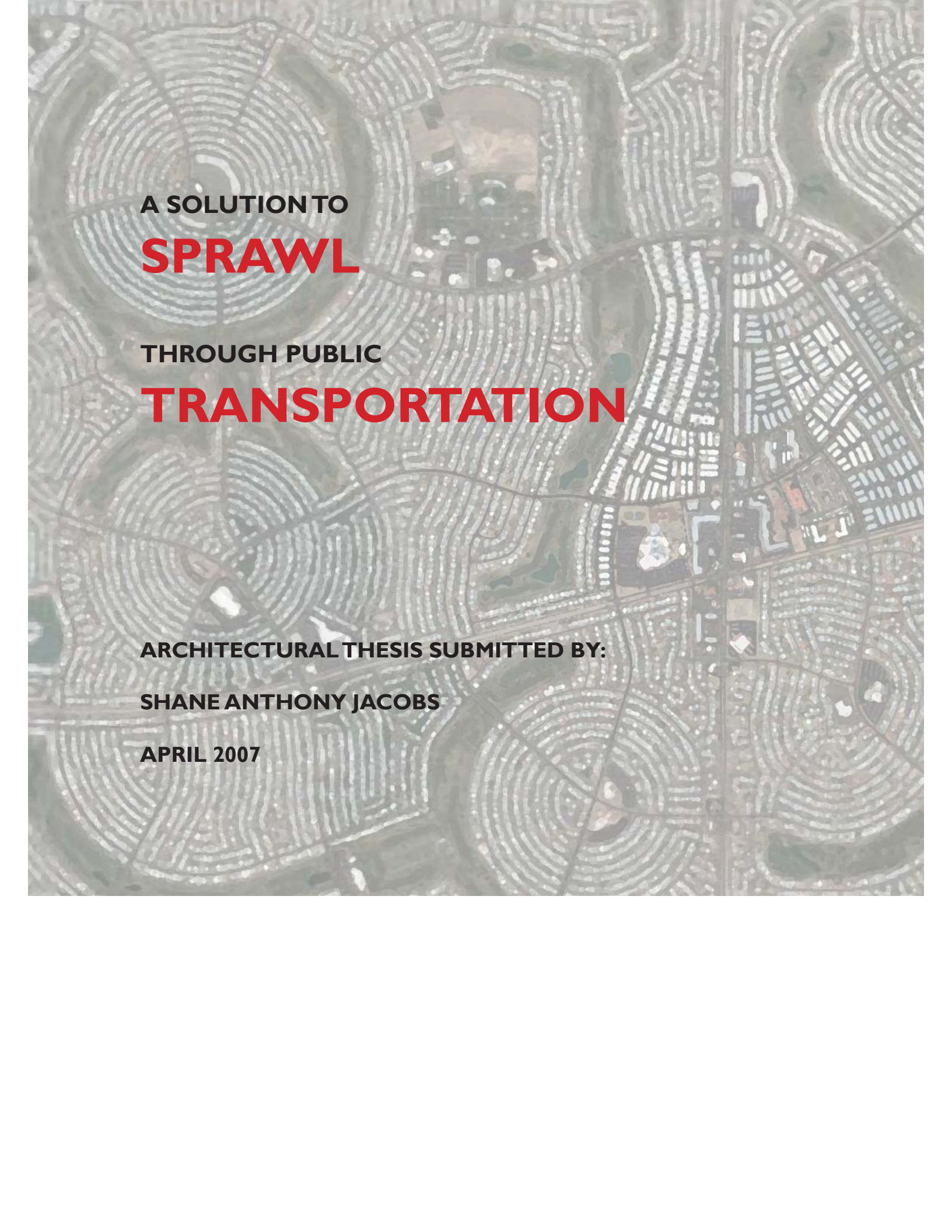


An aerial photograph of a suburban residential area, characterized by a dense network of winding roads and cul-de-sacs, creating a complex, organic pattern. The houses are small and closely packed, with green lawns and trees interspersed. The overall color palette is muted, with greys, browns, and greens.

A SOLUTION TO
SPRAWL

THROUGH PUBLIC
TRANSPORTATION

ARCHITECTURAL THESIS SUBMITTED BY:

SHANE ANTHONY JACOBS

APRIL 2007

A SOLUTION TO SPRAWL THROUGH PUBLIC TRANSPORTATION

An Architectural Thesis Submitted By:

Shane Anthony Jacobs

**A thesis submitted in partial fulfillment
of the requirements for the degree**

of

**Master
of
Architecture**

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April 2007**

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Shane Anthony Jacobs

April 2007

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In the early evening twilight on the Champs Elysees it was as though the world had suddenly gone mad. After the emptiness of summer, the traffic was more furious than ever. Day by day the fury of the traffic grew. To leave your house meant that once you had crossed the threshold you were a possible sacrifice to death in the shape of innumerable motors. I think back twenty years, when I was a student: the road belonged to us then.

-Le Corbusier, 1924

“As regard to the environment, the task of postmodern patience is to endure the limits of the land. This country is blessed with an extraordinarily rich and spacious continent. Our inability to live more nearly with the energy it yields and with its capacity for wastes bespeaks an impatient and immature culture.”¹

Driving down the streets you call home, through the hills you would hike and sled as a kid, by the rivers and ponds you swam and fished in; you realize that every trip made is to a place that is less and less like home. Entire ranches have been subdivided. The mom and pop stores have been replaced by corporate chains. Asphalt has been laid, lanes have been added, streets have been punched, and bridges have been erected. The open space and privacy that everyone moved there for is dwindling; the American Dream is deteriorating. Is sprawl unavoidable due to the inevitable growth our society demands or can we live and grow more efficiently, more sustainably? The desire to achieve a better life has broken down our city walls and depleted our resources. “The growth of the world population will lead to a tremendous demand for space, not only for buildings but also for farmland and areas reserved for nature.”² Even highway systems can’t seem to outpace suburbia. “Why has a higher standard of living somehow failed to result in a better quality of life?”³

A considerable amount of architecture and the majority of land planning revolves around the concept of the automobile. “Too many architects are becoming proponents of sprawl and the one-size-fits-all mentality that is strangling the earth.”⁴ In rural Montana, people build where they can drive; if one cannot drive there, someone will cut a road or build a bridge. In urban Montana, zoning has tied people to their cars due to its demand that different uses be divided throughout a given city. “People say they do not want to live near where they work, but that they would like to work near where they live.”⁵ What if we could uproot where people live, work, shop, exercise, and gather; rearrange their locations; then realign them in a community that enables a proficient life, with less pollution, traffic, stress, and resources used? Obviously, this isn’t feasible due to cost and the chaos of displacement. This thesis is intended to analyze the way we live, build, and move from place to place while destroying the reason why we live where we do.

This thesis will dissect transportation issues broadly in the United States and specific to the Missoula Valley and ultimately argue for the position of Missoula implementing a new model for the way it moves and grows. If realized, this process of rewiring will result in a series of incremental changes that have the ability to create a prototypical status for Missoula amongst other Montana and Northwestern cities that is unprecedented with regards to transportation as a solution to sprawl.



fig. 2 trolley car on Hyde Street, San Francisco



fig. 3 clamoring traffic

success and demise of public transit
and sprawl of america

*"Since classical antiquity, streets and city blocks had patterned the fabric of urban life. The street had always been a complex of functions: living space, playground, stage, workshop bazaar, transportation link."*⁶

Transit-oriented development has existed since the conception of the horse drawn trolley. While transit-oriented development may not be a breakthrough concept, the challenge of adapting it to a predominantly automobile oriented society is. Unlike today, early 20th century cities were designed around pedestrians, trolley systems, and railroads; a hierarchy of transportation and choices. Innovations have since altered that lifestyle.

Often, streetcar lines and their adjacent residential communities were developed by a single owner who built transit to increase value of a residential development by creating a connection between jobs in an urban center and housing at the periphery.⁷ The earliest example of this is the design and construction of Riverside, Illinois in 1868; five years after the Chicago, Burlington, Quincy Railroad was built through the 1,600 acre tract of land. Since, suburban developments have spurred where rail lines have radiated from a hub, leaving interstitial agricultural land to be developed by flexible motor car owners. The automobile bridged a "convenience" gap between public transportation and horse that increased the distance one could live outside the city. People once justified the location of their homes by their adjacency to the trolley lines, but the beauty beyond the gates of the city has allured its residents and their cars have towed the word "suburb" with them.

At the turn of the twentieth century, "streetcars located near homes connected their surroundings to a downtown center, and then sent passengers home by discharging them at nodes where shops and stores and neighborhoods evolved. Complex and comprehensive, the rail network consisted of streetcars plus two other forms of movement on tracks. The interurban, the electric streetcar, and the long distance passenger train formed a splendid tripartite system of mobility."⁸ Society and the automobile created

a separation in the tiered system of transportation. Dependency increased with convenience, modernity and technology prevailed while other forms of travel that built cities were forgotten.

Freedom and convenience have brought forth other mobility solutions and in turn, perpetual dilemmas. “[Cities] became truly modern through the catalysis of the automobile. Architects and city planners never favored the car, yet they found its modern logic irresistible. The passenger car, if anything, allowed the individual to conquer time and space by means of a universal device. Thus the automobile became the vehicle of modernism, the force that empowered builders to reorder the untidy and irrational structures of the late nineteenth and early twentieth centuries.”⁹ The interdependence between housing, jobs, and transit that brought the suburban commuter to the walkable city was broken down. Eventually, highways became the preferred transportation infrastructure in America and development was no longer dependent on public transit. “With the trolleys would go the cities they served. In their stead the motor suburb demanded ever more cars. Housed in places ill equipped to provide public transportation, some 13 million suburban Americans were now devoid of rail service altogether. Their cars crowded downtowns, heading in and out on the commute.”¹⁰

In stead of being recognized and ratified, this method of growth was left unchecked and actually supported. “Seventy-five percent of government expenditure for transportation in the United States in the postwar generation went for highways as opposed to one percent for urban mass transit.”¹¹ “While private transportation was flourishing with general taxpayer subsidies and the road was defined as a public good, mass transportation was floundering because of government decisions that the streetcar represented private investment and should ‘pay for itself.’”¹² Government organizations seemed to cater to the car industries, by which they were financially backed, while allowing the demise of the true public good- the public transit system. “Beginning in 1926 and continuing for the next thirty years, General Motors operated a subsidiary corporation to buy nearly bankrupt streetcar systems... and by 1950 had been involved in the replacement of more than one hundred streetcar operations [with General Motor buses]. A federal grand jury ultimately found the giant corporation guilty of criminal conspiracy for this effort, but the total fine- \$5000- was less



fig. 4 a vintage street car on The Embarcadero transports people from the Ferry Terminal to Fisherman's Wharf, San Francisco



fig. 5 rainstorm over Montana farmland

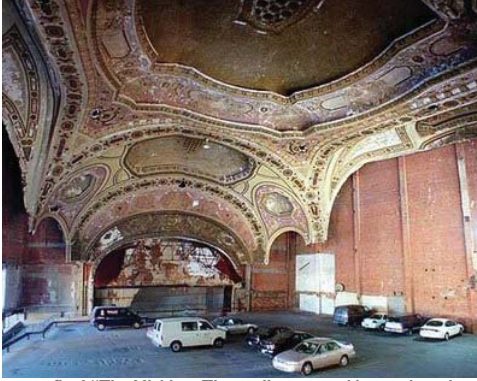


fig. 6 "The Michigan Theater" converted into a three-level parking garage in the late 1970s, Detroit Michigan



fig. 7 wide road near Thompson Falls, Montana



fig. 8 common scene at the gas pump during the oil crises of the 1970s

than the profit returned from the conversion of a single streetcar."¹³ The demise and replacement of alternative transportation gave society even less choices of mobility.

John Keats wrote in *The Insolent Chariots* "Motorcars actually created the demand for more highways, which in turn increased the need for more vehicles, and so on ad infinitum."¹⁴ Instead of adding lanes for the additional traffic that will debatably be generated by doing so, traffic engineers should consider reducing lanes and pursue alternative transportation infrastructure design. Our society currently stands at a crossroad of whether the car and highway are still plausible today. Jill Kruse conducted a study named *Remove it and They Will Disappear* in which she "analyzed 60 road closures worldwide, and found that 20 to 60 percent of driving trips disappeared rather than materializing elsewhere."¹⁵ This suggests that road closures force people to move closer to their driving destinations or seek other means of transportation to avoid the commute.

When roads are built and widened, people utilize land less efficiently and live less dense. Communities in the United States are not only built less dense, but while the average home size has expanded from 1,450 to 2,100 square feet, the average household size dropped from 3.3 to 2.6 persons. "In the years from 1950 to 1970, the motor vehicle population had grown four times faster than the human one. In subdivisions, being built at the rate of a million homes a year, deprived of sidewalk or crosswalk, human mobility was impaired. Zoned for exclusivity- house next to house, mall next to mall, and office park next to office park- auto-based land use had shaped a life that could not function without 2,000 pounds of steel and wheels."¹⁶ Not until the 1973 oil embargo would Americans realize the eventual end of their drive-in culture and its consequences. In *Crabgrass Frontier*, Kenneth T. Jackson quotes Clay McShane as succinctly summing up the change:

*Thus, in their headlong search for modernity through mobility, American urbanites made a decision to destroy the living environments of nineteenth-century neighborhoods by converting their gathering places into traffic jams, their playgrounds into motorways, and their shopping places into elongated parking lots. These paving decisions effectively made obsolete many of urban America's older neighborhoods.*¹⁷

a transit solution to sprawl

"The problem of transit and transportation alone is quite enough to demand the reconstruction of the modern city."

-Frederick Etchells, introduction to Le Corbusier¹⁸

Just as it is unrealistic to think that Montana cities won't grow in population, it is asinine to believe that Montana urban areas won't consume their neighboring agricultural lands and water sheds. The space is available now to plan the infrastructure needed to resolve the problem. Ironically, the land required for the solution is being decimated by the situation at hand. Montana must leverage its current attributes to find resolve; ranked 48th in terms of state population density (5.1 per square mile), Montana must be proactive before the beauty that is the pride of the state subsides to the spaghetti bowl of interstates that is Southern California.¹⁹

"Modernism has been the enemy of real urbanity. The catalyst of destruction was the automobile. It furnished the rationale for clearing away the untidy urban fabric and replaced it with a pseudopastoral landscape of towers in a park. It provided the vehicle for the upper and middle classes to seek a pseudorustic setting in the suburbs."²⁰ "We have seen how the highway dismantled streetcar cities and rail-linked suburbs that provided options. To right the transportation balance, cities and suburbs must be reconnected. The must be revamped with a viable infrastructure. The future of human mobility depends on reviving the built environment. To do so, [designers] must concentrate on land use and public transportation."²¹

Implementation of an intelligent land use policy has taken a back seat to popular forms of transit. "Over any given distance, the automobile expends more in terms of energy, amount of lane capacity, and capital. That's not calculating the environmental or land use exactions."²² Some fringe suburban commuters will drive up to thirty thousand miles a year by car while city dwellers only drive about eight thousand. The car and road consume four times the road and land space of a bus and twenty of rail. "There is, however, a much deeper problem than the way highways are placed



fig. 9 Madison River Valley near Ennis, Montana.



fig. 10 traffic between big box stores on Reserve Street, Highway 93. Missoula, Montana

and managed. It raises the question of why we are still building highways at all. The simple truth is that building more highways and widening existing roads, almost always motivated by concern over traffic, does nothing to reduce traffic. In the long run, it actually increases traffic. This revelation is so counterintuitive that it bears repeating: adding lanes makes traffic worse.”²³

Something must be done to break the futile cycle of traffic and suburban sprawl “in a nation where 58 percent of the population lives within two miles of public transportation, the connection of bus and streetcar, foot and ferry, train and bicycle in so-called intermodal linkages could return us to such once scorned means of circulation.”²⁴ A wider variety of street cars, light rails, buses, and trolleys can serve people so successfully that one could travel from any origin to any destination without a personal vehicle. Yet, there is a multitude of reasons why people do not use transit; the primary being that it is hard to serve sprawling suburban development effectively with transit. Here in lies the problem, the evolution of our society has brought the construction of our communities to a suffocating state. Public transit infrastructure simply included in suburban communities and other fringe metropolitan areas is rarely successful due to the sparse population of surrounding businesses and neighborhoods that are indicative of suburbs. A greater pedestrian traffic in these area is achieved by location efficiency, meaning density of retail space, dwelling units, and services. Eventually this mixed-use neighborhood fabric is organized in such a way that creates a symbiotic relationship between residential and commercial areas. These synergies define a new approach to city growth dubbed “transit-oriented development.”

“Settlement patterns depend more than anything else upon transportation systems, it is impossible to discuss one without discussing the other.”²⁵ In tandem with the settlement of America, society, in its pursuit of the “American Dream,” developed a mentality that people can build anywhere that they can drive; if they cannot drive there, someone will build a road or construct a bridge. To remedy this transportation-sprawl parallel, this inseparable link to our cars must be broken in one of two ways: by creating a public transportation infrastructure that is more attractive than driving or by a drastic, inevitable raise in personal transportation costs. Regardless of the catalyst, an accepted or forced break from personal automobiles would decrease the distance one could live from public transportation out of basic necessity. While European transit counterparts, whom had formerly lagged behind, quadrupled ridership, Americans simply let their cars overrun downtowns. “By paying a truthful \$5 a gallon, plus three to five times what the United States pays in visible car-based fees, the Japanese and Europeans have an awareness of costs. That consciousness makes them decrease their driving and curbs cars in cities. It encourages a more compact land use policy and hence promotes four to eight times as much public transport.”²⁶

Although suburban areas originated with all of the right intentions, they have been the “greatest misallocation of resources in the history of the world.”²⁷ Upper-middle class families in the 1870s through 1890s were leaving the cities for Victorian manors in an artificial park. These Victorian villa suburbs were built in response to the industrialization of the city and the degradation of the living environment that was attached to the industrial revolution. By the late nineteenth century, additional suburbs were sparked by streetcars that brought residents to and from their jobs that had moved from the cities due to environmental regulations. The Roaring Twenties, Great Depression and World War II lead to even more relocation of once city dwellers. Primarily built in response to the automobile, the next generation of suburbs widened the range of the “middle class” while attempting to reestablish a connection with nature. Inevitably, suburbs became a caricature of country living with no connection to actual naturally existing streams, trees, fields, or mountains. Suburbia has “none of the amenities of country life and none of the amenities of a town, in fact, it has all of the disadvantages of both.”²⁸ The worst deficiency of suburbs is the lack of public transportation. The harsh reality is

that because of the way the United States has sparsely developed, the automobile is the most convenient way travel. This holds true only because lack of density supports this auto-driven society and unrestricted growth. Transit-oriented development breaks this counterintuitive cycle by serving as a solution to each of these fundamental problems holistically.

Transit-oriented development facilitates land use policies surrounding transit services that greatly diminish travel and parking demand while increasing the efficiency of growth and development. Suburban sprawl currently leaves limited transportation opportunities that consist of sparse sidewalks and even less public transportation, further complicated by sparse amenities, leaving residents no choice but to drive. "When land uses lack synergy, they function as isolated uses and compound traffic and parking demands."²⁹ The advent of transit-oriented development would reduce resources in terms of street space, parking facilities, and traffic patrols; not to mention dependency on nonrenewable resources. In turn, transit-oriented development exploits the opportunity to transform once sprawling neighborhoods into more dense communities with infill construction and transit villages that serve walkable transit stations. This densification and pressurizing of population would redefine societal trends, behavioral patterns, and the way in which American communities grow. The established network has potential to interconnect as aspects of daily life and increase efficiencies of work and travel. "Growth... if not immediately adjacent to existing development, the new development should be at a concentration of infrastructure and, if possible, at a likely transit stop. In the best regional plans, existing and future rail lines serve as a basis for locating new neighborhoods and town centers."³⁰

If transit-oriented design is to work successfully, neighborhoods and destinations must be within a reasonable walking distance from transit stations. Walkers, bicyclists, the poor, young, and elderly are given the option to reconnect with the communities they once frequented. The perils of being segregated by miles of highway, wide-shoulder roads, and asphalt wrapped buildings are resolved by relaxing the automobile from our drive-in culture. This is most feasibly achieved by creating dense communities. Alternatively, the future of urban areas gripped by lack of infrastructure looks bleak. "City growth will be retarded with a tendency to develop congested, undesirable, and unhealthy districts unless rapid transit



fig. 11 view from highway 93, Salmon, Idaho



fig. 12 view of the Mission Range from highway 93, near St. Ignatius, Montana



fig. 13 Missoula Valley from Mount Sentinel

facilities are provided.”³¹ In *The New Transit Town*, Dittmar and Ohland anticipate transit-oriented development success:

*Imagine a region made up of a network of great neighborhoods- places where residents of diverse incomes, ages, and backgrounds have the option to walk to nearby shopping, parks, and schools; where streets are safe to walk along and public spaces are beautiful, inviting, and frequented; and where people can choose to take a train or bus to their destinations as easily and conveniently as a car. Imagine, as well, a region where job centers are convenient for employees around the clock, where they can easily take care of errands during lunch, catch a movie after work, or even bike to the office. These job centers, even those located in suburbia are linked to a network of neighborhoods and a revitalized downtown by high-quality, efficient transit.*³²

Sprawl of Montana towns and excessive single-family greenfield development would greatly be resolved through an approach that many Montanans may consider unnecessary. With ever increasing traffic numbers on Montana's highways, the widening of roads to accommodate these numbers, escalating gas prices, and a seemingly hopeless sprawl dilemma; I propose that Montana implement a mass transit system between rural and urban communities that challenges the way we live and commute. These systems would integrate with other forms of transit in order to reinstate a hierarchy of transportation in order to preserve our most priceless resource: space. New transit lines would link rural bike trails and sidewalks to existing city transit systems, regional bus systems, and airports. A large-scale mass transit system would reduce highway bound vehicular traffic, while promoting alternative means of mobility, creating a new paradigm of development, and becoming a necessary component of society.

four

site analysis

new missoula

"How crowded a roadway is at a given moment represents a condition of equilibrium between people's desire to drive and their reluctance to fight traffic."³³

history

Established in 1860, the city of Missoula sits at the junction of five valleys in west central Montana. Following Missoula's lead, a series of small towns were established on mainly lumber and agricultural industries throughout each of the adjoining valleys. These towns were established in approximately eight-mile increments; presumably the distance one could travel to and from in a day by horse. Construction of the Northern Pacific Railroad in 1883 expanded the town from 300 to 12,000 in 1920. "The presence of a railroad depot was the condition of survival for just about every town on this continent. The railroad not only brought commercial prosperity; it also sucked the life from the rural culture beyond its lines. In towns served by a railroad, the depot became a center of curiosity and entertainment. It rivaled school, church, and city center as the central point of public life."³⁴

As public transit decentralized large, industrial U.S. cities, the automobile decentralized Montana cities. "Missoula never had many residents at its center. The residential districts used to surround and support a center of stores, banks, businesses, bars, restaurants, hotels, and railroad stations. Under the centrifugal pull of the automobile, the center failed to hold. The suburbs spread out so far that it became impossible to walk into town, and it was inconvenient to drive there. Shopping centers with ample parking sprang up in the suburbs, businesses set up shop along the highways at the edge of town."³⁵ The most significant blow to downtown Missoula was the construction of a shopping mall along Highway 93, Missoula's corridor to the south.

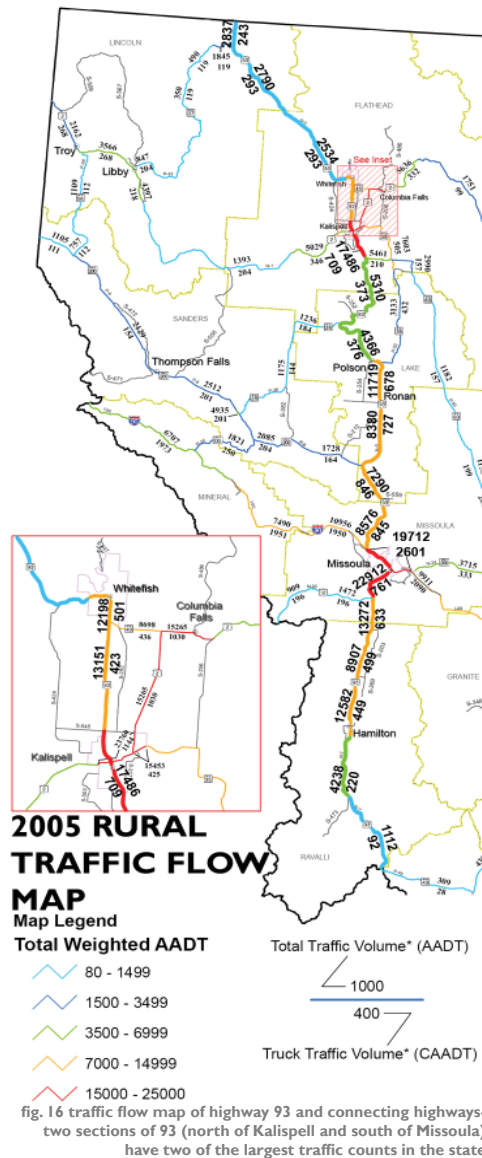
Ultimately connecting Jasper and Banff National Parks in Canada to Las Vegas and Phoenix, Montana share's 300 miles of the nearly 1800 miles of highway 93. Serving as the main north-



fig. 14 Missoula Valley corridors and network of small towns



fig. 15 Security Bank Building at the corner of Higgins Street and Main in the early 1900s, Missoula, Montana



south corridor in Western Montana, several portions of highway 93 have been expanded in the last 15 years due to the housing booms west of Missoula, the Bitterroot Valley (south of Missoula), and the Mission Valley (north of Missoula). The majority of the traffic on Highway 93 travels between Whitefish and Hamilton, the highest concentration of 22,912 cars per day, occurring just south of Missoula. "As roadway capacity in state highway corridors is increased, residential development will migrate out from cities to take advantage of intrinsic land values and lower land prices."³⁶ Simultaneously, "increased traffic capacity makes longer commutes less burdensome, and as a result, people are willing to live farther and farther from their workplace. As increasing numbers of people make similar decisions, the long-distance commute grows as crowded as the inner-city commuters clamor for additional lanes, and the cycle repeats itself."³⁷

The decentralization of the city center began to strangle the very thing the city was founded on. "Businesses in town closed. The railroad stations succumbed to the interstate highway and the airport. Downtown became ever more deserted and desolate."³⁸ Using tax-increment financing, the Missoula Redevelopment Agency reinvested the difference between property taxes on downtown property from one year to the next back into the downtown. This money has funded projects like a downtown parking garage and preserved waterfront property for parks and open space.

Since, Missoula's expansion has included the addition of two new exits into Missoula from Interstate 90, a series of "big box" stores, and a frenzy of suburban sprawl (see Missoula area



subdivisions map on p24) that create new challenges for Missoula. While the city expands westward, the automobile continues to plague the area; downtown Missoula has over 5,000 parking spaces, which is enough for either employees or customers, but not both. To remedy the problem, the city has issued free city bus rides to employees while raising parking fines and rates.

In 1995, under pressure resulting from Missoula's growth and strive to preserve land that makes the city unique, city and county officials adopted the "Missoula Urban Area Open Space Plan" and city voters passed a \$5 million bond to help implement the new plan that would create an open space system that consists of "over 3,300 acres of hillsides, wildlife-filled woody draws, stretches of riparian corridors with cottonwood gallery forests and river access, a bike commuter trail system, lands for a regional recreation complex and a small neighborhood park."³⁹ "We envision an integrated open space system that includes cornerstones and a diverse variety of lands, uses and values. We see uninterrupted skylines; continuously accessible river corridors; functioning wildlife habitat; access for low impact kinds of recreation; community level park; and a trail system that connects cornerstones and open space for recreation and non-motorized users."⁴⁰ (see parks and open space map on p21)

To currently use these open areas, one would have to drive; a reality that seems counterintuitive to the reason people engage in recreation away from city life. "Transportation infrastructure has always been one of the primary forces shaping development patterns in Montana. The state's oldest native villages and centers of populations- and later, cities, and towns- were located along rivers,



fig. 17 expansion of U.S. Highway 93 near Kalispell, Montana

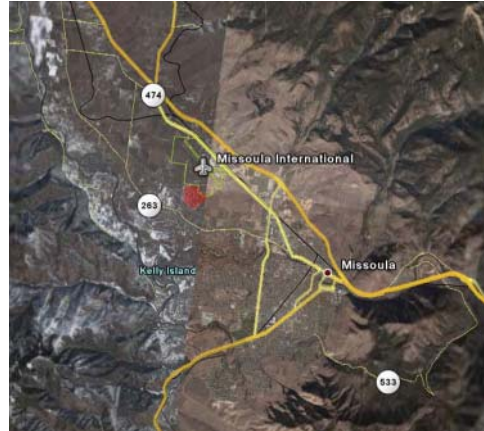


fig. 18 site relationship to airport, missoula



fig. 19 the Bitterroot River along highway 93, south of Missoula- the south hills area of Missoula (middle ground) is one of the valley's fastest growing



fig. 20 view out of the site looking west over adjacent farmland



fig. 21 farmland giving way to subdivisions

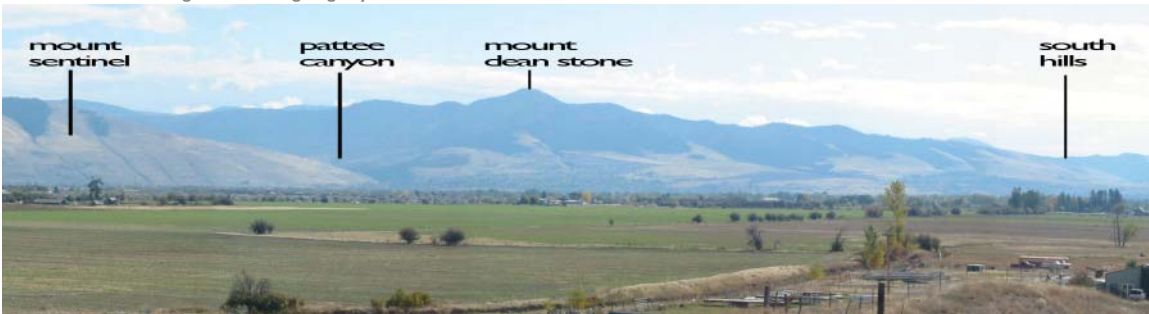


fig. 22 view of the Missoula Valley through the site, south to the Bitterroot Valley from Missoula International Airport

cross-country trade routes, and railroads. Since World War II, the location and growth of the state's communities has been driven primarily by the state's evolving network of roads, streets, and highways."⁴¹ The irony in areas of Montana like the Missoula Valley is that they serve as a habitat with immense biodiversity, ecosystems, and varied geology to a culture attached to their personal vehicles and segregated from their environment. "Montana's urban areas need balanced multimodal transportation systems with integrated motor vehicle, public transit, bicycle, and pedestrian networks."⁴²

present

In the last century, historic farm and ranchland has given way to people that refuse to live in Missoula under city ordinance, yet want to remain tied to Missoula's amenities and lifestyle. The industries of these original settlements have subsided, yet the people remain, and the jobs exist mainly in the larger communities of Missoula and Kalispell, and Hamilton. Today, the network of towns once founded on lumber and agricultural industries are predominantly residential communities that create a "metropolitan" area. Missoula's city limits are built at a density of 1.585 dwelling units per acre. An increase to four dwelling units per acre would increase density by 250 percent while preserving over half of the open land for Missoula. "From 1970 to 2004, Missoula County's population grew by 70%, while the amount of land developed grew by 228%."⁴³ This once agricultural land was subdivided to support growth. From 1988 through 1993, 27,646 acres of Missoula County's 1,673,698 acres were subdivided. "It is clear that wise transportation choices will have a major influence on development patterns in Montana- perhaps more than any other single force."⁴⁴

implementation

Known and the 42nd State in terms of income,⁴⁵ Montana still has potential to fund an alternative transit system, spending \$500 million annually on highway construction, repair and maintenance.⁴⁶ The passage of the 1997 update to the federal surface transportation authorization act (Transportation Equity Act for the 21st Century) brought “a major increase in annual highway funds flowing to Montana from the federal government (an increase of \$150 million annually). Virtually all of this money has gone into construction of new state highway capacity. The state continues to place little or no emphasis on development of a multimodal transportation program.”⁴⁷ This money could fund a public transit system that serves as a prototype for other rural states. Another viable solution would be the implementation of a hydrogen fuel cell infrastructure. In 2003, the Montana legislature passed a joint resolution supporting the implementation of a Montana hydrogen energy plan that is intended to “educate Montanans about the benefits of hydrogen economy, establish alliances with energy producers, and pursue national prominence with other states and agencies in the supply of hydrogen.”⁴⁸

transit station site selection

A smart transportation hub design starts with a master plan and site analysis. Design principles and the concept must be all-inclusive and integral throughout the site as well as the transit station. Integration with other forms of transit is necessary to reestablish a hierarchy of transportation; this includes existing and future forms of public transportation as well as personal transportation. Design for people to move efficiently between modes of transportation is



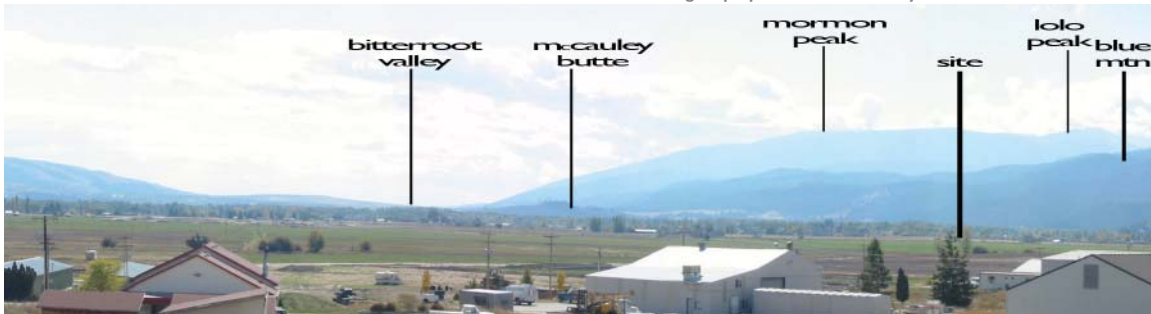
fig. 23 existing Missoula public bus system at downtown terminal



fig. 24 the Pendolino Train in Great Britain, capable of 140 mph



fig. 25 proposed national train system



vital for success and definitive of transit stations. (see non-motorized trails, bike lanes and bike routes map on p22).

"The effectiveness of transit-oriented development is highly influenced by the quality of the pedestrian environment. The internal and external system of walkways must be direct, well connected, safe, and visually interesting. Streetscape, urban design, building orientation, and public places all influence the decision to walk."⁴⁹ It should be assumed that the majority of walking trips will commence and terminate at the transportation station.

A transit hierarchy must be extended from the new transit station into a network of surrounding streets to create a designed, multimodal level of service that will relax or eliminate the automobile standards near transit- and pedestrian-oriented development and ultimately serve as a prototypical solution to reduce sprawl in the area.

the following series of assignments refer to local conditions on the facing page

1. The site will provide a pedestrian and public transportation connection to Missoula International Airport. Streets will be narrowed to cultivate pedestrian traffic and reduce vehicular traffic; creating a more walkable environment.
2. The transit station will accommodate existing city bus infrastructure. Missoula's existing bus system, *The Mountain Lion*, currently has routes established that serve Missoula International Airport, Highway 10 (north of the site), and Mullan Road (south of the site).
3. The transit station and site will accommodate a new high-speed train running north and south along Highway 93 by bypassing Missoula's city limits to the west, ultimately tying into the proposed national train system. Eventually, this system could expand and serve the entire Highway 93 corridor from Jasper, Alberta, to the suburbs of Phoenix, Arizona.
4. The transit station and site will be planned to accommodate a new light rail system, connecting existing Missoula to the new development via West Broadway Street, connecting Missoula east to west.
5. The site will accommodate vehicle parking for a portion of transit station patrons. Vehicles will be decreased in the adjacent proposed development and streetscapes by orienting it away from the pedestrian realm, behind buildings, or preferably within structures or underground. It is assumed that most of the station employees will reside in the new development or commute to and from work via one of the public transit systems.
6. Transit station will have a pedestrian and vehicular connection to Highway 10 via a new road.
7. Transit station will have a vehicular connection to Interstate 90 via exit 99 in West Missoula and new road intersecting Highway 10 to promote public transit for those traveling Interstate-90 with intent to intersect Highway 93 North or South.
8. The site will leave prime adjacent farm land open for agricultural purposes while providing adequate area for a dense transit-oriented development. (see agricultural soils map on p23). The project is sited on land that will undoubtedly be developed without considerations to density and transit adjacencies.

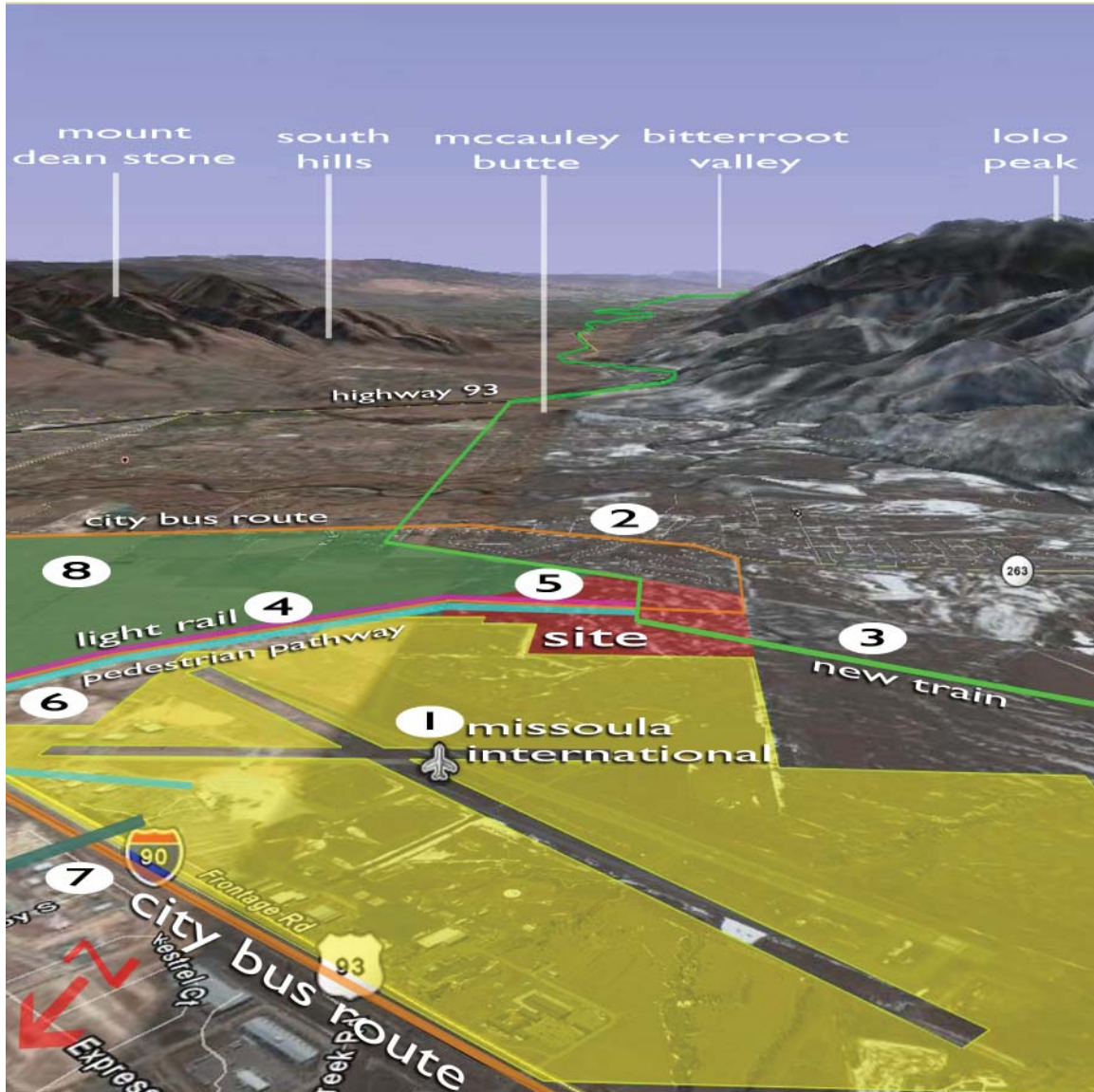


fig. 26 space adjacency diagram, looking south from the Missoula International Airport



fig. 27 sun setting on the Missoula Valley from the South Hills



fig. 28 remnants of the old Milwaukee Railroad on farmland adjacent to the site

future

The future of Western Montana and Missoula as its hub have a multitude of promising aspects. A transit hub in the rapidly developing quadrant of Missoula will serve as the catalyst for a master plan that is a piece of a greater network, built bottom-up and ultimately linking the front doors of Missoulians to any destination in the world without an automobile. This rewired idea of community would create mixed use, vitality, efficiency, and density in Missoula, while preserving open space. This type of community is fundamentally an Eastern idea where transportation is engrained into the city fabric while achieving a density that allows for open spaces. These growth policies harbor sustainable communities that allow land to simply exist undeveloped for recreation, food production, and agricultural purposes.

While a local Missoula resident is reconnected with the community and able to buy groceries without a vehicle, a resident of Hamilton can ski at Big Mountain in Whitefish. A Kalispell resident that works in Missoula can be in a video conference with a satellite office through a wireless internet connection on his commute to work. Furthermore, because he lives near the transit hub in Kalispell, he can leave his vehicle at the transit hub in Missoula and use it to run errands after work or during his lunch hour; driving considerably less miles every day. On the same train, a Jasper resident is heading south on her way to Las Vegas to meet up with a group of friends for spring break.

This transit system and growth policy can be adapted to nearly any community in Montana. Each hub serves as a potential lifeline to its community. People in neighboring towns will have the ability to drive to the nearest hub in order to park their vehicles and use public transportation. As globalization reduces the size of the planet and we constantly increase efficiencies, transit-oriented development hubs foster the desired interconnectivity while creating more dense, sustainable communities and open space.

climate

temperature⁵⁰

Temperatures in Missoula remain moderate throughout the year due to inversions created by the surrounding mountain ranges. January and December average lows and highs of 16 to 30 degrees Fahrenheit, respectively while July and August are the hottest months with average lows of 50 and average highs of 83.

precipitation⁵¹

Sitting in the rain shadow of the Bitterroot Mountains, Missoula's average 13.5 inches of rain per year classifies it as a semi-arid climate. May and June are Missoula's wettest months, with an average rainfall of 1.8 inches. February and November are the driest months with 0.8 inches of precipitation.

humidity⁵²

December is the most humid month in Missoula with an average high of 86% and an average low of 80%. August is the least humid month with an average high of 75% and average low of 31%.

wind⁵³

Missoula's average wind speed is 6.2 mph. Prevalent winds are to the NW year-round with the exception of December and January to the ESE.

psychrometric chart

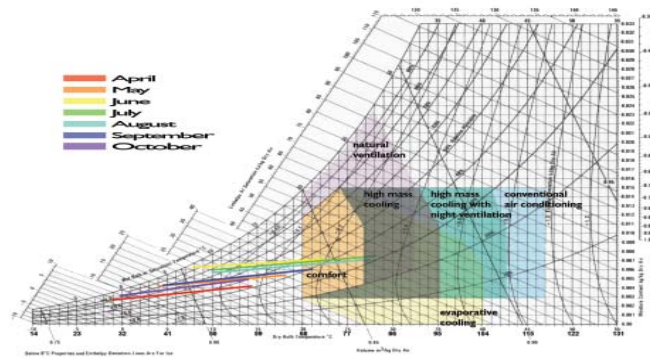


fig. 29 the start of a new subdivision adjacent to the site in prime agricultural soils



fig. 30 Grant Creek drainage (left) and new subdivision water feature (right) the proposed transit station is west (left) of this drainage. Photo taken from Old Milwaukee Railroad trestle.



fig.31 view out of site to the west over agricultural land



fig.32 view north, into site over Old Milwaukee Rail bed



fig. 33 view northwest into site



fig. 34 view northeast into site

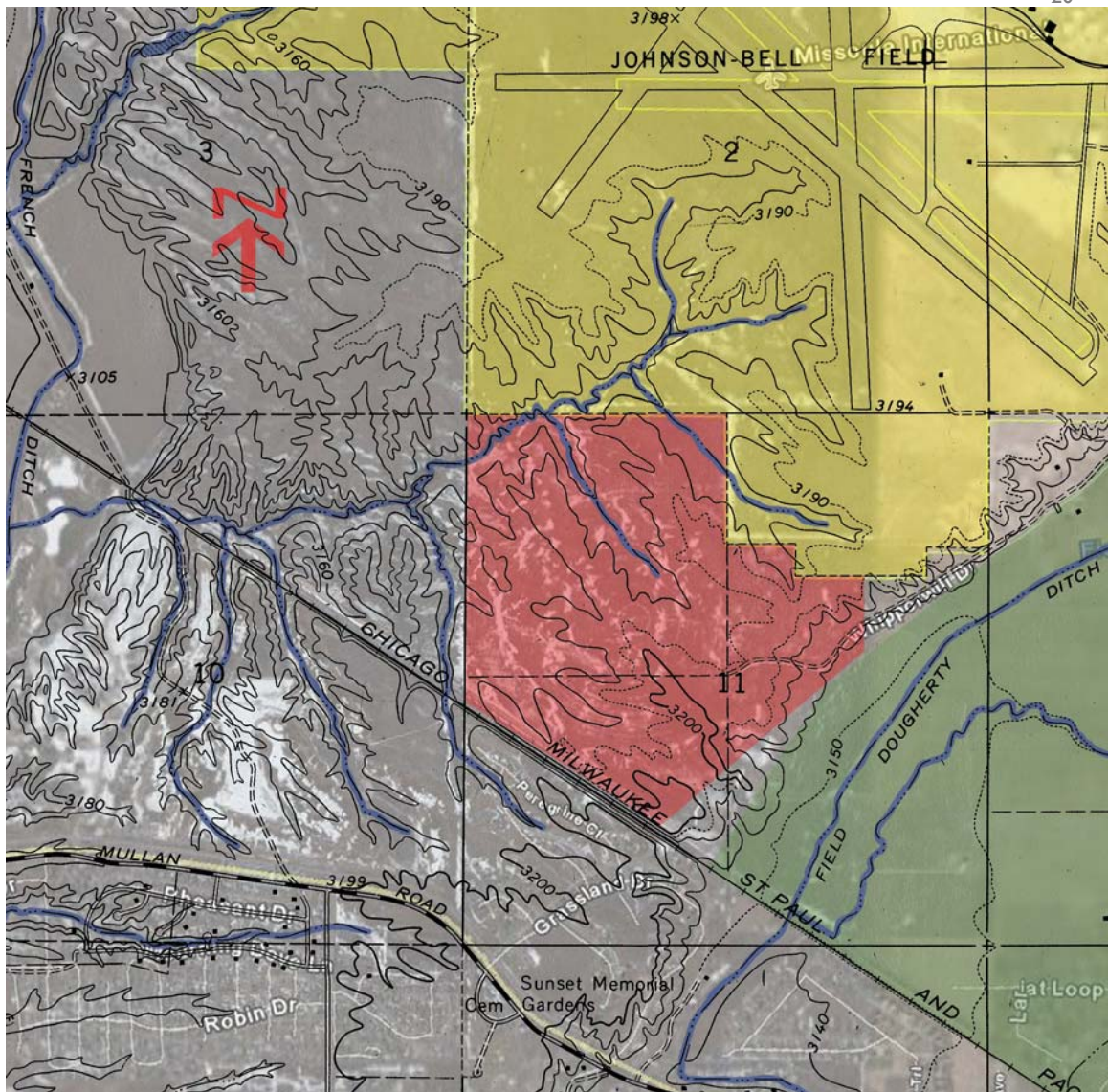


fig. 35 site with contours at 20-foot intervals

PARKS AND OPEN SPACE RECOMMENDATIONS FROM COMPREHENSIVE PLANS

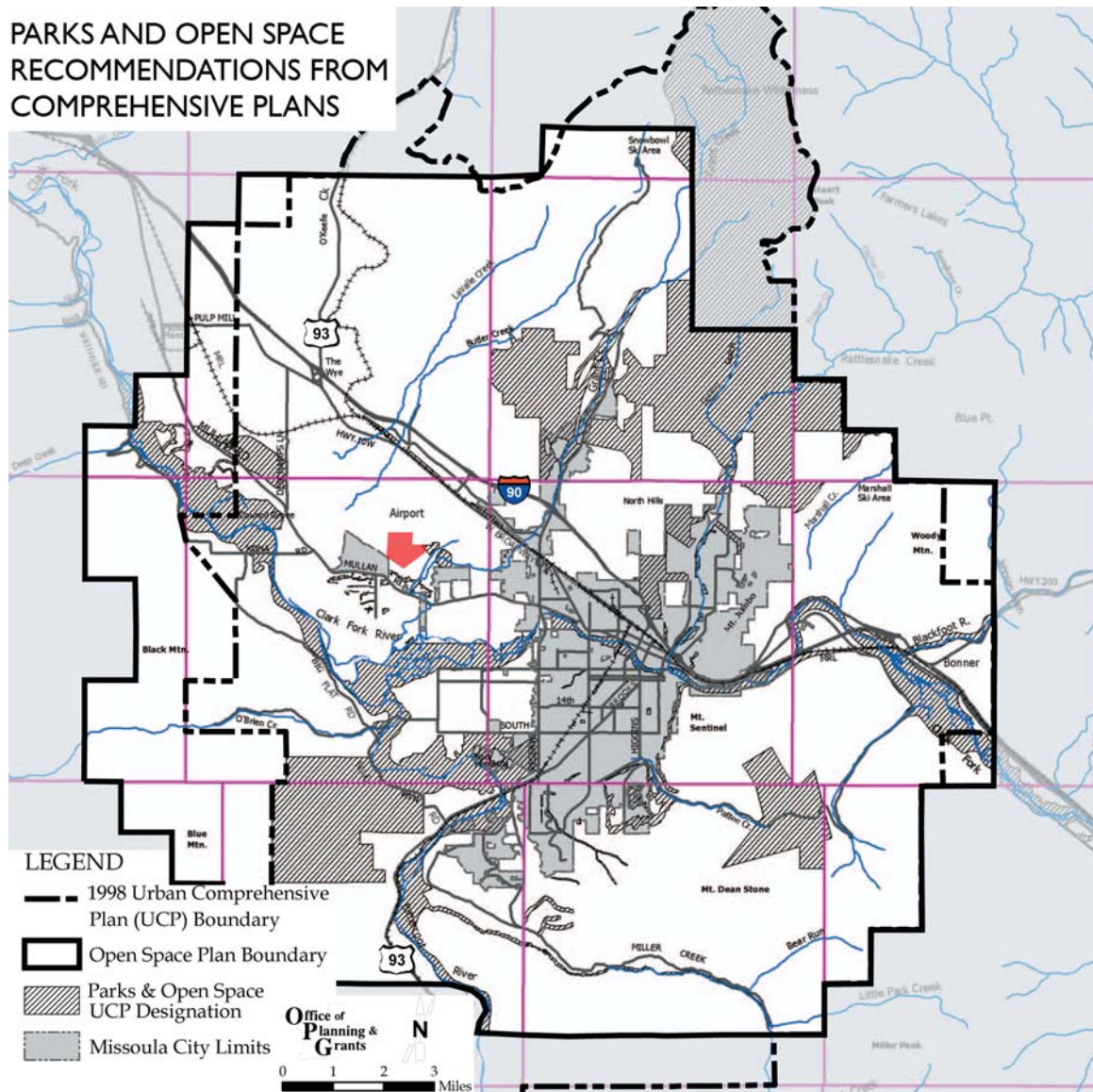


fig.36 missoula's parks and open space

NON-MOTORIZED TRAILS, BIKE LANES AND BIKE ROUTES

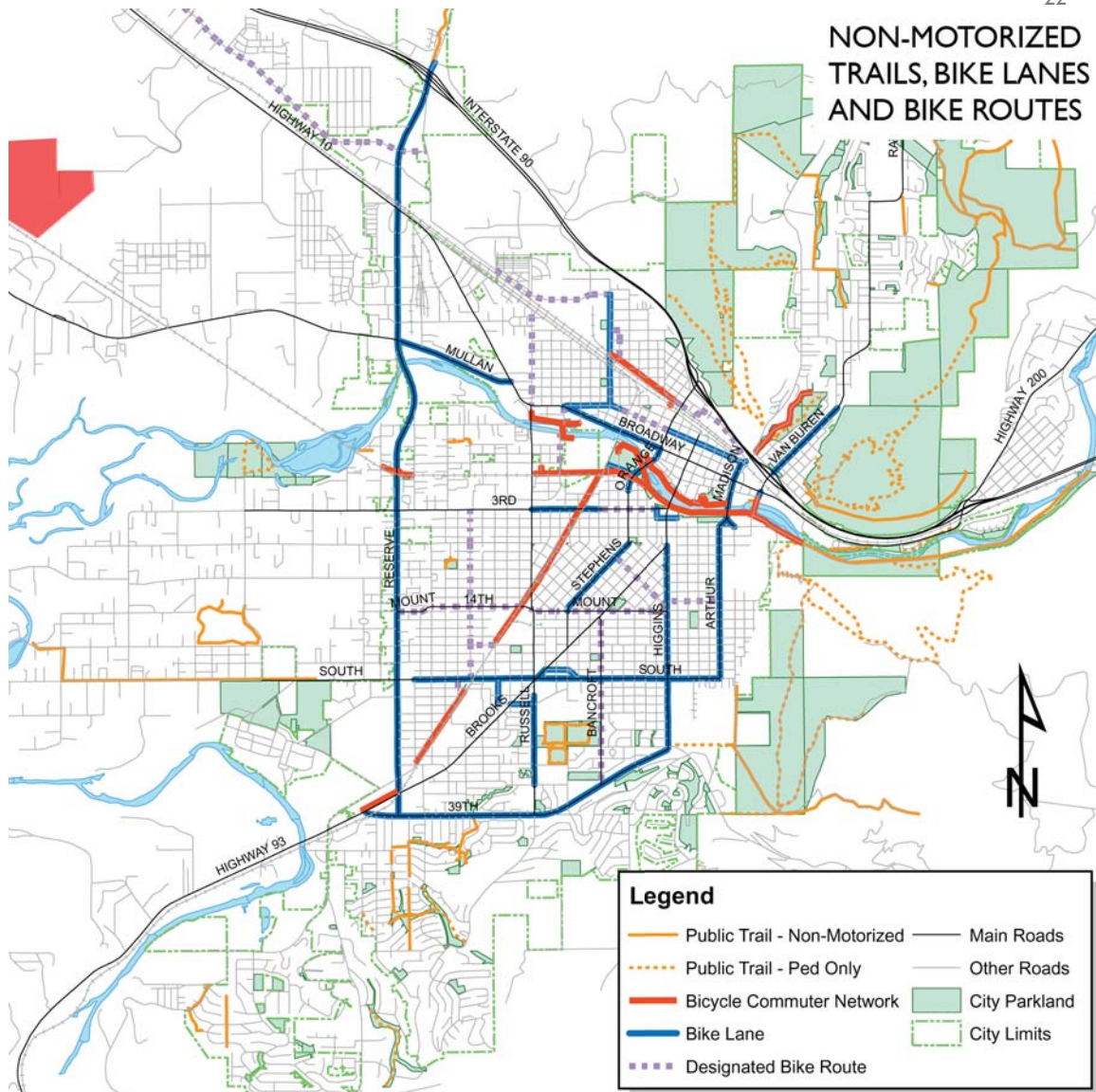


fig. 37 missoula's non-motorized trails, bike lanes, and bike routes

AGRICULTURAL SOILS OF PRIME AND STATEWIDE IMPORTANCE

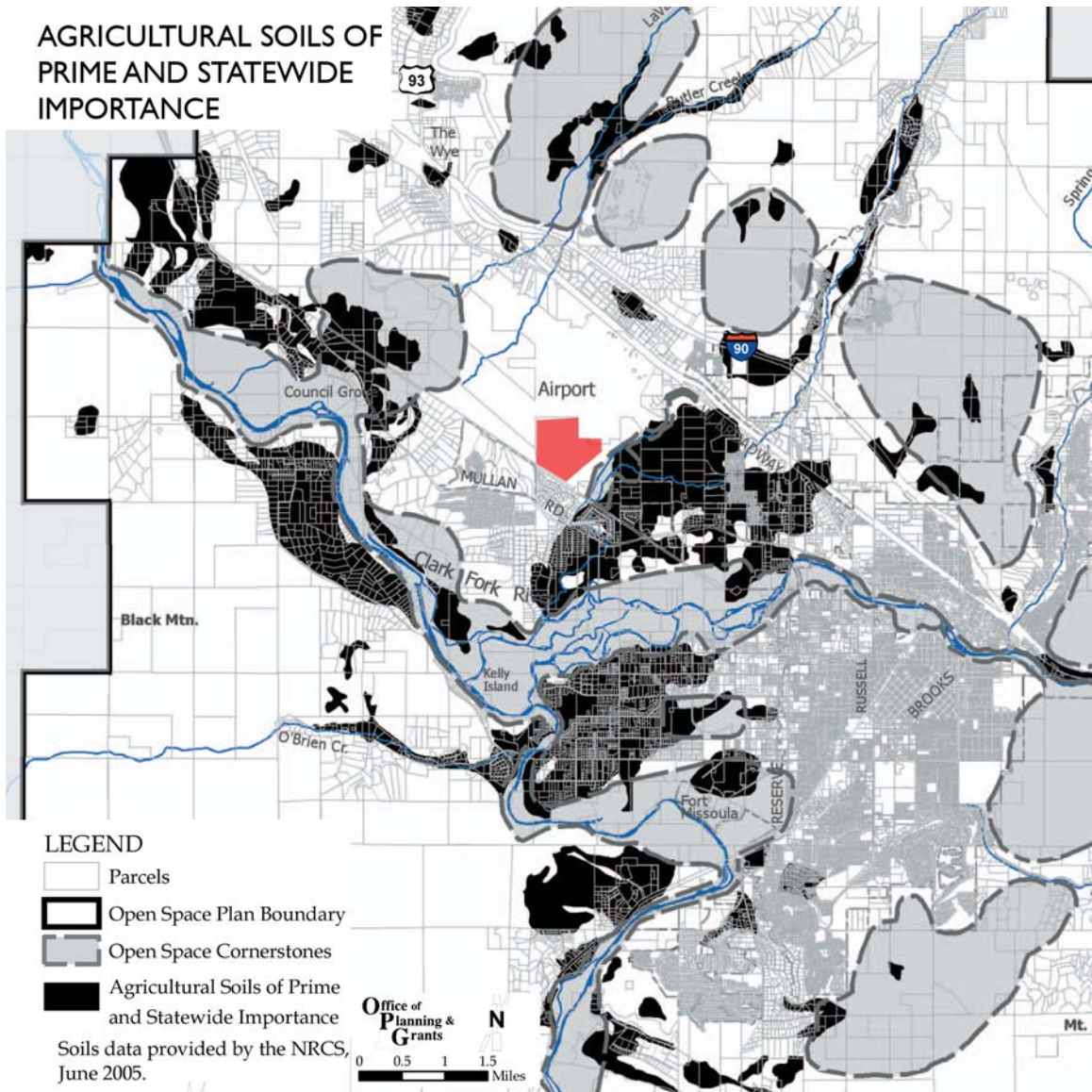


fig.38 missoula's prime agricultural soils

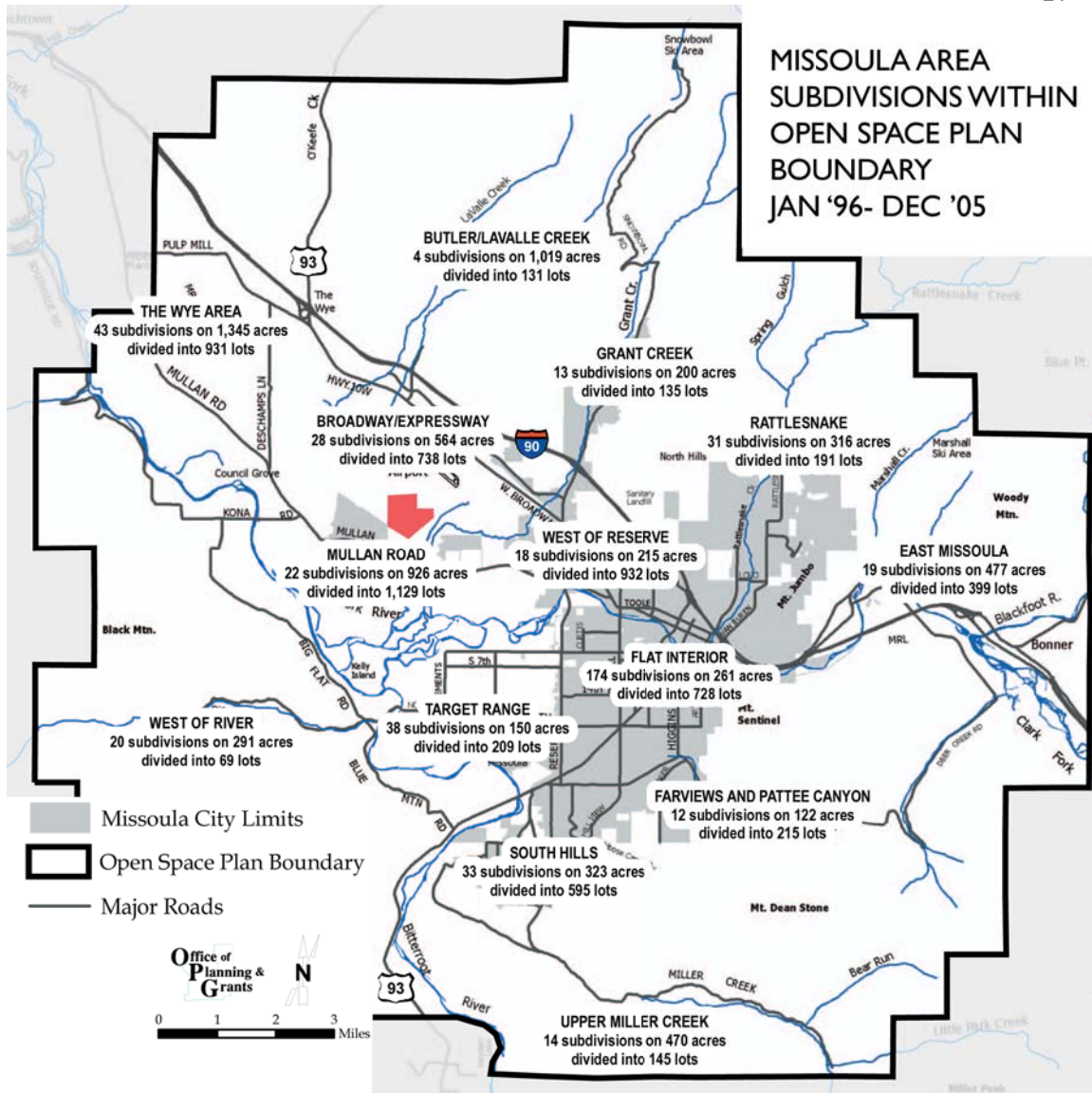


fig. 39 missoula area subdivisions within open space plan

rosslyn-ballston corridor
 mockingbird station
 barrio logan's mercado project
 san francisco ferry terminal
 amsterdam schiphol airport
 waterloo station



fig. 40 Rosslyn-Ballston concentrates dense, mixed-use development at the stations and developed sector plans to ensure that each maintains a distinct sense of community



fig. 41 the Rosslyn-Ballston plan focuses growth within a walkable radius of stations, neighborhoods, and natural areas

rosslyn-ballston corridor

The Rosslyn-Ballston corridor is a transit-oriented redevelopment that began as an initiative that was undertaken over three decades in a low density commercial corridor in Arlington County, Virginia, just outside of Washington D.C. The project site consisted of a three-mile passageway or low density commercial property that was never annexed by Rosslyn or Ballston which both were experiencing significant declines in population and commercial activity. The corridor was redeveloped while the surrounding residential neighborhoods, which date back to the early twentieth century, were preserved and have benefited from significant reinvestment. There has also been a shift in ownership away from absentee landlords to owners who live in their homes. Starting in 1972, there were 11,000 housing units, 16 million square feet of retail, 1,900 hotel rooms, and an 81 percent increase in the assessed value of land and improvements in a thirty year span. Today, vacancy rates are lower and rent is higher than other areas in the regions except Washington D.C. "If all the development in the two-square-mile corridor area were constructed instead on vacant suburban land at standard densities, it would cover more than fourteen square miles."⁵⁴ Transit ridership in the corridor is higher than anywhere else in the region other than the District of Columbia, and most arrive at stations on foot or by bus due to minimal long-term commuter parking.⁵⁵ Developers negotiated with the county board and staff, citizen commissions, and the community for higher densities than permitted in the county's General Land Use Plan. This resulted in the developments footing the cost for significant improvements to infrastructure. "Arlington County issued more than \$100 million in capital bonds to support

Metrorail construction, and funded the long-term financing of those bonds. In addition the county benefited from more than \$1 billion of the District of Columbia's Federal Highway Interstate Substitution funds- the largest such diversion of funding from highway to rail in the country."⁵⁶

mockingbird station

In recent years, the sprawling metropolitan Dallas-Fort Worth area has been trying to reinvent itself around rail and transit-oriented development. It began with the DART executive director, Roger Snoble's vision of high-density, mixed-use, transit-oriented developments, adjacent to his light-rail lines. "A 1999 study by the University of North Texas (UNT) showed property valuation within a quarter mile of DART stations were 25 percent higher than a control group of properties. The study found that land values around DART stations when considered alone (not including rents or occupancy rates) were double that in non-DART rail neighborhoods. A follow-up study in January of 2003 showed that the value of office properties near DART stations increased 53 percent more than comparable properties not served by rail between 1997 and 2001, and that the value of residential properties increased 39 percent more than a group of control properties."⁵⁷

Mockingbird Station was part of that initial vision of Roger Snoble and was realized by RTKL. In 2001, it won the Dallas Chapter AIA honor award. Mockingbird Station works as auto-oriented and transit-oriented environment with parking integrated either into the building interiors or underground. This station rewrote the Dallas-Fort Worth design and development standards that were eventually encoded into a new zoning ordinance for the city. "Mockingbird Station is a 10-acre, \$105 million "urban village" consisting of 211 loft-style apartments, 150,000 square feet of office space, an eight-screen independent film theater, and 183,000 square feet of retail, a half-dozen restaurants, a bank, and a dry cleaner. There is a full service grocery store and ninety other shops within a five-minute walk. There are 1,440 parking spaces, nearly all of which are located underground."⁵⁸



fig. 42 Mockingbird Station has the highest density population within three miles of any mass transit station in Texas



fig. 43 DART light-rail leaving the station



fig. 44 under the rail station vault over the loading platforms



fig. 45 the Mercado Apartments were the first new homes built in Barrio Logan in over a decade



fig. 46



fig. 47 Ferry Terminal Building from The Embarcadero Plaza, San Francisco

barrio logan's mercado project

Building off of its 1981 light-rail system, San Diego “planners were proposing two ambitious strategic plans- one for land use, one for transit- that sought to ease sprawl and traffic by accommodating growth in walkable, mixed-use village centers served by bus and trolley.”⁵⁹ “The plans were intrinsically linked: the City of Villages was predicated on adequate transit. Transit First was predicated on adequate density. If funded, they would chart a very different course of growth.”⁶⁰ Projecting one million more residents and 500,000 new jobs by 2030, San Diego had been rapidly developing what remained of its open space. “In 1990, the city redevelopment agency made Barrio Logan a redevelopment project area, allowing the use of tax increment financing- which meant any increases in property taxes as a result of redevelopment could be invested back into the neighborhood- and making it eligible for federal grants.”⁶¹ “Fortunately, residents of San Diego region, as elsewhere in the nation, were increasingly prioritizing ‘quality of life’- they wanted more sense of community, less time in traffic, more housing options, and to ensure the preservation of open space.”⁶² An increase in densities, from the existing regional average of 3.7 units per acre to 4.3, would reduce land consumption by 400,000 acres and reduce vehicle miles traveled by 22 percent. An “increase in the percentage of residents living within a quarter mile of transit from 3 percent to 17 percent in twenty years, and increase the percentage of jobs located within a quarter mile of transit from 15 to 43 percent.”⁶³

san francisco ferry terminal

The Ferry Terminal at the Northeast shore of San Francisco serves as the Gateway to its financial district. “Opened in 1898, it was the transportation focal point of San Francisco from the Gold Rush until the 1930s.”⁶⁴ Prior to the automobile and the opening of the Bay Bridge in 1936 and the Golden Gate Bridge in 1937, the ferry was the only way that people could reach the city without traveling around the bay and up the peninsula. “Passengers off the boats passed through an elegant two-story public area with repeating interior arches and overhead skylights. At its peak, as many as 50,000 people a day commuted by ferry.”⁶⁵

Construction of the double-decker Embarcadero Freeway in the 1960s, metaphorically and physically overshadowed the Ferry Terminal. “The historic interior of the Ferry Building structure, with

its mosaic floor and dramatic brick and ceramic arches, was lost in 1955, when much of the large open hall was filled in to accommodate standard office space with some retail use and general public use on the ground floor.”⁶⁶ “By the 1970s, automobile traffic overwhelmed thoroughfares in and out of the city. Marin Ferry Service resumed operation to provide transportation alternatives.”⁶⁷

Renovation funded by federal and state grants started in 2000 at a fast pace due to fears of BART strike, displacing tens of thousands of commuters back and forth to Larkspur, Sausalito, Vallejo, and Alameda. “The Ferry Building redevelopment represents approximately 65,000 square feet of first floor Marketplace space, and an additional 175,000 square feet of premium second and third floor office space.”⁶⁸ The Marketplace, organized along the central nave, provides a distinctive space for bringing together commuters, tourists, and the greater Bay Area’s agricultural wealth in a year-round farmer’s market four days a week. “Shops large and small celebrate food in all its forms, offering everything from artisan cheeses to the freshest of local fish. Restaurants and cafes serve cuisine representing the quality and cultural diversity of San Francisco’s best chefs.”⁶⁹ The Ferry Terminal is extremely pedestrian friendly; from the water front, to the street cars to BART.

amsterdam schiphol airport

Amsterdam’s Schiphol Airport is the “fourth busiest European gateway, with 44 million passengers in 2005 and 322,000 takeoffs and landings in a typical year. It isn’t uncommon for 100,000 travelers to pass through that airport in a single day.”⁷⁰ All built as one large terminal split into three departure halls, it’s simple design is easy for commuters to navigate. Taxis, buses, shuttles, and trains are all linked to the airport because long-term parking is so expensive. The Dutch railways operate a major train station underneath the main passenger terminal of the airport. Schiphol Airport is only a twenty minute train ride from central Amsterdam. There are a range of amenities at Schiphol Airport; from “24 hour shower facilities at the terminal hotel, a post office, a mortuary, a prayer room, wireless internet communication zones, a casino, and a 24 hour medical center with a pharmacy.”⁷¹ “The airport has a wide range of shops located throughout the terminal and at the Schiphol Plaza; including duty free shops, fashion boutiques, news agents, flower shops, gift shops, and music shops.”⁷²



fig. 48 second floor of the Ferry Terminal, San Francisco



fig. 49 plaza at Schiphol International, Amsterdam



fig. 50 train from Schiphol to downtown Amsterdam



fig. 51 Waterloo Station International Terminal, London



fig. 52 Waterloo Tube: Underground Station travelator



fig. 53 Waterloo aerial of domestic platforms and international trainsheds, London

waterloo station

Originally opened in London in July of 1848, Waterloo Station was torn down in 1900, rebuilt, and completed again in 1922. Today, Waterloo Station is a complex of four linked railway stations and a bus station. The Mainline Station accommodates trains that run to southwest England. The Mainline has an 800 foot concourse and 21 loading platforms. Adjoined to Waterloo Mainline is Waterloo International Station. Built in the early 1990s, its 1300 foot long glass canopy, supported by bowstring arches has won several design awards. Waterloo International is the current London terminal for Eurostar trains connecting France and Belgium. Also connected to mainline, Waterloo Underground Station was originally opened in 1898 and intended to connect northeast into the city of London. Now it is an all-electric metro railway system that covers the greater London area and owns the title of the world's oldest and largest underground system. It runs 253 miles and serves 274 stations. Connected to the Mainline Station via a footbridge, Waterloo East Railway Station was opened in 1869 and serves four loading platforms. The East Railway lines run east to Kent. The total Waterloo Station complex covers about 24.5 acres. Other than the four trains, Waterloo Station can be accessed by taxi, bus, or private car on Cab Road, or by foot via Westminster Bridge Road.

what makes a transit station work?

*"The railroad companies played a central role in the transformation of the common order. They built the most imposing public structures- both a widely spreading network of lines and the massive and luxurious stations [that] became the emblem of the gathering and convergence of thousands of people and hundreds of facilities."*⁷³

architectural typology

public transit station

The challenge of making public transportation successful lies in making it appealing. Public transportation must be fast and convenient in order to entice people to give up their cars. Alternative transit must meet and exceed the qualities of the automobile with respect to expense, cleanliness, audibility, speed, and productivity. The transit station must be safe, dry, and dignified. It should foster the same sense of community as the surrounding development while integrating mixed-uses and multimodal travel.

concourse

The concourse is a grandeur, highly efficient, day lit, space that serves as the heart of the transit hub itself, the surrounding new community, and the region alike. The concourse will include screens with necessary information of arrival and departure times. This space is constantly buzzing with chatter and activity. People sprint with their luggage or a briefcase to catch a connecting train while others mingle in the adjacent shops buying local goods. Serving as the path between loading platforms and retailers, the architecture of this space fosters warmth and safety in its inhabitants. From here, people have a connection with the time of day, weather, and views of the Missoula Valley.

platforms and waiting areas

The queuing areas should be designed to allow commuters to distinguish each mode of transportation from the others by architectural features, color, or the like. These areas should be safe



fig. 54 Ferry Terminal Building at night, San Francisco



fig. 55 Penn Station's 150- foot vaulted ceilings and arcade lined with shops, New York



fig. 56 first floor market place in the central nave of the Ferry Terminal, San Francisco



fig. 57 naturally lit central nave of the second of the Ferry Terminal

and comfortable while having a strong connection to the outdoors and views of the valley. Wireless internet will be incorporated into these spaces to increase productivity of commuters.

food and retail spaces

Easily accessed from the main concourse, the food court and retail shops consist of basic local amenities for commuters on their way to and from their destinations. Those that live in the adjacent transit-oriented development may do some of their shopping here on their way home from work to increase productivity and save trips to the market. The concourse and adjacent retail spaces can even become a farmers' market three or four days a week. These mixed-use spaces create a symbiotic relationship between the transit hub and the surrounding community; endorsing health and wellness while adding to the aroma of the concourse. These spaces will be day lit and supplemented with direct-indirect lighting.

safety

With recent airport security upgrades and an increase in terrorist alerts, safety is now a greater issue than ever. A sense of safety is achieved in the space by creating a functional floor plan, a sense of community from employees and retailers, and the presence of security.

offices

Employee and administration offices will blend into the fabric of the concourse walls, to merge employee circulation with commuter circulation and continue to promote community. Offices will be accessible and lit naturally, contributing to a healthy work environment.

parking

Although this transit hub is to serve a transit-oriented development, cars cannot be completely disregarded. Parking is still included and intended to create a secure space that encourages people to park their vehicles and use alternative transportation. Less parking is included than required by zoning ordinance in consideration that most employees will be arriving at the Transit Hub by foot or public transit. Underground or hidden parking will be incorporated into the design.

quantitative program

*"You cannot design or control city life; you can let it happen and contribute to it by allowing stores and residences, manufacturing and retailing, the utilitarian and extravagant to coexist."*⁷⁴

The following design guidelines were established in compliance with the AIAS and American Plastics Council sponsored design competition for a Transportation Hub.⁷⁵ It has been modified to capture to the intentions of this thesis

Passenger Train Services and Operations Areas

1. Station Services	850 S.F.
a. Passenger Train Offices	200 s.f.
b. Passenger Train managers Office	150 s.f.
c. Passenger Train Office Reception	200 s.f.
d. Train Crew Check-in Office	150 s.f.
e. Information Center/ Desk	150 s.f.
2. Waiting & Queuing Areas	62,600 S.F.
a. Platform Area	57,600 s.f.
b. Waiting Areas (not including platforms)	5,000 s.f.
3. Baggage, Mail, Package	2,150 S.F.
a. Supervisor's office	150 s.f.
b. General Handling Area	1,000 s.f.
c. Retrieval Desk	200 s.f.
d. Baggage Queuing	400 s.f.
e. Shipping and Receiving	250 s.f.
f. Maintenance Shop	150 s.f.

Light Rail Services & Operations Areas

1. Light Rail Total	15,350 S.F.
a. Waiting and Queuing Areas (including Platforms)	15,000 s.f.
b. Information Center/ Desk	150 s.f.
c. Light Rail Offices	200 s.f.

Bus Services & Operations Areas

1. Bus Total	4,450 S.F.
a. Waiting & Queuing Areas (including Platforms)	4000 s.f.
b. Information Center/ Desk	150 s.f.
c. Bus Offices (3 separate offices at 100 s.f. each)	300 s.f.

Transportation Hub Shared Services

1. Station Services	1,650 S.F.
a. Station Offices	200 s.f.
b. Station Managers Office	150 s.f.
c. Station Office Reception	200 s.f.
d. Telephones	100 s.f.
e. Public Toilets (M/F 500 s.f. each)	1,000 s.f.
2. Ticketing Facilities	1,825 S.F.
a. Ticket Queuing Area	350 s.f.
b. Fare Collection	300 s.f.
c. Accounting	350 s.f.
d. Cashiers	150 s.f.
e. Supervisor	150 s.f.
f. Storage	100 s.f.
g. Ticket Storage	50 s.f.
h. Staff Toilet	75 s.f.
i. Tour Office	200 s.f.
j. Equipment Room	100 s.f.
3. Cleaning Facilities & Equipment	1,050 S.F.
a. Custodial Equipment Storage	600 s.f.
b. Cleaning Supply Room	150 s.f.
c. Janitor's closets (2 at 50 s.f. each)	100 s.f.
d. Trash Storage	200 s.f.
4. Security Department	950 S.F.
e. Reception	200 s.f.
f. Workroom (security camera booth)	100 s.f.
g. Holding Room	100 s.f.
h. Security Office	150 s.f.
i. Interrogation Room	100 s.f.
j. Training & Assembly Room	250 s.f.
k. Storage Room	50 s.f.

5. Employee Facilities	1,900 S.F.
a. Employee's Lockers &Toilets	1,400 s.f.
b. Employee Lounge	500 s.f.

Concessions

1. Food Services	5,000 S.F.
a. Restaurant	3,000 s.f.
b. Fast-food/Snack Bar	1,000 s.f.
c. Cocktail Lounge	800 s.f.
d. Vending Machines	200 s.f.

2. Retail Shops	1,650 S.F.
a. Newsstand	500 s.f.
b. Car Rental (4 at 100 s.f. each)	400 s.f.
c. Gift Shop	500 s.f.
d. Flower Shop/ Booth	150 s.f.
e. City Information Booth	100 s.f.

Total Net Square Feet 99,425 S.F.

Mechanical, Structural, & Circulation 25,875 S.F.
(Plus 25% allowance)

Total Gross Square Feet 124,300 S.F.

Station Parking (on site) S.F.
Patron Parking
Employee Parking
Security Vehicle Parking

human safety

The following codes are derived from the IBC Code Book 2003

Base Allowable Area- Per Floor (Table 503 IBC)

Frontage Increase- 75% (506.2 IBC)

Sprinkler Increase- 200% (506.3 IBC)

Total Floor Area (net): 161,781 S.F.

Building Footprint: 43,506 S.F.

Chapter 3 (Use and Occupancy Classification):

A. Section 302.1 Assembly Group A-3: Includes Passenger Stations

Table 302.1.1 Incidental use areas: Storage rooms over 100 s.f. Provide 1-hr separation or automatic fire extinguishing system.

Chapter 5 (General Building Heights and Area):

A. Table 503 (Allowable Height and Area): Type II-A Construction

Allowable Max Height: 65 FT

Actual Height of Building= 42 FT

Allowable Area= 54,055 S.F. (506.1 General)

Actual Area of Floor= 43,506 S.F.

Chapter 6 (Types of Construction):

Section 602.2 Type II, Non-combustible Materials

Table 601: Type II-A; Structural Frame, Including Columns, Girders, Trusses: 1 Hours, Bearing Walls (Exterior & Interior): 1 Hours, Floor Construction: 1 Hours, Roof Construction: 1 Hours

Section 603.1 Combustible Materials in Type II Construction

1. Interior Floor Finishes and Interior Finish Trim (Doors, Windows, and Trim)

2. Blocking for Millwork and Handrails

3. Nailing and Furring Strips

4. Light-transmitting plastics

5. Exterior Plastic veneer

Chapter 7 (Fire-resistance-rated construction):

Section 704.2 Projections:

Eave overhang does not extend past a point 1/3 the distance to the lot line from an assumed plane where protected openings are required.

Section 704.2.1:

Type II Construction projections shall be of Non-Combustible materials.

704.11 Exception 1:

Parapets need not be provided on an exterior wall where the wall is not required to be fire-resistance-rated because of fire separation distance.

Section 705.3:

Fire Walls to be Non-combustible Materials

Section 705.4: Fire Resistive Rating

Group A = 3 hour fire resistant rating

See table 720 for various walls and partitions

Section 705.5.1: Exterior Walls

Where the fire wall intersects the exterior walls, the walls on both sides of the fire wall shall have a 1-hour fire resistive rating with $\frac{3}{4}$ " hour opening protection. The fire resistance of the exterior wall shall extend a minimum of 4'-0".

706.3.2 Exit Enclosures:

Fire barrier required where separating building area from an exit.

707.2 Exception 1:

Shaft enclosure not required

Section 715.3:

Fire door assemblies install per IDC and NFPA 80.

Section 717.2.2:

Fire blocking at stairways shall be provided at intervals not exceeding 10'-0"

Section 717.3.3 Exception:

Draftstopping is not required

Section 906.1:

Portable fire extinguishers required (International Fire Code).

Section 903.2.1.3:

Group A-3 Provide with Automatic Sprinkler System.

Chapter 10 (Means of Egress)

Table 1003.2.2.2 Maximum floor Area Allowances per Occupant

<u>Airport Terminal</u>	<u>Allowance</u>
Baggage claim	100 gross
Baggage handling	15 gross
Concourse	20 gross
Waiting Areas	300 gross

Section 1003.3.3.2 Protruding Objects:

Minimum Headroom 80". A Barrier shall be provided where the vertical clearance is less than 80" height. The leading edge of this barrier shall be located 27" maximum above floor.

Posting of occupant load

Assembly areas are required to provide a posted sign with the occupant load.

Section 1003.2.3: Minimum Egress width

Total Occupants Upper= 71

Total Occupants Main= 880

Total Occupants Plenum= 354

Total Occupants Subgrade= 143

Total=1628 Divided by 50%= 814

Multiply by .15 (Table 1003.2.3) = 123"- Exit door pairs to be 10'-6" doors.

Exit Continuity

Each requires accessible means of egress shall be continuous to a public way. Consists of a stairway within exits.

Accessible Means of Egress

One accessible means of egress is required.

Section 1004.2.1.1: Three or more exits

Where access to three or more exits is required at least two exit doors shall be placed a distance apart equal to not less than 1/3 the diagonal distance of the area served. Additional exits shall be arranged a reasonable distance apart.

Section 1004.2.4: Travel distance limitations

Table 1004.2.4 occupancy a travel distance = 250' with fire sprinkler system

Section 1018.1: Minimum number of exits

Table 1018.1 occupant load more than 1000 required to have 4 exits

Section 1005.3.2.2: Enclosures under Stairways

Walls and soffits within enclosed usable spaces under enclosed stairways shall be protected by 1-hour rated construction.

Section 1005.3.3: Enclosed Exit Stairway

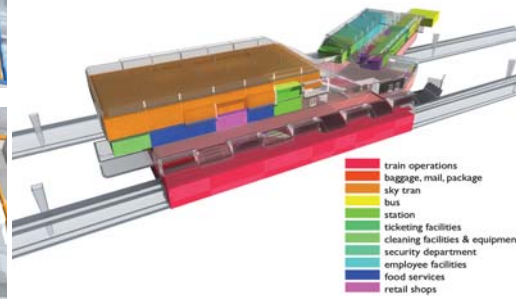
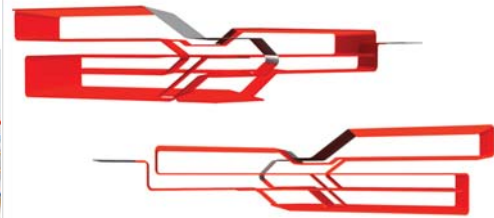
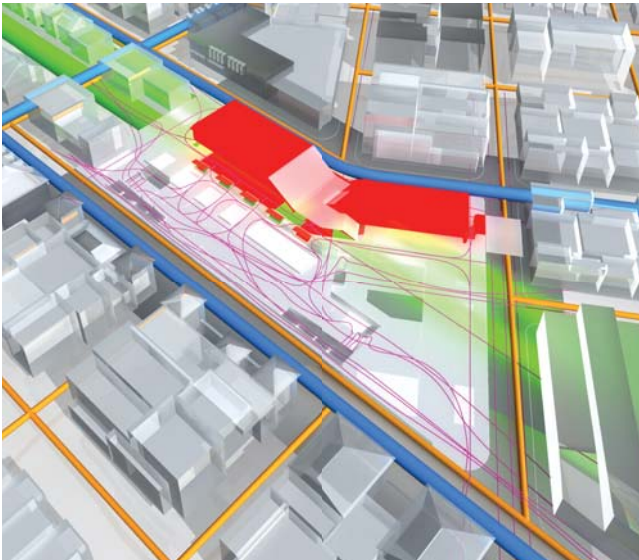
An enclosed exit stairway (Accessible means of egress) shall have a clear width of 44"

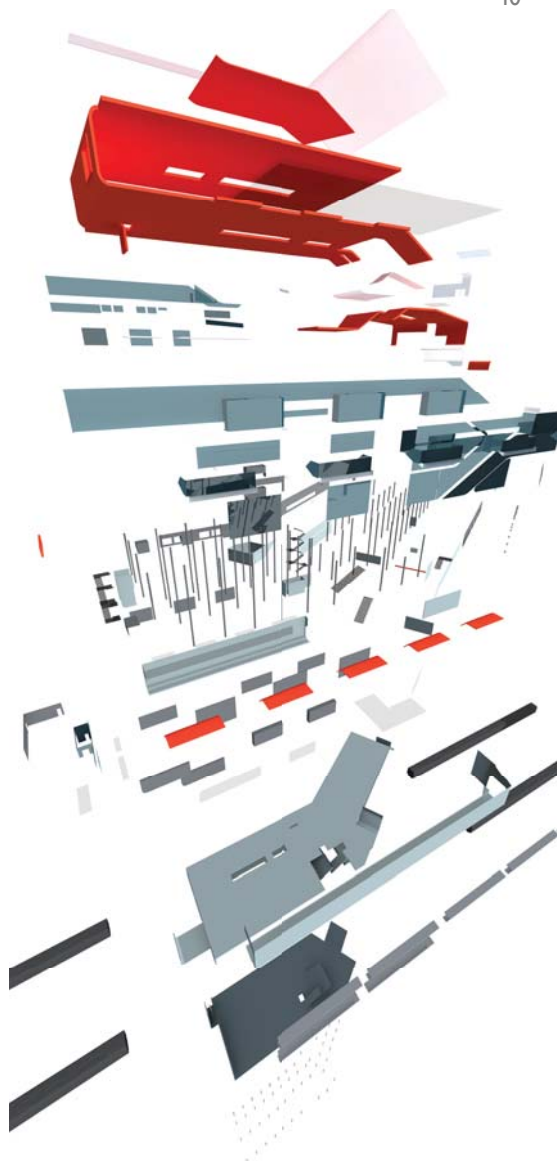
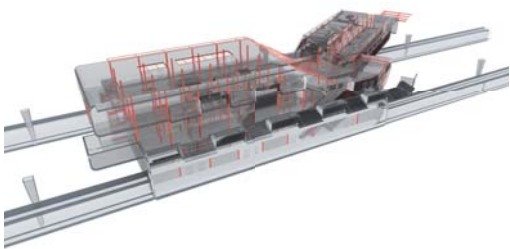
Section 1007.1: Boiler and Furnace Rooms

Greater than 500 s.f. of any equipment exceeds 400,000 btus is required to have two exits.

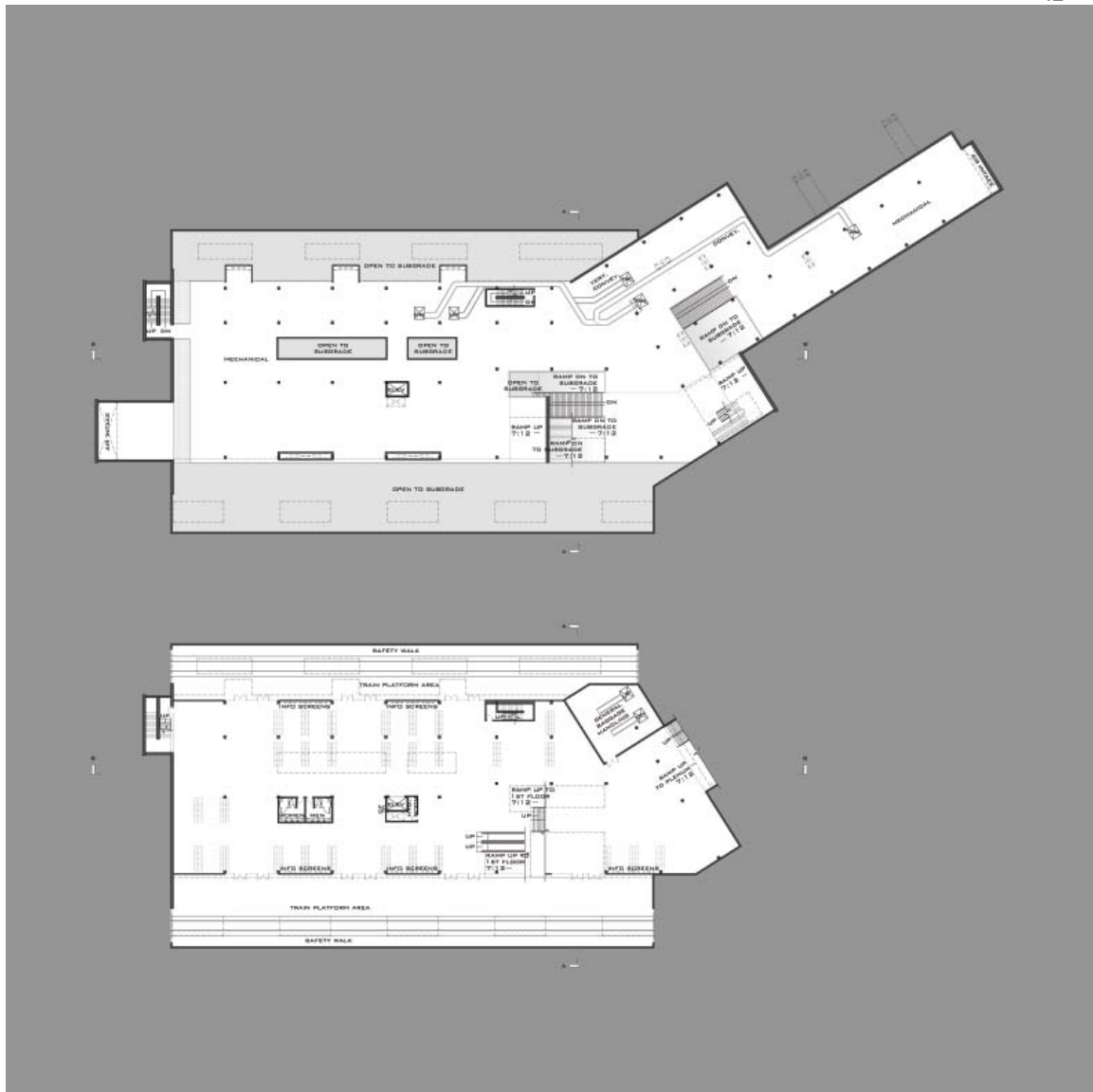
Section 2902.1 Minimum Number of Fixtures

Men Water Closets	1 per 500	23 (Assume 1/3 of water closets are substituted with urinals)
Women Water Closets	1 per 500	23
Lavatories	1 per 750	16
Drinking Fountains	1 per 1000	12
Others	1 service sink	

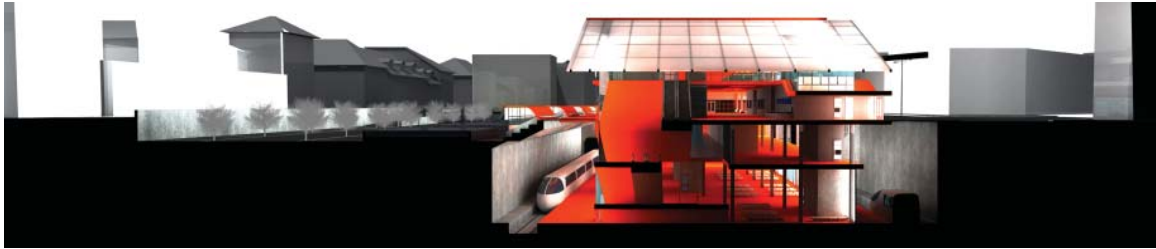


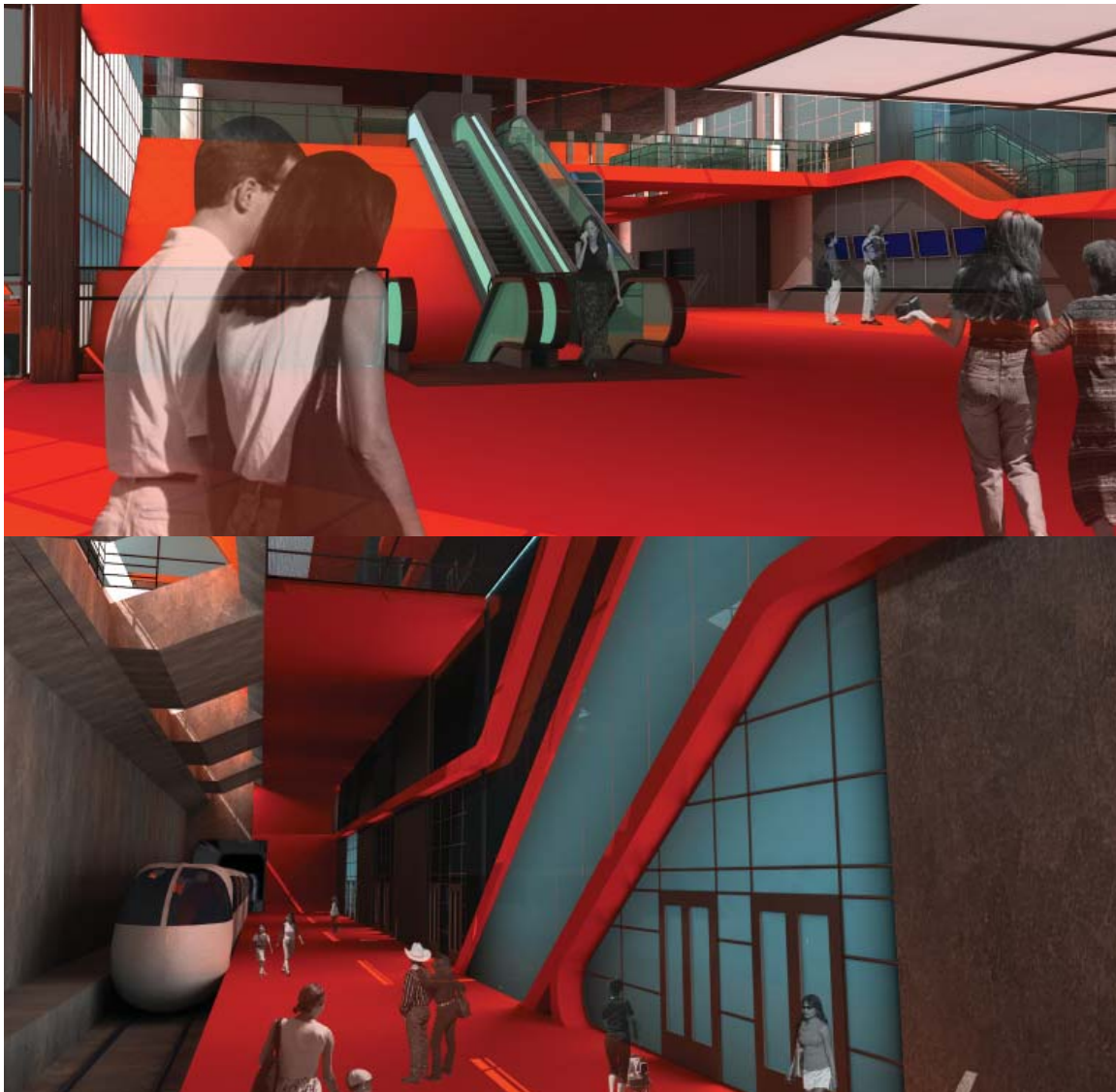


[illegible]



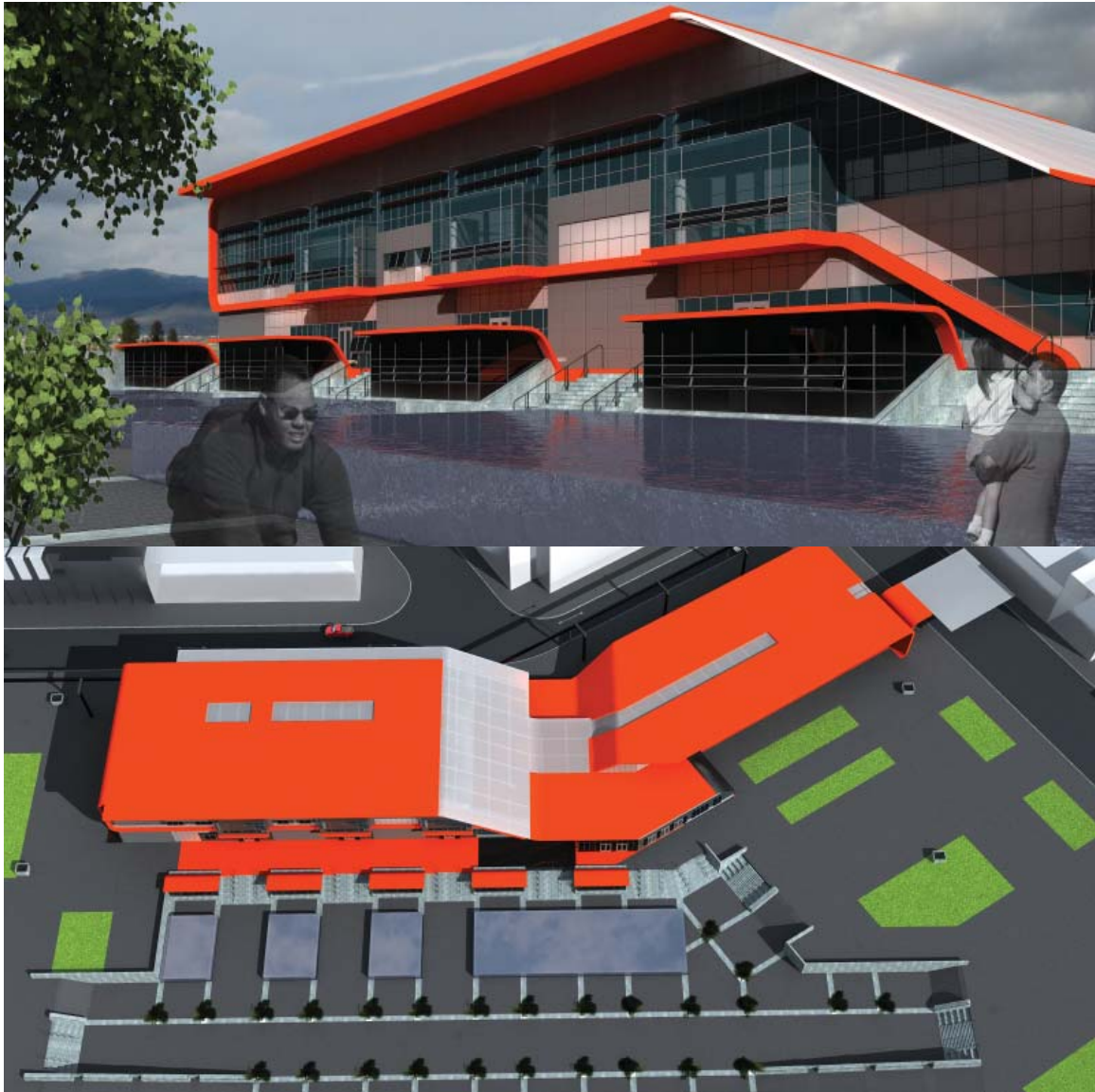
sections and elevations

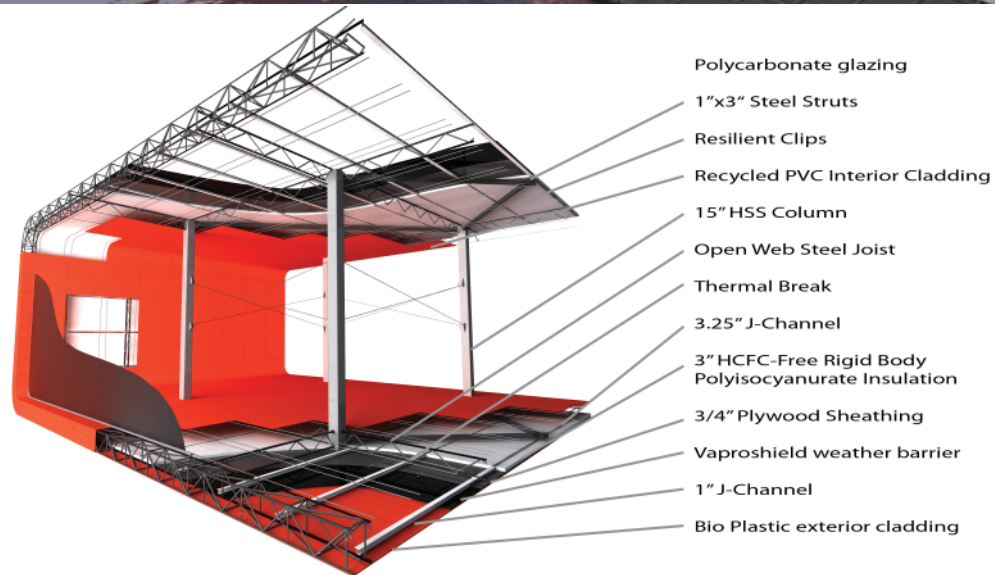








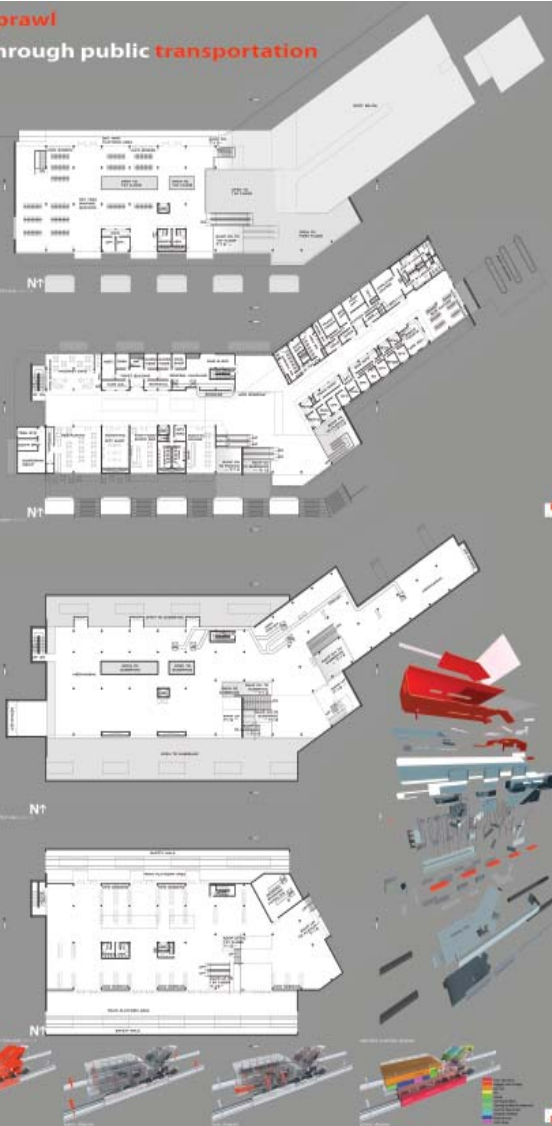




MōHUB



a solution to **sprawl**
through public **transportation**



Upon rationalizing the pros and cons of graduate school, it was clear to me at the crossroads of my undergraduate studies and professional career that a master's thesis would be an uphill battle, a test of my individual architectural abilities, and a process unlike any I had encountered before with regards to academia. Regardless, I welcomed the task with uncertainty and eager.

The book portion of my thesis really fell into place quickly. Writing about a topic in which I was passionate about made research, writing, and discussion less daunting and at times, exciting. The research portion created a further intimacy between my home town and me which, in turn, began to actually drive my design. Missoula being the only town I've ever really known, along with a look into its past, gave me a particular insight into what its future could really be like.

The most pivotal point in the design portion of my project was around the time of spring break. I had designed myself into a "corner" and put myself in a position where I felt like my building worked well in pieces, but failed as a whole in terms of composition. Every solution I pondered for days following this realization seemed to serve as an installation rather than a piece of the composition which really solidified the project and/or resolved any of the larger issues. I determined that I needed to back out of the project in scale and consider the entire building as "stitch" in the landscape that would "tie" the various modes of transportation together just as the definition of a transportation hub describes. Redesigning with the idea of both a figurative and symbolic nexus in mind gave me momentum to finish my project that resulted in a product far superior to the original design. I began my architectural career with a discussion about trusting the process; once again, those words test my character and ring true in the largest of my academic projects. Balancing on the decision of redesigning, weighing the risks and rewards, I realized that this is really the first time that such a move is all on me. It wasn't a professor mandating "start over." No, this time it came directly from my conscience, I was aware that I could better use the principles of good design to create something unique to Missoula and my program. I was growing without guidance. What a revelation to have on your way into the real world!

In hindsight, my thesis experience has been completely positive- I would do it again in an instant if given the chance. I am pleased with the theory that I have accumulated from mountains of journals and texts, precedents that I have familiarized myself with on a micro and macro level, as well as the multitude of design challenges that I have powered through; all on my own schedule, at my own pace, and in my preferred direction. Perhaps above all, I am most content with the fact that I am exactly where I feel I should be as an architectural student merging into a professional. I have completed a large body of independent work that included personal triumphs and fantastic failures that have resulted in overall growth and immense satisfaction in the final product.

endnotes

- ¹ Borgmann, Albert. Crossing the Postmodern Divide. (Chicago: The University of Chicago Press, 1992) 125.
- ² Tschumi, Bernard, and Irene Cheng. The State of Architecture at the Beginning of the 21st Century. (1st. New York: The Monacelli Press, 2003) 2.
- ³ Duany, Andres, Elizabeth Plater-Zyberk, and Jeff Speck. Suburban Nation: The Rise of Sprawl and the Decline of the American Dream. (1st ed. New York: North Point Press, 2000) xii
- ⁴ Tschumi and Cheng 23.
- ⁵ Cohen, Zev. "Lecture." 1995. IBID Duany, Plater-Zyberk, and Speck 21.
- ⁶ Borgmann 58.
- ⁷ Dittmar, Hank, and Gloria Ohland. The New Transit Town: Best Practices in Transit-Oriented Development. (Washington D.C.: Island Press, 2004) 5.
- ⁸ Kay, Jane Holtz. Asphalt Nation: How the Automobile Took Over America and How We Can Take it Back. (London: University of California Press, Ltd., 1997) 152.
- ⁹ Borgmann 58.
- ¹⁰ Kay 214.
- ¹¹ Jackson, Kenneth T. Crabgrass Frontier: The Suburbanization of the United States. (New York: Oxford University Press, 1985) 250.
- ¹² Jackson 168.
- ¹³ Jackson 170.
- ¹⁴ Jackson 270.
- ¹⁵ Duany, Plater-Zyberk, and Speck 90.
- ¹⁶ Kay 265.
- ¹⁷ IBID Jackson .168
- ¹⁸ Kay 301.
- ¹⁹ List of U.S. states by population density." 29 Nov 2006. Wikipedia. 7 Dec 2006 <http://en.wikipedia.org/wiki/List_of_U.S._states_by_population_density>.
- ²⁰ IBID Kay 169.
- ²¹ Borgmann 129.
- ²² Kay 136.
- ²³ Duany, Plater-Zyberk, and Speck 88.
- ²⁴ Kay 315.
- ²⁵ Duany, Plater-Zyberk, and Speck 85.
- ²⁶ Kay 129.
- ²⁷ The End of Suburbia: Oil Depletion and the Collapse of The American Dream. Dir. Gregory Greene. DVD. The Electric Wallpaper , 2004.
- ²⁸ The End of Suburbia.
- ²⁹ Dittmar and Ohland 124.

- ³⁰ Duany,Plater-Zyberk, and Speck 187.
- ³¹ Kay 149.
- ³² Dittmar and Ohland 20.
- ³³ Duany,Plater-Zyberk, and Speck 89.
- ³⁴ Borgmann 41.
- ³⁵ Borgmann 129.
- ³⁶ The Montana Smart Growth Coalition, Western Montana Alliance for Sustainable Transportation. "Montana Transportation Choices." 2004 10 Oct 2006 .
- ³⁷ Duany,Plater-Zyberk, and Speck 89.
- ³⁸ Borgmann 130.
- ³⁹ Missoula Parks and Recreation Department,"Missoula Urban Area Open Space Plan." 23 jun 2006 10 Oct 2006 <<http://www.ci.missoula.mt.us/parksrec/openspace.htm>>.
- ⁴⁰ Missoula Parks and Recreation Department.
- ⁴¹ The Montana Smart Growth Coalition.
- ⁴² The Montana Smart Growth Coalition.
- ⁴³ Missoula Parks and Recreation Department.
- ⁴⁴ The Montana Smart Growth Coalition.
- ⁴⁵ U.S. Census Bureau, "American Community Survey." Median Household Income. 25 Aug 2004. 29 Oct 2006 <<http://www.census.gov/acs/www/Products/Ranking/2003/R07T040.htm>>.
- ⁴⁶ The Montana Smart Growth Coalition.
- ⁴⁷ The Montana Smart Growth Coalition.
- ⁴⁸ Breakthrough Technologies Institute, Inc., "State Activities that Promote Fuel Cells and Hydrogen Infrastructure Development." July 2006 118-122. 20 jul 2006 <<http://www.fuelcells.org/info/StateActivity.pdf>>.
- ⁴⁹ Dittmar and Ohland 124.
- ⁵⁰ "Weather History." Missoula Weather History. 2002. CityRating.com. 31 Oct 2006 <<http://www.cityrating.com/cityweather.asp?City=Missoula>>.
- ⁵¹ Weather History.
- ⁵² Weather History.
- ⁵³ "Normals, Means, and Extremes." Missoula, Montana. Western Regional Climate Center. 3 Dec 2006 <<http://www.wrcc.dri.edu/cgi-bin/clilcd.pl?mt24153>>.
- ⁵⁴ Dittmar and Ohland 132.
- ⁵⁵ Dittmar and Ohland 132.
- ⁵⁶ Dittmar and Ohland 137.
- ⁵⁷ Dittmar and Ohland 157.
- ⁵⁸ Dittmar and Ohland 160.
- ⁵⁹ Dittmar and Ohland 212.
- ⁶⁰ Dittmar and Ohland 213.
- ⁶¹ Dittmar and Ohland 217.
- ⁶² Dittmar and Ohland 212.
- ⁶³ Dittmar and Ohland 213.

⁶⁴“History & Renovation.” Ferry Building History. 2005. Ferry Building. 24 Oct 2006 <<http://www.ferrybuildingmarketplace.com/history.php>>.

⁶⁵ History & Renovation.

⁶⁶ History & Renovation.

⁶⁷ History & Renovation.

⁶⁸ History & Renovation.

⁶⁹ History & Renovation.

⁷⁰ Imboden, Durant. Amsterdam Schiphol Airport. 2006. Europe for Visitors. 24 Oct 2006 <http://europeforvisitors.com/amsterdam/articles/amsterdam_schiphol_airport.htm>.

⁷¹ “Amsterdam Schiphol Airport Guide.” General Information. 2006. Travel Library. 24 Oct 2006 <http://www.travel-library.com/airports/europe/netherlands/amsterdam/amsterdam_schiphol_airport.html>.

⁷² Amsterdam Schiphol Airport Guide.

⁷³ Borgmann 41.

⁷⁴ Borgmann 131.

⁷⁵ A Transportation Hub, AIAS/APC 2007 Student Design Competition. “A Transportation Hub.” 21 Oct 2006 < <http://www.aias.org/plastics/program.pdf>>.

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bibliography

Alexander, Christopher, Ishikawa, Silverstein, Jacobson, King, Angel. A Pattern Language: Towns, Buildings, Construction. New York: Oxford University Press, 1977.

Alexander, Christopher, Neis, Anninou, King. A New Theory of Urban Design. New York: Oxford University Press, 1987.

"Amsterdam Schiphol Airport Guide." General Information. 2006. Travel Library. 24 Oct 2006 <http://www.travel-library.com/airports/europe/netherlands/amsterdam/amsterdam_schiphol_airport.html>.

Borgmann, Albert. Crossing the Postmodern Divide. Chicago: The University of Chicago Press, 1992.

Breakthrough Technologies Institute, Inc., "State Activities that Promote Fuel Cells and Hydrogen Infrastructure Development." July 2006 118-122. 20 Jul 2006 <<http://www.fuelcells.org/info/StateActivity.pdf>>.

Christensen, Tyler. "Western Montana Business Monthly." Downtown Missoula found its niche. 2005. Missoulia. 17 Oct 2006 <<http://www.mtinbusiness.com/current/bus04.php>>.

Cohen, Zev. "Lecture." 1995.

Dittmar, Hank, and Gloria Ohland. The New Transit Town: Best Practices in Transit-Oriented Development. Washington D.C.: Island Press, 2004.

Duany, Andres, Elizabeth Plater-Zyberk, and Jeff Speck. Suburban Nation: The Rise of Sprawl and the Decline of the American Dream. 1st ed. New York: North Point Press, 2000.

Dunphy, Robert T., Robert Cervero, Frederick C. Dock, Maureen McAvey, and Douglas R. Porter. Developing Around Transit: Strategies and Solutions That Work. Washington D.C.: ULI-the Urban Land Institute, 2004.

The End of Suburbia: Oil Depletion and the Collapse of The American Dream. Dir. Gregory Greene. DVD. The Electric Wallpaper, 2004.

Etchells, Frederick. "The City of Tomorrow and its Planning." Introduction to Le Corbusier.

"History & Renovation." Ferry Building History. 2005. Ferry Building. 24 Oct 2006 <<http://www.ferrybuildingmarketplace.com/history.php>>.

Imboden, Durant. Amsterdam Schiphol Airport. 2006. Europe for Visitors. 24 Oct 2006 <http://europeforvisitors.com/amsterdam/articles/amsterdam_schipohl_airport.htm>.

An Inconvenient Truth. Dir. Davis Guggenheim. Perf. Al Gore. DVD. Paramount, 2006.

Jackson, Kenneth T. Crabgrass Frontier: The Suburbanization of the United States. New York: Oxford University Press, 1985.

Jacobs, Jane. The Death and Life of Great American Cities. New York: Random House Inc., 1961.

Kay, Jane Holtz. Asphalt Nation: How the Automobile Took Over America and How We Can Take it Back. London: University of California Press, Ltd., 1997.

Kunstler, James Howard. The Geography of Nowhere: The Rise and Decline of America's Man-man Landscape. New York: Touchstone, 1993.

"List of U.S. states by population density." 29 Nov 2006. Wikipedia. 7 Dec 2006 <http://en.wikipedia.org/wiki/List_of_U.S._states_by_population_density>.

"Missoula Montana." 28 Oct 2006. Wikipedia. 31 Oct 2006 <http://en.wikipedia.org/wiki/Missoula,_Montana>.

Missoula Parks and Recreation Department, "Missoula Urban Area Open Space Plan." 23 jun 2006 10 Oct 2006 <<http://www.ci.missoula.mt.us/parksrec/openspace.htm>>.

The Montana Smart Growth Coalition, Western Montana Alliance for Sustainable Transportation. "Montana Transportation Choices." 2004 10 Oct 2006 .

New Dream, "Transportation and Urban Design." Overview and Connection to a New Dream. 1999. newdream.org. 17 Oct 2006 <<http://www.affluenza.org/cnad/transport.html>>.

New Urbanism, "Smart Transportation to Save the Planet." The New Train Plan. 17 Oct 2006 <<http://www.newtrains.org/pages/354055/index.htm>>.

"Normals, Means, and Extremes." Missoula, Montana. Western Regional Climate Center. 3 Dec 2006 <<http://www.wrcc.dri.edu/cgi-bin/cliilcd.pl?mt24153>>.

"Riverside, Ill." Encyclopedia of Chicago. 2005. Chicago Historical Society. 1 Dec 2006 <<http://www.encyclopedia.chicagohistory.org/pages/1080.html>>.

Solomon, Jonathan D. 13 Projects for the Sheridan Expressway. Pamphlet Architecture 26. New York: Princeton Architectural Press, 2004.

A Transportation Hub, AIAS/APC 2007 Student Design Competition. "A Transportation Hub." 21 Oct 2006 <<http://www.aias.org/plastics/program.pdf>>.

Tschumi, Bernard, and Irene Cheng. The State of Architecture at the Beginning of the 21st Century. 1st. New York: The Monacelli Press, 2003.

U.S. Census Bureau, "American Community Survey." Median Household Income. 25 Aug 2004. 29 Oct 2006 <<http://www.census.gov/acs/www/Products/Ranking/2003/R07T040.htm>>.

"Weather History." Missoula Weather History. 2002. CityRating.com. 31 Oct 2006 <<http://www.cityrating.com/cityweather.asp?City=Missoula>>.