Land Use and Access Relationship: Surveying the Landscape

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Abstract

Developments abutting urban arterials often have property access expectations that may not reflect the actual need. In today's environment where many agencies have adopted access management standards and policies in place, the developer's expectations for access can not always be readily achieved. Disagreements between the access permitting agency and developer can quickly become litigious in cases where the developer feels their proposal is not being treated fairly or that the agency is not being sensitive to their needs.

In response to this situation, a survey of seven urban arterial highways in the Portland metropolitan area was conducted to identify the existing status of property access, which may shed some light on public expectations for access to a given development. Each arterial surveyed maintains five lanes of traffic with average daily traffic volumes ranging from 30,000 to 45,000 vehicles. Data collected includes land use type and number, location, and type of accesses serving the property, with land use categories created for service-oriented businesses (high percentage of pass-by trips), general retail, office, industrial, multi-family residential, single-family residential subdivisions, institutional, and civic uses. Access information was recorded for each property to capture the number and types of access connected directly to the arterial, as well as those connected to side streets.

The purpose of this research is to provide agencies implementing access management practices and developers/property owners a tool to help support decisions regarding individual property access. In addition, this research will provide a point of reference when considering the appropriate location and number of accesses for proposed developments and may provide some insight for property access decisions that can be used during the planning stages of new facilities and access management plans. While this survey provides a better understanding of the current access landscape, it does not investigate the economic stability of properties studied. Rather, this study examines the existing landscape and provides empirical evidence of what currently exists and what types of access configurations are commonly associated with various land uses.

Introduction

Planning and access management practitioners have struggled in recent years to implement access management policy, encountering greater resistance as access management policy and standards have tended to become more restrictive, or as interest has been renewed in implementing old policy. Often agency and consulting practitioners claim no economic loss will occur with a restriction or elimination of access, while business owners and developers claim a tacit need for increased access. Both sides will typically cite an example from another road, city, or even region to "prove" their case and demonstrate that their proposal represents "fair" treatment.

The lack of information or misinformation on what kind of access is commonly used is a primary cause for the previous argument. Showing that one similar development is using a particular access configuration is rarely convincing to either party, as it fails to reveal how well that configuration is functioning, may exist in a notably different environment, and represents a very small sample size for comparison. Having a greater understanding of what types of access configurations are currently in use by various development types and sizes is an important step toward a more productive dialogue regarding the argument of how much and what type of access is appropriate or "fair" for a given proposal.

The purpose of this study is to supply an overview of property access configurations currently in use by various types and sizes of developments on arterial highways in the Portland metropolitan area. By compiling this information for hundreds of properties into a single, easily-referenced database, agency staff and developers/property owners will have a tool to help support decisions regarding individual property access. Furthermore, by better understanding, "where we are", we can gain insight into the general public's expectations for property access and the degree to which current policies conflict with those expectations.

History

Access management techniques and policies have largely developed over the last thirty years, with many of them developed in the 1970's (Stover 1970 and Glennon 1975). Since that time, a great deal of effort has been devoted to refining and testing various techniques, including the use of roadway applications as opposed to just driveway regulation.

Typical access management techniques include:

- Construction of non-traversable median barrier;
- Locating driveways away from intersections and signals;
- Aligning driveways to avoid conflicting left turns;
- Restricting movements at driveways;
- Constructing frontage roads;
- Driveway consolidation and consolidation of property access rights; and
- Increasing access spacing.

Access management policy can be traced back to the turn of the century. New Jersey enacted the first recognized state statute in 1902, which stated, "no public streets or other highways shall cross or intersect the speedway without the consent of the County" (Demosthenes, 1999). The interest to implement access management policy is perhaps best manifest through the Interstate Highway System design. Eisenhower himself noted, "One of its principal features in the provision for adequate right of way is to permit control of access to the highway itself. Otherwise, experience shows that the facility becomes prematurely obsolete due to developments crowding against the highway which make it unfit for the purposes for which it was designed," (A Ten Year National Highway Program, 1955).

Over time, access management policy changed along with the many new vehicles on the road. Commercial properties, especially those related to automobile service and sales, began locating near larger roads and requesting direct access. As economic pressures increased in the second half of the 20th century, so did the political pressure to circumvent the state statutes related to controlling access to the highway. It has only been recently, likely due to financial constraint and the need to extend the life of existing facilities, that states have regained an interest in implementing access management policy.

Common access management policies in use today include:

- Controlling access through purchase of property rights;
- Adopting access spacing standards;
- Discouraging flag lots and other subdivision;
- Linking approach permitting decisions to safety requirements; and
- Building systems with high local street connectivity.

The Oregon Story

In Oregon, highway access was unregulated until 1949, when the State Legislature realized that this pattern uncoordinated and uncontrolled connections would lead to hazardous conditions and inefficient travel. In response, a statute was passed that required obtaining written permission from ODOT prior to constructing any type of road approach to a state highway or applicable county governments for county-owned facilities. This written permission was issued in the form of approach permits. However, there was little guidance on how decisions were to be made when issuing such permits, leading to inconsistent treatments and poor highway management.

Modern access management policy took effect in 1999, with the adoption of the 1999 Oregon Highway Plan. In response to a growing need to stretch highway dollars through improved system management and concerns regarding inconsistent treatment of highway access requests, the Oregon Department of Transportation developed a comprehensive set of policies pertaining to access management addressing management objectives by functional classification, identifying access spacing standards, establishing criteria for the construction of non-traversable medians, increasing protections for interchange areas, and outlining procedures for policy deviations and appeals.

The following year, specific regulations created for the implementation of those policies were adopted as part of Oregon Administrative Rule 731-051, better known as Division 51. These regulations facilitated the consistent interpretation and implementation of the overarching policies and provided detailed procedures for processing approach applications that gave applicants the predictable process desired. In addition, they provided a great amount of guidance and established objective criteria for staff responsible for making decisions regarding highway approach issues.

While the establishment of these policies and implementing regulations has widely been considered a success that has benefited the state with improved highway management, as well as property owners by giving them a known and more predictable decision-making process, disagreement regarding access needs for individual development proposals is still common.

Economic Impacts of Access Management

One of the most critical factors related to implementation of policy are the perceived or real impacts to businesses when an alteration to the access configuration is proposed. Business owners often suggest altering their access will result in significant business loss, while state and local agencies typically downplay the effects. Research on the subject has been thin, likely due to the difficulty in analyzing the issue. Proprietary business information, the difficulty in controlling for macroeconomic flux and individual business practices are all critical to assessing economic impact.

While no concrete data on the economic impacts is available, several state DOTs have undergone their own examination. As a result of ten inverse condemnation suits, the Kansas DOT conducted an analysis that found, with one extreme exception, that the abutting uses remained at their highest and best use (Rees, Orrick and Marx 2000). In Texas, a study examining the impacts of left-turn restrictions found that perceptions before the project were worse than the actual impacts, and the worst impacts to the businesses were during construction and not after. In addition, business owners generally ranked “accessibility to store” lower than customer service, product quality and product price, but ahead of store hours and distance to travel (Eisele and Frawley 1999).

Iowa’s DOT found that after access management projects were completed, 80% of businesses reported sales as high or higher than before the project, 80% of businesses reported no customer complaints related to access after the project, and over 90% of motorists surveyed had a favorable opinion of the project (Williams 2000). Lastly, a study in Florida found that more than half of the merchants and 80% of corridor travelers favored the access management project (Williams 2000).

Portland, Oregon Highways

The Portland Metropolitan area had just under 2 million residents in the 2000 Census, encompassing six counties in two states (Bureau of Census, 2000). The metropolitan area has been growing at about 1.5 to 2 percent annually (Portland State University, 2006).

In the Portland area, the first major arterial highways were constructed in the 1930’s. Pacific Highway West, Powell Boulevard, Beaverton-Hillsdale Highway and Pacific Highway East were examples of roads constructed during this era, typically connecting the downtown core to the adjacent hinterlands. Shortly thereafter roads like 82nd Avenue began popping up, connecting the many axial roads leading from downtown to the hinterlands. These ring roads were being constructed in the 1940’s and 1950’s. Many of these roads have been updated in the 1980’s and 1990’s, with the Beaverton-Hillsdale Highway being updated in 2004. The management of access, or lack thereof, reflects the eras when these roads were originally built, when the areas developed, and to a lesser extent the more recent retrofit projects.

Murray Boulevard and Scholls Ferry Road, as they currently exist, were created in the late 1980’s and early 1990’s (Washington County, 2006). These roads were built with modern access management standards in mind. As a result, developments tend to take access from adjacent public streets, with fewer direct highway accesses per mile. The locations of all roadways discussed above are illustrated in Figure 1.

Methodology

Seven similar arterials in the Portland metropolitan area were selected for this study, with segments of similar length and operational characteristics chosen for comparison purposes. The location of each arterial is displayed in Figure 1, with key characteristics of the studied segments shown in Table 1.

Land uses surrounding each segment of roadway represent a mix of predominantly commercial and residential, with limited amounts of industrial and other uses. All corridors are fully developed, with few vacant properties remaining. Other significant characteristics are described below.

Pacific Highway West (OR 99W) is a State Highway that spans over 125 miles, connecting Portland to Eugene. However, in the study area, it also serves as a major urban arterial and is heavily traveled by statewide, regional, and local users. Most abutting properties are developed with commercial businesses and maintain direct access to the highway. This segment of the highway is one of the most congested roadways in the Portland metropolitan area.

Pacific Highway East (OR 99E) is also a State Highway and parallels Pacific Highway West from Portland to Eugene, with the two highways maintaining an average separation of about 10 miles. Much like the study segment on Pacific Highway West, this segment also serves as a major urban arterial and is heavily traveled by statewide, regional, and local users. Again, most abutting properties are developed with commercial businesses and many maintain direct access to the highway.

Beaverton-Hillsdale Highway (B-H Hwy) is a State Highway, but serves primarily local and regional travel with no statewide significance. Most abutting properties are developed with commercial businesses and many maintain direct access to the highway. However, in 2004, the Oregon Department of Transportation removed several private approaches in this area as part of a highway preservation project.

SE 82nd Avenue is another State Highway serving mainly local and regional users. It totals approximately 10 miles in length and parallels Interstate 205. Originally, many of the properties along this highway maintained single-family residences on small lots with frontages ranging from 50 to 100 feet in length. However, in the study area, nearly all properties have been converted to commercial uses, with many “big-box” stores constructed over the last five years that have consolidated both properties and highway accesses.

SE Powell Boulevard is a State Highway of approximately 60 miles in length that serves as a major urban arterial, as well as a popular route between Portland and recreational opportunities around Mount Hood and eastern Oregon. Within the study segment, land uses are mixed between commercial and residential uses. About 15 years ago, this highway was enhanced with sections of landscaped median and a series of short frontage roads averaging about two blocks in length each.

> **Scholls Ferry Road** is a former State Highway, now under the jurisdiction of Washington County. While land uses adjacent to this roadway are mixed between commercial and residential, the primary use of this facility is to provide access between a large number of residential subdivisions on the outskirts of the metropolitan area and the central city.
>
> **Murray Boulevard** is also under the jurisdiction of Washington County. This arterial is approximately six miles in length and is bordered by a wide variety of land uses including commercial, industrial, residential, office, and other developments. Murray Boulevard is used mostly for local travel.

Through the use of aerial photography and field surveys, the properties directly abutting each of these highway segments were examined, with the general land use category and size of each development recorded, as well as the number, type, and locations of existing access points. Land uses were grouped into either service commercial, general commercial, office, industrial, multi-family residential, single-family residential, institutional (e.g. schools, churches), or civic (e.g. parks and public buildings) categories.

These categories were broken down further to provide some differentiation between smaller and larger developments. To define the threshold between smaller and larger developments, a target trip generation of 500 average daily vehicles or 100 peak hour trips was used. Using the ITE Trip Generation Manual (Institute of Transportation Engineers, 2003), the number of square feet or units for each land use category that would generate trips within this target range was identified. These values were further refined by considering the typical sizes of developments in each category observed and the level of precision that would be appropriate given that most buildings would be measured using aerial photographs. The resulting land use categories used for this study are shown in Table 2. Note that the general commercial category was broken into three size groups to reflect the large range of sizes found in the field.

For the number, type, and locations of access points, each access to the property was recorded as being signalized or unsignalized, full movement or turn-restricted, and was noted as being on the mainline or a side street. Furthermore, whether or not the side street was signalized at the intersection with the mainline was noted, and properties with only mainline access possible were identified.

Service entrances were not included as access in this research. If buildings were physically connected, they were considered one business. In areas where multiple buildings shared a parking lot, they were considered as one business. Side streets behind developments that were parallel to the highway were counted so long as they had access to the highway. Parking spaces at car sales lots were not included as square-footage of the business.

Findings

Upon compiling the data collected for each studied arterial segment, the results were combined into a common database and analyzed. When considering the findings of this study, note that this inventory only represents the current status of arterial/property access and does not represent best or current practices or attempt to evaluate the effectiveness of any given configuration.

Tables 3, 4, and 5 show the various access configurations serving each type and size of development present. Table 3 shows the access configurations in use by all properties with only access to the arterial and no opportunity to access another street. Table 4 shows the access configurations in use by all properties with available access to a side street that is unsignalized at an intersection with the arterial. Table 5 shows the access configurations in use by all properties with available access to a side street that is signalized at an intersection with the arterial. In addition to being a resource when considering common access configurations for various types of developments, several key findings are noted below.

Access Density

Figure 2 provides a comparison of private access densities for each study arterial. The average density of private access points on an arterial is approximately 28 accesses per mile (average spacing of 375 feet on each side of the highway). OR 99W and OR 99E have access densities approximately 42% higher than the average at 40 accesses per mile (average spacing of 265 feet on each side of the highway), while Scholls Ferry Road had the lowest density at 6 accesses per mile (average spacing of 1,760 feet on each side of the highway).

Figure 2 also shows the average density of public street intersections is approximately 8 intersections per mile (average spacing of 660 feet). Powell Boulevard has an access density approximately 125% higher than the average at 18 intersections per mile (average spacing of 295 feet).

While a high public street density might suggest that there would be increased opportunity for provision of adjacent property access off of the arterial, the data from Figure 2 shows that such opportunities are not being taken advantage of. For example, Powell Boulevard and 82nd Avenue have the highest public street densities, but still maintain higher than average private access densities. On 82nd Avenue, two factors may be contributing to the high number of private accesses: 1) nearly all developments adjacent to 82nd Avenue are commercial in nature, and 2) while parallel roads are available for alternate access, some gaps in the system are still present that limit opportunities to remove access from the arterial.

The environment surrounding Powell Boulevard is somewhat different in that it is bounded to the north and south by residential neighborhoods maintaining a tight local street grid system. Most of these local streets, in addition to several short frontage roads, intersect Powell Boulevard creating a higher than normal density of public streets. However, the density of private accesses appears to be unaffected by this, as it remains close to the average for all arterials studied.

Contrary to expectations, Scholls Ferry Road and Murray Boulevard are among the lowest in public street density, yet maintain the lowest private access densities as well. Unlike 82nd

Avenue, Scholls Ferry Road has a significant amount of residential property and good parallel roadways on both sides of the arterial that provide alternative access.

Murray Boulevard has some large industrial and business parks where access is consolidated on ring roads and other minor streets before reaching the arterial, in addition to some residential properties taking access from local streets. The combination of these factors results in slightly lower than average access densities.

It should also be recognized that Scholls Ferry Road and Murray Boulevard are newer roadways than the other study arterials and that strategies to reduce direct arterial access were likely considered before some adjacent properties developed.

Access Location

Figure 3 provides a comparison of adjacent property access locations for each study arterial. On average, 52% of adjacent property access points are located on the arterial, while 48% are located on side streets. It should be recognized that this data includes accesses from all properties adjacent to the arterials, some of which do not abut other streets.

Figure 3 shows that Beaverton-Hillsdale Highway has a high percentage of direct arterial access points (73%), while on Scholls Ferry Road there is a very low percentage (18%). On Beaverton-Hillsdale Highway, this high reliance on direct arterial access may be due to the high percentage of commercially-oriented developments abutting the arterial with no significant network of parallel streets to provide alternate access. In contrast, Scholls Ferry Road is surrounded by a high percentage of residential developments and is complimented by a good parallel road network.

For properties developed with commercially-oriented businesses and office buildings, it is common for direct arterial access to be maintained even though alternate access is available to a side street. However, for industrial and residential land uses, reliance on only side street access becomes more prevalent when it is available. This trend is shown in Figure 4, which identifies how often each type of development inventoried relies only on side street access when it is available. Notice that the presence of direct arterial access does not appear to be associated with trip generation as much as with land use, as even large residential and industrial developments are more likely to forgo direct arterial access whereas even small commercial developments consistently keep it. It should be noted when reviewing this data that the number of occurrences for institutional and civic land uses were very low.

Number of Accesses per Development

Table 6 presents the same data as Tables 3, 4, and 5, but focuses on the number of access points serving various types of developments without regard for the access locations. When organized in this manner, other key findings become apparent.

The average number of access points found to be serving each development type is shown in Figure 5 (right-in/right-out accesses are counted as one whole access). Notice that other than for the service-commercial developments, the number of access points serving each type of development tends to increase as development size increases.

While Figure 5 shows that, on average, all development types are maintaining more than one access point, Figure 6, which shows the frequency of occurrence for access quantities, indicates that just under half of all developments surveyed were being served by only one access. Furthermore, nearly 85% of all developments were served by no more than two accesses. By examining the data in Table 6, it is shown that nearly all (81%) of the developments served by more than two accesses where commercially-oriented and that the size of the development was not a factor.

Conclusion

Considering the findings discussed above, the following conclusions were drawn from this study.

- **Residential and industrial land uses are more likely to rely solely on access from side streets when available.**
- **Even when side street access is available, many commercial and office developments continue to maintain access directly to the arterial.**
- **The number of accesses serving a development generally increases as development size increases.**
- **Nearly half of all developments surveyed were being served by no more than one access and over 80% of them were served by no more than two accesses.**
- **Of the developments being served by more than two accesses, 81% were commercially-oriented and the size of the development was not a factor.**
- **Access density on an arterial can be impacted by adjacent land use type, availability of parallel streets, and planning prior to property development.**
- **There is no correlation between private access density and public street connectivity. This is not likely a casual relationship as areas with high public street connectivity tend to be older, thus the road was built before access management was widely understood and implemented. While public street connections do provide opportunities, if they are not accessible to highway-adjacent properties and policies are not in place to direct access away from the arterials during development, their presence will not reduce private access density.**

While there are many factors that can influence the number and location of access points to a given property, this study of seven existing arterial corridors suggests that the type of land use and availability of alternate access through a parallel street system can play a role in minimizing the number of access points located directly on the adjacent arterial. When planning new arterial corridors, the concurrent construction of a good parallel road system that allows for adequate property depths and convenient signalized access to the arterial through public street intersections may be a key component in preserving the operational life of the arterial by providing opportunities to better manage access.

In addition, consideration should be given to making the provision of alternate access to properties with residential and industrial zoning a priority, as expectations for direct arterial access may be less likely. If direct access to these properties is limited as much as possible, direct access to properties maintaining commercial zoning, where such expectations may be more common, could be allowed while still achieving an overall net reduction in potential access points.

Furthermore, agencies with jurisdiction over access to arterials may consider modifying access management policies with respect to changing access expectations and desires for different land uses. For example, the provision of direct arterial access for land uses where direct access is not typically requested, such as residential and industrial developments, could be made more difficult to obtain than for land uses, such as commercial and office developments, where direct access is often expected.

Areas for Further Research

Because this study only inventoried existing access configurations without regard to the access management policies in place prior to property development, the implied expectations for various development types and sizes are based on conditions resulting from very different eras ranging from no regulation of highway access to very prescriptive regulation. To say that a new commercial development should be given two access points today based on this research is somewhat misleading since many of the developments included in the inventory may have occurred during a time when access was unregulated. Therefore, this study should be supplemented with another survey that considers only properties that have developed since the adoption of ODOT’s most recent access management policies and Division 51 to see how expectations may have changed since that time and what might be considered, “fair” treatment today.

In addition, this study only identified the types and quantities of access currently in use today and did not attempt to evaluate the effectiveness of these conditions. To gain insight into this matter, customers and users of some of these properties could be surveyed to get their opinions on how specific property access quantities and configurations are working.

Also, now that all accesses within each corridor have been inventoried, additional research could include an analysis of crash histories to see if a relationship exists between access density and crash rates.

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Figure 1: Highway segments surveyed within the Portland metropolitan area.

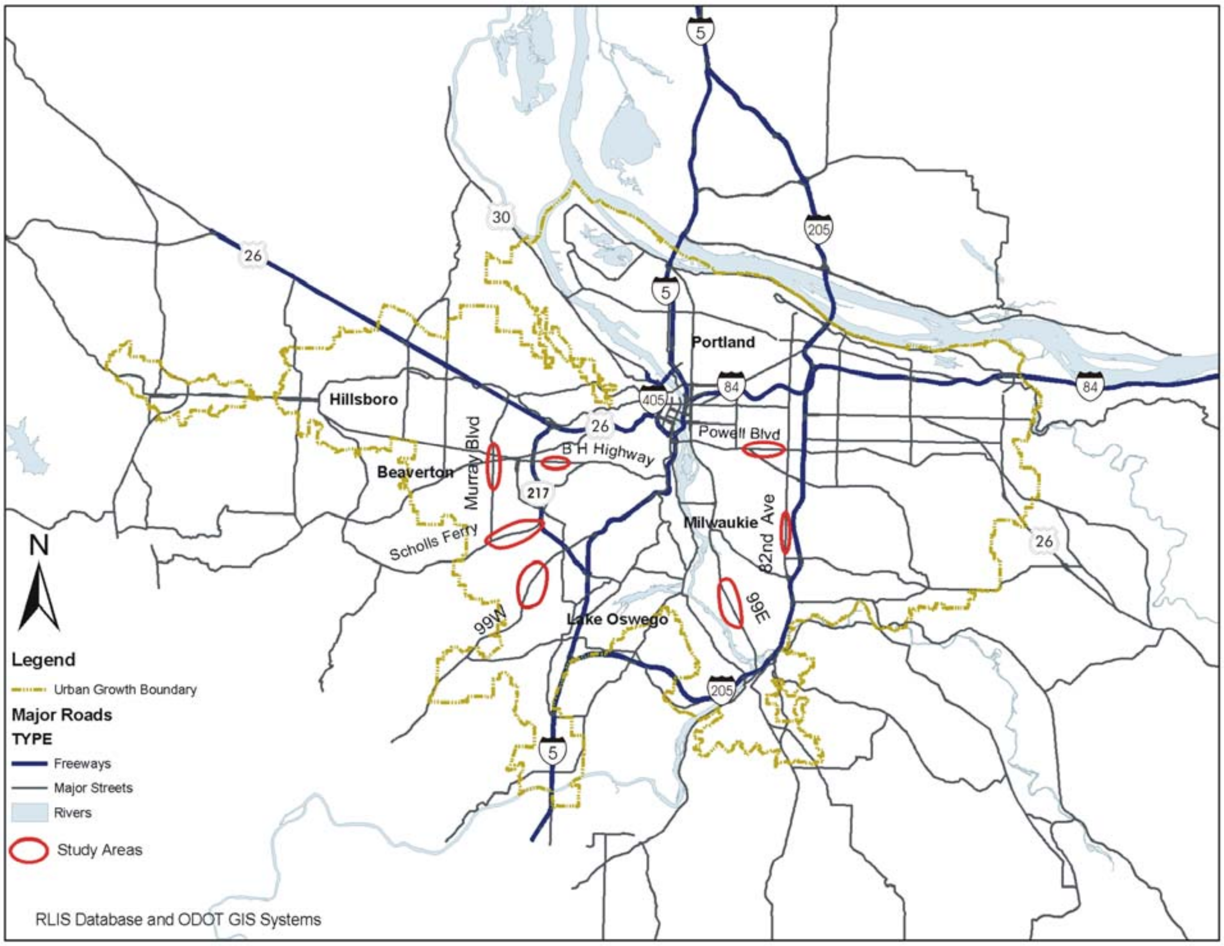

Table 1: Study Arterial Characteristics

Arterial Name	Segment	Segment Length (mi)	No. of Lanes	Posted Speed (mph)	Average Daily Traffic (vpd)
Pacific Highway West (OR 99W)	72nd Ave. to Gaarde St. / McDonald St.	2.34	5	35	45,000
Pacific Highway East (OR 99E)	Oak Grove Blvd. to Jennings Ave.	1.92	5	40	35,000
Beaverton-Hillsdale Highway (B-H Hwy)	OR 217 to Scholls Ferry Rd.	2.11	5	35	30,000
SE 82nd Ave.	Johnson Creek Blvd. to Sunnybrook Blvd.	1.86	5	35/45	35,000
SE Powell Blvd.	Foster Rd. to Interstate 205	2.24	5	35	30,000
Scholls Ferry Rd.	Nimbus Ave. to Murray Blvd.	1.87	5	35	35,000
Murray Blvd.	Allen Blvd. to Jenkins Rd.	1.93	5	40	30,000

Table 2: Study Land Use Categories

Land Use Types	Sizes
Service Commercial (CS)	> 3,000 SF
	≤ 3,000 SF
General Commercial (CG)	≥ 75,000 SF
	≥ 25 KSF, < 75 KSF
	< 25,000 SF
Office (Off)	≥ 50,000 SF
	< 50,000 SF
Industrial (Ind)	≥ 100,000 SF
	< 100,000 SF
Multi-Family Residential (MFR)	≥ 75 Units
	< 75 Units
Single-Family Residential (SFR)	≥ 50 Units
	< 50 Units
Institutional (Inst)	≥ 50,000 SF
	< 50,000 SF
Civic (Civ)	≥ 50,000 SF
	< 50,000 SF

Table 3: Number of Property Access Configurations by Development Type - Highway Access only Available

Land Use Type	Size	Access Configuration							
		2 Signalized + 1 RIRO	1 Signalized + 2 full	1 Signalized + 1 full	1 Signalized	2 full	1 full	2 RIRO	1 RIRO
Commercial - Service	> 3 KSF	0	0	0	0	3	4	0	1
	≤ 3 KSF	0	0	0	0	1	7	0	0
Commercial - General	≥ 75 KSF	1	1	1	0	0	0	0	0
	≥ 25 KSF, < 75 KSF	0	0	0	0	0	4	0	0
	< 25 KSF	0	0	1	0	13	48	1	2
Office	≥ 50 KSF	0	0	0	0	0	2	0	0
	< 50 KSF	0	0	0	2	1	6	0	0
Industrial	≥ 100 KSF	0	0	0	0	0	0	0	0
	< 100 KSF	0	0	0	1	0	1	0	0
Multi-Family Residential	≥ 75 Units	0	0	0	0	0	5	0	0
	< 75 Units	0	0	0	0	1	12	0	0
Single-Family Residential	≥ 50 Units	0	0	0	0	0	1	0	0
	< 50 Units	0	0	0	0	1	16	0	0
Institutional	≥ 50 KSF	0	0	0	0	1	1	0	0
	< 50 KSF	0	0	0	0	3	2	0	0
Civic	≥ 50 KSF	0	0	0	0	0	0	0	0
	< 50 KSF	0	0	0	0	0	0	0	0

Notes: RIRO = right-in/right-out; KSF = 1,000 square feet; Hwy = Highway; SS = side street.

Table 4: Number of Property Access Configurations by Development Type - Side Street Unsignalized at Highway Available

Land Use Type	Size	Access Configuration							
		1 full Hwy + 2 full SS	1 full Hwy + 1 full SS	1 full Hwy + 1 backage rd.	1 RIRO Hwy + 1 full SS	1 RIRO Hwy + 1 RIRO SS	2 full SS, no Hwy	1 full SS, no Hwy	1 full to frontage rd.
Commercial - Service	> 3 KSF	0	1	0	0	0	0	2	0
	≤ 3 KSF	0	2	0	0	0	1	1	0
Commercial - General	≥ 75 KSF	1	0	0	0	0	0	0	0
	≥ 25 KSF, < 75 KSF	3	1	0	0	0	0	2	0
	< 25 KSF	7	29	7	2	1	2	18	0
Office	≥ 50 KSF	0	0	0	0	0	0	0	0
	< 50 KSF	1	1	0	0	0	0	1	0
Industrial	≥ 100 KSF	0	0	0	0	0	0	0	0
	< 100 KSF	0	0	0	1	0	0	0	0
Multi-Family Residential	≥ 75 Units	0	0	0	0	0	1	0	0
	< 75 Units	0	2	0	0	0	0	11	5
Single-Family Residential	≥ 50 Units	0	1	0	0	0	1	0	0
	< 50 Units	1	1	0	1	0	0	10	27
Institutional	≥ 50 KSF	0	0	0	0	0	0	0	0
	< 50 KSF	0	0	0	0	0	0	0	0
Civic	≥ 50 KSF	0	0	0	0	0	0	0	0
	< 50 KSF	0	0	0	0	0	1	0	0

Notes: RIRO = right-in/right-out; KSF = 1,000 square feet; Hwy = Highway; SS = side street.

Table 4 (continued): Number of Property Access Configurations by Development Type - Side Street Unsignalized at Highway Available

Land Use Type	Size	Access Configuration							
		1 full Hwy + 2 full SS	1 full Hwy + 1 full SS	1 full Hwy + 1 backage rd.	1 RIRO Hwy + 1 full SS	1 RIRO Hwy + 1 RIRO SS	2 full SS, no Hwy	1 full SS, no Hwy	1 full to frontage rd.
Commercial - Service	> 3 KSF	0	1	0	0	0	0	2	0
	≤ 3 KSF	0	2	0	0	0	1	1	0
Commercial - General	≥ 75 KSF	1	0	0	0	0	0	0	0
	≥ 25 KSF, < 75 KSF	3	1	0	0	0	0	2	0
	< 25 KSF	7	29	7	2	1	2	18	0
Office	≥ 50 KSF	0	0	0	0	0	0	0	0
	< 50 KSF	1	1	0	0	0	0	1	0
Industrial	≥ 100 KSF	0	0	0	0	0	0	0	0
	< 100 KSF	0	0	0	1	0	0	0	0
Multi-Family Residential	≥ 75 Units	0	0	0	0	0	1	0	0
	< 75 Units	0	2	0	0	0	0	11	5
Single-Family Residential	≥ 50 Units	0	1	0	0	0	1	0	0
	< 50 Units	1	1	0	1	0	0	10	27
Institutional	≥ 50 KSF	0	0	0	0	0	0	0	0
	< 50 KSF	0	0	0	0	0	0	0	0
Civic	≥ 50 KSF	0	0	0	0	0	0	0	0
	< 50 KSF	0	0	0	0	0	1	0	0

Notes: RIRO = right-in/right-out; KSF = 1,000 square feet; Hwy = Highway; SS = side street.

Table 5: Number of Property Access Configurations by Development Type - Side Street Signalized at Highway Available

Land Use Type	Size	Access Configuration									
		3 full Hwy + 1 full SS	2 full Hwy + 5 full SS	2 full Hwy + 3 full SS	2 full Hwy + 2 full SS	2 full Hwy + 1 full SS	1 full Hwy + 2 RIRO Hwy + 1 RIRO SS	1 full Hwy + 1 RIRO Hwy + 1 full SS	1 full Hwy + 1 RIRO Hwy, no SS	1 full Hwy + 3 full SS	1 full Hwy + 2 full SS
Commercial - Service	> 3 KSF	0	0	0	0	0	0	0	0	0	0
	≤ 3 KSF	0	0	0	2	1	0	0	0	0	0
Commercial - General	≥ 75 KSF	1	1	0	3	1	1	1	0	0	0
	≥ 25 KSF, < 75 KSF	0	0	1	0	1	0	0	0	1	0
	< 25 KSF	0	0	0	1	5	0	0	0	0	0
Office	≥ 50 KSF	0	0	0	0	0	0	0	0	0	1
	< 50 KSF	0	0	0	0	0	0	0	0	0	0
Industrial	≥ 100 KSF	0	0	0	0	0	0	0	0	0	0
	< 100 KSF	0	0	0	0	0	0	0	0	0	0
Multi-Family Residential	≥ 75 Units	0	0	0	1	0	0	0	0	0	0
	< 75 Units	0	0	0	0	0	0	0	0	0	0
Single-Family Residential	≥ 50 Units	0	0	0	0	0	0	0	0	0	1
	< 50 Units	0	0	0	0	0	0	0	0	0	0
Institutional	≥ 50 KSF	0	0	0	1	0	0	0	0	0	0
	< 50 KSF	0	0	0	0	0	0	0	0	0	0
Civic	≥ 50 KSF	0	0	0	0	0	0	0	1	0	0
	< 50 KSF	0	0	0	0	0	0	0	0	0	0

Notes: RIRO = right-in/right-out; KSF = 1,000 square feet; Hwy = Highway; SS = side street.

Table 5 (continued): Number of Property Access Configurations by Development Type - Side Street Signalized at Highway Available

Land Use Type	Size	Access Configuration										
		1 full Hwy + 1 full SS	1 full Hwy + 1 backage rd.	2 RIRO Hwy + 3 full SS	1 RIRO Hwy + 2 full SS	1 RIRO Hwy + 1 full SS + 1 RIRO SS	1 RIRO Hwy + 1 full SS	1 RIRO Hwy, no SS	5 full SS, no Hwy	3 full SS, no Hwy	2 full SS, no Hwy	1 full SS, no Hwy
Commercial - Service	> 3 KSF	2	0	0	0	0	1	0	0	0	0	1
	≤ 3 KSF	8	0	0	0	0	1	0	0	0	0	1
Commercial - General	≥ 75 KSF	1	0	2	1	0	0	0	0	0	0	1
	≥ 25 KSF, < 75 KSF	3	0	0	0	0	1	0	0	0	1	0
	< 25 KSF	22	8	0	0	1	4	1	0	0	1	7
Office	≥ 50 KSF	0	0	0	0	0	0	0	0	0	0	0
	< 50 KSF	1	0	0	0	0	1	0	0	0	1	1
Industrial	≥ 100 KSF	0	0	0	0	0	0	0	1	0	1	0
	< 100 KSF	0	0	0	0	0	0	0	0	0	0	1
Multi-Family Residential	≥ 75 Units	0	0	0	0	0	1	0	3	0	5	0
	< 75 Units	0	0	0	0	0	0	0	0	0	0	1
Single-Family Residential	≥ 50 Units	0	0	0	0	0	0	0	1	0	1	0
	< 50 Units	0	2	0	0	0	0	0	0	0	0	0
Institutional	≥ 50 KSF	0	0	0	0	0	0	0	0	0	0	0
	< 50 KSF	1	0	0	0	0	0	0	0	0	1	1
Civic	≥ 50 KSF	0	0	0	0	0	0	0	0	0	0	0
	< 50 KSF	1	0	0	0	0	0	0	0	0	0	0

Notes: RIRO = right-in/right-out; KSF = 1,000 square feet; Hwy = Highway; SS = side street.

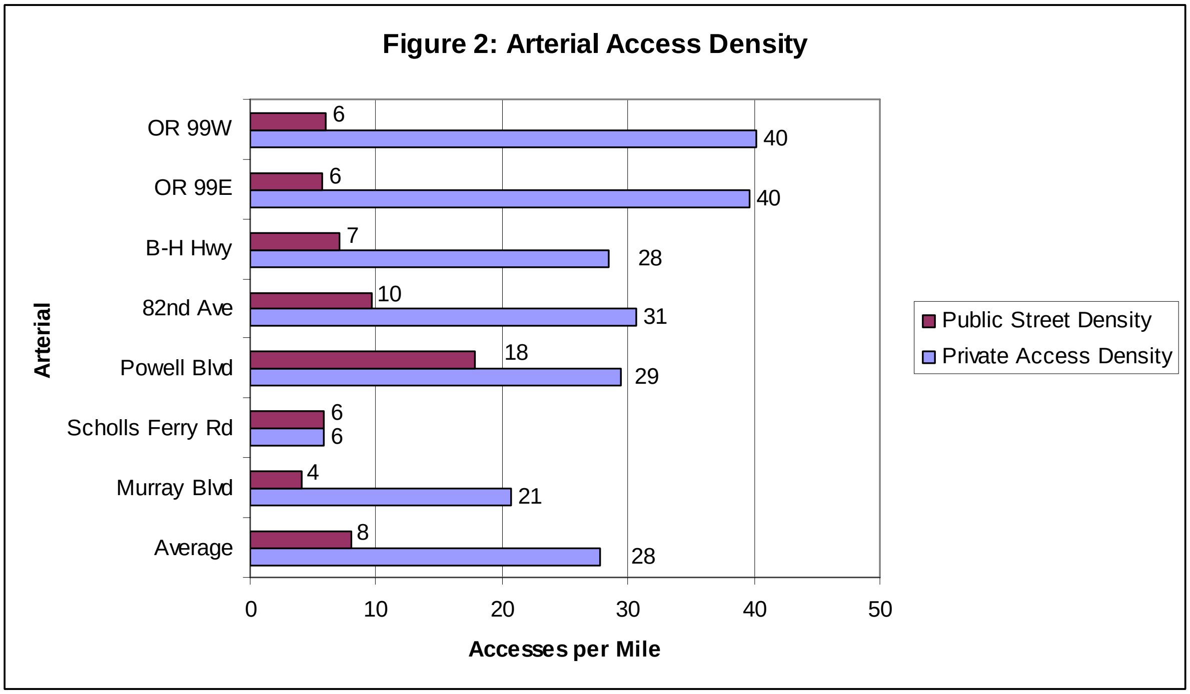
Figure 2: Arterial Access Density
Arterial
OR 99W
OR 99E
B-H Hwy
82nd Ave
Powell Blvd
Scholls Ferry Rd
Murray Blvd
Average
6
40
6
40
7
28
10
31
18
29
6
6
4
21
8
28
0
10
20
30
40
50
Accesses per Mile
Public Street Density
Private Access Density

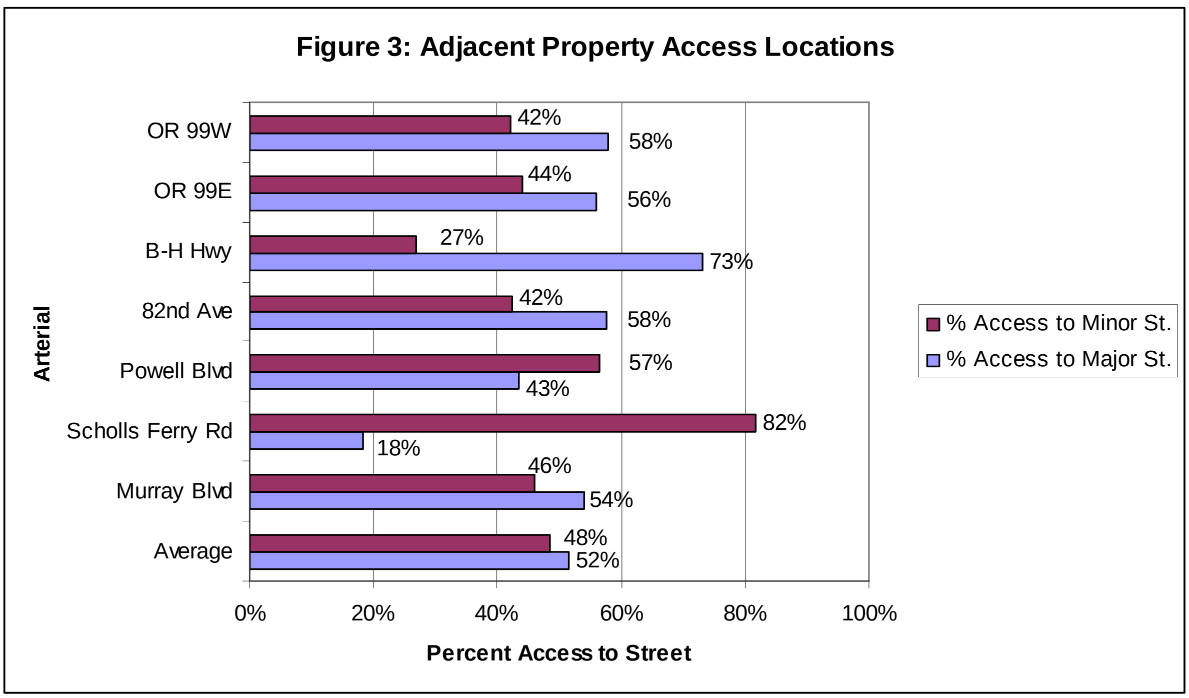
Figure 3: Adjacent Property Access Locations
Arterial
OR 99W
OR 99E
B-H Hwy
82nd Ave
Powell Blvd
Scholls Ferry Rd
Murray Blvd
Average
42%
58%
44%
56%
27%
73%
42%
58%
57%
43%
82%
18%
46%
54%
48%
52%
0%
20%
40%
60%
80%
100%
Percent Access to Street
% Access to Minor St.
% Access to Major St.

Figure 4: Percent of arterial-adjacent developments with no direct arterial access when other access is available

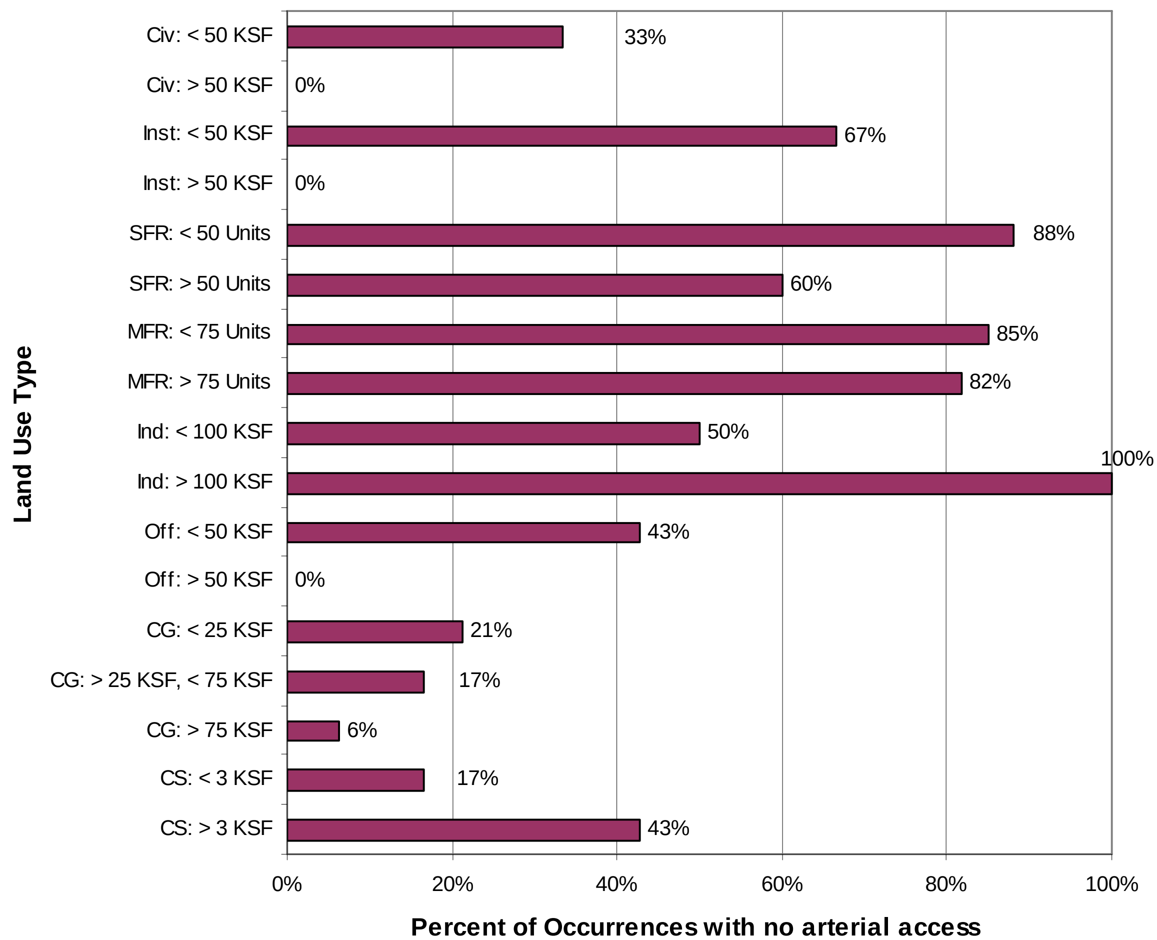

Table 6: Number of Occurrences of Access Quantities per Development Type

Land Use Type	Size	Number of Access Points												
		1 RIRO	2 RIRO	1 full	1 full + 1 RIRO	1 full + 2 RIRO	1 full + 3 RIRO	2 full	2 full + 1 RIRO	3 full	3 full + 2 RIRO	4 full	5 full	7 full
Commercial - Service	> 3 KSF	1	0	7	1	0	0	6	0	0	0	0	0	0
	≤ 3 KSF	0	0	9	1	0	0	12	0	2	0	2	0	0
Commercial - General	≥ 75 KSF	0	0	1	0	0	1	2	3	3	3	4	1	1
	≥ 25 KSF, < 75 KSF	0	0	6	1	0	0	6	0	7	0	1	1	0
	< 25 KSF	3	2	73	6	1	0	88	0	20	0	4	0	0
Office	≥ 50 KSF	0	0	2	0	0	0	0	0	1	0	0	0	0
	< 50 KSF	0	0	10	1	0	0	4	0	1	0	0	0	0
Industrial	≥ 100 KSF	0	0	0	0	0	0	1	0	0	0	0	1	0
	< 100 KSF	0	0	3	1	0	0	0	0	0	0	0	0	0
Multi-Family Residential	≥ 75 Units	0	0	5	1	0	0	6	0	0	0	1	3	0
	< 75 Units	0	0	29	0	0	0	3	0	1	0	0	0	0
Single-Family Residential	≥ 50 Units	0	0	1	0	0	0	3	0	1	0	0	1	0
	< 50 Units	0	0	53	1	0	0	4	0	1	0	0	0	0
Institutional	≥ 50 KSF	0	0	1	0	0	0	1	0	0	0	2	0	0
	< 50 KSF	0	0	3	0	0	0	5	0	0	0	0	0	0
Civic	≥ 50 KSF	0	0	0	1	0	0	0	0	0	0	0	0	0
	< 50 KSF	0	0	0	0	0	0	3	0	0	0	0	0	0

Notes: RIRO = right-in/right-out; KSF = 1,000 square feet.

Figure 5: Average Number of Accesses per Development Type

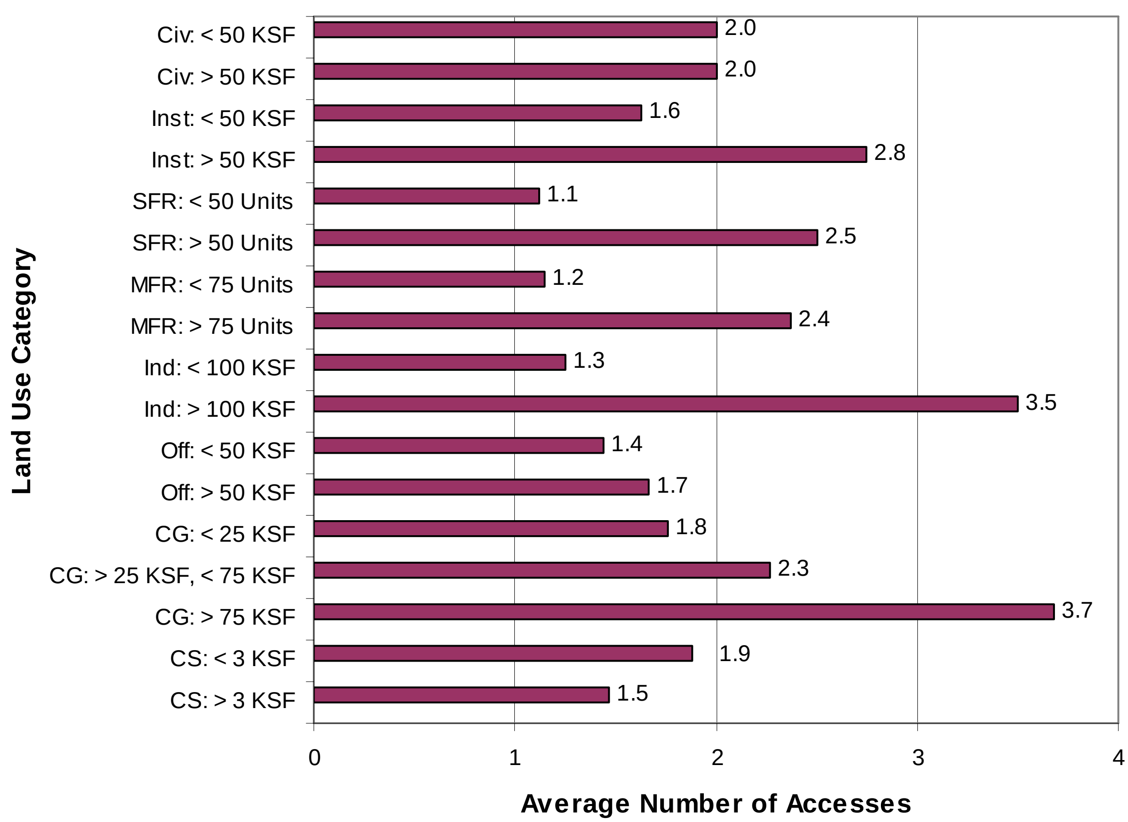

Figure 6: Access Points per Development