Smart Location Database

Version 2.0 User Guide

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Background

The Environmental Protection Agency's (EPA) Smart Location Database (SLD) was developed to address the growing demand for data products and tools that consistently compare the location efficiency of various places. The SLD summarizes several demographic, employment, and built environment variables for every Census block group (CBG) in the United States.[1] The attributes measured serve as indicators of the commonly cited "D" variables that have been shown in the transportation research literature to be related to travel behavior.[2] The Ds include concepts such as residential and employment *density*, land use *diversity*, *design* of the built environment, access to *destinations*, and *distance* to transit. SLD variables can be used as inputs to travel demand models, baseline data for scenario planning studies, and combined into composite indicators characterizing the relative location efficiency of CBG within U.S. metropolitan regions.

This report contains a detailed description of the data sources and methodologies used to calculate each of the variables contained in the SLD. It also discusses any known limitations associated with variables in the SLD. More information about the environmental significance of several individual variables contained in the SLD will be available in the form of fact sheets developed for EPA's EnviroAtlas[3]. Links to these fact sheets will be added to this document as they become available.

Prior versions of the SLD

A previous version of the SLD (version 0.2b) was released by EPA in early 2012. This report describes a completely new version of the SLD (version 2, herein referred to as simply the SLD) intended to replace the prior release. This updated SLD features new geographic boundaries (Census 2010 block groups), new data sources, new variables, and new methods of calculation. Due to these changes, it is not appropriate to directly compare values across the two datasets.

[1] SLD version 2.0 uses 2010 Census TIGER/Line polygons for defining block group boundaries.

[2] For a review of the research literature summarizing the relationship between built environment variables and travel behavior see Ewing and Cervero (2001; 2010), Kuzmyak et al. (2003), National Research Council (2009).

[3] www.epa.gov/research/enviroatlas

Accessing the Smart Location Database

The SLD is a free resource available to the public for download, web service, or viewing online. Options are described below:

Download:

The SLD can be downloaded as a single file geodatabase at EPA's Environmental Dataset Gateway[4]. Users who only wish to download data for a single state, metro region, or locality can use EPA's Clip and Ship tool[5].

Web service:

The SLD is available as an Esri mapping service, REST, SOAP, WMS, and KML. See the SLD web service[6] for details.

Viewing online:

Several variables from the SLD are available for viewing online. Go to http://www.epa.gov/smartgrowth/smartlocationdatabase.htm for details.

Variables available in the Smart Location Database

Table 1 lists all of the variables available in the SLD. SLD variables are grouped into topic areas.

Table 1 – Variables included in the Smart Location Database

Field	Description	Data source(s)	Coverage
Administrative			
GEOID10	Census block group 12-digit FIPS code	2010 Census TIGER/Line	Entire U.S.
TRACTCE10	Census tract FIPS code in which CBG resides	2010 Census TIGER/Line	Entire U.S.
CFIPS	County FIPS code	2010 Census TIGER/Line	Entire U.S.
SFIPS	State FIPS code	2010 Census TIGER/Line	Entire U.S.
CSA	Combined Statistical Area Code	US Census	Entire U.S.
CSA_Name	Name of CSA in which CBG resides	US Census	Entire U.S.
CBSA	FIPS for core based statistical area (CBSA) in which CBG resides	US Census	Entire U.S.
CBSA_Name	Name of CBSA in which CBG resides	US Census	Entire U.S.
CBSA-wide statistics (same value for all block groups within the same CBSA (metropolitan area))			
CBSA_Pop	Total population in CBSA	US Census	Entire U.S.
CBSA_Emp	Total employment in CBSA	Census LEHD, 2010	Entire U.S. (except PR)
CBSA_Wrk	Total number of workers that live in CBSA	Census LEHD, 2010	Entire U.S. (except PR)

[4] http://goo.gl/JCpdr
[5] http://edg.epa.gov/clipship/
[6] http://geodata.epa.gov/ArcGIS/rest/services/OA/SmartLocationDatabase/MapServer

Area			
Ac_Tot	Total geometric area of the CBG	2010 Census TIGER/Line	Entire U.S.
Ac_Unpr	Total land area in acres that is not protected from development (i.e., not a park or conservation area)	Census, Navteq parks, PAD-US	Entire U.S.
Ac_Water	Total water area in acres	Census, Navteq Water and Oceans	Entire U.S.
Ac_Land	Total land area in acres	Census, Navteq Water and Oceans	Entire U.S.
Demographics			
CountHU	Housing units, 2010	2010 decennial Census	Entire U.S.
HH	Households (occupied housing units), 2010	2010 decennial Census	Entire U.S.
TotPop	Population, 2010	2010 decennial Census	Entire U.S.
P_WrkAge	Percent of population that is working aged, 2010	2010 decennial Census	Entire U.S.
AutoOwn0	Number of households in CBG that own zero automobiles, 2010	ACS, 2010 decennial Census	Entire U.S.
Pct_AO0	Percent of zero-car households in CBG	ACS	Entire U.S.
AutoOwn1	Number of households in CBG that own one automobile, 2010	ACS, 2010 decennial Census	Entire U.S.
Pct_AO1	Percent of one-car households in CBG	ACS	Entire U.S.
AutoOwn2p	Number of households in CBG that own two or more automobiles, 2010	ACS, 2010 decennial Census	Entire U.S.
Pct_AO2p	Percent of two-plus-car households in CBG	ACS	Entire U.S.
Workers	# of workers in CBG (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
R_LowWageWk	# of workers earning $1250/month or less (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
R_MedWageWk	# of workers earning more than $1250/month but less than $3333/month (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
R_HiWageWk	# of workers earning $3333/month or more (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
R_PctLowWage	% LowWageWk of total #workers in a CBG (home location), 2010	Census LEHD, 2010	Entire U.S. (except PR)
Employment			
TotEmp	Total employment, 2010	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E5_Ret10	Retail jobs within a 5-tier employment classification scheme (LEHD: CNS07)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E5_Off10	Office jobs within a 5-tier employment classification scheme (LEHD: CNS09 + CNS10 + CNS11 + CNS13 + CNS20)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E5_Ind10	Industrial jobs within a 5-tier employment classification scheme (LEHD: CNS01 + CNS02 + CNS03 + CNS04 + CNS05 + CNS06 + CNS08)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)

E5_Svc10	Service jobs within a 5-tier employment classification scheme (LEHD: CNS12 + CNS14 + CNS15 + CNS16 + CNS19)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E5_Ent10	Entertainment jobs within a 5-tier employment classification scheme (LEHD: CNS17 + CNS18)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Ret10	Retail jobs within an 8-tier employment classification scheme (LEHD: CNS07)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Off10	Office jobs within an 8-tier employment classification scheme (LEHD: CNS09 + CNS10 + CNS11 + CNS13)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Ind10	Industrial jobs within an 8-tier employment classification scheme (LEHD: CNS01 + CNS02 + CNS03 + CNS04 + CNS05 + CNS06 + CNS08)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except MA, PR)
E8_Svc10	Service jobs within an 8-tier employment classification scheme (LEHD: CNS12 + CNS14 + CNS19)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Ent10	Entertainment jobs within an 8-tier employment classification scheme (LEHD: CNS17 + CNS18)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Ed10	Education jobs within an 8-tier employment classification scheme (LEHD: CNS15)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Hlth10	Health care jobs within an 8-tier employment classification scheme (LEHD: CNS16)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E8_Pub10	Public administration jobs within an 8-tier employment classification scheme (LEHD:CNS20)	Census LEHD, 2010 InfoUSA, 2011 (MA only)	Entire U.S. (except PR)
E_LowWageWk	# of workers earning $1250/month or less (work location), 2010	Census LEHD, 2010	Entire U.S. (except MA and PR)
E_MedWageWk	# of workers earning more than $1250/month but less than $3333/month (work location), 2010	Census LEHD, 2010	Entire U.S. (except MA and PR)
E_HiWageWk	# of workers earning $3333/month or more (work location), 2010	Census LEHD, 2010	Entire U.S. (except MA and PR)
E_PctLowWage	% LowWageWk of total #workers in a CBG (work location), 2010	Census LEHD, 2010	Entire U.S. (except MA and PR)
D1 - Density			
D1a	Gross residential density (HU/acre) on unprotected land	Derived from other SLD variables	Entire U.S.
D1b	Gross population density (people/acre) on unprotected land	Derived from other SLD variables	Entire U.S.
D1c	Gross employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c5_Ret10	Gross retail (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c5_Off10	Gross office (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c5_Ind10	Gross industrial (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)

D1c5_Svc10	Gross service (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c5_Ent10	Gross entertainment (5-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Ret10	Gross retail (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Off10	Gross office (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Ind10	Gross industrial (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Svc10	Gross service (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Ent10	Gross entertainment (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Ed10	Gross education(8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Hlth10	Gross health care (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1c8_Pub10	Gross retail (8-tier) employment density (jobs/acre) on unprotected land	Derived from other SLD variables	Entire U.S. (except PR)
D1d	Gross activity density (employment + HUs) on unprotected land	Derived from other SLD variables	Entire U.S. (PR does not reflect employment)
D1_Flag	Flag indicating that density metrics are based on total CBG land acreage rather than unprotected acreage	Derived from other SLD variables	Entire U.S. (PR does not reflect employment)
D2 - Diversity			
D2a_JpHH	Jobs per household	Derived from other SLD variables	Entire U.S. (except PR)
D2b_E5Mix	5-tier employment entropy (denominator set to observed employment types in the CBG)	Derived from other SLD variables	Entire U.S. (except PR)
D2b_E5MixA	5-tier employment entropy (denominator set to the static 5 employment types in the CBG)	Derived from other SLD variables	Entire U.S. (except PR)
D2b_E8Mix	8-tier employment entropy (denominator set to observed employment types in the CBG)	Derived from other SLD variables	Entire U.S. (except PR)
D2b_E8MixA	8-tier employment entropy (denominator set to the static 8 employment types in the CBG)	Derived from other SLD variables	Entire U.S. (except PR)
D2a_EpHHm	Employment and household entropy	Derived from other SLD variables	Entire U.S. (except PR)
D2c_TrpMx1	Employment and Household entropy (based on vehicle trip production and trip attractions including all 5 employment categories)	Derived from other SLD variables	Entire U.S. (except PR)
D2c_TrpMx2	Employment and Household Entropy calculations, based on trips production and trip attractions including 4 of the 5 employment	Derived from other SLD variables	Entire U.S. (except PR)

	categories (excluding industrial)		
D2c_TripEq	Trip productions and trip attractions equilibrium index; the closer to one, the more balanced the trip making	Derived from other SLD variables	Entire U.S. (except PR)
D2r_JobPop	Regional Diversity. Standard calculation based on population and total employment: Deviation of CBG ratio of jobs/pop from regional average ratio of jobs/pop	Derived from other SLD variables	Entire U.S. (except PR)
D2r_WrkEmp	Household Workers per Job, as compared to the region: Deviation of CBG ratio of household workers/job from regional average ratio of household workers/job	Derived from other SLD variables	Entire U.S. (except PR)
D2a_WrkEmp	Household Workers per Job, by CBG	Derived from other SLD variables	Entire U.S. (except PR)
D2c_WrEmIx	Household Workers per Job Equilibrium Index; the closer to one the more balanced the resident workers and jobs in the CBG.	Derived from other SLD variables	Entire U.S. (except PR)
D3 – Design			
D3a	Total road network density	NAVSTREETS	Entire U.S.
D3aao	Network density in terms of facility miles of auto-oriented links per square mile	NAVSTREETS	Entire U.S.
D3amm	Network density in terms of facility miles of multi-modal links per square mile	NAVSTREETS	Entire U.S.
D3apo	Network density in terms of facility miles of pedestrian-oriented links per square mile	NAVSTREETS	Entire U.S.
D3b	Street intersection density (weighted, auto-oriented intersections eliminated)	NAVSTREETS	Entire U.S.
D3bao	Intersection density in terms of auto-oriented intersections per square mile	NAVSTREETS	Entire U.S.
D3bmm3	Intersection density in terms of multi-modal intersections having three legs per square mile	NAVSTREETS	Entire U.S.
D3bmm4	Intersection density in terms of multi-modal intersections having four or more legs per square mile	NAVSTREETS	Entire U.S.
D3bpo3	Intersection density in terms of pedestrian-oriented intersections having three legs per square mile	NAVSTREETS	Entire U.S.
D3bpo4	Intersection density in terms of pedestrian-oriented intersections having four or more legs per square mile	NAVSTREETS	Entire U.S.

D4 –Transit			
D4a	Distance from population weighted centroid to nearest transit stop (meters)	GTFS; TOD Database 2012	Participating GTFS transit service areas/TOD Database locations
D4b025	Proportion of CBG employment within ¼ mile of fixed-guideway transit stop	TOD Database 2012, SLD unprotected area polygons	Entire U.S.
D4b050	Proportion of CBG employment within ½ mile of fixed-guideway transit stop	TOD Database 2012, SLD unprotected area polygons	Entire U.S.
D4c	Aggregate frequency of transit service within 0.25 miles of block group boundary per hour during evening peak period	GTFS	Participating GTFS transit service areas
D4d	Aggregate frequency of transit service (D4c) per square mile	Derived from other SLD variables	Participating GTFS transit service areas
D5 – Destination Accessibility			
D5ar	Jobs within 45 minutes auto travel time, time-decay (network travel time) weighted	NAVSTREETS	Entire U.S. (except PR)
D5ae	Working age population within 45 minutes auto travel time, time-decay (network travel time) weighted	NAVSTREETS	Entire U.S.
D5br	Jobs within 45-minute transit commute, distance decay (walk network travel time, GTFS schedules) weighted	NAVSTREEETS GTFS	Participating GTFS transit service areas (except PR)
D5be	Working-age population within 45-minute transit commute, time decay (walk network travel time, GTFS schedules) weighted	NAVSTREETS GTFS	Participating GTFS transit service areas
D5cr	Proportional Accessibility to Regional Destinations - Auto: Employment accessibility expressed as a ratio of total MSA accessibility	Derived from other SLD variables	Entire U.S. (except PR)
D5cri	Regional Centrality Index – Auto: CBG D5cr score relative to max CBSA D5cr score	Derived from other SLD variables	Entire U.S.
D5ce	Proportional Accessibility to Regional Destinations - Auto: Working age population accessibility expressed as a ratio of total CBSA accessibility	Derived from other SLD variables	Entire U.S.
D5cei	Regional Centrality Index – Auto: CBG D5ce score relative to max CBSA D5ce score	Derived from other SLD variables	Entire U.S.
D5dr	Proportional Accessibility of Regional Destinations - Transit: Employment accessibility expressed as a ratio of total MSA accessibility	Derived from other SLD variables	Participating GTFS transit service areas
D5dri	Regional Centrality Index – Transit: CBG D5dr score relative to max CBSA D5dr score	Derived from other SLD variables	Participating GTFS transit service areas
D5de	Proportional Accessibility of Regional Destinations - Transit: Working age population accessibility expressed as a ratio of total MSA	Derived from other SLD variables	Participating GTFS transit service areas

	accessibility		
D5dei	Regional Centrality Index – Transit: CBG D5de score relative to max CBSA D5de score	Derived from other SLD variables	Participating GTFS transit service areas

Data Sources

This section summarized each of the data sources used to develop the SLD. These include several Census datasets (TIGER/Line, 2010 summary file 1, American Community Survey, and Longitudinal Employer-Household Dynamics), NAVTEQ highway/streets and parks data, Protected Areas Database of the United States (PAD-US), fixed-guideway transit station locations from the TOD Database, and local transit service data shared in the General Transit Feed Specification (GTFS).

Block ground boundaries

EPA obtained CBG boundaries from 2010 Census TIGER/Line shapefiles and combined them into a single national ArcGIS feature class. TIGER2010_bg10 is the basic geographic dataset to which all SLD variables are appended. It represents the 2010 geographic boundaries of all CBGs in the United States. EPA also obtained 2010 block group "centers of population"[7] from the Census. These centroids were used in geoprocessing routines developed for spatially derived variables, notably the distance to transit and regional accessibility measures. Finally, the US Census provides tables relating county and county equivalent areas to core based statistical areas (CBSA) and combined statistical areas (CSA). EPA used these tables to associate block groups with their respective metropolitan areas based on county location.

2010 Census

EPA obtained basic population, demographic, and housing data for CBG from the 2010 Census Summary File 1 (SF1).[8] SF1 contains data compiled from the 2010 Decennial Census questions. EPA's Office of Environmental Information tabulated 2010 SF1 data for all U.S. CBG in two tables SF1HOUBG and SF1POPBG. SF1HOUBG contains data on housing units, occupancy and tenure. SF1POPBG contains data on population, race, ethnicity, age, and sex.

American Community Survey (ACS)

EPA obtained additional socioeconomic and demographic variables from the 2006-2010 ACS Five-Year Estimates. The ACS summary file tabulates variables that are not included in the Census SF1 for 2010 – such as household automobile ownership.

Longitudinal Employer-Household Dynamics (LEHD)

US Census LEHD Origin-Destination Employment Statistics (LODES) tables summarize employment at the census block level for all 50 states, the District of Columbia, Puerto Rico and the US Virgin Islands. However, the territories and the Commonwealth of Massachusetts are not "regular production"

[7] http://www.census.gov/geo/reference/centersofpop.html
[8] http://www.census.gov/2010census/data/

partners in LEHD, and some data for these jurisdictions are not available[9]. LODES version 6.X utilizes 2010 Census block boundaries. The latest update (version 6.1) is an augmentation of version 6.0 and includes two previously un-reported job types that represent federal employment.[10]

The SLD references the LODES Work Area Characteristics (WAC) tables for employment tabulations. Variables concerning the home location of workers by wage level were obtained from the LODES Residence Area Characteristics (RAC). The structures and field definitions of the RAC and WAC datasets are identical and displayed for reference in Table 2.

Table 2: LODES Work/Residence Area Characteristics (variables summarized in the SLD)

Pos	Variable	Type	Len	Explanation
1	h_geocode	Char	15	Residence/Workplace Census Block Code
2	C000	Num	8	Total Number of Jobs
6	CE01	Num	8	Number of jobs with earnings $1250/month or less
7	CE02	Num	8	Number of jobs with earnings $1251/month to $3333/month
8	CE03	Num	8	Number of jobs with earnings greater than $3333/month
9	CNS01	Num	8	Number of jobs in NAICS sector 11 (Agriculture, Forestry, Fishing and Hunting)
10	CNS02	Num	8	Number of jobs in NAICS sector 21 (Mining, Quarrying, and Oil and Gas Extraction)
11	CNS03	Num	8	Number of jobs in NAICS sector 22 (Utilities)
12	CNS04	Num	8	Number of jobs in NAICS sector 23 (Construction)
13	CNS05	Num	8	Number of jobs in NAICS sector 31-33 (Manufacturing)
14	CNS06	Num	8	Number of jobs in NAICS sector 42 (Wholesale Trade)
15	CNS07	Num	8	Number of jobs in NAICS sector 44-45 (Retail Trade)
16	CNS08	Num	8	Number of jobs in NAICS sector 48-49 (Transportation and Warehousing)
17	CNS09	Num	8	Number of jobs in NAICS sector 51 (Information)
18	CNS10	Num	8	Number of jobs in NAICS sector 52 (Finance and Insurance)
19	CNS11	Num	8	Number of jobs in NAICS sector 53 (Real Estate and Rental and Leasing)
20	CNS12	Num	8	Number of jobs in NAICS sector 54 (Professional, Scientific, and Technical Services)
21	CNS13	Num	8	Number of jobs in NAICS sector 55 (Management of Companies and Enterprises)
22	CNS14	Num	8	Number of jobs in NAICS sector 56 (Administrative and Support and Waster Management and Remediation Services)
23	CNS15	Num	8	Number of jobs in NAICS sector 61 (Educational Services)
24	CNS16	Num	8	Number of jobs in NAICS sector 62 (Health Care and Social

[9] EPA later obtained several Massachusetts employment variables from Metropolitan Area Planning Council. See Info USA below for details.
[10] More information about LODES data can be found at http://lehd.did.census.gov/data/. More information about NAICS (North American Industry Classification System) can be found at http://www.census.gov/eos/www/naics/.

Table 2: LODES Work/Residence Area Characteristics (variables summarized in the SLD)				
Pos	Variable	Type	Len	Explanation
				Assistance)
25	CNS17	Num	8	Number of jobs in NAICS sector 71 (Arts, Entertainment, and Recreation)
26	CNS18	Num	8	Number of jobs in NAICS sector 72 (Accommodation and Food Services)
27	CNS19	Num	8	Number of jobs in NAICS sector 81 (Other Services [except Public Administration])
28	CNS20	Num	8	Number of jobs in NAICS sector 92 (Public Administration)

InfoUSA

Midway through the development of the SLD version 2.0 EPA obtained several employment variables for Massachusetts to compensate for the lack of data availability in the LEHD. Metropolitan Area Planning Council (MAPC) shared these data with EPA. The original data source for these variables is InfoUSA[11], 2011. These data were obtained after the drive-time accessibility analysis and therefore employment accessibility by automobile (D5ar) is not summarized for Massachusetts.

NAVTEQ

EPA has a license to use several NAVTEQ data layers[12] (release date 2011 Q3) including NAVSTREETS for developing spatially derived variables such as intersection density and automobile accessibility metrics. The NAVSTREETS dataset is a detailed nationwide street network with rich attribute information, include functional class and speed categories, direction of travel restrictions, vehicular and pedestrian restrictions, tags for highway ramps and other variables of interest for developing a multimodal travel network and characterizing network design. Additional NAVTEQ layers that were used to support the SLD update include water features and land use layers that were referenced in calculating CBG developable area.

PAD-US

The US Geological Survey (USGS) developed the Protected Areas Database[13] as an inventory of the protection status of public lands and voluntarily provided private conservation lands across the U.S. EPA used data from PAD-US version 1.3 to identify land area protected from development.

TOD Database

The Center for Transit Oriented Development (CTOD) maintains an inventory of existing, planned, and proposed fixed-guideway transit station locations throughout the country as of 2011. Fixed-route transit systems included are heavy rail, light rail, commuter rail, streetcars, bus rapid transit (with dedicated right of way) and cable cars. The database also includes some Amtrak stations that serve commuters. These data can be viewed online in the Transit Oriented Development (TOD) Database.[14] EPA obtained

[11] http://www.infousa.com/
[12] http://www.navteq.com/products_data.htm
[13] http://gapanalysis.usgs.gov/padus/
[14] http://toddata.cnt.org/

the locations of all existing fixed-guideway transit stations. Table 7 in Appendix A lists all metropolitan regions with existing fixed-guideway transit service featured in the TOD Database.

GTFS

Local transit agencies can use GTFS (or General Transit Feed Specification[15]) to share transit schedules and associated geographic information in a common format. GTFS files contain stop locations, stop times, routes and trips, and other attributes of the transit network. EPA obtained GTFS data for use in metrics summarizing transit service availability, frequency, and accessibility to destinations via transit. This data was obtained during the months of December, 2012 and January, 2013. Not all transit agencies share their data in this format. But the vast majority of large transit agencies do so. Table 8 in Appendix A lists the 228 transit agencies whose data is reflected in SLD metrics. An analysis of data from the National Transit Database showed that transit agencies with GTFS data reflected in the SLD account for 88% of all transit ridership in the United States. Since many metropolitan regions are served by multiple transit agencies, SLD metrics derived from GTFS data may paint an incomplete picture of service. Therefore we also calculated for each metropolitan region the percentage of all transit ridership that occurred on systems whose GTFS data is reflected in the SLD. Table 9 in Appendix A displays these findings.

Technical Approach

This section summarizes the derivation of all variables in the SLD including the methodologies used for internally and spatially derived variables. The discussion is organized by variable category (see Table 1 for category headings and a full list of variables).

Administrative

All administrative variables were joined directly from 2010 Census data. Metropolitan area groupings were derived from the Census CBSA/CSA table downloaded from the US Census website. The table reflects 2009 CSA and CBSA groupings by combined state-county FIPS code. The CSA, CSA_Name, CBSA, and CBSA_Name fields were populated by grouping CBGs according to their state and county IDs and matching these to the CSA/CBSA table.

Demographic

Demographic variables were joined directly from 2010 Census data. These include population and residential activity in each CBG as well as residential-location-based socioeconomic variables. Variables about worker earnings feature the prefix “R_” to reflect that they summarize workers by home/residence location rather than work location.

- Population (TotPop) and housing units (CountHU) were tabulated from the SF1POPBG and SF1HOUBG tables, respectively.

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[15] Learn more about the GTFS at https://developers.google.com/transit/gtfs/. Agencies can post raw GTFS files for public download on the GTFS data exchange (http://www.gtfs-data-exchange.com/). A full listing of agencies that do and do not share their data in GTFS format is available at City-Go-Round (http://www.citygoround.org/agencies/).

- P_WrkAge was referenced from the SF1POPBG table's PCT_AGE_GT17 field. This field represents the proportion of the population greater than age 17.
- Auto ownership fields were derived from the ACS table B25044 and were calculated in two steps. First, percent auto ownership fields were calculated as the share of all households having zero cars (Pct_AO0), one car (Pct_AO1), or two or more cars (Pct_AO2p) with respect to total households reported in the ACS table. These percent auto ownership rates were then applied to the CountHU10 field of the Demographics table to ascertain the number of households estimated to own zero cars (AutoOwn0), one car (AutoOwn1), or two or more cars (AutoOwn2p). The process was conducted in this order because isolated discrepancies were observed between the total number of households reported in the ACS table and the corresponding figure in the SF1HOUBG table. The SF1HOUBG table was given precedence, and only the auto ownership rates were taken directly from the ACS table.
- The number of workers was summarized from LEHD RAC tables, which report employment based on worker residence.
- The LEHD RAC tables were also referenced to produce wage stratification variables for each CBG based on worker residence. High wage workers earn more than $3,333 per month while low wage workers earn $1,250 or less per month. Medium wage workers are in between. The total number of workers comprised by each wage group was tabulated for each CBG in the R_LowWageWk, R_MedWageWk, and R_HighWageWk fields. The share of total workers comprised by low wage workers for each CBG is reported in the R_PctLowWage field.

Employment

Employment variables report job activity in each CBG as well as workplace-location-based socioeconomic characteristics. Variables summarizing worker earnings feature the prefix "E_" to reflect that they summarize workers by employment location rather than home location. Data for Massachusetts were obtained from InfoUSA. All other employment data are from LEHD. The LEHD WAC and RAC tables were consolidated from several state- and territory-level tables into a nationwide dataset and then summarized by block group (the raw tables are summarized by Census block). Derivation of employment variables from LEHD data is described below.

- Total employment (TotEmp) was summarized for each block group from the LEHD WAC tables, using the C000 field (total number of jobs).
- A five-tier employment type classification was developed. These fields are marked by the "E5_" prefix in the Employment table. The five-tier classification summarizes employment into the following groups: retail, office, service, industrial, and entertainment. The derivations of the five-tier employment breakdown from the LEHD WAC tables are displayed in Table 3.
- Additionally, and eight-tier employment type classification was developed. These fields are marked by the "E8_" prefix in the Employment table. The eight-tier classification summarizes employment into the following groups: retail, office, service, industrial, entertainment, education, healthcare, and public administration. The derivations of the eight-tier employment breakdown from the LEHD WAC tables are displayed in Table 4.

- Finally, wage stratification variables based on workplace location were developed for each CBG. High wage workers (E_HiWageWk) earn more than $3,333 per month while low wage workers (E_LowWageWk) earn $1,250 or less per month. Medium wage workers (E_MedWageWk) are in between. The total number of workers comprised by each wage group was tabulated for each CBG. The share of total workers comprised by low wage workers for each CBG is reported in the E_PctLowWage field.

Table 3: Grouping of LODES Work Area Characteristics CNS Fields to Support Five-Tier Mix Variable

Pos	Variable	Type	Len	Explanation
1	h_geocode	Char	15	Residence/Workplace Census Block Code
Office Jobs				
17	CNS09	Num	8	Number of jobs in NAICS sector 51 (Information)
18	CNS10	Num	8	Number of jobs in NAICS sector 52 (Finance and Insurance)
19	CNS11	Num	8	Number of jobs in NAICS sector 53 (Real Estate and Rental and Leasing)
21	CNS13	Num	8	Number of jobs in NAICS sector 55 (Management of Companies and Enterprises)
28	CNS20	Num	8	Number of jobs in NAICS sector 92 (Public Administration)
Retail Jobs				
15	CNS07	Num	8	Number of jobs in NAICS sector 44-45 (Retail Trade)
Industrial Jobs				
9	CNS01	Num	8	Number of jobs in NAICS sector 11 (Agriculture, Forestry, Fishing and Hunting)
10	CNS02	Num	8	Number of jobs in NAICS sector 21 (Mining, Quarrying, and Oil and Gas Extraction)
11	CNS03	Num	8	Number of jobs in NAICS sector 22 (Utilities)
12	CNS04	Num	8	Number of jobs in NAICS sector 23 (Construction)
13	CNS05	Num	8	Number of jobs in NAICS sector 31-33 (Manufacturing)
14	CNS06	Num	8	Number of jobs in NAICS sector 42 (Wholesale Trade)
16	CNS08	Num	8	Number of jobs in NAICS sector 48-49 (Transportation and Warehousing)
Services Jobs				
20	CNS12	Num	8	Number of jobs in NAICS sector 54 (Professional, Scientific, and Technical Services)
22	CNS14	Num	8	Number of jobs in NAICS sector 56 (Administrative and Support and Waste Management and Remediation Services)
23	CNS15	Num	8	Number of jobs in NAICS sector 61 (Educational Services)
24	CNS16	Num	8	Number of jobs in NAICS sector 62 (Health Care and Social Assistance)
27	CNS19	Num	8	Number of jobs in NAICS sector 81 (Other Services [except Public Administration])
Entertainment/Accommodations/Food Services Jobs				
25	CNS17	Num	8	Number of jobs in NAICS sector 71 (Arts, Entertainment, and

Table 3: Grouping of LODES Work Area Characteristics CNS Fields to Support Five-Tier Mix Variable

Pos	Variable	Type	Len	Explanation
				Recreation)
26	CNS18	Num	8	Number of jobs in NAICS sector 72 (Accommodation and Food Services)

Table 4: Grouping of LODES Work Area Characteristics CNS Fields to Support Eight-Tier Mix Variable

Pos	Variable	Type	Len	Explanation
1	h_geocode	Char	15	Residence/Workplace Census Block Code
Office Jobs				
17	CNS09	Num	8	Number of jobs in NAICS sector 51 (Information)
18	CNS10	Num	8	Number of jobs in NAICS sector 52 (Finance and Insurance)
19	CNS11	Num	8	Number of jobs in NAICS sector 53 (Real Estate and Rental and Leasing)
21	CNS13	Num	8	Number of jobs in NAICS sector 55 (Management of Companies and Enterprises)
Retail Jobs				
15	CNS07	Num	8	Number of jobs in NAICS sector 44-45 (Retail Trade)
Industrial Jobs				
9	CNS01	Num	8	Number of jobs in NAICS sector 11 (Agriculture, Forestry, Fishing and Hunting)
10	CNS02	Num	8	Number of jobs in NAICS sector 21 (Mining, Quarrying, and Oil and Gas Extraction)
11	CNS03	Num	8	Number of jobs in NAICS sector 22 (Utilities)
12	CNS04	Num	8	Number of jobs in NAICS sector 23 (Construction)
13	CNS05	Num	8	Number of jobs in NAICS sector 31-33 (Manufacturing)
14	CNS06	Num	8	Number of jobs in NAICS sector 42 (Wholesale Trade)
16	CNS08	Num	8	Number of jobs in NAICS sector 48-49 (Transportation and Warehousing)
Services Jobs				
20	CNS12	Num	8	Number of jobs in NAICS sector 54 (Professional, Scientific, and Technical Services)
22	CNS14	Num	8	Number of jobs in NAICS sector 56 (Administrative and Support and Waste Management and Remediation Services)
27	CNS19	Num	8	Number of jobs in NAICS sector 81 (Other Services [except Public Administration])
Entertainment/Accommodations/Food Services Jobs				
25	CNS17	Num	8	Number of jobs in NAICS sector 71 (Arts, Entertainment, and Recreation)
26	CNS18	Num	8	Number of jobs in NAICS sector 72 (Accommodation and Food Services)

Table 4: Grouping of LODES Work Area Characteristics CNS Fields to Support Eight-Tier Mix Variable				
Pos	Variable	Type	Len	Explanation
Education Jobs				
23	CNS15	Num	8	Number of jobs in NAICS sector 61 (Educational Services)
Healthcare Jobs				
24	CNS16	Num	8	Number of jobs in NAICS sector 62 (Health Care and Social Assistance)
Public Administration Jobs				
28	CNS20	Num	8	Number of jobs in NAICS sector 92 (Public Administration)

Area

EPA calculated values of total CBG area (Ac_Total), unprotected area (Ac_Unpr), and land area (Ac_Land). Ac_Unpr represents the total land area in the block group that is not protected from development activity. This variable is used in the calculation of all density metrics (D1), proportional area metrics (D4b), and they inform intrazonal travel times used in calculating the regional accessibility metrics (D5).

EPA analyzed NAVTEQ and PAD-US data to identify areas within each block group that are protected from development. First we queried the NAVTEQ land use layer to select only the following land use types: federal, state, and local parks; animal parks (zoos); cemeteries; and beaches. Next we selected features in the PAD-US database with the exception of State land trust properties[16] and those classified as having "no known restrictions to development". Separately, we selected all features in the NAVTEQ water layer. We then intersected and dissolved all selected areas into a single polygon layer that represented all areas in which development is restricted, either due to physical or institutional constraints. We then unioned the resulting protected areas layer with the CBG polygons layer in GIS. This allowed for the geometric calculation of the protected and unprotected portions of CBG polygons.[17]

EPA ran all geometric calculations in the USA Contiguous Albers Equal Area Conic USGS projected coordinate system except features in Alaska and Hawaii, which used the Alaska Albers Equal Area Conic and the Hawaii Albers Equal Area Conic projections, respectively.

Density (D1)

All density variables summarize population, housing, or employment within a block group per unprotected block group acreage (Ac_Unpr). The primary density variables are: D1a – Housing Units per

[16] A review of properties owned by state land trusts within urbanized areas revealed residential development on most or all acreage. This was the case even when PAD-US indicated Status 3 protection (permanent protection from conversion of natural land cover for the majority of the area but subject to extractive uses). For this reason we removed all properties owned by state land trusts with Status 3 protection from the analysis of protected areas.

[17] Note, we also created a separate shapefile of all protected and unprotected areas by CBG. Search the EPA Environmental Data Gateway or contact the authors to learn more about availability.

Unprotected Acre; D1b – Population per Unprotected Acre; D1c – Jobs per Unprotected Acre, and D1d - Total Activity Units (jobs + housing units) per Unprotected Acre. D1c is also broken down into employment categories, displaying the density of office jobs, for example, per unprotected acre. The definitions of employment categories parallel those specified in the Employment table. Variables with the "D1c5..." prefix summarize employment based on the 5-tier ("E5…") employment classification scheme. Variables with the "D1c8..." prefix summarize employment based on the 8-tier ("E8…") employment classification scheme.

In some cases we observed unexpectedly high activity densities in known low density areas. This occurred in block groups in which nearly all of the land area is considered to be protected. In such cases it was clear that population, housing, and/or employment is present in otherwise protected areas. To correct this problem, we selected all block groups in which the unprotected area represented less than one half of one percent of its total area. In these block groups we recalculated all density metrics to be based on total land area, rather than unprotected area. CBGs to which this adjustment applied have a value of 1 in the D1_Flag field.

Land Use Diversity (D2)

Land use diversity refers to the relative mix of land uses within a zone of analysis. There are a number of different ways to measure the mix of land uses, and the SLD includes a variety of alternative metrics. Since we do not have data about land area allocated to different uses within each census block group, we instead make assumptions about the relative mix of uses based on housing unit counts and job counts broken down by employment sector. All data used to derive land use diversity variables are listed in Table 1 above. Detailed descriptions and methods of calculation for each D2 variable can be found in Table 5.

There are two notable limitations to keep in mind when interpreting these metrics. First, the D2 variables say nothing about how different uses or activities are spatially distributed within a census block group. A very large block group in an area of low density development may include a variety of different activities. But those activities may be spatially separated within the block group area. As a result any given part of the block group might have very little diversity when examined in detail. Another problem emerges in some higher density urban areas. Here block groups may be quite small in size. So a uniformly residential blockgroup might be located next to a block group with a greater diversity of land uses. These metrics will assess the residential block group to be low in diversity even though the diverse land uses are just a short walk away. In other words, the analysis contributing to these metrics did not consider activities outside of block group boundaries.

Table 5: Detailed description of Land Use Diversity (D2) Variables

Field name	Description	Method of calculation
D2a_JpHH	Jobs to Household Balance per CBG	TotEmp/HH

D2b_E5Mix	This employment mix (or entropy) variable uses the 5-tier employment categories to calculate employment mix. The entropy denominator is set to observed existing employment types within each CBG. The entropy equation was originally applied by Robert Cervero in 1988, and has been used since then in different land use entropy formulations.	D2b_E5Mix = -E/(ln(N)) Where: E=(E5_Ret10/TotEmp)*ln(E5_Ret10/TotEmp) + (E5_Off10/TotEmp)*ln(E5_Off10/TotEmp) + (E5_Ind10/TotEmp)*ln(E5_Ind10/TotEmp) + (E5_Svc10/TotEmp)*ln(E5_Svc10/TotEmp) + (E5_Ent10/TotEmp)*ln(E5_Ent10/TotEmp) N= number of the employment types with employment > 0.
D2b_E5MixA	This employment mix (or entropy) variable uses the 5-tier employment categories from Census LEHD, 2010 to calculate employment mix. The entropy denominator is set to observed all 5 employment types within each CBG.	D2b_E5MixA = -E/(ln(5)) Where: E=(E5_Ret10/TotEmp)*ln(E5_Ret10/TotEmp) + (E5_Off10/TotEmp)*ln(E5_Off10/TotEmp) + (E5_Ind10/TotEmp)*ln(E5_Ind10/TotEmp) + (E5_Svc10/TotEmp)*ln(E5_Svc10/TotEmp) + (E5_Ent10/TotEmp)*ln(E5_Ent10/TotEmp)
D2b_E8Mix	This employment mix (or entropy) variable uses the 8-tier employment categories from Census LEHD, 2010 to calculate employment mix. The entropy denominator is set to observed existing employment types within each CBG.	D2b_E8Mix = -E/(ln(N)) Where: E=(E8_Ret10/TotEmp)*ln(E8_Ret10/TotEmp) + (E8_Off10/TotEmp)*ln(E8_Off10/TotEmp) + (E8_Ind10/TotEmp)*ln(E8_Ind10/TotEmp) + (E8_Svc10/TotEmp)*ln(E8_Svc10/TotEmp) + (E8_Ent10/TotEmp)*ln(E8_Ent10/TotEmp) + (E8_Ed10/TotEmp)*ln(E8_Ed10/TotEmp) + (E8_Hlth10/TotEmp)*ln(E8_Hlth10/TotEmp) + (E8_Pub10/TotEmp)*ln(E8_Pub10/TotEmp) N= number of the employment types with employment > 0.
D2b_E8MixA	This employment mix (or entropy) variable uses the 8-tier employment categories from Census LEHD, 2010 to calculate employment mix. The entropy denominator is set to observed all 8 employment types within each CBG.	D2b_E8MixA = -E/(ln(8)) Where: E=(E8_Ret10/TotEmp)*ln(E8_Ret10/TotEmp) + (E8_Off10/TotEmp)*ln(E8_Off10/TotEmp) + (E8_Ind10/TotEmp)*ln(E8_Ind10/TotEmp) + (E8_Svc10/TotEmp)*ln(E8_Svc10/TotEmp) + (E8_Ent10/TotEmp)*ln(E8_Ent10/TotEmp) + (E8_Ed10/TotEmp)*ln(E8_Ed10/TotEmp) + (E8_Hlth10/TotEmp)*ln(E8_Hlth10/TotEmp) + (E8_Pub10/TotEmp)*ln(E8_Pub10/TotEmp)

D2a_EpHHm	Employment and household entropy calculations, where employment and occupied housing are both included in the entropy calculations. This measure uses the 5-tier employment categories.	D2a_EpHHm = -A/(ln(N)) Where: A = (HH/TotAct)*ln(HH/TotAct) + (E5_Ret10/TotAct)*ln(E5_Ret10/TotAct) + (E5_Off10/TotAct)*ln(E5_Off10/TotAct) + (E5_Ind10/TotAct)*ln(E5_Ind10/TotAct) + (E5_Svc10/TotAct)*ln(E5_Svc10/TotAct) + (E5_Ent10/TotAct)*ln(E5_Ent10/TotAct) TotAct = TotEmp + HH N= number of activity categories (employment or households) with count > 0.
D2c_TrpMx1	Employment and household entropy calculations, based on trip production and trip attractions including 5 employment categories. The vehicle trip productions and attractions are derived by multiplying average ITE vehicle trip generation rates by employment types and households. The trip generation rates were used as a proxy for trip activity.	D2c_TrpMx1 = - [H(VT) +E(VT)]/(ln(6)) Where: H(VT) + E(VT) = (HH*11/ TotVT)*ln(HH*11/ TotVT) + (E5_Ret10*22/ TotVT)*ln(E5_Ret10*22/ TotVT) + (E5_Off10*3/ TotVT)*ln(E5_Off10*3/ TotVT) + (E5_Ind10*2/ TotVT)*ln(E5_Ind10*2/ TotVT) + (E5_Svc10*31/ TotVT)*ln(E5_Svc10*31/ TotVT) + (E5_Ent10*43/ TotVT)*ln(E5_Ent10*43/ TotVT) TotVT = Total trips generated (production and attraction) for all activity categories in the block group based on ITE Trip Generation Rates (rates shown in equation above)
D2c_TrpMx2	Employment and household entropy calculations, based on trip productions and trip attractions including 4 of the 5 employment categories (excluding industrial). The vehicle trip productions and attractions are derived by multiplying average ITE vehicle trip generation rates by employment types and households. The trip generation rates were used as a proxy for trip activity.	Employment and Household Trips Mix = - [H(VT) +E(VT)]/(ln(5)) Where: H(VT) + E(VT) = (HH*11/VT)*ln(HH*11/VT) + (E5_Ret10*22/TotVT)*ln(E5_Ret10*22/ TotVT) + (E5_Off10*3/ TotVT)*ln(E5_Off10*3/ TotVT) + (E5_Svc10*31/ TotVT)*ln(E5_Svc10*31/ TotVT) + (E5_Ent10*43/ TotVT)*ln(E5_Ent10*43/ TotVT) TotVT = Total trips generated (production and attraction) for all activity categories (excluding industrial jobs) in the block group based on ITE Trip Generation Rates

D2c_TripEq	Trip Equilibrium Index. It is derived by calculating trip productions and trip attractions by CBG; the closer to one, the more balanced the trip making at the CBG level. The vehicle trip productions and attractions were derived by multiplying average ITE vehicle trip generation rates by employment types and households. The trip generation rates were used as a proxy for trip activity.	D2c_TripEq = *exp*(- |[H(VT)/E(VT)]-1|) Where: H(VT) = Productions: total occupied household units in CBG * ITE Vehicle Trip (VT) Generation E(VT) = Total trip attractions for the 5 employment categories based on ITE Trip Generation Rates ***exp*** = the exponential function (e [approximately 2.718281828] raised to the power of the number in parenthesis)
D2r_JobPop	Regional Diversity. Calculated based on total population and total employment by CBG. It quantifies the deviation of the CBG ratio of jobs/pop from the regional average ratio of jobs/pop.	**D2r_JobPop** = 1- |(b*(TotPop-TotEmp))/(b*(TotPop+TotEmp))| Where b=CBSA_Pop/CBSA_Emp
D2r_WrkEmp	Household Workers per Job, as compared to the region. It quantifies the deviation of CBG ratio of household workers/job from regional average ratio of household workers/job.	**D2r_WrkEmp** = 1- |(b*(Workers - TotEmp))/(b*(Workers +TotEmp))| Where b=CBSA_Wrk/CBSA_Emp
D2a_WrkEmp	Household Workers per Job, by CBG.	**D2a_WrkEmp** = Workers/TotEmp
D2c_WrEmIx	Working population and actual jobs equilibrium Index. The closer to one the more balanced the resident workers and jobs in a CBG.	**D2c_WrEmIx** = ***exp***(-|(Workers/TotEmp) -1|) Where ***exp*** = the exponential function (e [approximately 2.718281828] raised to the power of the number in parenthesis)

Urban Design (D3)

The D3 variables measure urban design in terms of street network density (D3a…) and street intersection density (D3b…) by facility orientation (automobile, multimodal, or pedestrian). The denominator in D3a calculations is total block group area (Ac_Tot). The denominator in D3b calculations is total land area (Ac_Land). Additionally, D3b summarizes total intersection density, weighted to reflect connectivity for pedestrian and bicycle travel. While intersection density is often used as an indicator of more walkable urban design, it is important to note that the source data (NAVTEQ) provides no information regarding the presence or quality of sidewalks.

The D3 variables required substantial preparation of the NAVTEQ Streets and Zlevels layers to describe facility orientation of each network feature. The Streets layer displays network links and includes a host of link-level attributes like functional class, speed category, direction of travel (one-way or two-way), auto or pedestrian restrictions, and tags for ramps, tunnels, and bridges. The Zlevels layer displays all points of articulation on the network (including intersections, which are identified by the INTERSECT field) and attribute data that includes node identifiers, link identifiers, and relative elevation fields to govern connectivity at coincident grade separated nodes.

Node features are stacked with each feature representing an endpoint of a particular link in the Streets layer. Thus, where three coincident node features are found, three associated links and their descriptive attributes can be related to that point, which would (in most cases) represent a three-way intersection. This relationship between the Streets and Zlevels layers allowed street network and intersections to be summarized by type in the D3 table.

Deriving the D3 metrics required several steps. First, we grouped streets into facility categories: auto-oriented links, multi-modal links, and pedestrian-oriented links. Then we summarized these facility categories to obtain total facility miles by type for each CBG. Next, we joined the link-level facility groups to the Zlevels layer based on link ID. Finally we counted intersections in each CBG based on the types of facilities found at the intersection and the number of legs at the intersection (for multi-modal and pedestrian-oriented intersections). The summary figures of facility miles by type and intersection total by type and number of legs were divided by the total land area for each CBG to obtain network density (facility miles per square mile) and intersection density (intersections per square mile) for each CBG.

Links were grouped into facility categories as follows:

- Auto Oriented facilities:
    - Any controlled access highway, tollway, highway ramp, or other facility on which automobiles are allowed but pedestrians are restricted
    - Any arterial street having a speed category value of 3 or lower (speeds are 55 mph or higher)
    - Any arterial street having a speed category value of 4 (between 41 and 54 mph) where car travel is restricted to one-way traffic
    - Any arterial street having four or more lanes of travel in a single direction (implied eight lanes bi-directional – turn lanes and other auxiliary lanes are not counted)
    - For all of the above, ferries and parking lot roads were excluded.
- Multi-modal facilities:
    - Any arterial or local street having a speed category of 4 (between 41 and 54 mph) where car travel is permitted in both directions
    - Any arterial or local street having a speed category of 5 (between 31 and 40 mph)
    - Any arterial or local street having a speed category of 6 (between 21 and 30 mph) where car travel is restricted to one-way traffic
    - For all of the above, autos and pedestrians must be permitted on the link
    - For all of the above, controlled access highways, tollways, highway ramps, ferries, parking lot roads, tunnels, and facilities having four or more lanes of travel in a single direction (implied eight lanes bi-directional) are excluded

- Pedestrian-oriented facilities:
  - Any arterial or local street having a speed category of 6 (between 21 and 30 mph) where car travel is permitted in both directions
  - Any arterial or local street having a speed category of 7 or higher (less than 21 mph).
  - Any local street having a speed category of 6 (between 21 and 30 mph)
  - Any pathway or trail[18] on which automobile travel is not permitted (speed category 8).
  - For all of the above, pedestrians must be permitted on the link
  - For all of the above, controlled access highways, tollways, highway ramps, ferries, parking lot roads, tunnels, and facilities having four or more lanes of travel in a single direction (implied eight lanes bi-directional) are excluded

EPA classified all street links as either auto-oriented, multi-modal, or pedestrian-oriented using the criteria described above. D3a is calculated by summing links from all three categories above and dividing by land acre (Ac_Land). D3aao, D3amm, and D3apo calculate density of auto-oriented, multi-modal, and pedestrian-oriented links, respectively.

To identify intersections by facility type, we first joined the links to the Zlevels layer. Intersection nodes were queried out of the Zlevels layer where INTERSECT = 'Y' and dissolved into discrete intersections based on the node id's and Zlevel attributes (the latter ensuring that coincident grade-separated nodes were not counted as one intersection). For each intersection, the total number of legs at the intersection was summarized and any intersection with fewer than three legs was discarded. At that point, intersections were summarized by type for each CBG:

- Intersections at which auto-oriented facilities met or at which auto-oriented facilities intersected multimodal facilities were described as auto-oriented intersections and summed for each CBG regardless of the total number of legs.
- Intersections at which multi-modal facilities met or at which multi-modal facilities intersected pedestrian oriented facilities were described as multi-modal intersections and summed for each CBG where the number of legs was equal to three and where the number of legs was greater than 3.
- Intersections at which pedestrian-oriented facilities met were described as pedestrian-oriented intersections and summed for each CBG where the number of legs was equal to three and where the number of legs was greater than 3.

These intersection groupings are displayed in Table 5.

Table 5. Intersection type groupings and corresponding D3 variables

Intersection Type	Legs	Intersecting Facilities		D Variable
1. Auto	n/a	Auto	Auto	D3bao

[18] While NAVTEQ data does include some pedestrian pathways and bicycle trails, coverage is far less comprehensive than it is for automobile facilities. When these bike/ped facilities do exist in the NAVTEQ database, they are considered in SLD metrics.

		Auto	Multi-Modal	
2. Multi-Modal: 3-leg	3	Multi-Modal	Multi-Modal	D3bmm3
		Multi-Modal	Ped-Oriented	
3. Multi-Modal: 4-leg	4	Multi-Modal	Multi-Modal	Dbmm4
		Multi-Modal	Ped-Oriented	
4. Ped-Oriented: 3-leg	3	Ped-Oriented	Ped-Oriented	D3bpo3
5. Ped-Oriented: 4-leg	4	Ped-Oriented	Ped-Oriented	D3bpo4

Finally, the total number of intersections was discounted in some cases to account for a peculiarity in the structure of the NAVTEQ Streets layer where a divided highway intersects another facility. The detailed rendition of the street network provided by the Streets layer means that divided highways are portrayed as individual one-way links. Thus when an undivided street intersects a divided highway, it intersects in two places, at the "from-bound" link and at the "to-bound" link. A traveler would interpret such a location as a single intersection, but it would be tabulated as two intersections in the processes described above. This effect is compounded when two divided highways intersect each other.

To account for this condition, individual intersections were discounted based on the number of one-way links found at the intersection. Where a one-way link intersected a two-way link, the intersection was counted as half an intersection; and where two one-way links intersected, the intersection was counted as a quarter of an intersection. This prevented intersection counts in areas with a high density of auto-oriented facilities (such as in the vicinity of a freeway interchange) from being exaggerated. Since most of these types of intersections were found among auto-oriented facilities, the discount primary affected auto-oriented intersection counts, though some reduction in the number of multi-modal and pedestrian-oriented facilities will also have resulted from the application of this rule.

EPA calculated total weighted intersection density (D3b) by creating a weighted sum of component intersection density metrics. Auto-oriented intersections were given zero weight to reflect the fact that in many instances auto-oriented intersections are a barrier to pedestrian and bicycle mobility. Furthermore, since three-way intersections do not promote street connectivity as effectively as four-way intersections, their relative weight was reduced accordingly.[19] The formula for calculating D3b is as follows:

D3b = (D3bmm3 *0.667) + Dbmm4 + (D3bpo3 *0.667) + D3bpo4

Transit Service (D4)

The D4 variables measure transit availability, proximity, frequency, and density. Two data sources are used to calculate transit metrics. First EPA obtained transit service data in GTFS format from over 200

[19] EPA diminished the weight of three-way intersections by one third. This weight was chosen to reflect the diminished choice of routes that a traveler faces when reaching a 3-way intersection when compared to a 4-way intersection (2 choices instead of 3).

transit agencies[20] across the United States. This data includes the geographic location of all transit stops as well as service schedules for all routes that serve those stops. EPA also obtained point location data for all existing fixed-guideway transit service in the U.S. This includes rail, streetcars, ferries, trolleys, and some bus rapid transit systems. Metrics that rely on local transit service (D4a, D4c, and D4d) reflect data availability. Users may wish to reference Appendix A to determine which transit systems are reflected in these data.

D4a – Distance from population-weighted centroid to nearest transit stop

D4a measures the minimum walk distance between the population weighted CBG centroid and the nearest transit stop. To calculate this metric, an origin-destination matrix problem was initiated in the ArcGIS Network Analyst extension. GTFS transit stops and fixed-guideway transit station locations were plotted on the map along with CBG centroids. A custom geoprocessing model was run that iteratively selected transit stops - grouped according to their original GTFS datasets (TOD Database points run as a single group) – as origins in the network analysis, found any CBG centroids within a three-quarter mile straight-line radius (roughly a 15 minute walk) of any selected stop to add as destinations in the network analysis, and then traced the network distance along the NAVTEQ Streets network between the stop origins and CBG destinations. (It was assumed that the walking distance in either direction – from stops to CBG centroids or vice versa – would be the same.) A cutoff of 1207 meters (the native distance impedance attribute in the NAVTEQ network) was applied when solving the network problem. This distance is almost exactly three-quarters of a mile. Note that the initial selection of destinations was based on a straight line distance whereas the network solve is limited to finding those pre-selected destinations that are a 15 minute walk from a transit stop based on network distances. The initial selection is made simply to limit the number of potential destinations that are added to the OD matrix network problem.

When the network solve succeeded for each iteration, the results were appended to a master table of stop-CBG OD pairs with the network travel distance included as an attribute. When all stop-CBG OD pairs had been found and listed in the master table, the table was then summarized by CBG to find the minimum network travel distance to a transit stop from that CBG centroid. The network travel distances, initially reported in meters, were converted to miles. This is the value reported as D4a. All block groups with centroids that are more than ¾ miles from a transit stop are given a value of -99999.

Since the network problem was solved based on distance rather than travel time, there was no accounting for delays at intersections in determining the shortest path between a stop origin and CBG centroid destination. The inclusion of stations from the TOD Database allowed areas that have fixed-guideway transit but which do not provide GTFS data to be included in the D4a tabulation. Charlotte, North Carolina is an example of such an area.

[20] A full list of transit agencies with GTFS data reflected in these metrics is available in Appendix A.

D4b – Proportion of block group within ¼ mile (D4b025) or ½ mile (D4b050) of a fixed-guideway transit stop

To calculate the D4b variables, fixed-guideway transit station locations (from TOD Database) were plotted on a map and buffered at a distance of one-quarter of a mile and then again at one-half of a mile. Each respective set of buffers was then intersected with the CBG unprotected areas polygons developed in the making of the Area variables. The resulting shapes represent the polygons formed by the intersection of the CBG boundaries, all unprotected areas, and the transit station area buffers. The area of each polygon was compared to the unprotected area of its corresponding CBG to determine the proportion of the polygon's unprotected area that is found within one-quarter or one-half mile of a rapid transit station. This value roughly approximates the proportion of the CBG's activity (housing units and employment) that are proximate to rapid transit.

The station area buffers were based on straight line distances, not network distances. The process could be improved in future versions of the SLD to include the development of network based service area polygons around transit stations. A second potential improvement would involve assessing developed area in a CBG based on land cover data to define the portions of the CBG in which activities are located rather than referencing the CBG's unprotected area. This augmentation, however, is expected to require a substantially higher level of effort to develop than that associated with defining protected areas.

The D4b variables are reported as proportions (values range from zero to one) which can be applied to the CBG's activity totals in the Demographics and Employment tables to approximate the number of housing units and jobs that CBG contains that are located around rapid transit stations.

D4c – Aggregate frequency of transit service per hour during evening peak period

EPA analyzed GTFS data to calculate the frequency of service for each transit route between 4:00 and 7:00 PM on a weekday. Then, for each block group, EPA identified transit routes with service that stops within 0.4 km (0.25 miles). Finally EPA summed total aggregate service frequency by block group. Values for this metric are expressed as service frequency per hour of service. All block groups in areas where GTFS service data are unavailable are given the value -99999.

D4d – Aggregate frequency of transit service per square mile

D4d simply measures transit frequency per square mile of land area. This metric is calculated by dividing D4c by Ac_Land (total land acreage) then converting to units per square mile. In a few instances where Ac_Land = 0, total block group acreage (Ac_Tot) was used as the denominator. All block groups in areas where GTFS service data are unavailable are given the value -99999.

Destination Accessibility (D5)

The most sophisticated variables to be included in the SLD address CBG-to-CBG accessibility. The primary variables (D5ar, D5a3, D5br, D5be) all measure jobs or working-age population within a 45-minute commute via automobile (D5a..) or transit (D5b..). Variables with an "r" reflect accessibility from residences to jobs. Variables with an "e" reflect accessibility from employment locations to working-age population. A travel-time decay formula is used in each calculation to weigh jobs/population closer to the origin CBG more strongly than those further away. D5c and D5d measure accessibility relative to other CBG within the same metropolitan region (CBSA). The approach to developing each of these measures is described below.

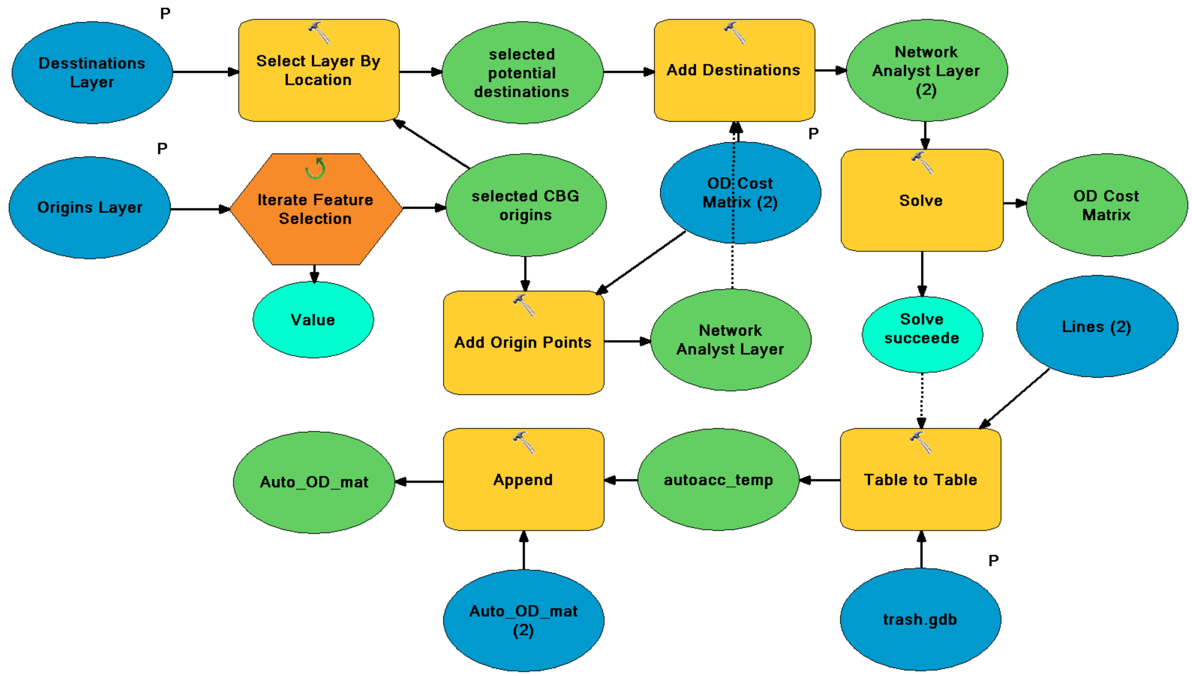
D5a –Destination Accessibility via Automobile Travel

A geoprocessing model was developed to facilitate the calculation and tabulation of auto-accessible CBGs from a given origin CBG within a 45-minute drive time. The NAVTEQ Streets feature class was used as the source feature in an ArcGIS network dataset that covers the entire U.S. and Puerto Rico. The NAVTEQ features and tables that support the network development process were fed into the "Process NAVSTREETS Street Data" tool within the Vendor Street Data Processing Tools for ArcGIS 10 toolset, which is available for public download from the ArcGIS Resource Center website.[21] The tool output was a complete national network dataset with distance (meters) and travel time (minutes) attributes as well as signpost and other directional details, direction of travel and vehicle type restrictions, turn restrictions and delays, and a host of other variables. The tool automatically defines travel time on network links based on their length and assumed travel speeds based on speed category.

The network analysis was run as an iterative process for each CBG centroid. The geoprocessing model is displayed in Figure 2. The model adds CBG centroids from a user-defined set of potential origins to the OD matrix network problem. It then runs a spatial query to select all potential CBG centroid destinations within a 45 mile straight line distance from any of the selected origins. The OD matrix network problem is solved and the results exported to a temporary table and subsequently appended to a consolidated master table of OD pairs for a given study area. Regardless of how origins were iteratively added to the analysis, destinations were always selected from a comprehensive nationwide set of CBG centroids.

[21] http://resources.arcgis.com/gallery/file/geoprocessing/details?entryID=7DD58DB5-1422-2418-A0EC-0929C2387760 , November, 2012

Figure 2 – Geoprocessing Model for Calculation and Tabulation of Auto Origin-Destination Matrix Tables



Dark blue oval = geoprocessor input; Light blue oval = geoprocessor parameter; Green oval = geoprocessor output; Cyan oval = condition; Yellow box = geoprocessing task; Orange hexagon = feature selection iterator

After creating the OD matrix tables for auto accessibility EPA joined the employment and working age population values from the Employment and Demographics tables to the associated destination CBG of each CBG to CBG OD pair. We used a decay function to adjust activity values (population or employment) according to their distances from their respective origins as tabulated in the OD matrices. The distance decay formula was derived from the report "Travel Estimation Techniques for Urban Planning" (NCHRP Report 365, Transportation Research Board, 1998) and is displayed below:

$$D5\ Acc_i = \sum_{j=1}^{n} \boldsymbol{Emp}_j * f(d)_{ij}$$

where

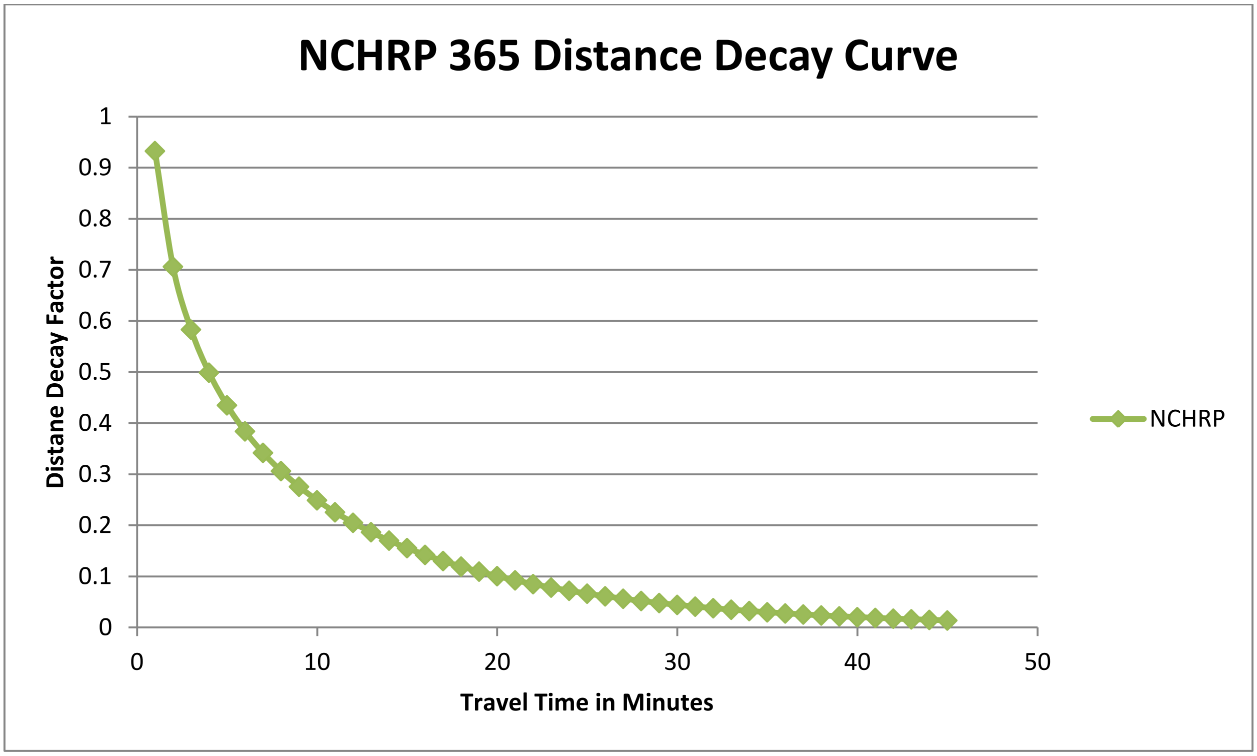
$\boldsymbol{D5\ Acc_i}$ is the destination accessibility for CBG *i*,
$\boldsymbol{Emp_j}$ is the measure of Working-Age Population in the CBG *j*, and
$\boldsymbol{f(d)_{ij}}$ is the measure of impedance between CBG *i* and CBG *j*.

$$f\,(d)_{ij} = a * d_{ij}^{-b} * e^{-c*(d_{ij})}$$

Where, **a** = 1, **b** = 0.300, and **c**= 0.070; please note that **e**, is the exponential function.

This function *f(d)*$_{ij}$ produces the curve displayed in Figure 3. The equation emphasizes close proximity, decaying rapidly as travel time increases up to about 10 minutes, at which point the friction resulting from marginal increases in travel time begin to ease. The decay factor approaches zero as travel time increases beyond 40 minutes.

Figure 3 – NCHRP 365 Distance Decay Curve



The OD matrix development process did not account for intrazonal travel. Although rows were added to the matrices where the destination CBG centroid was the same as the origin CBG centroid, the travel time reported for the OD pair was zero. A travel time of zero cannot be weighted using the distance decay formula described above, so to account for intrazonal destinations, intrazonal travel time was estimated for each CBG. The formula for estimated intrazonal travel time was also taken from NCHRP 365:

$$T_{iz}=0.5*\sqrt{A_i}*\frac{60}{s_i}$$

where

T_{iz} is the intrazonal travel time for CBG *i* in minutes,
A_i is the unprotected area of CBG *i* in square miles, and
s_i is the estimated travel speed within CBG *i* in miles per hour.

This equation required the estimation of a typical intrazonal travel speed. This was accomplished by classifying each CBG as "urban," "suburban," or "rural" based on activity density in the CBG. Activity densities were joined from the D1 – Density table and represent the total number of jobs and dwelling units per unprotected acre for each CBG. CBGs where total activity density was less than 0.5 activity units per unprotected acre were deemed "rural" and assigned an intrazonal travel speed of 35 mile per hour. CBGs with activity densities higher than 6 units per unprotected acre were classified as urban and assigned a travel speed of 15 miles per hour. All other CBGs were classified as suburban and assigned an intrazonal speed of 25 miles per hour. These designations were developed through visual inspection of areas well known to the study team. They only influenced the tabulation of intrazonal travel times and were not used in any other part of the analysis.

After all travel times had been fully tabulated - whether intrazonal derived from equations or interzonal derived from the network analysis model – employment and working age population totals at destination CBGs were decayed by the distance decay curve described above and summed for each origin CBG. The sum of distance-decayed employment accessible from each CBG is reflected in the variable D5ar; the corresponding figure for working-age population accessible from each CBG is reflected in the variable D5ae.

Destination Accessibility via Transit (D5b)

Transit accessibility was assessed in essentially the same way as auto accessibility, although the development of CBG to CBG OD matrices was more complex. The process involved the preparation of five different OD matrices that were utilized in different ways during the course of the analysis. The five OD matrices are described briefly below:

1. <u>CBG centroid to transit stops (also used in D4a)</u>: Contains network walk travel times from CBG centroids to transit stops; model of access and egress portions of transit trips.
2. <u>CBG centroid to CBG centroid by walking</u>: Contains network walk travel times between CBG centroids; model of walk-to-destinations opportunities.
3. <u>Transit stop to transit stop by walking</u>: Contains network walk travel times between transit stops; model of walk-to-transfer opportunities; used as an interim table supporting the transit stop to transit stop by transit vehicle matrix.
4. <u>Transit stop event to transit stop event by transit vehicle</u>: Contains GTFS schedule-derived in vehicle travel times between transit stop events on a single transit vehicle and on a trip-by-trip basis; model of transit service; used as an interim table supporting the transit stop to transit stop by transit vehicle matrix.
5. <u>Transit stop to transit stop by transit vehicle</u>: Contains minimum travel times between stop locations based on connected stop events, in vehicle times, and walk to transfer times; model of total transit system connectivity from boarding stop to all potential alighting stops by fastest route combination.

The transit analysis focused on the basic phases of a transit trip: walking to access transit service, the in-vehicle trip, walking and/or waiting to make a transfer, the second in-vehicle trip (where available), and walk egress from a transit stop to a destination. Each phase is described below with references to the matrices as enumerated above (i.e. Matrix 1 is the CBG centroid to transit stops matrix).

Walk Access to Transit

Walk access to transit was modeled as the network distance from a CBG centroid to each accessible transit stop in the GTFS data set within a 15-minute walk allowance. Travel distances were stored in Matrix 1. A standard wait time of 5 minutes to make the first boarding was applied.

In-Vehicle Time (first trip)

From walk accessible stops, additional ride accessible stops were located. These were stops to which a traveler could ride from the walk accessible stops based on the transit trips serving those stops. The maximum in-vehicle time permitted was 45 minutes. The total amount of in vehicle time from the walk accessible stop of origin was retained when modeling transfer opportunities.

Transfers

For all ride accessible stop events, there may exist transfer opportunities. These were found through matrix 3. Ten minutes total transfer time was permitted, of which five could be spent walking to make the transfer. The arrival time at each ride accessible stop was retained in the data tables when analyzing transfer opportunities. The transfer opportunity stop event needed to be within a five-minute walk of the ride accessible stop of alighting, occurring no more than ten minutes after alighting but after the alighting time plus the walk to transfer time.

In-Vehicle Time (second trip)

A maximum of 45 minutes in vehicle time was allowed. Thus the stops accessible by riding during the second trip had to be reachable within 45 minutes *minus* the time spent on the first in-vehicle leg of the trip. At the completion of the analysis of the second in-vehicle leg of the transit trip, all stop event OD pairs were compiled in matrix 4. Stop events were linked to their stop locations, and pairs were summarized to find the fastest travel time between stop locations by any combination of walking, riding and transferring during the analysis time period (PM peak). The resulting table was matrix 5.

Walk Egress

With the fastest travel times between stops tabulated in matrix 5, the total travel time between each origin CBG and all transit stops could be derived by adding the walk access time to walk accessible stops and the additional in-vehicle/transfer time required to reach additional stops. From all accessible stops, matrix 1 was again deployed to determine walk egress time to destination CBGs. With walk egress time known, total travel time between CBG OD pairs was known, although in many cases, the same OD pair appeared many times due to the multiplicity of ride accessible stops and connected CBG destinations at the egress end. Thus, that table was summarized to find the minimum total travel time between CBGs in a scratch version of the final CBG to CBG transit travel times matrix.

Walk Competitiveness

For some OD pairs – especially in highly urbanized areas – walk travel times to neighboring CBGs were expected to be competitive with transit travel times, especially considering the five minute wait time required for the first boarding of a transit vehicle in the transit accessibility analysis. Thus, walk times between neighboring CBGs were analyzed for all CBGs that had some access to transit. A maximum 15 minute walk from origin to destination was permitted. The resulting table (matrix 2) was merged with the scratch CBG to CBG transit travel times matrix, and summarized to find the minimum travel time between zones by transit or by walking where walking was modeled to be more expedient than transit.

The final CBG to CBG matrix was utilized in the same fashion as the auto accessibility matrices, incorporating the same distance decay formula and the same conceptual means of accounting for intrazonal trip making[22] to summarize regional accessibility to jobs and working age population provided by transit.

Transit accessibility was analyzed for the PM peak travel period only, as typically this is a period of relatively intense levels of transit service and during which a rich mix of commuting and discretionary trip-making takes place. GTFS schedules were queried to isolate trips and their related stop events that occur within the 4:45 PM to 7 PM time frame. There is no hard and fast departure time from the CBG origin. Rather, since all possible permutations of traveling by transit between stops were analyzed in the development of matrix 5, the CBG to CBG travel times reported in the final matrix reflect the optimal transit trip connecting those CBGs in the PPM peak period. In the development of matrices 4 and 5, the first transit trips had to be boarded prior to 5:45 PM. These and other key parameters of the transit analysis as described herein are summarized in Table 6 below.

Table 6 –Attributes and Parameters of Transit Accessibility Analysis

Full Travel Period	4:45 PM to 7:00 PM
Travel Period of Walk Departure from CBG origin	4:45 PM to 5:40 PM
Travel Period of First Trip Boarding	5:00 PM to 5:45 PM
Maximum Possible Total Travel Time for the Transit Trip	90 minutes
Maximum Walk Time Allowed for Access	15 minutes
Wait time to Board First Trip	5 minutes
Maximum Total In-Vehicle Travel Time	45 minutes (first and second trips combined)
Number of Transfers Allowed	1
Maximum Time Allowed for Waiting to Make a Transfer	10 minutes
Maximum Time Allowed for Walking to Make a Transfer (subsumed within time for waiting to make a transfer)	5 minutes
Maximum Walk Time Allowed for Egress	15 minutes

Accounting for directional transit service

The transit accessibility analysis was conducted for the PM peak period. However there are several examples of places served only by AM peak period service towards downtown and PM peak period

[22] No urban, suburban, or rural place type categorization was done for determining intrazonal speeds in the transit analysis. Instead, a constant 3 mph walk speed was used.

service away from downtown. This analysis assumes that directional transit service is always conforms to this symmetrical pattern. In other words, our assumption is that if a traveler can go from downtown to a suburban residential area in the PM peak, they can also go from the residential area to downtown in the AM peak. To emulate this AM peak service, an analysis of reverse accessibility (from destination CBG to origin CBG) was conducted. The maximum D5b values associated with a given CBG are reflected in D5br and D5be. CBG for which D5b scores reflect reverse accessibility are flagged with a value of "1" in two corresponding fields: D5br_Flag and D5be_Flag.

As with other metrics that rely on GTFS data, all block groups in areas where GTFS service data are unavailable are given the value -99999.

Proportional and Relative Accessibility (D5c, D5d)

EPA calculated an additional set of accessibility variables to measure accessibility relative to other CBG within the same metropolitan region (CBSA). First we measured CBG accessibility as a ratio of total CBSA accessibility. For instance D5cr was calculated by dividing the CBG's D5ar score by the sum of all D5ar scores for CBG within the same CBSA. Additionally, EPA calculated CBG accessibility relative to the CBG with greatest accessibility within the same CBSA. For instance D5cri was calculated by dividing the CBG's D5cr score by the maximum D5cr score within the same CBSA.

Appendix A: Regions with transit service data reflected in SLD metrics

The TOD Database includes a listing of all metropolitan regions with fixed-guideway transit stations featured in their dataset. These regions are listed in Table 7. Note that this list does not include some regions with a single commuter station or ferry terminal. Atlantic City, NJ, Albany, OR and Bellingham, WA are examples of such places.

Table 7. Regions with fixed-guideway transit service locations reflected in SLD metrics

- Albany, NY
- Albuquerque
- Atlanta
- Austin
- Baltimore
- Boston
- Buffalo
- Charlotte
- Chicago
- Cleveland
- Dallas
- Denver
- Detroit
- Eugene
- Harrisburg, PA
- Hartford, CT
- Houston
- Jacksonville
- Kansas City
- Las Vegas
- Los Angeles
- Memphis
- Miami
- Milwaukee
- Minneapolis--St. Paul
- Nashville
- New Orleans
- New York
- Norfolk--Virginia Beach
- Philadelphia
- Phoenix
- Pittsburgh
- Portland, OR
- Sacramento
- Salt Lake City
- San Diego
- San Francisco Bay Area
- San Juan, PR
- Seattle
- St. Louis
- Tampa
- Washington ,DC

Table 8. Transit agencies with GTFS service data reflected in SLD metrics

Agency Name	Service Area	Date of GTFS file obtained
City of Albany / Linn Benton Loop	Albany, OR	2012
Linn Shuttle	Albany, OR	2012
ABQ Ride	Albuquerque, NM	2012
LANTA	Allentown-Bethlehem, PA	2012
Ann Arbor Transportation Authority	Ann Arbor, MI	2012
University of Michigan Transit Services	Ann Arbor, MI	2012
Annapolis Transit	Annapolis, MD	2011
Asheville Transit Service	Asheville, NC	2012
Sunset Empire Transportation District	Astoria-Seaside, OR	2012
Metropolitan Atlanta Rapid Transit Authority	Atlanta, GA	2012
Capital Metro	Austin, TX	2012
Golden Empire Transit District	Bakersfield, CA	2012
BWI Thurgood Marshall Intl Airport	Baltimore, MD	2011
Charm City Circulator	Baltimore, MD	2011
Howard Transit	Baltimore, MD	2011
Maryland Transit Administration	Baltimore, MD	2011
Cascades East Transit	Bend, OR	2012

Birmingham Jefferson County Transit Authority	Birmingham, AL	2012
Blacksburg Transit	Blacksburg, VA	2012
Bloomington Transit	Bloomington, IN	2012
Massport	Boston, MA	2012
MBTA	Boston, MA	2012
Merrimack Valley Regional Transit Authority	Boston, MA	2012
MetroWest Regional Transit Authority	Boston, MA	2012
Lexpress	Boston, MA	2009
Kitsap Transit	Bremerton, WA	2012
NFTA-METRO	Buffalo, NY	2012
Butte-Silver Bow	Butte, MT	2013
Eastern Sierra Transit Authority	California and Nevada (Intercity)	2012
Cape Cod Regional Transit Authority (CCRTA)	Cape Cod, MA	2010
Champaign Urbana Mass Transit District	Champaign-Urbana, IL	2012
Chapel Hill Transit	Chapel Hill, NC	2010
Charlottesville Area Transit	Charlottesville, VA	2012
Chicago Transit Authority	Chicago, IL	2012
Metra	Chicago, IL	2012
Pace Suburban Bus Service	Chicago, IL	2012
North Indiana Commuter Transportation District	Chicago, IL	2010
Southwest Ohio Regional Transit Authority	Cincinatti, OH	2012
Transit Authority of Northern Kentucky	Cincinatti, OH	2012
Clemson Area Transit	Clemson, SC	2012
Greater Cleveland Regional Transit Authority	Cleveland, OH	2012
Mountain Metropolitan Transit	Colorado Springs, CO	2010
Central Ohio Transit Authority	Columbus, OH	2012
Coos County Area Transit	Coos Bay, OR	2011
Curry Public Transit	Coos Bay, OR	2011
Porter Stage Lines	Coos Bay, OR	2012
Corona Cruiser	Corona, CA	2012
Corvallis Transit System	Corvallis, OR	2012
Cottonwood Area Transit	Cottonwood, AZ	2012
Allegany County Transit	Cumberland, MD	2012
DALLAS AREA RAPID TRANSIT	Dallas-Ft Worth, TX	2012
Fort Worth Transportation Authority	Dallas-Ft Worth, TX	2012
DART First State	Delaware (Statewide)	2012
Regional Transportation District	Denver, CO	2012
Detroit Department of Transportation	Detroit, MI	2012
Duluth Transit Authority	Duluth, MN	2012
Lane Transit District	Eugene, OR	2012

Arcata & Mad River Transit System	Eureka-Arcata, CA	2012
Eureka Transit Service	Eureka-Arcata, CA	2012
Redwood Transit System	Eureka-Arcata, CA	2012
Community Transit	Everett, WA	2010
Fairfield and Suisun Transit	Fairfield, CA	2012
Razorback Transit	Fayetteville, AK	2009
Montachusett Regional Transit Authority	Fitchburg, MA	2012
Frederick Transit Meet-The-MARC	Frederick, MD	2011
TransIT Services of Frederick County	Frederick, MD	2013
Lee County Transit	Ft Myers, FL	2011
Citilink	Ft Wayne, IN	2012
Cape Ann Transportation Authority	Gloucester, MA	2012
Franklin Regional Transit Authority	Greenfield, MA	2012
Gunnison Valley RTA	Gunnison, CO	2013
Hampton Roads Transit (HRT)	Hampton Roads, VA	2011
TheBus	Honolulu, HI	2011
Columbia Area Transit	Hood River, OR	2012
Metropolitan Transit Authority of Harris County	Houston, TX	2012
Huntsville Shuttle	Huntsville, AL	2012
IndyGo	Indianapolis, IN	2012
Irvine Shuttle	Irvine, CA	2009
Island Transit	Island County, WA	2012
People Mover	John Day, OR	2011
KCATA	Kansas City, MO-KS	2012
The JO	Kansas City, MO-KS	2012
Kingsport	Kingsport, TN	2012
Basin Transit Service	Klamath Falls, OR	2010
The Shuttle, Inc.	Klamath Falls, OR	2012
Municipal Transit Utility	La Crosse, WI	2012
CityBus	Lafayette, IN	2011
Lakeland	Lakeland, FL	2011
Regional Transportation Commission of Southern Nevada	Las Vegas, NV	2012
LexTran	Lexington, KY	2012
Central Arkansas Transit Authority	Little Rock, AK	2012
Metro - Los Angeles	Los Angeles, CA	2012
Metrolink Trains	Los Angeles, CA	2012
Municipal Area Express (MAX)	Los Angeles, CA	2012
Torrance Transit	Los Angeles, CA	2012
Transit Authority of River City	Louisville, KY	2012
Lowell Regional Transit Authority	Lowell, MA	2012

Metro Transit-City of Madison	Madison, WI	2012
City of Maricopa	Maricopa, AZ	2010
Mason Transit	Mason County, WA	2011
RVTD	Medford, OR	2010
Space Coast Area Transit	Melbourne-Palm Bay, FL	2012
Mendocino Transit Authority	Mendocino, CA	2012
Broward County Transit	Miami-Ft Lauderdale, FL	2012
Miami Dade Transit	Miami-Ft Lauderdale, FL	2012
Tri-Rail	Miami-Ft Lauderdale, FL	2009
City of Milton-Freewater Oregon	Milton-Freewater, OR	2011
Milwaukee County Transit System	Milwaukee, WI	2012
Anoka County	Minneapolis-St. Paul, MN	2011
Maple Grove	Minneapolis-St. Paul, MN	2011
Metro Transit (Minneapolis)	Minneapolis-St. Paul, MN	2011
Minneapolis	Minneapolis-St. Paul, MN	2011
Minnesota Valley	Minneapolis-St. Paul, MN	2011
Other (Minnesota)	Minneapolis-St. Paul, MN	2011
Plymouth	Minneapolis-St. Paul, MN	2011
Prior Lake	Minneapolis-St. Paul, MN	2011
Saint Paul	Minneapolis-St. Paul, MN	2011
Scott County	Minneapolis-St. Paul, MN	2011
Shakopee	Minneapolis-St. Paul, MN	2011
SouthWest Transit	Minneapolis-St. Paul, MN	2011
University of Minnesota	Minneapolis-St. Paul, MN	2011
Mountain Line	Missoula, MT	2012
Ceres Area Transit	Modesto, CA	2012
Modesto Area Express	Modesto, CA	2012
Monroe County Transit Authority	Monroe County, PA	2012
Regional Transportation Authority	Nashville, TN	2010
Shore Line East	New Haven-New London, CT	2012
NJ TRANSIT BUS	New Jersey (Statewide)	2012
NJ TRANSIT RAIL	New Jersey (Statewide)	2012
Coach USA -Short Line	New York (Intercity)	2010
Bee-Line Bus	New York, NY	2012
Long Island Bus	New York, NY	2011
Long Island Rail Road	New York, NY	2012
Metro-North Railroad	New York, NY	2012
MNR Hudson Rail Link	New York, NY	2012
MTA Bus Company	New York, NY	2012
MTA New York City Transit	New York, NY	2012

NY Waterway	New York, NY	2012
Port Authority of New York & New Jersey	New York, NY	2011
Rockland County Department of Public Transportation	New York, NY	2012
TAPPANZEE EXPRESS	New York, NY	2010
Norwalk Transit	Norwalk, CT	2012
Intercity Transit	Olympia, WA	2012
Orange County Transportation Authority	Orange County, CA	2012
Sunline Transit Agency	Palm Springs-Indio, CA	2011
Port Authority Transit Corporation	Philadelphia, PA	2011
SEPTA Rail	Philadelphia, PA	2012
SEPTA Bus	Philadelphia, PA	2012
Port Authority of Allegheny County	Pittsburgh, PA	2012
Berkshire Regional Transit Authority	Pittsfield, MA	2011
Jefferson Transit Authority	Port Townsend, WA	2012
Ride Connection	Portland, OR	2012
TriMet	Portland, OR	2012
Rhode Island Public Transit Authority	Providence, RI	2012
NC State University Wolfline	Raleigh-Durham, NC	2010
Capital Area Transit	Raleigh-Durham, NC	2012
Cary Transit	Raleigh-Durham, NC	2012
Durham Area Transit Authority	Raleigh-Durham, NC	2010
Triangle Transit	Raleigh-Durham, NC	2010
Redding Area Bus Authority	Redding, PA	2012
RTC RIDE	Reno, NV	2012
Riverside Transit Agency	Riverside, CA	2012
Rochester-Genesee Regional Transportation Authority	Rochester, NY	2012
U-Trans	Roseburg, OR	2012
Unitrans (Davis)	Sacramento, CA	2012
Capitol Corridor Joint Powers Authority	Sacramento, CA	2012
Roseville Transit	Sacramento, CA	2012
Sacramento Regional Transit	Sacramento, CA	2012
Cherriots	Salem-Keizer, OR	2012
CityGo	Salina, KS	2009
Utah Transit Authority	Salt Lake City, UT	2012
San Benito County Express	San Benito County, CA	2012
MTS	San Diego, CA	2012
North County Transit District	San Diego, CA	2012
AC Transit	San Francisco Bay Area, CA	2011

AirBART	San Francisco Bay Area, CA	2012
Bay Area Rapid Transit	San Francisco Bay Area, CA	2012
Baylink	San Francisco Bay Area, CA	2012
Blue & Gold Fleet	San Francisco Bay Area, CA	2012
Caltrain	San Francisco Bay Area, CA	2012
County Connection	San Francisco Bay Area, CA	2012
Golden Gate Ferry	San Francisco Bay Area, CA	2012
Harbor Bay Ferry	San Francisco Bay Area, CA	2012
Marin Transit	San Francisco Bay Area, CA	2012
Menlo Park Midday Shuttle	San Francisco Bay Area, CA	2011
Rio Vista Delta Breeze	San Francisco Bay Area, CA	2012
San Francisco Municipal Transportation Agency	San Francisco Bay Area, CA	2012
San Luis Obispo Regional Transit Authority	San Luis Obispo, CA	2012
City of Sandy	Sandy, OR	2012
Santa Cruz Metro	Santa Cruz, CA	2012
Santa Rosa CityBus	Santa Rosa, CA	2010
Sarasota County Area Transit	Sarasota, FL	2012
City of Seattle	Seattle, WA	2012
King County Marine Divison	Seattle, WA	2012
Metro Transit (Seattle)	Seattle, WA	2012
Sound Transit	Seattle, WA	2012
Spokane Transit Authority	Spokane, WA	2012
PVTA	Springfield, MA	2012
Metro St. Louis	St. Louis, MO	2012
San Joaquin Regional Transit District (RTD)	Stockton, CA	2012
Susanville Indian Rancheria Public Transportation Program	Susanville, CA	2012
Alpine Meadows Shuttle	Tahoe, CA	2012
Homewood Ski Shuttle	Tahoe, CA	2012
North Lake Tahoe Express - 24 hour advance reservations required	Tahoe, CA	2012
Northstar-at-Tahoe	Tahoe, CA	2012

Squaw Valley USA	Tahoe, CA	2012
Tahoe Area Regional Transit	Tahoe, CA	2012
Town of Truckee	Tahoe, CA	2012
PSTA	Tampa-St. Petersburg-Clearwater, FL	2012
Hillsborough Area Regional Transit	Tampa-St. Petersburg-Clearwater, FL	2012
Tehama Rural Area Express	Tehama County, CA	2012
Thousand Oaks Transit	Thousand Oaks, CA	2012
Tillamook County Transportation District	Tillamook, OR	2012
Topeka Metro	Topeka, KS	2012
Trinity Transit	Trinity County, CA	2011
Bus Line Service of Turlock	Turlock, CA	2012
Stanislaus Regional Transit	Turlock, CA	2012
Confederated Tribes of the Umatilla Indian Reservation	Umatilla Reservation, OR	2012
Montgomery County MD Ride On	Washington, DC	2012
Maryland Transit Administration	Washington, DC	2011
Central Maryland Regional Transit	Washington, DC	2011
Arlington Transit	Washington, DC	2012
Fairfax Connector	Washington, DC	2012
DC Circulator	Washington, DC	2012
Washington Metropolitan Area Transit Authority	Washington, DC	2012
Shuttle-UM: Department of Transportation Services	Washington, DC	2010
South Metro Area Regional Transit	Wilsonville, OR	2012
Siskiyou Transit and General Express	Yreka, CA	2012

Table 9. SLD Transit Data Coverage Summarized as Percentage of total Metropolitan Region Transit Ridership

Many metropolitan regions are served by multiple transit agencies. We analyzed agency ridership data in the National Transit Database and then summarized by metropolitan region in order to calculate the percentage of all transit trips that occurred on systems whose GTFS data is reflected in the SLD. This information can be used to help assess the reliability of SLD transit accessibility metrics in a region of interest.

Metropolitan Region	Ridership on GTFS Systems	Ridership on Non-GTFS Systems	% of Total Ridership on GTFS Systems	Key Agencies Missing (only for large metros with partial coverage)
Abilene, TX	-	476,924	0%	
Akron, OH	-	6,162,278	0%	
Albany, GA	-	944,273	0%	
Albany-Lebanon, OR				*GTFS available. But no NTD ridership stats. Assumed 100% on GTFS systems.*
Albany-Schenectady-Troy, NY	-	15,194,277	0%	
Albuquerque, NM	10,760,389	1,083,003	91%	
Alexandria, LA	-	820,450	0%	
Allentown-Bethlehem-Easton, PA-NJ	5,505,748	-	100%	
Altoona, PA	-	595,098	0%	
Amarillo, TX	-	328,602	0%	
Ames, IA	-	4,991,935	0%	
Anchorage, AK	-	4,297,794	0%	
Anderson, IN	-	153,963	0%	
Ann Arbor, MI	11,956,664	-	100%	
Appleton, WI	-	966,548	0%	
Asheville, NC	1,622,510	-	100%	
Athens-Clarke County, GA	-	11,257,766	0%	
Atlanta-Sandy Springs-Marietta, GA	156,062,900	10,793,280	94%	
Augusta-Richmond County, GA-SC	-	645,967	0%	

Austin-Round Rock-San Marcos, TX	38,417,485	-	100%	
Bakersfield-Delano, CA	7,514,503	-	100%	
Baltimore-Towson, MD	123,711,543	-	100%	
Bangor, ME	-	869,999	0%	
Barnstable Town, MA	-	409,625	0%	
Baton Rouge, LA	-	3,729,315	0%	
Battle Creek, MI	-	523,237	0%	
Bay City, MI	-	557,942	0%	
Beaumont-Port Arthur, TX	-	756,323	0%	
Bellingham, WA	-	5,623,158	0%	
Bend, OR	274,084	-	100%	
Billings, MT	-	675,340	0%	
Binghamton, NY	-	3,057,920	0%	
Birmingham-Hoover, AL	2,805,110	-	100%	
Bismarck, ND	-	131,601	0%	
Blacksburg-Christiansburg-Radford, VA	2,954,415	-	100%	
Bloomington, IN	3,027,877	-	100%	
Bloomington-Normal, IL	-	1,609,081	0%	
Boise City-Nampa, ID	-	1,405,568	0%	
Boston-Cambridge-Quincy, MA-NH	369,816,619	2,847,043	99%	
Boulder, CO			100%	Served by RTD (Denver)
Bremerton-Silverdale, WA	3,940,635	-	100%	
Bridgeport-Stamford-Norwalk, CT	1,915,195	8,995,984	18%	Greater Bridgeport Transit Authority; Connecticut Transit - Stamford Division; Milford Transit District
Brownsville-Harlingen, TX	-	1,610,151	0%	
Buffalo-Niagara Falls, NY	28,204,712	-	100%	

Burlington-South Burlington, VT	-	2,514,563	0%	
Butte-Silver Bow, MT				*GTFS available. But no NTD ridership stats. Assumed SLD includes 100% of service.*
Canton-Massillon, OH	-	2,025,920	0%	
Cape Coral-Fort Myers, FL	3,040,037	-	100%	
Casper, WY	-	118,849	0%	
Cedar Rapids, IA	-	1,156,975	0%	
Champaign-Urbana, IL	9,975,213	-	100%	
Charleston, WV	-	2,462,650	0%	
Charleston-North Charleston-Summerville, SC	-	3,990,364	0%	
Charlotte-Gastonia-Rock Hill, NC-SC	-	25,090,603	0%	
Charlottesville, VA	2,012,462	-	100%	
Chattanooga, TN-GA	-	3,072,978	0%	
Cheyenne, WY	-	255,348	0%	
Chicago-Joliet-Naperville, IL-IN-WI	626,191,057	1,302,563	100%	
Chico, CA	-	1,285,013	0%	
Cincinnati-Middletown, OH-KY-IN	26,587,332	247,265	99%	
Clarksville, TN-KY	-	710,983	0%	
Cleveland, TN	-	38,976	0%	
Cleveland-Elyria-Mentor, OH	45,071,314	1,119,037	98%	
Coeur d'Alene, ID	-	445,484	0%	
College Station-Bryan, TX	-	1,290,739	0%	
Colorado Springs, CO	3,152,990	-	100%	
Columbia, MO	-	2,263,406	0%	
Columbia, SC	-	2,019,912	0%	
Columbus, GA-AL	-	1,150,708	0%	

Columbus, OH	17,208,787	-	100%	
Coos Bay, OR				*GTFS available. But no NTD ridership stats. Assumed SLD includes 100% of service.*
Corpus Christi, TX	-	5,076,379	0%	
Corvallis, OR	680,402	-	100%	
Crestview-Fort Walton Beach-Destin, FL	-	172,122	0%	
Cumberland, MD-WV	153,661	-	100%	
Dallas-Fort Worth-Arlington, TX	70,586,142	-	100%	
Danville, IL	-	522,062	0%	
Danville, VA	-	233,729	0%	
Davenport-Moline-Rock Island, IA-IL	-	4,168,735	0%	
Dayton, OH	-	10,130,959	0%	
Decatur, IN	-	1,257,409	0%	
Deltona-Daytona Beach-Ormond Beach, FL	-	3,071,247	0%	
Denver-Aurora-Broomfield, CO	96,981,435	-	100%	
Des Moines-West Des Moines, IA	-	4,513,648	0%	
Detroit-Warren-Livonia, MI	38,603,132	14,715,703	72%	Suburban Mobility Authority for Regional Transport
Dover, DE	9,146,873	-	100%	
Dubuque, IA	-	293,252	0%	
Duluth, MN-WI	3,173,485	-	100%	
Durham-Chapel Hill, NC	14,178,569	-	100%	
Eau Claire, WI	-	951,405	0%	
El Centro, CA	-	556,433	0%	
El Paso, TX	-	12,179,796	0%	
Elmira, NY	-	640,742	0%	
Erie, PA	-	3,025,785	0%	

Eugene-Springfield, OR	11,732,650	-	100%	
Eureka-Arcata-Fortuna, CA				*GTFS available. But no NTD ridership stats. Assumed SLD includes 100% of service.*
Evansville, IN-KY	-	1,831,479	0%	
Fairbanks, AK	-	357,816	0%	
Fajardo, PR	-	41,656	0%	
Fargo, ND-MN	-	1,872,630	0%	
Fayetteville, NC	-	992,886	0%	
Fayetteville-Springdale-Rogers, AR-MO	1,327,673	177,959	88%	Fayetteville Area System
Flagstaff, AZ	-	1,142,932	0%	
Flint, MI	-	5,154,073	0%	
Florence, SC	-	104,968	0%	
Fond du Lac, WI	-	135,579	0%	
Fort Collins-Loveland, CO	-	2,050,034	0%	
Fort Smith, AR-OK	-	197,098	0%	
Fort Wayne, IN	1,791,787	-	100%	
Fresno, CA	-	14,062,016	0%	
Gainesville, FL	-	8,939,980	0%	
Gainesville, GA	-	115,245	0%	
Glens Falls, NY	-	316,535	0%	
Grand Forks, ND-MN	-	271,704	0%	
Grand Junction, CO	-	859,193	0%	
Grand Rapids-Wyoming, MI	-	8,865,687	0%	
Great Falls, MT	-	369,472	0%	
Greeley, CO	-	529,791	0%	
Green Bay, WI		1,354,368	0%	

Greensboro-High Point, NC	-	5,137,679	0%	
Greenville-Mauldin-Easley, SC	-	742,100	0%	
Gulfport-Biloxi, MS	-	690,886	0%	
Hagerstown-Martinsburg, MD-WV	-	374,280	0%	
Hanford-Corcoran, CA	-	911,059	0%	
Harrisburg-Carlisle, PA	-	3,182,747	0%	
Harrisonburg, VA	-	1,686,751	0%	
Hartford-West Hartford-East Hartford, CT	-	15,589,020	0%	
Hickory-Lenoir-Morganton, NC	-	159,298	0%	
Holland-Grand Haven, MI	-	218,535	0%	
Honolulu, HI	77,403,365	-	100%	
Hood River, OR				*GTFS available. But no NTD ridership stats. Assumed SLD includes 100% of service.*
Houston-Sugar Land-Baytown, TX	84,408,919	142,654	100%	
Huntington-Ashland, WV-KY-OH	-	789,769	0%	
Huntsville, AL	325,222	-	100%	
Idaho Falls, ID	-	48,067	0%	
Indianapolis-Carmel, IN	8,199,806	-	100%	
Iowa City, IA	-	6,509,641	0%	
Ithaca, NY	-	3,351,817	0%	
Jackson, MI	-	505,934	0%	
Jackson, MS	-	516,721	0%	
Jackson, TN	-	535,903	0%	
Jacksonville, FL	-	10,703,555	0%	
Janesville, WI	-	442,602	0%	
Jefferson City, MO	-	333,713	0%	

Johnson City, TN	-	541,762	0%	
Johnstown, PA	-	1,201,113	0%	
Kalamazoo-Portage, MI	-	2,937,109	0%	
Kankakee-Bradley, IL	-	617,748	0%	
Kansas City, MO-KS	15,474,361	-	100%	
Kennewick-Pasco-Richland, WA	-	3,663,535	0%	
Kingston, NY	-	321,426	0%	
Klamath Falls, OR				*GTFS available. But no NTD ridership stats. Assumed SLD includes 100% of service.*
Knoxville, TN	-	3,454,995	0%	
La Crosse, WI-MN	1,189,841	-	100%	
Lafayette, IN	4,720,438	-	100%	
Lafayette, LA	-	1,460,059	0%	
Lakeland-Winter Haven, FL	1,450,988	466,008	76%	Polk County Transit Services Division - Polk County
Lancaster, PA	-	2,043,029	0%	
Lansing-East Lansing, MI	-	10,884,977	0%	
Laredo, TX	-	3,987,845	0%	
Las Cruces, NM	-	656,590	0%	
Las Vegas-Paradise, NV	66,100,239	-	100%	
Lawrence, KS	-	930,753	0%	
Lawton, OK	-	407,988	0%	
Lebanon, PA	-	308,274	0%	
Lewiston-Auburn, ME	-	224,917	0%	
Lexington-Fayette, KY	6,064,260	-	100%	
Lincoln, NE	-	1,733,188	0%	
Little Rock-North Little Rock-Conway, AR	2,462,990	-	100%	

Logan, UT-ID	-	1,792,273	0%	
Longview, WA	-	444,789	0%	
Los Angeles-Long Beach-Santa Ana, CA	559,824,227	134,626,557	81%	City of Los Angeles Department of Transportation; Long Beach Transit; Santa Monica's Big Blue Bus
Louisville/Jefferson County, KY-IN	15,520,760	-	100%	
Lubbock, TX	-	2,674,171	0%	
Lynchburg, VA	-	2,954,860	0%	
Macon, GA	-	900,264	0%	
Madison, WI	13,588,426	-	100%	
Manchester-Nashua, NH	-	969,853	0%	
Mansfield, OH	-	263,376	0%	
McAllen-Edinburg-Mission, TX	-	81,441	0%	
Medford, OR	1,055,445	-	100%	
Memphis, TN-MS-AR	-	11,472,021	0%	
Merced, CA	-	1,189,281	0%	
Miami-Fort Lauderdale-Pompano Beach, FL	143,468,788	12,200,880	92%	
Milwaukee-Waukesha-West Allis, WI	46,767,776	1,430,430	97%	
Minneapolis-St. Paul-Bloomington, MN-WI	87,523,236	-	100%	
Missoula, MT	828,887	338,168	71%	The University of Montana - ASUM Transportation
Mobile, AL	-	1,107,048	0%	
Modesto, CA	3,478,032	-	100%	
Monroe, LA	-	1,193,421	0%	
Montgomery, AL	-	1,298,751	0%	
Morgantown, WV	-	1,155,417	0%	
Mount Vernon-Anacortes, WA	-	508,212	0%	
Muncie, IN	-	1,865,419	0%	

Muskegon-Norton Shores, MI	-	606,178	0%	
Myrtle Beach-North Myrtle Beach-Conway, SC	-	384,585	0%	
Napa, CA	-	747,718	0%	
Naples-Marco Island, FL	-	1,109,710	0%	
Nashville-Davidson--Murfreesboro--Franklin, TN	204,470	10,405,963	2%	Metropolitan Transit Authority
New Haven-Milford, CT	-	8,625,669	0%	
New Orleans-Metairie-Kenner, LA	-	19,358,992	0%	
New York-Northern New Jersey-Long Island, NY-NJ-PA	3,919,867,556	87,689,144	98%	
Niles-Benton Harbor, MI	-	18,904	0%	
North Port-Bradenton-Sarasota, FL	2,551,650	1,403,104	65%	Manatee County Area Transit
Norwich-New London, CT	-	1,133,645	0%	
Odessa, TX	-	399,482	0%	
Oklahoma City, OK	-	2,684,087	0%	
Olympia, WA	4,298,328	-	100%	
Omaha-Council Bluffs, NE-IA	-	4,039,585	0%	
Orlando-Kissimmee-Sanford, FL	-	23,747,795	0%	
Oshkosh-Neenah, WI	-	913,226	0%	
Oxnard-Thousand Oaks-Ventura, CA	185,681	4,353,834	4%	Gold Coast Transit; Ventura Intercity Service Transit Authority
Palm Bay-Melbourne-Titusville, FL	1,418,430	-	100%	
Pensacola-Ferry Pass-Brent, FL	-	1,802,426	0%	
Peoria, IL	-	2,673,759	0%	
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	356,538,501	-	100%	
Phoenix-Mesa-Glendale, AZ	-	75,885,375	0%	
Pittsburgh, PA	66,977,678	1,308,580	98%	
Pittsfield, MA	505,566	-	100%	

Pocatello, ID	-	417,965	0%	
Port St. Lucie, FL	-	129,998	0%	
Portland-South Portland-Biddeford, ME	-	2,740,398	0%	
Portland-Vancouver-Hillsboro, OR-WA	107,463,360	6,496,056	94%	
Poughkeepsie-Newburgh-Middletown, NY	-	1,459,927	0%	
Providence-New Bedford-Fall River, RI-MA	19,819,547	2,520,242	89%	
Pueblo, CO	-	904,693	0%	
Racine, WI	-	1,384,411	0%	
Raleigh-Cary, NC	7,182,060	-	100%	
Rapid City, SD	-	231,150	0%	
Reading, PA	-	2,916,928	0%	
Redding, CA	821,731	-	100%	
Reno-Sparks, NV	8,449,134	-	100%	
Richmond, VA	-	13,841,903	0%	
Riverside-San Bernardino-Ontario, CA	8,131,306	15,010,345	35%	Omnitrans
Roanoke, VA	-	2,539,745	0%	
Rochester, MN	-	1,584,502	0%	
Rochester, NY	16,918,131	-	100%	
Rockford, IL	-	1,748,003	0%	
Rome, GA	-	690,511	0%	
Roseburg, OR				*GTFS available. But no NTD ridership stats. Assumed SLD includes 100% of service.*
Sacramento--Arden-Arcade--Roseville, CA	38,876,858	4,031,658	91%	
Saginaw-Saginaw Township North, MI	-	1,031,667	0%	
Salem, OR	4,746,944	-	100%	
Salina, KS				*GTFS available. But no NTD ridership stats. Assumed SLD includes 100% of service.*

Salinas, CA	-	4,399,711	0%	
Salisbury, MD	-	431,797	0%	
Salt Lake City, UT	35,364,620	-	100%	
San Angelo, TX	-	168,647	0%	
San Antonio-New Braunfels, TX	-	43,296,328	0%	
San Diego-Carlsbad-San Marcos, CA	100,277,280	3,601,503	97%	
San Francisco-Oakland-Fremont, CA	423,195,275	26,898,631	94%	
San Jose-Sunnyvale-Santa Clara, CA	-	45,532,563	0%	
San Juan-Caguas-Guaynabo, PR	-	70,952,537	0%	
San Luis Obispo-Paso Robles, CA	552,782	1,032,232	35%	City of San Luis Obispo
Santa Barbara-Santa Maria-Goleta, CA	-	9,563,841	0%	
Santa Cruz-Watsonville, CA	6,026,920	-	100%	
Santa Fe, NM	-	790,373	0%	
Santa Rosa-Petaluma, CA	2,858,142	1,556,384	65%	Sonoma County Transit; City of Petaluma
Savannah, GA	-	3,729,694	0%	
Scranton--Wilkes-Barre, PA	-	3,600,595	0%	
Seattle-Tacoma-Bellevue, WA	135,466,499	47,255,611	74%	Washington State Ferries; Pierce County Transportation Benefit Area Authority
Sebastian-Vero Beach, FL	-	594,128	0%	
Sheboygan, WI	-	452,605	0%	
Sherman-Denison, TX	-	32,375	0%	
Shreveport-Bossier City, LA	-	3,068,875	0%	
Sioux City, IA-NE-SD	-	1,157,470	0%	
Sioux Falls, SD	-	927,282	0%	
South Bend-Mishawaka, IN-MI	-	2,662,984	0%	
Spartanburg, SC	-	534,599	0%	

Spokane, WA	11,152,841	-	100%	
Springfield, IL	-	1,644,631	0%	
Springfield, MA	11,882,301	-	100%	
Springfield, MO	-	1,458,164	0%	
Springfield, OH	-	365,904	0%	
St. Cloud, MN	-	2,247,033	0%	
St. Joseph, MO-KS	-	387,287	0%	
St. Louis, MO-IL	52,077,835	2,265,542	96%	
State College, PA	-	7,001,149	0%	
Stockton, CA	4,728,186	797,328	86%	Altamont Commuter Express
Sumter, SC	-	165,928	0%	
Syracuse, NY	-	14,527,502	0%	
Tallahassee, FL	-	4,409,041	0%	
Tampa-St. Petersburg-Clearwater, FL	25,584,253	926,076	97%	
Terre Haute, IN	-	299,876	0%	
Toledo, OH	-	6,984,265	0%	
Topeka, KS	1,550,279	-	100%	
Tucson, AZ		21,575,374	0%	
Tulsa, OK	-	2,688,967	0%	
Tuskegee, AL	-	194,742	0%	
Vallejo-Fairfield, CA	982,682	2,214,557	31%	City of Vallejo Transportation Program
Victoria, TX	-	261,170	0%	
Virginia Beach-Norfolk-Newport News, VA-NC	15,517,047	-	100%	
Visalia-Porterville, CA	-	2,109,045	0%	
Waco, TX	-	636,111	0%	
Washington-Arlington-Alexandria, DC-VA-MD-WV	474,383,822	18,205,204	96%	

Waterloo-Cedar Falls, IA	-	467,772	0%
Wausau, WI	-	794,121	0%
Wenatchee-East Wenatchee, WA	-	905,853	0%
Wheeling, WV-OH	-	426,338	0%
Wichita, KS	-	2,170,346	0%
Williamsport, PA	-	1,295,620	0%
Wilmington, NC	-	1,424,123	0%
Winston-Salem, NC	-	2,957,172	0%
Worcester, MA	-	3,176,035	0%
Yakima, WA	-	1,349,024	0%
York-Hanover, PA	-	1,410,278	0%
Youngstown-Warren-Boardman, OH-PA	-	1,787,501	0%
Yuba City, CA	-	985,081	0%
Yuma, AZ	-	331,240	0%