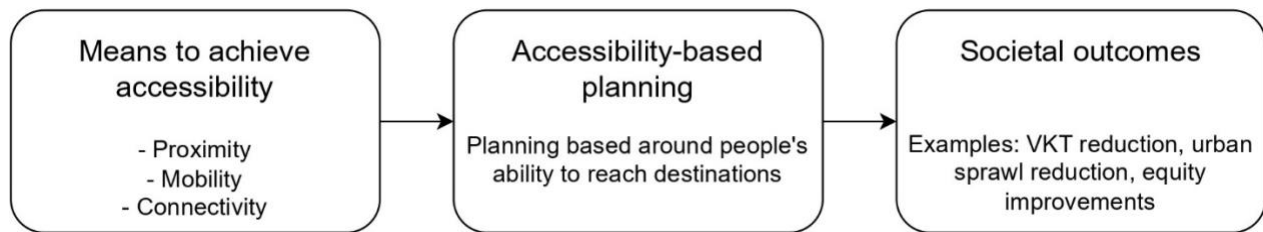


Figure 4.1 Conceptual diagram of accessibility-based planning

When assessing the policy documents, raters read the whole document and searched for key terms, phrases and concepts. Each question was answered based on a binary scoring system (yes/no), meaning a document could obtain a score from 0 to 20. The binary scoring approach reduces subjectivity associated with categorical scoring. Two different raters assessed the integration of accessibility using the content analysis framework presented in Table 4.3. Both raters evaluated all documents. To ensure the validity of the results, interrater reliability was measured with Cohen's Kappa. This statistical measure is used to assess the degree of agreement between two raters, while accounting for chance or randomness. A score of 1 indicates perfect agreement, while 0 implies agreement equivalent to chance. We obtained a value of 0.708 (similar to the Proffitt et al. (2019) value of 0.68). This corresponds to a substantial level of agreement (Landis & Koch, 1977), supporting the validity of the accessibility scores. Then, we completed a reconciliation protocol to review every disagreement between the raters and identify the appropriate score.

Table 4.3 Content analysis framework for the evaluation of accessibility integration

Category	ID	Question	Rationale	Key terms, phrases, concepts	Means, shift or outcomes
Definition and vision of accessibility	1	Does the plan explicitly define accessibility as the ease of reaching destinations?	A working definition of accessibility is key to planning for accessibility.	‘Accessibility’ is explicitly defined. How?	Shift
	2	Does the definition include reference to both land use and transportation integration?	Accessibility depends on both land use and the transportation infrastructure.	‘Land use’ and ‘transport’ are mentioned jointly.	Means
	3	Is accessibility linked to broader environmental or social goals?	Alignment ensures consistency with broader goals, since accessibility influences the sustainable development of cities.	Sustainable development, sustainability, SDGs, durability, complete communities	Outcomes
	4	Do any of the goals reflect a focus on the ease of reaching destinations/engaging in activities?	Making it easier to engage in activities – rather than simply making it easier to travel – indicates a focus on ends rather than means.	Goal(s) mention ‘origins’, ‘destinations’, or specific locations. They recognise activities that create the demand for travel.	Shift
Transport component	5	Do any of the goals focus on reducing the need for travel?	Reducing the need for travel requires coordinating transportation and land use planning to reduce auto-mobility, associated emissions, and demand for roadway capacity.	Travel reduction, demand management, reduce VKT/travel.	Outcomes

Table 4.4 Content analysis framework for the evaluation of accessibility integration (suite)

	6	Do any of the goals focus on increasing travel options (i.e. multiple modes, including non-motorised modes)?	Increasing travel options uncouples accessibility and roadway capacity.	Multimodal, non-motorised, transit, mode split, mode choice.	Outcomes
	7	Do any of the goals aim to reduce automobile use or highlight the benefits of such a shift?	Reducing automobile dependence promotes access to destinations with other modes of transportation.	Reduced car dependence, modal shift	Outcomes
Land use component	8	Do any of the goals promote or rely on mixed-use development in neighborhoods?	Mixed-use neighborhoods inherently improve accessibility by reducing distances between origins and destinations of interest.	Mix-used development (multiple uses), zoning, X-minute city, Transit-oriented development	Means
	9	Do any of the goals recognize how density contributes to improving accessibility?	Compact development reduces trip distances and encourages sustainable modes.	Density, densification, compact development	Means
	10	Do any of the goals contribute to accessibility improvements across underserved areas (e.g., suburban or peri-urban)?	Improving access in areas that are often poorly served by transport and land use investments addresses spatial equity.	Spatial inequity, transport poor neighborhoods, transport divide	Shift
Individual and equity component	11	Do any of the goals contribute to addressing accessibility disparities (e.g., low-income, age, disabled)?	Addressing disparities ensures equitable accessibility.	Vulnerable groups (low-income, age, carless), gender differences in travel behaviour, transport poverty	Shift

Table 4.5 Content analysis framework for the evaluation of accessibility integration (suite)

	12	Do any of the goals include language on meeting the needs of individuals and specific population groups (as opposed to system performance)?	Determining the transportation needs of individuals and groups is a prerequisite to evaluating how well the existing system serves them.	Goal(s) define or highlight specific population groups or neighbourhoods. Goal(s) tie service to people, not vehicles. Goal(s) mention equity.	Outcomes
Temporal component	13	Do any of the goals contribute to accessibility improvements at different times of the day (e.g., peak vs. off-peak transit service)?	Transport policies typically focus on peak-hour service but fail to address off-peak accessibility.	Non-commuter travel, Peak vs.off-peak service levels	Shift
Indicators	14	Do any of the indicators assess the integration of land use and transportation strategies?	When transportation strategies are considered in isolation, land use decisions are often made by default.	The plan uses quantitative or qualitative indicators to assess the linkage between land use and transportation.	Means
	15	Do any of the indicators focus on VKT (vehicle kilometers traveled) reduction?	A place where people can accomplish everyday tasks with less driving is more accessible than a place where people drive more.	Projects are selected/prioritised by their effect on VKT.	Outcomes
	16	Do any of the indicators include the share of jobs or other destinations within a specific travel time or distance (reflecting the ease of reaching destinations)?	Cumulative opportunity measures, gravity measures, and time/distance to the closest destinations(s) are the most common methods of quantifying location and personal accessibility.	The plan evaluates/prioritises projects by calculating their effect on the number of jobs or other destinations available within a given travel time.	Shift

Table 4.6 Content analysis framework for the evaluation of accessibility integration (suite)

17	Does the plan use isochrone (e.g., "X% of residents can reach a school within 15 minutes") or accessibility maps?	Accessibility isochrone maps display spatial disparities and accessibility.	Accessibility, and isochrone maps	Shift
18	Are access to destinations indicators accompanied by measurable targets?	Having clear accessibility targets ensures that accessibility is an objective and not only used as a "buzzword".	"Increase accessibility by X%", "Ensure that X% of the population can reach Z within Y minutes"	Shift
19	Do the indicators include access to non-work destinations (e.g. education, healthcare, or parks)?	Many plans emphasize commuting (home-to-work) trips, but true accessibility encompasses all daily activities.	The plan evaluates/prioritises projects by calculating their effect on the number of non-work destinations available within a given travel time.	Shift
20	Do the indicators assess accessibility outcomes for specific population groups (e.g., low-income, older adults, disabled people)?	Measuring accessibility for specific population groups ensures that indicators capture equity outcomes.	The plan evaluates/prioritises projects by calculating their effect on the number of destinations available for specific groups of the population.	Shift

Note: Questions in white were designed by Proffitt et al. (2019), while questions in gray were added or significantly modified from the original framework.

4.3.3.1 Category 1: Definition and vision of accessibility

The definition of accessibility category includes four distinct questions. Question 1 assesses if a working definition of accessibility is presented in the document. In comparison to the Proffitt et al. (2019) framework, the question is adapted to specifically verify that accessibility is defined as the ease of reaching destinations, opportunities or services.

The two following questions were added to validate that the definition includes a reference to the land use and transport components, and a link to broader environmental or social goals respectively. These questions assess the accessibility paradigm shift, as discussed by Banister (2008) who argues for a greater consideration of the social and environmental aspects in comparison to the historical emphasis on economic evaluation. A question from the initial framework, to assess if accessibility was only considered alongside mobility, was removed. The first three questions evaluate if accessibility is clearly defined, and in this study, every document that included a proper definition of the accessibility concept, reflecting the ease of reaching destinations, avoided conflation with mobility. Other planning documents could define accessibility as the ‘ease of reaching destinations’ while considering accessibility alongside mobility. Since this was not the case in the studied documents, the question from the initial framework was removed to avoid duplication of the scores.

The last question of this category assesses whether any accessibility goals are stated in the policy document. This question assesses the documents’ focus on enabling the population to reach destinations of interest, in contrast to simply making it easier to travel. This question was taken directly from the Proffitt et al. (2019) framework and is also in line with previous research (Boisjoly & El-Geneidy, 2017a, 2017b) who found that the presence of accessibility goals in policy documents is a key factor supporting the adoption of accessibility indicators by practitioners.

4.3.3.2 Category 2: Transport component

The transport component is evaluated using three questions on reducing the need for travel, increasing multimodality and reducing automobile use. They refer mainly to the transportation modes used and number of trips, not strictly to the transport component of accessibility as defined by Geurs and van Wee (2004). The first two questions are taken directly from the Proffitt et al. (2019) content analysis framework. The first assesses if a goal focuses on reducing trips, which

would lead to lower environmental impacts (by transportation systems) (Banister, 2008). The second assesses if any goals focus on increasing service offering of sustainable transportation modes. Having access to different transportation modes can allow individuals to reach local destinations (e.g., parks, grocery stores, drug stores) by active modes, and regional destinations of interest (e.g., jobs and schools) by public transport.

In the Proffitt et al. (2019) framework, the third question related to the transport component assessed if reducing congestion was a stated goal. The authors argue that prioritizing reducing congestion indicates a focus on mobility. Since reducing congestion was seldom stated as a goal in Canadian documents, the question was reframed to assess whether a goal focuses on reducing automobile use. In fact, accessibility-based planning usually leads to the prioritization of active and collective modes over cars (Banister, 2008; Bertolini et al., 2005).

4.3.3.3 Category 3: Land use component

The three questions on land use were designed to address gaps in the framework developed by Proffitt et al. (2019). Improvements to transportation infrastructure and services are only one of the ways to increase the population's accessibility. Designing dense and mixed-use communities, combined with strategies to support the population's ability to move (i.e., mobility) through these communities, can lead to increased accessibility, for example through the design of TODs and 15-minute cities (Papa & Bertolini, 2015).

In line with land use interventions, questions 8 and 9 assess the presence of goals related to the mixed-use development and population density, respectively. Goals to promote mixed-use development and higher densities are directly related to the "proximity" aspect of accessibility (Gil Solá et al., 2018), as having access to local destinations reduces the need for long, resource-heavy and pricy trips.

The third question analyzes whether any goals contribute to accessibility improvements across areas outside of central neighborhoods. In fact, some suburban and peri-urban boroughs often face accessibility barriers as more resources are allocated towards urban centers and also given the historical design of the land use and transport systems (Banister, 2011).

4.3.3.4 Category 4: Individual component

The individual component of accessibility is assessed with two questions, a new one addressing accessibility disparities between groups of population (e.g., older adults, low-income households) and a second one taken from Proffitt et al. (2019) on the consideration of the population's needs (and not only the performance of transport systems).

Accessibility indicators are often calculated spatially (i.e., location-based), meaning that they represent the access to destinations for individuals living in a specific area without considering the needs and characteristics of their respective inhabitants (Negm et al., 2025). Even though some boroughs with different socio-economic conditions might have similar levels of accessibility, some researchers argue that resources should be allocated towards population groups who are limited in their activity participation due to their lack of accessibility (Pereira et al., 2017). Moreover, the second question evaluates if meeting the needs of individuals is discussed in any goals rather than solely system performances.

4.3.3.5 Category 5: Temporality

Temporality is assessed with one question to evaluate the presence of goals related to the improvement of accessibility outside the peak hours. Planning public transport services at all times of the day ensures that it services all population groups and their needs (Lubitow et al., 2017). It highlights the role of public transport as an essential service, not only to stimulate economic activity (Lubitow et al., 2017).

4.3.3.6 Category 6: Indicators

The last seven questions evaluate the presence of indicators related to accessibility. Note that this study only assesses indicators of accessibility to destinations and not accessibility to transport infrastructure (e.g., access to a metro station).

The first question assesses whether any indicator is defined to measure the integration of land use and transportation (or accessibility). As discussed previously, improving accessibility or access is often stated as a policy goal, but accessibility indicators are rarely included (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019). Even though the indicator might not directly measure accessibility, integrated measures of land use and transportation (e.g., % of new housing in the service area of a public transport station) can lead to increased accessibility. Indicators on vehicle

kilometers traveled (VKT) reduction are also associated with reduced car usage and a shift towards alternative modes of transportation (Banister, 2008). Both these questions were designed by Proffitt et al. (2019) and kept identical.

Question 16 assesses the presence of accessibility indicators to any destination as a general indicator. In addition, since increasing accessibility is sometimes confined to only measuring and targeting accessibility to jobs, question 19 focuses on indicators specifically related to non-work-related activities (e.g., grocery stores, parks, schools). As indicated by Banister (2008), access to everyday, local destinations (e.g., parks and grocery stores) is essential to promote the accessibility paradigm shift.

Accessibility and isochrone maps (a best practice identified by Boisjoly and El-Geneidy (2017a)), the presence of measurable targets, and the definition of accessibility indicators for specific groups of the population (e.g., older adults, low-income households, women) represent new questions added to the framework. Past research has shown that measurable targets are a best practice in policy documents to effectively reach goals, and strategies (Gudmundsson et al., 2015). Lastly, many studies have shown disparities in accessibility for vulnerable groups of the population (El-Geneidy et al., 2016; Grisé et al., 2019), supporting the consideration of specific accessibility targets.

4.3.4 Qualitative content analysis

The research team conducted a complementary qualitative content analysis to extract the relevant material associated with the research objectives. First, building on previous research investigating the integration of accessibility in planning documents (Boisjoly & El-Geneidy, 2017a), we systematically reviewed all plans using a structuring content analysis strategy. Such an approach aims to extract the relevant materials associated with our research objectives (Mayring, 2014). Therefore, in line with our content analysis framework and previous research, we extracted the accessibility-related vision, definitions, goals, and indicators. This content analysis was conducted in parallel with the content analysis framework presented in Table 4.3. We scored every document in a spreadsheet and extracted the excerpts associated with each question of our framework in a separate spreadsheet. Examples of excerpts for this step are shown in Appendix A.

The extracted material was then grouped into four key themes using a deductive approach. Specifically, four key themes were identified based on the study's objective and on the literature

on the barriers and opportunities to accessibility planning (Boisjoly & El-Geneidy, 2017a), and then refined through an iterative coding framework (Flick, 2014; Srivastava & Hopwood, 2009): (i) accessibility and mobility, (ii) integrated land use and transport, (iii) accessibility goals and components, and (iv) accessibility indicators. All excerpts were assigned to one or more theme in a deductive manner, and the themes were then refined iteratively. If needed, the authors went back to the excerpts in the plans to get more context and additional excerpts were added. The theme (i) accessibility and mobility, referring to the confusion found between mobility and accessibility, was consistently identified in the previous literature assessing planning documents (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019). In this study, most of the content extracted was related to the framework questions 1 to 4 on the definition of accessibility and confirmed the relevance of this theme. The second theme (ii) integrated land use and transport refers to the extent to which documents discuss the integration of land use and transport, if the integration is coined as accessibility, and how it relates to other planning strategies (e.g., TODs). The integration of land use and transport was found to be instrumental in supporting accessibility planning in previous research (Bertolini et al., 2005; Straatemeier & Bertolini, 2020) and also appeared as a predominant theme in our study. In some cases, the excerpts pointed to full sections of the documents presenting key concepts or planning approaches (e.g., complete communities or TOD) that were assessed to illustrate how these relate to accessibility and its components. In these cases, additional excerpts were added when relevant. Themes (iii) and (iv) were directly linked to the content analysis framework that built on previous research (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019) highlighting the instrumentality of accessibility goals and indicators to support accessibility planning. Excerpts related to theme (iii) emerged mainly from questions 5 to 13 on accessibility goals and also revealed the importance of assessing the different components of accessibility. Lastly, the excerpts for theme (iv) were mainly derived from indicators found in the documents (questions 14 to 20).

Once the thematic assignment was finalized, for each theme, all excerpts were combined into a single document. An in-depth analysis of each document was then conducted to identify, synthesize and summarize the key findings. This enabled a more refined and nuanced understanding of how accessibility is considered in the different plans.

Lastly, based on the results of this analysis, a subset of plans was analyzed more in-depth in the discussion section on policy alignment and governance. The plans were selected based on the

analysis of the excerpts, in an attempt to identify best practices as well as weaknesses in the integration of accessibility. The aim was to assess the overall alignment of the vision, definitions, goals, and indicators throughout the plan. Plans studied for this step include Translink's Transport 2050, the City of Toronto's Official Plan and the Plan d'urbanisme et de mobilité 2050 from the City of Montreal. Documents from the three most populous cities in Canada offered insight about accessibility integration in contexts where multiple planning organizations operate. They were selected as examples of good or inadequate policy alignment and governance structure to promote accessibility integration.

4.4 Results: Content analysis framework

The results of the content analysis coding framework for the 20 questions are presented in Figure 4.2, with the scores representing the percentages of documents obtaining a point for this specific question and the absolute number of documents indicated inside the bar plots.

Regarding the first category of questions (definition and vision), only 14 documents define accessibility as the ease or the possibility of reaching destinations (see Figure 4.2). Out of these 14 documents, five include notions related to land use and transport in their accessibility definition (Question 2). Interestingly, even though most documents do not define accessibility, more than half (27/40) state that improving access to destinations of interest can have positive social and environmental impacts. Lastly, most of the documents (36/40) include goal(s) that reflect the ease of reaching destinations.

In addition to the general goal of increasing access to destinations, the documents also include specific goals related to the transport component of accessibility (second category). Respectively, 35%, 95%, and 83% of the documents have goals related to reducing the need to travel (in terms of number of trips), increasing travel options and reducing automobile use. As for the land use component (third category), almost every document introduces goals to promote dense and mixed communities or to design transportation systems around these communities. Conversely, only 23 out of 40 documents propose projects (e.g., new demand-responsive bus line in a suburban neighborhood) or state goals which could improve accessibility across underserved areas. Notably, every document contains language on meeting the needs of the population and not only improving the performance of transportation systems (individual component). For the last component of

accessibility, temporality, only a few documents (9/40) include goals which could lead to accessibility improvements at different times of the day.

Regarding the indicators category, indicators of land use and transportation are found in 23 out of 40 documents, while only 11 documents include a VKT reduction indicator. As such, although every document includes one or multiple goals related to the four components of accessibility, these goals do not directly translate into accessibility indicators. Only 12 documents include an indicator of the number of destinations accessible within a distance or time threshold, as presented in Table 4.7. Even when an accessibility indicator is stated, few documents include an isochrone map (10%) or a measurable target (18%). Finally, 11 documents (28%) focus on improving accessibility to activities other than jobs, and three (8%) include accessibility measures for specific groups of the population (e.g., children, low-income individuals or people with disabilities).

We can also observe distinctions in the results and their averages between questions related to the “means to achieve accessibility” (62%), to the “accessibility shift” (38%) and to the “societal outcomes” (68%). As explained previously, most indicator-related questions reflect accessibility-based planning (i.e., accessibility shift). Since their scores are lower on average, the scores for the accessibility shift category are also generally lower. The gap in the results between questions on means and outcomes (which often relate to goals) versus those about the accessibility shift (mostly questions on indicators) highlights inconsistencies in accessibility integration across plans. When looking more closely at the results of the accessibility shift questions for each plan, we observe the following results: (i) no document scored a point for each of the 10 questions evaluating the accessibility shift, and (ii) only 11 documents obtained at least 50% of the points for this category of questions, largely due to the accessibility-indicators questions. These results suggest that most organizations are not currently planning based on accessibility, even if they aspire to it and might be laying the foundations to support it. Nonetheless, most documents include goals which relate to outcomes of accessibility-based planning, even though they do not plan through the accessibility lens. This limited translation of goals into indicators will be further assessed in the discussion section.

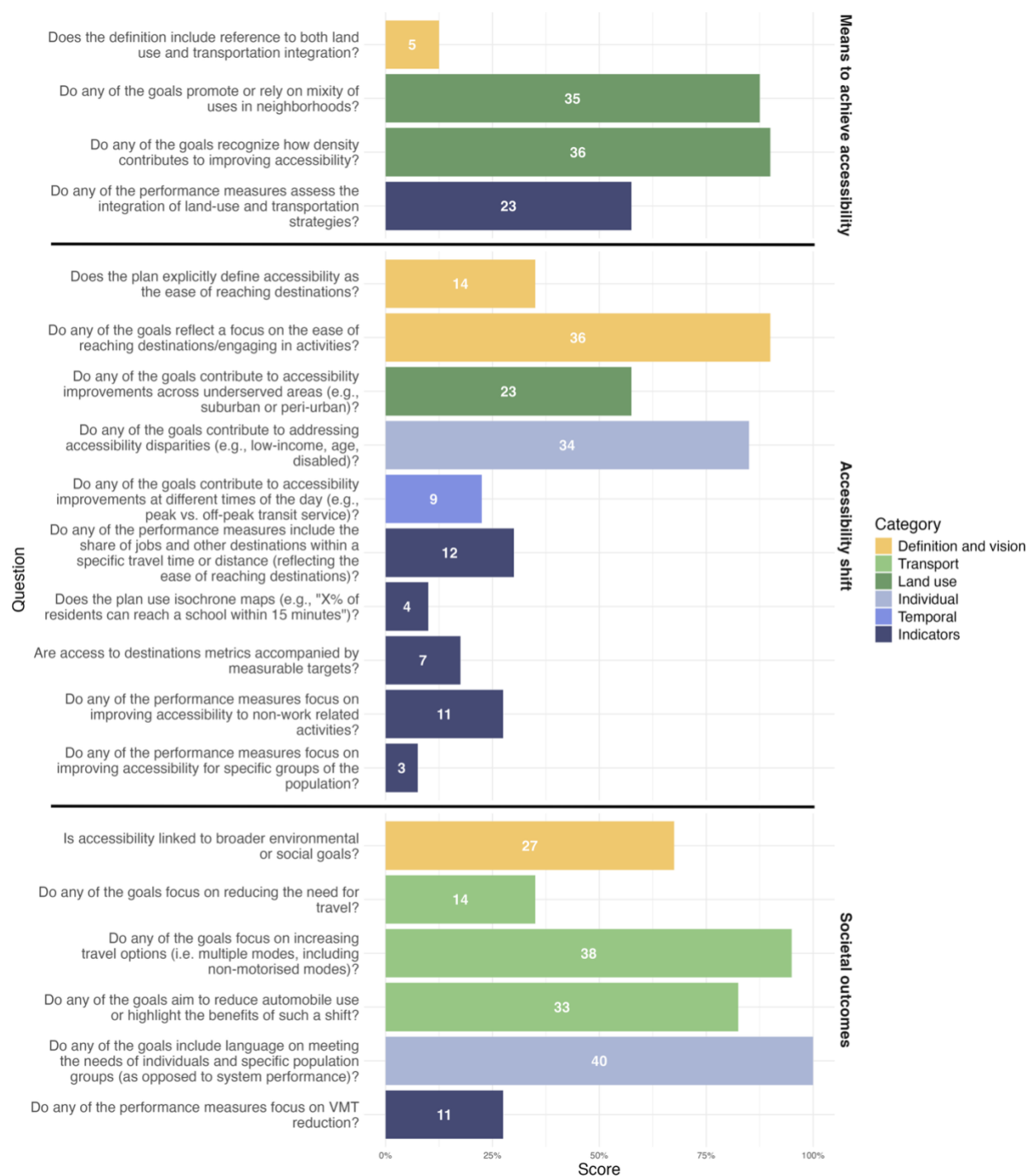


Figure 4.2 Results of the content analysis framework for each question

To further examine the accessibility indicators included in the different documents, Table 4.7 details the indicators associated with each document. For the 12 documents including accessibility to destinations indicators, the destinations, the modes, and the scale considered vary greatly. Some

documents measure access to destinations of interest, such as parks (City of Calgary, 2024; City of Ottawa, 2022; City of Vancouver, 2022; Ville de Montréal, 2024) and health centers (Ontario Ministry of Transportation, 2022; Translink, 2022), while others measure accessibility to jobs (Metrolinx, 2018; Translink, 2022).

Table 4.7 Accessibility indicators mentioned in Canadian land use and transport policy documents

Organization	Document name	Document type	Indicator(s)
Autorité régionale de transport métropolitain (ARTM; Montreal Regional Metropolitan Transport Authority)	Plan stratégique de développement du transport collectif 2025-2034	Transport agency	Percentage of the population for whom access to public transport has become more competitive (*)
Ville de Montréal (City of Montreal)	Plan d'urbanisme et de mobilité 2050	Municipality (integrated land use and transport)	- By 2050, 75% of Montrealers live within a 15-minute walk of key everyday resources. (*) - By 2050, 48% of the areas in Montreal's employment hubs are accessible by both the structured public transit network and the high-quality cycling network. (*) - By 2050, 30,500 m² of new library space is added across the city to ensure quality access for at least 70% of Montrealers. (*) - By 2050, in prioritized opportunity areas, Montreal sets a target of 10 m² of publicly accessible parks and green spaces per resident within a 15-minute walking distance. (*)
Metrolinx (Toronto)	2041 Regional Transportation Plan	Transport agency	The average GTHA resident will have access to 320,000 more jobs within 1 hour by transit
Translink (Vancouver)	Transport 2050	Transport agency	Accessibility to jobs, education, healthcare, and green spaces by active transportation

Table 4.8 Accessibility indicators mentioned in Canadian land use and transport policy documents (suite)

City of Calgary (Calgary)	Calgary Transportation Plan 2020	Municipality (transport)	Per cent of population within Major and Community Activity Centres, and 600 m of Urban and Neighbourhood Corridors
City of Ottawa (Ottawa)	Transportation Master Plan Policies and TMP Capital Infrastructure Plan	Municipality (transport)	Number of major destinations within walking distance to the corridor
Ontario Ministry of Transportation (Toronto and Hamilton)	Connecting the GGH: A Transportation Plan for the Greater Golden Horseshoe	Transport agency	- % of residents that can access a major hospital in less than 45 minutes by non auto mode - % of residents that can access a post secondary institution in less than 45 minutes by non auto mode - % of low-income residents that can access a major hospital in less than 45 minutes by non auto mode
Communauté métropolitaine de Québec (Quebec City Metropolitan Community)	Bâtir 2031 : Le Plan métropolitain d'aménagement et de développement du territoire de la Communauté métropolitaine de Québec	Land use agency	- Number of households within 800 meters of a public school, cultural or sports center, grocery store or pharmacy. (*) - Number of households within 400 meters of an outdoor recreational space such as a park, square or landscaped natural environment. (*)
City of Edmonton (Edmonton)	Edmonton City Plan	Municipality (land use)	Population within reasonable distance to Basic Services
City of Vancouver (Vancouver)	Vancouver Plan	Municipality (land use)	Ninety-nine percent of residents live within a 10-minute walk of a park or green space.

Table 4.9 Accessibility indicators mentioned in Canadian land use and transport policy documents (suite)

City of Calgary (Calgary)	Municipal Development Plan	Municipality (land use)	Per cent of housing units within 400 metres of a multifunctional park
City of Ottawa (Ottawa)	Official Plan	Municipality (land use)	In general, and to support health, climate resiliency, accessibility and gender and social equity, the City shall seek to provide all urban residents with the following minimum access to high-quality greenspace: a) Within a 5-minute safe walking distance (400 metres), a public greenspace providing space for passive or active recreation; b) Within a 10-minute safe walking distance (800 metres), two green public spaces; and c) Within a 15-minute trip by transit, a publicly-owned natural area.
Note: (*) Originally in French, and translated to English			

4.4.1 Analysis by type of document

Figure 4.3 shows the scores for the six categories of questions by type of document. The maximum score that can be obtained for each category is indicated as a reference point. First, at the municipal level, when comparing the land use documents (light blue) and the transport (medium blue) documents, we observe the following trend: land use documents obtain higher scores for the indicators category, whereas transport documents score higher for the transport and land use components of accessibility. Interestingly, this trend differs when comparing the land use and transportation planning authorities (red and green), the latter obtains higher scores for every category. Lastly, the City of Montreal's Plan d'urbanisme et de mobilité 2050, which is the only plan that integrates land use and transport in one strategic document, obtains the maximum scores for the definition, transport, land use and individual categories (Ville de Montréal, 2024). Considering this is the only integrated transport and land use document in our sample, results can't be generalized to all documents of this type. However, this result indicates that integrated land use and transport planning can support accessibility.

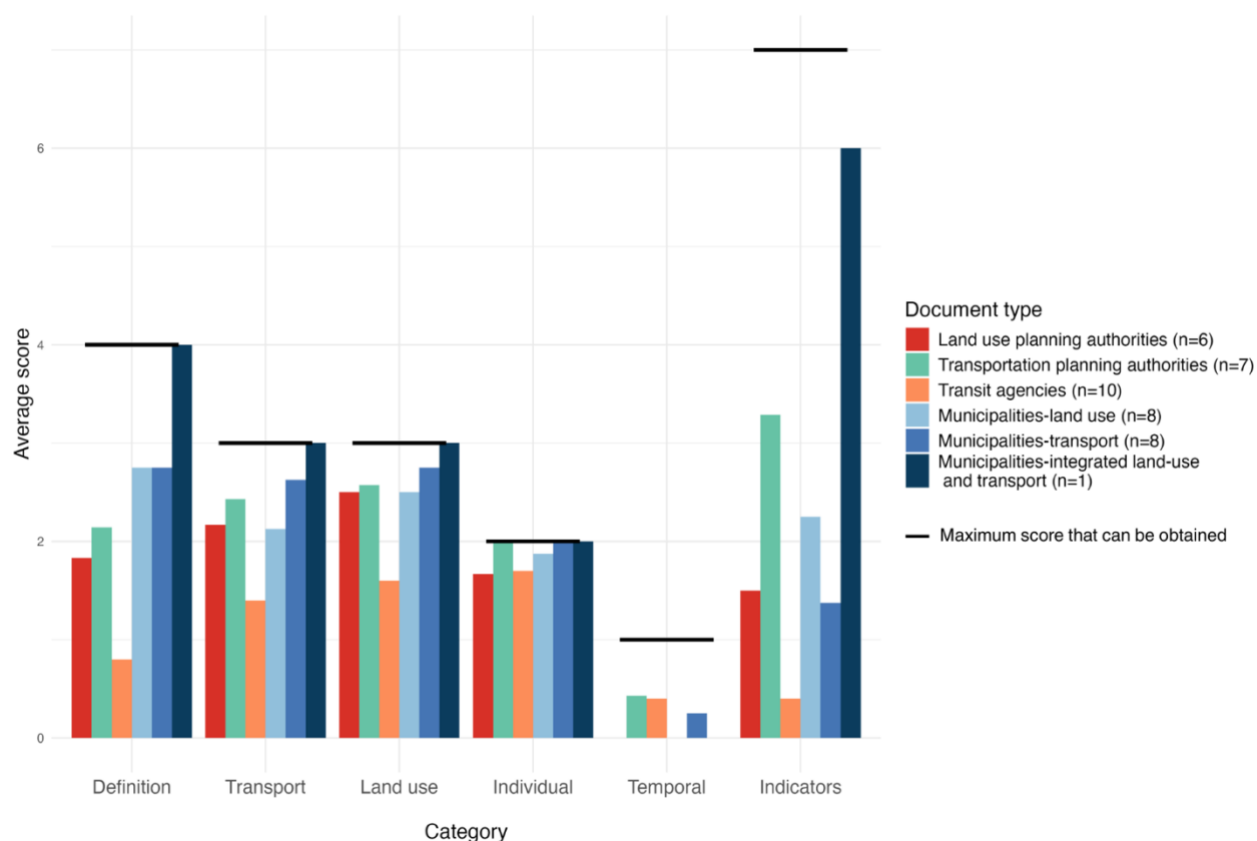


Figure 4.3 Accessibility scores for different document types and question categories

Finally, Figure 4.4 shows document scores based on document type and year of publication, with documents collected ranging from 2009 to 2025. This analysis does not infer causality between year of publication and accessibility integration, but some descriptive trends can nonetheless be identified. First, the graph reveals that, at the municipal level, the more recent documents score higher than their older counterparts. For example, the plans produced before 2019 all score below 14, whereas among the more recent ones, more than half (8/12) have a score of 13 or above. Second, looking at all document types, the six documents with the highest scores (14 and above) have been published from 2022 onwards, and out of the 12 documents with the highest score (13 and above), eight are municipal documents. In comparison, no transit agency has obtained an accessibility score higher than 50%, even when considering recent documents.

Interestingly, when comparing these results with the ones presented in Table 4.7, we can conclude that every document with access to destinations indicators (n=12) was published in the last five years, with the exception of the Communauté métropolitaine de Québec (2013) and the Metrolinx

(2018) documents. This highlights the recent trend towards improved integration of these indicators.

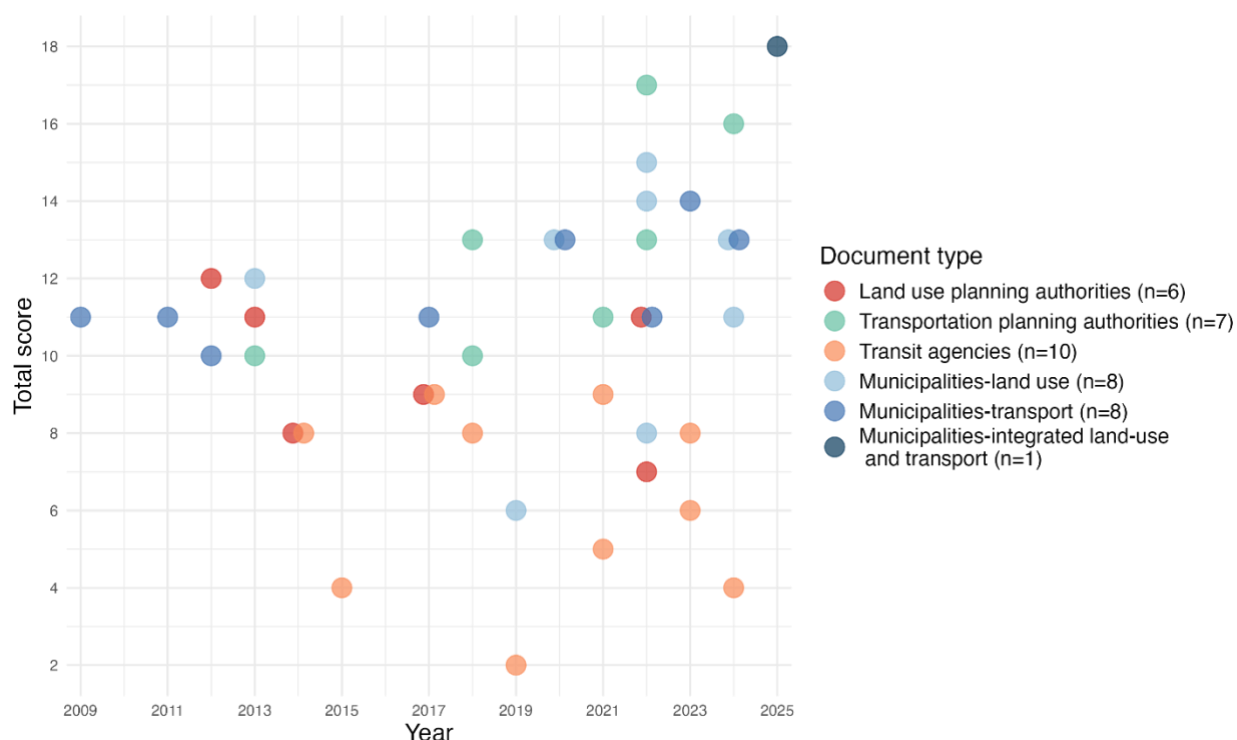


Figure 4.4 Accessibility scores by year of publication and document type

4.4.2 Analysis by government levels

The comparison of accessibility scores across different government levels, namely the provincial (n=2), metropolitan (n=11), and municipal (n=27) levels revealed no notable differences. For the three government levels, the average results are around 50%. For the provincial and metropolitan levels, documents collected are produced by land use or transportation planning authorities, and most of these documents score around 50%. Documents at the municipal level are published by municipalities (with 14 out of 17 documents scoring above 50%), and transit agencies (with all 10 documents scoring below 50%).

4.4.3 Analysis by municipality

The results for the documents in effect in every municipality are presented with radar plots in Figure 4.5 and the respective population size of the municipal area in 2021 (Statistics Canada, 2022), with plan numbers referring to the ones in Table 4.2. The scores are grouped by categories

of questions and standardized from 0 to 100 (i.e., a score of 2 out of 3 questions for the land use component would be shown as 67%, as is the case for the Vancouver Plan). Note that the results for the temporal component are skewed, since only one point is attributed, leading to either a null (0%) or a full (100%) score.

Findings show that most municipalities do not exhibit a homogenous pattern (e.g., all documents from one municipality scoring high scores in the same categories for all documents), suggesting that accessibility integration is not consistent within a municipality. For instance, no municipality scores consistently high for the temporal component across several documents. In all cases, only one document (or none) scores in the temporal component. Similarly, whereas Montreal, Vancouver and Edmonton have two documents with the highest score for the indicators, not all plans in these municipalities score high in this category.

Within several municipalities, discrepancies between the type of documents can be observed. In the Ottawa radar plot, there is a clear contrast between documents produced by the City of Ottawa, namely the land use (i.e., Official Plan (City of Ottawa, 2022)) and transportation (i.e., Transportation Master Plan Policies and TMP Capital Infrastructure Plan (City of Ottawa, 2023)) documents which both score 14/20, and the Transit Services Five-Year Roadmap produced by Ottawa's transit agency (score of 2/20 (OC Transpo, 2019)). This discrepancy between results of transit agencies and other organization types is also observable in other municipalities (e.g., Hamilton, Montreal, Toronto).

Overall, in order, the highest scoring documents are the Plan d'urbanisme et de mobilité 2050 (Ville de Montréal, 2024) (City of Montreal), Transport 2050 (Translink, 2022) (Translink; Vancouver), the Plan stratégique de développement du transport collectif 2025-2034 (Autorité régionale de transport métropolitain, 2024) (ARTM; Montreal Regional Metropolitan Transport Authority), and equally ranked the Vancouver Plan (City of Vancouver, 2022) (City of Vancouver), as well as Ottawa's Transportation Master Plan (City of Ottawa, 2023) and Official Plan (City of Ottawa, 2022) (City of Ottawa). Interestingly, these three municipalities do not display a clear trend in terms of region. They are located in three distinct provinces, one on the west coast of the country, and the two others in the east of the country. In terms of population size, Montreal, Vancouver and Ottawa are located in the second, third and fourth largest metropolitan regions respectively (Statistics Canada, 2026). In contrast, documents from Halifax (the smallest municipality in our

sample) score low with an average of 44%, with no documents obtaining more than 50% (2/4) for the definition and 29% (2/7) for the indicators' categories.

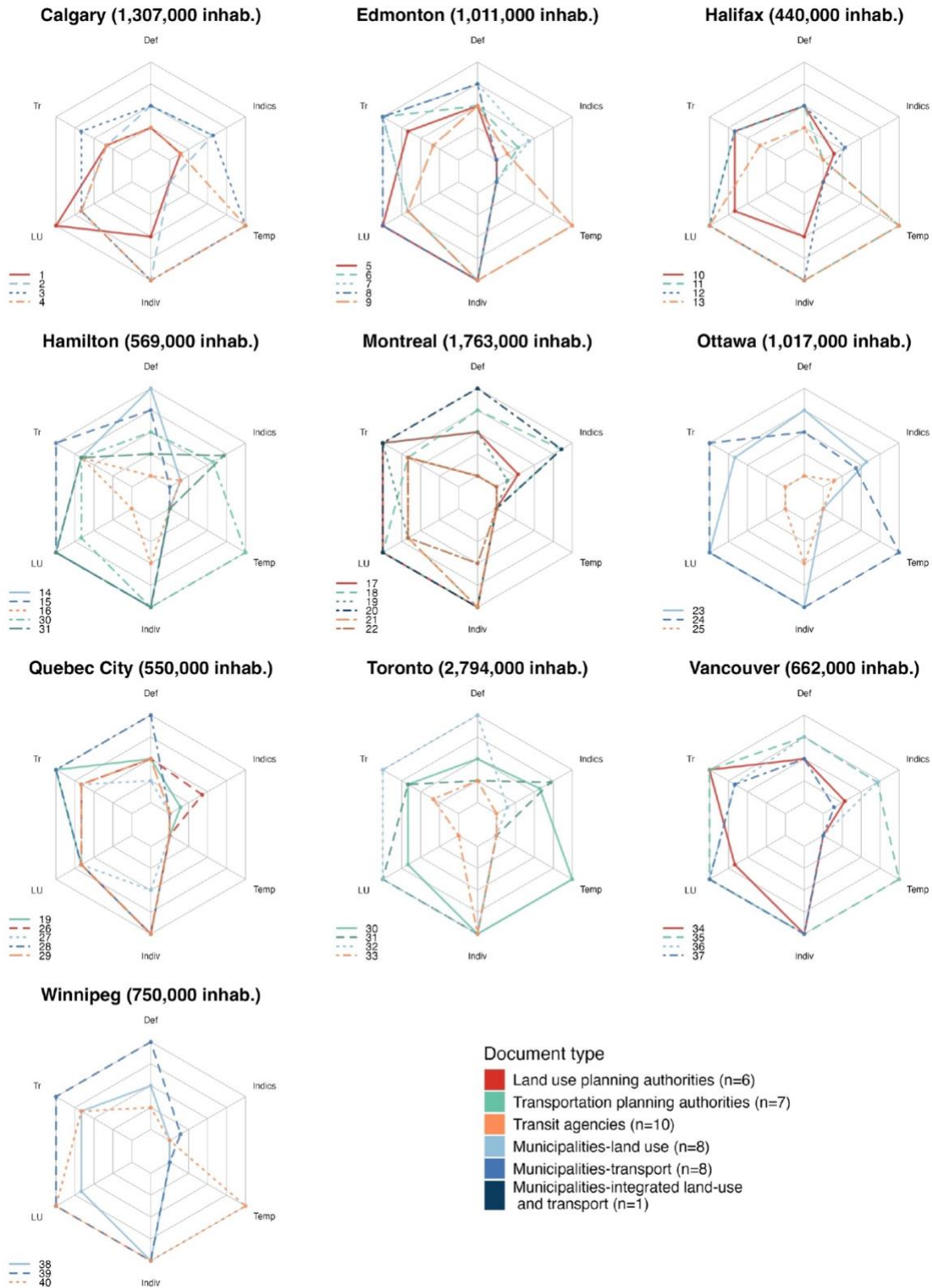


Figure 4.5 Accessibility scores for policy documents from 10 Canadian municipalities

4.5 Results: Qualitative content analysis

4.5.1 Mobility and accessibility

The document analysis reveals that accessibility is often tokenistic in Canadian transport and land use documents, as observed nearly a decade ago by Boisjoly and El-Geneidy (2017a) in international transport planning documents. In the documents, “access” and “accessibility” are often used to discuss universal accessibility or access to transport infrastructure, rather than destinations specifically. As presented in Figure 4.2, only 14 plans define accessibility in terms of access to destinations. For instance, accessibility is clearly defined in the Transportation Master Plan of the City of Winnipeg, as follows: “Daily needs such as employment, services, healthcare, school, daycare, and more are accessed through the transportation system. As a result, the transportation system plays a powerful role in people’s ability to access opportunities and therefore prosper.” (City of Winnipeg, 2024)

Some documents discuss the ease of reaching destinations, yet they do not associate this concept with accessibility. For instance, Ottawa’s Official Plan (City of Ottawa, 2022) starts the mobility section with “Land use and transportation are fundamentally connected”. At its core, accessibility, not mobility, is the connection between land use and transportation (Bertolini et al., 2005). The conflation between accessibility and mobility extends beyond simply the definition in each document. This is evident in Metro Vancouver’s Metro 2050 (Metro Vancouver, 2022) document, which has a section titled “Improving Accessibility and Mobility and Reducing Congestion”. This is an unnecessary duplication as mobility is a component of accessibility, with accessibility also considering the impact of land use on reaching destinations. Further, the literature indicates that planning to improve automobile speeds and reducing congestion may not lead to improved accessibility and policy documents should be careful when proposing such interventions to improve accessibility (Levine et al., 2012).

Nevertheless, in some plans, the gap between accessibility and mobility is made explicit. In its Transport 2050, Translink argues in favor of the shift from a mobility to an accessibility paradigm (Translink, 2022). They state that “we should focus on access, rather than just specifically mobility. After all, the purpose of most transportation is not simply to move around, but to connect us to the people, places, and opportunities that matter most [...]”. To the authors’ knowledge, this study is

the first to find an explicit reference to the paradigm shift in a policy document. This call to the accessibility paradigm shift is in line with the recent literature on the subject (Handy, 2020).

4.5.2 Integrated land use and transport

A common theme in the land use and transportation documents reviewed in this study is the necessity to integrate the planning of land use and transport systems. Multiple documents define accessibility as the interaction between land use and transport. For example, Metro 2050 (City of Vancouver, 2022) includes a strategy to better integrate land use planning with transport planning, namely through TOD and complete communities, which are examples of accessibility improvements through land use strategies. Research has shown a positive association between TODs and accessibility (Papa & Bertolini, 2015), while highlighting how TODs contribute to a greater use of sustainable transportation modes (Appleyard, 2023). In line with the literature, this Metro Vancouver document views land use strategies as conditions to promote sustainable mobility habits.

Nevertheless, accessibility is not always coined as the concept bridging land use and transport systems. The City of Halifax includes a section on integrated planning in its Integrated Mobility Plan, where universal accessibility is discussed (City of Halifax, 2017). Yet, no description of the accessibility to destinations concept is presented. In terms of document structure, the City of Edmonton's Transportation Master Plan (City of Edmonton, 2009) separates its strategic goals into "Transportation and Land Use Integration" and "Access and Mobility" among others. This example highlights how accessibility can be employed as a buzzword, and not as the integration of land use and transport.

Other documents do not discuss integrated planning of land use or transport or perpetuate the mobility paradigm. For instance, Edmonton's Transit Strategy identifies "mobility" as one of its core values (City of Edmonton, 2017). As discussed previously, individuals do not intrinsically need to move but rather to be able to reach destinations of interest (Handy, 2020). The Ontario Ministry of Transportation also promotes the construction and widening of highways to reduce congestion while defining accessibility indicators (Ontario Ministry of Transportation, 2022).

4.5.3 Planning goals: the four components of accessibility

Most of the documents included goals related to the ease of reaching destinations, consistent with previous research (Boisjoly & El-Geneidy, 2017a). Additionally, at least one of the four accessibility components (i.e., transport, land use, individual, and temporality) is addressed in every document analyzed.

Looking first at the transport component, multiple documents highlighted a tension between reducing automobile use and alleviating congestion. A focus on reducing congestion often conceals the goal of improving the ease of movement for car users. For instance, building new highways is justified by the necessity to reduce congestion as found in Ontario GGH (Ontario Ministry of Transportation, 2022), even though the supposition that building highways leads to reduced congestion has been debunked (Cervero, 2003; Hymel, 2019; Volker et al., 2020). The opposite is true in Vancouver's Metro 2050 (Metro Vancouver, 2022), where reduced car use is stated as the condition for traffic reduction. Similarly, in its Transportation Master Plan (City of Edmonton, 2009), the City of Edmonton highlights how transportation demand management can lead to lower car use through the reduction of the number and length of trips. These dichotomous results highlight how similar mobility-related goals can support or hinder accessibility, depending on the underlying approaches that are promoted to achieve these goals.

Reducing car use is closely linked to the land use component of accessibility, which is addressed in almost all plans, although to a different extent. Promoting shorter trips is analogous to the proximity aspect of accessibility, as having the possibility to access closer destinations positively favours the use of active modes (Elldér et al., 2018). In line with this, several plans have underlying density and mixed-use goals. As stated in the Integrated Regional Transportation Master Plan from the Edmonton Metropolitan Region Board, grouping employment hubs, commerce, and residences can lead to a modal shift towards sustainable transportation modes (Edmonton Metropolitan Region Board, 2021). Similarly, in the Vancouver Plan, the City of Vancouver highlights how densely populated areas should have access to key amenities (City of Vancouver, 2022). In fact, planning new opportunities (e.g., grocery stores, parks, drug stores) in dense areas directly improves accessibility for much of the population (Levine et al., 2012). As stated in many documents, density is also associated with higher use of active modes and public transport (Frank & Pivo, 1994).

With respect to the individual components, all plans touch on the individual needs and specific population groups. Objectives to improve accessibility for specific groups of the population can be found in multiple documents. Documents discuss the accessibility needs of older adults (Metrolinx, 2018; Ministère des Transports et de la Mobilité durable, 2018) and children (City of Ottawa, 2023; Metrolinx, 2018). Some also mention spatial inequities and how low-income neighborhoods should be targeted for future land use and/or transport interventions (Calgary Transit, 2023; City of Winnipeg, 2024).

Lastly, findings show that the temporal component is the most overlooked. Only four documents include goals to improve accessibility during off-peak hours. As such, most documents focus on peak public transport service, such as the City of Hamilton, which designed a travel demand forecasting model solely for the analysis of AM peak trips (City of Hamilton, 2022). This approach reinforces the planning of public transport systems around the commuters' needs and to stimulate economic activity (Smith et al., 2025), while neglecting the diverse needs of different population groups. Along these lines, the City of Ottawa argues that “off-peak destination accessibility by transit is important for some members of equity-deserving groups” (City of Ottawa, 2023), as found in the literature (Smith et al., 2025). Similarly, Halifax Transit states that “service must also be operated during time periods when demand is lower to accommodate trips which do not take place during traditional rush hour periods like trips to appointments, university classes, shopping destinations, and social visits” (Halifax Transit, 2014). These findings show that the diversity of needs in terms of temporality is present in some documents but still remains a marginalized component. The focus is often on this peak period because there is a concentration of trips at that point, but a system designed only for those trips will not meet the general needs of the population (Lubitow et al., 2017).

Overall, findings reveal that, in terms of goals, accessibility is very much oriented towards the land use and transport components and with a consideration for equity-deserving groups, although the temporal component, which is key to support equitable accessibility, is often left out.

4.5.4 Accessibility indicators

In line with previous research (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025), the prevalence of accessibility-focused goals does not directly translate into accessibility indicators in most policy documents studied. As an example, the City of Winnipeg provides a

detailed definition of accessibility and its components (City of Winnipeg, 2024). Yet, it does not include access to destination indicators, even though multiple indicators are included (e.g., sustainable mode share, access to a public transport stop, car ownership). Further, in cases where accessibility indicators are defined, the land use and transport components are put forward, whereas the individual and temporal components are quasi-absent. As shown in Table 4.7, three documents include accessibility indicators or targets explicitly about the individual component (City of Montreal, ARTM, and Ontario Ministry of Transportation) and no indicator considers the temporal dimension.

As for the type of accessibility indicators, it is similar across most documents. In most cases, simple cumulative-opportunity measures (e.g., the number of jobs accessible (Metrolinx, 2018)) are defined at the expense of more complex indicators. As found in recent research, these measures are easy to communicate and simple to compute and correlated with complex measures, despite being less theoretically sound (Kapatsila et al., 2023). The City of Montreal developed a broad range of accessibility measures, namely having access to key amenities (i.e., grocery store, drug store, park, daycare, school) within 15 minutes on foot, but also a more complex measure of accessibility integrating supply and demand. In relation to transportation modes, no documents consider improvements to accessibility by car. Interestingly, in Translink's Regional Transportation Strategy (Translink, 2022) and the ARTM's Plan stratégique de développement du transport collectif 2025-2034 (Autorité régionale de transport métropolitain, 2024), accessibility by public transport is compared to accessibility by car, through a competitiveness indicator.

4.6 Discussion: Policy alignment and governance

Achieving accessibility outcomes in transport planning depends on governance structures that align goals with delivery (Pei et al., 2010). Clear and accountable frameworks are essential for tracking progress, and the integration of governance institutions—across different organisational levels and within individual agencies—ensures that actions are coordinated rather than siloed (Rode & da Cruz, 2018). Although this study did not assess governance processes specifically, this discussion expands on how meaningfully the accessibility concept is represented in the documents.

In some documents, accessibility is meaningfully embedded within performance frameworks through explicit links between organisational resources, actions, and intended outcomes. These linkages provide a roadmap for delivery and are valuable in supporting transparent allocation of

time, staff, and funding to proposed actions. Pei et al. (2010) emphasise this point, identifying the articulation of causal relationships between agency actions and desired outcomes as a key component of effective transport performance frameworks. By contrast, Gudmundsson (2003) warns that failing to adopt such an approach may lead strategies to target symptoms, such as congestion, rather than addressing underlying structural drivers, such as low-density land use.

As a key example, Translink's Regional Transportation Strategy for Vancouver has adopted this approach. The document articulates logical connections between actions, strategies, goals, and vision and identifies indicators through specific evaluation methods and targets, as illustrated in Figure 4.6 (Translink, 2022).



Figure 4.6 An example visualisation of the logical chain of delivery from the Translink document (created by the authors)

In contrast, the City of Toronto's Official Plan (City of Toronto, 2024) clearly defines accessibility but does not translate the document's policies into actions to deliver long term accessibility outcomes or identify measurable indicators. For example, the document includes a policy

commitment to develop “appropriate targets and indicators”, however, in their absence, it is impossible to measure the success of the document. As Cornet and Gudmundsson (2015) argue, indicators give transport strategies meaning, and without them it is difficult to hold decision-makers accountable for policy commitments. This omission creates a lack of clarity in the roadmap to improving accessibility and risks reducing the concept to a superficial level, as there is no mechanism for measuring success.

This challenge of aligning accessibility with delivery frameworks is evident both horizontally (e.g., between municipalities and transit agencies operating at the municipal level) and vertically across different organizations and spatial levels (i.e., the different land use and transport organizations operating within a singular city). This is consistent with research, which identified tensions between transportation government organizations operating at different levels (Hull, 2008). For instance, in this study, both municipalities and transit agencies are municipal entities, but their documents obtained respectively the highest and the lowest scores. This indicates that the type of document influences accessibility scores beyond the publisher’s government level.

Accordingly, the findings point to an uneven integration of accessibility across institutions, resulting in misaligned outcomes even within the same spatial scale. Rode and da Cruz (2018) argue that the shift from a mobility paradigm to an accessibility paradigm has created governance challenges due to the more complex and cross-cutting nature of accessibility. Whereas mobility focuses on specific modes of transport—such as cycling, public transport, or private vehicles—that can be more easily partitioned between governance levels, accessibility requires integration across multiple interdependent systems. For example, transit authorities scoring higher in the temporal component may reflect their responsibility for managing peak and off-peak services. Conversely, a lack of accessibility indicators in the documents may reflect these fragmented responsibilities, as transit agencies are not involved in land use planning.

Municipal governments, by comparison, are less present in the temporal category, which may be linked to their historical focus on systems that typically do not experience peak fluctuations, such as walking, cycling, and land use planning. In line with this observation, Veeneman and Mulley (2018) found that local governments tended to focus on ‘place’ based or people-oriented projects, while higher levels focused on larger scale movement projects. The study recommends that one approach integrating these elements is to ensure balanced funding across all levels of government.

In addition to differences in goals and vision, there are also discrepancies in the consideration of accessibility indicators (see Table 4.7). In the Canadian context, municipalities appear to be leading institutions in the integration of land use and transport accessibility components - consistent with their ability to regulate both. Nonetheless, they rarely define indicators assessing both land use and transport. Also, as mentioned above, accessibility indicators are found in the documents of land use and transport planning authorities, but not in those of transit agencies.

This could be explained by the competencies of Canadian transit agencies. In most municipalities, they have narrower institutional mandates and are seldom responsible for operating public transport services. They do not hold any influence on urban development or land use and transport integration (Tremblay-Racicot, 2023). This leads them to focus on service supply over broader accessibility integration. Conversely, transportation, land use agencies, and municipalities produce a range of planning documents that relate to accessibility integration. As argued in Candel and Biesbroek (2016), coherence is best when all actors involved coordinate their policy goals to address a specific problem. In the context of this study, we can identify incoherences as illustrated in Figure 4.5. Organizations within the same municipality often have different conceptions of accessibility. This causes organizations to adopt distinct goals, and measures to reach these goals, though they oversee the same municipality.

Differences are also evident in the types of destinations included in accessibility across governance levels. Municipalities such as Montreal and Vancouver have adopted indicators focused on access by active modes to local destinations (e.g., parks and libraries). By contrast, metropolitan agencies such as Metrolinx (Toronto) or the ARTM (Montreal) measure accessibility to destinations of regional importance (e.g., jobs and health centers) primarily via public transport. Past research has identified this dichotomy (i.e., the consideration of different scales) between higher and local levels of government (Veeneman & Mulley, 2018). Reflecting this, Metro Vancouver explicitly highlights in Metro 2050 that regional accessibility should complement local accessibility (Metro Vancouver, 2022). Notably, some organizations operating at a scale larger than municipalities, such as the Communauté métropolitaine de Québec (Quebec City) and Translink (Vancouver), still include indicators for access to local destinations.

Overall, these results underscore the importance and the challenges of integrating accessibility both vertically across different scales (e.g., municipal, regional, and provincial) and horizontally across

institutions working at the same scale. It also highlights how accessibility, by nature, can require a stronger cooperation between agencies.

4.7 Conclusion

This study assessed the integration of accessibility in Canadian transport and land use policy documents using a content analysis framework complemented by a qualitative analysis. The main contribution of this study is the assessment and comparison of multiple documents within a city and from different sectors and governance scales. This approach allowed us to shed light on key challenges of accessibility implementation, namely the scale mismatch between different planning entities, and the sectorial mismatch (i.e. land use vs transportation planning) given that they have distinct approaches, mandates and objectives. Findings show that most documents integrate accessibility (understood as the ease of reaching destinations) in their goals. Yet, despite the fact that the accessibility components are discussed and assessed in Canadian policy documents, most have not yet adopted accessibility indicators. When adopted, the indicators focus on the land use and transport components. This raises the question of the extent to which equity, which is discussed in most plans, translates into actionable indicators. In addition, there still exists confusion between mobility and accessibility, and a tendency to still put forward mobility indicators when discussing accessibility.

The results also reveal discrepancies in the integration of accessibility components (i.e., transport, land use, individual, temporality) between different organization types operating at different government levels. Both transport and land use documents from municipalities obtain high scores. Further, the Plan d'urbanisme et de mobilité 2050 from the City of Montreal obtains the highest score, as the only integrated transport and land use document. Transit agencies score the lowest, as no documents include accessibility indicators and only one (out of 10 transit agencies) defines accessibility to destinations. Lastly, while municipalities and regional entities are instrumental in supporting accessibility planning, results show that the integration of accessibility is not homogenous within every city.

Quantitative and qualitative results can also inform the work of planners and policymakers. They give insight into identified best practices for the design of accessibility indicators and for improving governance alignment. Most accessibility indicators included in the studied documents are cumulative-opportunity measures, which involve counting the number of destinations (e.g., parks,

jobs, health centers) that are accessible below a certain time or distance threshold. This may suggest that measures easily communicable are preferred over more theoretically sound measures by the planning practice (as found in previous research (Boisjoly & El-Geneidy, 2017a)). These measures were also found to be correlated with more complex accessibility measures (Kapatsila et al., 2023). In addition to the design of easy-to-communicate measures, there is also a need to consider a range of destinations, and at different times of day, particularly those relevant from an equity standpoint (Soukhov, Mooney, et al., 2025; Soukhov, Ravensbergen, et al., 2025). For instance, the City of Ottawa mentions in its Transportation Master Plan how members of equity-seeking groups often rely on off-peak accessibility by transit (City of Ottawa, 2023). In terms of accessibility measures, the City of Montreal defines indicators for key daily destinations, including grocery stores, pharmacies, parks, schools and daycares (Ville de Montréal, 2024). Beyond measurement, agencies must integrate accessibility more coherently across organizations overseeing one city. In the Montreal context, the ARTM and the City of Montreal both have public transport accessibility targets. Yet, their definitions and targets remain misaligned. To promote coherent accessibility-based planning, a first step would be to consistently embed accessibility definition and indicators into formal planning documents across different agencies.

Nonetheless, there are limitations to this study. First, the assessed documents come from different organizations, each with their own roles, competencies, and responsibilities. This implies that some organizations, namely municipalities, are predisposed to better integrate accessibility, as they have direct competencies over land use and transportation planning (as opposed to transit agencies) in the Canadian context. Documents have different purposes (e.g., long-term planning, corporate planning, strategic planning), lengths, and structures. Although this is a limit, this heterogeneity of plans is central to the study's objectives as we aimed to compare different types of documents.

Second, using a content analysis framework implies some limitations. There is an inherent subjectivity associated with raters analyzing documents. To reduce this subjectivity, we decided to code every question using binary scoring. This in turn limits the consideration of the quality (or depth) of an answer to a question of the framework. For instance, a document presenting one accessibility indicator would get one point, as would a document defining multiple accessibility indicators for many destinations and modes of transportation. Nonetheless, the limits of the framework approach are mitigated by the complementary qualitative analysis. This approach seeks to uncover the underlying structures and considers the quality of the different components. This

approach also presents some limitations in the interpretability of the results, considering it was done without following a structured method (e.g., thematic analysis).

Another limit is that this study is solely based on policy documents, without comparing stated objectives and actual outcomes. Future research could explore if and how policy documents influence the work of practitioners and if they are successful in attaining their accessibility goals. Similarly, the processes underlying the developments of the plans have not been examined. Future research on this could help understand the barriers and opportunities associated with an improved integration of accessibility in policy documents. Along these lines, governance is a promising avenue for future research. Processes and causes underlying inconsistencies could be evaluated through a policy theory lens.

Future studies could also replicate our methods to other contexts and countries. This study focused on ten large Canadian municipalities (i.e., population over 250,000 inhabitants), which limits the interpretation of the results, especially in rural or non-Occidental contexts. Results could also differ for smaller cities with different planning entities.

Overall, the findings demonstrate that accessibility is gaining traction in planning, with more recent documents obtaining higher score, but that more efforts are required to support a comprehensive and consistent integration.

**CHAPITRE 5 ARTICLE 2: ACCESSIBILITY IN ACTION:
PARTICIPATORY PLANNING WORKSHOPS WITH LAND USE AND
TRANSPORT PRACTITIONERS IN MONTREAL, CANADA**

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Abstract

Accessibility, the ease of reaching destinations, is a concept bridging land use and transportation planning. Despite a consensus in research on its relevance for the planning practice, few practitioners or organizations have systematically adopted and applied accessibility-based planning. This paper aims to evaluate planning opportunities for accessibility indicators and barriers to the implementation of this paradigm shift. To do so, we design a practice-oriented methodology that builds on three workshops with municipal practitioners in Montreal, Canada. Accessibility indicators are first co-created with practitioners based on their current needs and priorities. Then, their usability, as well as technical, institutional, and political barriers are assessed with focus groups, participant-generated data, and observations. Our findings show that the

practitioners understand the concept of accessibility and acknowledge its importance. In all three case studies, accessibility indicators were identified as useful for validating or refining knowledge, planning land use and transport projects, and communicating with other actors. The practitioners confirmed the need to design accessibility indicators that are easy to communicate and interpret, resulting in only location-based measures being defined. In terms of modes and destinations, the practitioners were keen to evaluate the access to local destinations, namely grocery stores and parks, by walking and cycling. Institutional barriers, including the partition of mandates between organizations and the translation of strategic goals into actions, were identified as prime conditions impeding accessibility-based planning. This paper is relevant to practitioners and researchers aiming to understand the opportunities and barriers related to accessibility-based planning.

Keywords: accessibility, transport, land use, participatory workshop, paradigm shift, focus group

5.1 Introduction

Transportation planning has long hinged on mobility, an approach based on facilitating movement (often by automobiles) that has inherent limitations (Levine et al., 2019). This strategy has contributed to the expanding costs of road infrastructure, greenhouse gas emissions, and urban sprawl among others (Banister, 2011). Most importantly, these mobility-oriented transport systems have not fully fulfilled their main goal: to enable the population to reach essential destinations (Levine et al., 2019; Martens, 2019).

Accessibility, essentially the ease of reaching destinations, is viewed as a paradigm shift from the traditional mobility-based approach (Banister, 2008). It stems from the core idea that individuals use transportation modes to reach destinations they value and thereby conduct their daily activities (Geurs & van Wee, 2004; Handy, 2020). However, planning practice has not yet mainstreamed this approach, except in a few instances in Europe (Geurs, 2018) and in Hong Kong (Yang et al., 2025). Past research has identified many barriers impeding the implementation of accessibility, including technical (e.g., data availability, lack of knowledge), institutional (e.g., lack of coordination between organizations), and political (e.g., election cycles, lack of funding) barriers (Boisjoly & El-Geneidy, 2017a; Papa et al., 2016). Whereas these studies have assessed the accessibility shift through policy documents and planners' perspectives (through surveys mainly), only a few studies (see Pönkänen et al. 2025; Silva et al. 2017) have examined the adoption of accessibility-based planning directly on the ground. Given the diversity of contexts and demonstrated relevance of these studies, there is a need to expand this body of research (given past studies have typically focused on the European context (Pönkänen et al., 2025; Silva et al., 2017)) by further conducting research in direct collaboration with practitioners or planners.

The aim of this research project is, therefore, to identify opportunities and barriers to the implementation of accessibility indicators in planning practice through real-world case studies. To do so, we designed a methodology building on participatory planning workshops, in which we operationalized the accessibility concept with practitioners from the City of Montreal, seeking to answer the following research questions:

- RQ1. In practice: How do practitioners currently understand and operationalize accessibility as defined and used by researchers?

- RQ2. Potential: How can accessibility indicators be used by practitioners?
- RQ3. Usability limitations: What barriers do practitioners face (or expect to face) when using accessibility indicators?
- RQ4. Institutional conditions: How do current institutional and governance structures impede or promote the accessibility paradigm shift?

This methodology comprises three distinct case studies, each building on a series of participatory planning workshops with local practitioners to co-develop accessibility indicators, analyze proposed land use and transport projects through these indicators, and then assess their usability, specifically in the specific context of their work. Through these workshops, data is collected using focus groups, participant-generated data, and observations.

5.2 Literature review

5.2.1 Accessibility

Accessibility to destinations is a multidimensional concept which builds on four components: transport (infrastructure and services), land use (spatial distribution of origins and opportunities), individual (needs and constraints), and temporality (availability over time) (Geurs & van Wee, 2004). It measures the potential to reach destinations, which is what individuals seek when using transportation systems (Handy, 2020), and is an integrated measure of land use and transport. Hence, the accessibility paradigm is more comprehensive than the mobility paradigm, which only considers the ability to move (Ferreira et al., 2012; Levine et al., 2019). As such, mobility is only one way to improve access to destinations, which can also be improved through proximity (between origins and destinations) and connectivity (i.e., delivery services) (Levine et al., 2019). A key critique of the mobility-paradigm is that this long-standing and uneven focus on mobility has not led to better accessibility for the population (Levine et al., 2019; Silva, 2020).

To support the accessibility paradigm shift, many types of accessibility indicators have been defined in research (Geurs & van Wee, 2004), including location-based measures which quantify the ability for individuals to reach destinations from a specific origin (i.e., location). These measures have gained attention in research and practice considering their ease of computation, operationalization, and communication (Boisjoly & El-Geneidy, 2017a; Geurs & van Wee, 2004; Siddiq & Taylor, 2021). The most popular location-based measure is the cumulative-opportunity

measure, which counts the number of opportunities that can be reached within a time or distance threshold (Boisjoly & El-Geneidy, 2017b; Marwal & Silva, 2022). It represents a tangible quantity, making it particularly easy to communicate and interpret (Boisjoly & El-Geneidy, 2017a; Handy & Niemeier, 1997). To overcome the limits associated with a binary threshold, gravity-based measures use a function to weigh opportunities based on their travel cost (e.g., time or distance) (Marwal & Silva, 2022). Despite their conceptual differences, past research has shown a strong and positive correlation (with a coefficient around 0.9) between cumulative-opportunity and gravity-based measures (Kapatsila et al., 2023; Santana Palacios & El-Geneidy, 2022). Other types of accessibility measures have been developed by researchers, such as person-based or utility-based measures, but their implementation in practice remains limited due to their inherent complexity (Siddiq & Taylor, 2021).

Given their ease of computation and communication, location-based measures, specifically the cumulative-opportunity measures, are the most commonly used by practitioners (Boisjoly & El-Geneidy, 2017b; Geurs & van Wee, 2004; Siddiq & Taylor, 2021). In terms of modes and destinations, most indicators focus on accessibility by car (and some by public transport) to jobs and employment centres (Boisjoly & El-Geneidy, 2017a). More recent policy documents have started to integrate active modes of transport and more diverse destinations such as leisure, commercial, and health destinations (Boisjoly & El-Geneidy, 2017b; Siddiq & Taylor, 2021). However, the integration of daily destinations (e.g., shops, grocery stores) in accessibility measures remains limited (Siddiq & Taylor, 2021). This can be attributed to the historical roots of accessibility, which have typically involved the study of accessibility by faster modes, such as car and public transport, at a regional scale (Levine, 2020; Silva & Altieri, 2022).

More recently, a stream of research has focused on accessibility to proximity destinations, such as grocery stores, pharmacies, parks, and schools (Silva et al., 2023, 2025). This concept, also referred to as local or neighborhood accessibility, builds on the idea that individuals should have access to nearby necessities by walking or cycling (Silva et al., 2023). These observations are the foundations of the 15-minute city (Moreno et al., 2021), which has gained traction in research, mainly in the last five years (Knap et al., 2023; Staricco, 2022; Teixeira et al., 2024).

5.2.2 Accessibility in planning

Notwithstanding the fact that research has long recognized enhancing accessibility as the central goal of transport planning (Handy, 2020), examples of accessibility implementation remain limited in the planning practice realm (Boisjoly & El-Geneidy, 2017a, 2017b; Rowangould et al., 2024). A first stream of research investigated the barriers and opportunities to accessibility-based planning through the (i) assessment of policy documents (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025) and (ii) interviews and survey with practitioners (Boisjoly & El-Geneidy, 2017b; Papa et al., 2016; Siddiq & Taylor, 2021).

These studies have identified several common barriers to the implementation of accessibility in practice. In a survey, Boisjoly and El-Geneidy (2017b) found technical barriers (e.g., time, data, knowledge) as the most prominent, followed closely by the lack of a regulatory framework. These findings are consistent with interviews conducted by Siddiq and Taylor (2021), whom also identified the difficulty of finding a standard accessibility indicator and the path dependency of organization planning based on mobility. Practitioners are using existing tools (e.g., cost-benefit analysis, level of service), which are defined to tackle current planning objectives. These processes are sometimes slow to change and even if they were open to change, practitioners lack time to learn new methods (Rowangould et al., 2024). This shift is also made difficult by political priorities. Accessibility is a potential of interaction, and thus less tangible than measures of mobility (e.g., congestion is visible for car drivers) for elected officials and the population (Handy, 2020).

Nonetheless, these studies have also identified contexts in which accessibility indicators or tools are used (Boisjoly & El-Geneidy, 2017a, 2017b; Siddiq & Taylor, 2021). Boisjoly and El-Geneidy (2017b), building on a sample composed of 80% of practitioners from North America, identified that around half practitioners used accessibility indicators in their work, with most metrics being travel time proxies. Additionally, the authors found that practitioners from the private sector have typically used accessibility on their own initiative, whereas planners working in public agencies have worked with accessibility indicators to comply with new planning requirements. Ultimately, these examples of accessibility integration show that accessibility-based planning is gaining traction in practice but is still limited, especially in North America (Boisjoly & El-Geneidy, 2017a, 2017b; Siddiq & Taylor, 2021).

5.2.3 Participatory research projects on accessibility

To further understand why accessibility is slow to gain traction, the integration of accessibility in practice has been examined through action research projects, also referred to as experiential workshops or case studies (Hull et al., 2012; Kinigadner & Büttner, 2021; Pajares et al., 2021, 2022; Pönkänen et al., 2025; Silva et al., 2019; Straatemeier et al., 2010; Straatemeier & Bertolini, 2020). Specific methodological details differ, but they broadly follow this structure: (i) definition of a topic or project to study, (ii) co-development of accessibility measures, (iii) assessment of the perceptions and experiences of practitioners.

Whereas several policy documents in North America and Europe include accessibility indicators, most planning applications and examples of accessibility instruments found in the literature come from Europe (Bertolini et al., 2019). The most extensive work on this subject is the COST Action TU1002, “Accessibility Instruments for Planning Practice in Europe” (Bertolini et al., 2019; Hull et al., 2012; Silva et al., 2017, 2019). This initiative has evaluated the integration of accessibility theory and instruments in Europe and Australia. The researchers evaluated the usefulness of accessibility instruments according to practitioners and user-friendliness according to developers. Accessibility instruments were first classified based on seven criteria: topic of study, roles, spatial scales, types of accessibility measures, transportation modes, trip purposes and visualization output. The authors gathered feedback from 80 participants on 20 accessibility instruments through workshops and surveys. Findings show that most practitioners viewed the accessibility instrument they tested as useful. They also identified the availability of data and the segregation of land use and transportation institutions as possible barriers to the usefulness of these instruments, a finding consistent with past research (Boisjoly & El-Geneidy, 2017b; Papa et al., 2016).

Another significant work for our study is the *Joint Accessibility Design* of Straatemeier & Bertolini (Straatemeier & Bertolini, 2008), first developed in 2008, and then evaluated in the COST Action TU1002 project (Hull et al., 2012). The authors developed a framework to promote accessibility-based planning (Straatemeier & Bertolini, 2008). It is based on four steps: (i) common conceptualization of accessibility between researchers and practitioners, (ii) accessibility measurement, (iii) development of scenarios and analysis of accessibility gains, and (iv) evaluation of opportunities and barriers for accessibility-based planning. They then applied this framework during three workshops with land use and transport practitioners, and the case studies were conducted in the cities of Almere and Rotterdam in the Netherlands (Straatemeier & Bertolini,

2020). Overall, during the workshops, participants commented that they were pleased with the new knowledge acquired during the case studies and found the accessibility instrument useful. The research team also evaluated the long-term impact of their project. Practitioners in Rotterdam highlighted how the *Joint Accessibility Design* was a catalyst for the integration of accessibility indicators in transportation studies in Rotterdam. Nonetheless, findings show that implementing accessibility requires institutional changes (e.g., implementing accessibility analysis in current tools, politicization of accessibility) to the land use and transport planning fields (Straatemeier & Bertolini, 2020).

More recently, Pönkänen et al. (2025) developed a tool to measure accessibility to several daily destinations (e.g., libraries, jobs, grocery store) and computed the Palma ratio, an inequality measure. The researchers then built an online visualization tool and evaluated its usability through focus groups with transport planners in Finland. Results showed that practitioners agreed on the relevance of accessibility as a concept that bridges land use and transportation planning. They identified many potential uses including diagnosis, ex-ante evaluation, and transportation project planning, though availability and quality of data were cited as potential barriers, again in line with past research (Boisjoly & El-Geneidy, 2017b; Papa et al., 2016).

5.2.4 Research gap

Our study builds on previous work (Silva et al., 2017; Straatemeier & Bertolini, 2008, 2020) that evaluated opportunities for accessibility-based planning through participatory studies. While previous research has identified the potential of accessibility-based planning (Silva et al., 2019), it also highlighted the need for practice-oriented research documenting opportunities for accessibility indicators to tackle implementation shortfalls (Silva & Larsson, 2019). This study contributes to filling this gap by evaluating the factors supporting or impeding accessibility-based planning through a research action methodology. To our knowledge, this study is the first to conduct participatory planning workshops to better understand accessibility implementation in the North American context. This contribution is significant considering North American cities generally differ from European cities in terms of travel patterns (e.g., travel behaviour, automobile ownership), urban development, transportation systems, and governance structure. Many cities where accessibility workshops were conducted during the COST Action TU1002 project, including Munich (Büttner et al., 2018) and Madrid (Hull et al., 2012), exhibit spatial characteristics, such as compact urban form and sustainable transportation systems that are conducive to accessibility-

based planning. Conversely, North American cities have been built around the automobile and the segregation of land uses. Hence, institutional barriers are likely to be more pronounced, and our findings could be valuable to planners working in car-dependent and segregated urban pattern contexts.

5.3 Context

5.3.1 Land use, transport, and governance in Montreal, Canada

The City of Montreal has around 1.7 million residents (Statistics Canada, 2022) and is served by a metro system consisting of four lines (68 stations), a newly constructed light rail system with 19 operating stations (as of 2026) as well as buses and suburban trains (almost exclusively during peak hours, and with low frequency). In terms of active mobility, the Montreal territory is covered by the Express Bike Network (Réseau express vélo), a protected bike lane system of 191 kilometres (Ville de Montréal, 2025). In the City of Montreal, the mode shares were 52% (automobile), 26% (public transport), 19% (walking and cycling), and 3% (other modes) in 2018 (Autorité régionale de transport métropolitain, 2020). Figure 5.1 shows the three neighborhoods (LaSalle, Montréal-Nord, Côte-des-Neiges – Notre-Dame-de-Grâce) in which the case studies are conducted, alongside the metro network, which is the most influential public transport service in terms of travel behavior and land use developments in the city.

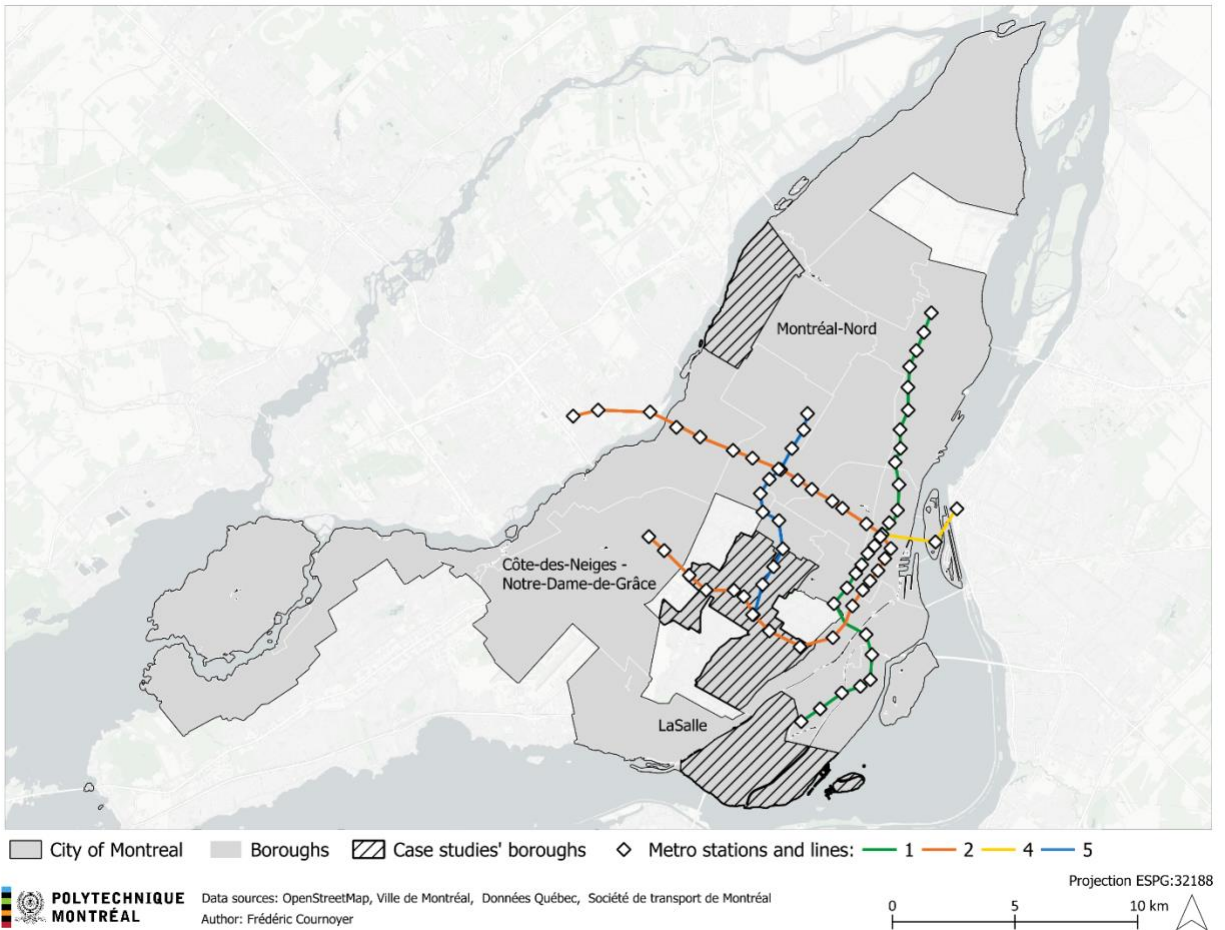


Figure 5.1 Context map of Montreal, Canada and case studies' boroughs

5.3.2 Urban and mobility planning strategy 2050 (PUM 2050)

The latest urban and mobility planning strategy of the City of Montreal was adopted in June 2025 and was published by the Urban Planning and Mobility Department (the integration of urban and transport planning into one department occurred in 2019 in Montreal) (Ville de Montréal, 2024). This strategy, referred to as the PUM 2050, acts as the reference document in terms of land use and transport orientations, strategies, goals, and indicators for the City of Montreal. Accessibility is a central component of the PUM 2050. The document emphasizes the importance of supporting accessibility by public transport and active modes. Alongside, land use interventions (e.g., mixed-use development, densification, transit-oriented development) are seen as key levers to promote sustainable transportation habits. Consequently, our study occurs at a time when the accessibility

paradigm shift is gathering momentum in the City of Montreal, and the boroughs are required to adapt their policies and planning strategies to align with the PUM.

The document includes four specific accessibility targets: (i) by 2050, 75% of Montrealers live within a 15-minute walk of key everyday resources, (ii) by 2050, 48% of the areas in Montreal's employment hubs are accessible by both the structured public transit network and the high-quality cycling network, (iii) by 2050, 30,500 m² of new library space is added across the city to ensure quality access for at least 70% of Montrealers, and (iv) by 2050, in prioritized opportunity areas, Montreal sets a target of 10 m² of publicly accessible parks and green spaces per resident within a 15-minute walking distance (Ville de Montréal, 2024).

In terms of governance and local planning, the municipal boroughs need to comply to the policy directions outlined in the PUM 2050. In such a way, boroughs have adopted or will adopt a “Local mobility strategy” (Plan local de déplacements), which dictates their transportation vision, priorities, and projects. These typically include localized interventions, such as the development of cycling infrastructure or the installation of traffic calming measures. When projects overlap multiple boroughs or when they have a municipal reach, the Urban Planning and Mobility Department coordinates and supports the work.

5.4 Data and methodology

To achieve the study objectives, we developed a methodology based on participatory planning workshops, building on the *Joint Accessibility Design* proposed by Straatemeier & Bertolini (2008, 2020). This approach was adopted to go beyond the technical barriers identified in previous studies (mostly surveys) and evaluate barriers emerging from the workshops wherein practitioners are conceptualizing accessibility indicators. The contribution of this approach is threefold: first, in this study, the research team conducted the technical work and calculated the accessibility indicators, which were then given to practitioners. In such a manner, we can evaluate the usefulness of accessibility indicators if they are in the hands of planners. Second, accessibility is inherently multidisciplinary. If planners are to use accessibility indicators for planning projects or decision-making, this process necessarily involves the collaboration of practitioners from different disciplines. Conducting workshops allows us to gather practitioners from different backgrounds and with different work mandates. Third, the workshops replicate, with some differences, the structure and content of a real-life work meeting held by practitioners. This is instrumental to our

project, as it gives the opportunity to participants to think and talk of accessibility with their language, words, and concepts. As discussed by Kitzinger (1994), case studies and focus groups can be disorderly (which complicates data collection and analysis), but are representative of what multidisciplinary teams can experience.

5.4.1 Case studies and workshops design

Montreal was selected as the overall context to conduct the three case studies given its recent focus on accessibility-based planning, as found in previous research (Cournoyer, White, et al., 2026). Three boroughs were then selected to undertake the case studies. We decided to conduct the workshops with boroughs since they are the ones responsible for implementing the accessibility targets at the local level. For two of the case studies (Montréal-Nord and Lasalle – see Figure 5.1), the project was carried out exclusively with practitioners from the municipal boroughs, and the case studies addressed the general land use and transport planning for the whole borough. For the third case study, located in the borough Côte-des-Neiges – Notre-Dame-de-Grâce, a specific project (the Quartier Namur-Hippodrome - QNH) was selected, and participants included planners from the borough, but also from the Urban Planning and Mobility Department of the City of Montreal, given the municipal reach of the project selected for the case study (see Section 5.1 for more details).

The selection process of boroughs was based on four criteria: (i) identified as a priority sector in the PUM 2050, (ii) the availability and interest of possible participants, (iii) having on-going accessibility related projects or targets (enabling us to assess the adoption of accessibility indicators in practice) and (iv) the selection of a diversity of boroughs in terms of land use, transport characteristics, and in their current level of accessibility integration.

In terms of participants, practitioners from different disciplines, including urban planners, mobility engineers, community development agents, and economic development agents were gathered. As accessibility is a concept relevant to multiple professions, it was important to gather professionals with different backgrounds, perspectives, and work mandates to answer our research questions. To recruit the participants, we asked team directors or coordinators to invite every practitioner whose work could relate to transport or land use to participate in the workshops. We did not aim to gather a representative sample of land use and transport practitioners, but rather to meet every practitioner

whose work could benefit to and from the workshops. Table 5.1 presents the number of participants for the case studies. Past research suggests that many factors, such as the aim and specificity of the study, as well as underlying theory, influence the ideal number of participants for qualitative research (Malterud et al., 2016). Although no exact guideline exists, the body of literature on qualitative research (Malterud et al., 2016) and transport research (Cunha et al., 2023) suggests a sample from six to ten participants. In line with this, we aimed to gather around six participants, to enable discussions among practitioners with different roles and mandates. The Montréal-Nord case study is singular, given it operates with fewer human resources than the other two municipal boroughs and not all participants were available for the three workshops, explaining the smaller sample size. After the project was granted ethics approval from the university's ethics board, participants signed a consent form and specific details on their occupation are not given for privacy considerations.

Table 5.1 Number of participants for the case studies

	First workshop	Second workshop	Third workshop
LaSalle	5	6	6
Montréal-Nord	3	2	5
Namur-Hippodrome (QNH)	6*	6	5
*workshop held online			

Building on Straatemeier & Bertolini (2008, 2020), the core of this research consists of three workshops of two hours with practitioners, for each of the three case studies. All workshops were held in-person, except for the first workshop for the QNH case study (as requested by the participants). In-person attendance was instrumental for the second and third workshops, since we were presenting maps, and aiming to generate discussions between practitioners and researchers. Figure 5.2 presents the objectives, structure and outputs of each workshop, alongside the work conducted by the research team between the workshops.

First workshop

Objectives

- (i) Introduce the concept of accessibility
- (ii) Understand the context of the borough and their projects
- (iii) Define the subject of analysis and the needs of the borough
- (iv) Link their projects to accessibility indicators and PUM 2050 targets

Structure

- First focus group (30 mins): Evaluation of the knowledge of practitioners
- Presentation of accessibility theory and indicators
- Co-creation of accessibility measures based on the borough's needs and planning priorities

The research team calculates the initial accessibility indicators.

Second workshop

Objectives

- (i) Analysis of spatial and numerical accessibility (maps, indicators, data)
- (ii) Creation of scenarios

Structure

- Presentation of accessibility results and indicators
- Co-creation of transport and/or land use planning scenarios
- Second focus group (30 mins): Evaluation of the usability of accessibility indicators for scenario creation

The research team generates transport and/or land use scenarios and calculates the updated accessibility indicators.

Third workshop

Objectives

- (i) Analysis of scenarios and hypothetical choice of a scenario
- (ii) Review of barriers and opportunities for implementing accessibility indicators in planning
- (iii) Review of the case studies process

Structure

- Presentation of accessibility results and indicators from new scenarios
- Third focus group (60 mins): Evaluation of the usability of accessibility indicators, the barriers to implementation, and the case studies process

Figure 5.2 Participatory planning workshops workflow

During the first workshop, prior to presenting the project, we first evaluated the practitioners' knowledge and understanding of accessibility through a 30-minute focus group (details for focus groups will be given in Section 4.2). Then, we presented the concept of accessibility together with different location-based accessibility measures. Six types of location-based measures were presented to practitioners: the closest destination, cumulative opportunity measures, passive accessibility (e.g., this major destination is accessible by five residential lots in a 15-minute walk),

composite accessibility indicators (e.g., integrated measure of access and quality of parks, see El Murr et al. (2025) for an example), gravity-based measures, and floating catchment area measures. The goal was to showcase existing accessibility measures without influencing their future choice of measures (among the ones presented). The next step was to co-create accessibility indicators with boroughs to address their needs and priorities.

Following the first workshop, maps and graphs were created to spatially and numerically present the results of the accessibility analysis. The second workshop started with the presentation of the accessibility results to the practitioners to collect their reactions, thoughts, and comments. The second half of the workshop was dedicated to a 30-minute focus group (questions will be presented in the next section) and to the definition of land use and transport scenarios to be evaluated. In the context of this study, scenarios refer to transport (e.g., new bike path, development of a bus line) and/or land use (e.g., densification, generation of opportunities) proposed interventions, as done in previous research (see Caiati et al., (2025)).

Following the second workshop, new maps and refined indicators were created to show how the identified land use and transport scenarios would impact accessibility. The third workshop then consisted of a discussion of the scenario results with the practitioner and a 60-minute focus group, aiming to review the case studies process and identify the opportunities and barriers for the implementation of accessibility indicators with practitioners.

5.4.2 Data collection and analysis

Figure 5.3 presents the data collection process defined to answer our research questions. Structured around our four research questions, the data collection included focus groups, participant-generated data, and observations. Workshops (including focus groups) were recorded to facilitate data collection and analysis.

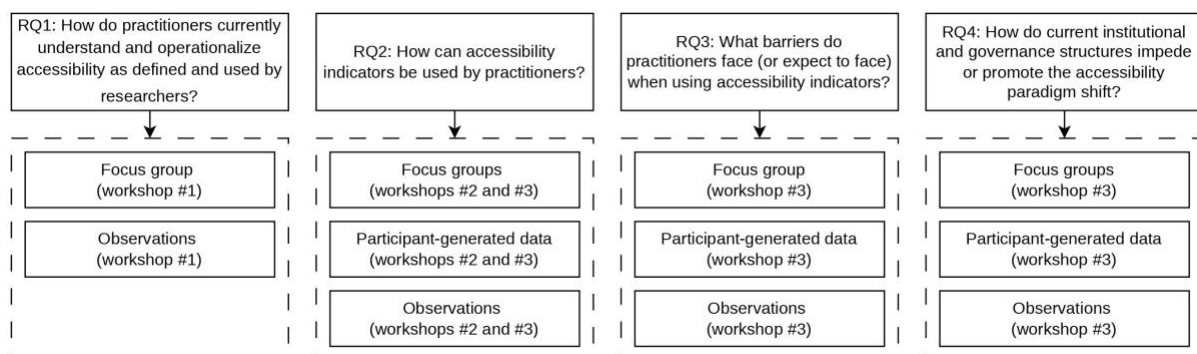


Figure 5.3 Data collection and analysis framework

5.4.2.1 Focus group questions

To answer our research questions, we decided to conduct three short focus groups, one during each workshop, for each case study. Focus groups are a qualitative method used to obtain opinions from participants about a specific and common subject of interest (Kitzinger, 1994). Many studies on transportation or land use (see for example Cunha et al. (2023) and Nello-Deakin (2024)) have conducted focus groups to assess the perceptions, opinions and experiences of planners. As discussed previously, the main motivation to choose this method of data collection was the multidisciplinary nature of accessibility. Accessibility-based planning involves land use and transportation planners, but also practitioners from related disciplines (e.g., economic development, social inclusion), which involves building a common vision with their respective knowledge and background.

Table 5.2 presents the questions designed for each focus group. These were designed to address our four research questions in light of the literature on the barriers to (and usability of) accessibility adoption (Pönkänen et al., 2025; Silva et al., 2017). We planned a low number of questions not to restrict the thoughts of planners and let them bring the conversation to other topics if they deemed it relevant. Participants were also given sheets of paper to note their thoughts during the focus groups. Considering the limited amount of time available, some participants might not have been able to participate in every discussion. In these instances, they could note down their thoughts. Members of the research team noted answers and discussions during the focus groups, which were then corroborated with the transcription of the audio recording.

Table 5.2 Focus groups' questions

Research question	Focus group #1 (30 minutes)
RQ1	Q1: What do you know about the concept of accessibility to destinations (components, definition, context)?
RQ1	Q2: What indicators or data do you use to plan mobility, transportation, or urban development projects?

Table 5.2 Focus groups' questions (suite)

Focus group #2 (30 minutes)	
RQ2	Q3 The data is mainly presented in the form of maps. Would other tools or indicators be more appropriate?
RQ2	Q4 What contributions do accessibility indicators make to design potential land use and transport interventions to be evaluated?
Focus group #3 (60 minutes)	
RQ2	Q5: At what stage(s) of a project (e.g., strategic planning, active decision-making, passive decision-making, plan evaluation, project evaluation, corridor study) would accessibility indicators be relevant or useful?
RQ2	Q6: Can these indicators be integrated into some of your current tools?
RQ3	Q7: What is currently preventing you from using accessibility indicators in your work?
RQ4	Q8: Could this change be supported by a regulatory framework? What resources (e.g., time, tools, money) would be needed?
RQ4	Q9: Could there be resistance to integrating accessibility? If so, from whom and why?

5.4.2.2 Participant-generated data

The second category of data collected includes participant-generated data. When maps and indicators were presented to practitioners, they were asked to note down their first impressions and thoughts. They were given sticky notes and coloured dots (red, blue, green) to identify weaknesses, possibilities, and strengths of accessibility maps. These notes helped us enrich and corroborate the results of the focus groups and answer our research questions, as shown in Figure 5.3.

5.4.2.3 Observations

In addition to everything that was written and said, we also observed how participants interacted and expressed reactions. As expressed by Clifton & Handy (2003), it is relevant to observe

participants in a working context that simulates their daily life (and work) to understand their behaviour. In our case studies, during the focus groups, participants (positively and negatively) reacted to their colleagues' or the research team's comments, which helped us understand if there was a consensus over a certain topic. Reactions were also relevant when maps and indicators were presented or in relation with the time spent on subjects, given practitioners were sometimes interested in elaborating more and in other cases would be brief in their remarks. As these observations are not entirely captured by the audio recording of the workshop, they were noted by the research team members.

5.4.3 Data analysis

Workshops were recorded and the entirety of the qualitative material, including focus groups discussions, participant-generated data, and researcher observations, including pictures of presented accessibility maps (and annotations), were transcribed. The first step of analysis (results presented in section 5.1) consisted in documenting each case study. First, for each case study, the material of the three workshops (see Figure 5.2) was reviewed to document how accessibility was collectively explored, as done in previous research (Straatemeier & Bertolini, 2020). This included a description of which accessibility indicators were chosen and why, how the scenarios were defined, and which trip purposes and transportation modes were considered. A summary is presented in Section 5.1 and further details are available in the supplementary material. This step was essential to reconstruct the workshop process and highlight how accessibility knowledge was co-produced with practitioners. This approach is consistent with literature on case study theory (Flyvbjerg, 2006) that highlights the importance of the co-creation process of knowledge and not only the outputs. Note that the aggregated results are presented for privacy reasons, without naming the practitioners or their specific occupations. When relevant, anonymized excerpts are presented.

In the second step (results presented in section 5.2), the data analysis followed an iterative process and the content was evaluated using a deductive strategy (Flick, 2014; Srivastava & Hopwood, 2009). Focus group questions, participant-generated data, and researcher observations were treated jointly to answer each research question. The research questions were predefined based on the accessibility literature (Boisjoly & El-Geneidy, 2017b; Papa et al., 2016; Silva et al., 2017), and refined based on the findings of the case studies. As shown in Figure 5.3, we categorized relevant

excerpts from transcripts into four categories, one for each research questions (one excerpt can be assigned to more than one category). This was done manually by the first author and resulted in full corpus of qualitative material for each research question in a distinct text document. For privacy considerations, results are aggregated for the three boroughs. This approach cross-validates results across case studies to identify if results and opinions are shared between practitioners from different working groups (as done in previous research (Cunha et al., 2023)), which is consistent with case study theory (Yin, 2017).

5.4.4 Accessibility calculations

The *r5r* package was used to calculate accessibility measures (Pereira et al., 2021). As will be presented in the results section (Section 5.1), all indicators calculated were cumulative-opportunity measures (except for one measure of passive accessibility). For the cumulative-opportunity measures, travel time matrices were obtained with *r5r*, and then a filter was applied to count the number of destinations accessible under a time threshold (e.g., 15 minutes in the context of the 15-minute city), following equations 1 and 2 (Boisjoly & El-Geneidy, 2016; Geurs & van Wee, 2004):

$$A_i = \sum_j O_j f(C_{ij}) \quad (5.1)$$

$$f(C_{ij}) = \begin{cases} 1 & \text{if } C_{ij} \leq t \\ 0 & \text{if } C_{ij} > t \end{cases} \quad (5.2)$$

with A_i representing the number of destinations accessible for residential lot i , O_j the number of destinations at location j , and $f(C_{ij})$ the weighting function which returns 1 if the travel time C_{ij} is under a certain time threshold or 0 if it is over.

The passive accessibility measure calculated in this study counted the number of residential lots in the catchment area of a destination under a specified time threshold, based on equation 3 (Lee & Salih, 2024):

$$PA_j = \sum_i d_i f(C_{ij}) \quad (5.3)$$

where PA_j is the passive accessibility score of a destination, d_i is the number of dwellings of residential lot i , and $f(C_{ij})$ the weighting function which returns 1 if the travel time C_{ij} is under a certain time threshold or 0 if it is over.

The accessibility measures were calculated at the residential lot level (the smallest spatial residential unit in the Canadian context), in line with past research having identified that smaller scales minimize inaccuracy of accessibility results (Jasso Chávez & Manaugh, 2025). Four datasets were required: the road network, origins (i.e., residential lots), public transport files (when necessary), and destinations. The different datasets, collected on June 16, 2025, and their source are presented in Table 5.3. Destinations were chosen based on the needs and priorities of practitioners and only the main source of data is presented in Table 5.3. Since the work carried out was at a relatively small scale, we were able to manually validate each destination dataset. When possible, such as in the case of grocery stores, we analyzed multiple databases (e.g., City of Montreal, OpenStreetMap, Quebec Enterprise Register) to increase accuracy of the data. Specific details about data will be given for the three case studies in the next sections.

Table 5.3 Data used for accessibility calculations

Data	Source	Geometry / file type
Road network	BBBike (Schneider, 2025)	Polylines / .pbf
Origins (residential lots)	Ministère des Affaires municipales et de l'Habitation (Ministère des Affaires municipales et de l'Habitation, 2022)	Polygons / .shp
General Transit Feed Specification (GTFS) Files	Société de transport de Montréal (Société de transport de Montréal, 2025)	GTFS format
<i>Destinations</i>		
Schools	Ministère de l'Éducation et Ministère de l'Enseignement supérieur (Ministère de l'Éducation et Ministère de l'Enseignement supérieur, 2017)	Points / .shp
Daycares	Ministère de la Famille (Ministère de la Famille, 2019)	Points / .csv
Parks	Ville de Montréal (Ville de Montréal, 2019)	Polygons / .csv
Pharmacies	OpenStreetMap (OpenStreetMap contributors, 2025)	Points / .geojson
Grocery stores	Ville de Montréal (Ville de Montréal, 2017)	Points / .shp
Hospitals	Ministère de la Santé et des services sociaux (Ministère de la Santé et des services sociaux, 2020)	Points / .shp
Shops	OpenStreetMap (OpenStreetMap contributors, 2025)	Points / .geojson
Public services	Ville de Montréal (Ville de Montréal, 2021)	Points / .shp

5.5 Results and discussion

5.5.1 Case studies – Co-creation of indicators and scenarios

Table 5.4 presents the indicators and scenarios that were codeveloped during the workshops (see supplementary material for further details). For each case studies, between two and three indicators were selected. Most notably, indicators for the 15-minute city were selected for the three case studies. As for the scenarios, three of them relate to land use interventions (in Lasalle and QNH), where the scenario in Montreal-Nord focuses on transport interventions.

Table 5.4 Indicators and scenarios defined during the workshops

	Indicators	Scenarios
LaSalle	• 15-minute city • Combined Index of Park Quality and Accessibility for Youth (CIPQAY) • Walking accessibility to grocery stores	• Development of non-residential lots into residential lots • Construction of new parks
Montréal-Nord	• 15-minute city • Biking accessibility to proximity destinations (LTS 2 and LTS 4) • Accessibility by public transport to public services, hospitals, grocery stores, and shops (peak and off-peak)	• Henri-Bourassa sustainable mobility corridor (new bus rapid transit and cycling infrastructure)
Namur-Hippodrome	• 15-minute city • Passive accessibility	• Long-term phasing of residential lots and destinations

In Lasalle, practitioners quickly stated their interest to study the 15-minute city and accessibility to proximity destinations (e.g., parks, grocery stores, schools). Three accessibility indicators were defined: (i) a composite indicator of the 15-minute city (as defined in the PUM 2050), (ii) the combined index of park quality and accessibility for youth (CIPQAY) (Cournoyer, Waygood, et al., 2026; El Murr et al., 2023, 2025), and (iii) an indicator of accessibility to grocery stores integrating quality. Two scenarios were defined with the practitioners based on the accessibility maps presented: (i) the redevelopment of non-residential into residential lots and (ii) the development of new parks. When presented with the results, practitioners struggled with the complexity of the different categories of the 15-minute city (see Figure 5.4 for an example) and the CIPQAY index. Accordingly, for the third workshop, simpler cumulative-opportunity measures were defined and presented with maps. Overall, practitioners stated that this second round of accessibility indicators were of greater use, since we had updated the indicators based on their comments.

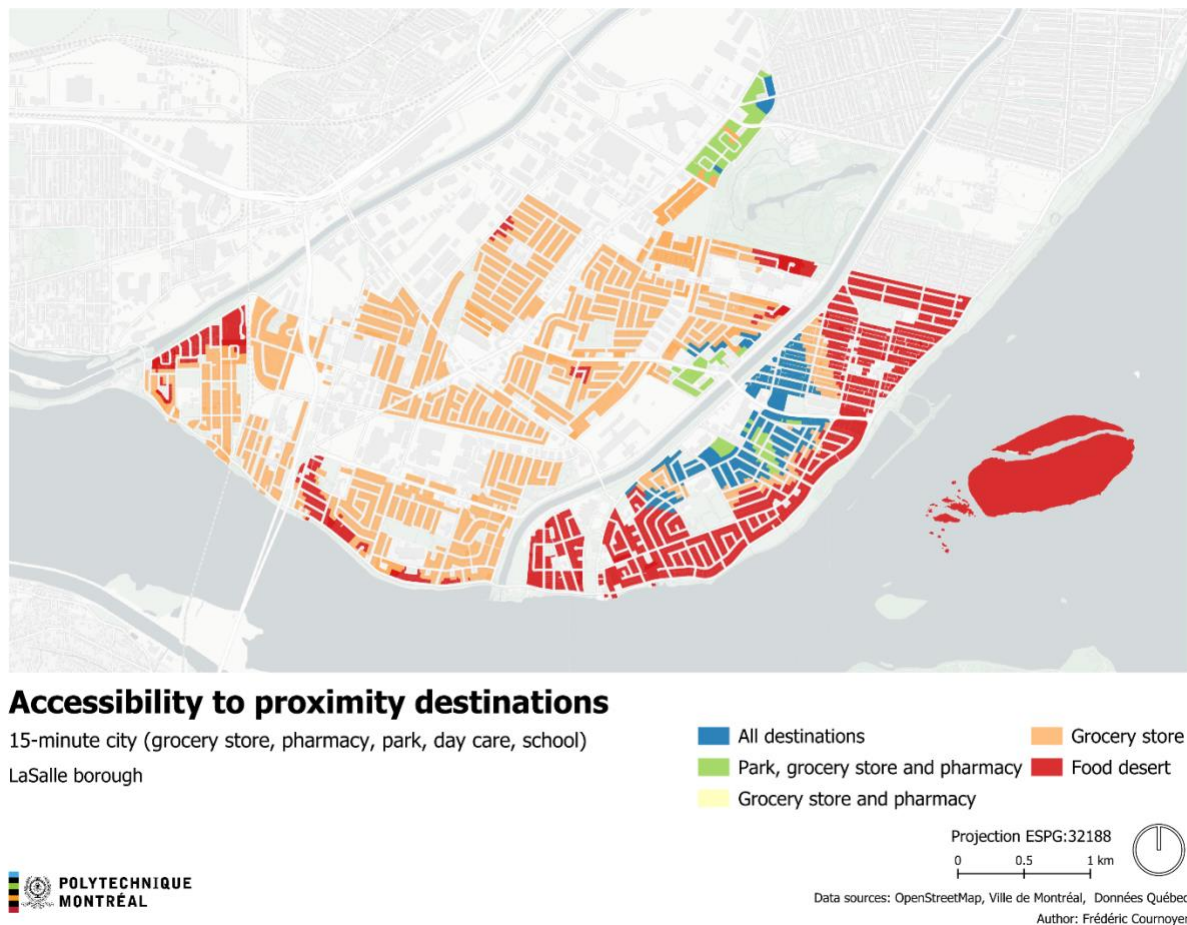


Figure 5.4 Map of the 15-minute city in LaSalle presented during the second workshop

In Montréal-Nord, practitioners stated that the 15-minute city was not a short-term objective of the borough considering the current state of the transportation infrastructure and urban development patterns. Practitioners were interested in receiving a diagnostic of accessibility to proximity destinations by walking (proposed by the research team based on the PUM 2050), but felt that they had limited capacity to enact meaningful improvements. The Henri-Bourassa sustainable mobility corridor and the projected cycling infrastructure were, instead, considered as the topics of interest. The corridor consists in the implementation of a new bus rapid transit (BRT) service and a protected cycle lane. In line with this, in collaboration with practitioners, it was decided to study accessibility to proximity destinations by cycling and accessibility to destinations by public transport. For cycling accessibility, we calculated accessibility to schools, parks, and public services using with a 15-minute time threshold and two levels of traffic stress (medium comfort – LTS 2 and low comfort – LTS 4). For public transport, accessibility to public services, hospitals, grocery stores,

and stores was calculated using a cumulative opportunity measure with a time threshold of 30 minutes. An example for accessibility to shops is shown in Figure 5.5. Two measures were defined: one for the peak period (6 am to 9 am) and one for the off-peak (11 am to 14 pm) period. When presented with the results during the second workshop, practitioners were mostly satisfied with the public transport and cycling indicators. Practitioners mentioned that the methodology and the presentation of indicators were easy to comprehend. For the public transport and cycling indicators, they viewed the possibility of sharing the results to the public transport agency in Montreal and to decision-makers, with the purpose of justifying the need for new transportation projects.



Figure 5.5 Accessibility to shops by public transport in Montréal-Nord

The context of the Namur-Hippodrome Neighborhood project (Quartier Namur-Hippodrome or QNH) differs from the previous case studies, as it consists of an empty site which is to be developed – in three phases – to host around twenty thousand dwellings, as well as local amenities (e.g.,

grocery stores, pharmacies), and services (e.g., schools, daycares, parks, libraries, cultural centers) in the next decades. Practitioners, from the borough and from the City of Montréal, expressed that access to daily destinations in a 15-minute walk was a central component of the QNH vision, since QNH is intended to be a self-sufficient neighborhood, with very low automobile use. To calculate accessibility, residential lots and road segments for QNH were manually drawn in QGIS. At the start of the second workshop, accessibility maps for each of the destinations (i.e., grocery stores, pharmacies, parks, daycares, schools, and public services) were presented to practitioners. We also presented the numerical distribution of accessibility for each destination (see Figure 5.6b). The scenarios defined were based on the three development phases (including residential lots and destinations development) as shown in Figure 5.6a. For each destination, we calculated three sets of accessibility indicators, one for each phase. During the third and final workshop, we presented the accessibility maps associated with each phase. As an example, Figure 5.6a shows the accessibility to grocery stores for the three phases. In the last workshop, the practitioners expressed their wish to integrate accessibility indicators in the actual planning of the project. Accordingly, QNH practitioners noted their interest to pursue the collaboration with the research team to refine the accessibility analyses.

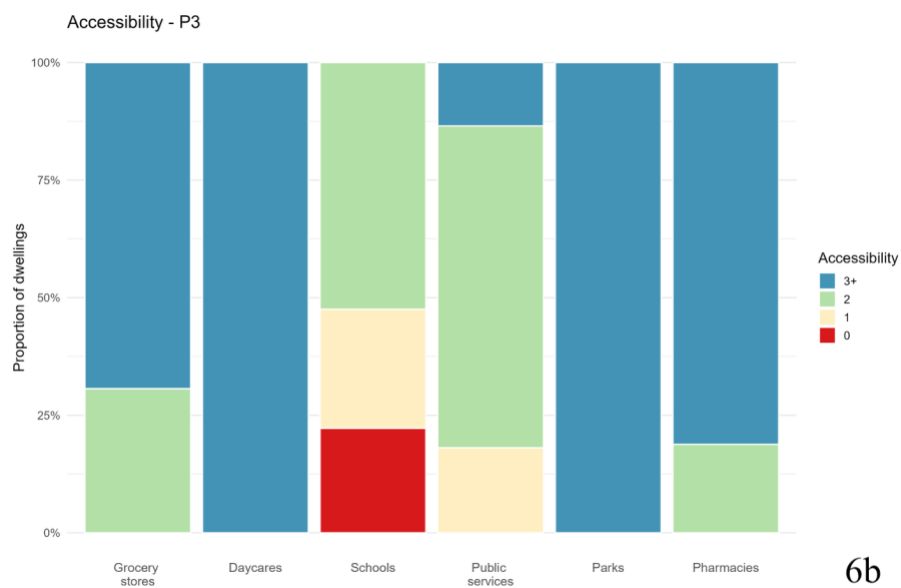


Figure 5.6 Accessibility to grocery stores in QNH (6a) / Numerical accessibility for the third phase of QNH (6b)

5.5.2 Barriers and opportunities to accessibility-based planning

5.5.2.1 RQ1: How is accessibility currently understood and operationalized by practitioners?

The first focus group was held at the beginning of the first workshop: before presenting the research project to the participants, we asked them to define accessibility in the context of their work and discuss how it relates to their work.

Most practitioners associated accessibility with the possibility of reaching destinations. Most also repeatedly mentioned the “ease” of the trip, and not simply the possibility to achieve it. For instance, a practitioner stated: “I think it's the ability to successfully reach a desired location, and then the fact that it's more or less easy, safe, user-friendly.” In the three focus groups, the ease and the safety of the trip referred to the fact that, in the three boroughs, some roads, boulevards (due to the hazard created by traffic) and underpasses (due to personal safety) were seen as unfavorable for active trips, given they created barriers to accessing local destinations. Practitioners also mentioned several physical barriers (e.g., railways) which prolonged trips and led to some residents crossing them illegally. Overall, the practitioners insisted on the distinction between the theoretical indicators and the lived experiences of individuals.

Equity considerations were also mentioned by practitioners in the three focus groups. The comments often emphasized the different abilities of different population groups, for example: “What is accessible to me may not be accessible to an older person.” There were few to no mentions of the importance of assessing spatial disparities: in LaSalle and Montréal-Nord, practitioners viewed the majority of their neighborhood as socio-economically vulnerable, and thus in need of transport and land use interventions across the entire borough. In the case of QNH, spatial disparities did not come up as a concern, potentially because of the small area size or because there are no residents yet.

Across the three case studies, no practitioner had previously calculated accessibility indicators. Nonetheless, in two instances, practitioners had worked with such indicators. One practitioner mentioned that their team had collaborated with a transport planning firm to calculate park catchment areas, and another borough mentioned the use of the “Equity Index for Living Environments” (see Ville de Montréal (2022)) developed by the City of Montreal, which includes

a component of “access to proximity resources” and deprivation levels. How the practitioners used or were planning to use these indicators remained, however, unclear.

Then, we also aimed to determine what were the commonalities and gaps between researchers’ conceptualization of accessibility and practitioners’ understanding. First, as discussed above, the practitioners’ definition of accessibility closely matched the literature on accessibility. Second, a preference for simpler indicators was observed, in line with a growing body of research seeking to bridge the gap between research and practice (Boisjoly & El-Geneidy, 2017a; Kapatsila et al., 2023). Simply put, past research has identified a dichotomy between defining easy to communicate (and to compute) and theoretically-sound measures (Kapatsila et al., 2023). These two criteria are often in conflict, since defining more complex measures might involve impedance functions or random utility theory, which comes at the detriment of ease of communication and interpretability (Boisjoly & El-Geneidy, 2017a; Siddiq & Taylor, 2021; te Brömmelstroet et al., 2016). In our study, all accessibility indicators defined through the collaborative processes were either cumulative-opportunity (n=7) or passive accessibility measures (n=1). These measures are easier to compute and represent something tangible (e.g., having access to 3 grocery stores within a 15-minute walk), making them easier to communicate. Although more theoretically-sound measures (e.g., gravity-based or floating catchment area measures) were presented to practitioners, they showed little interest to measure them. This is a key result stemming from the case studies: even when presented with the opportunity to have access to more complex indicators, practitioners opted for the simpler ones. This suggests that even when the methodological and technical barriers of accessibility computation are removed, cumulative-opportunity measures are preferred by practitioners, and our case studies revealed that this is mainly due to interpretation and communication purposes.

In terms of destinations, the only theoretically complex indicator (the CIPQAY, a composite indicator of park accessibility and quality) generated by the research team and discussed with the practitioners was not understood nor valued. From a research perspective, this measure (the CIPQAY) seemed relevant, as its correlation with perceived accessibility and satisfaction with access to parks was shown in previous studies (Cournoyer, Waygood, et al., 2026; El Murr et al., 2023, 2025). This points towards the fact that ease of communication might be more important than theoretical soundness in several cases, a finding consistent with previous studies (Boisjoly & El-Geneidy, 2017a). It also reflects the call for more “simplicity” echoed in previous research on

the development of accessibility indicators, specifically in the context of proximity-based accessibility planning (Silva et al., 2017). Combining a simpler quantitative measure of accessibility with qualitative data may be more effective than designing complex calculated measures of accessibility as discussed by Handy & Niemeier (1997). It is important to note that this finding, the propensity for simpler measures, may be a result of the local scale of analysis of the three case studies. In fact, accessibility indicators were chosen by practitioners to assess localized priorities and interventions, relating to local accessibility and proximity-centred accessibility. As such, our findings do not directly apply to regional transport and land use planning.

The importance of developing measures that can be understood by a range of stakeholders was also evident during the presentation of the accessibility maps. Many practitioners evoked that the categories of the 15-minute city (see Figure 5.4) were hard to grasp. Therefore, we adapted our maps for the third workshop, to only present one type of destination per map (see Figure 5.6a) for example). In addition to their own understanding, practitioners often discussed how the maps and indicators could be communicated to other stakeholders, namely elected officials and the population. This confirmed that the ease of communication was seen as important for both the design and the presentation of indicators.

As presented before, practitioners often mentioned how theoretical accessibility differs from what people might experience. They did not coin this observation as “perceived accessibility”, but their explanations matched the concept as defined in research (Negm et al., 2025). A practitioner explained how they viewed the difference between calculated and perceived accessibility: “We see that these homes have access to two daycare centres ‘on paper.’ But if crossing the Décarie Highway [an urban freeway running next to the QNH] is too dangerous or complicated, you could almost say that access doesn't really exist.” Another practitioner stated, in relation to the ease of completing certain trips: “The model shows potential, but we know that reality is more complex”. Accordingly, another avenue, and one unanimously mentioned by practitioners, for developing accessibility measures would be to integrate different levels of road comfort, safety, and/or danger, similar to our cycling LTS analysis. This could partly reduce the gap between calculated and perceived measures of accessibility, as demonstrated by Pot et al. (2021). Specifically, the individual component of accessibility (i.e. needs, preferences, constraints of individuals) may better be reflected if notions of traffic danger, personal safety and comfort are integrated.

5.5.2.2 RQ2: How can accessibility indicators be used by practitioners?

Across the three case studies, the third focus group (held at the end of the last workshop) revealed that practitioners viewed accessibility indicators as potential tools to support land use and transport planning in the context of their work. We classified the possible uses brought up by the practitioners in three categories (see Table 5.5): (i) territorial assessment, (ii) scenario evaluation, and (iii) communication strategies. Table 5.5 describes the three categories, alongside excerpts illustrating the potential usefulness of the indicators as described by practitioners.

Table 5.5 Possible uses of accessibility indicators for land use and transport planners

Category	Description	Excerpts
1. Territorial assessment • Validation or refinement of local knowledge • Integration of accessibility indicators in existing strategic documents	Identify underserved areas, service deserts, community severance	• <i>The grocery store map helps us identify food deserts.</i> • <i>In the Parks Master Plan, we work extensively with a prioritisation index. It's interesting to see how your maps could be combined with our index — quantity versus quality, basically.</i>
2. Scenario evaluation • Project prioritization • Long-term vision assessment • Monitoring of planning objectives	Compare impact of land use and transport scenarios on accessibility	• <i>These indicators could help us validate scenarios, for example, to see whether a future park will actually serve a large number of people or not.</i> • <i>Accessibility simulations could take into account the minimum densities set out in the “Metropolitan planning and development plan” and PUM to see if there are enough parks and services in the right locations.</i> • <i>The grocery store map is directly useful to us for working on food deserts and urban agriculture policy. It finally gives us something solid to base our assessment on.</i>
3. Decision-support levers • Communication with elected officials and other stakeholders • Business establishment incentives	Provide evidence-based justification for projects	• <i>The maps would be very useful in our discussions with the neighbourhood round table, the “Integrated university health and social services centres”, or food security partners. They provide figures, not just impressions.</i> • <i>There, you can show [accessibility indicators] to elected officials and they understand all this. In terms of communication, it's fine, it's great. The findings in the report are at a level suitable for an elected official.</i> • <i>We could specifically target certain sectors and say, “We'll give you some money to help you set up here,” because we know there's a shortage of bakeries and grocery stores.</i>

First, it emerged from the workshops that accessibility to destinations indicators could be a tool to identify gaps in the land use and/or transport systems. For example, practitioners observed how accessibility indicators helped identify food deserts as well as neighborhoods cut off from their surroundings due to poor cycling infrastructure. In both instances, this knowledge was not necessarily new to planners, but they emphasized that the indicators helped them put numbers on their prior assumptions and provided them with visualization tools. Therefore, practitioners highlighted the value of visualizing the current situation through maps, and to validate and refine local knowledge. Overall, in all three boroughs, practitioners repeatedly mentioned the usefulness of the maps as visualisation tools.

Practitioners working on QNH were also interested in assessing the numerical distribution of accessibility (e.g., 25% of dwellings would live in a food desert). To do so, bar graphs were presented during the second and third workshops (see Figure 5.6b). A lot of discussion went into the color scheme and categorization, highlighting the value practitioners gave to this tool. After refining the maps, practitioners stated that these measures could be easily understood by professionals from other disciplines, the population, and elected officials. They also highlighted how accessibility maps and indicators could be integrated into some of their strategic documents, namely in their “Urban agriculture action plan” (*Plan d'action en agriculture urbaine*) and “Local mobility strategy” (*Plan local de déplacements*).

Second, according to practitioners, accessibility indicators could be integrated into the planning process of land use and transportation projects. They suggested the possibility of measuring accessibility gains of localized interventions, such as the design of a new park or a new cycling facility. Additionally, practitioners noted that scenario analysis was an important and recurrent task for them, and that accessibility indicators could complement the traditional outputs of these analyses. For instance, practitioners in Montréal-Nord pointed out that accessibility maps showed drastic accessibility gains for some areas of the borough. The scenario analysis of the planned cycling network enabled them to identify which dwellings would be able to reach destinations that they previously could not (under a specific time threshold and with comfortable cycling links). These observations are also applicable to land use interventions. LaSalle practitioners mentioned the usefulness of accessibility indicators to support the planning of new parks or to prompt

businesses into settling in an area lacking a service such as a grocery store or a pharmacy. Practitioners also mentioned that the accessibility analyses could help them promote residential development in sectors that currently offer good accessibility to daily amenities.

Third, practitioners often observed that indicators could facilitate interdisciplinary collaboration and communication with elected officials and other actors such as developers, residents, and public transport agencies. This observation became evident when participants from Montréal-Nord suggested inviting some of their colleagues after the second workshop, realizing that accessibility indicators could be valuable to the work of a range of planners and could inform decision-making. In addition to practitioners participating in the case studies, the participants indicated that accessibility indicators could be valuable to community roundtables, community-based partners, and municipal employees from other departments. One precise example given was the opportunity to share accessibility results to the public transport agency in Montréal to raise awareness on the lack of public transport service on local roads. Finally, practitioners stated that our findings could be of general interest for current and future residents to know areas with greater accessibility to key daily amenities.

5.5.2.3 RQ3: What barriers do practitioners face (or expect to face) when using accessibility indicators?

Although accessibility indicators were viewed as useful and insightful by practitioners, they identified many conceptual/methodological and technical barriers to their usability (Table 5.6).

Table 5.6 Barriers to the use of accessibility indicators for land use and transport planners

Category of barriers	Description	Excerpts
1. Conceptual and methodological - Conceptual - Interpretive - Data	- Indicators measure potential, not real accessibility; do not capture lived experience; do not reflect user heterogeneity. - Incomplete, outdated, or hard-to-maintain datasets on shops, parks, networks, etc.	<i>The model does not reflect the actual experience: families do not cross the Décarie Highway.</i> <i>We need reliable, up-to-date data, otherwise we cannot rely on the maps.</i>
2. Technical - Resource	Lack of staff time, insufficient funding, saturated planning agendas.	<i>We do not have the human resources to keep this system up to date.</i>

Conceptual and methodological barriers, as defined by the research team, refer to difficulties of conceptualizing and interpreting results, as well as obtaining quality data. During the three case studies, practitioners emphasized that calculated accessibility did not equate to “lived” or “perceived” accessibility. To them, the results portrayed theoretical accessibility, meaning that a trip under a certain time threshold would be possible to achieve. These observations were often in conflict with the practical knowledge of planners. As such, considerations such as safe infrastructure for active modes or the level of traffic hazard are not integrated in the accessibility calculations but were felt by the practitioners to be key considerations. They pointed out that some vulnerable groups, including older adults or children, may choose to avoid walking on a specific sidewalk if it was bordered by fast-moving vehicles, which is a common landscape in the three boroughs. These observations by practitioners are consistent with research on the impacts of traffic danger on “lived” accessibility (Abdollahi et al., 2025; Tavakoli et al., 2024). A case study in Montreal found that children’s accessibility to important destinations, including educational, leisure, and green destinations could be reduced by 75% when considering traffic danger (Tavakoli et al., 2024).

The necessity to obtain recent, reliable, and complete datasets was also unanimously mentioned. During the three case studies, we undertook very localized and precise analyses. For instance, the

analysis of food deserts was conducted in the three boroughs. In each case, practitioners wanted to confirm, without any doubt, that the food deserts identified did not have access to a grocery store. This implied validating the data through an iterative process and using multiple data sources, including the practitioners' local knowledge. Without accurate data, practitioners noted that the indicators would lose credibility and their usability would be limited. This is an important limit considering the lack of up-to date and precise datasets. It also points out to the importance of including practitioners in the process, as shown in previous research (Straatemeier et al., 2010).

The second category of barriers refers to technical difficulties, and specifically the lack of dedicated resources for the development of accessibility indicators. Practitioners underlined that their current staff did not currently have the knowledge and ability to conduct accessibility analysis, through tools such as r5r, and with data such as GTFS data, or OpenStreetMap. They also emphasized that they lacked the time to develop the necessary skills. According to participants, this would limit their capability to develop an in-house system and lead to dependence on external resources.

5.5.2.4 RQ4: How do current institutional and governance structures impede or promote the accessibility paradigm shift?

In addition to usability barriers, practitioners described how institutional governance and political factors impede the accessibility paradigm shift, which is a result consistent with past research on policy integration (Hull, 2008). First, practitioners highlighted challenges related to the implementation of accessibility indicators into existing tools and practices. Practitioners mentioned that they were developing projects and making decisions using existing tools developed by the City and boroughs, and that decision makers were likely to question the relevance of developing a new tool. They also explained how their multiple internal mandates limited their availability to integrate a transversal concept such as accessibility, and that they lacked a clear framework to integrate accessibility across multiple departments. In all case studies, practitioners expressed that a clear pathway to reach the accessibility targets from the PUM 2050 was lacking and questioned this top-down approach, although we observed that the PUM 2050 guided their definition of accessibility indicators. Respondents raised some concerns over the future steps to achieve such targets. They mentioned that it was unclear to them how boroughs' specific targets would be set. This unclear roadmap to systematic implementation due to the lack of coordination between involved actors is

a result consistent with past research on the implementation of the Toronto's Growth Plan in Canada (Filion et al., 2015). Practitioners also highlighted that the decision process often fell outside the scope of their responsibilities and mandates. An example given by a practitioner was that they could identify a need for an elementary school in their borough (based on a gap in local access), but ultimately, the decision to plan a new school would be made by the Ministry of Education. In line with this, they noted that they could not force businesses to open grocery stores in food deserts. A practitioner summarized the institutional barriers impeding accessibility-based planning: "Even when you have a good diagnosis, it takes a long time to take action: you have to change regulations, zoning, the ten-year capital expenditure program... It doesn't happen in a few months."

Overall, the practitioners met viewed institutional governance as more problematic than technical capabilities, as found in previous research (Filion et al., 2015) and specifically in the European context (Papa et al., 2016; Silva et al., 2017). For instance, the QNH Project is designed to become a 15-minute city, which implies practitioners are expected to produce accessibility calculations. This resulted in practitioners requesting many more outputs from the project to be used later, compared to the other two case studies (i.e., LaSalle and Montréal-Nord). For the other case studies, the path to accessibility-based planning was less clear, which resulted in a lower motivation to use the outputs of the research project in the context of their work. This observation calls for more research on the ways forward to overcome institutional governance to promote accessibility-based planning. Future research could explore how institutional barriers impact land use and transportation actors within municipalities, metropolitan planning organizations or municipal boroughs. The lack of local guidelines (stemming from elected officials namely) also appeared to be a key determinant. Future research into the different governance structures is also warranted.

Despite these obstacles, practitioners were motivated to identify governance conditions that could promote the accessibility paradigm shift. As discussed previously, practitioners expressed how the *Urban and mobility planning strategy 2050*, by introducing accessibility, was a first step to bring the accessibility concept into prominence in the Montreal planning practice. All three boroughs highlighted how evidence-based planning is growing and how decision makers seek data, indicators and maps. Practitioners agreed accessibility indicators aligned well with this trend, particularly when they could show spatial inequities and disparities.

5.6 Conclusion

This paper evaluated the opportunities and the barriers to the implementation of accessibility in land use and transportation planning, using participatory planning workshops. Our methodology, structured around three workshops, aimed to co-create accessibility indicators and evaluate land use or transportation scenarios with these indicators. This way, we integrated the needs and priorities of practitioners into the design of accessibility indicators, to then evaluate the usability of the said indicators in the context of their work mandate.

A key finding emerging from our case studies is the perceived usefulness of cumulative-opportunity measures by practitioners to assess local accessibility. Although the choice of accessibility indicators is a subject of discord in research (Geurs & van Wee, 2004; Kapatsila et al., 2023), workshop participants unanimously preferred easy to communicate measures over theoretical soundness. While keeping measures easily comprehensible, practitioners also called for better integration of notions related to lived, experienced and perceived accessibility. Another key finding is the importance of the refinement process of indicators through the workshops. The final indicators were tailored to the practitioners' needs, given there is not an "one size fits all" accessibility indicator. Moreover, institutional and governance barriers were identified as the prime factors impeding the accessibility paradigm shift.

There are some limitations to this study. First, the project is based on three case studies conducted within the same municipality. The three boroughs display variations in terms of population, land use and transportation characteristics, but they operate within the same municipality. The findings, hence, cannot be directly generalized to other cities or governance contexts. Nonetheless, our study confirms results analogous to those of previous studies in the European context (Silva et al., 2017; Straatemeier & Bertolini, 2020). Second, we gathered practitioners from various fields, but other actors involved in the accessibility paradigm shift, such as residents and elected officials were not considered. Third, the study focuses on exploratory planning contexts that do not necessarily reflect the actual work of practitioners met during the case studies, and therefore land use and transportation planners in Montreal. Workshops built on projects deemed relevant by practitioners, but not strictly on projects that were currently conducted. Future research could explore the

opportunities of accessibility-based planning with current work and projects of practitioners without designing a “fictive” workshop context.

Despite some limitations, our study has identified implementation opportunities for accessibility indicators and current governance and institutional factors impeding accessibility-based planning. Our findings support future research on the streamlining of accessibility indicators and the diversity of institutional barriers. This methodology, building on case studies and focus groups, can be replicated in other contexts to enrich the body of literature on accessibility-based planning.

CHAPITRE 6 DISCUSSION

Ce mémoire a contribué au bassin de littérature sur les barrières et les opportunités pour l'implantation d'une planification urbaine basée sur l'accessibilité. Les chapitres 4 et 5 ont permis de respectivement évaluer l'intégration de l'accessibilité dans les documents de planification et dans le milieu pratique. Les principaux résultats sont les suivants :

1. Le milieu de la pratique développe un intérêt grandissant pour les indicateurs d'accessibilité;
2. Les indicateurs d'accessibilité simples à calculer et à communiquer (p.ex. mesures d'opportunités cumulées) sont préférés par le milieu pratique;
3. Les municipalités et les arrondissements sont des organisations propices à la planification axée sur l'accessibilité;
4. La cohérence entre les organisations œuvrant à différentes échelles au sein d'une même municipalité semble limitée;
5. Le milieu politique est un acteur à mobiliser pour favoriser un changement de paradigme vers l'accessibilité.

D'abord, l'analyse des plans et les études de cas ont montré l'intérêt grandissant du milieu pratique pour l'accessibilité. Dans le chapitre 4, un niveau d'intégration plus élevé a été identifié dans les plans produits dans les cinq dernières années que dans ceux produits lors de la décennie précédente (2010-2019), ce qui souligne une tendance à la hausse. Un de ces plans, le PUM 2050, a guidé la planification des études de cas réalisées dans le chapitre 5. Les professionnels en transport et en urbanisme rencontrés dans le cadre des ateliers participatifs se sont montrés fortement intéressés par la planification basée sur l'accessibilité et par l'utilisation future d'indicateurs d'accessibilité. La facilité d'intégrer les indicateurs d'accessibilité dans leurs outils actuels variait selon les caractéristiques et les ressources des arrondissements rencontrés.

Concernant les indicateurs, les deux articles de ce mémoire ont montré la prédominance, dans le milieu pratique, des indicateurs d'opportunités cumulées qui sont une sous-catégorie des indicateurs basés sur la localisation (*location-based accessibility measures*). Comme présenté dans le chapitre 4, 12 des 40 documents étudiés intègrent des indicateurs d'accessibilité et chaque document (à l'exception du PUM 2050 de la Ville de Montréal) définit exclusivement des indicateurs basés sur la localisation qui sont couramment considérés comme les plus simples à

développer et à communiquer (Geurs & van Wee, 2004). De manière similaire, tous les indicateurs d'accessibilité (n=8) développés lors des ateliers participatifs avec les professionnels de la Ville de Montréal et de ses arrondissements sont des indicateurs basés sur la localisation. Qui plus est, 7 de ces 8 indicateurs sont des mesures d'opportunités cumulées. Ces résultats sont analogues avec d'autres études sur le sujet qui ont montré que les professionnels du milieu pratique tendent à favoriser la facilité de communiquer et de présenter les indicateurs au détriment de leur rigueur scientifique (Boisjoly & El-Geneidy, 2017b; Rowangould et al., 2024). Il faut noter que les professionnels rencontrés ont tout de même mentionné l'importance de considérer la sécurité des déplacements ainsi que l'accessibilité perçue dans les analyses d'accessibilité, deux éléments négligés dans les calculs d'accessibilité réalisés.

Les deux articles de ce mémoire ont permis d'identifier que les villes et les arrondissements étaient présentement des milieux propices pour mobiliser des indicateurs d'accessibilité. Dans le premier article, les plans de transport et d'aménagement produits par les villes obtiennent des résultats parmi les plus élevés. Ces résultats concordent avec les mandats et pouvoirs des villes, considérant que dans le cas spécifique de la Ville de Montréal, l'organe central et ses arrondissements sont responsables du développement du réseau cyclable et piétonnier. Ils ont également certains outils pour favoriser le développement de commerces et de services. Ces deux rôles leur permettent de développer des interventions pour favoriser l'accès local à des destinations de proximité, une stratégie mentionnée par les professionnels rencontrés lors des études de cas. En effet, les arrondissements rencontrés pourraient éventuellement mobiliser les connaissances et les outils d'accessibilité développés dans le cadre de ce mémoire dans leurs processus de planification.

Bien que ce changement de paradigme soit porté à différentes échelles, il existe un écart entre l'approche des différents types d'organisation et différentes villes œuvrant sur le même territoire. Si l'on prend l'exemple de la Ville de Montréal et des autres organisations œuvrant sur le territoire montréalais, les résultats du chapitre 4 indiquent que la Ville de Montréal et l'ARTM définissent l'accessibilité, des objectifs pour trois des quatre composantes de l'accessibilité ainsi que des indicateurs et des cibles d'accessibilité en transport en commun. Toutefois, Exo et la STM, les agences de transport en commun opérant des services dans la municipalité, n'incluent pas d'indicateurs d'accessibilité et peu d'objectifs d'accessibilité dans leurs documents stratégiques. Si cela peut être dû à la définition des mandats des opérateurs de transport en commun et le fait qu'ils n'ont aucun pouvoir sur l'aménagement du territoire, il est néanmoins possible que cette

dichotomie limite l'utilisation d'indicateurs d'accessibilité pour planifier les services de transport en commun à Montréal. On peut notamment estimer qu'il sera difficile de développer des quartiers axés sur le transport en commun si les agences de transport en commun ne mobilisent pas les indicateurs d'accessibilité dans leurs outils de planification. Cette barrière institutionnelle a aussi été observée lors des ateliers participatifs avec les professionnels de Montréal-Nord. Ces derniers ont souligné la pertinence des indicateurs d'accessibilité en transport en commun que l'équipe de recherche avait calculés. Toutefois, ils ont également mentionné que la STM utilisait d'autres données et mesures pour planifier leurs services. Pour que les indicateurs d'accessibilité guident systématiquement la planification des transports à Montréal, il serait nécessaire que les organisations concernées, comme la Ville de Montréal et la STM, conjuguent leurs efforts pour se doter d'une vision et de mesures d'accessibilité communes.

Un autre défi en lien avec la cohérence entre les différents paliers concerne le manque de lignes directrices spécifiques à chaque arrondissement pour intégrer l'accessibilité selon leurs caractéristiques et particularités. Les arrondissements montréalais rencontrés ont mentionné que le cheminement pour atteindre les objectifs et les cibles d'accessibilité définis dans le PUM 2050 de la Ville de Montréal est incertain. Au niveau des objectifs, ce ne sont pas tous les arrondissements qui sont suffisamment matures, en matière de développement urbain et de systèmes de transport pour favoriser une planification urbaine basée sur l'accessibilité. Par exemple, les professionnels rencontrés à Montréal-Nord ont mentionné que la ville des 15 minutes et que l'accessibilité par la proximité n'étaient pas des objectifs de l'arrondissement, alors que les membres de l'équipe du Projet Namur-Hippodrome (Arrondissement Côte-des-Neiges–Notre-Dame-de-Grâces et Service de l'urbanisme et de la mobilité de la Ville de Montréal) ont mentionné l'inverse. Ainsi, la vision du PUM 2050, centrée sur l'accessibilité ne se traduira pas de manière semblable dans tous les arrondissements. De même, les professionnels rencontrés ne savaient pas si des ressources et de l'expertise nécessaires au développement d'indicateurs d'accessibilité seraient mises à leur disposition.

Les deux chapitres et articles se rejoignent également sur le constat que l'intégration de l'accessibilité en pratique pourrait être facilitée si le changement de paradigme de l'accessibilité était porté par le milieu politique, un résultat qui rejoint la littérature sur le sujet (Handy, 2020). Le chapitre 4 a montré que l'accessibilité n'est pas intégrée de manière systématique, à travers des objectifs et des cibles, dans les documents de planification du territoire et des transports au Canada.

Les études de cas réalisées dans le cadre du chapitre 5 ont quant à elles permis d'identifier que la barrière politique est une des plus importantes selon les professionnels rencontrés. Ces derniers ont mentionné que les projets étudiés et les priorités des équipes de transport et d'urbanisme sont dictés par le milieu politique. Ultimement, ceci implique qu'en dépit des avancées en recherche pour réduire l'écart avec le milieu de la pratique, un autre acteur prédominant dans ce changement de paradigme est le politique.

En somme, ce mémoire a identifié l'intérêt croissant du milieu pratique pour l'accessibilité, qui s'exprime à travers une vision ancrée sur l'intégration du territoire et des systèmes de transports. Bien que plusieurs initiatives centrées sur l'accessibilité, comme la démarche du PUM 2050, soient en cours à Montréal, il y a un manque de directives claires qui définissent les prochaines étapes de ce changement de paradigme. Des barrières institutionnelles, comme la ségrégation des mandats reliés à la planification du territoire et des transports, ainsi que les barrières politiques pourraient limiter ce changement de paradigme vers l'accessibilité.

CHAPITRE 7 CONCLUSION

7.1 Synthèse des travaux de recherche et contributions

Ce projet de recherche cherchait avant tout à réduire l'écart entre la recherche sur l'accessibilité et l'intégration du concept en pratique, une lacune importante dans les domaines de la planification des transports et l'aménagement du territoire. Dans cette optique, deux sous-objectifs de recherche complémentaires ont été définis :

(1) évaluer l'intégration de l'accessibilité dans les plans d'aménagement et de transport, en comparant les différences entre types d'organisations et paliers gouvernementaux et

(2) identifier les facteurs facilitant ou limitant l'utilisation d'indicateurs d'accessibilité par des professionnels en transport et en aménagement.

Concernant le premier sous-objectif de recherche, peu de documents Canadiens incluent des objectifs et des indicateurs d'accessibilité, un résultat cohérent avec la littérature sur ce sujet (Boisjoly & El-Geneidy, 2017a; Proffitt et al., 2019; Tuffour et al., 2025). Ces résultats varient au niveau horizontal, c'est-à-dire selon le type d'organisations qui publie le document : les villes obtiennent généralement les résultats les plus élevés, suivies de près par les agences de planification du territoire et des transports (p.ex. Autorité régionale de transport métropolitain et Translink). Les opérateurs de transport en commun (p.ex. Société de transport de Montréal, Réseau de transport de la Capitale) obtiennent en moyenne les résultats les plus faibles. Des différences sont également observées « verticalement » entre les échelles provinciale, métropolitaine et municipale. Un autre résultat est qu'au sein même de municipalités canadiennes, les organisations y œuvrant, comme la Ville de Montréal, la Société de transport de Montréal et Exo dans le cas de Montréal, ne considèrent pas de manière homogène et systématique l'accessibilité.

Les résultats du chapitre 4 sont pertinents pour le milieu de la recherche, mais également pour le milieu de la pratique en transport et en aménagement au Canada. Ces résultats indiquent au milieu de la recherche qu'il faut davantage étudier comment l'accessibilité est intégrée par différents types d'organisations œuvrant à des échelles spatiales distinctes. Les documents de planification ne constituent pas un tout homogène. Pour le milieu de la pratique au Canada, les résultats permettent d'identifier des pistes pour une meilleure intégration de l'accessibilité dans les documents de planification. L'étude a permis d'identifier des exemples pour chaque type de document. On peut

notamment penser au *Plan d'urbanisme et de mobilité 2050* de la Ville de Montréal (Ville de Montréal, 2024) qui obtient le résultat le plus élevé. Dans ce document, l'accessibilité est conceptualisée comme liant la planification du territoire et des transports. Cette vision est ensuite traduite en indicateurs et cibles d'accessibilité pour plusieurs types de destinations, comme les parcs, les épiceries et les bibliothèques.

Le chapitre 5 vient approfondir le bassin de connaissances sur les opportunités et barrières pour l'intégration d'indicateurs d'accessibilité dans les travaux du milieu de la pratique pour répondre au deuxième sous-objectif de recherche. Alors que plusieurs études ont évalué l'intégration de l'accessibilité en pratique d'un point de vue externe à l'aide de sondages et d'entrevues (Boisjoly & El-Geneidy, 2017b; Rowangould et al., 2024; Siddiq & Taylor, 2021), la méthodologie développée dans le cadre de cette étude visait à collaborer avec des acteurs du milieu de la pratique. Qui plus est, pour autant que l'auteur de ce mémoire puisse en juger, cette étude est la première publiée à développer un projet d'ateliers participatifs pour évaluer l'implantation des indicateurs d'accessibilité en Amérique du Nord. La très grande majorité des études passées se sont concentrées sur le contexte européen, avec une seule en Australie (Silva et al., 2017). Ainsi, trois études de cas ont été réalisées avec des arrondissements de la Ville de Montréal : LaSalle, Montréal-Nord et Côte-des-Neiges–Notre-Dame-de-Grâces. Cette dernière étude de cas portait plus spécifiquement sur le Projet Namur-Hippodrome, ce qui a également impliqué la collaboration du Service de l'urbanisme et de la mobilité de la Ville de Montréal.

Ce deuxième projet a produit plusieurs contributions notables pour la littérature sur l'intégration de l'accessibilité dans la planification urbaine. D'abord, les résultats confirment les barrières à l'implantation de l'accessibilité identifiées précédemment en recherche, comme les barrières techniques, institutionnelles et politiques (Papa et al., 2016; Silva et al., 2017). Certaines barrières mentionnées par les participants incluent le manque de personnel pour déployer les outils d'accessibilité et la difficulté de maintenir ces outils à jour avec des données de qualité. La validation de la littérature est un résultat notable considérant que ce projet de recherche est réalisé à Montréal, un contexte différent des études réalisées précédemment. En ce qui a trait aux opportunités d'utilisation des indicateurs d'accessibilité, les groupes de discussion ont permis d'identifier trois catégories qui sont cohérentes avec la littérature (Papa et al., 2016) : (1) le diagnostic territorial, (2) l'évaluation de projets et de scénarios et (3) le soutien à la prise de décisions. Des exemples sont la visualisation des lacunes en accessibilité, la communication avec

les élus pour les sensibiliser à des enjeux d'accessibilité et l'évaluation des gains en accessibilité associés à des nouveaux projets de transport ou d'infrastructures publiques. De plus, il est ressorti que les participants valorisent une planification fondée sur les données probantes et que les indicateurs d'accessibilité peuvent contribuer à soutenir cette planification. Le projet de recherche a aussi permis de confirmer l'importance d'indicateurs d'accessibilité simples pour les professionnels, même dans un contexte de travail où l'équipe de recherche pouvait développer des mesures plus complexes et leur fournir.

7.2 Limites

Malgré les contributions de ce projet de recherche énoncées plus haut, quelques limites méthodologiques doivent être mentionnées. D'abord, concernant le premier article de ce mémoire (chapitre 4), une limite importante est reliée à la méthodologie et spécifiquement au cadre d'analyse développé. Le cadre d'analyse se base sur des résultats binaires (0 ou 1), ce qui simplifie l'évaluation des plans, mais limite la profondeur de l'analyse. Ainsi, pour la question #16 du cadre (« Est-ce que le document inclue des indicateurs mesurant la part des emplois ou d'autres destinations dans un temps de trajet ou une distance spécifique? »), un document incluant un indicateur d'accessibilité obtiendrait un point, tout comme un document incluant une dizaine d'indicateurs. Qui plus est, l'approche utilisée ne permet pas d'évaluer si les objectifs et les cibles énoncés dans les documents seront bien atteints en pratique.

Cette dernière limite s'applique également au deuxième article. Les ateliers participatifs avec les professionnels n'ont pas permis d'identifier quels seront les rôles, les mandats et les responsabilités des arrondissements pour atteindre les cibles d'accessibilité énoncées dans le *Plan d'urbanisme et de mobilité 2050* de la Ville de Montréal. L'intégration de l'accessibilité dans le *Plan d'urbanisme et de mobilité 2050* a bien été évaluée dans le premier article de ce mémoire, mais les impacts de ce nouveau document pour la pratique en transport et en aménagement n'ont pas été identifiés.

Pour ce qui est des limites spécifiques au deuxième article, un point notable concerne la spécificité des études de cas choisies. Bien que les conclusions soient cohérentes avec la littérature, les trois arrondissements choisis sont au sein de la même municipalité, la Ville de Montréal. Des municipalités avec des caractéristiques différentes pourraient faire face à d'autres barrières à l'implantation de l'accessibilité. Qui plus est, les municipalités (et les arrondissements dans le contexte montréalais) ne sont qu'un des acteurs mobilisant l'accessibilité et des concepts analogues

dans leurs outils de planification. Cette étude n'a pas donc pas évalué comment des organisations comme la Société de transport de Montréal ou l'Autorité régionale de transport métropolitain intègrent l'accessibilité dans leur planification.

7.3 Perspectives de recherche

Ces limites sont également source de nombreuses perspectives de recherche. Un questionnaire majeur et peu étudié dans la littérature demeure le lien entre les objectifs énoncés dans les documents de planification et leur implantation en pratique, considérant que ces deux éléments sont typiquement étudiés de manière indépendante. Dans le contexte montréalais avec le PUM 2050 de la Ville de Montréal ou dans d'autres contextes, il serait pertinent d'évaluer quelles sont les conditions qui permettent d'atteindre les objectifs et les cibles définis dans un document de planification.

Dans le même ordre d'idées, la méthodologie du deuxième article, basée sur des ateliers participatifs, pourrait être répliquée pour évaluer l'intégration de l'accessibilité à plusieurs échelles spatiales simultanément. Comme identifié dans ce mémoire et dans la littérature (voir Hull (2008)), il existe, dans plusieurs contextes, un manque de planification intégrée au niveau vertical, c'est-à-dire entre des organisations métropolitaines et municipales par exemple. Il serait pertinent de mieux comprendre comment des organisations œuvrant dans la même région conjuguent leurs mandats et objectifs pour planifier les transports et le territoire selon l'accessibilité.

Ensuite, ce mémoire a également contribué au débat en recherche sur les avantages et les défis reliés aux différents types de mesures d'accessibilité (voir Kapatsila et al. (2023)). Les résultats ont montré que les mesures simples et faciles à communiquer sont généralement prédominantes dans les documents de planifications et préférées par les professionnels. Néanmoins, les professionnels rencontrés ont souligné le besoin de développer des mesures qui reflètent adéquatement l'accessibilité perçue et vécue par la population. Des projets de recherches futurs pourraient se pencher sur le développement d'indicateurs d'accessibilité spécifiques aux contextes et aux besoins de professionnels en transport et en urbanisme.

Puis, cette étude, comme plusieurs autres, a relevé le besoin de politiser l'accessibilité pour faciliter son adoption en pratique. Comme identifié en recherche (Boisjoly & El-Geneidy, 2017b), les professionnels utilisent des indicateurs et des mesures de performance pour se conformer aux documents de planification en vigueur. Alors, de futurs projets de recherche sont nécessaires pour

mieux comprendre comment basculer le débat politique de la mobilité, entre autres les discussions autour de la congestion et du stationnement, vers l'accessibilité.

Finalement, de futures recherches pourraient évaluer comment d'autres acteurs, comme la population, la société civile et les développeurs immobiliers portent le changement de paradigme de l'accessibilité. Les connaissances, les compétences et les opinions de ces acteurs pourraient contribuer à favoriser la planification basée sur l'accessibilité.

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ANNEXE A DOCUMENT SUPPLÉMENTAIRE POUR LE DEUXIÈME ARTICLE

Case studies: accessibility indicators and scenarios

Case study 1: LaSalle

Workshop 1: Context and accessibility indicators

The land use and transport characteristics of the LaSalle borough are presented in Figure A.1. The borough exhibits characteristics that are typically found in Canadian suburban and peri-urban areas such as the segregation of land uses. A major transportation concern mentioned by the practitioners was the lack of a structuring public transport network. As such, the borough has long advocated for the extension of the metro's green line (see Figure A.1), given the end station is located right on the outside edge of the borough, or the construction of a tramway on Newman Boulevard (shown in Figure A.1 - left). According to the practitioners, and in line with the PUM 2050, this boulevard crosses the neighborhood, acts as a physical barrier in view of the poor active mobility infrastructure and the intensity of traffic (in terms of number and speed of cars) and is considered a heat island (Ville de Montréal, 2024). It was repeatedly mentioned by the practitioners as the transportation backbone of LaSalle, with many current challenges but also opportunities for redevelopment, as stated by one practitioner: "Newman is a planned area for redevelopment. For me, it's 'fertile ground' for improving things with each project."

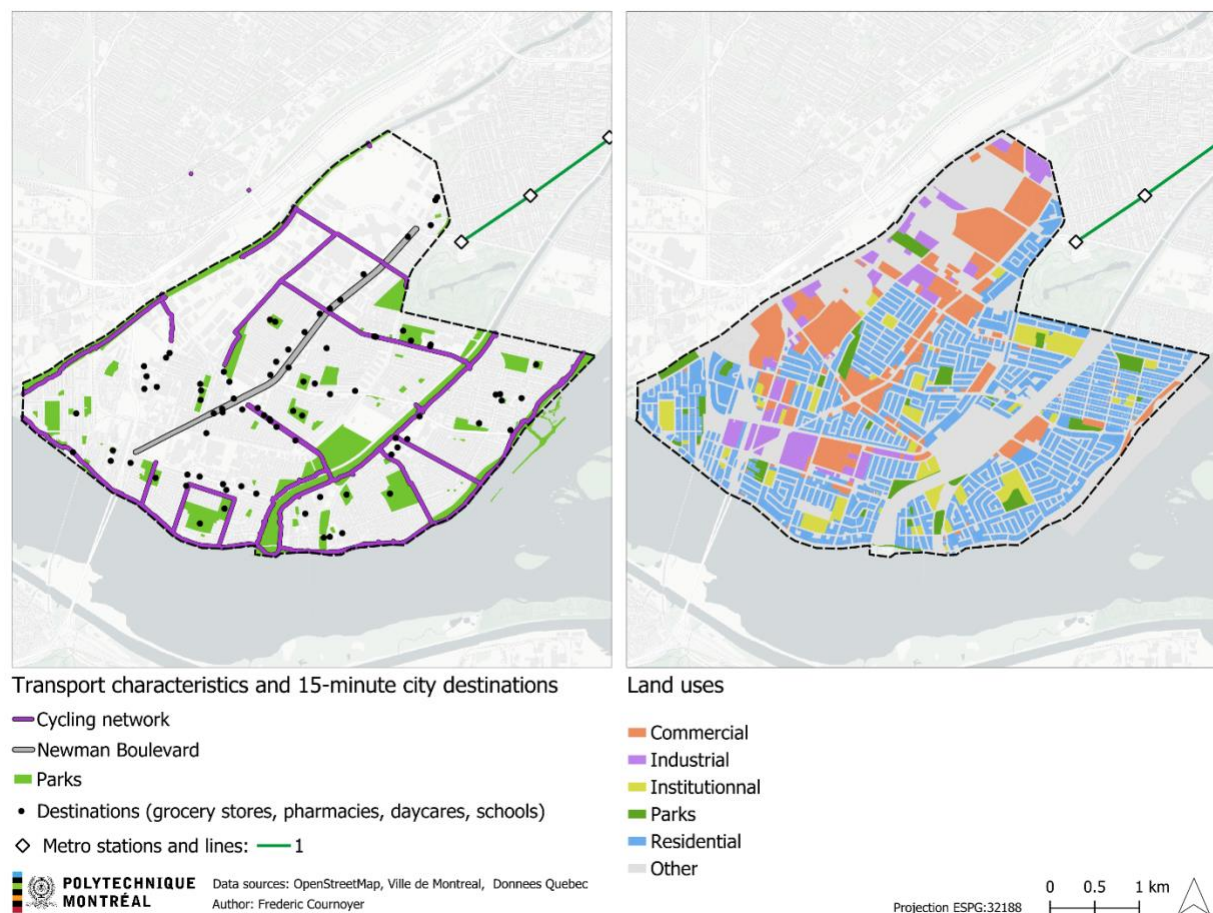


Figure A.1 Land use and transport characteristics in LaSalle

Practitioners from LaSalle quickly stated their interest to study the 15-minute city and accessibility to proximity destinations (e.g., parks, grocery stores, schools). Three accessibility indicators were defined: (i) a composite indicator of the 15-minute city (as defined in the PUM 2050), (ii) the combined index of park quality and accessibility for youth (CIPQAY) (Cournoyer, Waygood, et al., 2026; El Murr et al., 2023, 2025), and (iii) an indicator of accessibility to grocery stores integrating quality.

As presented previously, the “Urban and mobility planning strategy 2050” of the City of Montreal states that a residential lot should have access to at least one of each of the following amenities to be considered in a 15-minute city: grocery store, pharmacy, park, school, and daycare. Practitioners decided to build their indicators based on these guidelines. Other parameters were also defined based on the PUM 2050 values, including the time threshold of 15 minutes and a walking speed of 3.6 km/h, which amounts to a network distance of 900 metres (Ville de Montréal, 2024). This

distance is in the lower end of values considered in previous research (Hosford et al., 2022), but is inclusive of population groups whom may not be able to walk longer distances (e.g., children, older adults).

Based on a request from practitioners the two other indicators were defined to integrate measurement of quality as the 15-minute city indicator only considers the number of destinations. In line with the literature, practitioners insisted that parks (Cournoyer, Waygood, et al., 2026) and grocery stores (Nilsson et al., 2015) vary greatly in quality which directly impacts how individuals perceive their attractiveness. For instance, a practitioner highlighted the importance of considering the diversity of food stores: “Specialised shops and small fruit shops do not always appear in the data, but they still influence residents' daily lives”.

As for the park indicator, the parks data obtained from the City of Montreal encompassed anything from a small public space to a nature park with several amenities. The CIPQAY, an integrated measure of accessibility and quality that considers park amenities, the presence of nature, the size of parks, safety, and maintenance (see El Murr et al. (2025) for more details) was presented to practitioners in response to their concerns about the limits associated with simply measuring the number of parks accessible (and not their quality). Practitioners then expressed their interest to have this indicator calculated for their borough. Note that the CIPQAY is a composite indicator building on cumulative-opportunity measures of accessibility.

Similarly, as emphasized by the practitioners, grocery stores also differ in terms of size and availability of products. Accordingly, a measure of quality was defined with four categories based on a decision of the research team following discussions with practitioners on the relevance of integrating quality into accessibility indicators: (1) access to at least one grocery store and three specialty food stores, (2) access to at least one grocery store, (3) access to at least a corner store (or pharmacy that sells food items), (4) no destination accessible. One subject of debate concerned the definition of a grocery store, or rather what this category included or not. We collectively arrived at the conclusion that a grocery store is a shop where an individual could buy a range of items including both perishable (produce, meat) and nonperishables, which includes fresh vegetables, fruits, bread, meat, among others. Thus, corner stores and pharmacies would not be considered grocery stores, nor would specialty food stores such as bakeries or fishmongers (e.g., bakeries, fish shop).

Workshop 2: Presentation of the indicators and definition of the scenarios

Figure A.2 presents the map of the 15-minute city that was presented to practitioners from the LaSalle borough during the second workshop of this case study. Instead of presenting a map with a binary symbology (i.e., having access to 15-minute city amenities or not), the research team defined a scale of five colours to represent categories: (1) having access to at least one destination for the five destinations of the 15-minute city, (2) having access to at least one park, one grocery store, and one pharmacy, (3) having access to at least one grocery store and one pharmacy, (4) having access to at least one grocery store, (5) food desert (i.e., having access to no grocery store, but perhaps to other destinations). For practitioners, this scale was counterintuitive, and they had difficulties understanding the spatial patterns of accessibility. Another concern mentioned by the practitioner was the absence of the destinations on the map (example: points representing the location of the grocery stores), since only accessibility values were shown.

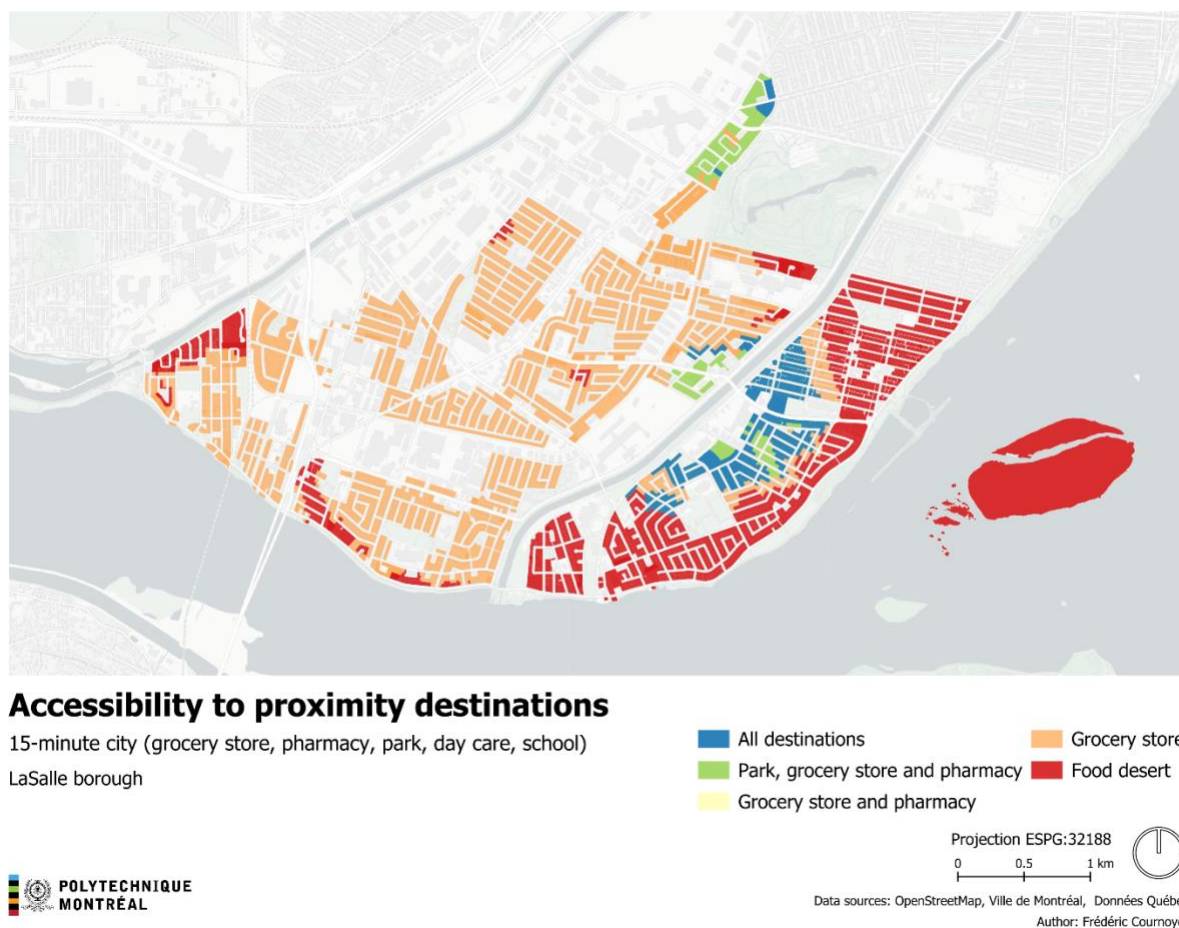


Figure A.2 Map of the 15-minute city in LaSalle presented during the second workshop

Practitioners also struggled to analyze the CIPQAY index results. The CIPQAY index is a composite indicator of many factors (17) and residential lots receive a value ranging from 0 to 30. Practitioners were not part of the design of this index, nor had they received extensive details about the methodology. The practitioners felt that they had good very precise knowledge of park supply and were surprised to see relatively low accessibility close to a park they personally identified as a high-quality park. The CIPQAY score is “relative”, meaning it depicts the accessibility of a residential lot in comparison to other residential lots in Montreal. Thus, in the context, the quality of the park might be judged sufficient, but CIPQAY indicated that the houses did not have much access to park amenities as houses in other parts of Montreal.

Practitioners valued the quality-based indicator of accessibility to grocery stores. A recurrent comment was the added value of the different categories (e.g., (1) access to at least one grocery store and three specialty food stores, (2) access to at least one grocery store, (3) access to at least a corner store (or pharmacy that sells food items), (4) no destination accessible) compared to simply measuring the number of destinations accessible. There was also a consensus on the importance of promoting proximity access to grocery stores for the whole population.

Overall, after clarifications about the accessibility scales and methodology (especially for the 15-minute city and for the CIPQAY) were given, the practitioners were able to grasp the accessibility indicators presented (although some modifications were proposed). The three indicators validated the knowledge of practitioners on access to grocery stores and to 15-minute city amenities, but not for park access. Although previous research demonstrated that the parc access index (CIPQAY) was associated with individuals’ perceptions of access (El Murr et al., 2023), this study revealed that some gaps remain and warrant further investigation.

In addition to the difficulty of immediately understanding the CIPQAY and the 15-minute city indicators, the biggest concern expressed by the practitioners was errors related to the location of existing destinations (specifically grocery stores and pharmacies). Destinations were defined based on open data, which involved certain limitations. This study revealed the importance of having high-quality data when making micro-scale analysis. Often, some destinations were missing, especially pharmacies and grocery stores. The local knowledge of the practitioners enabled the research team to validate each data point and make any correction when necessary.

Two scenarios were defined with the practitioners based on the accessibility maps presented: (i) the redevelopment of non-residential (every lot not classified as “residential” in Figure A.1), into residential lots and (ii) the development of new parks around the Newman Boulevard (see Figure A.1 - left). For the first scenario, practitioners were interested in identifying lots that were not currently residential but would benefit from good accessibility to proximity amenities (e.g., grocery stores, pharmacies, parks, schools, daycares) if zoning laws were to change to allow residential development. They were also planning to redevelop lots surrounding the Newman Boulevard and were keen to assess the optimal location of new parks to improve accessibility to green spaces for the population. For the second scenario, two indicators were defined for parks, one based on the number of parks accessible and one on the surface area in hectares. As mentioned above, the practitioners struggled with the interpretation of the composite CIPQAY index and emphasized that some results did not correspond to their local knowledge. Accordingly, this composite index was left out and replaced by simpler indicators. Rather than a complex indicator like CIPQAY, practitioners expressed preference for a measure that would combine surface and the number of the parks. However, it should be noted, that analysis of people's satisfaction with parks was not statistically related to those measures, but was to CIPQAY. As such, a potential conflict between practitioners’ desire for more basic measures and residents' preferences might exist.

Workshop 3: Analysis of the scenarios

For the third workshop, starting with the first scenario, one map for each destination of the 15-minute city was presented, given that the categorical scale (including all destinations) initially presented to the practitioners proved to be difficult to interpret. An example is shown for grocery stores in Figure A.3. On the left, lots with uses other than residential (e.g., commercial, industrial) are shown, and residential lots are shown on the right. This was a specific request from practitioners, to evaluate current accessibility (based on existing residential lots), as well as potential accessibility for non-residential lots.

Overall, practitioners stated that this second round of accessibility indicators were of greater use, since we had updated the indicators based on their comments. One important finding was the necessity to define accessibility indicators based on the specificities of each destination. For instance, practitioners often mentioned how individuals value the “quality” of a park (e.g., available amenities, park surface area) or a grocery store (e.g., products available), which is not the case for

a pharmacy. On the other hand, children attend one school, which for some children is not the one closest to their house. These observations called for destination-specific accessibility indicators.

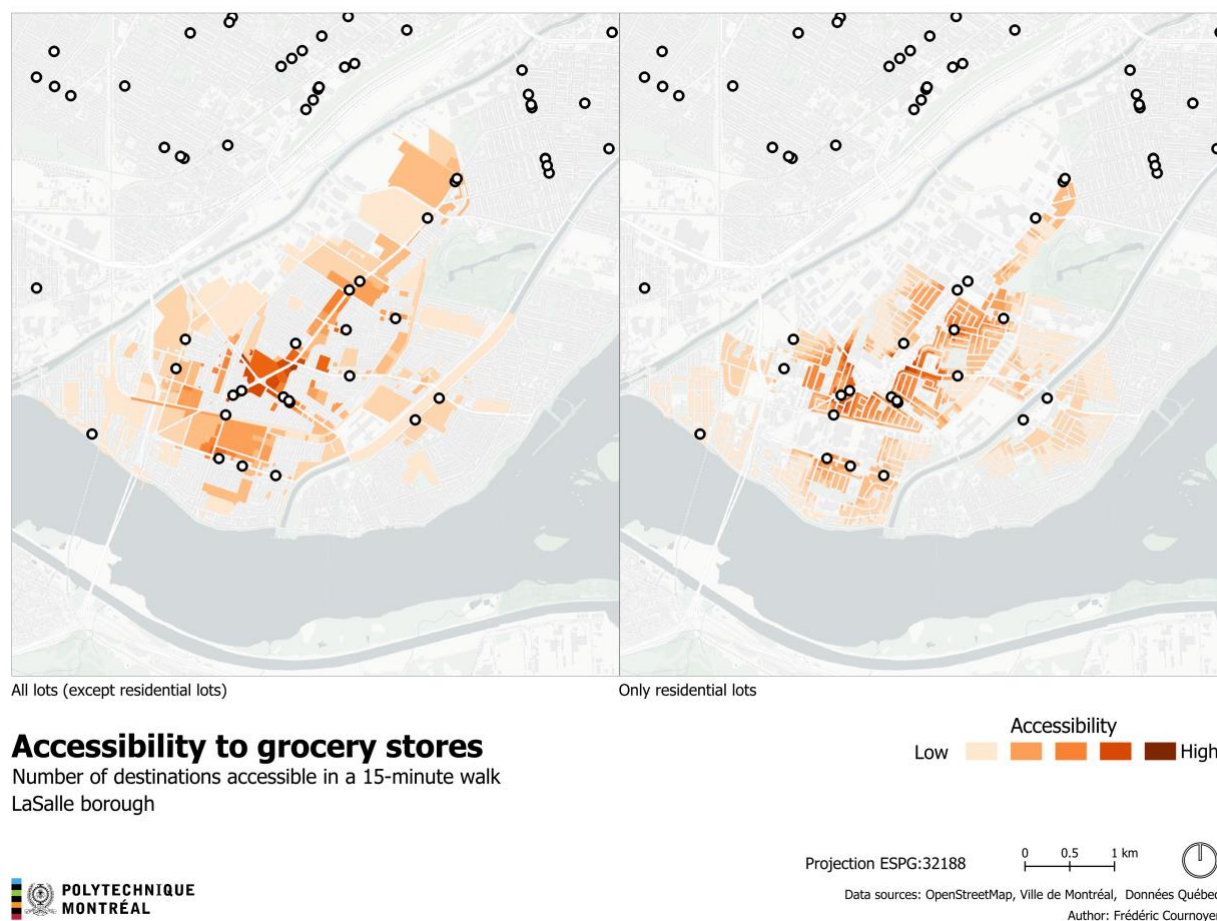


Figure A.3 Accessibility to grocery stores in LaSalle

Case study 2: Montréal-Nord

Workshop 1: Context and accessibility indicators

Figure A.4 shows the land use and transport characteristics of Montréal-Nord. As is the case with LaSalle, the modal share of the automobile is high in Montréal-Nord (61%) (Autorité régionale de transport métropolitain, 2020). From an equity standpoint, Montréal-Nord also has a high proportion of socioeconomic vulnerable individuals (Ville de Montréal, 2022, 2024).

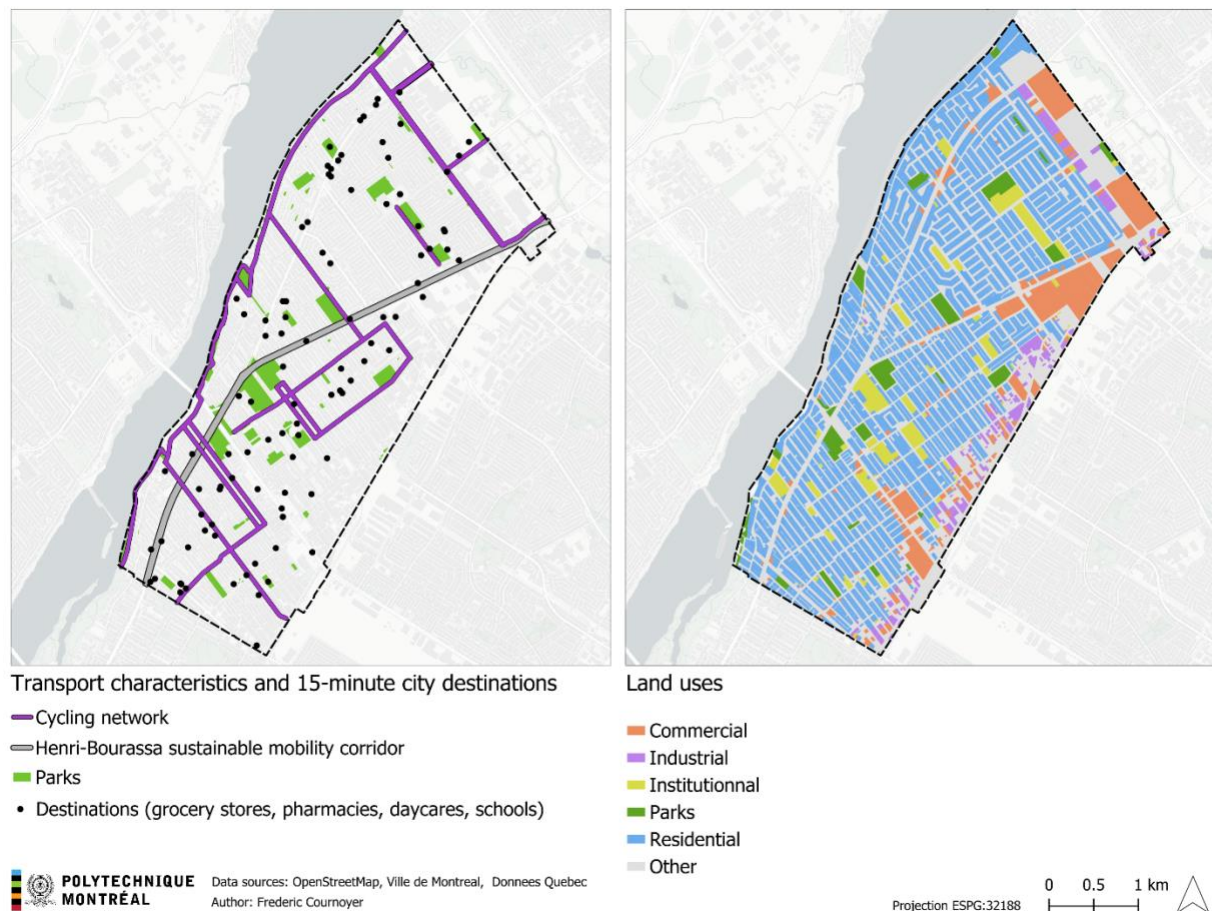


Figure A.4 Land use and transport characteristics in Montréal-Nord

During the first workshop, practitioners stated that the 15-minute city is not a short-term objective of the borough considering the current state of the transportation infrastructure and urban development patterns. Practitioners were interested in receiving a diagnostic of accessibility to proximity destinations by walking (proposed by the research team based on the PUM 2050), but felt that they had limited capacity to enact meaningful improvements. One contributing factor was the borough's elected official belonging to a different party than the one in power at the City, which had guided the development of the PUM 2050.

The Henri-Bourassa sustainable mobility corridor was defined as the scenario to study accessibility gains. That scenario is an ongoing project in Montréal-Nord with plans to pursue the development on other segments of the boulevard in the upcoming years. In collaboration with practitioners, it was decided to study accessibility to proximity destinations (e.g., elementary and high schools, parks, public services) by cycling, considering ongoing and planned cycling projects, including the

cycling infrastructure on Henri-Bourassa sustainable mobility corridor. A cumulative opportunity measure was developed: the number of opportunities (all destinations combined) accessible within a 15-minute bike ride. The research team proposed to integrate measures of cycling levels of traffic stress (LTS) in the accessibility measurement as done in previous research (Murphy & Owen, 2019; Williams et al., 2024). These levels consider that not every individual can tolerate the same level of stress when cycling. For instance, some destinations may not be accessible to children if their trip involves riding on a high-speed boulevard. We therefore considered two measures of traffic stress: a comfortable trip (LTS 2) that may suit less experienced riders and children, and a high-stress trip (LTS 4) which would be a cycling trip that can include segments on high stress roads (e.g., boulevards). The r5r package considers road classification to assign LTS levels. This process is simplified, and more details can be found in the package documentation (Pereira et al., 2021). The practitioners believed consideration of traffic stress better reflects perceived accessibility of cyclists, notably when considering children making trips to destinations such as schools or parks.

Another project that was consistently mentioned by the practitioners was the construction of a new BRT service in the borough (Henri-Bourassa sustainable mobility corridor – see Figure A.4). Thus, we calculated current accessibility to public services, hospitals, grocery stores, and stores by public transport using a cumulative opportunity measure with a time threshold of 30 minutes. Two measures were defined: one for the peak period (6 am to 9 am) and one for the off-peak (11 am to 14 pm) period. As done in past research (see Fransen et al. (2015)), we defined a measure of average accessibility to account for frequency of service. We calculated accessibility every 5 minutes and then averaged the results. Accessibility was calculated for a randomly chosen day, Wednesday, the 2nd of July 2025, which is representative of public transport provision during the weekdays. The destinations chosen and parameters defined were based on discussions with practitioners, building on the boroughs' priorities and also the research team's knowledge on accessibility literature.

Overall, in this borough, indicators were selected based on the anticipated improvements to the transport network, rather than on an integrated land use and transport planning strategy.

Workshop 2: Presentation of the indicators and definition of the scenarios

Practitioners from Montréal-Nord expressed during the second workshop that the 15-minute city composite indicator was counterintuitive, as was the case for LaSalle practitioners. They had difficulties understanding the nuances of the different categories (the same map as Figure A.2 was

presented, but for the Montréal-Nord context). Ultimately, when the research team explained how to interpret the indicator, it confirmed their prior assumptions, being that most residential lots in Montréal-Nord do not have access to a basket of proximity destinations. On the other hand, practitioners were mostly satisfied with the public transport and cycling indicators. In the case of accessibility by public transport (see Figure A.5 for an example), practitioners felt that the indicators clearly showed distinct patterns for (i) both time spans (i.e., peak vs off-peak) and (ii) between the different types of destinations. Similar findings were observed for the cycling indicators, especially for the LTS 2 accessibility indicator, which considers comfortable traffic stress. Practitioners were able to highlight, with these maps, landlocked sectors in the borough that were surrounded by high traffic stress roads (and thus inaccessible when considering a LTS value of 2).



Figure A.5 Accessibility to shops by public transport in Montréal-Nord

To evaluate cycling accessibility gains, we modelled the new cycling infrastructure of the Henri-Bourassa sustainable mobility corridor. To do so, we modified the OSM network to specify which road segments now included protected cycling facilities. The new accessibility calculations considered these road segments as available when LTS 2 was defined as the traffic stress. For the new BRT system, it was necessary to modify the GTFS files to reproduce the operational parameters of the new public transport service. The hypotheses chosen were a reduction of 10% of travel times for buses running on the sustainable mobility corridor, based on previous research (Carvalho & El-Geneidy, 2025) and no increase of frequency planned. It is expected that the parameters significantly influence the accessibility results, but the aim of this study was not to precisely evaluate the accessibility gains of a new BRT service. Rather, we aimed at assessing the usability of the accessibility indicators to evaluate this scenario. Moreover, travel time gains of BRT service highly vary depending on the context, and there is no certitude that the transit agency in Montreal would increase the frequency of service. Past research has also explored the accessibility benefits of a new BRT system (Singh et al., 2022), but few details on how to modify GTFS files to simulate a new public transport service exist.

Workshop 3: Analysis of the scenarios

The aim of the third workshop was to discuss the analysis of the scenarios with the practitioners. The research team presented the accessibility gains of the planned BRT service and the new cycling infrastructure through a series of map. For the public transport indicators, we presented the results before and after the implementation of a BRT service. Results for the cycling accessibility were only presented for the LTS 2 (comfortable level of stress) as the new cycling infrastructure did not impact LTS 4 accessibility calculations, as shown in Figure A.6.

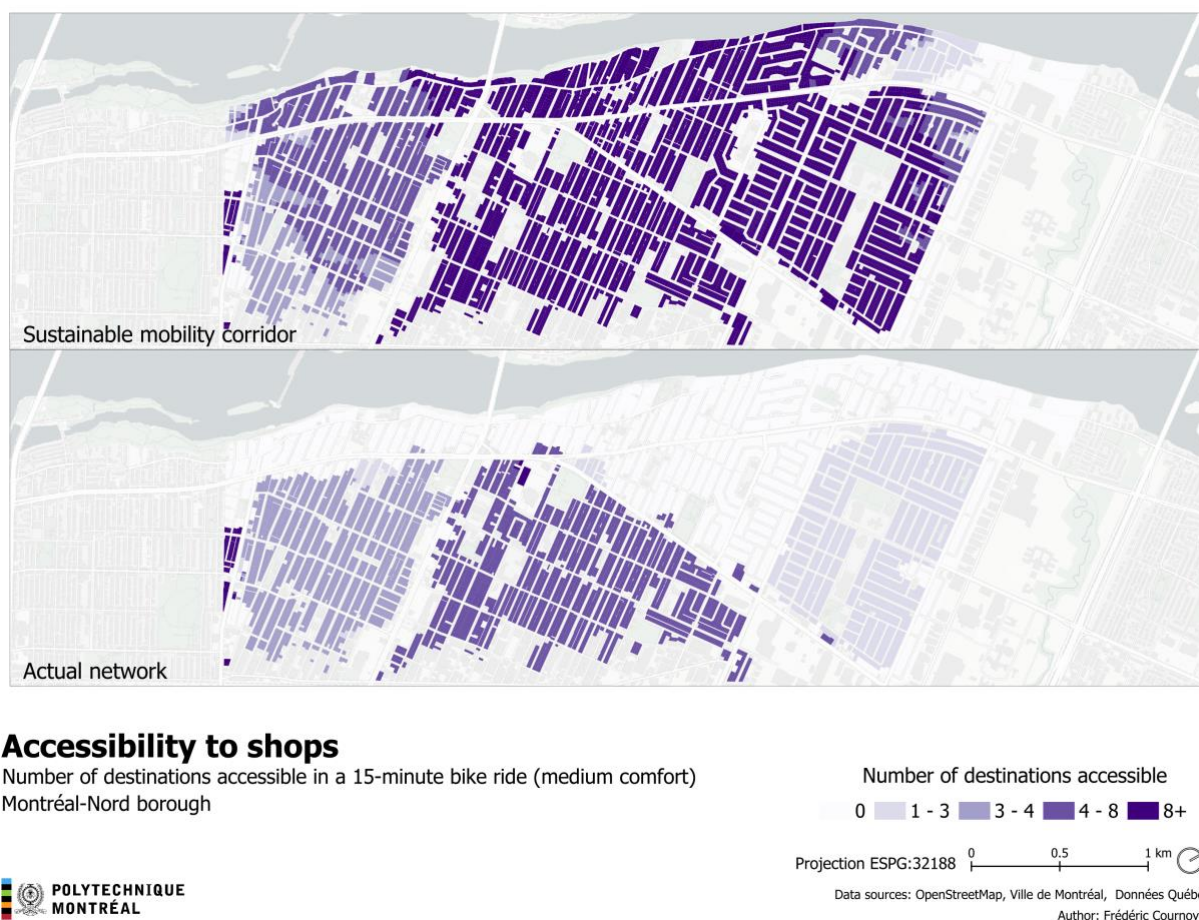


Figure A.6 Accessibility to shops by cycling in Montréal-Nord

As mentioned previously, Montréal-Nord practitioners invited some of their colleagues to the third workshop, after realizing that accessibility indicators could be relevant for their work. Overall, practitioners in the workshop were satisfied with the accessibility indicators. They mentioned that the methodology and the presentation of indicators were easy to comprehend. For both the public transport and cycling indicators respectively, they viewed the possibility of sharing the results to the public transport agency in Montreal and to decision-makers, with the purpose of justifying the need for new transportation projects.

Case study 3: Namur-Hippodrome

Workshop 1: Context and accessibility indicators

The context of the Namur-Hippodrome Neighborhood project (*Quartier Namur-Hippodrome or QNH*) is unique. It consists of an empty site which is to be developed to host around twenty thousand dwellings, as well as local amenities (e.g., grocery stores, pharmacies), and services (e.g.,

schools, daycares, parks, libraries, cultural centers) in the next decades. Its location as well as the land use and transport characteristics of the Côte-des-Neiges neighborhood are presented in Figure A.7. In contrast to the first two case studies, we were not studying accessibility for the whole neighborhood, but strictly for the QNH site and its neighboring lots (which are shown in Figure A.7). An important transport service for QNH is the Namur metro station (see Figure A.7).

Practitioners, from the borough and from the City of Montréal, expressed that access to daily destinations in a 15-minute walk was a central component of the QNH vision. QNH is intended to be a self-sufficient neighborhood, with very low automobile use. The project is managed by the Côte-des-Neiges borough and by planners from the Urban Planning and Mobility Department of the City (*Service de l'urbanisme et de la mobilité*) given its regional scale of influence. To calculate accessibility, residential lots and road segments for QNH were manually drawn in QGIS. As done in previous case studies, it was determined with practitioners that the 15-minute city indicators defined by the City of Montreal would be calculated. In addition to the 15-minute city indicator, accessibility to public services, such as libraries and community centres was also measured, being deemed important services by QNH practitioners. Considering the regional attractiveness of destinations available in QNH, a measure of passive accessibility (catchment area) on foot and by public transport was also developed at the request of the practitioners. This passive accessibility measure shows isochrones of travel times to the centroid of QNH. Accordingly, it answers the question: “Who has access to QNH in a 15-minute walk (or with a 30-minute public transport trip)?”.

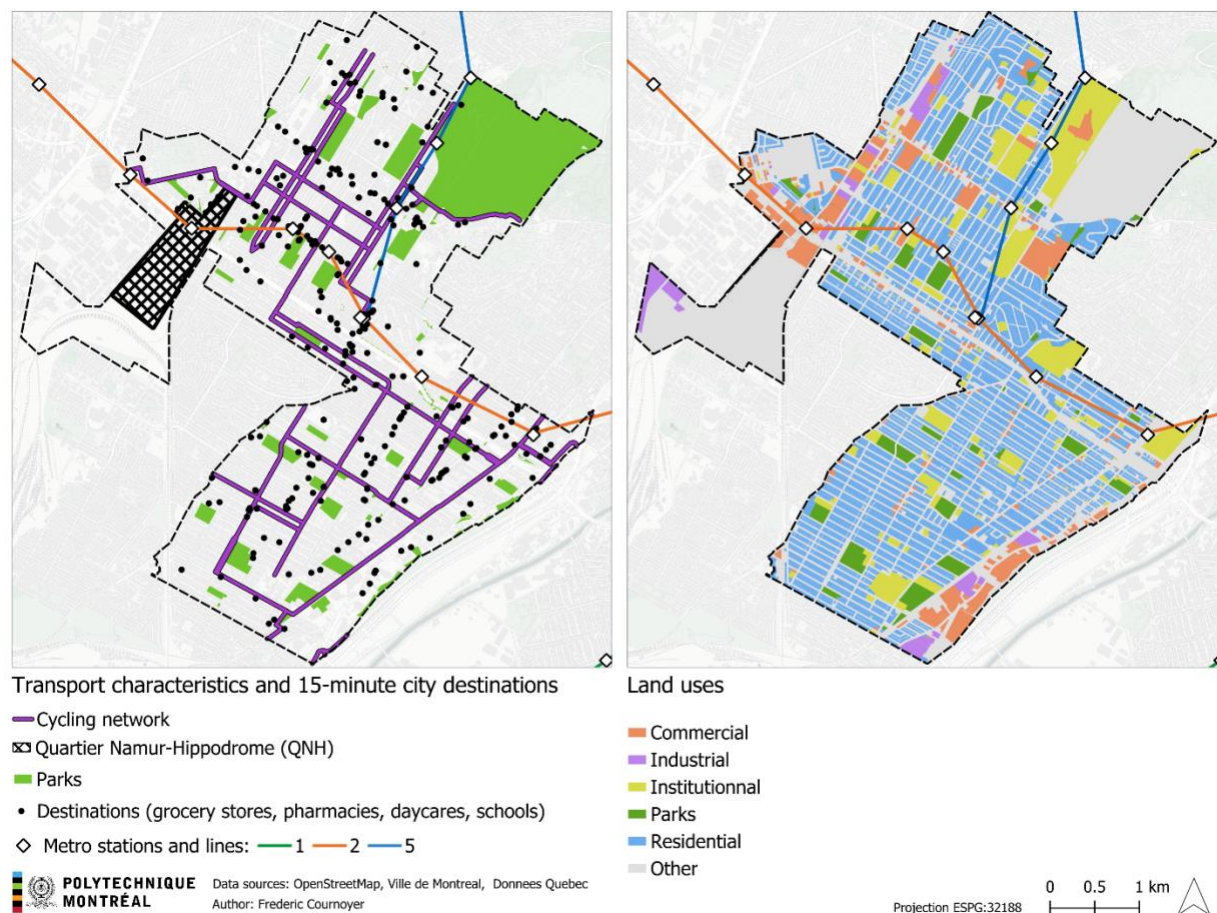


Figure A.7 Land use and transport characteristics in Côte-des-Neiges-Notre-Dame-de-Grâce

Workshop 2: Presentation of the indicators and definition of the scenarios

Maps for each of the destinations were presented to practitioners at the start of the second workshop. We also presented the numerical distribution of accessibility (e.g, the % of residents having access to 0,1,2,3+ destinations). Even though construction of amenities, services, and housing is planned simultaneously, indicators were only calculated based on existing destinations in the surrounding areas. As visible in Figure A.8, few destinations are available in areas close to QNH. Practitioners expressed that this would be contrary to the vision of QNH, as most residents would not be able to access key destinations by active modes. Accordingly, they emphasized the need to include the phasing of the implementation of the services and amenities in the definition of the scenarios. Practitioners decided not to keep passive transit accessibility indicators for the remainder of the project. This was determined considering these indicators could not be directly used by their team to plan QNH, as opposed to the other indicators.



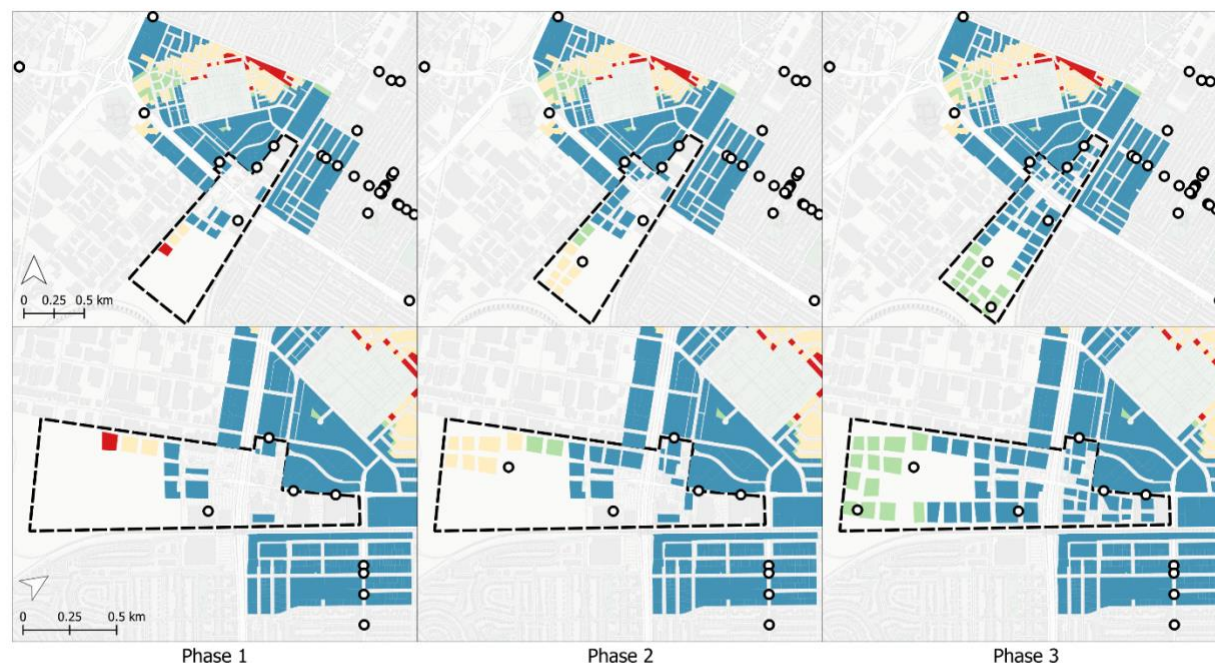
Figure A.8 Accessibility to grocery stores in the Namur-Hippodrome neighborhood (second workshop)

The scenarios defined included the phasing of residential lots and destinations planned in QNH. The residential units and services are to be progressively built in the sector, and the planning team had defined three phases. Therefore, for each destination, we calculated three accessibility indicators, one for each phase. Each indicator reflects a different phase of QNH, with distinct urban development and destinations accessible. Practitioners consistently emphasized the importance that the first residents to settle in the neighborhood have access to all essential destinations. Accordingly, they were concerned with the need to coordinate the construction of residential units and key daily destinations (e.g., schools, grocery stores). Otherwise, the first residents of QNH would need to reach destinations outside the neighborhood using their private automobile. The

practitioners shared the planned locations and phasing (i.e., their estimated date of construction) of grocery stores, pharmacies, parks, schools, and daycares. We also modelled walkways and footbridges (planned in different phases) which were planned to allow residents to cross the railroad (see Figure A.8) to the south-east which creates a barrier and limits access from/to the south-east sector of QNH. Many discussions originated from the need to integrate these barriers into accessibility calculations, as expressed by a practitioner: “We need to understand how each new link actually changes the situation. Not all links will arrive at once; they must be integrated phase by phase.”.

Workshop 3: Analysis of the scenarios

During the third and final workshop, we presented accessibility maps, showing the accessibility diagnosis at every phase of the QNH project. Figure A.9 shows accessibility to grocery stores. The classification used is the access to 0, 1, 2 or 3+ destinations. One map for each of the six destinations was presented. One important finding according to practitioners was the impact of the new destinations of the QNH project on lots outside its territory. As seen in Figure A.9, lots outside QNH (dotted polygon) have access and benefit from destinations inside QNH.



Accessibility to grocery stores

Number of destinations accessible in a 15-minute walk
Namur-Hippodrome Project

○ Grocery stores
□ Quartier Namur-Hippodrome (QNH)
Number of destinations accessible 0 1 2 3+

POLYTECHNIQUE MONTREAL Data sources: OpenStreetMap, Ville de Montréal, Données Québec
Author: Frédéric Courmoyer

Figure A.9 Accessibility to grocery stores in the Namur-Hippodrome neighborhood (third workshop)

We also presented the updated numerical accessibility results based on the planned phases. Figure A.10 shows the proportion of dwellings and their accessibility levels (0 destination accessible, 1, 2, 3 or more) for each destination. These are not representative of the final state of QNH, given the planning process is still ongoing. However, with these indicators, practitioners realized that around 25% of new dwellings would not have access to a school within a 15-minute walk based on the data the research team was given. All practitioners were interested in the accessibility results and participated in the discussions. As explained previously, the QNH case study was singular, as the practitioners expressed their need to integrate accessibility indicators in the planning of the project. Accordingly, QNH practitioners expressed their interest to pursue the collaboration between the research team to refine the accessibility analyses.

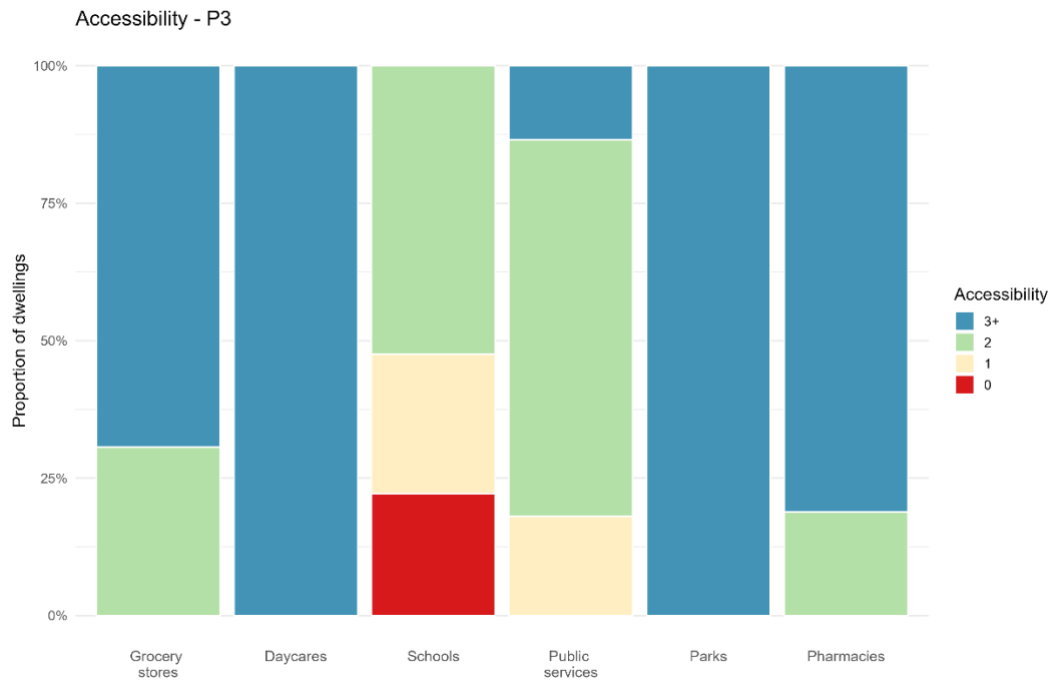


Figure A.10 Numerical accessibility for the third phase of the Namur-Hippodrome Project (third workshop)