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# Transportation Urbanism

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***Transportation Urbanism***

by

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A Design Thesis

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*Where is the edge of the city?*  
*As far as you can see?*  
*As far as you can think?*  
*As far as its transportation system can take you?*

## Introduction

The purpose of this thesis exploration is to propose a new type of building development in order to enhance the abilities of the current building and transportation infrastructure so that it is better able to serve the future of the city. Therefore, the product of this thesis should be able to consider the projected growth of the city the development serves, and be able to reduce the effects of suburban sprawl by encouraging more dense development patterns at the periphery of the city.

The new development to be proposed should focus itself along unused or under-utilized land with direct connections to existing transportation networks. The solution of this thesis exploration should be mindful of how it connects to the city in order to facilitate the movement of goods and people into, out of, and through the site.

Another important aspect to be considered is the potential integration of future transportation modes on the site – which will influence the way the site is developed. This means the new development, designed to serve the growth of transportation networks will look to develop new programmatic relationships between its transportation systems and the future buildings/users on the site.

The development, as a new construction aligned with the goals of architecture and transportation, should consider its own sustainability as a new development type, potentially influencing the way our cities grow into the future. Consequently, the solution should look to incorporate renewable energy sources and consider the agricultural potential of the site.

## Where is the Edge of the City?

The definition of the city has clearly followed the technological potential of the civilization. Before the Middle Ages, cities had to be very small – most restricting its boundaries to within 5 km or less – in order to allow its citizens the ability to travel throughout the city by foot.<sup>1</sup> More recently, transportation modes have been developed at incredible rates throughout the nineteenth and twentieth centuries to accommodate the rapid geographical expansion and population growth of our cities throughout the world.

What these facts indicate is an apparent, however less recognized, symbiotic relationship between architecture and its transportation networks. When we think of transportation systems – whether by car, train, airplane or walking, we hint at the importance of an established network which connects people to different places throughout the landscape. However, until it comes to asking/giving directions, we typically take these types of systems for granted due to their effectiveness of the transportation systems available in each city. Without these elaborate networks which rely on multiple modes of transportation, not only would we be without electricity, unless we lived near the source we would also be incapable of settling outside the reach of agriculturally feasible landscapes or most importantly, natural water resources. With this in mind,

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<sup>1</sup> Winy Maas and Grace La, eds., *Skycar City: A Pre-emptive History* (New York, NY: Actar, 2007), 22.

transportation systems have grown with the city, encouraging trade, growth and development to serve cities into the future.

The process of this thesis exploration took many turns, which allowed it to look at many different facets of the transportation systems that connect our cities. The research included in the following text attempts to explain the connections which were made throughout the design process, investigating transportation systems at a variety of scales. Learning how cities were developed along transportation systems - thus connecting them is where the process began. Research eventually led to the discovery of how the national interstate system was revolutionary in creating a high-speed transportation network which connected metropolises across the United States.

This is where research diverged, focusing on developing unused or underutilized space which could be then interconnected via pre-existing networks along transportation routes. Identifying interchanges along America's interstates possessed the potential of space which I was searching for - creating a complex web of places and modes of transportation which connect to each other. However, it's important to realize that our current transportation infrastructure has numerous issues which could radically affect the future of our cities and our personal mobility. Among these problems are the aging roads, bridges, tunnels and rails which need to be fixed to ensure safety might be the most important for the short term goals of transportation. Furthermore, population increases, global climate change, and the generation of energy begin to place huge strains on transportation networks.

Currently, cities are expanding their boundaries at outstanding rates due to typical suburban development at the periphery. These developments, though serving the housing market, place undesirable stress to agricultural land, require more land for less dense developments, and increase the need for roads to expand capacity in order to serve commuters. Realizing that we are headed down a path to an unsustainable future which threatens the efficiency of our transportation systems, now is the time to consider other solutions to the way we conceive of the city. This suggests developing a new definition for planning and organizing the city - especially where the future is most able to be controlled at the periphery. By forming a new type of urbanism which values the efficiency of transportation systems with the construction of mass transit options, we can establish more dense urban form which responds to and enhances the transportation systems created.

## **America's Next Innovation**

In this first phase, research was directed towards planning for America's next transportation innovation – presumably through high speed rail. Historically, the United States has been witness to a few promises of high-speed, intercity mass transportation proposals. One of these promises occurred during a

presidential election and ultimately led to the development of Amtrak's East coast route connecting Boston, MA with our nation's capital, Washington D.C.<sup>2</sup> More recently in 2009, U.S. President Barack Obama said he wanted to develop a national high-speed rail network as part of that year's Stimulus Package.<sup>3</sup> However, the United States has no definitive plans set towards implementing this high-speed rail network – and remains one of the only developed nations without this type of mass transit, behind England, France, Germany, Spain, China, and Japan – among others.

Investigation into how the future high-speed network would be integrated first depended on identification and location of our nation's existing transportation infrastructural networks and how those networks were tied into the cities they served. It was through this research that I began to identify just how influential transportation technology was in the growth and development of America's cities.

## **The History of Transportation in America**

Before the 1800's, America's cities – as with major metropolitan areas throughout the globe were geographically limited to places with navigable waterways.<sup>4</sup> This is due to the importance of water for the sustenance of life, the production of agricultural products for food, and the capacity of the civilization to trade goods originating from distant places. What this meant for American cities was that without the presence of a canal, settlements were not able to be formed, thereby limiting the westward expansion of the United States at the Missouri River. It wasn't until after the Lewis and Clark expeditions in the early 1800's that America began to grow substantially and at a rate much quicker than in its first 100 years.<sup>5</sup>

By the 1850's, the development of railroads added a new dimension to travel in America. Enormous railway building booms pushed companies in the North and Midwest to construct routes that linked nearly every major city – essentially replacing canals as America's main mode of transportation.<sup>6</sup> To capitalize on this newly constructed network, U.S. President Abraham Lincoln established the Homestead Act, encouraging the development of community settlements along the railroad.<sup>7</sup>

It wasn't until 1956 that America's next big transportation innovation would be introduced – the Interstate highway. With the Federal-Aid Highway Act, U.S. President Dwight D. Eisenhower restored the nation's spark for high-speed highways to connect the vast territory.<sup>8</sup> What made the interstate different from its transportation network predecessors was that they were built for speed, creating more efficient

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<sup>2</sup> Martha Thorne, ed., *Modern Trains and Splendid Stations: Architecture, Design, and Rail Travel for the Twenty-First Century* (London: Merrell, 2001), 45.

<sup>3</sup> <http://www.fra.dot.gov/Page/P0060>

<sup>4</sup> The Henry Ford Organization, last modified 2011, <http://www.thehenryford.org/education/erb/TransportationPastPresentAndFuture.pdf>, 74.

<sup>5</sup> Douglas Perry, "The Lewis and Clark Expedition," National Archives, <http://www.archives.gov/education/lessons/lewis-clark/>.

<sup>6</sup> The Henry Ford Organization, 12, 78.

<sup>7</sup> Lee Ann Potter and Wynn Schamel, "Homestead Act of 1862," National Archives, last modified 1997, <http://www.archives.gov/education/lessons/homestead-act/>.

<sup>8</sup> Richard Weingroff, "Federal-Aid Highway Act of 1956: Creating the Interstate System," National Atlas of the United States, last modified 2013, [http://www.nationalatlas.gov/articles/transportation/a\\_highway.html](http://www.nationalatlas.gov/articles/transportation/a_highway.html).

routes of transportation between already established cities across the nation. More than that, the interstate highway offered travelers independence, serving the personal automobile as an affordable option for long distance travel.

Running concurrently with the construction of interstate highways across the nation, transportation by aircraft had become both a popular and affordable option for long distance travel in the 1960s. The rise in popularity of airplanes began to replace intercity railroad transportation in the same way railroads replaced transportation by waterways – and the decrease in ridership numbers was catastrophic for intercity rail transportation.<sup>9</sup> Eventually, railroads were not able to profitably operate networks across the nation, but as early as 1974, states started to compensate for that long distance travel with the completion of entire sections of interstate highways.<sup>10</sup>

### **The Impact of the Interstate Highway on Cities**

Looking at the effects of these transportation systems, it becomes clear that transportation has been one of the largest dictators of where we have built cities throughout our nation's history. In fact, it is also possible to correlate the increases in population within a city to the multiplicity of transportation systems that serve it; e.g. its access to waterways, railroads, interstates. Peculiarly enough, I began to notice a trend in the preliminary maps of the national high-speed rail network, as well as text describing future plans for implementation of such a network that I saw as problematic. The current plan for a high-speed rail network utilizes existing railroad infrastructure to create high-speed connections.<sup>11</sup> However, remembering back to the construction of the various transportation networks, the interstate highways, rather than the railroads, were developed as the most efficient high-speed connection between cities.

My question is: why don't we utilize the most efficient ground transportation network in America (the interstate highways) as a guide for developing a new high-speed transportation network? Whether we cite speed as a determining factor or some other factor, the current infrastructure of railroads is not adequate to support a high-speed train, let alone inadequate to support its own projected capacity (to be discussed in further detail).

This realization of the impact of the interstate on the cities at a national scale led to the investigation of its influence at the city scale. Due to the immense number of cities in the United States with large populations, I decided to narrow the scope of further investigation down to what I considered Midwest regional cities. The reasoning for this decision was influenced by my ability to further investigate a potential site for the forthcoming thesis solution, including visiting the site. Rather than taking a more in-depth approach through demographic regions or city districts, the purpose of this investigation was to represent the way interstates interacted with the cities they connected to, and potentially unveil a network of interconnections across numerous interstate highways.

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<sup>9</sup> The Henry Ford Organization, 122-123.

<sup>10</sup> George Koster, "A Story of Highway Development in Nebraska," Nebraska Department of Roads, last modified 1997, <http://www.transportation.nebraska.gov/history/docs/history-general.pdf>, 82-87.

<sup>11</sup> Elliott McLaughlin, "5 Questions on High-Speed Rail and It's Future," Cable News Network US, last modified 2013, <http://www.cnn.com/2013/07/25/us/spain-high-speed-rail-5-questions/index.html>.

At this point, the goal became to identify not only how the interstates played a role in the larger national network, or how they flowed through the cities they served, but also how these interstates behaved at very specific instances. I wanted to develop a typology map of the types of interstate interchanges, which focused on these interchanges for their potential in developing a future network of already-interconnected spaces which are increasingly becoming more complex and requiring more land area to facilitate the connections they serve.

## **The Three Conditions of the City**

After collecting and analyzing the feedback from the first review, it became important to identify how the location of the interchange, in relationship to the city, affects the potential for integrating future transportation modes at these micro nodes. I've identified three distinct conditions – the rural, suburban and urban conditions of the city in order to accomplish this.

### **The Rural Condition**

The rural condition, located outside of the city, is the smallest of the three identified nodes, usually serving small population centers. The potential for occupying unused or under-utilized land is greatest in the rural condition because of the lack of building infrastructure. This also implies that the availability of resources and the ability to interface multiple modes of transportation are also at its lowest among the three conditions due to its location away from population centers. One implication for a successful integration of new transportation modes at a rural site is that it should be located between two large population centers and act as a midpoint for the two – also serving smaller communities.

### **The Suburban Condition**

The suburban condition, located at the edge of the city, has the most variance among the three conditions. The reason for such a variance has everything to do with the city it borders, and its connection to an interstate system serving the city it borders. Typically, suburban developments are home to large portions of the population of a city because of their ability to provide the luxury of city living mixed with the comfort and safety of a neighborhood for raising a family. Because of this, the potential for implementation of future transportation systems is high, but also dependent on the population density of the suburb because of its ability to serve the people that live in the development. The opportunity to capitalize on the working members of the population to deliver them to and from work during rush hour has the capability to reduce the numbers of cars on the roads and the need for parking in the urban core.

### **The Urban Condition**

The urban condition, located near/within the central business district of a city, is the largest of the three conditions. Its main function is to receive large masses of the population during the day and be able

to effectively distribute those commuters throughout the city. The urban condition, although dependent on the personal automobile at this time, will need to make a critical switch over to mass public transportation options to reduce congestion in the city core. Out of the three conditions, the urban condition has the best opportunity to introduce new modes of transportation to serve the population. One last consideration, but probably the most important for the urban condition, is how the destinations need to be able to connect people's residences to their workplaces. If public transportation in the urban core is inconvenient to its users, it will not be used.

Understanding the variances between the current conditions and the potentials and limitations each one presents allows us to be able to project their potential into the future. The major problem many cities face is how they plan to control their own growth. Currently, population estimates and transportation projections indicate a grim future – one which lacks the proper infrastructure (building stock and road capacity) to accommodate the needs of the future city.

With the creation of transportation destinations (hubs) distributed among the three conditions, cities would be able to intelligently plan its future transportation systems based on centers of residence, business and recreation to better serve the community. This would create public mass transit corridors, which have the ability to operate more efficiently on its own networks, but then be able to come together to serve the greatest amount of the population.<sup>12</sup> What this means is that separating different modes of transportation (light rail, bus, personal automobile, etc.) more evenly distributes the loads of traffic, and allows each mode to operate independently of the others, while still providing access to the other modes at transportation destinations (hubs).<sup>13</sup> A system which operates under these types of conditions can then begin to unveil potential linkages between the transportation networks at play and the developments they serve. For instance, the most efficient mode of transportation through a single neighborhood might be a bus rather than a light rail train, which serves several neighborhoods on its path into the central business district.

## Requirements for Transit

Although I mentioned the importance of creating a convenient transportation network, another factor is also at play – the societal image placed on public mass transit systems. In the central part of America, people see public transportation in many negative ways. These negative opinions range from public transportation is for the poor, to the inconvenience of switching modes of transportation, the increase of travel times, to even sitting next to someone over being alone in your own personal automobile. To make public transportation a feasible option for Midwesterners, planners have to make the conscious decision to locate multimodal stations (1) nearby to where people already live, (2) on the way between home and work, and (3) along large collector streets which attract the most commuters. Another consideration is what types of public transportation options will be available, and how people will access the stations. If it requires driving, then there needs to be adequate space for parking one's car, as can be seen in the growing popularity of park-and-ride stations. Bike storage should also be considered for nearby

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<sup>12</sup> Keller Easterling, *Organization Space: Landscapes, Highways, and Houses in America* (Cambridge, MA: MIT Press, 1999), 77-79.

<sup>13</sup> Easterling, *Organization Space: Landscapes, Highways*, 99.



residents and commuters, encouraging the expansion of pedestrian and bicycle routes which feed into the station.

As mentioned before, part of the inconvenience of public mass transit is the amount of time it can add to the commute. Between switching modes (from car to train/bus), transfer times and waiting for the train/bus, people could be adding ten or more minutes to their travel time. Another factor affecting the time of travel would be how the city deals with distributing the large amount of people looking to use public transportation, especially during rush hour. To keep from overcrowding, it's important to plan modes based on their capacity and frequency of operation in order to provide enough support.

The last leg of the trip, the arrival to the destination station, is perhaps the most critical in terms of getting correct. Public transportation provides the greatest value to its users if stations are spaced in a way to allow commuters to reach their final destination within a 5-15 minute walk.<sup>14</sup> Separations of stations and destination points greater than the 15 minutes make the walk much longer than people are willing to take, and add to the inconvenience of using public transportation.

At this point in the thesis exploration, it became important for me to start making decisions regarding site requirements and programmatic land uses which would not only support, but potentially enhance the flow of traffic through a site. Although identifying a transportation hub as a regional center for activity might be a little stretched at this early stage, it's important to recognize the population draws of a regional center, and its potential effects on the city. Furthermore, making the connection that regional centers (not to be confused with centers for behavioral reformation) depend on their location near heavily travelled routes, primarily interstates.

The main question is: what types of programmatic land uses are supportive of interstate highway functions? Shopping centers, convention centers and distribution centers immediately come to mind, but the list isn't limited to these. Also included in the mix for functions supportive of interstates are major office, business, and industrial employment centers, regional government institution centers and large scale recreation facilities. Due to the great numbers of people expected to visit or use the facilities, they have shared close relationships with their interstates, as the interstate has the capacity to efficiently transport these user groups more quickly, as well as the visibility along major thoroughfares to organically attract attention by passers-by.

### **Transportation between Lincoln and Omaha, Nebraska**

Nebraska's opportunity to create new modes of transportation to serve its two growing metropolitan centers is becoming more apparent with projected growths of its cities – both in terms of population and land area. Currently, there are three different types of transportation networks linking Omaha and Lincoln which attract different markets of commuters/freight transportation, U.S. Highway 6, U.S. Interstate 80, and the Burlington Northern Santa Fe railroad. Because my research showed that the greatest potential impact

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<sup>14</sup> New Jersey Transit, *Planning for Transit-Friendly Land Use: A Handbook for New Jersey Communities* (n.p.: New Jersey Transit, 1994), 5.

of transportation lies with the interstate highways, I felt that it was most important to focus on allowing these three avenues to transfer goods and people efficiently. I began by mapping out each of the individual interstate intersections along the 60 mile stretch in order to identify sites with the greatest potential for development. Though varied in their shape, capacity and land size, each was positioned in reference to how it connected to smaller towns and state highways along the way. In particular, all three modes of transportation directly link Omaha and Lincoln to Waverly, Greenwood, Ashland, and Gretna to the northwest of Interstate 80 along Highway 6 and the railroad.

After the mapping process, preliminary planning for new transportation routes – ideally featuring some form of intercity rail network began with the generation of hand-sketches exploring sectional qualities of intersections along the route. Initially, I began planning for the new route to serve both the downtown centers of Lincoln and Omaha, as well as operating along “O” Street and Dodge Street as some of the busiest stretches of road in each city. These routes attracted me primarily because of their ability to create the most potential for high frequency routes, since both downtown areas and these high capacity roads already served as a transportation backbone in its respective city – which means they already attract large numbers of commuters. Along the route, I sketched plans of the intersections, picking some of the sites to explore further in section to understand the quality of space as well as the spatial requirements of different transportation types flowing through the sites. I indicated the major existing Interstate or highway, including local distributor roads in the vicinity, as well as highlighting unused or under-utilized spaces immediately adjacent to the preliminary route I identified.

## Transportation Precedents

After collecting and analyzing the feedback from the second review, it became important to identify precedents to study both how individual cities, as well as transportation building types connect with one another. When it came to identifying cities to research for precedent studies, I wanted to break the group down into two parts: a regional scale and a global scale. At a regional scale, I selected Denver, CO, Minneapolis, MN and St. Louis, MO as examples for the integration of light rail systems into the cities. The reasons I selected each of these cities was for the initial successes of recently implemented transportation systems in each city, as well as its relationship in terms of size and demographics to Nebraska’s Lincoln and Omaha.

Internationally, identifying global cities such as Lille, France, London, England and Beijing, China for their unique and highly efficient transportation networks helped to understand how transportation doesn’t only exist within the cities, but also defines how places connect to each other. Determining factors for each of these cities selections were primarily based upon the necessity of each to provide multiple modes of public mass transportation to facilitate the movement of people and goods throughout the cities. Using this information as precedent studies helps me to understand the challenges of other systems and how city officials were able to make such transportation networks work for them.

Similar to my approach with the cities research, breaking apart the transportation building types into two categories better served my interests as the project slowly evolved to include train stations and airports. The reasons I selected these two types of transportation buildings was simple: the ability for each to connect great populations of people to other modes of transit within the city, as well as connect people to other places entirely. I identified Flintholm Station in Copenhagen, Denmark, Berlin Hauptbahnhof in Berlin, Germany, and Beijing South Station in Beijing, China as precedents in train station organization based on the types of services they offered, their connection to other forms of transportation, and scalar differences. For airport precedents, I identified Eppley Airfield in Omaha, Nebraska, John Fitzgerald Kennedy (JFK) International airport serving the New York Metropolitan Area, and Incheon International Airport in Seoul, South Korea to explore the how the range of scales affects the amounts of services available at each airport. The amount and quality of services increased with each scalar shift, and comparing the details between JFK and Incheon made it apparent how the United States is falling behind in providing transportation services.

However, the goal of the building type precedents study wasn't only to examine what services were available. Rather, I wanted to explore how their organizations of commuter circulation through the space allowed for clear connections between the various modes of transportation. In each of the cases, the effectiveness of the transportation system reaches far beyond the stations which the transportation system is serving – beginning at the starting point and ending at the final destination. What this indicated to me was that each individual transportation system didn't only depend on these specific moments where architecture is used to facilitate transportation, but also how that connection tied its way into the rest of the built environment. The only thing that connects all these specific destinations together is the organization of transportation.

## Transportation Regionalism

In this way, transportation is the one central, shared concern of governing entities within a region.<sup>15</sup> In fact, transportation is one of the only things that blur the boundaries of the city, acting as a network tying each city throughout the nation together. There are many areas in the United States which already have models for metro governments (e.g. Minneapolis/St. Paul, St. Louis/Indiana, etc.). What sets these governing bodies apart is the realization that even at the local levels, the future of the built environment is not a local scale problem, but one that requires cooperation and foresight.<sup>16</sup>

Transportation as a regional concern is connected to urban form, a key to shaping and guiding regional land use. This is important to consider when we realize that as our cities expand their boundaries with the increasing population numbers, we settle further and further beyond walkable city centers.<sup>17</sup> This requires larger roads to carry more people by car, and almost eliminates the possibility of reducing our

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<sup>15</sup> Moshe Safdie and Wendy Kohn, *The City After the Automobile: An Architect's Vision* (New York, NY: BasicBooks, 1997), 119-120.

<sup>16</sup> Safdie and Kohn, *The City After the Automobile*, 118.

<sup>17</sup> Safdie and Kohn, *The City After the Automobile*, 120.

dependence on mobility.<sup>18</sup> The big question to be answered is what will happen once there is no longer any room to expand roads, and the capacity of the roads becomes inadequate to serve its commuters? That is why now is the time to start planning our future mobility, and the answer is public mass transit.

## Planning the Two Cities

After the third review (intentionally withheld for its content relating to the site), the feedback I had gotten from the faculty of Architecture professors indicated large gaps in my logic for operating in Nebraska. For these purposes, I had made the conscious decision to take a step back to examine what made the stretch of interstate between Lincoln and Omaha a special place for my architectural intervention. For the first month after the winter break, I spent time analyzing the local and national planning predictions which applied to the growth of the respective cities and transportation capacity concerns.

### Lincoln - Nebraska

Starting with Lincoln, I found predictable growth patterns since the 1950's out from the edge of the city. Surprisingly, however, Lincoln's growth has progressed multi-directionally with strong growth to the south and east.<sup>19</sup> Thinking about these findings in retrospect, it began to make sense to me as a Lincoln resident for the last six years that this accurately is describing Lincoln's growth since large new developments have been recently constructed to handle the demand for new residential and commercial centers in these areas. What didn't make sense to me was how Lincoln seemed to be ignoring its connection to Nebraska's other large metropolitan area – a mere 60 miles away.

Something that especially stuck out in Lincoln's 2040 Plan was the identification of demographic preferences which somewhat contradicted the current growth patterns of the city. Apparently, senior citizens and Generation Y (Early 1980s-2000) desired a more urban setting within the center of the city.<sup>20</sup> There are three reasons people prefer these locations inside of the city – access to public mass transit, proximity to shopping and dining, and smaller dwellings which require less maintenance.<sup>21</sup> However, instead of catering to this large portion of the population, the city grows outward – making the availability of public transportation more difficult, as well as building larger homes occupying larger lots. Lincoln has also become recently guilty of land acquisition policies known as "leap-frogging", which means developments are purchasing cheaper agricultural land further away from the city limits in order to pressure those farmers on the periphery to sell their property.<sup>22</sup> This is urban sprawl at its finest, only it caters to Lincoln's agenda

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<sup>18</sup> Ibid.

<sup>19</sup> LPlan 2040: *Lincoln/Lancaster County 2040 Comprehensive Plan* (Lincoln, NE: Lincoln Metropolitan Planning Organization, 2011), 10.5.

<sup>20</sup> LPlan 2040: Lincoln/Lancaster County, 10.22.

<sup>21</sup> LPlan 2040: Lincoln/Lancaster County, 2.4-2.5.

<sup>22</sup> LPlan 2040: Lincoln/Lancaster County, 2.7.

for growth, taking advantage of prime agricultural land surrounding the city and still not providing to the needs of its residents.

### Omaha (Metropolitan) - Nebraska

In the same amount of time (since the 1950's), Omaha's growth patterns have understandably grown predominantly westward – due to its relationship immediately adjacent to the Missouri River.<sup>23</sup> In addition, large population surges have been apparent in neighboring Sarpy County cities including Ralston, Papillion, and Bellevue – creating a near-continuous urban condition which considerably adds to the population of the Omaha metropolitan area. Because of this, Omaha's development patterns have been dependent on the automobile – contributing to increased traffic congestion, limitations on pedestrian and public mass transportation activity.<sup>24</sup> Recognizing this as a problem, Omaha has taken steps outlined in their planning document to help mitigate some of these transportation issues. The plan says that all new development will be designed to accommodate automobile circulation – because of the city's reliance on streets to move people.<sup>25</sup> It doesn't stop there; continuing on to encourage pedestrian movement and promoting design decisions which enable the future of mass transit and alternative modes of transportation to be integrated into the development.<sup>26</sup>

### A Potential Future Crisis

Although these plans call out the most ideal situation in each respective city, the thing they fail to do is identify the some of the major issues which connects Lincoln and Omaha together through their transportation systems – primarily the interstate and railroad networks. Currently, Interstate 80 carries the highest volumes of traffic in Nebraska. More specifically, the stretch between Lincoln and Omaha carries an average of 45,000 vehicles a day according to the Nebraska Department of Roads engineers.<sup>27</sup> The Metropolitan Area Planning Agency – who is responsible for regional planning for Douglas, Sarpy and Washington counties in Nebraska, and Pottawattamie and Mills counties in Iowa; reported in 2010 that this number surges to approximately 175,000 daily commuters on Interstate 80 in Omaha.<sup>28</sup>

What these numbers don't tell you is the amount of commuters Interstate 80 carries for workers in one city who live in the other. Respectfully, Lincoln and Omaha exchange 9,000 and 8,000 employees/residents daily – which accounts for nearly 40 percent of the 45,000 vehicles travelling the stretch of Interstate 80 daily.<sup>29</sup> Even if this isn't a problem now, it's time to consider projections to vehicle miles travelled completed by the U.S. Department of Energy (DOE). According to an early 2000s study, the

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<sup>23</sup> City of Omaha Urban Planning, Mayor of Omaha, *Omaha Master Plan - Concept Element*, report no. 264 (Omaha, NE: Planning Omaha, 1999), 13.

<sup>24</sup> City of Omaha Urban Planning, Mayor of Omaha, *Omaha Master Plan - Concept*, 42.

<sup>25</sup> Ibid.

<sup>26</sup> Ibid.

<sup>27</sup> Robynn Tysver, "I-80 Project: Full Speed Ahead," Omaha World Herald (Omaha, NE), June 2, 2011, Iowa; Metro; Nebraska; Sunrise edition, News, 01A.

<sup>28</sup> Metropolitan Area Planning Agency. *2035 Long-Range*. (Omaha, NE; MAPA, 2010), 53.

<sup>29</sup> Tysver, "I-80 Project: Full Speed," News, 01A.

DOE forecasts an increase of 59% of personal automobiles on Interstates between 2005 and 2030.<sup>30</sup> That means Interstate 80's sparkling new 6-lane interstate between Lincoln and Omaha will see 71,550 up to 287,250 vehicles per day – far exceeding its current capacity, and the capability of the interstate to expand any further to meet those numbers.

Switching to freight traffic, the Federal Highway Administration in 2002 calculated the movement by highways and railroads for 2035 – approximately the same timeframe for Lincoln and Omaha's current city plans. For clarification, this data only relates to freight traffic, including semi-trucks and trains exclusively. The study projects that freight traffic via highways will nearly double by the year 2035, increasing up to 98%, and that freight traffic via railroads will grow an equally astonishing 78% during that same time.<sup>31</sup>

With up to 80 trains traversing the BNSF railroad between Lincoln and Omaha daily, it can be a challenge to schedule all these trains along the stretch, which has the capacity of a single set of tracks along most of the alignment.<sup>32</sup> Once that number jumps to 140 trains daily by 2035, even the existing rail won't be able to meet the capacity needed. It would be almost out of the question to even consider the continuation of AMTRAK services connecting Lincoln and Omaha along the California Zephyr route (which utilizes the BNSF tracks in the region), which links Chicago, Denver and San Francisco.

In short, continuing down the transportation path we are headed for leads to major transportation challenges in a state which sees some of the highest numbers of commuter and freight traffic in the country due to its centralized location in the nation. The key here is to find ways to separate these different markets of traffic, allowing each to function more efficiently as originally intended. This means that the creation of a transportation corridor which utilizes multiple modes of transportation should be the next step. However, due to the unique relationship shared between transportation and the built environment, this transportation corridor should also be developed with respect to a new type of urban form – one which embraces the separations and differences between each new transportation mode and begins to enhance land use policies along the corridor.

What if I told you such a corridor already exists in between Lincoln and Omaha? Instead of current land-area growth projections of the cities, we have the capability of developing higher quality transportation connections between Nebraska's major metropolitan areas, reducing current projections of suburban sprawl in each area, and preserving some of the nation's best agricultural land in the process.

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<sup>30</sup> Reid Ewing et al., *Growing Cooler: The Evidence on Urban Development and Climate Change* (Washington D.C.: Urban Land Institute, 2007), 13.

<sup>31</sup> Metropolitan Area Planning Agency. *2035 Long-Range*. (Omaha, NE; MAPA, 2010) 148, 151.

<sup>32</sup> Lincoln/Lancaster County Planning Department, Mobility and Transportation, *Lincoln/Lancaster County Comprehensive Plan* (Lincoln, NE: Lincoln/Lancaster County Planning Department, 2006), A54.

## Transportation Urbanism

Since interstate highways help to define the structure of most of America's cities, the biggest challenge we face moving forward is to identify opportunities along these interstate networks that can support a new corridor – inclusive of both transportation and building development objectives.<sup>33</sup> In most of the nation's large metropolitan areas, these opportunities mean significant changes to the current way we plan and build our cities to favor different travel markets which seek alternative methods to the personal automobile for mass transportation networks.

The nation's growth and the need to meet mobility, environmental and energy objectives place demands on our public transportation systems.<sup>34</sup> Most of America's transportation networks (roads, rail, bridges, etc.) are out of date, yet our dependence on these forms of transportation and the lack of appropriate funding keep these networks in active use. However, the growth of our cities suggests the need to expand service areas of our roads, increase frequency of public transportation, and improve the efficiency of these networks to serve our growing demands.

Therefore, we need to focus on mobility itself for rationalizing transportation.<sup>35</sup> The best way to do this is to focus on the best type of transportation system to satisfy the mobility desired. A transportation system that performs well allows its users to choose between multiple modes of transportation.<sup>36</sup> It's important to realize that although the personal automobile will continue to be the preferred form for transportation for the foreseeable future. As fuel prices continue to rise – alternative modes of transportation become more important to everyone. Consequently, transforming a corridor's land use to a more transit-oriented pattern encourages the building and operating of new transit lines, as well as building functional spaces which support transit. In fact, research suggests that a corridor with employment and residential development spread throughout encourages more balanced travel flows on nearby transportation systems.<sup>37</sup>

### The Three Goals

There are three goals central to the development of Transportation Urbanism: transportation should be highly valued, density should focus to small areas, and development on the edge of cities. The first and most important goal should be a restored value of efficiency of its transportation.<sup>38</sup> In many cases, this means identifying the various travel markets at play within a region/along a high-speed interurban corridor and evaluating how best to serve their desired form of mobility. Another goal of Transportation

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<sup>33</sup> Christopher E. Ferrell et al., *"Reinventing the Urban Interstate: A New Paradigm for Multimodal Corridors,"* Transit Cooperative Research Program, no. 145 (2011): 100.

<sup>34</sup> Ferrell et al., *"Reinventing the Urban Interstate,"* 6-7.

<sup>35</sup> Safdie and Kohn, *The City After the Automobile*, 135.

<sup>36</sup> Easterling, *Organization Space: Landscapes, Highways*, 77, 88.

<sup>37</sup> Ferrell et al., *"Reinventing the Urban Interstate,"* 49.

<sup>38</sup> Hank Dittmar and Gloria Ohland, eds., *The New Transit Town: Best Practices in Transit-Oriented Development* (Washington D.C.: Island Press, 2004), 46.

Urbanism should be to focus density to a small area.<sup>39</sup> Higher density developments provide more opportunities to integrate more efficient transportation networks by responding to current forms of suburban sprawl, which places pressure on city roads. The last goal of Transportation Urbanism identifies the urban "edge" or rural condition as the best place to integrate this new form of development.<sup>40</sup> Similar to creating density, developing on the edge of the city makes sense for many reasons – including its capability to directly respond to suburban sprawl, as well as the potential to maximize under-utilized or unused land. Furthermore, developing on the edge of the city maximizes the infrastructure's ability to serve the greatest number of people along its path while also creating a new development pattern for the growth of the city.

### A Multimodal Corridor - Defined

The first thing to identify is what constitutes a multimodal corridor. A multimodal corridor creates a mass transit system that runs parallel to the interstate networks so that it can then be paired in the median of, immediately adjacent to, or offset from the interstate.<sup>41</sup> Mass transit modes which meet the criteria include high capacity, fixed route modes such as heavy rail, light rail (LRT) and bus rapid transit (BRT) because they encourage concentrated station land use and distributed nodes along a route.<sup>42</sup> One of the benefits of placing mass transit and interstate networks parallel to each other is the increased cooperation in the planning, design and operation of these facilities results in the two systems complementing each other.<sup>43</sup> Multimodal corridors also provide additional and redundant transportation capacity, which provides long-term travel growth and offers users a choice between multiple transportation modes.<sup>44</sup>

To be able to successfully convert an automobile-dominated interstate system into a transit-oriented multimodal corridor requires a minimum of two steps. The first step requires the construction of new transit supported facilities.<sup>45</sup> These facilities (stations) for the preferred mode would be based on mobility requirements and built within the interstate corridor (in-median, adjacent to, offset from the interstate). In order to compete with the interstate for travel times, the transit facilities would need to be developed with long distances in-between stops to attract sufficient ridership numbers in the beginning.<sup>46</sup> Additionally, in order to draw commuters away from the interstates and onto the transit system, stations should prioritize access by automobiles and buses, which will require certain design aspects to allow for an easy transfer between modes.<sup>47</sup> First and foremost, automobile oriented corridors require stations to be located near the interstate interchange ramps to encourage interstate to transit transfers as well as provide parking for commuters desiring to transfer from the interstate to transit.<sup>48</sup> When allotting space for parking,

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<sup>39</sup> Dittmar and Ohland, *The New Transit Town*, 116.

<sup>40</sup> Safdie and Kohn, *The City After the Automobile*, 27.

<sup>41</sup> Ferrell et al., "Reinventing the Urban Interstate," 12.

<sup>42</sup> Ferrell et al., "Reinventing the Urban Interstate," 6-7.

<sup>43</sup> Ferrell et al., "Reinventing the Urban Interstate," 11.

<sup>44</sup> Ferrell et al., "Reinventing the Urban Interstate," 12-13.

<sup>45</sup> Ferrell et al., "Reinventing the Urban Interstate," 16.

<sup>46</sup> Jonathan Levine et al., "Does Accessibility Require Density or Speed?," *Journal of the American Planning Association* 78, no. 2 (2012): 158.

<sup>47</sup> Ferrell et al., "Reinventing the Urban Interstate," 14.

<sup>48</sup> Ibid.



the number of commuters on the roads, local employees, and other land uses of the site which require significant parking capacity should be considered.<sup>49</sup> Among other features, there should also be bus bays for quick transfers to rail transit, and drop-off/pick-up areas near station entrances to ease the intermodal transfer process for commuters.

Once drawing enough commuters from the existing interstate, the second step involves the construction of infill stations which will be able to provide greater accessibility for the transit riders to new corridor land uses.<sup>50</sup> This has the potential to encourage further development as well as the creation of new transit connections. For this process, it's important to distinguish between local stations and multimodal transfer stations – which depend on the types of development created by the new transit systems. Local access stations should be designed to accommodate commuters from the local neighborhoods surrounding the stations.<sup>51</sup> The amount of services for these stations might be limited to one or two alternative transportation modes, but will feed into the other modes of transportation at multimodal stations oriented to the interstate. By primarily serving the interstate traffic, multimodal stations attract automobile and bus commuters, some of which will have travelled greater distances to reach the stations to make a transfer to mass transit.<sup>52</sup> These multimodal stations will have greater numbers of alternative transportation modes compared to the local access station in order to meet capacity expectations, as well as serve greater numbers of preferred transportation markets depending on the type of mobility desired.

The most important thing to keep in mind during the development of Transportation Urbanism sites is how the transportation system and the built environment relate to each other. A high level of accessibility from the transportation system provides a critical mass of demand for particular activities/land uses – primarily distribution centers, shopping centers, and employment/residential centers. In the same way, these high density areas provided by the built environment will influence the development of a higher capacity within the transportation networks – leading to the development of multiple modes of transportation which serve these high density developments.

## The Existing Corridor

For Nebraska's major metropolitan areas – Lincoln and Omaha, establishing the corridor is already complete, as U.S. Highway 6, Interstate 80 and the BNSF railroad all operate within one half mile of each other. As stated in previous research, these three modes of transportation already provide critical linkages between Lincoln and Omaha, if not throughout the entire nation. However, research provided earlier signifies a sign of the times to come – representative of a flood of taillights lining Interstate 80, filling up Highway 6 way beyond capacity, and creating an embarrassing situation for BNSF and Union Pacific

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<sup>49</sup> Ibid.

<sup>50</sup> Ferrell et al., *"Reinventing the Urban Interstate,"* 16.

<sup>51</sup> Ferrell et al., *"Reinventing the Urban Interstate,"* 39-40.

<sup>52</sup> Ibid.

regarding over-capacity of the existing tracks, both of whom have national headquarters located in Nebraska.

This is where Transportation Urbanism comes in – recognizing the potential for development along each of these modes of transportation and creating stronger connections between Lincoln and Omaha. One way to accomplish this is by identifying the different travel markets and allowing them to operate independently in a way which best serves each type of mobility desired. Now is the time to ask the big “what if” questions such as what if we had public mass transit that was both cost effective and more efficient to use than our current automobile-centered method of transportation?

What if we constructed a dedicated light rail network which could be used to transport the large number of commuters between Lincoln and Omaha, thus eliminating that extra capacity we expect the Interstate to carry?

What if Lincoln and Omaha began to redefine themselves as cities by changing their development patterns in favor of a linear urbanism focusing around Interstate 80 featuring higher density, more accessible land uses, thus preserving our rich history and identity as an agricultural state?

## EXIT 432: Nebraska Crossing

The site I've selected for my thesis investigation is at Interstate 80 Exit 432, not only for its centralized location relative to Lincoln and Omaha, but for many other reasons as well. One of the biggest reasons why this interstate interchange was chosen over the other six between the two cities is the recent redevelopment of the regional Nebraska Crossing outlets mall adjacent to the site. In addition to that, the site occupies land which both Gretna planning boards as well as the Metropolitan Area Planning Agency (MAPA) recognized the potential for development at the site in their long term planning documents.<sup>53</sup> Lastly, the site occupies a section of land where Interstate 80, U.S. Highway 6, and BNSF tracks – three routes which directly connect Lincoln and Omaha, operate within a half mile of each other.

This site offered a unique opportunity for transportation to influence the future development between Lincoln and Omaha. Between each of the three existing transportation routes at the site, each one was developed to serve different markets. The interstate operates as Nebraska's long-distance, high-speed connection between Lincoln and Omaha, catering not only to traffic generated in-state, but also serving national trucking markets. Highway 6, an alternate route running parallel to Interstate 80, serves a much different crowd – travelling through small local towns such as Waverly, Greenwood, Ashland and Gretna on its way from Lincoln to Omaha. Although this offers a travel time disadvantage to the interstate, Highway 6 still attracts a lot of traffic daily.

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<sup>53</sup> Metropolitan Area Planning Agency. *2035 Long-Range*. (Omaha, NE; MAPA, 2010) 6-22.

The wider target zone of the newly redeveloped Nebraska Crossing outlets mall expands the market potential of the site, ensuring the increasing need for more efficient transportation networks through the site. In March of 2012, demolition began on the worn mall, constructed in 1991, in favor of a more consumer friendly layout.<sup>54</sup> This project features 350,000 square feet of new construction worth \$112 million dollars, and establishes the site as a regional center – attracting shoppers from Sioux Falls, SD to Kansas City, MO, and North Platte, NE to Iowa City, IA (a range of approximately 2.5 hours by car).<sup>55</sup> This also means that the new Nebraska Crossing development is expected to serve the community well into the future. As such, this is a significant planning opportunity to design our growing cities in conjunction with our growing need for transportation.

The initial success of the Nebraska Crossing outlets is difficult to deny. Typically, we would expect to see high numbers in the first several months of a new outlets mall, and Nebraska Crossing is no exception. With thousands of visitors within the first weekend of opening, there were numerous successes to be shared for the new project, but there were also problems which began to surface – all which revolved around the transportation infrastructure. The limited availability of parking and access into the site left long queuing lines of traffic backed up onto the highways. This forced people to get creative about parking, going anywhere they could – including along the shoulders of Highways 31 and 6.<sup>56</sup> Although numbers dropped a little after the first few months, the outlets mall is still drawing large crowds. Retail sales by mid-March were still 300-400% above initial goals, and the developers wanted to capitalize on this success by planning an additional 100,000 square feet of retail space expected to be completed in 2015.<sup>57</sup> However, these plans don't solve the problems; they only address the successes of the project.

## Integrating Transportation Urbanism

Instead of thinking about the future of the site and the sustainability of these types of development (most notably witnessed in the sprawling development along Highway 81 outside of nearby York, NE), we look to taking over productive farmland with large paved parking lots and newly designed retail space. The time is here to address the real issues at hand, and begin planning this site incrementally in phases to address the growing popularity of the site, which includes how people get here. As it situates itself along Interstate 80, an already popular route for commuters/workers travelling between Lincoln and Omaha, there is huge potential in forming mass transit lines which not only serve Nebraska Crossing outlets, but also the downtown entertainment and business centers of Nebraska's largest cities.

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<sup>54</sup> Kathryn Cates Moore, *"New Nebraska Crossing Outlet Mall Exceeding Expectations,"* Lincoln Journal Star (Lincoln, NE), February 15, 2014, Directions. [http://journalstar.com/special-section/new-directions/new-nebraska-crossing-outlet-mall-exceeding-expectations/article\\_8a90b7cb-4b3b-56c0-8c4f-ff7532e68293.html](http://journalstar.com/special-section/new-directions/new-nebraska-crossing-outlet-mall-exceeding-expectations/article_8a90b7cb-4b3b-56c0-8c4f-ff7532e68293.html).

<sup>55</sup> Moore, *"New Nebraska Crossing Outlet,"* Directions.

<sup>56</sup> Janice Podsada, *"Parking Issues Aside, Nebraska Crossing Outlets a Hit on Opening Day,"* Omaha World Herald (Omaha, NE), November 15, 2013, Money, [http://www.omaha.com/money/parking-issues-aside-nebraska-crossing-outlets-a-hit-on-opening/article\\_cdec85f-e9c1-56ea-8148-4cab0a8faeae.html](http://www.omaha.com/money/parking-issues-aside-nebraska-crossing-outlets-a-hit-on-opening/article_cdec85f-e9c1-56ea-8148-4cab0a8faeae.html).

<sup>57</sup> Moore, *"New Nebraska Crossing Outlet,"* Directions.

## Phase One

In the first phase of development, we look to the north-eastern quadrant of Exit 432 along Interstate 80, which is where Nebraska Crossing outlets mall is located. Due to current plans for expansion to the retail outlets, phase one looks to combat current problems at the site, as well as address the plans for expansion. By taking an “urban infill” method of development, which looks to relocate parking and construct the new 100,000 square feet of proposed retail space, we are able to directly confront the pre-prescribed methods of sprawling development patterns.

Solving the parking issues at the site is the most important part of this phase. By addressing this problem early on, numerous opportunities begin to present themselves for the future of the site. The biggest problem with the parking on the site now is that there isn't enough of it, and replacing viable agricultural fields with paved parking isn't a solution either. Instead, I saw potential in the topography of the site for relocating parking. The site was excavated nearly 30 feet along Highway 31 (the State Highway which crosses over Interstate 80 at the site) for the construction of the original 1991 outlets mall, providing ample space for parking structures directly beneath the highway. This allows for the site to begin expanding its program to include other services which might appeal to commuters at the site. The best part about locating parking beneath the highway not in how it can solve parking issues for the outlets mall, but how it can begin to serve parking for future developments at the adjacent site on the northwest side of Highway 31.

Creating density here at the site by placing the new 100,000 square foot construction immediately adjacent to the existing retail buildings maintains the developers' goals of a more pedestrian friendly shopping environment. Additionally, it opens the site up to include programmatic elements missing from a place looking to draw people in from longer distances – a hotel, dining options and mass transit bus stops. The reasons for choosing these programs are simple, they are necessary for attracting people to the site and each of these programs coordinate well with retail destinations, as well as serve commuters better along Interstate 80.

It's also a perfect opportunity in this phase to get a feel for the local interest in mass transit options along Interstate 80 or alternate routes such as Highway 6. Introducing long distance, high capacity bus routes serviced by Lincoln's StarTran and/or Omaha's Metro would be a great opportunity to begin shaping the corridor for transportation-oriented development. The reason why a regional bus route would be the best option at this early phase is because it doesn't require pricy investments on the front end to install tracks, etc., and also allows flexibility to changes in the route at a future date.

## Phase Two

In the second phase of development, focus shifts from the Crossing outlets to the site directly across Highway 31 to the west. Currently, this land is used as agriculture fields; however, the topography on the site is mostly difficult for farming purposes – requiring a terracing approach to grow crops. Like the Nebraska Crossing outlets mall, this site benefits from its adjacency to Interstate 80 and Highway 6 as major transportation routes to/through the area. The main goals of this phase include capitalizing on the

location between Lincoln and Omaha to set up satellite offices and a light rail service to the business and entertainment centers of the two cities.

In this phase, the construction of light rail tracks will be critical for the goals of Transportation Urbanism. This new mode of transportation would need to be elevated in order to address the dangerous conditions of the speeds of operation (which ensure that wildlife/automobiles don't end up on the tracks), and deal with the difficult topography, especially east of the Platte River. Utilizing the parking structures constructed as part of phase one, the integration of the light rail allows the site to serve as a park-and-ride station for commuters – midway between Lincoln and Omaha. This allows people options between automobile, bus and light rail as they travel by giving them space to park their cars at the site and switch modes of transportation easily.

The addition will be able to serve the projected need of 31,500 commuters travelling along the Interstate by 2040, eliminating a portion of the daily commuter traffic on the route. However, the simple fact that travelling by mass transit will reduce the cost of transportation and the harmful emissions over the personal automobile would seem to interest people, but it won't draw people away from the independence offered by cars. For those who choose this method for transportation, the trains offer many benefits – such as more even distribution of peak loads by the nature of the train operating schedule. This is because time spent on the train doesn't require the concentration that driving does, allowing commuters the ability for additional time for productivity or leisure on the way to their destinations.

With the light rail, it is important to establish a center for business operations at the site, not only to alleviate the strain on the central business districts of each city to develop enough square footage to accommodate the increase in worker numbers, but also reduce the amount of time workers would need to spend on their commute to/from work. The incorporation of office space at the site would be able to help with both of these factors, in addition to helping further distribute the peak loads on each of the modes of transportation by reducing the time needed for commuting (since the commute would only require half the distance compared to driving all the way between each city).

The design of the offices would need to tie in directly with the light rail, potentially connecting the need for a multimodal transit station with that of a destination. By stacking programmatic elements, the development can begin to establish higher levels of density at the site. This helps to eliminate the need for additional infrastructure to be developed (roads, water/electrical lines, etc.), and creates more efficient circulation patterns by containing activity within a series of interconnected buildings. These interconnected buildings would need to emphasize four design criteria for success: platform continuity between the buildings for the light rail, the enclosure of space for the multimodal transportation hub, the creation of public space by overlapping programmatic elements, and providing physical linkages between buildings for ease of circulation.

### **Phase Three**

In the third phase of development, the growth of the site to include satellite offices and a transportation hub justifies the need for the site to support permanent residence structures. To counter

traditional suburban growth, it's important to maintain high density land use methods by coupling the addition of residential units and an alternate light rail connection between Lincoln and Omaha along Highway 6. These two programmatic features will begin to embrace the growing populations of the surrounding metropolitan areas and respond to their needs for transportation.

The residential units, like the office buildings in phase two, will be stacked programmatically on top of both existing parking structures from phase one, as well as additional retail space which will be necessary at the site to accommodate for its growth. This means that a sophisticated effort will need to be made in order to facilitate the vertical circulation and separation of public and private spaces. These residential buildings should also take organizational cues from the office buildings, offering physical connections between each other as well as create interior space through public courtyards at the retail level – connecting directly to the multimodal transportation hub and offices.

In addition, the incorporation of a second light rail connection between Lincoln and Omaha along Highway 6 will help to define the transportation corridor being created. Unlike the light rail route adjacent to Interstate 80, this route offset from the interstate along the highway will not provide time travel benefits over the Interstate. Instead, the purpose of this installation would be for better service to the smaller communities located along Highway 6, Gretna, Ashland, Greenwood, and Waverly. This way, transportation would be able to preserve rural Nebraska communities and act as a catalyst for future development in smaller established towns. In addition, the light rail route would continue along the stretches of Highway 6 which flow into Lincoln and Omaha – continuing to serve Nebraska's metropolitan areas via frequently travelled corridors such as Dodge Street (Omaha) and potentially switching over from Cornhusker Highway to "O" Street in Lincoln.

## **Phase Four**

In the fourth phase of development, much further into the future, projected increases in population of Lincoln and Omaha could seriously threaten the agricultural landscape of Eastern Nebraska. However, due to proper attention from years earlier, a new form of urbanism has arose – effectively restraining unsustainable suburban sprawl and replacing it with high density development along the transportation corridor. The influx of people into the site for work or shopping has created the critical mass for developing residential blocks aimed to provide housing and amenities to more people. The creation of these residential blocks will take on a form not yet common for people living outside the city center – one which limits the need for automobiles for mobility. Instead, access to a developed network of mass transit options allows these users to travel between Lincoln and Omaha easily, connecting them to both business and entertainment centers – as well as other popular destinations in both cities.

However, the size and density at Exit 432 allows them to live in a location without the need to travel into the city frequently like before. Instead, people living/working/shopping here at the site require a different type of accessibility which will be provided through pedestrian circulation paths linking the programmatic areas of the site together with limited interaction with the vehicles in the streets. Instead, the residential buildings should be developed in a way which creates interior community spaces within the

block, each connected to a larger pedestrian pathway. Additionally, the site offers direct visual access towards the Platte River valley, and the buildings should stagger in height to preserve the view of the river and natural surroundings.

## **Generation Potential**

Of the many things that are important to securing the future of our cities aside from creating a new development which enhances transportation, taking our food and energy resources into consideration could be among the most important. It's important to note that the availability of these two types of resources are becoming more and more threatened due to global climate change. As our situation progresses, cities need to become more self-sufficient instead of continuing to rely on energy and food resources coming from a distance.

## **Agricultural Production**

The biggest challenge to the future of agricultural production in Sarpy county, aside from climate shifts, would be the growth of the cities along the north-eastern edge – which have recently been taking a leap-frog approach to land acquisition. In addition, the terrain gets increasingly more difficult as you approach the bluffs, characteristic of the Omaha/Council Bluffs metropolitan areas. The site at Exit 432 serves as the edge between the Platte River valley to the west and the hilly terrain to the east. Being so far away from major cities, the site has been mostly preserved for agricultural use – regularly producing corn/wheat/soybeans along with the rest of the county. Although the site will mostly retain its agricultural production, future growth projections of Gretna extend out beyond Interstate 80, completely enveloping the site.

However, creating density provided by transportation urbanism at the periphery targets land which has the greatest potential for agricultural production. Constraining development patterns to more intelligent transit-oriented forms along existing corridors ensures that farmland will not be wastefully expended outside the city. Furthermore, cities can begin to designate requirements for urban Greenspaces in these new developments – focusing on the need for agricultural growing space and recreational areas to break up the built fabric. By developing food production closer to urban centers, we reduce the distance required for transportation, which improves freshness and begins to support the local agricultural economy.

The future of the site adjacent to Interstate 80, especially at Exit 432, needs to consider its rich agricultural history in order to preserve its future. The pattern of development dictated in the four phases is critical to the future of development along the rest of the I-80 corridor. For this reason, my solution considered not only the agricultural potential of the site, but also the difficult topographical features of the sensitive environment near the Platte River. By promoting a more dense development nearby the interstate intersection and existing Nebraska Crossing Outlets mall, the solution utilizes the most accessible

areas of the site. By doing this, the development also indirectly addresses its role in the environment by preserving agricultural farmland to the west – as you approach the Platte River Valley.

## Energy Production

According studies done by the Nebraska Energy Office and the Natural Resource Defense Council, Nebraska has other valuable resources compared to those of other states in the Union: solar and wind energy. Respectively, Nebraska ranks 13<sup>th</sup> and 4<sup>th</sup> in the nation for solar and wind energy potential.<sup>58</sup> However, the state has yet to capitalize on these resources for a more traditional approach to energy production through coal and natural gas.<sup>59</sup> The use of coal and natural gas are finite natural resources, and contribute to CO2 emissions – meaning we need to figure out alternative methods which are more sound for the environment. These reasons to start altering our energy generation and use patterns now could impact the state's economy and development trends.

Throughout the country, energy consumption is shared between three sectors: buildings (commercial and residential), industry and transportation.<sup>60</sup> Two of the three sectors are directly addressed in the goals of Transportation Urbanism at Exit 432. By building more densely and creating potential for alternative modes of transportation, we can begin to have significant effects to the amount of energy we consume. Dense developments – especially ones nearby generating sources do not require great transmission distances which ultimately result in the loss of energy. Likewise, alternative modes of transportation help to secure the safety and reliability of our energy resources through the creation of mass transit.

In this way, any development in Nebraska – especially at Exit 432 should begin developing its land in a way which capitalizes on the potential for renewable energy generation for a couple reasons. The ability for buildings to power themselves becomes even more important when we begin to consider the significant threat natural disasters in the Midwest pose to energy transmission lines. By creating developments which generate all or a portion of their own energy through the installation of solar photovoltaic panels and wind turbines, we could potentially power not only these new buildings, but also provide an infrastructure for transporting energy back into the city grid. In addition, utilizing the expanse of land we have preserved through a more dense development in less agriculturally prime land lends itself well to large generation fields for wind turbines and solar panels.

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<sup>58</sup> "Renewable Energy for America: Harvesting the Benefits of Homegrown, Renewable Energy," Natural Resources Defense Council, last modified 2011, <http://www.nrdc.org/energy/renewables/nebraska.asp>.

<sup>59</sup> State of Nebraska Nebraska Energy Office, 2011 Nebraska Energy Plan (Lincoln, NE: n.p., 2011), 10.

<sup>60</sup> "AEO2014 Early Release Overview," U.S. Energy Information Administration, last modified December 16, 2013, "Renewable Energy for America: Harvesting the Benefits of Homegrown, Renewable Energy," Natural Resources Defense Council, last modified 2011, <http://www.nrdc.org/energy/renewables/nebraska.asp>.



## Conclusion

The goals of my thesis exploration were 1. to propose a new transit-supportive development, 2. located in unused or underutilized land near transportation, 3. consider the potential of transit integration, and 4. should look to incorporate renewable resources. After considering the history of American transportation innovation, I recognized how important a role the Interstate Highway System plays not only on transportation, but also in the ways it has shaped our cities. The State of Nebraska isn't excluded from this, however, with the potential to redefine the relationship between its two largest cities – Lincoln and Omaha.

The next phase was to identify cities, networks, and individual instances of architecture which embrace positive qualities of transportation and evaluate them as precedent studies. This helped to understand how people move through them, and what the transportation options were that began to define the structure of the city. I then moved back to Nebraska, getting familiar with the future city projections as outlined in Lincoln's and Omaha's planning documents – paying particular attention to the growth of the cities and their transportation plans. However, there were serious holes in the logic of the two sets of plans – potentially creating a future crisis for transportation efficiency.

Tying all this research together, I had begun to identify a new type of urbanism – **Transportation Urbanism**. The major goals of transportation urbanism are 1. to create high value for transportation, 2. focus density to a small area, and 3. locate itself at the periphery of the city - where it has the greatest impact for future development. One of the most important components to transportation urbanism is to identify a transportation corridor which is supportive of the future integration of multimodal transportation options. The exciting news for the future of Lincoln's and Omaha's development patterns, they have a close enough relationship to create intercity mass transit networks – and the transportation corridor to integrate these networks already exists.

The high success of the new Nebraska Crossing Outlets Mall located along Interstate 80 at Exit 432: Gretna/HWY 6 has a lot to do with its prime location between Lincoln and Omaha metropolitan areas. Not only that, but Nebraska's key connection to national transportation networks makes this one of the most important routes in the region – having the capability to serve a much wider target zone that includes areas of western Nebraska, Iowa, South Dakota, Kansas and Missouri. With this breadth of impact, there is a very high potential to integrate the principles of Transportation Urbanism into the site.

The integration of phases into the development plan helps to intelligently convert an automobile-oriented corridor into an transit-oriented corridor overtime – ensuring that it continues to serve the future of the site. The future development includes plans to address the current problems of parking and wasteful expansion to promote higher density development around the outlets mall. As the program expands, the importance for developing office and residential buildings help to build Exit 432 into a destination center. With that in mind, it's important to continually incorporate mass-transit routes into the development.

Lastly, Transportation Urbanism has the ability to change the way we think about renewable resource production. The importance of energy and food production on the site helps to ensure the

sustainability of our cities by considering the future needs. The reasons energy and food are also very important is the rising cost of energy, using non-renewable resources, and the harmful gases emitted from conventional energy generation plants contributed to the global climate change. In addition, the ability of our cities to produce their own food will be important especially if we consider the population growth.

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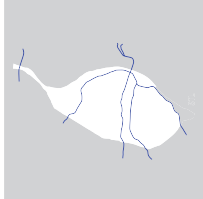
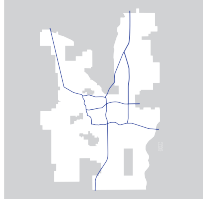
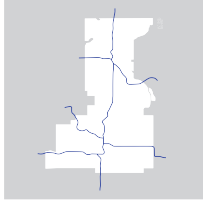
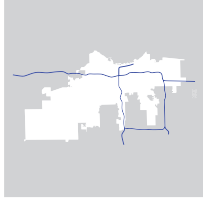
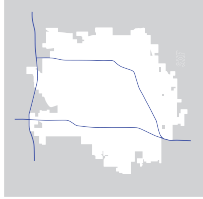
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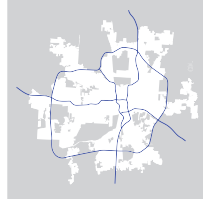
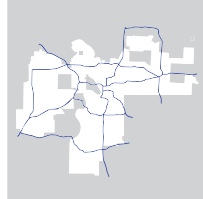
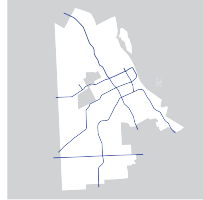
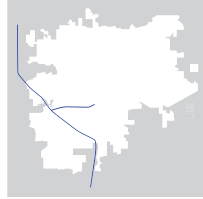
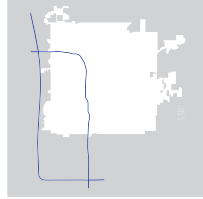
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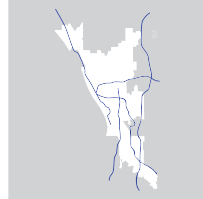
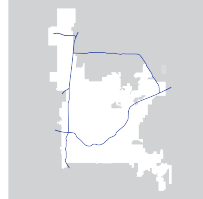
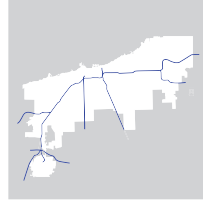
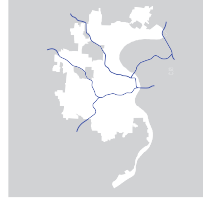
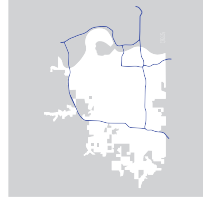
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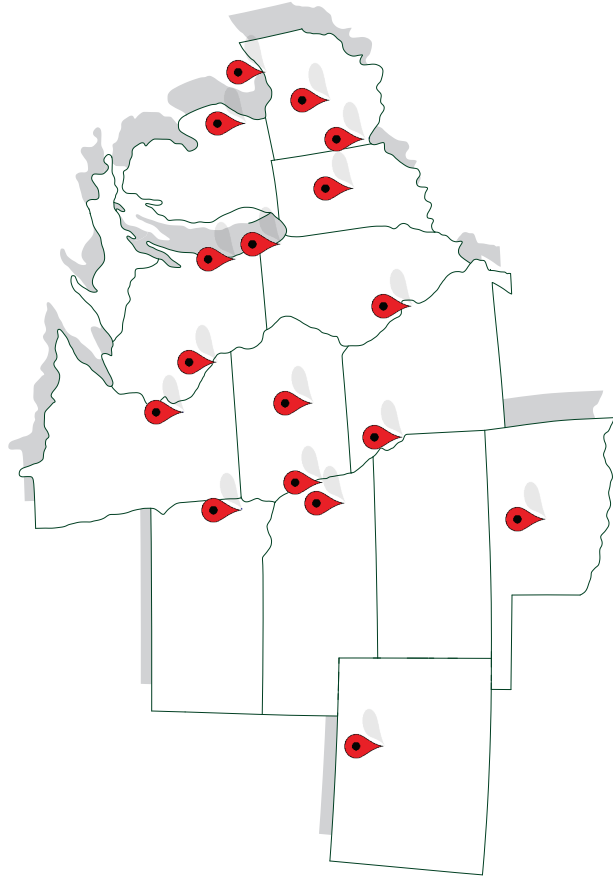


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DEN 70 25 225 270

CHI 90 94 55 57 294 290 190

CIN 75 74 71 471 275



**MINNEAPOLIS /ST. PAUL**  
MINNESOTA  
POPULATION: 3.28 million  
LAND AREA: 114.58 sq miles

**OKLAHOMA CITY**  
MINNESOTA  
POPULATION: 993,999  
LAND AREA: 63 sq miles

**ST. LOUIS**  
MISSOURI  
POPULATION: 2,181,772  
LAND AREA: 167.2 sq miles

**COLUMBUS**  
OHIO  
POPULATION: 609,704  
LAND AREA: 223.19 miles

**DES MOINES**  
IOWA  
POPULATION: 204,468  
LAND AREA: 82.6 sq miles

**KANSAS CITY**  
KANSAS/MISSOURI  
POPULATION: 411,974  
LAND AREA: 447.4 sq miles

**CHICAGO**  
ILLINOIS  
POPULATION: 2.76 million  
LAND AREA: 234 sq miles

**CINCINNATI**  
OHIO  
POPULATION: 294,550  
LAND AREA: 79.34 sq miles

**OMAHA**  
NEBRASKA  
POPULATION: 451,670  
LAND AREA: 132.3 sq miles

**LINCOLN**  
NEBRASKA  
POPULATION: 263,424  
LAND AREA: 93.34 sq miles

**DENVER**  
COLORADO  
POPULATION: 654,235  
LAND AREA: 154.9 sq miles

**SIOUX FALLS**  
SOUTH DAKOTA  
POPULATION: 159,908  
LAND AREA: 73.47 sq miles

**MILWAUKEE**  
WISCONSIN  
POPULATION: 598,916  
LAND AREA: 160.3 sq miles

**CLEVELAND**  
OHIO  
POPULATION: 392,928  
LAND AREA: 82.47 sq miles

**DETROIT**  
MICHIGAN  
POPULATION: 719,475  
LAND AREA: 142.9 sq miles

## BUSES



Bus services use buses on conventional roads to carrying numerous passengers on shorter journeys.

CHI STL DEN  
KC OKC LNK  
OMA DSM



## REGIONAL NETWORKS

Transportation services with regional connections.

CHI STL DEN  
KC OKC LNK  
OMA DSM



## INT'L AIRPORT

Air travel occurs at high speeds, and is often only feasible over longer distances.

CHI STL DEN  
KC DSM

## LIGHT RAIL



Higher capacity than buses, but must follow dedicated rails and wires, limiting their flexibility.

DEN KC OKC



## HEAVY RAIL

Allow high capacity on short or long distance, but require track, signaling, and stations to be built.

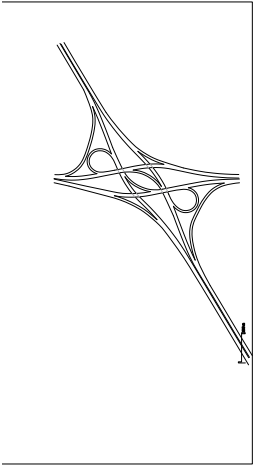
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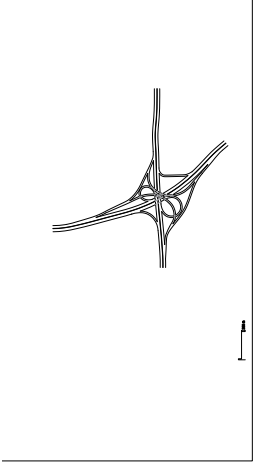
## FERRY BOATS

A ferry is a boat used to carry passengers, and sometimes their vehicles, across a body of water.

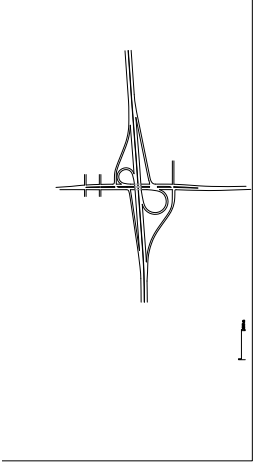
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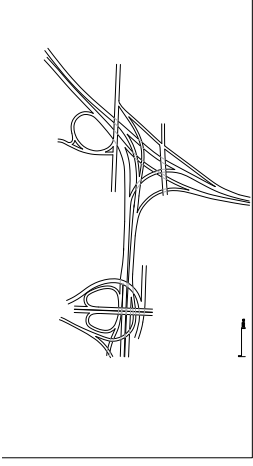
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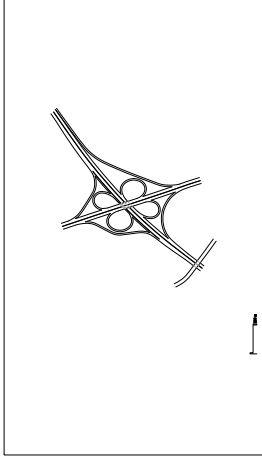
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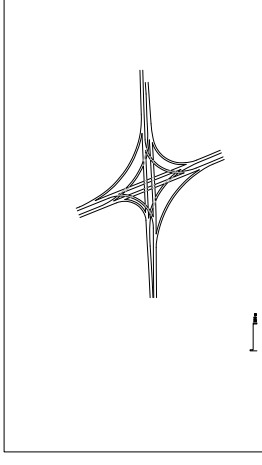
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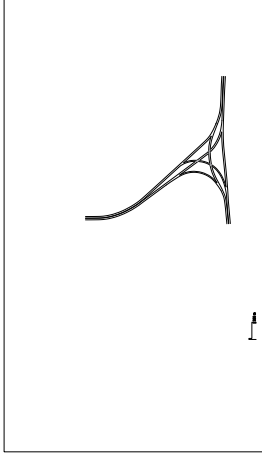
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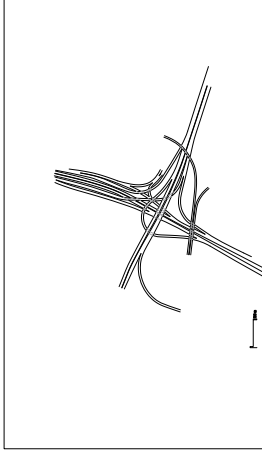
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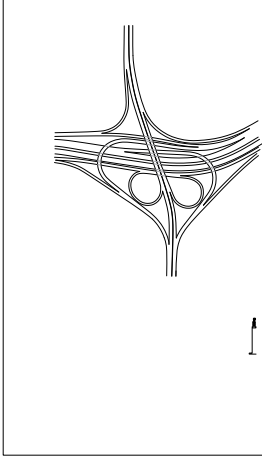
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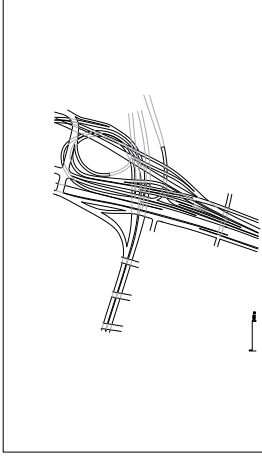
OMA  
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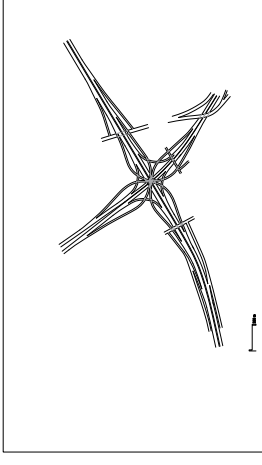
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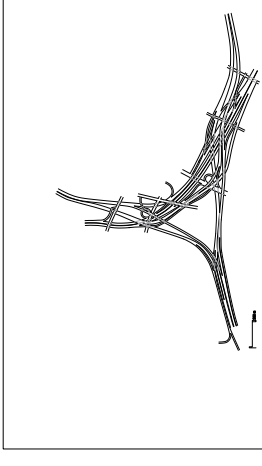
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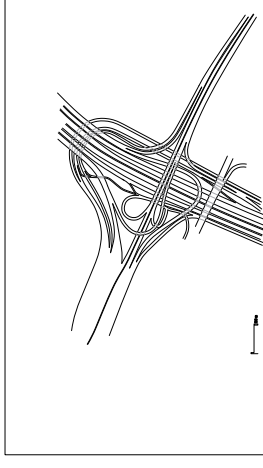
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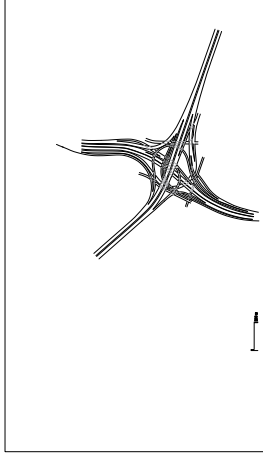
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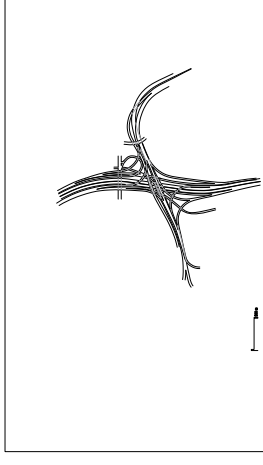
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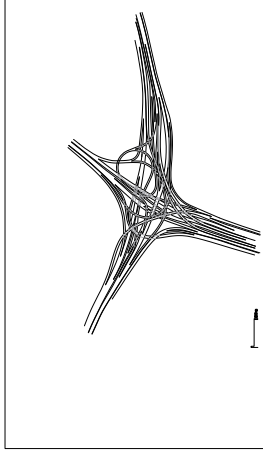
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SFO  
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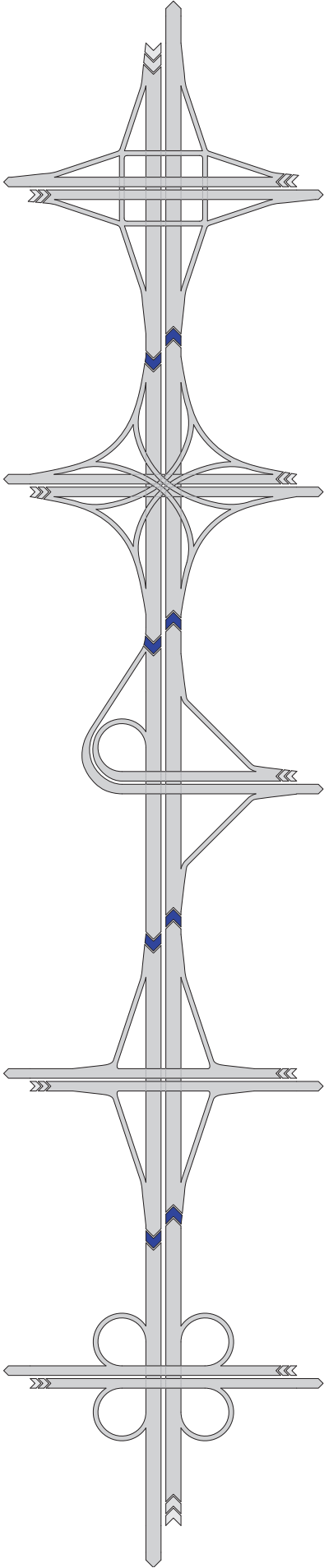


SEA  
POPULATION 620,700  
5 90



WDC  
POPULATION 632,300  
95 495 395

# INTERSTATE INTERSECTION TYPOLOGY MAP



**01** CLOVERLEAF INTERCHANGE

The classic cloverleaf allows "non-stop" full access between two busy roads. Traffic merges and weaves, but does not cross at-grade, unless the interchange is too congested, no stopping is required.

Typically a cloverleaf is used where a freeway intersects a busy surface street, though many older freeway-freeway interchanges are also cloverleafs.

**02** DIAMOND INTERCHANGE

The basic diamond is often the design of choice for lower-traffic interchanges without special constraints. It does not scale up well to heavy traffic on the surface street or ramps. Traffic signals can be installed at the two points where the ramps meet the surface street, but high enough traffic volumes can cause backups on the street and the ramps. All ramps function to connect the freeway to the surface street, as well as transition traffic from low speeds, or a dead stop, to freeway speeds.

**03** TRUMPET INTERCHANGE

This is a conceptually simple way to end one freeway at another. Like a cloverleaf, it requires only one or two bridges, and designing for higher speed will take up more land.

Often an interchange involving a toll freeway to another freeway will be a double trumpet, with all connecting traffic stopping at a toll station between the trumpets. Sometimes more roads join in.

**04** STACK INTERCHANGE

Each road has a direct connection to the other roadways, with no looping or weaving, and the ramps can see for about a mile. If the ramps are two lanes wide, the interchange has quite high capacity and drivers with good tires probably won't even have to slow down. What's more, they're easy to navigate.

The disadvantages may include geometry, materials cost, and local opposition. To raise a ramp 60 feet or more requires a lot of concrete, or fill, or both.

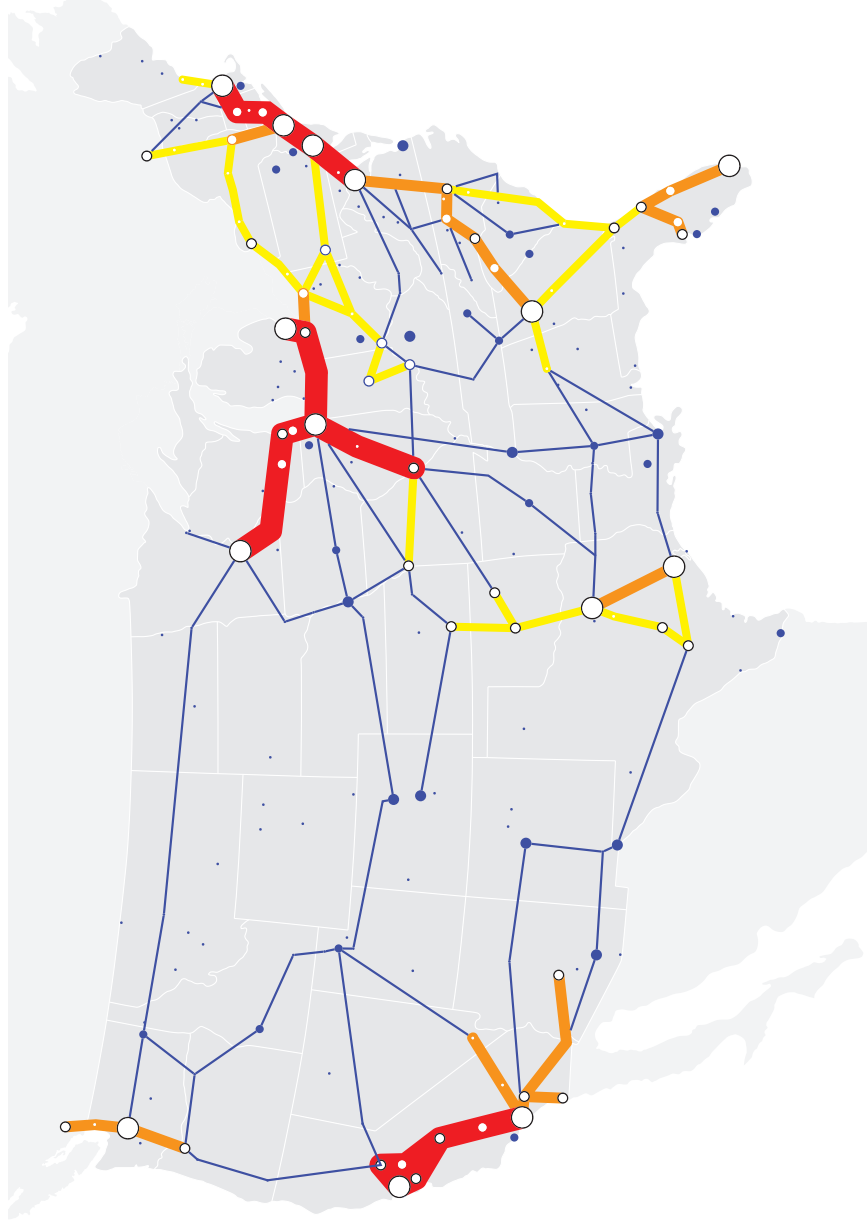
**05** VOLLEYBALL INTERCHANGE

All turning motions are handled in an intermediate square structure connecting the eight ramps. Turning traffic travels around the square in the same direction as a roundabout in that country. Through traffic can proceed on either intersecting road without stopping.

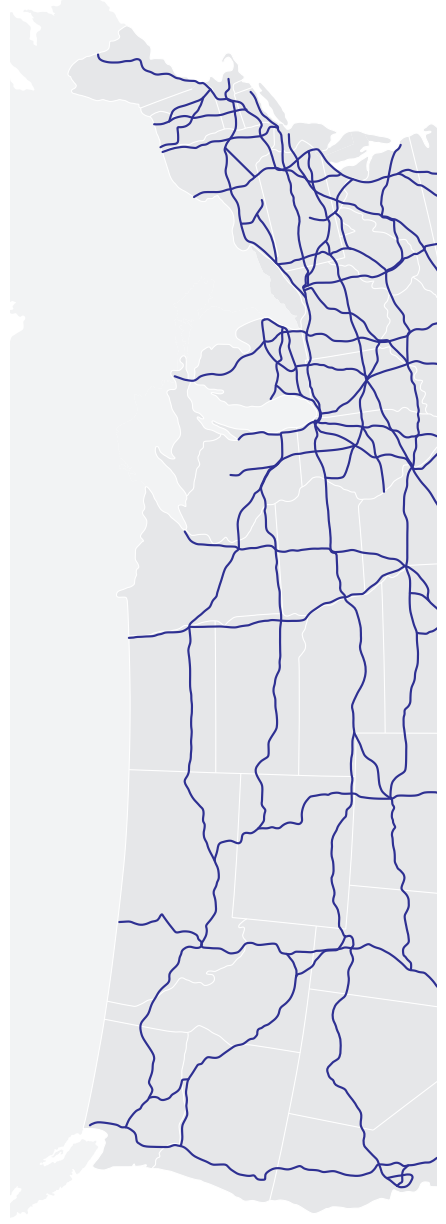
The volleyball's disadvantages include a large number of bridges and low capacity compared to more directional interchanges.

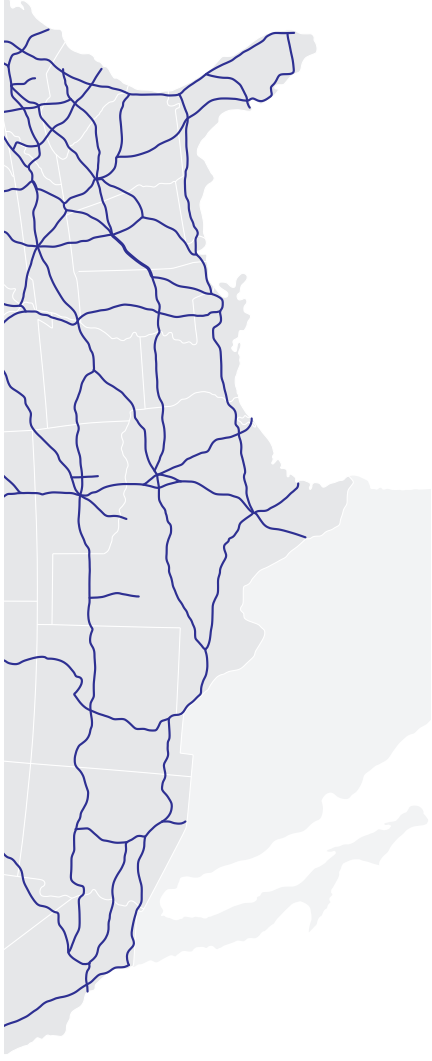


HIGH SPEED RAIL PROPOSED NETWORK

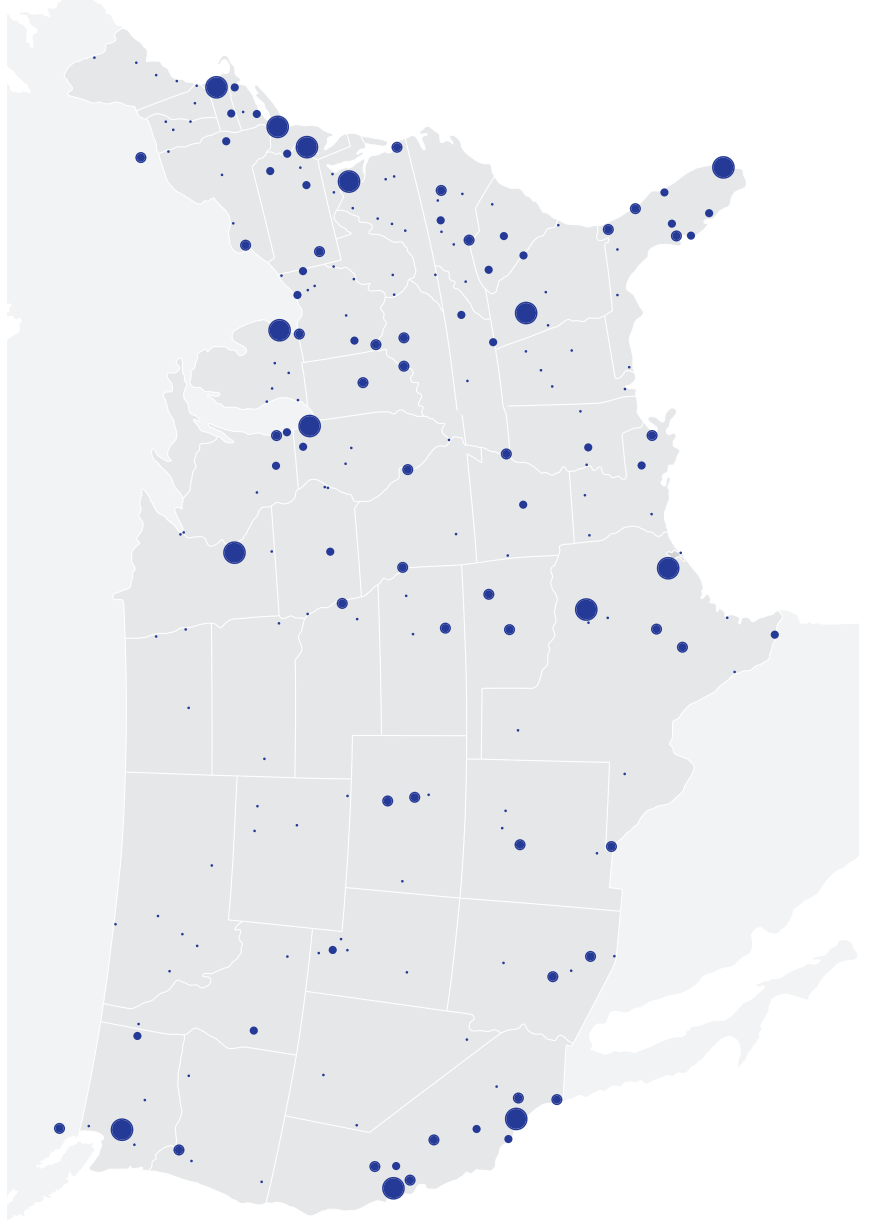


U.S. INTERSTATE NETWORK





U.S. MAJOR CITIES



## Tracing the evolution of transportation and the city throughout the history of the United States post-1800.

**1850:** By this time, over 9,000 miles of railroad lines had been constructed.  
**1850s:** The development of railroads from the 1830s added a new dimension of travel in America, adding 3,000 miles of tracks by the 40s, which had tripled by 1850, now traversing almost every state east of the Mississippi River.

**1850s:** After the 1850's, stage coach routes declined East of the Mississippi as the popularity of railroad transportation for people and mail increased.

**1850-60:** Enormous railway building booms in the United States push railroad companies in the North and Midwest to construct networks that link nearly every major city by this time, replacing canals for the main mode of transportation.

**1860s:** After the Civil War, the overall trend was toward urban growth and concentration, which brought with it problems still faced by cities today: overcrowding, police and fire protection, water supply, roads, education and sanitation.

**1862:** President Lincoln signs the Homestead Act, encouraging the development of community settlements along the railroads.

**1869:** The Oregon Trail and its many offshoots were used by about 400,000 settlers, ranchers, farmers, miners, businessmen and families.

**1869:** The Golden Spike is laid, connecting the Union Pacific and Central Pacific railroads forming a cross-continental railroad route.

**1869:** The nation had created a nationwide mechanized transportation network which revolutionized the population and economy of the west - catalyzing the transition from wagon trains to a modern transportation system.

As cities and frontier regions became more interconnected, manufacturing replaced trade as a primary form of wealth creation with the emergence of factory systems, marking the end of the preindustrial movement and the beginning of industrial expansion.

**1872:** The equine flu-like epidemic swept through the cities, killing horses used for transportation by the thousands and bringing commerce to a virtual standstill.

**1873:** The first successful cable car line was opened on Clay Street in San Francisco, designed by Andrew Smith.

**1800:** The only practical way to travel and trade across long distances was along the nation's natural waterways.

In the early 19th century, the development of Midwest and Southern states drained by the Mississippi River System was accelerated by the introduction of steamboats - producing both passenger and freight traffic.

**1804:** Louis and Clark, following the acquisition of the Louisiana Purchase in 1803, began the Corps of Discovery Expedition to explore and map the newly acquired land for the most "direct and practical water communication". Early United States population was centered on its Atlantic Coast, with all major centers located on a natural harbor or navigable waterway.

Low population density between these centers resulted in heavy reliance of coastwise and riverboat shipping.

**1804:** Louis and Clark, following the acquisition of the Louisiana Purchase in 1803, began the Corps of Discovery Expedition to explore and map the newly acquired land for the most "direct and practical water communication".

**1820s:** Improvements in water travel transformed inland journeys into pleasure trips rather than ordeals via canals, which were admittedly slow, but smoother and far more comfortable than overland travel.

**1825:** New England builders developed the four-wheel pleasure wagon, designed to be pulled by a single horse with the capability to carry light freight and be used by passengers.

**1825:** The opening of the Erie Canal revolutionized settlement and future expansion in the Great Lakes region, now connecting the Great Lakes to New York City.

**1810-30:** Technological advances in transportation changed where and how people migrated.

**1836:** The first migrant wagon train was organized at Independence, MO, leading to Fort Hill, ID.

**1831:** Abraham Brower began the first horse-drawn omnibus in New York with Philadelphia, Boston and other cities adopting similar systems within a few years with a fare of 12.5 cents per ride.

**1811-40:** The Oregon Trail was laid by fur-trappers and traders, passable only on foot or horseback.

**1840s:** Elegant steamboats, which were faster and more luxurious than canal boats and cheaper and more comfortable than stagecoaches, carried passengers across major lakes and rivers. By the mid 1800's, logs were laid side-by-side to create "corduroy roads", which was essential in the development of highway transportation.

**1900:** 8,000 personal automobiles are owned by Americans.

At the beginning of the 20th century, railroads employed nearly 10% of all industrial work, making it one of the nation's largest businesses.

**1902:** By this time, mass production techniques took off with four companies producing vehicles in the thousands annually.

**1902:** The American Automobile Association (AAA) and several smaller highway associations and local touring clubs had begun preparing and publishing travel guides for motorists.

**1903:** The first cross country road trip by automobile was completed, lasting 63 days from coast to coast.

Throughout the early 1900's, immigrants continued to travel to America by ocean liners from Europe and China.

As people began travelling by car, railroad commuter transportation lost a lot of its popularity, making railroad companies concentrate solely on hauling freight.

The advent of the automobile signaled the end of railroads as a predominant form of transportation, ushering in the 'Age of Mobility'.

**1905:** Orville and Wilbur Wright's design of their 1903 airplane was refined, now a fully controllable aircraft capable of staying aloft as long as the tank had fuel.

**1910:** The United States had one of the world's greatest national transportation systems, which included 353,000 miles of railroad tracks, carrying over 970 million passengers.

**1892-1913:** Most cities had replaced cable lines with electric streetcars

**1913:** The Lincoln Highway became an early 20th century example leading to a national highway system.

Interurban rail services and trolley cars ridership declined due to the advent of motorized buses and the lack of a dedicated Right-of-Way.

**1913:** Regularly Scheduled bus service, including set points of departure and arrival were started in Minnesota.

**1913:** The automobile buying experience changed when new cars began to be sold on credit.

**1865-1915:** The desire to travel was stimulated by a spate of books, guides and accounts, but also expanded to newspapers with travel suggestions, advertisements and travel accounts.

**1915:** Nearly a billion train tickets were sold, about triple the figure for 1885.

**1916:** The rental car industry began in Nebraska as Joe Saunders began renting out his Ford Model T automobile to travelling salesmen.

**1916:** The railroad industry was a massive employer, growing from 163,000 employees in the 1870s to 1.7 million employees - which was about 4% of the nation's workers.

By WWII, trains not only carried goods (equal to nearly all long distance freight), but also carried over 90% of wartime passengers.

**1914-18:** During WWI, the railroads proved incapable of functioning as a cohesive system, forcing the US government to nationalize the rail industry.

**1919:** Oregon is the first state in the union to institute a gasoline tax.

**1920:** 8,000,000 personal automobiles are owned by Americans.

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**1916, 21:** The Federal Aid Road Act and the Federal Aid Highway Act (respectively) provided states with federal matching funds for the construction and improvement of highways.

**1923:** Two Lieutenants in the United States Army completed the first non-stop cross-country flight.

**1920s:** As the civil air transportation network of airports and infrastructure expanded, air travel became more accessible to the general public by the late 1920's, now scheduling passenger flights.

**1925:** US Airmail service commenced, later being transferred to commercial airline carriers in 1925.

**1925:** The inauguration of a federal road system standardized numbered routes and road signs across the country.

**1926:** The Air Commerce Act established the authority of the federal government to regulate aviation routes, rates and safety standards.

**1908-27:** Ford's Model T became the most widely produced car of the era - earning World's Most Influential Car.

**1927:** The Ford Tri-Motor could carry 10 passengers in addition to a load of mail in relative comfort.

**1927:** Charles Lindbergh's nonstop solo flight from New York to Paris captured the eyes and minds of the world as it was the first across the Atlantic Ocean, and longest flight to date.

**1929:** Gasoline taxes across the country were used to cover a large portion of road construction costs, enough to institute a Federal Government gasoline tax by 1932.

**1929:** The United States had about 6,200 bus carriers with a combined total of 354,250 buses covered approximately 35,000 miles of routes throughout the country.

**1929:** In 1919, nearly 90% of all cars were open with no fixed roof, but within a decade, 90% of all cars had closed cabs.

**1929:** Foreign travel was encouraged by more efficient modes of transportation both en route to and in the European countries, with travel via ocean liner reaching its peak at this point.

**1930:** The first commercial AM radio was introduced, branded Motorola.

**1930:** Population in Detroit reached 1.6 million, encompassing over 140 square miles of land compared to the 1860s, where Detroit covered roughly 5 square miles and had a population of just over 45,000.

Cities across the nation had begun annexing outlying areas and increasing municipal control over hundreds of square miles, benefiting cities by expanding tax base to fund new construction like roads, lights and sewage.

**1930:** After WWI, the automobile emerged as the principal mode of pleasure travel - to a point where the first two decades saw the number of private automobiles increase to 8 million in 1920, and nearly tripled again by 1930.

**1932:** Ford Motor Company introduced the V-8 engine.

**1930s:** The first drive-in movie theater opened in New Jersey.

**1930s:** Interstate bus companies such as Greyhound Lines (incorporated in 1929) had begun to take popularity away from the commuter rails by the mid-1930's.

**1930s:** Trucks were first used extensively by the military during WWI, but increases in the construction of paved roads gave trucking a significant foothold.

From the 1930s on, about 80 percent to 85 percent of all vacation trips were taken by automobile.

**1942:** In February, the automotive plants were converted in order to produce tanks, guns, airplanes and engines, as well as motor vehicles of many types in preparation to enter WWII.

**1940s:** Aviation made great strides during WWII, leading to the rapid growth of both passenger and cargo traffic after the war.

**1940s:** Railroad companies made a valiant effort to revive their business by improving their operating efficiency through the use of new power sources and by adopting new, streamlined designs for their trains.

After the wars, popularity of the personal automobile grew at record numbers.

**1947:** Due to the Naperville Train Massacre a year prior, the Interstate Commerce Commission (ICC) ordered all railroads to install an automatic train stop, automatic train control and cab signalling wherever trains would travel 80 mph or greater.



standardized flat wooden pallets were developed after WWII for transferring freight between warehouses, trucks, railroad cars, ships and aircraft.

post-WWII housing expansion and the transformation of the former dependent cities into self-sufficient communities led to the development of the interstate highway system, which provided a means for long-distance travel and facilitated the growth of suburban areas.

s: Trucking magnate Malcolm McLean is credited with transforming container shipping from an impractical idea into a massive industry that slashed the cost of moving goods and established truly global industries with experiments in intermodal shipping and hauling using metal containers.

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1980-2002: Intermodal freight transport had a huge impact on commercial transportation, bringing consumers a previously unimaginable variety of low-cost products from around the globe and paved the way for Asia to become the world's workshop.

2002: Though originally reported in 1988 as carcinogenic to animals, the EPA began considering components of diesel exhaust to be carcinogenic to humans as well.

1998-2003: The Transportation Equity Act for the 21st Century (TEA-21) authorized the federal surface transportation programs for highways, highway safety and transit for this six-year period, requiring six planning factors be included in regional transportation plans.

2004: In terms of passenger numbers, 17 of the world's 30 busiest airports and 12 of the world's 30 busiest in terms of cargo are in the United States.

2006: Petroleum refiners were required by the Environmental Protection Agency (EPA) to begin producing "ultra-low sulfur diesel" with 97% less sulfur than before, reducing harmful emissions by 90%.

2008: The Savings Energy Through Public Transportation Act awards cities federal grants to mass transit authorities to lower fares for commuters and expand transit services.

2005-09: The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users Act (SAFETEA-LU) contains a host of provisions and earmarks intended to improve and maintain the surface transportation infrastructure of the US, including the Interstate Highway system, transit systems, bicycling and pedestrian facilities and freight rail operations.

2009: A study conducted found that traffic congestion costs the United States approximately \$87.2 billion - increasing 63% over the past decade.

2009: A Federal allocation of \$8 billion for high-speed rail (HSR) projects was part of the President's annual Stimulus Package - prompting U.S. Federal and State Planners to coordinate the expansion of HSR in America.

2010: About one-quarter of all vehicle miles driven in the United States use the interstate system annually, featuring a total length of 47,182 miles, making it the world's second largest transportation network after China.

2011: The network of interstates, U.S. highways, state highways and local roads of counties - including their municipal streets, is a total of 3,980,817 miles (of road) in length.

2012: Amtrak made a \$151 billion proposal to build its first dedicated HSR line by 2040, promising trains reaching speeds up to 220 mph between New York City and Washington D.C.

Amtrak reportedly served a record 31.2 million passengers, nearly 2/3 of which come from the 10 largest metropolitan areas in the nation.

The United States has 25,482 miles of navigable inland channels, exclusive of the Great Lakes.

2009: With the rise of gas prices, Americans began to voice their demands for smaller, more fuel-efficient vehicles.

2009: With the country in a recession and automobile sales falling, American auto makers faced bankruptcy, later seeking financial assistance from the US government.

1970s: Lower airfares, a product of Congress' decision to deregulate the airline industry, attracted more non-business air travellers and began introducing automobile rentals to a wider audience.

1970s: World events and a new world market threatened the traditional ways of American manufacturing, which could not compete with low labor costs in places like Mexico, Japan, Taiwan, China, Vietnam and Indonesia.

1970s: About 8,000 travel agencies planned and arranged trips for domestic and foreign travelers in the United States.

1970s: The micro-electronics revolution of the 1970's brought electronic fuel injection, anti-lock brakes, traction control, electronically controlled automatic transmissions and automatic stability control systems to the automobile.

1980: By passing the Motor Carrier Act, Congress had elected to deregulate the railroads, creating a regulatory environment which was more favorable to the economics of the railroad industry.

1984: America saw the first solar-powered vehicle make its way across the US, known as the TSAR (otherwise called "Phoenix") crossed the country from San Diego, CA to Jacksonville, FL in 45 days.

1986: The final section of the coast-to-coast Interstate 80 is dedicated on the Western edge of Salt Lake City, UT - forming the longest contiguous freeway in the world.

1990s: Leasing had become a popular way to acquire a vehicle.

1992: Although the whole of the National Interstate system was proclaimed complete, two of the original interstates remain discontinuous due to local opposition.

1993: Fuel-Cell and Hybrid-Electric vehicle development was a key focus when President Clinton launched the Partnership for a New Generation of Vehicles.

1991-97: The first US federal legislation of this type in the post-interstate Highway System, the Intermodal Surface Transportation Efficiency Act (ISTEA) presented an overall intermodal approach to highway and transit funding, with collaborative planning requirements which gave significant additional powers to metropolitan planning organizations.

1997: The Kyoto Protocol was the first significant worldwide agreement with reduction targets focused on reducing four greenhouse gases - carbon dioxide, nitrous oxide, sulfur hexafluoride and methane, along with two groups of gases - hydrofluorocarbons and perfluorocarbons.

1997: General Motors (GM) introduced the EV1, an electric-powered two-door, two-passenger car available for leasing only.

1998: Research on biodiesel as a fuel source was started in both the US Department of Energy and the US Department of Agriculture.

Some 75 percent of American travelers in Europe had gone there by plane; in a decade only three percent of all travelers abroad had journeyed to their nations by sea.

s: After the Interstate Highway System was constructed, the trucking industry came to dominate the freight industry.

s: At this point, transportation by aircraft had become both a popular and reliable option for long distance travel for Americans, which decreased the intercity shipping programs to a point where railroads could no longer profitably operate as passenger trains in American cities.

s: Plans for a national high-speed rail system date back to the High-Speed Transportation Act.

s: Only 10,000 rail passenger cars were in operation, amounting to an 85% fleet reduction from 1929.

s: Ralph Nader's "Unsafe at Any Speed" indictment of automotive safety helped safety regulations.

s: The US Postal Service switched its operation from passenger trains over to mail and airplanes as modes of transportation.

s: The National Traffic and Motor Vehicle Safety Act required new cars to have air bags, padded dashboards, safety door latches and hinges, impact-absorbing steering columns and other safety features.

70 The International Organization for Standardization (ISO) issued standards for shipping container sizes, based upon the US Department of Defense standards for military use.

s: Congress creates the National Railroad Passenger Corporation (known today as Amtrak) to maintain limited intercity rail passenger service in most parts of the country.

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# REGIONAL

What are regional examples of cities with developed multimodal public transportation options?



Mass transit systems in Denver, CO are operated by Regional Transportation District. Across their light rail system, they currently have 47 miles of tracks with connection points at 46 different stations. The RTD accommodates 20,639,000 riders per year. The LRT system has 6 lines (C, D, E, H, F) which follows the lettering of the zone structure established throughout Denver (A, B, C, D). This is a surface level train system, separated from the road by a median. In addition, RTD operates nearly 1,000 buses on 148 routes, 172 light rail vehicles on 47 miles of track.

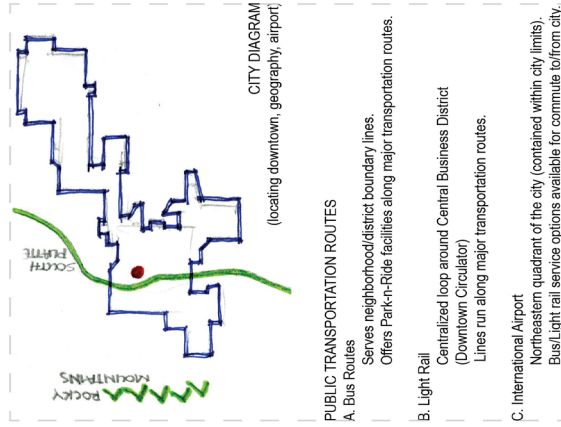
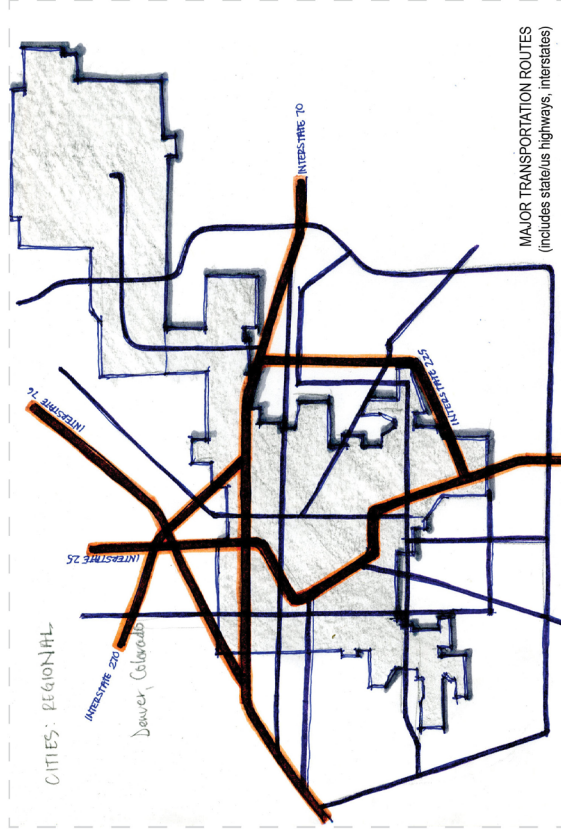
Denver's LRT predates low floor technology and includes steps to allow a low platform, along with wheelchair access bridges for high-level platforms. Denver also has a fenced in ROW surface, elevated sections, and operates in downtown streets in dedicated lanes. Trains run every 15 minutes during the day, with extra rush-hour service provided.

Although most stations throughout the entire network feature automobile and bike parking, each of the corridors feature special characteristics. The central corridor runs opposite one-way traffic, which increases safety by making motorists more aware of train movement. The southwest corridor, which primarily serves industries, has a flyover section of tracks. The southeast corridor, one of the busiest routes in the network, connects Denver's two largest employment centers – the Central Business District and the Denver Tech Center. The west corridor connects the government center in Golden to Downtown Denver's Union Station.

The fare to use Denver's RTD services is \$1.75 (2-zone ride), \$3.00 (3-zone ride), \$4.00 (for all zones). Tickets can be purchased from vending machines at the stations and are valid for one and a half hours. Unlike other

places, day passes can only be purchased at one of two stations across the network. To promote the use of mass transit, employers purchase eopass for employees which offers 7-day access to public transportation, as well as having payroll tax savings, pre-tax savings, and transit pass discounts for employees/employees.

Union station redevelopment program for urban transit center will house commuter rail train hall with 8 at-grade tracks for passenger rail as well as serve existing Amtrak and SkitTrain services; regional bus facility located below grade and will include 22 bays (16 for RTD regional and express buses, 4 for the Downtown Circulator buses, and 2 for other commercial carriers/expansion); light rail station and platforms, 16th Street Mall Shuttle –providing easy connections between the free service and the light rail/ passenger rail at the station; the Downtown Circulator –connecting Union Station to employment centers and service to light rail, passenger rail, regional bus via underground; and public spaces at grade which create a series of interconnected parks/plazas which tie the site together.



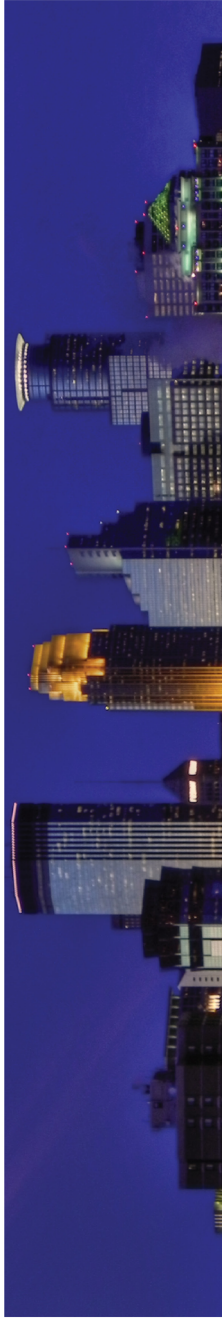
## GRID DEVELOPMENT PATTERNS

A. BOUNDARY ORIENTED (PLATTE RIVER)  
Street fabric most evident to the east of Platte River in Denver's Central Business District.

B. ORGANIC NEIGHBORHOODS  
Secondary street fabric used in residential neighborhood development pattern along the fringe boundary.

C. ORTHOGONAL GRID  
Primary street fabric used in residential neighborhood development pattern forming a majority of city's fabric.





Metrolink currently operates the Blue Line, NorthStar commuter Rail, and 123 bus routes (66 of which provide local service, 55 express routes, and 6 contract service routes). Surface features/characteristics along the line include sections which run parallel to traffic on the side of the road; sections of off-street rails with fully separated ROW; sections which run on-street, separated from traffic by a curb; sections which are separated from traffic by a median in the road; as well as tunnel sections and elevated off-grade sections.

Though the trains can reach a max speed of 55 mph, general service speeds

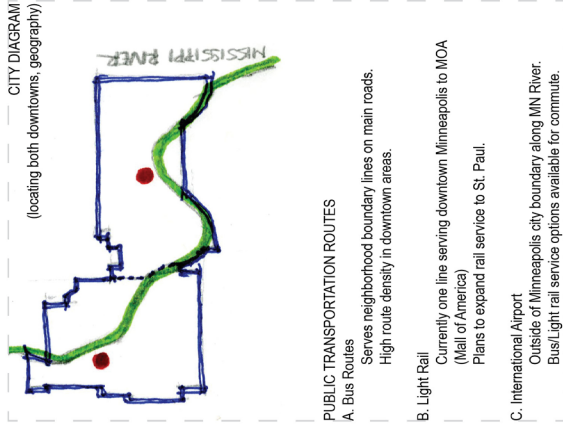
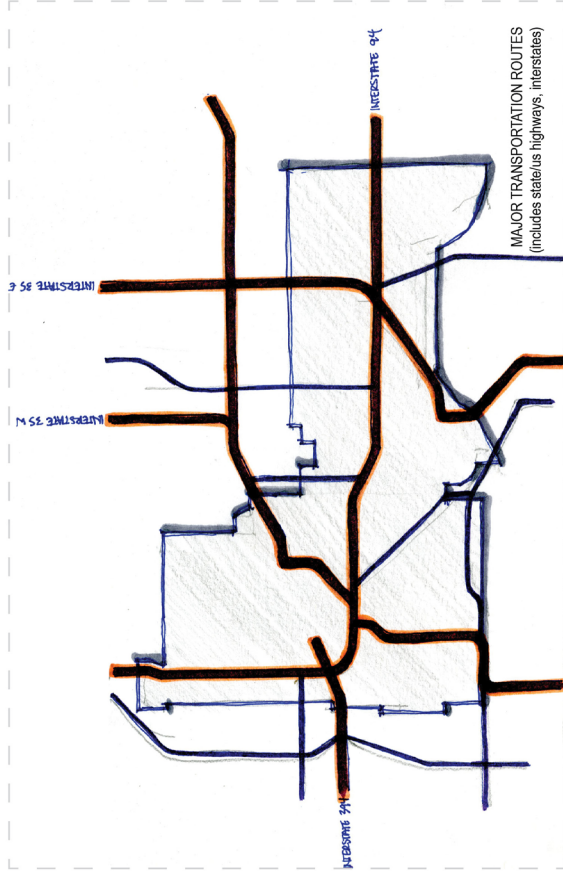
along the line is 40 mph or slower. Additionally, the train cars feature a 70% low floor design, meaning that 70% of the floor inside the vehicle is within 14" from the ground – allowing for step-free access for disabled, plus bikes and strollers via the elevated platforms. Each car is also equipped with security cameras in each of its three sections: A, B, C. With 4 luggage racks and 4 bike hangers per car, the trains look to appeal to a variety of passenger needs, with direct service to each airport terminal (available 24 hrs./day). The train cars themselves are electrically powered by wires 16' overhead. A total of 46 Metrolink bus routes directly connect to 14 stations, and feature timed transfers to ensure efficiency for passengers.

Fare integration of the LRT is the same as bus fares with transfers valid between the transit systems for up to two and a half hours. Service frequency runs on intervals of 7.5 minutes during rush hour, 10 minutes during midday and on weekends, 15 minutes for early evening service, and approximately 30 minutes red-eye service.

The rail vehicle stops for traffic signals in downtown Minneapolis, but uses signal pre-emption along much of the route, allowing trains to speed through

by lowering gates and turning traffic signals red. Synchronization of the different signals has been very problematic. Since parking in downtown Minneapolis is always expensive, commuters use the light rail to get to work by driving to one of the three Park-and-Ride stations along the line which features more than 2,000 parking spaces. Several bus routes are timed to meet trains at many of the stations, making travel more convenient for commuters who don't live near stations.

Metropolitan Council in 2011 officially renamed the Hiawatha line to the Blue Line as part of a broader color scheme for identifying Twin Cities transit lines, including LRT to St. Paul (Green) which is under construction, and future Bus Rapid Transit lines (Red, Orange). The new Green line to St. Paul will create 18 new stations, and share 5 stations with the Blue Line. Travel time between the two cities downtown districts is expected to take 39 minutes. Growth to the transit system happens beyond the rail lines with a planned BRT "Orange" route, and future transformation to 12 urban corridors with high ridership into BRT lines within the next decade.



#### PUBLIC TRANSPORTATION ROUTES

- A. Bus Routes
  - Serves neighborhood boundary lines on main roads.
  - High route density in downtown areas.
- B. Light Rail
  - Currently one line serving downtown Minneapolis to MOA (Mall of America)
  - Plans to expand rail service to St. Paul.
- C. International Airport
  - Outside of Minneapolis city boundary along MN River.
  - Bus/Light rail service options available for commute.

#### GRID DEVELOPMENT PATTERNS (St. Paul)

A. BOUNDARY ORIENTED (MISSISSIPPI RIVER)  
Street fabric forming urban downtown pattern immediately adjacent to the northern bank of the river.



#### B. ORTHOGONAL GRID

Primary street fabric used in residential neighborhood development pattern, features irregular rectilinear block sizes.



#### C. ORGANIC NEIGHBORHOODS

Secondary street fabric used in residential neighborhood development pattern evident along south-east fringe.





## ST. LOUIS MISSOURI

POPULATION: 318,172  
LAND AREA: 66.2 sq miles

St. Louis' MetroLink public transit system services St. Louis and the MetroEast area of Illinois – consisting of two lines (Red, Blue) which connect Lambert-St. Louis International Airport and Shrewsbury, MO with Scott AFB near Shiloh, IL through downtown St. Louis. MetroLink operates both the light rail and MetroBus transportation in the city.

MetroLink uses a proof-of-payment system in which you purchase tickets at vending machines (available at all stations). There are several types of tickets available, ranging from single ride tickets to monthly passes. All of the passes feature unlimited rides via bus or rail for the length specified,

with the exception of the 1 ride pass. Trains usually run every 7 minutes during peak hours, and intervals of 15 minutes on weeknights.

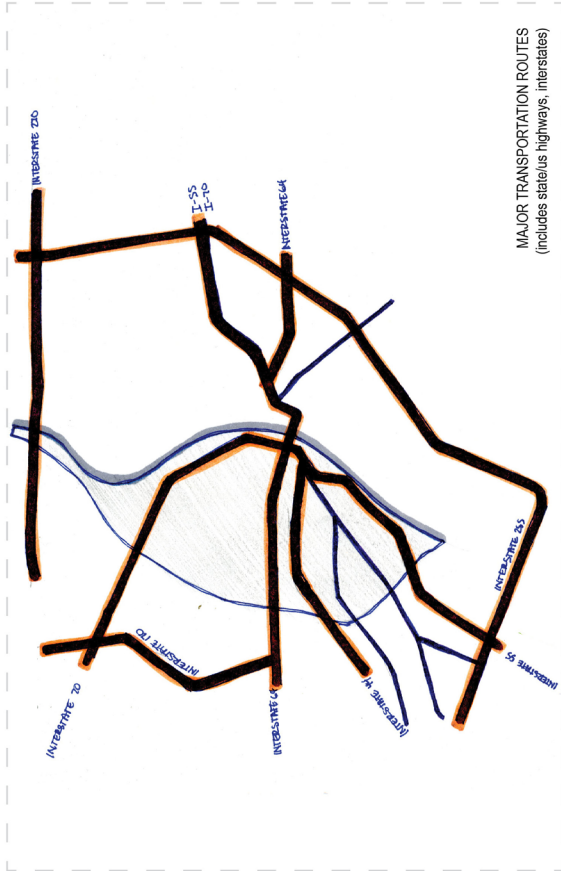
The LRT system features 37 stations across the two lines, carrying 17,128,400 passengers in 2012. The two lines run entirely on independent ROW for all of their alignment, although there are several level crossings. ROW distinctions across the line include fenced at-grade ROW, elevated ROW at Lambert, former/current railway ROW, and a tunnel in the downtown area. With low-level platform cars (with steps), the platform meets the floor of the vehicles at 20 cm above the track. A fleet of 87 LRT vehicles each has the capacity to seat 72 passengers, with additional space for 106 standing passengers. Cars are powered by an electric motor which gets power through a catenary wire with a 750-volt supply.

All MetroBus vehicles are equipped with lifts/ramps to comply with ADA accessibility guidelines. Additionally, all MetroLink station platforms are accessible via ramps or elevators. Another feature for attracting more passengers is the Bike-and-Ride program by MetroLink which incorporates bike racks on all MetroBus vehicles, the ability to bring your bike on

MetroLink rail cars, as well as parking your bike at bike racks provided at the stations.

Metro Park-and-Ride is another program designed to allow passengers to park their vehicles at lots and garages near 30 LRT stations throughout the network and commute to work on the trains (almost all Park-and-Ride facilities are free of charge). Intercom systems, emergency telephones and 24/7 security are available for passenger safety on all vehicles.

Gateway Multimodal Transportation center is a rail and bus terminal in St. Louis which serves Amtrak, St. Louis' MetroLink, MetroBus regional buses, Greyhound cross-country buses and taxis. In addition to the transportation linkages, the station also features a food court which hosts local sundries and deli businesses, as well as franchised food outlets (KFC, Pizza Hut). 18 MetroBus routes as well as 5 Madison County Transit buses have stops at the station. In 2010, 900 Amtrak passengers were serviced each day, as the station serves three separate Amtrak lines.



MAJOR TRANSPORTATION ROUTES  
(includes state/us highways, interstates)

### GRID DEVELOPMENT PATTERNS

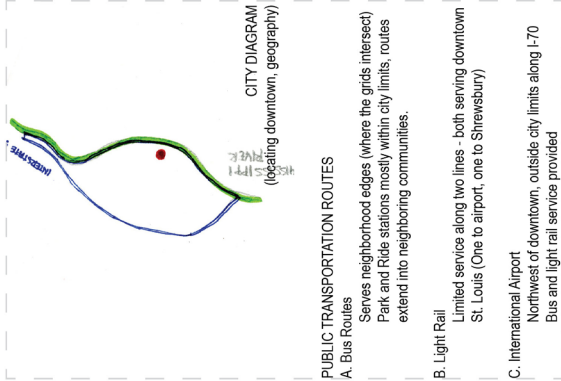
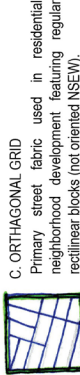
**A. BOUNDARY ORIENTED (MISSISSIPPI RIVER)**  
Street fabric most evident immediately adjacent to the river in the urban downtown district. City grid constantly re-orient itself.



**B. INTERSECTING ORTHOGONAL GRIDS**  
Numerous areas feature intersections of different orthogonal grids (orientation to river); latent residential neighborhood development pattern.



**C. ORTHOGONAL GRID**  
Primary street fabric used in residential neighborhood development featuring regular rectilinear blocks (not oriented NSEW).



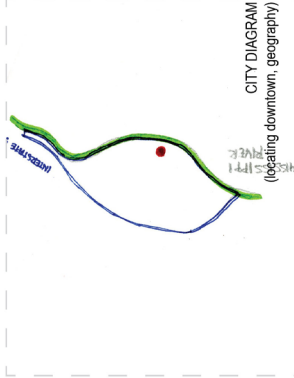
PUBLIC TRANSPORTATION ROUTES

**A. Bus Routes**  
Serves neighborhood edges (where the grids intersect) Park and Ride stations mostly within city limits, routes extend into neighboring communities.

**B. Light Rail**  
Limited service along two lines – both serving downtown St. Louis (One to airport, one to Shrewsbury)

**C. International Airport**  
Northwest of downtown, outside city limits along I-70 Bus and light rail service provided

CITY DIAGRAM  
(locating downtown, geography)



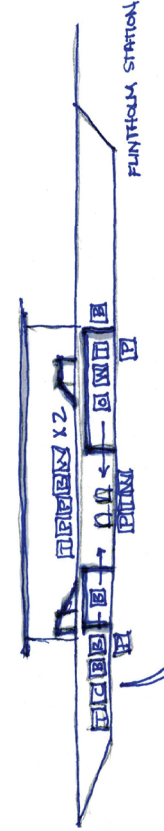
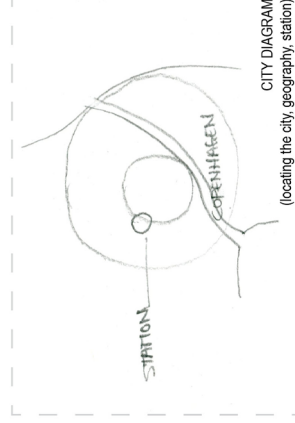
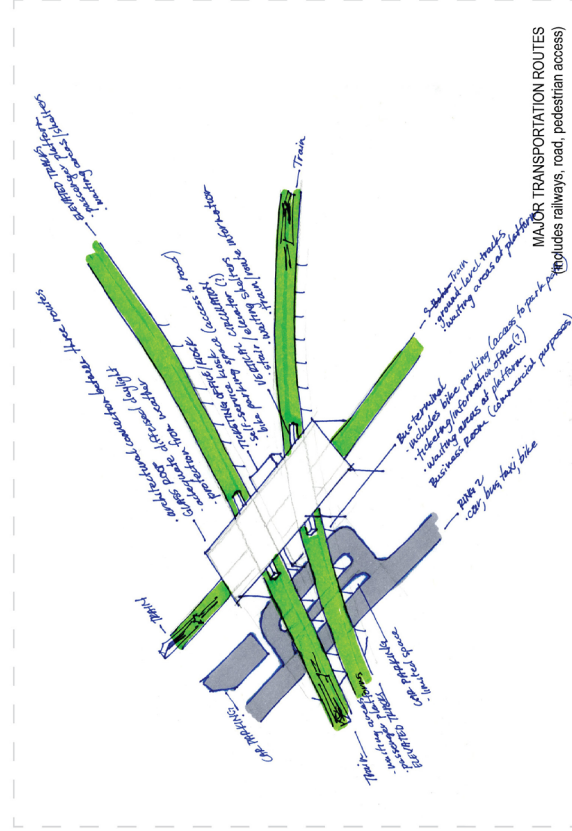




The Flintholm Station in Copenhagen, built in connection with the new Metro Copenhagen, the Danish Railway and DSB S-trains, is designed with a passenger capacity of 60,000 in train, making it the third largest station in Denmark, and the largest station on the Ringbanen (the Ring Railway). Early on, the objectives of the design were to convert the site to be able to serve the rail, but also to accommodate to pedestrians, bicycles and vehicles. The flow is secured by limiting the distance between the different systems of bus, train and metro as much as possible.

The principal idea behind the design was to merge the three stations in one not only so that passengers would have to refer one station, but also to create a multimodal transportation hub capable of serving a larger commuter audience thanks to its location and program. A very large glass roof covers all 3 stations and serves as image and landmark for the station. Underneath the glass roof different facilities are located depending on each system. The bridges leading up to the station, which is located in a park, are made of steel.

were renewed at the same time in order to create a sense of uniformity. The design was carried out to allow all three transportation clients to express their own individual identity and at the same time to ensure that the station appears as a harmonious entity. The station is situated in a park and the existing bridges in the area have been renovated to ensure homogenous expression.









## BEIJING SOUTH STATION BEIJING, CHINA

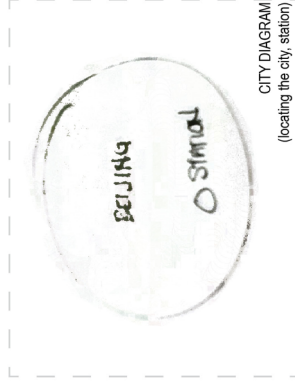
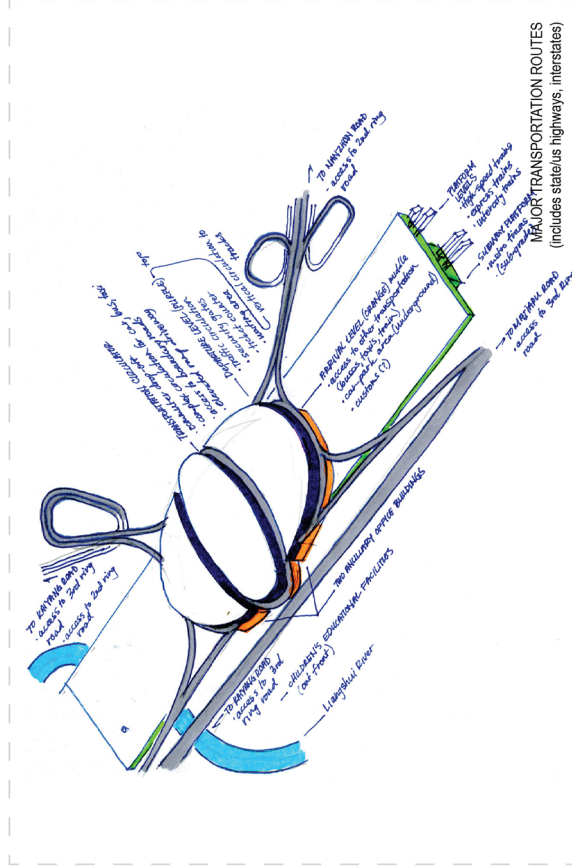
PROGRAM AREA: 144,190 sq meters

Beijing South Station, completed in August 2008 after the Olympic Games, is a fully integrated multi-modal transportation hub which serves as a "gateway" to the capital and a vital link to China's new high-speed intercity rail network. A major urban building and masterplan, it is one of the largest contemporary railway stations in the world designed for passenger turnover of 105 million annually. To accommodate these vast numbers, a new model in railway station design was developed, integrating the multi-modal transport interchange facility with a vertical separation strategy designed so that passenger traffic flows are direct, convenient and highly efficient. Situated half a kilometre from the city's old station in Fengtai district between the

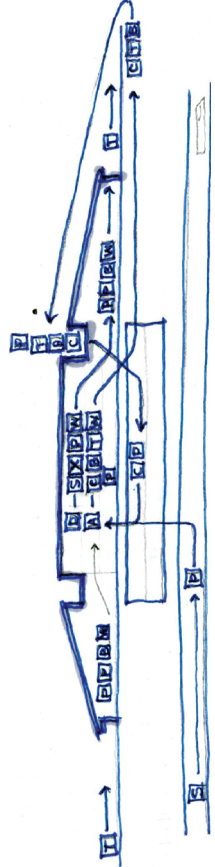
second and third ring roads, the new Beijing Station will serve as a high-speed intercity rail link which connects Beijing with the Yangtze River Delta cities of Tianjin and Shanghai, with a catchment area of 270 million people. As the station is immense in scale, the architectural form and structure are clear, simple and people oriented and take into consideration the different operational and management of the various rail lines, station entrances, exits, waiting areas and interchange zones taking place within—the station takes a simple ellipse form that accommodates 3 principle floor levels with two mezzanine floor levels for car-parking and two ancillary gateway office buildings. With such large volumes of passengers it is essential to separate the incoming and departing passengers. One of the main design objectives was to have the passengers board and alight trains with the shortest distance and time possible.

The design strategy also incorporates separate zones catering for seamless integration and transition to different types of vehicular traffic including 909 underground basement car-parking spaces, 28 taxi drop-off bays, 24 taxi pick-up bays with 138 queuing spaces and 38 bus spaces (12 drop-off spaces and 26 pick-up bays with 48 queuing spaces) as a comprehensive transport hub. The elliptical plan form is effective in providing an innovative

solution to the station's vehicular traffic flow. The overhead road network can adjust to the traffic flows to and from the station area in all directions and assist in relieving the congestion of the surrounding urban arterial roads. There are a total of 11 island platforms and 2 side platforms with 24 platform edges for high-speed trains (450 metres long). Express trains (500 metres long) and Intercity trains (450 metres long); 2 island platforms with 4 platform edges for the Metro trains (120 metres long) in the basement levels.



CITY DIAGRAM  
(locating the city, station)





# AIRPORTS

What are existing airport complex precedents that deal with a variety of transportation options for travelers?



Omaha's Eppley Airfield, a medium hub airport, three miles northeast of the city, is the largest airport in Nebraska – serving the Omaha, NE and Council Bluffs, IA metropolitan areas. Between two concourses in its terminal building, Eppley Airfield handles about 90 airline flights per day, serving nearly 4.5 million passengers each year. Since 2012, all scheduled airline flights from Omaha terminate within the United States. Though it is not as large as JFK, LAX or O'Hare, Eppley Airfield offers service to many popular stops across the country. Southwest Airlines and United Airlines have dominated the airport in the past, accounting for 50% of the almost 400 flights

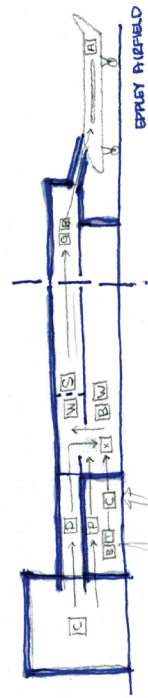
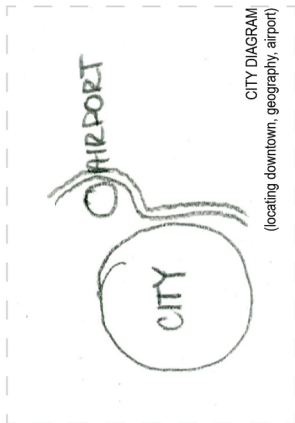
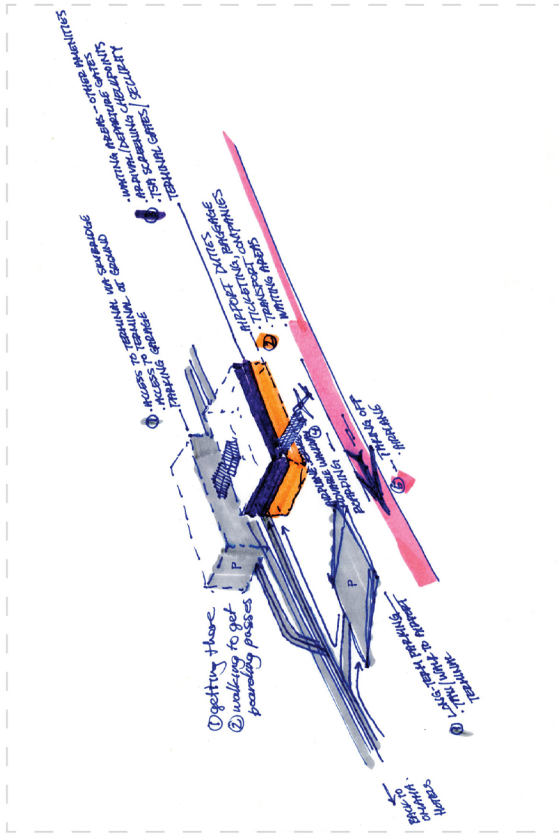
Eppley handles per week.

As far as public transit from the airport goes, one MAT bus line (Line 16) serves Eppley in a north-south route between the North Omaha Transit Center and downtown, passing through the airport passenger driveway. Service on this line is available during the work week, but only provides service during peak traffic hour. Other ground transportation options are provided by rental car service, taxis, and airport/hotel shuttles – including shuttle service to nearby Lincoln (Nebraska), Sioux City (Iowa), and Sioux Falls (South Dakota). The airport has adequate surface and garage parking for both long and short term limits, provided at a comparable rate to other airports in the region.

With little of the traffic congestion that plagues many US airports, at Eppley, you can step onto one plane only a few minutes after leaving your house or hotel room. Speaking of hotel rooms, both hotel and motel web listings on the airport's website include internet hyperlinks to the different hotel chains, their distance from the airport, and room prices for convenience. Other things that make Omaha a popular destination in the nation include

its five Fortune 500 companies, the College World Series and the nationally renowned Henry Doorny Zoo.

Recently, flooding of the Missouri River jeopardized the airport and its infrastructure as many parts of Nebraska, Iowa and Missouri along the river's edge saw drastic increases in the water level. This flood forced the shutdown of nearby Interstate 29 which runs along the Missouri River on the Iowa side, as well as flooded thousands of acres of arable farming land throughout the region – creating a disaster area whose effects are still being felt. In fact, Eppley occupies an odd hook of Nebraska state territory which encircles Carter Lake - considered a town in Iowa. This peculiar geography was caused years ago as the result of another Missouri River flood which entirely re-routed the Missouri to its present day location around the perimeter of the airport.





The John F. Kennedy International Airport, named after the late President of the United States, is located in Queens, New York. Operating in excess of 70 airlines out of the airport, JFK International is known as one of only two airports in all of North America (the other being Toronto Pearson International Airport) which offers regularly scheduled direct flights to all six inhabited continents around the globe. This includes serving most major destination locations throughout the world, which makes JFK one of the busiest and most recognized airport hubs to fly through in the world. As well as airline transportation, the airport also features shopping, dining, hotels and numerous transportation options to all its passengers. Of those

transportation options, passengers can pair/pick between AirTrain (an elevated light rail network that circles the airport with service to all terminals), public subways and buses, to taxis and limousines; and is located along the Van Wyck Expressway for regional highway travel.

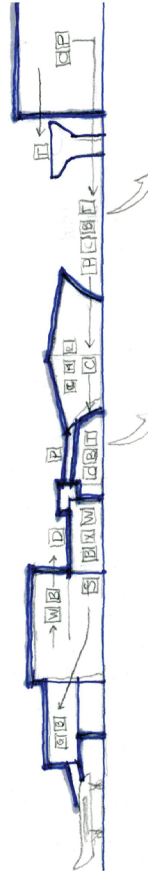
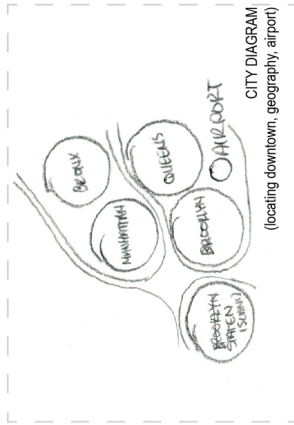
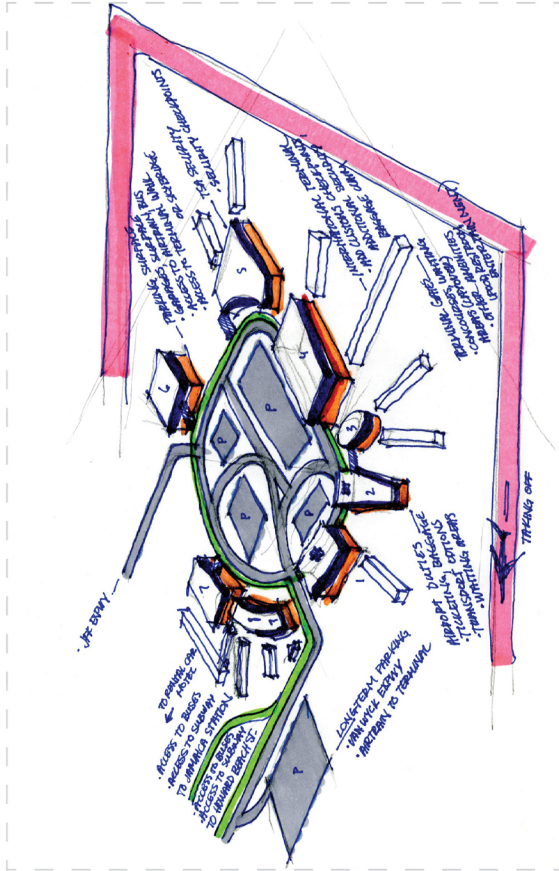
Although taxis can be expensive ways to travel (\$52 flat fare to Manhattan), JFK also offers a taxi service from the airport. For all trips between 4:00 PM and 8:00 PM, a \$1.00 peak surcharge is included, while 50% surcharges for trips between 8:00 PM and 4:00 PM will be applied. There is also a 50% NY State tax to trips within New York, but this fee doesn't apply for passengers travelling to one destination. With this taxi service, one fare pays for all passengers to one destination, with the max of 4 passengers per car (5 for minivan/taxi).

For those looking to avoid the expense of the taxis and have used mass transit before, both the subway and the NYC Airport bus service offer much more affordable transportation options to and from JFK International. Using the Subway from Lower Manhattan/Brooklyn, travel time to the airport takes approximately 60-75 minutes; and transferring to the AirTrain elevated light rail from Howard Beach Station, it takes roughly another 15 minutes to JFK depending on what terminal you are flying out of.

Passengers should expect a similar trip coming from Midtown Manhattan, taking 60-75 minutes, and an extra 15 minutes from the Jamaica Station via AirTrain. The NYC Airport offers a service which departs roughly every 30 minutes - Bus Terminal, Grand Central Station and Penn Station for \$16. As far as additional network bus routes to/from JFK, three NYC bus routes operated by the MTA provide direct service between the airport and nearby neighborhoods - including Q10, Q3 and B15 buses. Free transfers between bus and subway are available, valid only on the MetroCard.

JFK also offers options for passengers looking to connect between airports in the area. If you are planning to travel to LaGuardia, use the shuttle bus service provided. For service between JFK-Newark, use AirTrain.

The airport also offers safe, secure parking with rates including tax, easy access to terminals and multiple forms of payment accepted. Current parking lot locations include Terminal 7 Parking (Orange), Terminals 1+2 Parking (Green), Terminal 8 Parking (Red), Terminal 4+5 Parking (Blue, Yellow), and long term surface parking.







**INCHEON INT'L**  
SEOUL, SOUTH KOREA  
LAND AREA: 5,615 hectares

Incheon International Airport, located four miles west of Seoul (South Korea), serves as an international civilian and cargo traffic hub in East Asia. Incheon is the eighth busiest airport worldwide in terms of passenger statistics and in terms of international passengers in 2010, as well as fourth busiest by cargo traffic. By 2011, those passenger numbers rose to 35,062,376 recorded that year. Airport authorities claim that average departure and arrival takes only 19 minutes (compared to a 60 min. worldwide average) and 12 minutes (45 minutes) respectively, significantly lower than the rest of the world – making it one of the fastest airports in the world for customs processing. The airport has 74 boarding gates altogether, with 44 in the

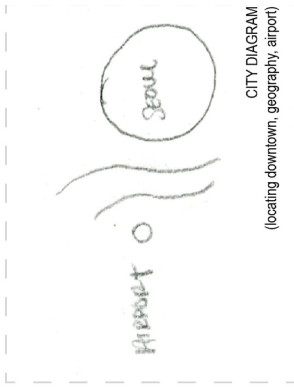
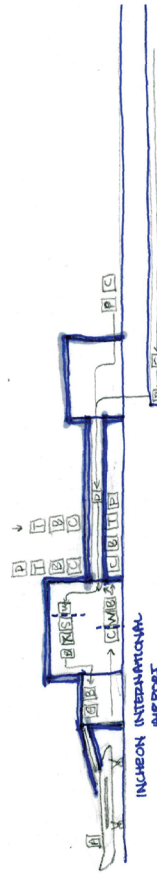
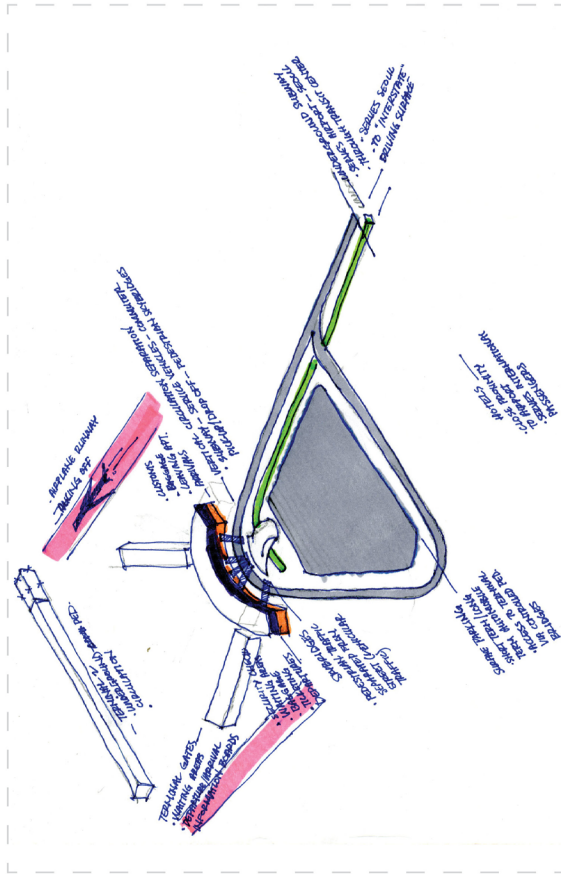
Main Terminal and the other 30 in Concourse A, which serve over 90 airlines operating both commuter and cargo transportation.

The Incheon International Expressway is used exclusively by traffic to/from Incheon International Airport that enables passengers to arrive on time. It has six to eight lanes and its total length is 40.2 km from the Banghwa Bridge to the airport. Short term parking lots on 1st and 3rd floors are provided for cars only. To get to the terminal, passengers should use passageways provided on both the ground level and underground levels. Long term parking is divided into car, bus, taxi and long term parking (outdoors) sections. To get to the arrival level at the passenger terminal, you can board circuit buses to the airport operation center for convenience in serving hundreds of thousands of international passengers – with buses operating on approximately 12 minute intervals. In order to keep traffic congestion down directly in front of the terminals, they've redirected traffic 1 km away from entering the passenger terminal onto a ramp towards the airport.

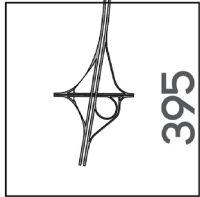
The Incheon International Airport railroad connects Incheon International

Airport to Seoul Station in downtown Seoul. From there, commuters have access to Seoul's subway systems. Non-stop express trains take 43 minutes, and regular trains which make stops at all stations along the line which takes 53 minutes.

The airport has a golf course, spa, private sleeping rooms, ice skating rink, casino, indoor gardens and a Museum of Korean culture available for all passengers to the airport. The airport also features a state-of-the-art runway lights system which is tied into special computers operable at the Control Tower for progressive airplane taxiing by manipulating the runway lights. All runways are equipped with 1L CAT IIIb low light /visibility lights.



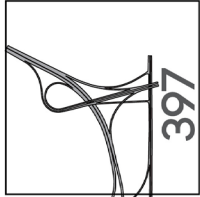
CITY DIAGRAM  
(locating downtown, geography, airport)



395

NW 48TH STREET  
HIGHWAY 6

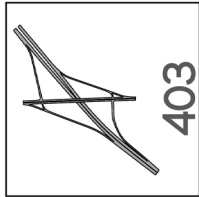
Shoemakers, Frontier Harley-Davidson,  
US Army Reserve, Lancaster Co. Corrections



397

HIGHWAY 77

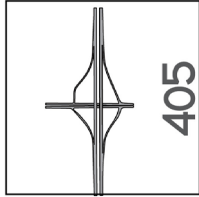
"O" Street (Highway 6)  
Rosa Parks Way, Roca, Beatrice



403

N 27TH STREET

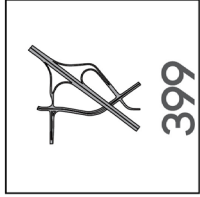
Raymond Fire Dept., Hampton Inn Suites,  
Tractor Supply Co., Anderson Auto Group



405

N 56TH STREET  
HIGHWAY 77

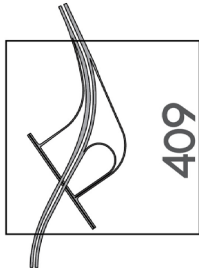
Aardvark Antique Mail, Abbott Sports Complex,  
Nebraska Public Power District, Wahoo



399

W CORNHUSKER HWY

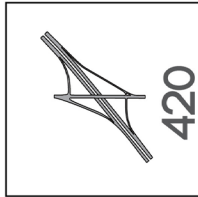
Duncan Aviation, Lincoln Municipal Airport,  
Nebraska Air National Guard



409

CORNHUSKER HWY  
HIGHWAY 6

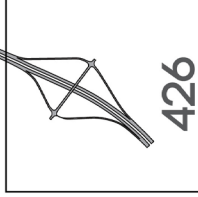
Garner Industries, Novartis Consumer Health,  
Waverly



420

238TH STREET

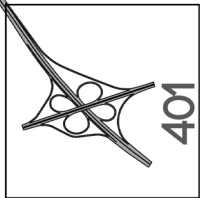
Pine Grove RV Park, Platte Valley Antique Mall,  
Nebraska Raceway Park, Ashland



426

W PARK HIGHWAY

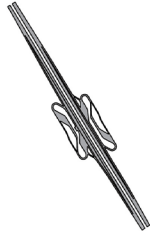
Mahoney State Park, Strategic Air+Space  
Museum, Wildlife Safari Park, Platte River



401

INTERSTATE 180  
HIGHWAY 34

Camp-A-Way RV Park, Kawasaki Motors  
Manufacturing, Seward



TRUCK WEIGH STATION



WESTBOUND  
REST STOP



**Bicycle:** Lincoln's bicycle and pedestrian trail system is called "Great Plains Trails Network" and provides residents and visitors access to over 131 miles of hard surface and crushed rock trails, including a street-level protected bike lane network downtown.  
**Automobile:** Lincoln serves Highway 34, Highway 6, Highway 77 and Highway 2, in addition to the section of Interstate 80. Interstate 180 spur provides a direct connection to the downtown area. These highway routes form a radial pattern, originating out of downtown.



**Taxi:** There are three taxi/shuttle services recognized in Lincoln offering taxi, courier and delivery services throughout the city. Airport shuttles are also available.



**Public Transportation:** StarTran is the name of the city's public transportation operator, which is responsible for the operation of regular, fixed-route bus system.  
The time transfer mass transit system operates 17 regular lines and one Downtown Circulator.

## ② Between the Cities



**OMALINK:** an airport shuttle offering express service between Lincoln and Omaha seven days a week - including holidays. Offers safe, convenient and reliable high-quality ground transportation services (including van, shuttle, charter, town car and limousine options).



**Highway:** highway cargo train coast-to

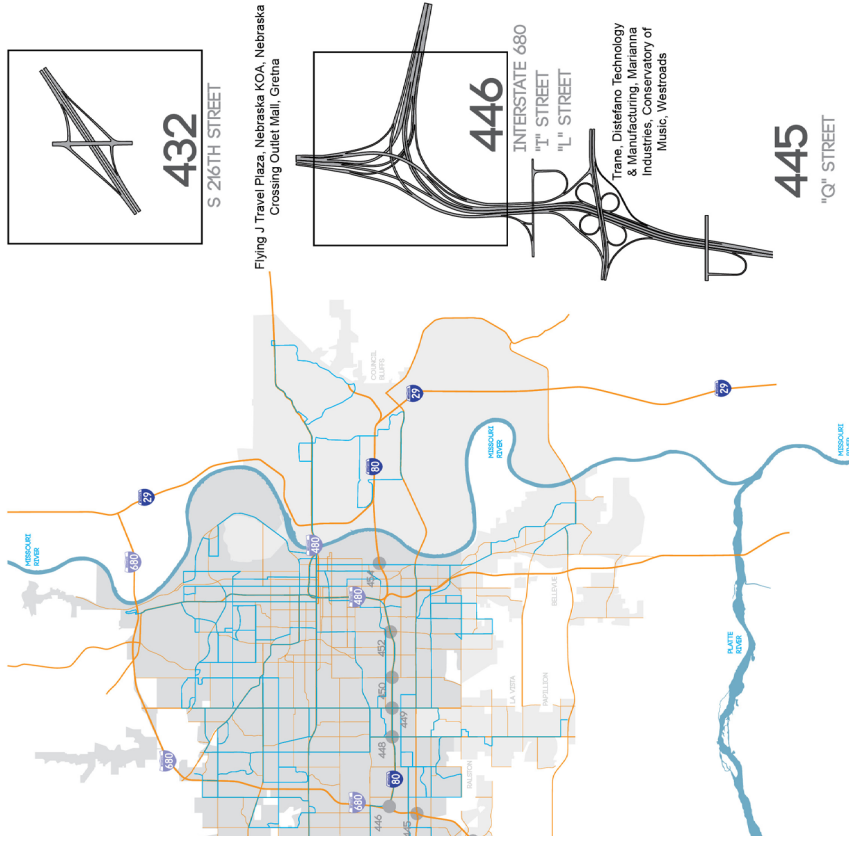
## ① Throughout the City



**BNSF Railroad:** BNSF is a subsidiary of Berkshire Hathaway Inc. - a multinational conglomerate holding company headquartered in Omaha, NE. Provides freight transportation services between the Mississippi River and the Pacific Coast.  
**Union Pacific Railroad:** Union Pacific Railroad (Union Pacific Corporation) is headquartered in Omaha, NE. Union Pacific has reached agreements with competing railroad corporations, allowing the operation of trains on additional miles of railroad tracks.



**Megat:** with t Megat low - ti Black bus se Omaha ticket



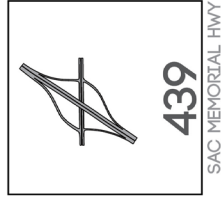
**ways:** Lincoln and Omaha are connected via two express ways: Interstate 80 and US Highway 6. High concentrations of freight and personal automobile traffic travel along this stretch so, being one of the only Interstate Highway routes connecting the two cities.

- jabus:** Megabus operates a point-to-point network of routes, buses making few stops en route to their destination.
  - jabus has no waiting rooms and no bus terminals to keep costs - translating to an extremely affordable transportation mode.
- ★ Hills Stage Lines:** A regional bus network providing express service to Lincoln and Omaha, with line terminals' being in alha and Denver. Both NE cities include passenger stops, stng counters and package shipping options.

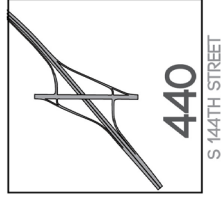
**Amtrak:** Travel between Lincoln and Omaha is possible along Amtrak's "California Zephyr" route, which travels between Chicago and San Francisco. Omaha's station is located near downtown at 10th and Pacific, while Lincoln's station is located in the Haymarket District along Pinnacle Arena Drive.

**Lincoln Airport:** A joint public/military airport, Lincoln Airport is also home to Duncan Aviation - handling approximately 215 flights per day on average. The 12,901 foot primary runway was designated as an emergency landing site for the Space Shuttle.

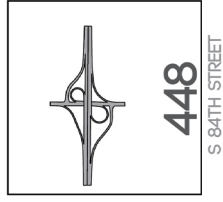
**Eppley Airfield:** Eppley Airfield in Omaha handles approximately 400 flights per week between its two concourses, featuring a total of 20 gates. The airport operates service to numerous major air traffic destinations throughout the country.



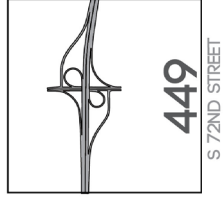
Papillion, La Vista, Bellevue, Gretna  
Vala's Pumpkin Patch



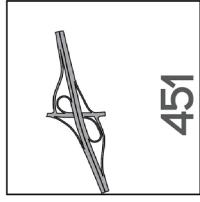
Chalco Hills Recreation Area, Werner Enterprises, Omaha Fire Dept #65



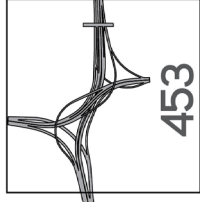
Frederick Square Shopping Center, Conoco Park,  
Metro Self Storage, Matheson-Linweld



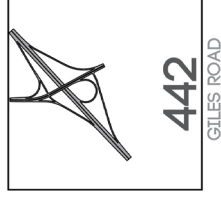
Thermo King, Nebraska Technical Services,  
National Guard Armory, College of St. Mary's



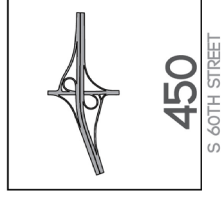
Titan Machinery, Alegent Creighton Reference Laboratory, Douglas Co. Health Department



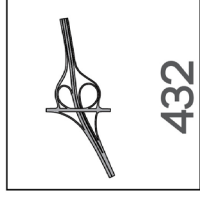
Creighton University Campus,  
Metro Community College



PayPal, Embassy Suites Hotel/Conference Center, Performance Auto, Harrison Street



Keiwi Infrastructure, Omaha Firefighter's Hall  
Nebraska Department of Labor State Office



Henry Dorley Zoo, Lauritzen Gardens, Old Market/Downtown. Missouri River. Amtrak

What transportation modes are available to people in Nebraska (specifically Lincoln and Omaha) to facilitate the movement of goods and people?

**Amtrak:** Travel between Lincoln and Omaha is possible along Amtrak's "California Zephyr" route, which travels between Chicago and San Francisco. Omaha's station is located near downtown at 10th and Pacific, while Lincoln's station is located in the Haymarket District along Pinnacle Arena Drive.

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**Eppley Airfield:** Eppley Airfield in Omaha handles approximately 400 flights per week between its two concourses, featuring a total of 20 gates. The airport operates service to numerous major air traffic destinations throughout the country.

**Amtrak:** Travel between Lincoln and Omaha is possible along Amtrak's "California Zephyr" route, which travels between Chicago and San Francisco. Omaha's station is located near downtown at 10th and Pacific, while Lincoln's station is located in the Haymarket District along Pinnacle Arena Drive.

**Lincoln Airport:** A joint public/military airport, Lincoln Airport is also home to Duncan Aviation - handling approximately 215 flights per day on average. The 12,901 foot primary runway was designated as an emergency landing site for the Space Shuttle.

**Eppley Airfield:** Eppley Airfield in Omaha handles approximately 400 flights per week between its two concourses, featuring a total of 20 gates. The airport operates service to numerous major air traffic destinations throughout the country.

**Public Transportation:** Metro is the public transportation operator, which is responsible for the operation of fixed-route, express/commuter bus routes. In addition, Metro has turn-key contracts with five contiguous political jurisdictions (Nebraska: Ralston, La Vista, Bellevue, Papillion and Iowa: Council Bluffs).

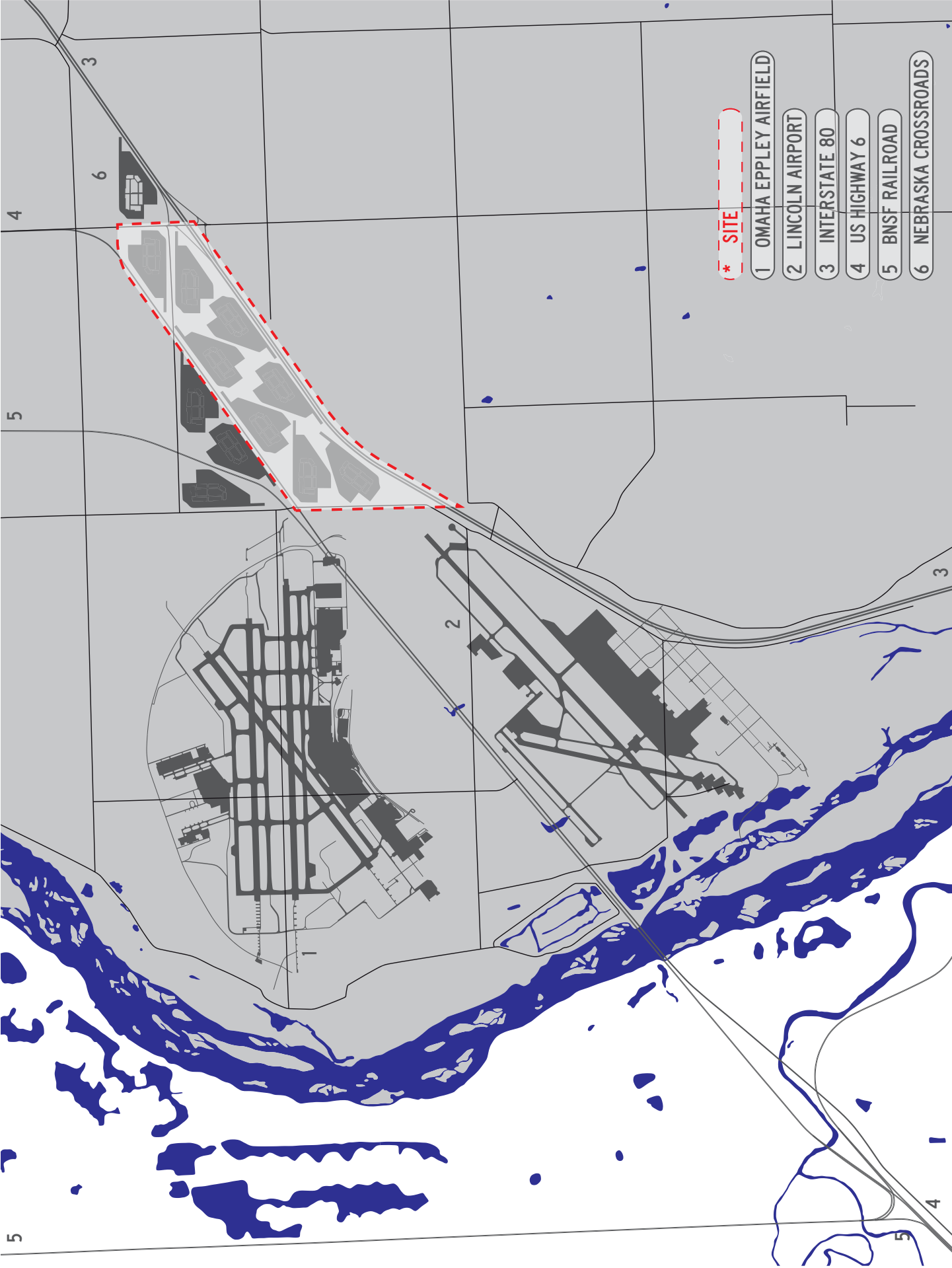
**Bicycles:** Omaha's bicycle and pedestrian trail system is called "Paths to Discovery", and is ranked 36th in the nation's top 50 bike cities due to the public-private synergy which resulted in 20 miles of new bike lanes and a pilot bike-share program. Since 1990, more than 95 miles of paved, interconnected trails have been constructed.

**Taxi:** There are eleven taxi/shuttle services recognized in Omaha, offering taxi, courier, delivery services and airport shuttles throughout the city.

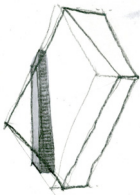
**Automobile:** Omaha serves Highway 75, Highway 6, Highway 275, Highway 31, Highway 92, Highway 288, Highway 64, Highway 36, and Highway 133, in addition to the section of Interstate 80, Interstate 480 and Interstate 680 create an interstate ring around the downtown area.

## ① Throughout the City









**BNSF RAILROAD**  
serves Amtrak - commuter traffic  
serves BNSF, Union Pacific - freight traffic  
-----  
connects large cities, small towns



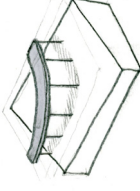
US HIGHWAY 6  
serves local automobile - commuter traffic  
serves local trucking - freight traffic  
serves local farming equipment - agricultural traffic  
connects large cities, small towns



INTERSTATE 60  
serves local automobile - commuter traffic  
serves long-distance automobile - commuter traffic  
serves local trucking - freight traffic  
serves long-distance trucking - freight traffic

---

provides access points to small towns,  
serves larger cities - some via downtown areas



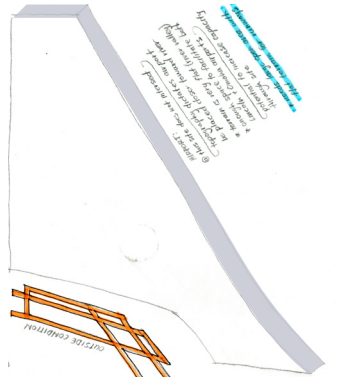
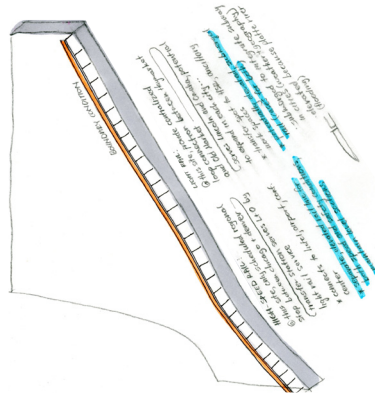
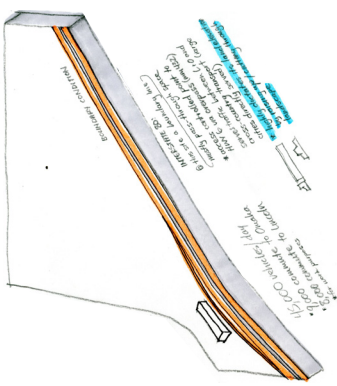
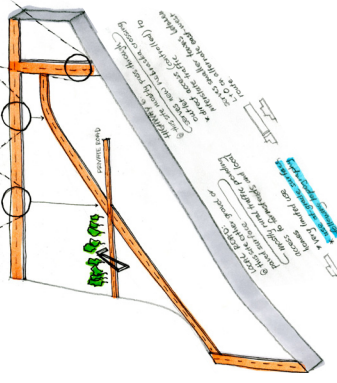
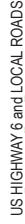
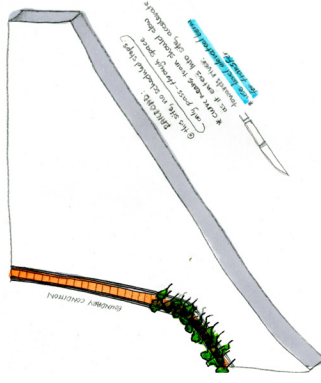
**LIGHT RAIL**  
serves local fixed-point destinations: commuter traffic  
serves long-distance fixed-point destinations: commuter traffic

-----

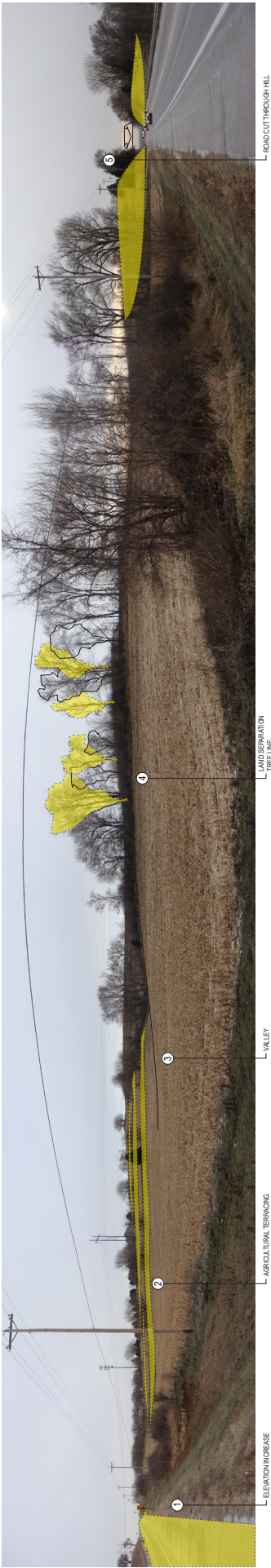
can be separated at-grade (elevated, underground, tunnels)  
typically small scale local stops



**AIRPORT**  
serves long-distance fixed-point destinations; commuter traffic  
serves long-distance fixed-point destinations; freight traffic  
offers rapid service to destinations (typically large  
transportation, economic and social city centers)



existing transportation infrastructure inventory through the site



Valley looking toward Holy Family Shrine



Shrine represents a high point in landscape  
Visual access across site

Private road through middle of the site



\*Private Property No Trespassing\*  
Street is elevated from landscape.

Agricultural terracing off US Highway 6



Stepping to manage grade, control water flow  
More usable land for crop production

Valley conditions between Highway 6, terrace



North side of BNSF Railway tracks



Flat agricultural land ideal for supporting  
airport program

Visual pathway to river from I-80

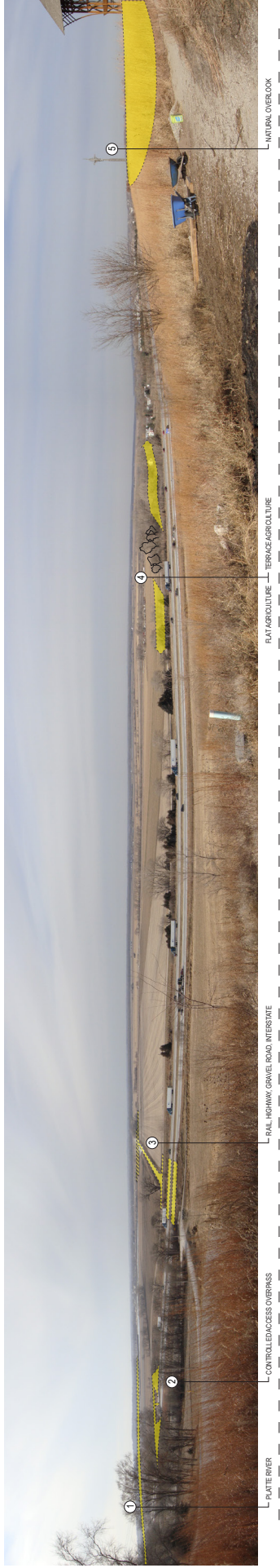


Hills at the periphery with view towards Platte  
Chance to separate program, provide open space

# NATURAL

topographical inventory of the site





Hilltop near Holy Family Shrine, I-80



Gravel road does not intersect I-80  
Flat land towards Platte River

Gravel road at southern-most point, I-80



Grade increase of I-80  
Road follows topography through gentle curve

Elevation change along US Highway 6



Grade change at edge between hills-flatland  
Large land terracing shown by road.

Electric power lines criss-cross site



Power line transmission through site  
Doesn't always follow roads, across open land

US Highway 6 Intersection (stoplight)



Attracts a lot of automobile traffic  
Demonstrated need for parking

BNSF Railroad, US Highway 6, Agricultural Land



# INFRASTRUCTURAL systems inventory of the site

## CONSERVATIVE:

locates HSR along the existing BNSF Railway (national network plan)

### Problems:

Going through small towns and less populated areas at high speeds either means the infrastructure separates from grade through the towns; or the condition of speed needs to constantly change for at-grade railroad crossings in urban cores/population centers.

### Benefits:

Large cities don't need to change much of the infrastructure to accommodate the new system.

The need for new right-of-way development rights might not be applicable since the infrastructure for the high speed rail network would already be in place, with the exception of retrofitting existing tracks to accommodate for the new trains.

### Drawbacks:

Small towns which wouldn't be directly serviced by the new rail transportation system would lose highway traffic which would eliminate some of its economic generation.

Unless dedicated tracks are laid down, operating on freight rails raises the issue of competing with companies such as BNSF and Union Pacific for commuter rail transportation - hurts both systems by taking away the carrying capacity by accommodating both.

### Other:

Cities would need to consider zoning factors related to commuter rail stops, which typically run through industrialized districts in the city.

## INTELLIGENT:

locates HSR along the existing Interstate Highway infrastructure

### Problems:

Preferences larger cities, where some Interstates directly serve downtown areas, creating a need for circulation separation for operation and access.

Requires obtaining independent right-of-way development rights.

How does this begin to influence transportation corridors in America by focusing the movement of people along the ground around a backbone network?

### Benefits:

Circulation and congestion issues revolving around interstate traffic is lessened by providing alternative transportation modes.

Public transportation projects in America have seen high rates of success in the recent history, prompting city planning departments to expand the network with additional modes of transportation or new routes to serve greater percentages of the population.

Lessen our reliance on cars by predicting transportation routes by generalizing origin and destination points.

### Drawbacks:

Figuring out spatial logistics associated with operating train service near Interstates and in dense urban fabric, including accessibility, parking, etc.

### Other:

Development plans for the national network more closely represents Interstate pathways as routes/connections between cities.

## COMPROMISE:

switching between sections of existing Interstate Highway sections and freight rail sections

### Problems:

Determining the most intelligent and economically feasible route between larger cities, population centers, urban areas which has the greatest potential to draw the largest numbers of commuters.

Takes up considerable amounts of land to switch back and forth between the Interstate and railroads - especially revolving around the issue when the two networks aren't located near each other.

### Benefits:

Identifies needs in high-traffic areas, interfacing between transportation modes that make sense and provide the greatest opportunity for switching between automobile, train, etc.

Requires less planning for new routes, since it would be restricted to one or the other based on distance, topography, expected ridership demographics.

### Drawbacks:

Switching between Interstate and railroad networks has the potential to actually weaken the high speed rail network, adding unnecessary costs for construction and rendering more land unusable than focusing around one type of development.

### Other:

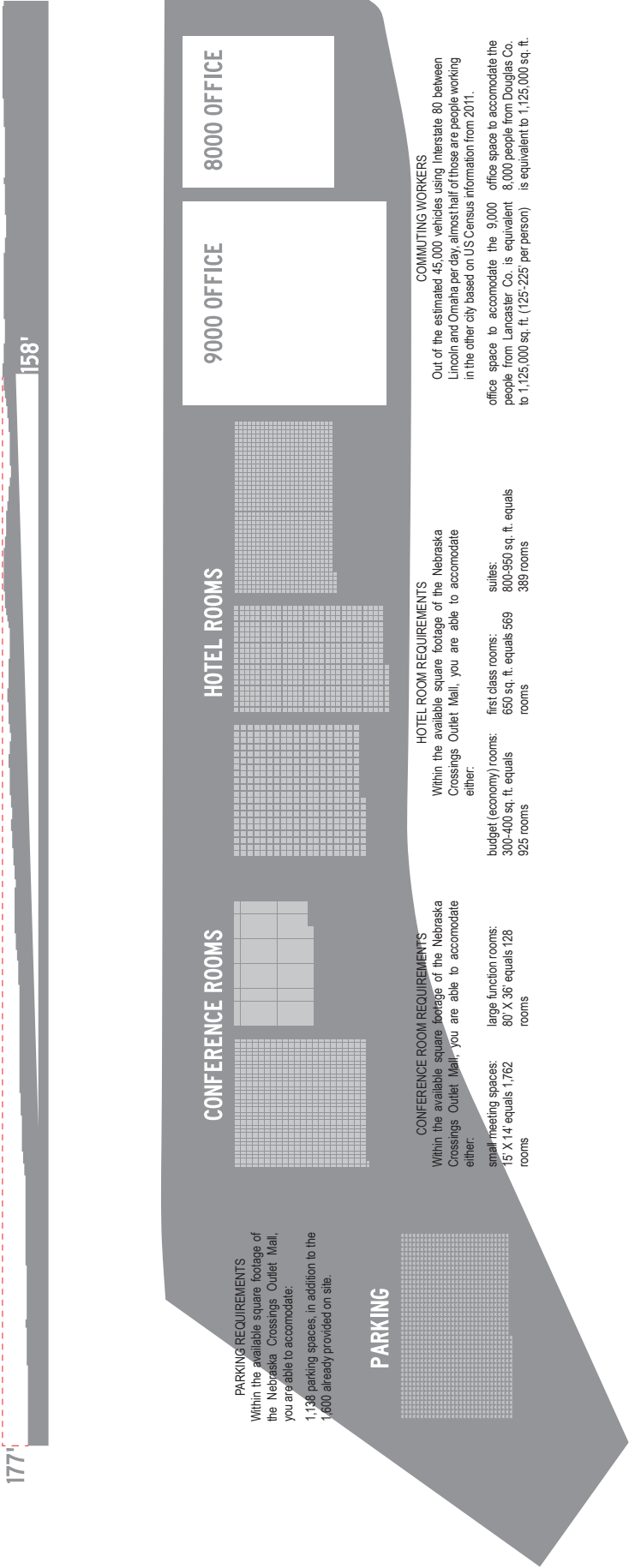
Regional high speed rail networks focused along the Interstate could interface with local light rail projects restrained to freight tracks at locations where the railroad and Interstate run close to each other.

# APPROACH

locating the high-speed rail network along existing infrastructural paths

HIGH SPEED TRAIN SLOPE REQUIREMENTS

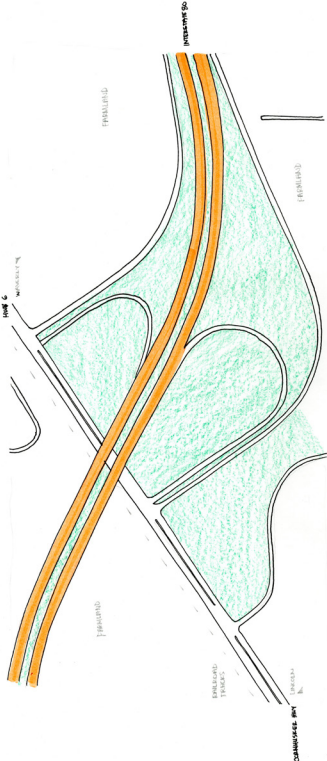
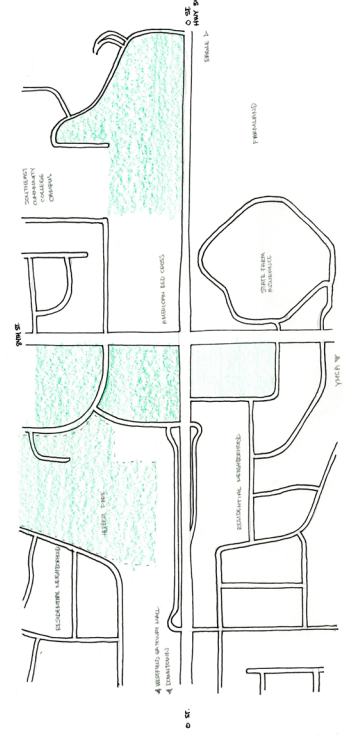
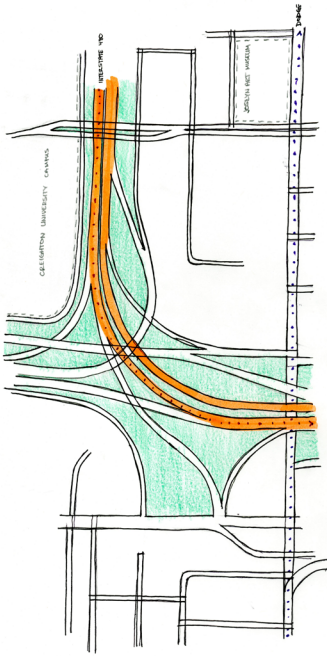
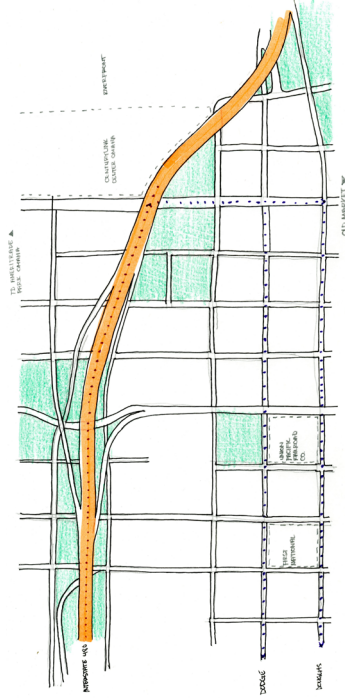
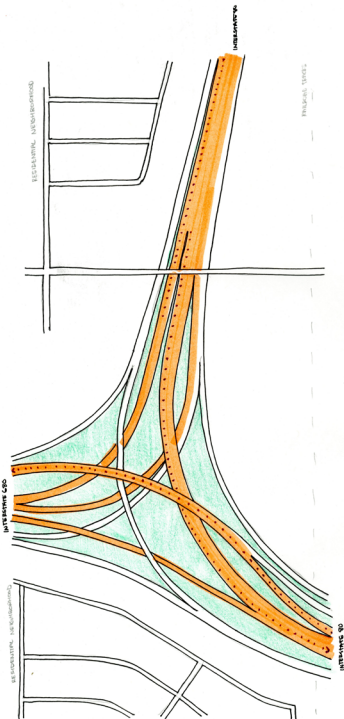
Recent precedent studies completed in California for their integration of a high-speed rail network show that slopes between one and three percent are acceptable for the tracks - which is the equivalent to 158' /mile (3%) or 52' /mile (1%). Across the site adjacent to the new Nebraska Crossings Outlet Mall, the most drastic sloping area of the site decreases at a three percent slope (177' at the highest-to-lowest points) - proving that the multimodal transit hub has the potential to locate itself at either the highest point on the site or further down along the site section.



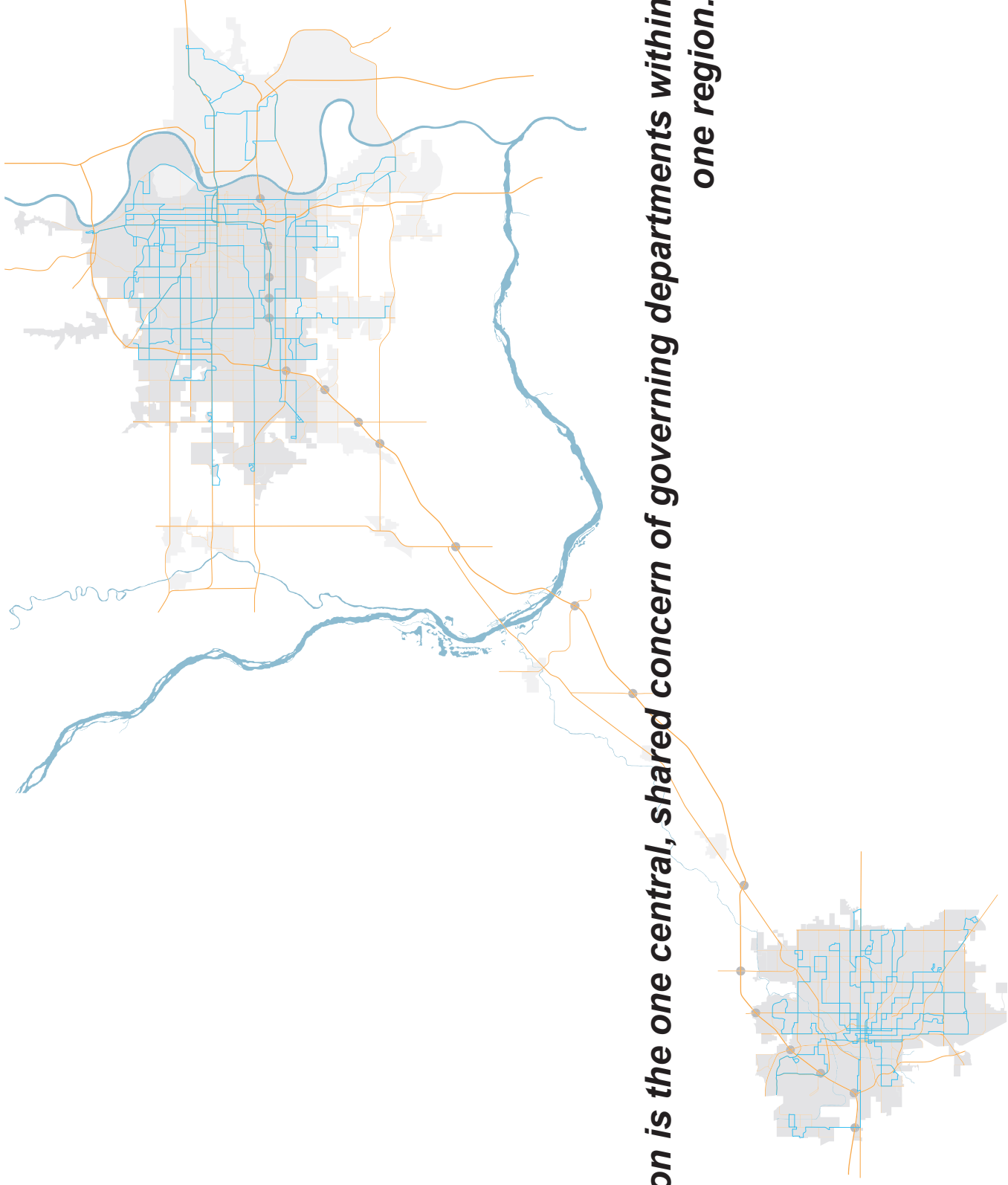
**PROGRAM**  
spatial comparisons to nebraska crossing outlet





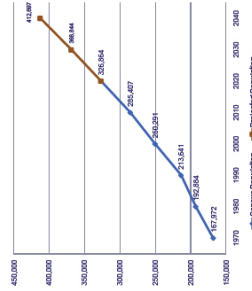
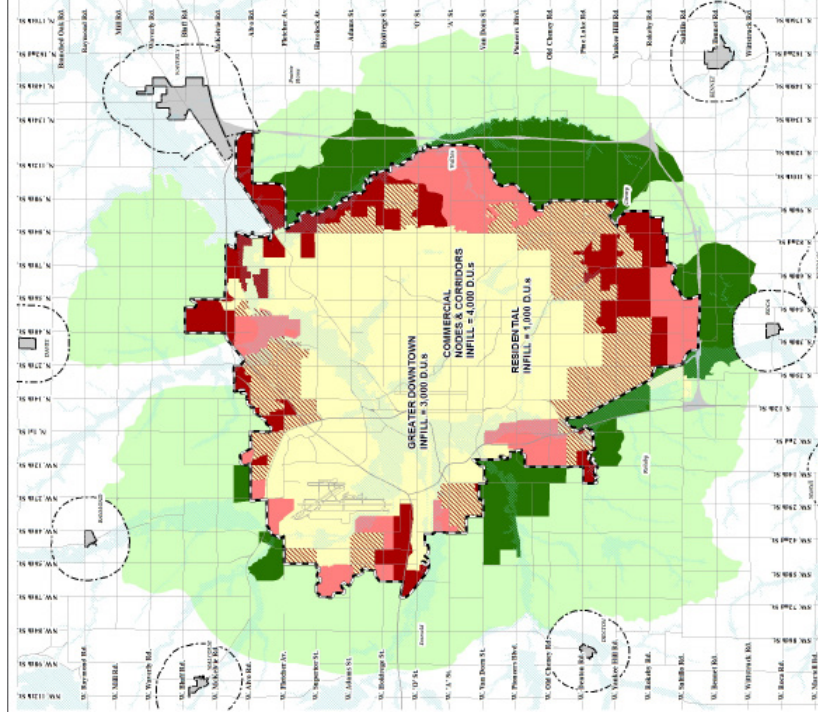


***Transportation is the one central, shared concern of governing departments within one region.***



LEFT: Mapping the relationships between Lincoln and Omaha, isolating transportation networks connecting the two cities.

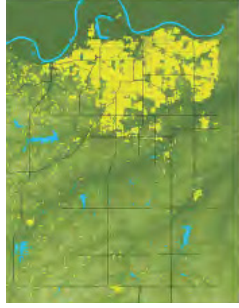




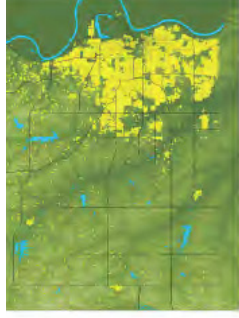
**Since the 1950s, the majority of development in Lincoln has been on the edges of the city, progressing multi-directionally with strong growth to the south and east.**

Over 65, Generation Y demographics express a desire for a more urban setting which includes **access to transit, proximity to shopping and dining, and smaller dwellings.**

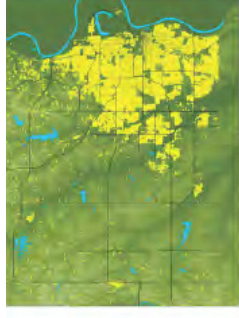
LEFT: Expected population growth in Lancaster County, CENTER: 2040 Priority Growth Areas in Lincoln and neighboring towns, RIGHT: Documenting growth in Lincoln from 1950-present.



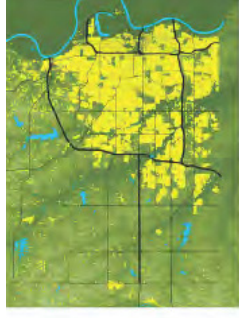
Population: 223,800  
Urbanized Area: 44 mi<sup>2</sup>



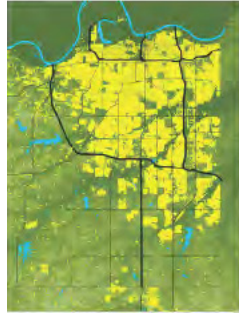
Population: 251,100  
Urbanized Area: 48 mi<sup>2</sup>



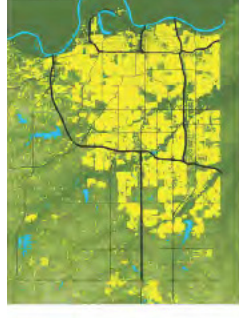
Population: 301,600  
Urbanized Area: 61 mi<sup>2</sup>



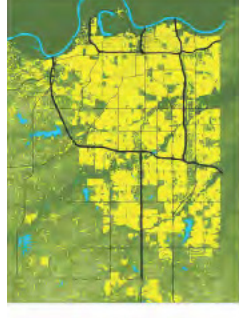
Population: 346,900  
Urbanized Area: 82 mi<sup>2</sup>



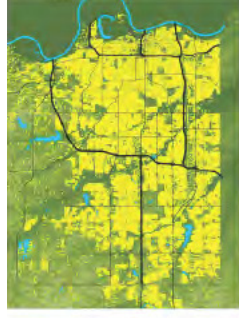
Population: 313,900  
Urbanized Area: 96 mi<sup>2</sup>



Population: 335,800  
Urbanized Area: 110 mi<sup>2</sup>



Population: 390,000  
Urbanized Area: 126 mi<sup>2</sup>



Population: 408,900  
Urbanized Area: 153 mi<sup>2</sup>

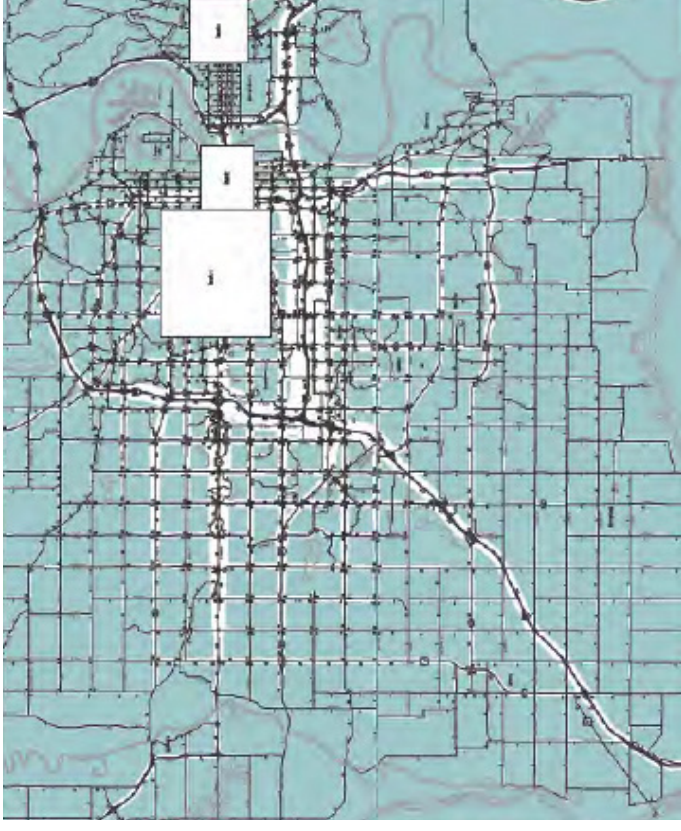
RIGHT: Documenting Omaha's population and land area growth between 1940-2010.

***Since the 1950s, Omaha's development patterns have been dependent on the automobile.***

Development patterns contribute to **increased traffic congestion,**  
**limitations on the pedestrian and mass transit activity.**

(LESS THAN THREE MILES) **50%**  
(ONE MILE OR LESS) **25%**

**2/3** of Americans cannot drive



RIGHT: Traffic volumes and flow patterns based on 2008 traffic volumes in Douglas and Sary Counties.

***As long as we continue to settle outside the boundaries for walkable city centers,  
our dependence on mobility will remain constant or increase.***



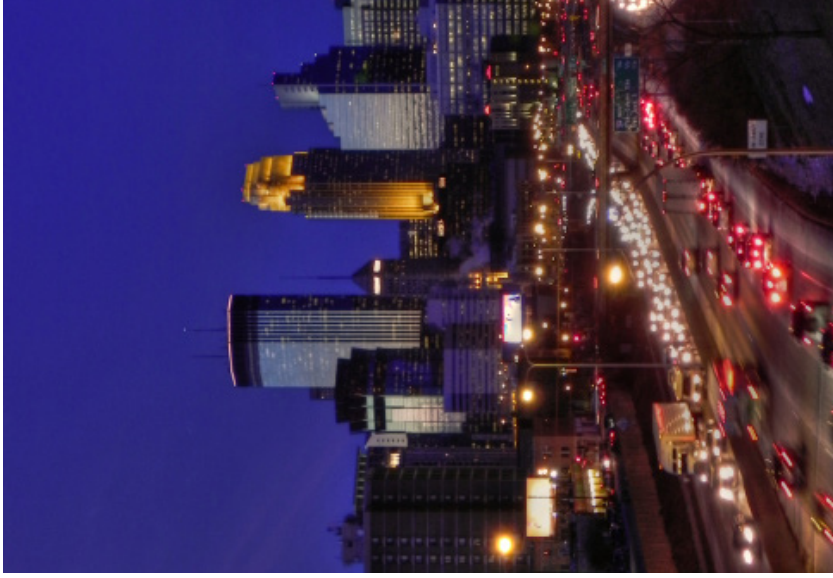
## ***How can you use mass transit ridership statistics in nearby regional cities to justify the investment in alternative public transportation modes in Lincoln and Omaha?***

Productive transit service requires **higher density** land development patterns that **link areas and employment, retail and service centers**.

Techniques for **reducing traffic demands** by **deferring trips to alternate modes of transportation** or **minimizing peak demands** reduces the need to increase the capacity of roads and reduces the cost for new projects.



...IS NOW CARRYING  
UP TO 14,000 PEOPLE  
ON WEEKDAYS  
EXCEEDING ORIGINAL  
PROJECTIONS  
BY **67%**

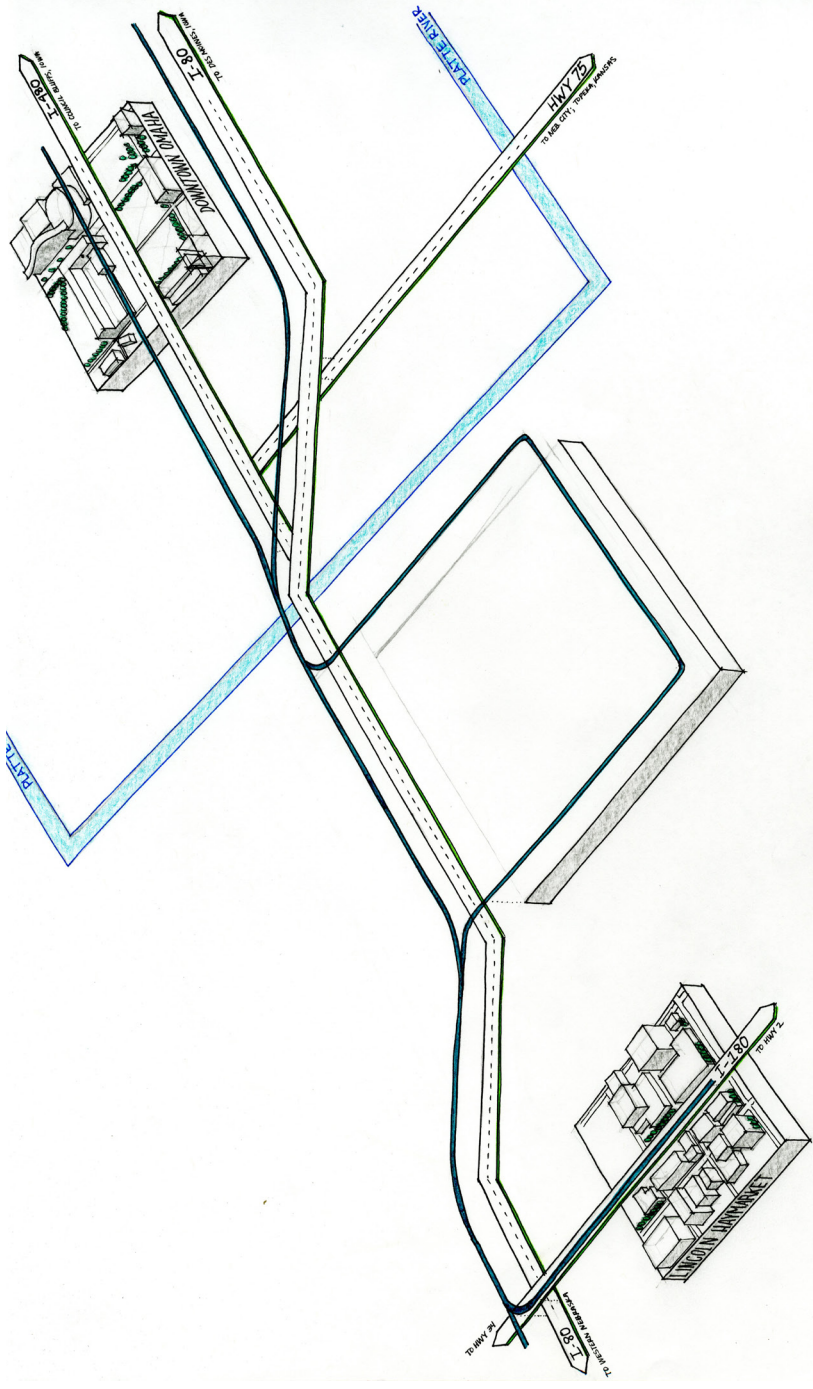


AFTER EIGHT  
YEARS, RIDERSHIP  
HAS REACHED  
**40,000**  
EXCEEDING THE 20-YEAR  
PROJECTION OF 37,000



LESS THAN TWO YEARS  
AFTER OPENING,  
ALREADY EXCEEDED ITS  
2020 RIDERSHIP OF  
**24,800**  
DAILY

LEFT: Denver's RTD Southwest Line. CENTER: St. Louis' Metrolink Light Rail.  
RIGHT: Minneapolis' Metro Blue Line.



## ***Located at Interstate 80 Exit 432 (near Gretna), the mall positions itself in-between Lincoln and Omaha***

Expands the market potential of the mall, with the ability to attract from Nebraska's population centers.

**35 miles east of Lincoln**  
**20 miles west of Omaha**

LEFT: Aerial Photograph over the newly completed Nebraska Crossing Outlets at Exit 432 along I-80. Also visible in the photo is Hwy's 6 and 31, and BNSF railroad.





Opening Fall 2013 / INet™ Proprietary Network

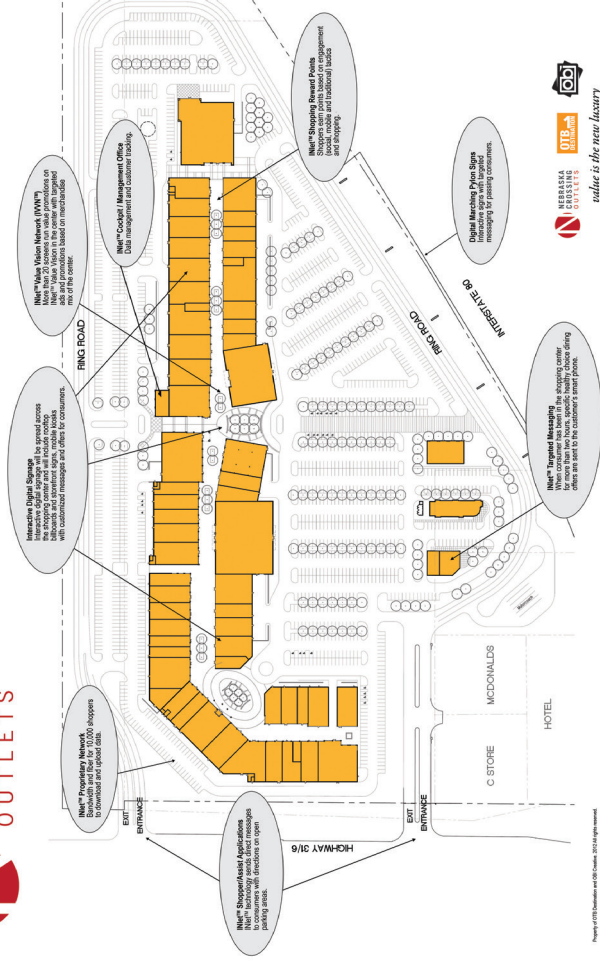


Image © 2013 Intel and © 2013 Intel. All rights reserved.



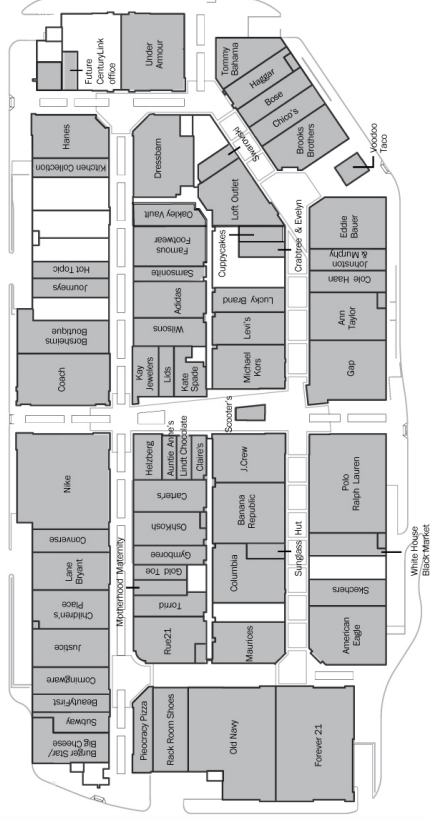
value is the new luxury

***In March 2012, demolition began on the worn 1991 mall and by April, “vertical construction” had begun.***

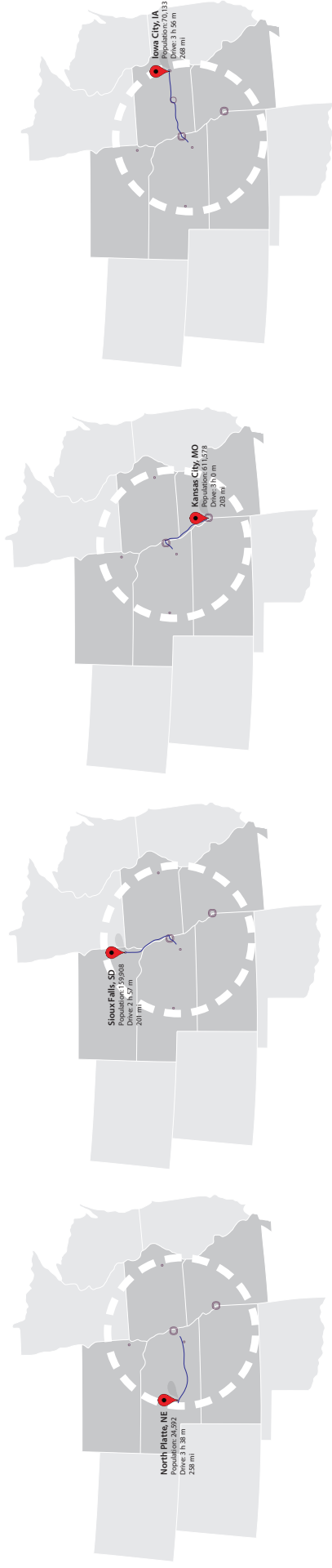
The original mall’s **straight-line** layout wasn’t very consumer friendly and outdated. The new mall has an **“oval race track” design**, which is easier to navigate, and the density of the stores allows for more tenants.

LEFT: Previous Outlet Mall design with minor additions to expand the retail potential of the site.  
RIGHT: New Outlet Mall layout design is more pedestrian friendly with the oval race track design.

NEBRASKA CROSSING OUTLETS



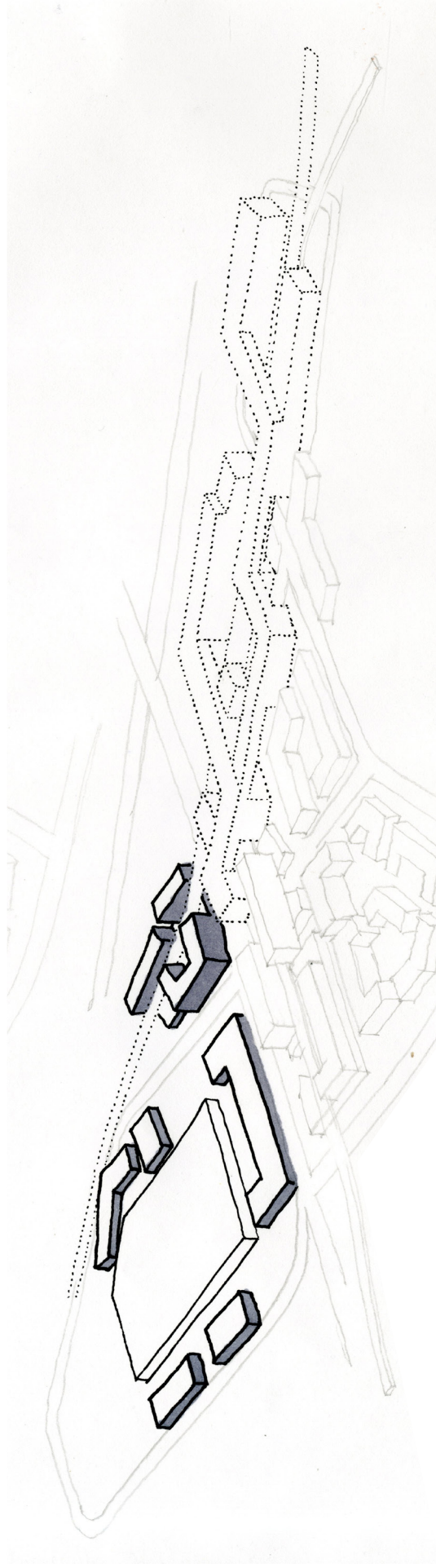
LEFT: Projected target zone maps outlining the distance and time expectant travelers would spend en route to the new outlets mall.



*As a regional center, it is anticipated to serve the community well into the future, and therefore should be planned in phases to accommodate the current conditions in the cities, and promote the introduction of additional mass transit connections.*

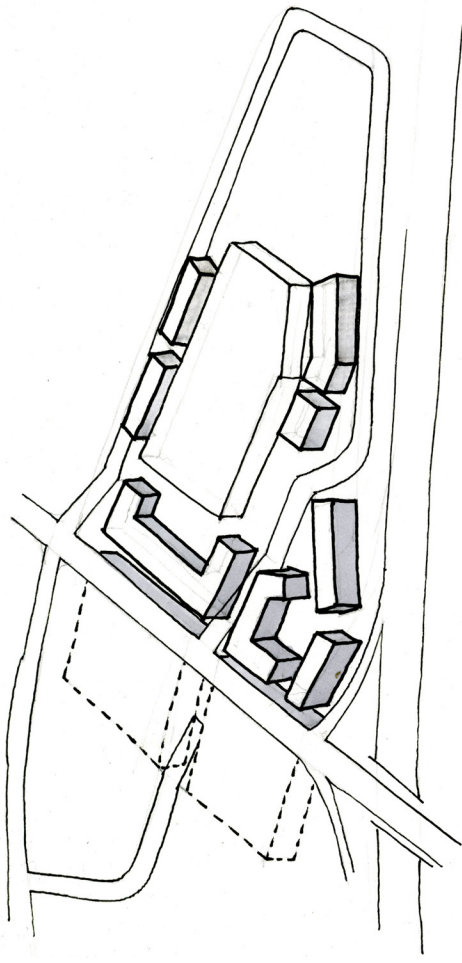
The mall's wider **target zone** includes shoppers from Sioux Falls to Kansas City, and North Platte to Iowa City - **a range of approximately 2.5 hours by car.**



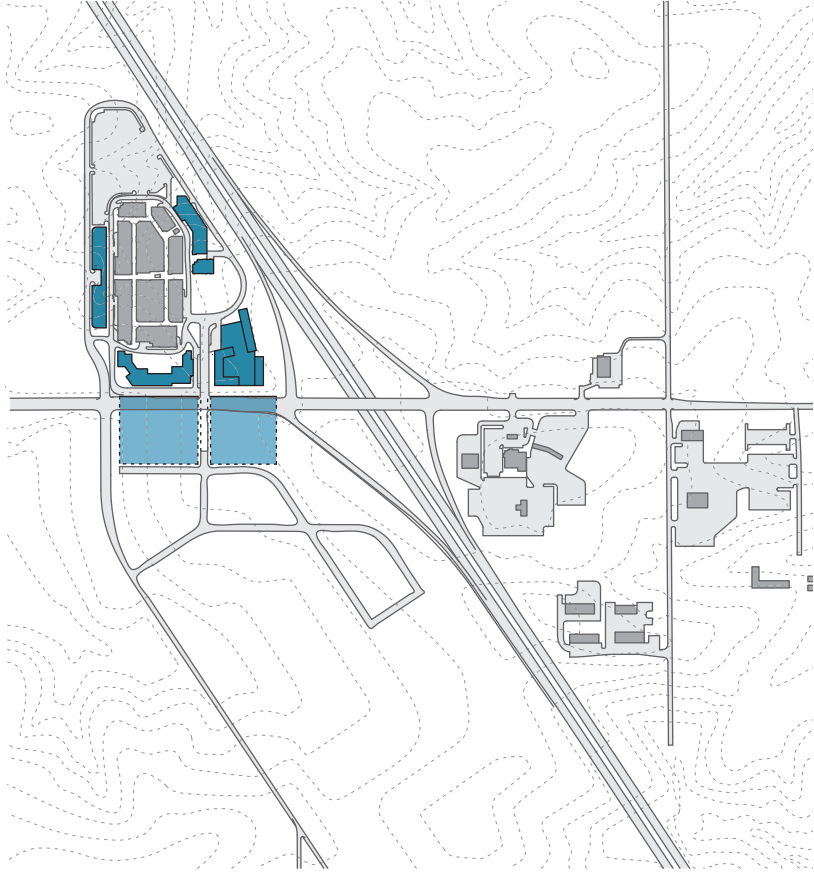


# PHASE 1

CROSSING OUTLETS + NEW RETAIL + HOTEL + PARKING

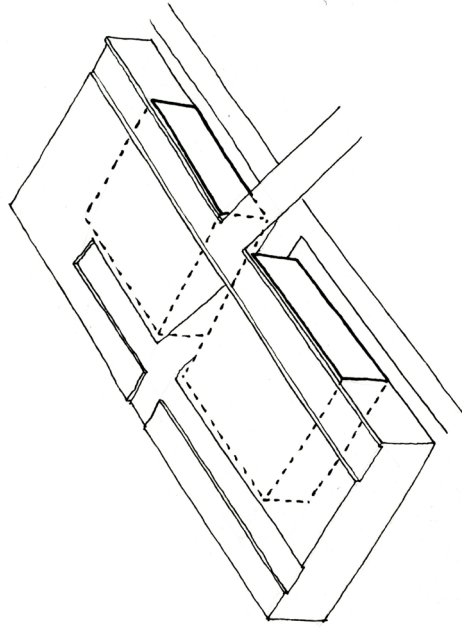


***Due to current plans for expansion to the retail outlets, consider an “urban infill” method of development which supports the future of the site.***

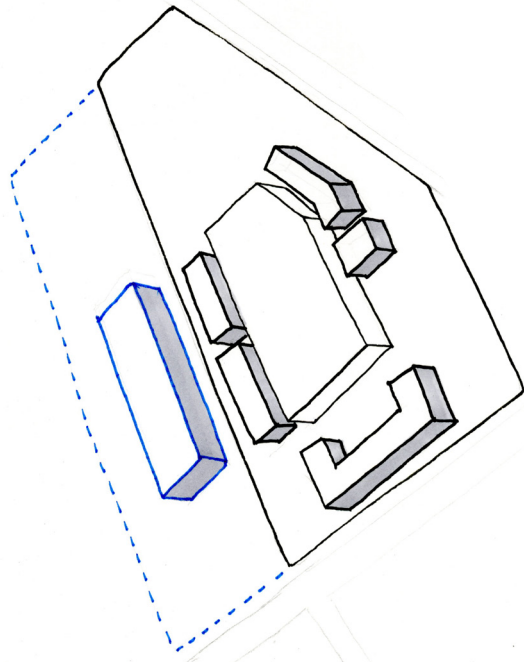


LEFT: Roman city plan showing Cardo and Decumanus as organizing elements.  
RIGHT: The urban fabric existent in the Manhattan borough, New York City.

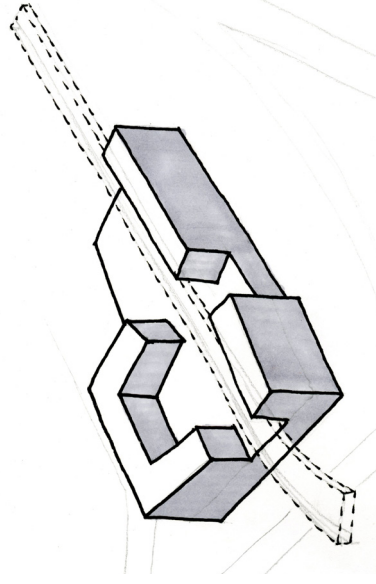
Existing problems at the site including **parking and sprawling plans**, are not intelligent forms of development. Begin to expand the program to include other services which might appeal to commuters to the site.



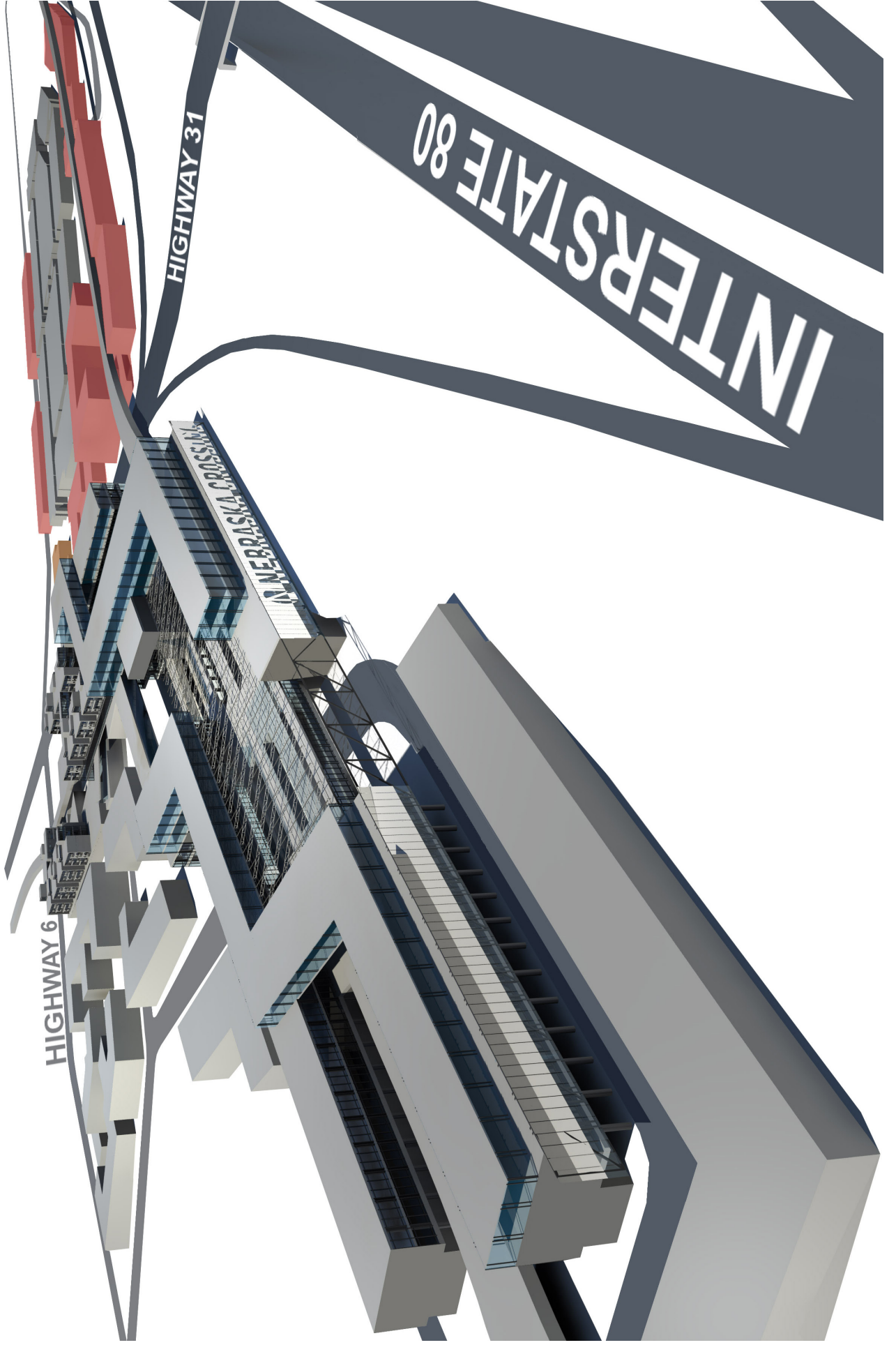
*bury parking*



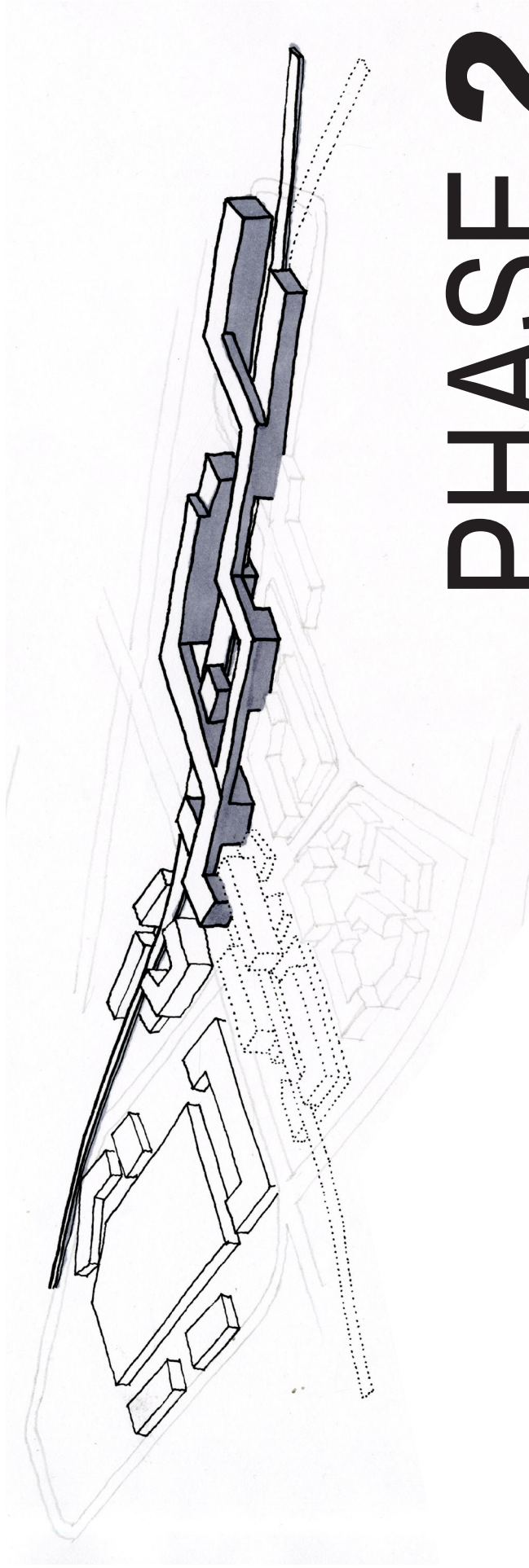
*redistribute program*



*future planning*

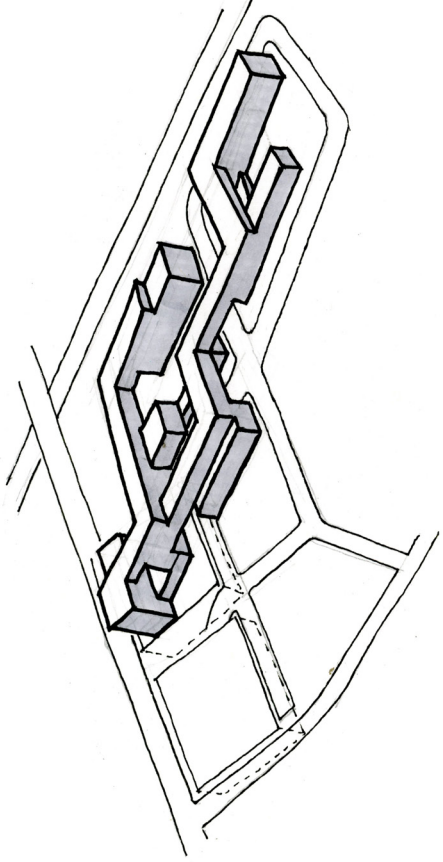






# PHASE 2

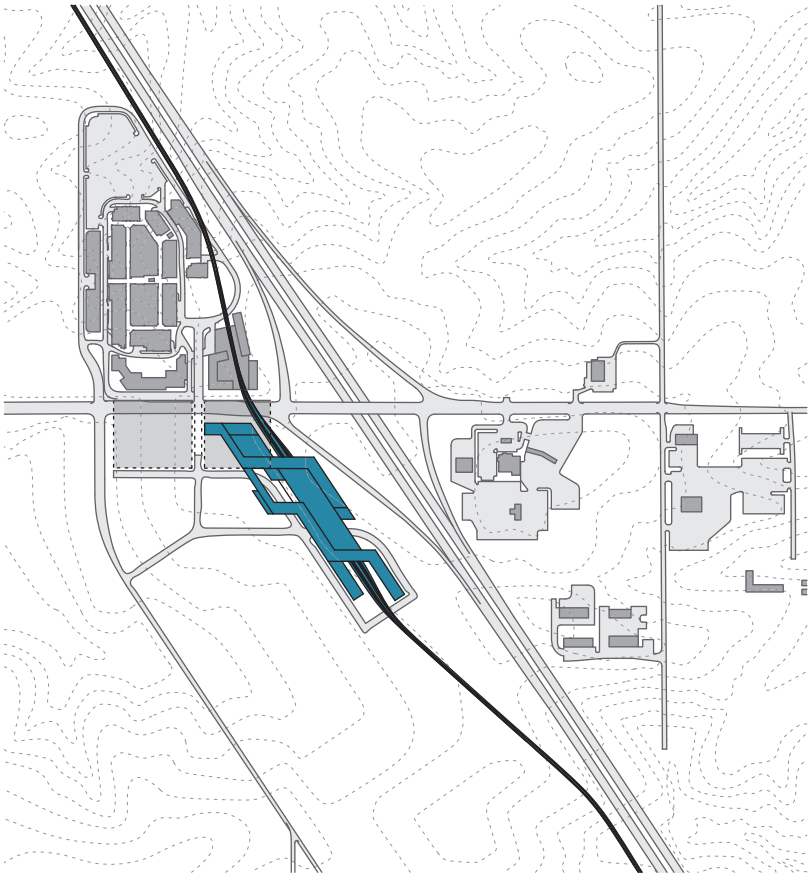
INTERMODAL TRANSIT HUB + OFFICES + I-80 LIGHT RAIL



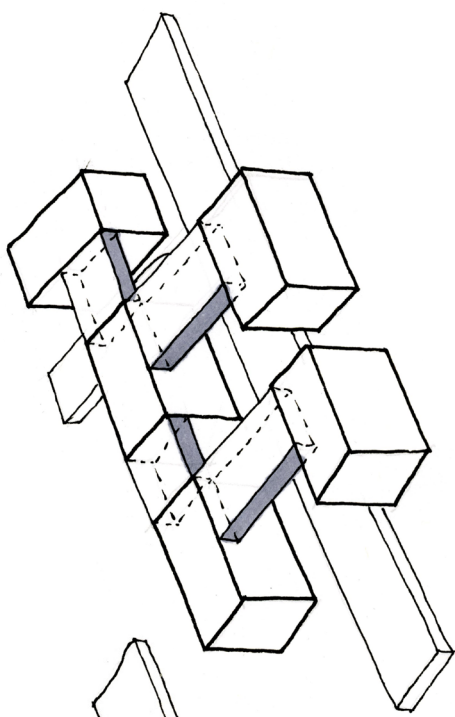
## ***Capitalizing on the location between Lincoln and Omaha to set up satellite offices and light rail service - reducing loads on existing infrastructure***

**17,000 employees** live in Lincoln/Omaha and work in the other city, and by 2050, that number increases to **approx. 31,500 commuting employees.**

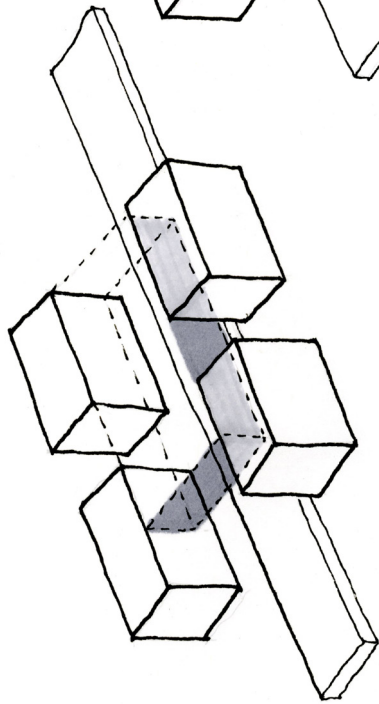
Technology in transportation has made it easier to skip the car, but information technology has made advancements which allow workers/commuters the ability to skip the commute all together.



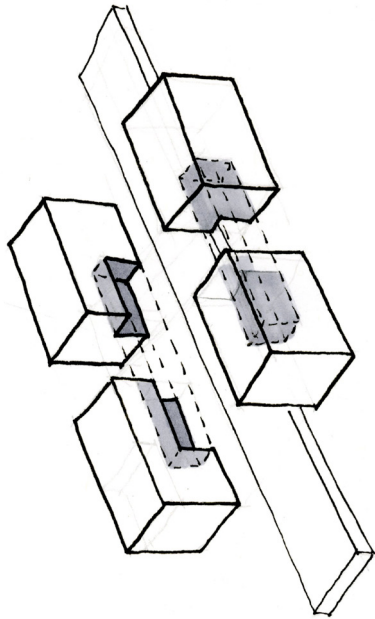
LEFT: Perspective Sketch of phase 2 intervention on the site.  
RIGHT: Plan view of phase 2.



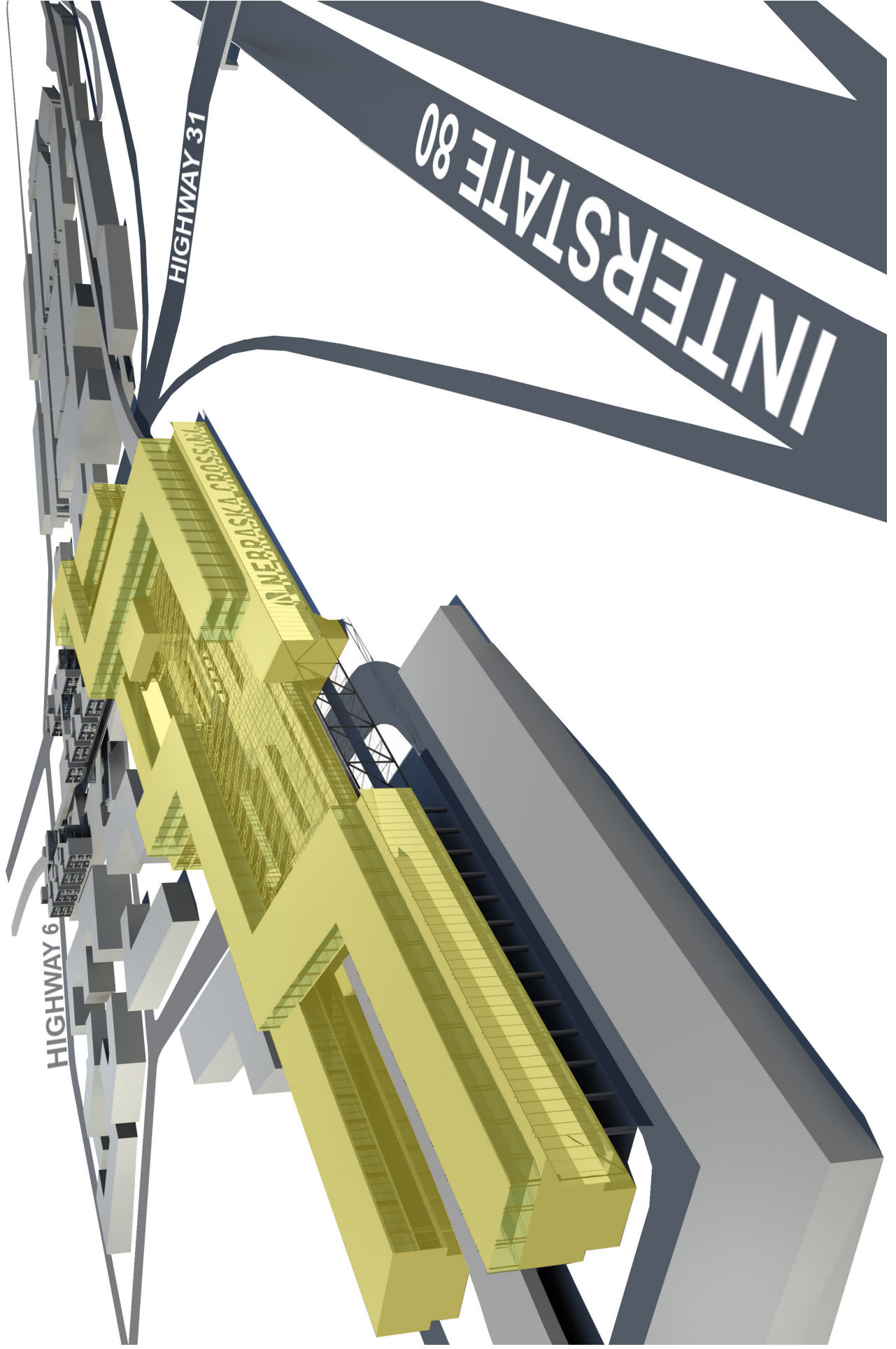
*linked connections*



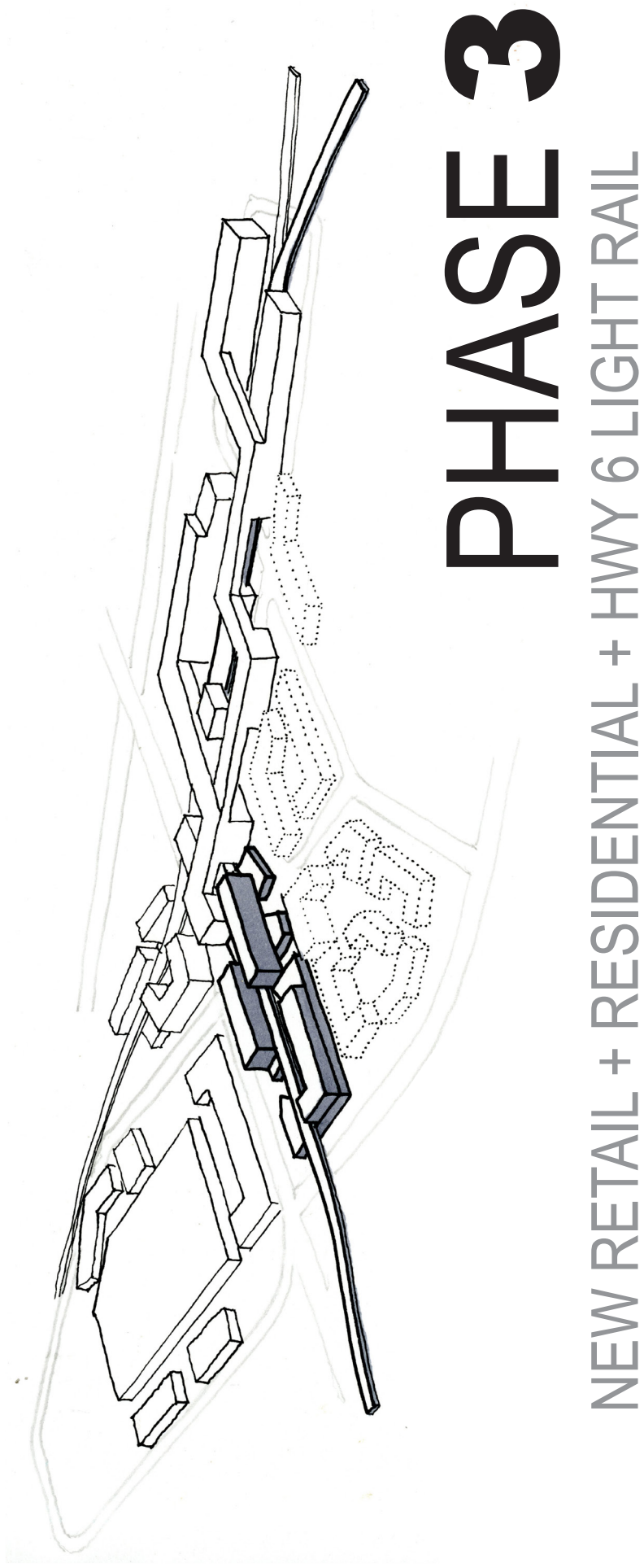
*enclosure of space*



*platform continuity*

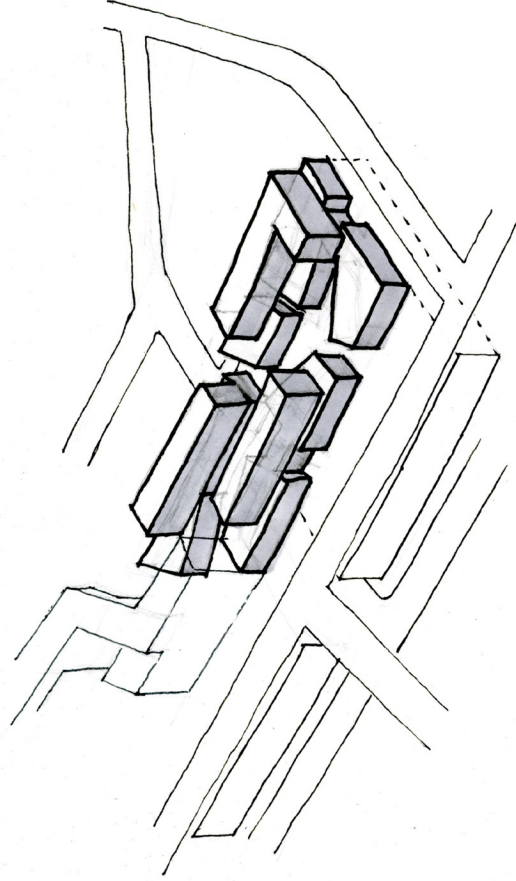






# PHASE 3

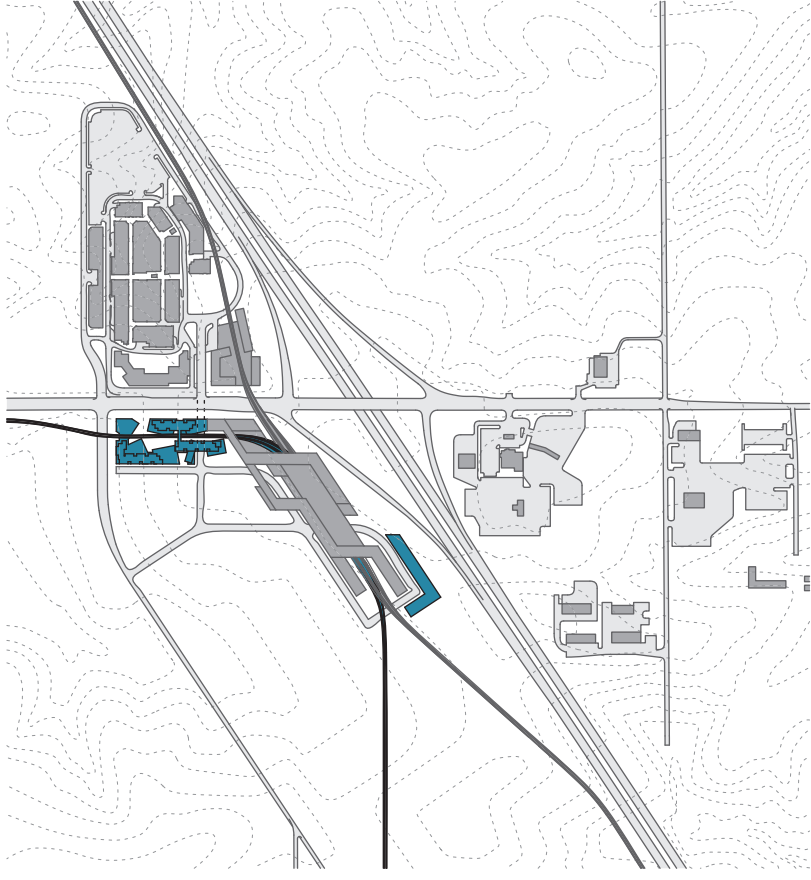
NEW RETAIL + RESIDENTIAL + HWY 6 LIGHT RAIL



***The growth of the site to include satellite offices and a transportation hub justifies the need for the site to support permanent residence structures.***

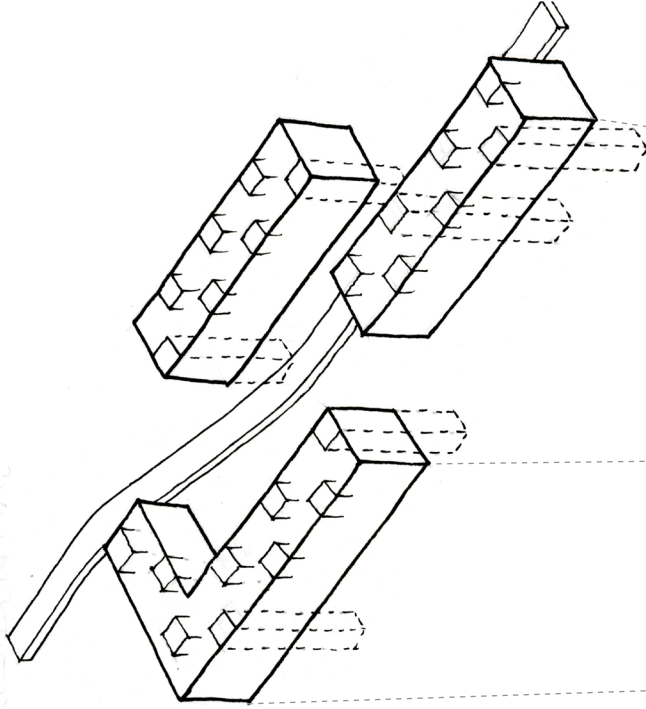
To counter traditional suburban growth, introduce higher density land use methods which couple the addition of residential units and an alternate Light Rail connection between Lincoln and Omaha along Highway 6.

Transportation has the potential to preserve rural Nebraska and act as a catalyst for future development in smaller towns.

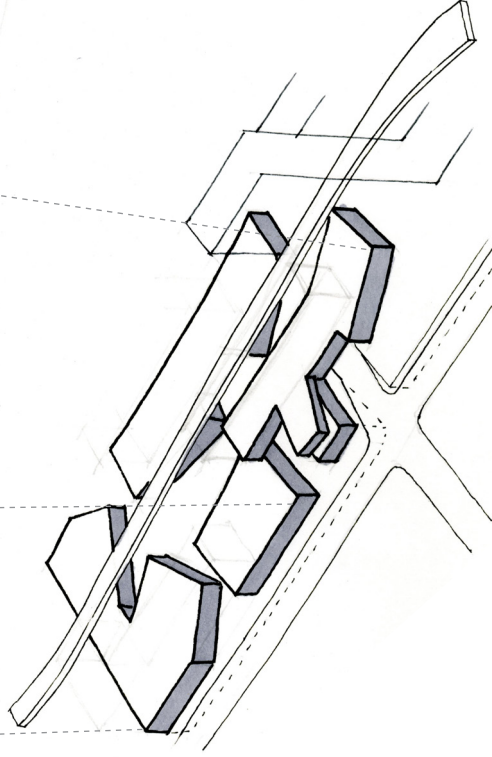


LEFT: Perspective Sketch of phase 3 intervention on site  
RIGHT: Plan view of phase 3.

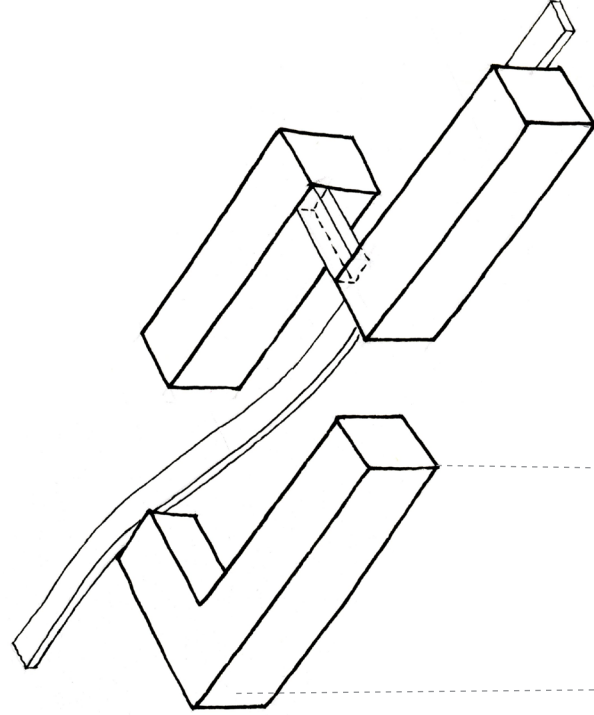
TRANSITION



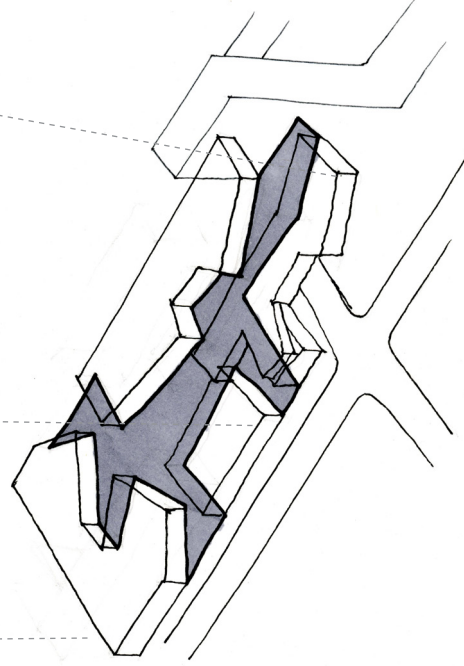
**vertical circulation**



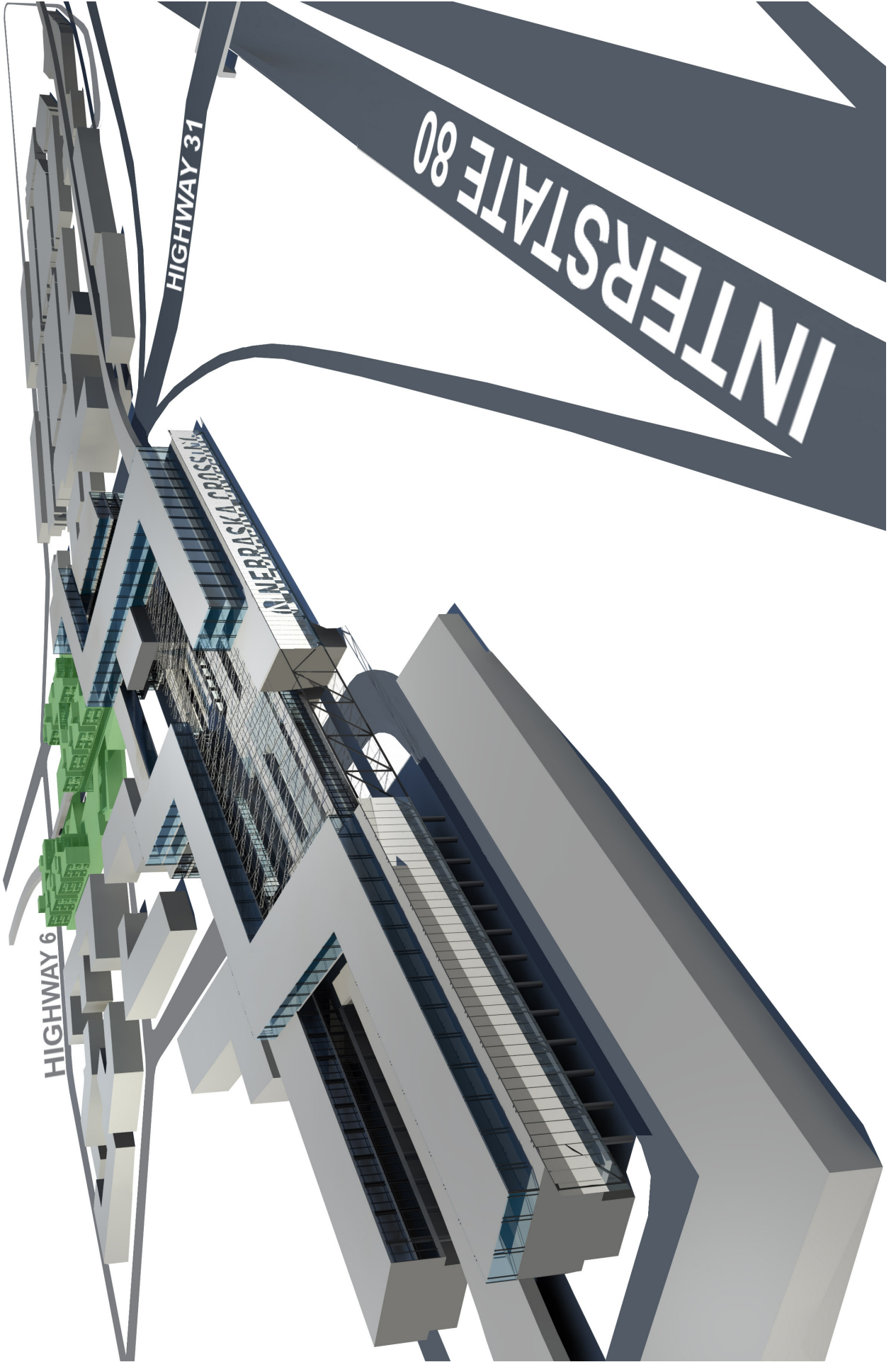
**relationship with light rail**



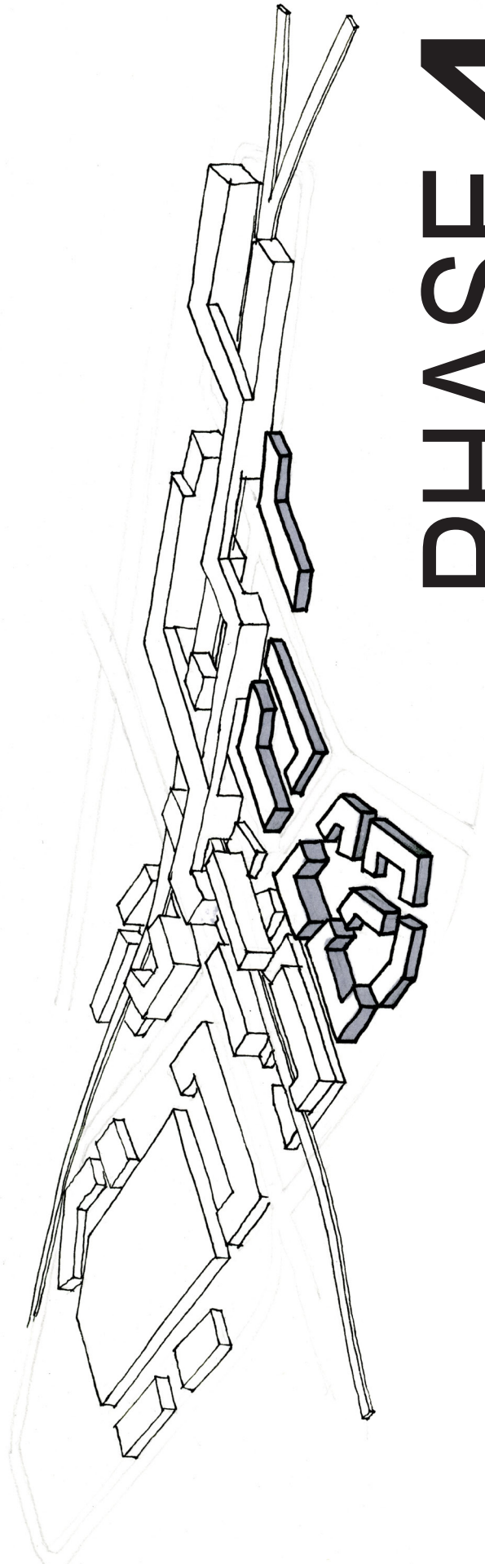
**skybridge linkages**



**public spaces**



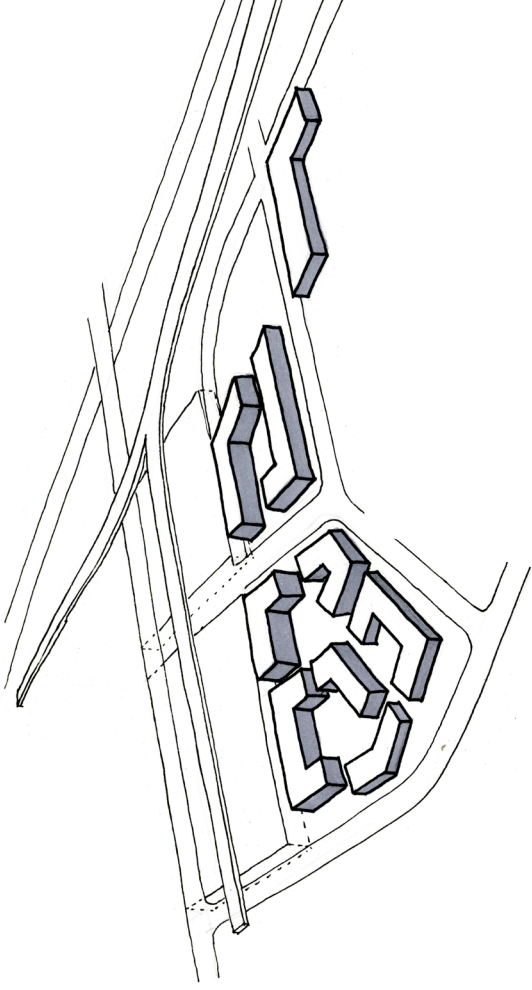




# PHASE 4

RESIDENTIAL BLOCKS + COMMUNITY SPACES

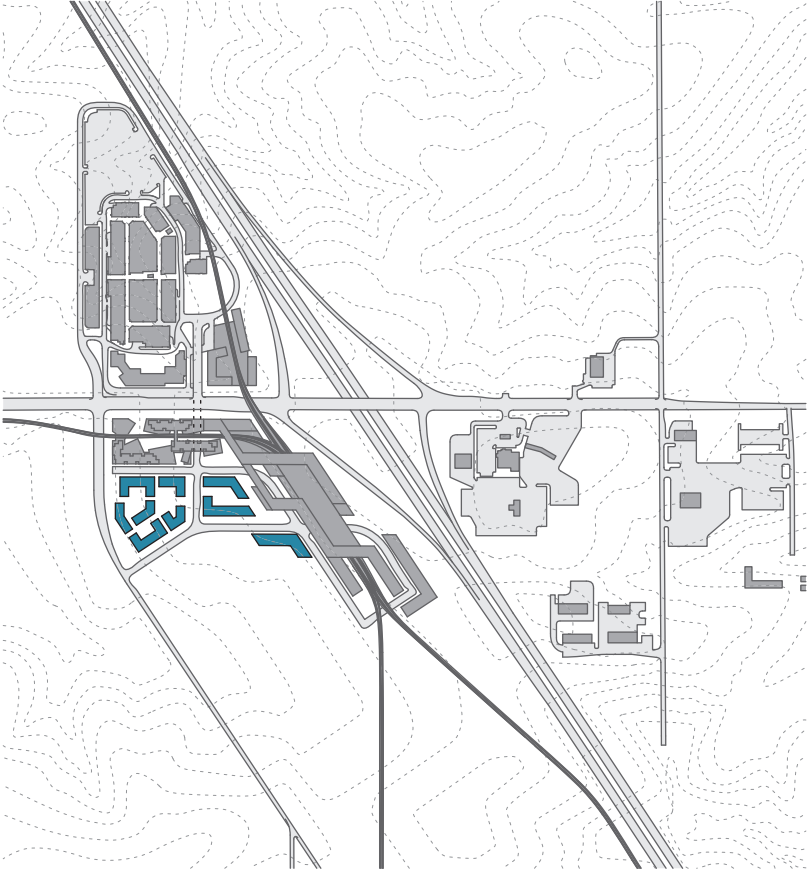




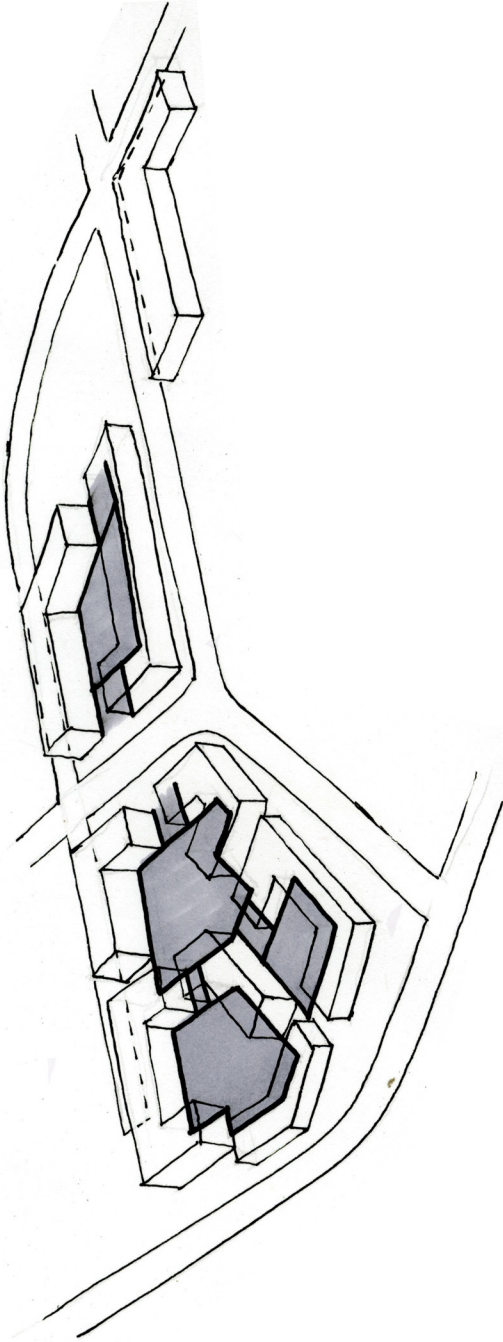
***With the projected increase in population of Lincoln and Omaha, land for housing will be at a premium - especially around city periphery.***

The population at the site will reach a critical mass of occupants needing  
shops aimed towards convenience/amenities requirements.

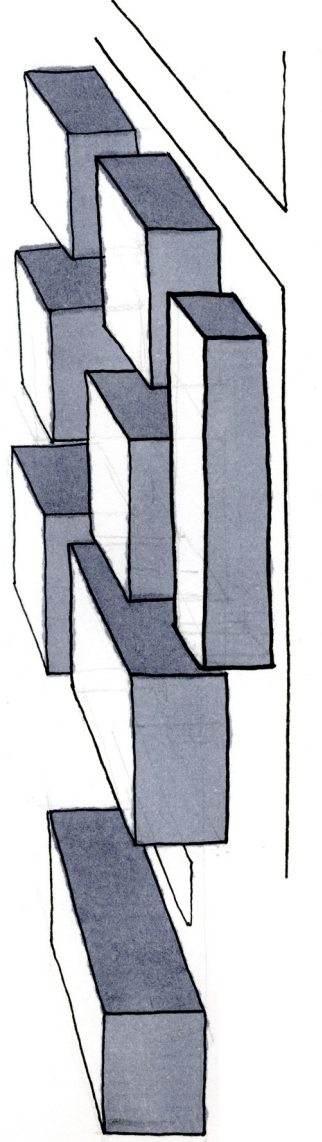
**Separating pedestrian movement** through the site from the street edge  
creates opportunities within the residential blocks for pedestrian paths  
connecting community spaces.



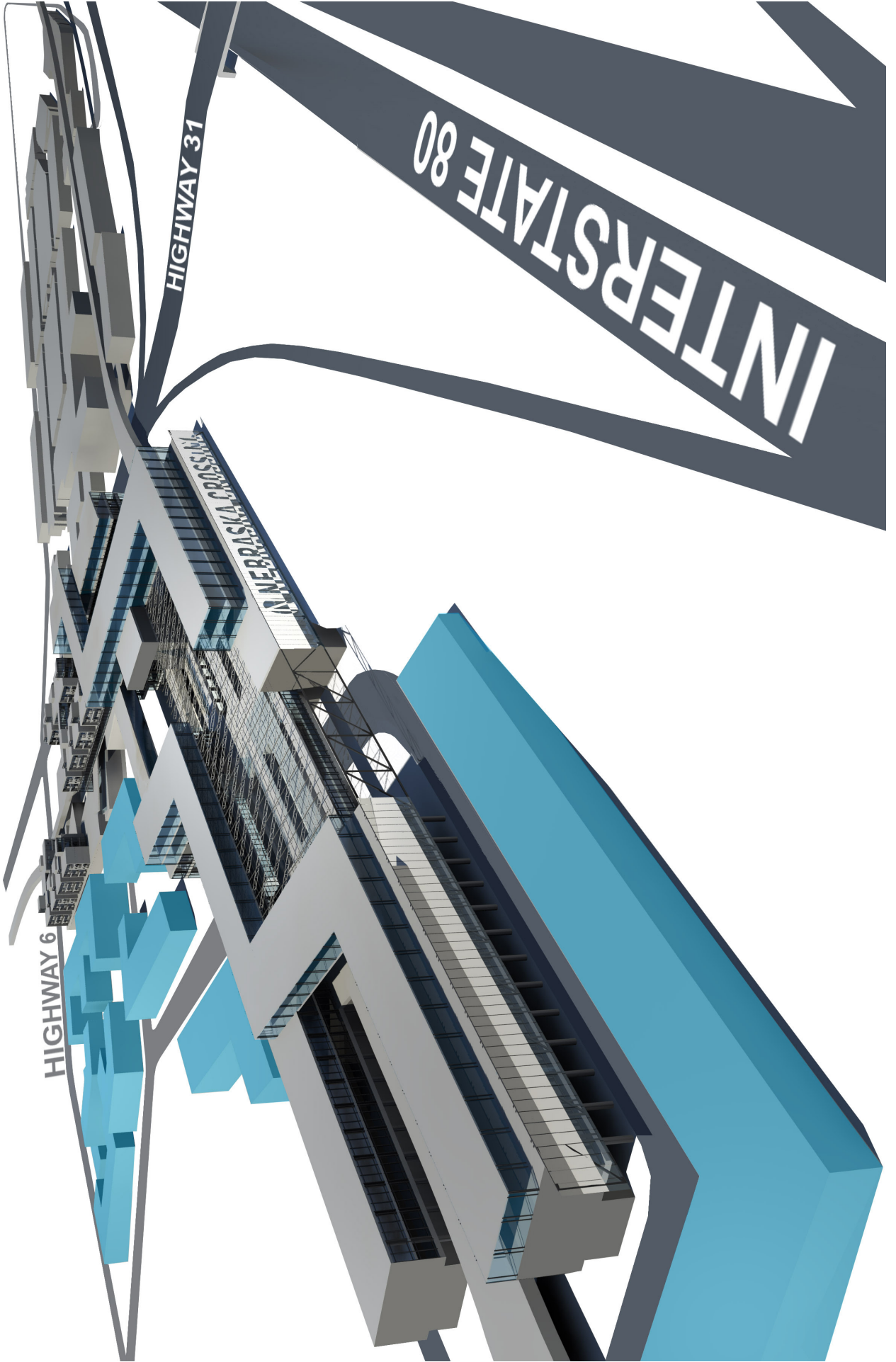
LEFT: Exploded Axonometric Program Diagram  
RIGHT: Perspective Circulation Program Sketch



*public spaces*



*staggering building heights*





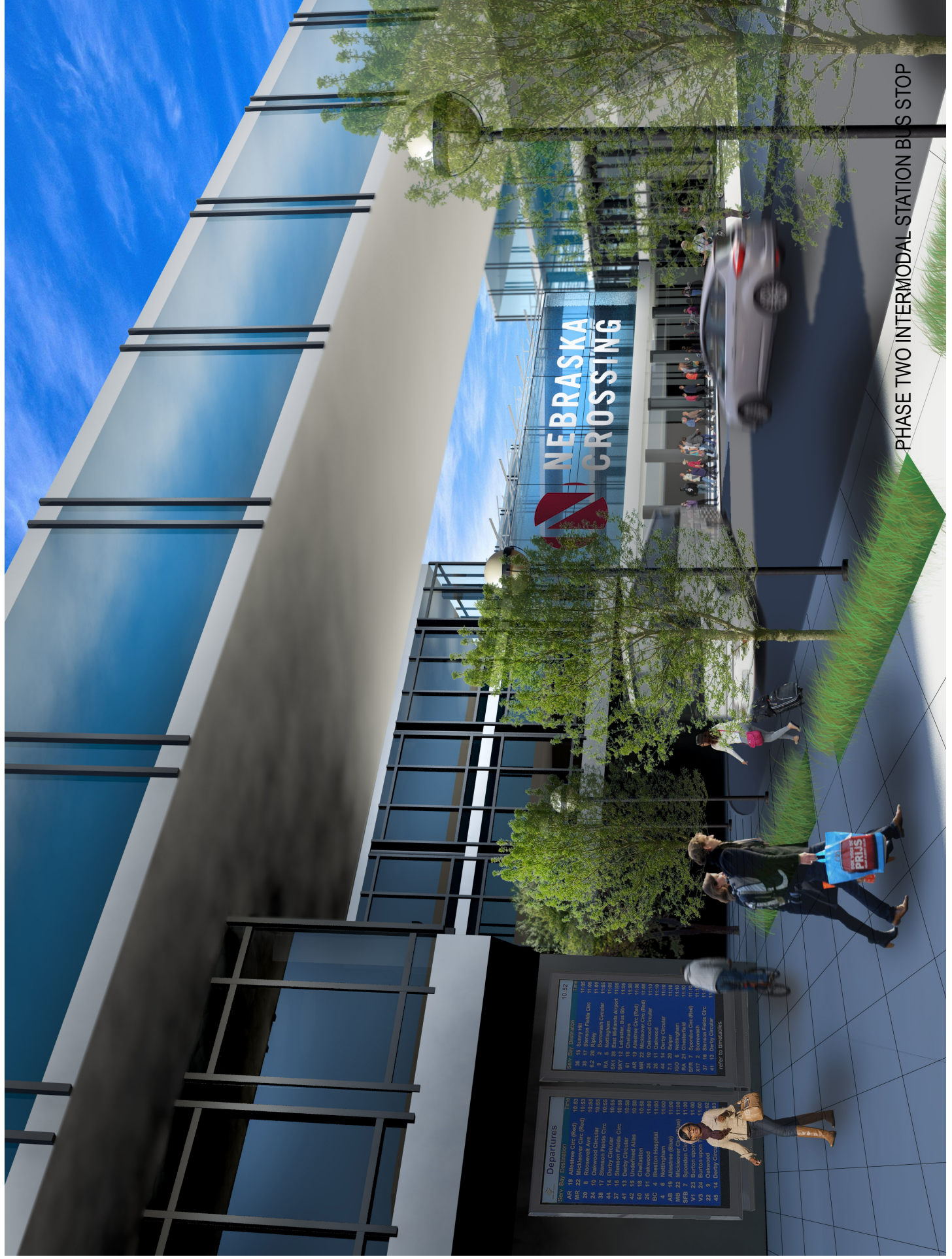






PHASE TWO MULTIMODAL STATION  
TRACKS AND PLATFORM LEVEL







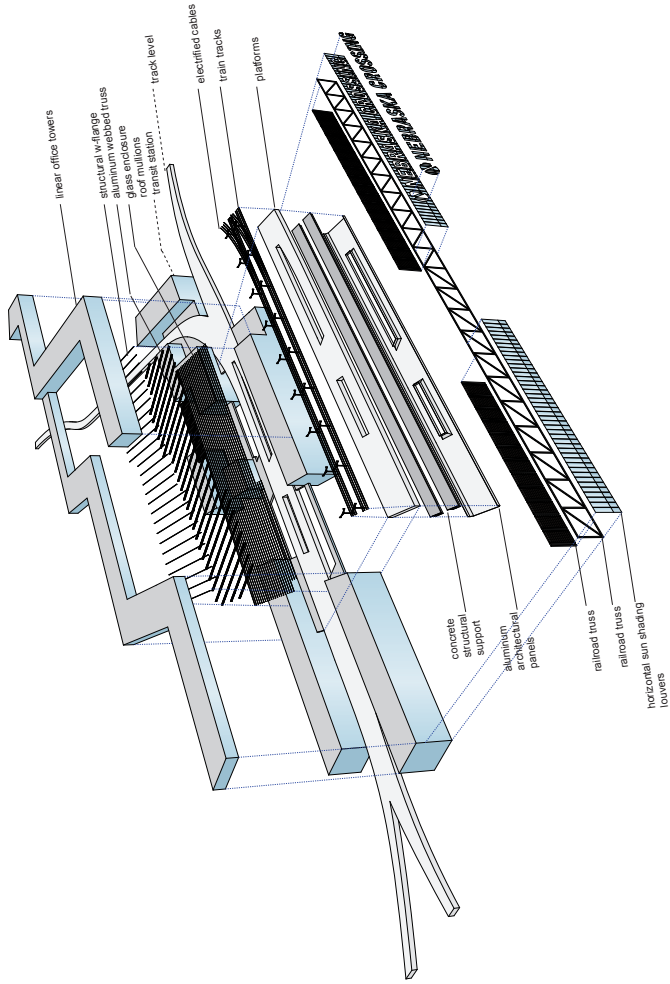


PHASE THREE RESIDENTIAL DEVELOPMENT  
+ HIGHWAY 6 LIGHT RAIL

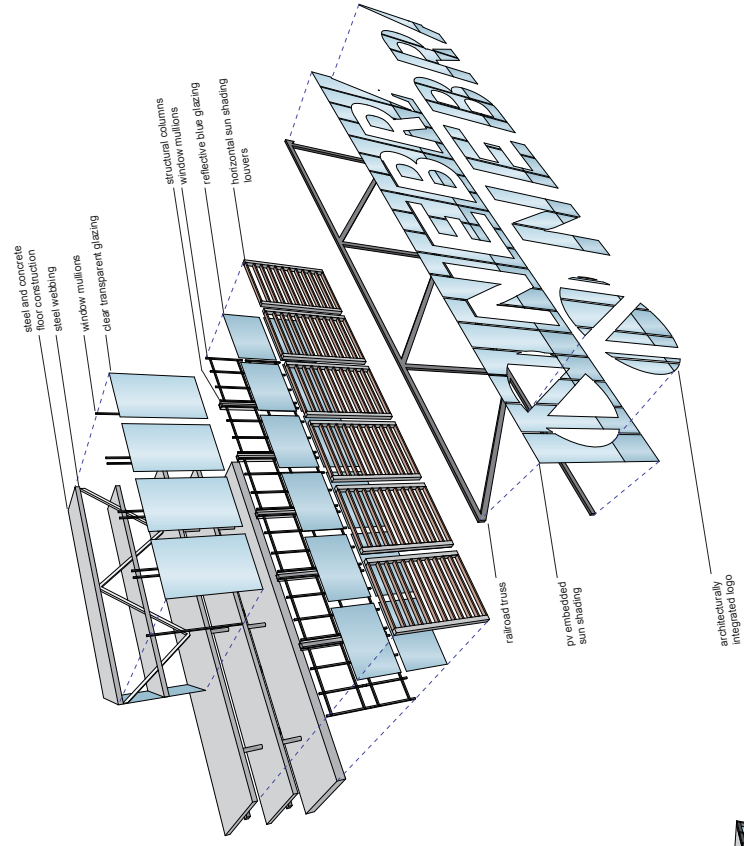




PHASE THREE RESIDENTIAL + RETAIL PUBLIC SPACE

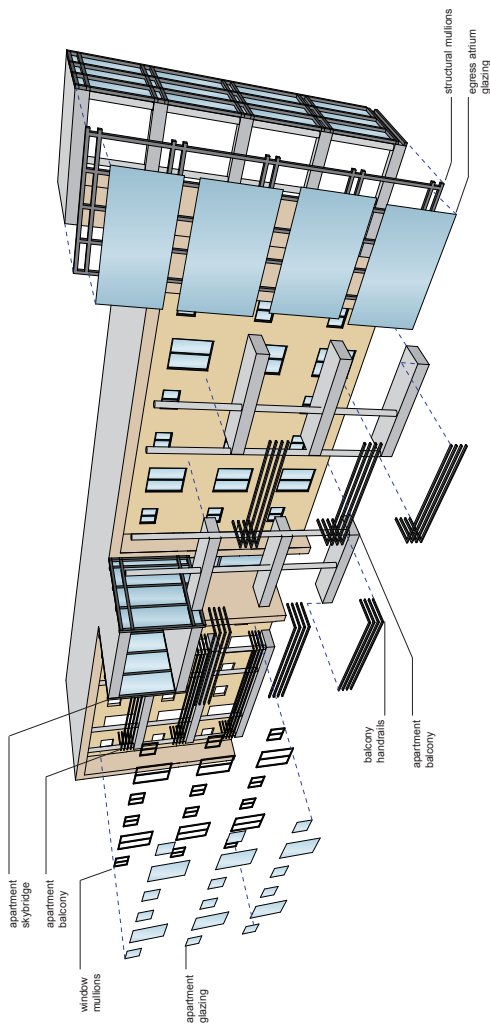


EXPLODED AXONOMETRIC  
multimodal transit and office buildings

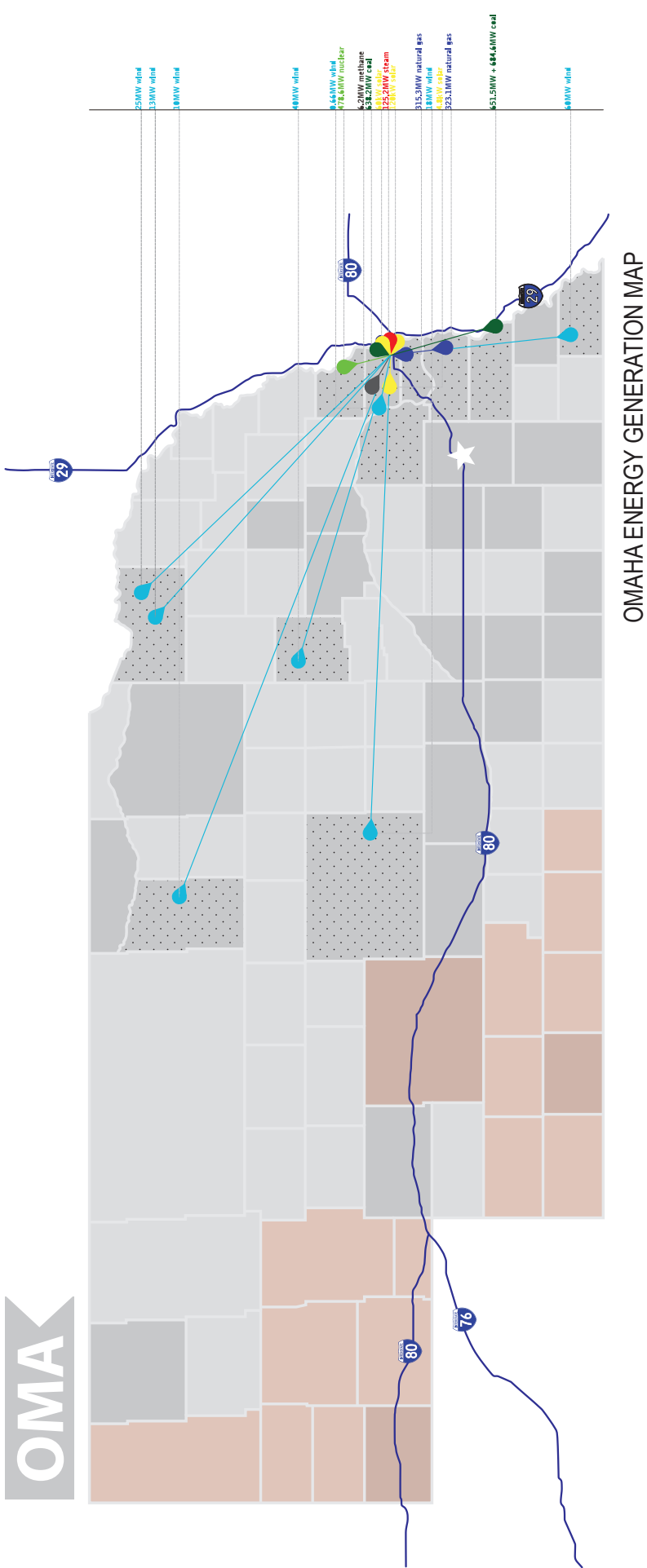


EXPLODED AXONOMETRIC  
residential buildings

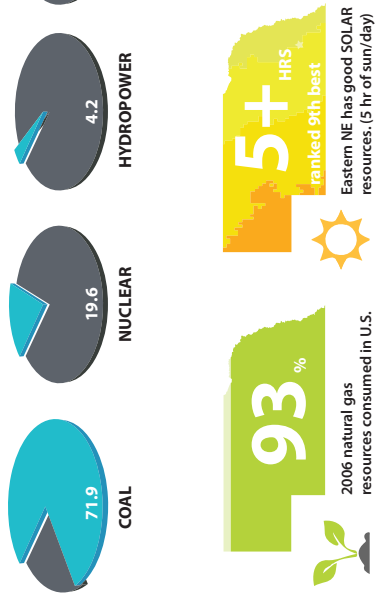
EXPLODED AXONOMETRIC  
residential buildings



# OMA

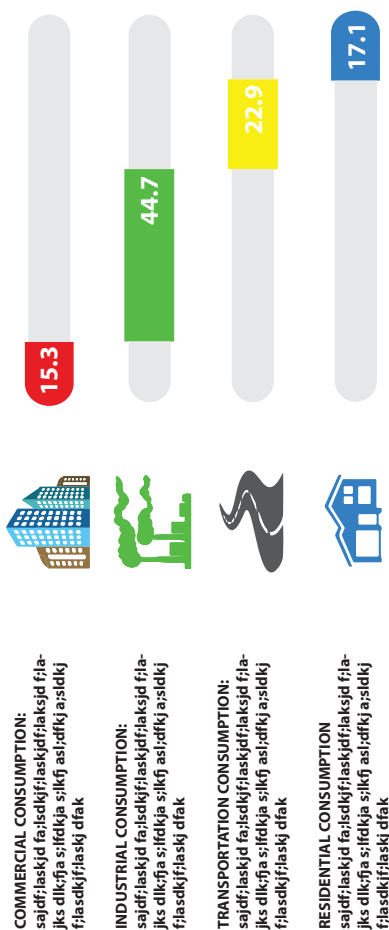


## % ENERGY PRODUCTION BY FUEL SOURCE

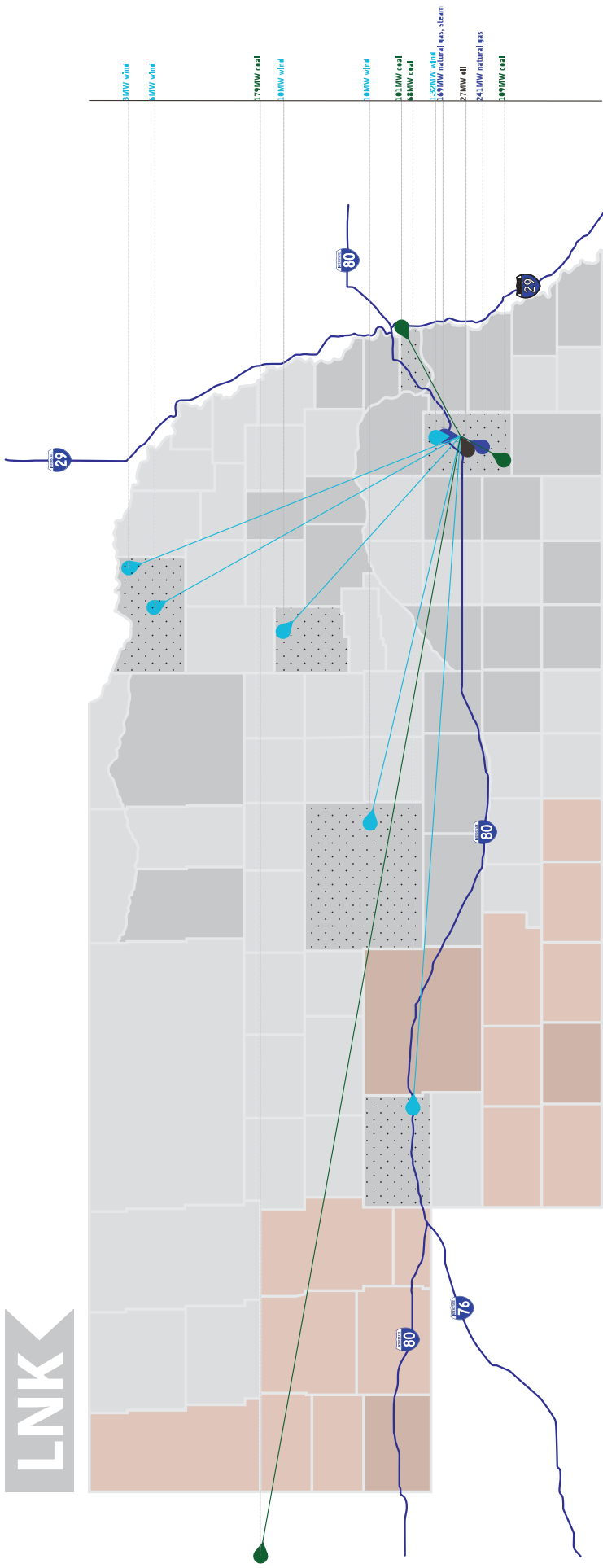


## NATURAL GAS VS. RENEWABLE RESOURCE POTENTIAL

## ENERGY CONSUMPTION BY SECTOR

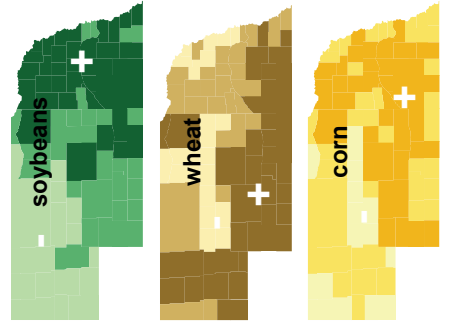






LINCOLN ENERGY GENERATION MAP

AGRICULTURE PRODUCTION



AGRICULTURAL AREA + PROJECTED CITY GROWTH

