UTAH COUNTY GRID STUDY

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REGIONAL HIGHWAY GRID NETWORK STUDY

INTRODUCTION

Gridded street networks are proven to add capacity to the transportation network by providing better access and mobility choices for users. Gridded networks, sometimes called 'connected communities', are highly effective in absorbing and mitigating demand on roadways.

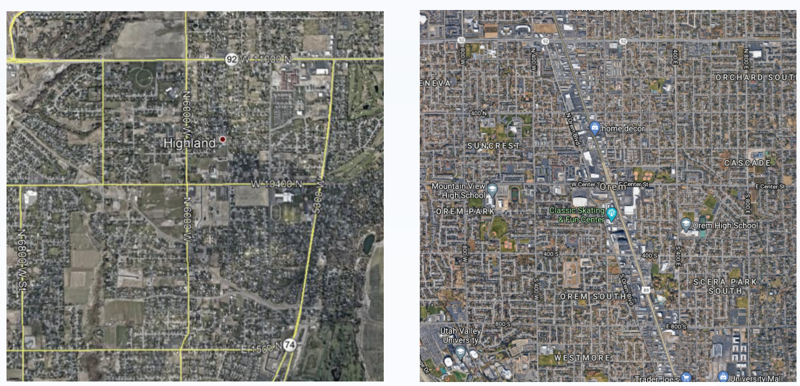
Research at the local, national, and international level has been conducted on grid systems to determine benefits and create spacing recommendations. While most grid network policy is enacted at the city level, the regional benefits of implementation are notable. Understanding those benefits and creating uniform policy at the regional level will improve the quality of life for commuters at a regional level with added benefits at the local level.

WHAT IS A REGIONAL GRID?

Roadways serve two main purposes, to provide **mobility** and **access**.

A regional grid is a roadway network that provides multiple routes **(access)** to destinations for commuters and other travelers. The more connections created, the faster and further people can get to their place of work, school, or to commercial districts **(mobility)**. Currently, much of Utah County lacks enough of these regional roadways, or complete roadways, to keep up with the demand of travel, causing major congestion at peak times. With growth projections for the area, this will continue to get worse. It is important to acknowledge that many historic Utah County city centers were set up with a grid system, gridded networks must also exist outside the core in more suburban and rural environments to accommodate the regional travel needs. The use of roads classified as Collectors and Arterials help facilitate this movement of cars; below are details on what those classifications mean. A regional gridded network will look and function differently than the gridded areas of city centers; proper sizing and spacing of the main arterials and collectors is key. Straight gridded connections are not always necessary, these roadways may be curvilinear and still enhance the regional grid network.

WHAT IS A REGIONAL GRID SYSTEM



These two networks differ because the network on the left lacks key regional connectors and most traffic is concentrated on one major facility, while the network on the right provides multiple travel options to those moving between cities.

NEED

Utah County originally developed as small farming communities; the historic city centers laid out in a gridded network. Over time these communities grew organically, unifying urban and suburban areas without clear borders and without necessary regional connections to facilitate travel between cities. Because this growth happened slowly, regional transportation systems were not preemptively planned, and the network was not implemented on a regional scale or in a way that anticipated growth.

Today, we have data and tools to predict the impacts future growth will place on our roadway network. Utah County is growing rapidly, much faster than most regions in the state. It is expected to double in population in the next thirty years, which equates to a 100 percent growth rate, a rate twice as high as any other county along the Wasatch Front. By 2050, Utah County will add 660,000 more people surpassing 1.3 million people. By 2065, Utah County will be comparable in population to Salt Lake County both at 1.6 million people (MAG TransPlan50). Because of this rapid growth in the county, it is more important than ever to ensure cities are thinking on a regional level and see the importance of creating a connected transportation system that can accommodate the inevitable increase in travelers.

Mountainland Association of Governments (MAG) has developed a thorough long-range plan that will guide the future of the network in Utah County. As part of that plan, MAG conducted a preliminary study for an 'ideal' gridded network for Utah County. Those recommendations will be refined to ensure that the proposed regional grid network increases capacity, reduces travel times, and meets regional and local goals. MAG and the Utah County cities within the study area understand the importance of managing and adapting to this growth to lessen the demand on existing infrastructure and improve quality of life.

BENEFITS OF A GRID SYSTEM

A grid system provides a better experience for all users and modes and has demonstrated success in cities all over the county. Moving forward, the goal is to implement a similar successful system on a regional level, providing connections between cities to maximize benefits for commuters and other travelers.

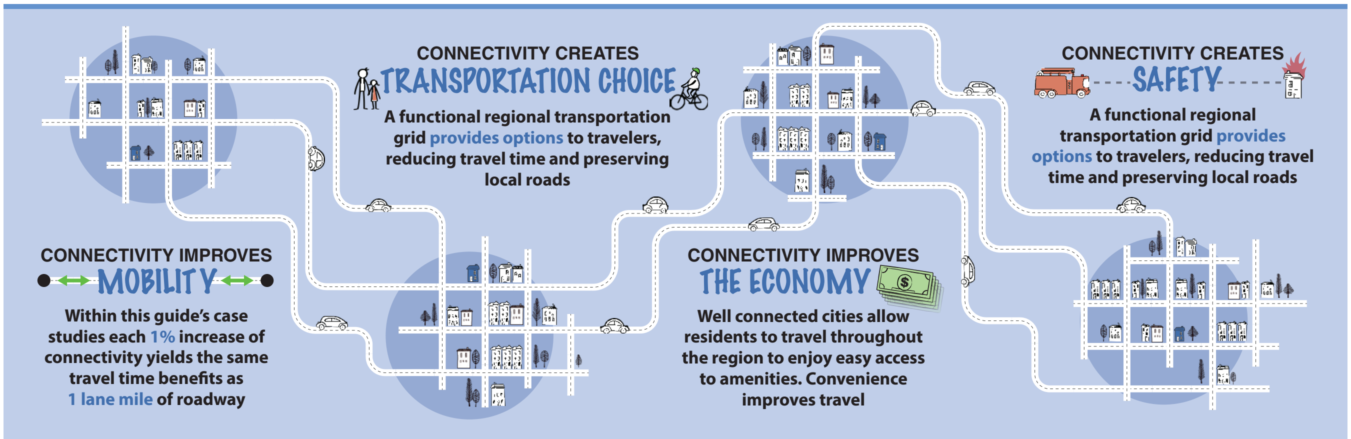
Grid systems allow traffic to be dispersed rather than concentrated onto limited thoroughfares, which reduces the impacts of high traffic volumes on roadways. Impacts are measurable in capital costs for maintenance due to overuse and wear on pavement and create major delays for travelers during construction when no viable alternative routes are available. Social impacts are also quantifiable for commute-based trips, as well as other trips including to and from school and various commercial areas. Congestion is compounded with limited regional roadways, increasing travel times. Adding regional routes will also protect residential collectors, allowing them to provide more direct and safer transportation for those driving, walking, riding a bike. **With a functional regional transportation system, local roads can remain local.**

For this purpose, we have quantified the benefits of a grid system into four categories:

1. Mobility & Connectivity
2. Safety
3. Economic Vitality
4. Health

Mobility and Connectivity

The greatest benefit of a gridded network is **enhanced mobility for all roadway users**. As additional roadway connections are created, improvements to congestions, safety, and active transportation are seen. While the goal of this study is to determine regional strategies for mobility, by doing so, many local benefits are realized as well.

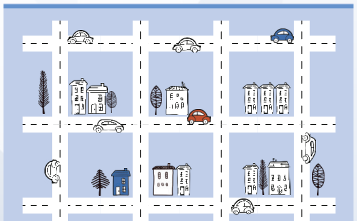


Good street connectivity redistributes traffic providing more options and better accessibility for all modes but particularly for automobiles.

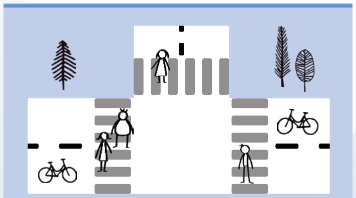
More direct routes generate fewer vehicle miles of travel (VMT) than conventional suburban networks by allowing travelers to choose alternate routes to destinations. This reduces travel delay and provides a layer of convenience to users to avoid construction, congestion, and increase reliability of the network overall. Pedestrians and bicyclists on a local level also see tremendous benefits from a well-connected network, short blocks and a gridded network led to significant increases in active transportation. Many city general plans in Utah County prioritize goals related to enhancing safe walkable communities.

> **“Enhancing connectivity has been proven to better accommodate more traffic than a traditional roadway widening exercise would.”**

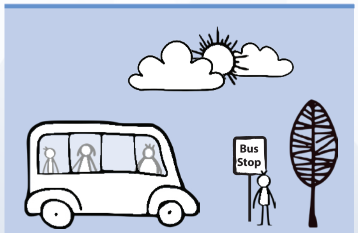
Better street connectivity provides travelers with greater choice of travel modes. In a well-connected network, active transportation modes and transit become more viable choices largely because they reduce walking and bicycling distances among origins and destinations. This means that these types of networks are less automobile dependent.



VMT's reduced from 2-70% with good street connectivity



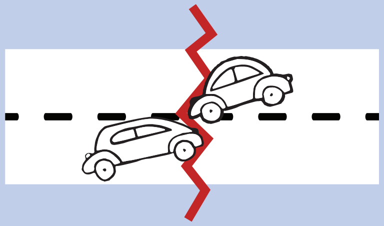
Increasing Street Connectivity improved access for those on foot and bike by 87-99%



Improved transit reliablility and access

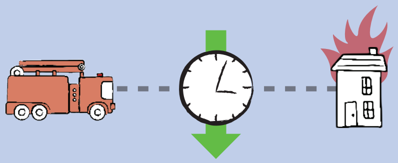
Safety

A well-connected network offers better safety for all users and enhances the community's overall health and safety compared to a system with less connectivity. **Car and pedestrian conflicts become fewer and crash severities are reduced with less congested streets.** It's also important to note that creating access to and through neighborhoods does not denote high-speed high-volume roadways in all areas. This study will consider the built environment in Utah County and make recommendations that are context sensitive. For example, a roadway connection in a neighborhood would likely be narrow and low speed, versus a roadway connection to a commercial district that will need multiple lanes with less driveways and fewer cross-street conflicts.



485% increase in accident rates per year per mile as street widths went from **24′** to **36′**

Grid networks provide better access for those on foot. By spreading traffic out to more routes and alleviating congestion on major thoroughfares, many streets naturally become lower volume and lower speed – creating a safer walkable environment for those who must or choose to walk.



Reduced Response Time

By expanding the gridded network and adding a variety of street typologies and widths to the system, it drastically improves safety. Reducing opportunities for conflicts by slowing speeds and alleviating demand on roadways creates a safer environment for all users.

A benefit with easy data to track is the reduction in response time for emergency medical service (EMS) vehicles. A redundancy in the network allows multiple routes and the ability to avoid congestion, construction, or other blockage delays to quickly arrive on an emergency scene. It also shortens the physical distance emergency responders must travel, and in some studies has shown that connectivity improvements saved cities from having to build a new fire station to service the same area.

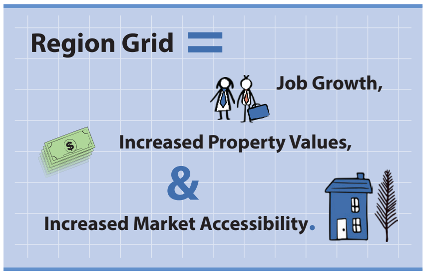
CASE STUDY: In 2020, Saratoga Springs experienced a wildland fire that required residential evacuation. This area has only one significant route in and out of the community, which caused significant delays in evacuation. It caused similar strain for EMS response time and access.

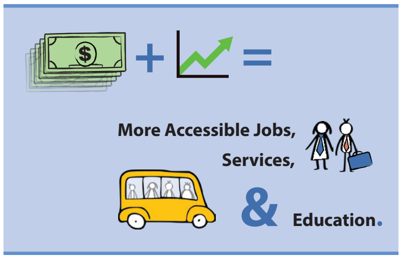
Economic Vitality

Gridded networks and expanded connectivity are good for job growth, property values, and market accessibility. Inter-regional, regional, and local connectivity has been studied, and an impact model combining transportation and economic benefits was developed. The measures are:

- Increases in productivity
- Job growth
- Reduced transportation/materials costs
- Increased customer base/revenue

On a regional level, improved connectivity reduces travel times, resulting in something called **market accessibility**. Market accessibility estimates how accessible certain markets are like jobs, services, and education are to households. Increased mobility improves market accessibility. Good market accessibility is good for business, and something future employers tend to look for when citing new workspaces. It is also good for business because shorter travel times reduces the cost of transporting goods, improves access for the customer base of any given business, and helps bolster sales.





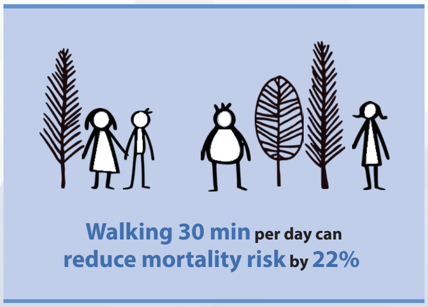
For local residential property owners, connectivity results in lower household transportation costs and increased personal time. Notable economic measures on the local level include **job growth and job density** in all sectors including service and retail, as well as **local tax benefits** such as sales and property taxes.

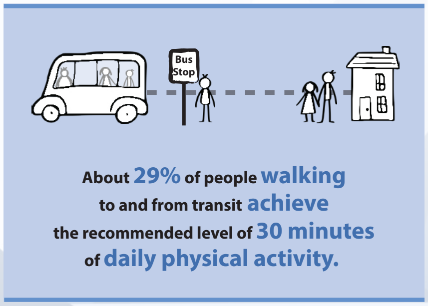
Encouraging non-motorized travel with connected communities increases access to employment and services by transit. Increasing the range of access by transit provides more job choices within the traveled area. Better transit creates jobs, stimulating development, boosting business revenue, increasing local and state revenues, saving employers money, decreasing pollution, and conserving energy.

According to national research, consumers are willing to pay a premium to live in a walkable community with higher-than-average densities, mixed use and housing types, interconnected streets, and prominent public spaces. Less walkable spaces tend to have lower incomes, higher unemployment, and lower education levels. Street design improvements can also have an impact on retail rents.

Health

Encouraging walking and biking by design makes a community livable, and tangible health benefits are seen. A connected regional network does that, even unintentionally. The health benefits of a gridded network are directly linked to the benefits associated with mobility. A connected transportation system that offers route choices, more direct paths, and walkable calm streets incentivizes people to use active transportation more. **Worker productivity and numerous health benefits are associated with biking: those who bike regularly saw a 32% decrease in sick days taken and a 55% decrease in healthcare costs, all while seeing a 55% increase in productivity.**





SPACING GUIDELINES & RECOMMENDATIONS

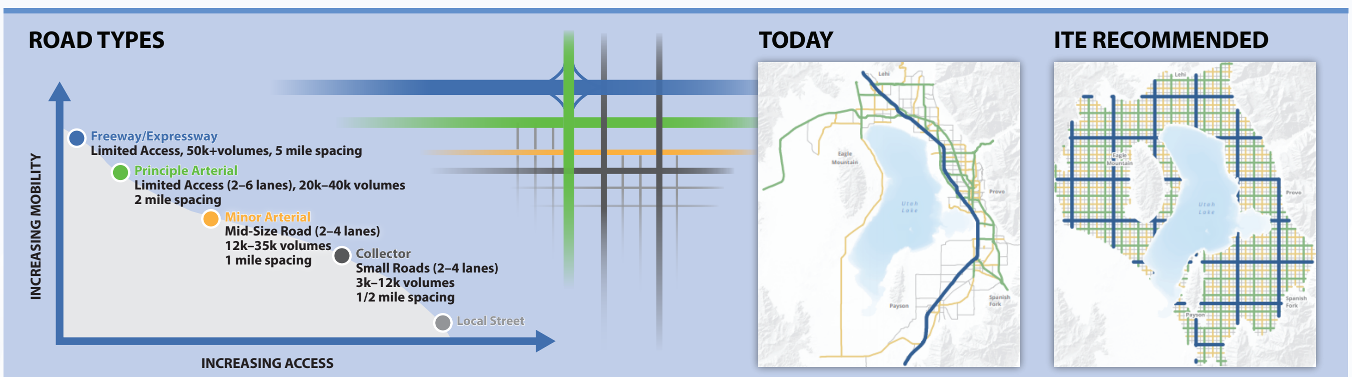
Recommendations have been taken from local and national studies including the Utah Street Connectivity Guide, ITE, Portland Metro, and PennDOT and others. Most case studies are from specific cities rather than regions, for example Portland, OR. While Portland may have a very different built environment in the downtown core, there are still less dense suburban neighborhoods within city limits that mirror Utah County's built environment. As the ideal grid network is developed, adjustments will be made to reduce impacts and optimize funding resources.

> **"It is important to understand our unique built environment, geographic constraints, and existing transportation network in Utah County in the next phases of this study."**

This section provides:

- Street Spacing Recommendations
- Example Codes
- Case Studies

The Institute of Traffic Engineers (ITE) has provided a guide entitled Planning Urban Roadway Systems. In this guide, it is important to note that Arterials and Collectors have the same spacing recommendations and are ultimately used interchangeably, in that, they offer the same benefits if the spacing is adequate. While MAG, UDOT and FHWA classify regional arterials and collectors similarly, local jurisdictions often have their own separate classifications that may not adhere to FHWA functional classes. The goal of this study is to create regionally-accepted roadway classifications for a regional gridded network. Generally, Collectors "collect" traffic from local roads and distribute traffic to Arterial roadways. Collectors are generally shorter routes than Arterials, but longer than Local Roads. Arterials have fewer access points, and control access very well; like with the use of on or off-ramps or signalized intersections. An ideal grid network uses a combination of Arterials, Collectors, and Local Roads to create a balance of **access** (fast and far), and **mobility** (many opportunities).



Arterials	
DISTANCE SERVED	Longest routes
ACCESS POINTS	Fewer driveways or cross streets
SPEED LIMIT	High speeds, ~ 40-55+ mph
TRAVEL LANES	Several

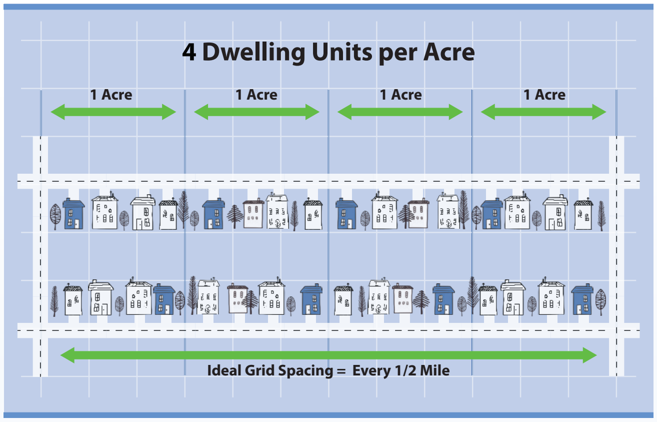
Collectors	
DISTANCE SERVED	Medium length routes
ACCESS POINTS	Some driveways or cross streets
SPEED LIMIT	Medium speeds, ~ 30-35+ mph
TRAVEL LANES	Several

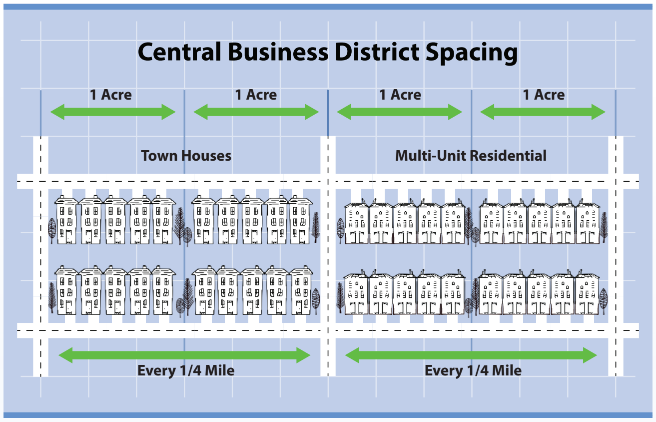
S.R. 92 in Lehi (Arterial)

400 S. in Springville (Collector)

FIGURE 1. Arterial & Collector Spacing Recommendations

Both facilities can often be used interchangeable, the most important factor is that they are appropriately spaced throughout the region. Existing roadway classifications in Utah County vary by city, a goal of this effort is to create a uniform classification for regional roadways.

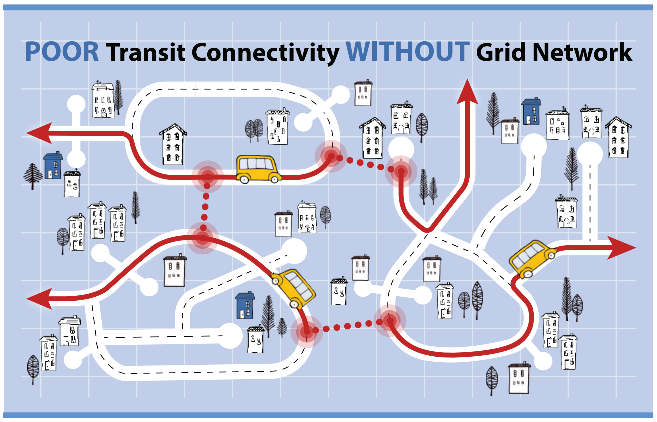


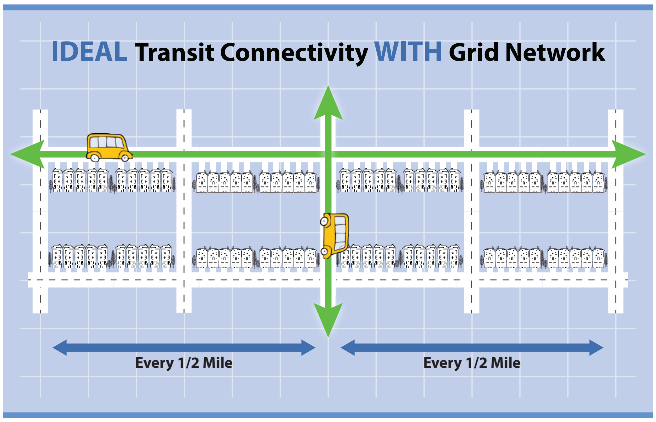


Central Business Districts	1,000-2,000 feet
Suburban Activity Centers	¼ to ½ mile
Rural or exurban developments (up to 3 units per acre)	1 mile
Suburban developments (up to 6 units per acre)	½ mile
Suburban developments (up to 12 units per acre)	¼ mile
Urban developments	¼ mile, consider adding one-ways if developments are over 20 units per acre

FIGURE 2. Transit Spacing Recommendations

If the gridded network is implemented with the spacing guidelines listed above, transit will function better. When transit routes are forced onto circuitous winding routes through neighborhoods, they are less desirable, take longer to get people to destinations, and are therefore used less. A grid network is the ideal built environment to accommodate good access to transit stops, and reliable and frequent service. The more attractive and convenient transit service becomes, the more people will utilize it.





Transit Compatible Roadways	Every ½ mile within grid pattern, allowing everyone to be within ¼ mile from a transit stop
Spacing of Bus Stops - Urban Area	¼ mile
Spacing of Bus Stops - Rural	Up to 1 mile
Note: route spacing should be designed in conjunction with existing fixed-guideway systems (rail or BRT facilities)	

In addition to the standard roadway spacing guidelines developed above, ITE also recommends a specific methodology for calculating roadway spacing based on density, and existing and future land use build out. As the grid network is refined and specific recommendations are made for Utah County, an analysis will be conducted to recommend additional network needs for Utah County based on this methodology. There will be instances where closer spacing than what is listed above is recommended, as well as farther spacing than what is listed above. This will be determined by an ITE developed equation and conducting traffic scenario modeling.

Example Codes

The following examples provide a national snapshot of best practices, codified spacing requirements, and other codes. These will act as a reference when creating tailored recommendations and strategies for Utah County. MAG will lead and coordinate with individual cities to define what these should look like on a regional scale here.

Summary of Street Connectivity Standards:

Location	Max. Local Street Intersection Spacing (feet)	Max. Arterial Intersection Spacing (feet)	Street Stubs Required?	Cul-De-Sacs Allowed	Max. Cul-De-Sac Length (feet)
Portland Metro	530	530	No	No (with exceptions)	200
City of Portland	530	530	Yes	No (with exceptions)	200
Beaverton, OR	530	1000	Yes	No (with exceptions)	200
Eugene	600	none	Yes	No (with exceptions)	400
Fort Collins, CO	(Max, Block size 7-12 acres)	660 - 1,320	Yes	Limited	660

Boulder, CO	300 - 350 recommended	none	Yes	Yes, discouraged	600
Huntersville, NC	250 - 500	no data	Yes	No (with exceptions)	350
Cornelius, NC	200 - 1,320		Yes	No (with exceptions)	250
Conover, NC	400 - 1,200	no data	Yes	Yes	500
Raleigh, NC	1,500	no data	Yes	Yes	400 - 800
Cary, NC	Index = 1.2	1,250 - 1,500	Yes	Yes	900
Middletown, DE	Index = 1.7	none	Yes	Yes, discouraged	1,000
Orlando, FL	Index = 1.7	none	Yes	Yes	700 (30 units)

(Source: Handy, Paterson and Butler 2004)

Summary of Connectivity Requirements:

Location	Max. Spacing Between Bike/Ped Connections (feet)	Local Street Width (feet)	Private Street Allowed?	Gated Streets Allowed?
Portland Metro	330	<28	Not Regulated	Not Regulated
City of Portland	330		Limited	No
Beaverton, OR	330	20 - 34	Limited	No
Eugene	Connections required at cul-de-sacs	20 - 34	Limited	Limited
Fort Collins, CO	700	24 - 36	Limited	No
Boulder, CO	300 - 350 recommended	24 - 36	No	No
Huntersville, NC	none	18 - 26	No	No
Cornelius, NC	none	18 - 26	Yes	No
Conover, NC	none	22	No	No
Raleigh, NC	none	26	Discouraged	Discouraged
Cary, NC	If index waved	27	Yes	No
Middletown, DE	no data	24 - 32	No	No
Orlando, FL	none	24 min.	Yes	No

(Source: Handy, Paterson and Butler 2004)

Case Studies

West Valley City, UT – Traffic Redistribution:

Researchers simulated and compared twelve different scenarios including enhanced connectivity, street widening, and traffic calming measures. **The results show that enhanced connectivity scenarios accommodate more traffic than the scenarios with street widening,** and benefits both traversing and traffic. The main factors that influenced this were reduced trip distances, reduced number of trips, multiple alternative routes, shifts from personal vehicles to other modes, and redistribution of traffic throughout the network which increases the network-wide capacity. This increased accessibility in turn increases mobility throughout the network. (Tasic et al. 2005.)

Charlotte, NC – Cul-de-sac Reduction:

In 2003 the City Council unanimously voted to change the subdivision ordinance to end the use of cul-de-sacs for future new development and move toward a more connected system. "Charlotte went cul-de-sac happy in the 1970s and 1980s," said Mayor Pat McCrory. "We failed to develop a grid system of roads and now we have gridlock." A 2008 study by the city found that the average response time rose from 4.5 minutes in the mid-1970s to 5.5 minutes in 2002, as neighborhoods with less-connected street networks were built. But in subdivisions constructed since 2001 when the connected streets ordinance was enacted, the average response time dropped thirty seconds, to 5 minutes.

Longmont, CO – Ideal Street Width:

A study conducted revealed that wider streets were correlated with higher crash rates – a 485% increase in accident rates per year per mile as street widths increased from 24 feet to 36 feet. Over 20,000 police reports were reviewed and compared against criteria for evaluating the probability that street design contributed to the accidents. (Swift, Painter and Goldstein 2006.)

Utah Connectivity Modeling – Improved Connectivity:

An example from the Utah Street Connectivity Guide shows that proposed street connectivity improvements in the cities of Lehi, Layton, and Tooele Valley will:

- Provided a significant reduction in travel time and delay in both urban and suburban networks
- Improved connectivity in three communities by 32% leading to a 17% decrease in delay
- Vehicle miles traveled (VMTs) on larger streets was significantly reduced

MEASURING SUCCESS

Designing a Connectivity Index for Utah County can help quantify how well roadways connect people between cities. This can be measured in expanded travel areas, reduced congestion, and maybe most importantly – reduced travel times. The mapping tool created for this study will allow decision makers at regional and local levels to see the tangible benefits of adding roadway connections, and help them to develop a measurement formula to decide the future.

The measurement formula future for the Utah County grid system should be consistent across the project area/region to accurately measure the baseline scenario and future successes and should be easy enough to calculate without strenuous data collection or use of staff time/resources.

Examples of connectivity index formulas include:

EXAMPLE A:

An Accessibility Index is calculated as actual travel distances divided by direct travel distances (Actual Walking Distance / Direct Distance). If streets are well connected people can travel nearly directly to destinations, resulting in a low index. If the street network has many unconnected dead-ends and blocks are large, people much travel farther to

reach destinations, resulting in a higher index. An index of 1.0 is the best possible rating, indicating that pedestrians can walk directly to a destination. An average value of 1.5 is considered acceptable.

EXAMPLE B:

The number of roadway links divided by the number of roadway nodes (Ewing, 1996). Links are the segments between intersections, node the intersections themselves. A higher index means that travelers have increased route choice, allowing more direct connections for access between any two locations. According to this index, a simple box is scored a 1.0. A four-square grid scores a 1.33 while a nine-square grid scores a 1.5. Dead-end and cul-de-sac streets reduce the index value. This sort of connectivity is particularly important for nonmotorized accessibility. A score of 1.4 is the minimum needed for a walkable community.

EXAMPLE C:

The number of surface street intersections within a given area, such as a square mile. The more intersections, the greater the degree of connectivity.

RESOURCES

The following resources were used to create these recommendations and will serve as useful guidelines moving forward.

1. Roadway Connectivity – Creating More Connected Roadway and Pathway Networks | Victoria Transport Policy Institute
2. Utah Street Connectivity Guide | WFRC, UTA, UDOT, MAG
3. Designing Walkable Urban Thoroughfares: A Context Sensitive Approach | Institute of Transportation Engineers
4. Improving Connectivity and System Function through Local Planning | Pennsylvania Department of Transportation
5. Design Manual, Part 2 – Highway Design | Pennsylvania Department of Transportation
6. Design Manual Part 1X | Pennsylvania Department of Transportation
7. Successful Streets: Performance Measures, Community Engagement, and Urban Street Design | Massachusetts Institute of Technology Dept. of Urban Studies and Planning
8. Smart Growth Streets and Emergency Response | U. S. Environmental Protection Agency
9. Emergency Response & Street Design | The Congress for New Urbanism