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Minimizing Urban Sprawl through Open Space Design Strategies: The Case of Tucson, Arizona

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Abstract: Urban sprawl refers to the change in land use outside an urban center that results in a relatively dispersed form of residential or commercial development and causes the loss of open space, farmland, or wildlife resource. Alternative methods of development, such as “smart growth” techniques and “New Urbanism” principles are being promoted as a set of ideas to mitigate urban sprawl, to encourage sustainable growth and facilitate infill development. The purpose of this paper is to address the problems due to the current urban sprawl in Tucson, Arizona. The paper further analyses a suitable site for redevelopment and offers open space design strategies to maximize the use of the undeveloped open spaces within the existing urban fabric by creating activity centers with sustainable development. The paper will also seek the possibilities of creating a connection within the city that would offer a continuous and perceptible urban environment through redevelopment of potential sites. Through various concept alternative developments, a final proposed master plan for the chosen site is generated by connecting three potential areas redeveloped to accommodate mixed-use functions through alternative modes of transportation, linking Tucson in the East-West direction in an attempt to minimize the current urban sprawl.

Keywords: Urban Sprawl, Connectivity, Open Space Design, Alternative Modes of Transportation, Infill Development

INTRODUCTION

Urban sprawl as described by Williams (2000) is “the outward spread of commercial, industrial, and residential development into open spaces located on the fringes of urban centers” (Williams 2000, 24). The concepts of *Smart growth* and *New Urbanism* principles are seen as ways of combating urban sprawl and building better communities.

These principles depreciate suburban sprawl while promoting denser urban centers, focusing on mixed land use, pedestrianism, aesthetic and architectural continuity as opposed to growing towards the outskirts of the city; leading to decay of downtown areas. According to the American Planning Association (APA) (2002), “Compact, transit accessible, pedestrian oriented, mixed-use, infill development patterns and land reuse symbolizes the application of the principles of *Smart Growth* and *New Urbanism*.” These solutions include increasing the population density within built areas in the urban fabric by encouraging infill developments that provide opportunity to transform underused urban areas into inviting public realms. Responsive infill gives a place new life, making it more functional, exciting, beautiful and sustainable, while at the same time preserving its character and history, increasing reliance on public transit and other environment-friendly modes such as walking and biking instead of dependence on automobile.

Tucson, Arizona like many other cities has been experiencing urban sprawl for a long time. The current development is growing in such a way that suggests it will not stop until it reaches the outskirts of the city resulting in destruction of open spaces and disconnection from the downtown. The downtown comprising the important civic, cultural, historic functions provides a dynamic physical focus for Tucson's unique ethnic, cultural and artistic diversity by creating a vital activity center with important arts facilities, historic buildings, offices, residents, unique restaurants, convention hotels and retail spaces. The disconnection from the vital city center due to lack of activities, pedestrian friendly streets and public transit are making Tucson lose its sense of identity, the rich civic, cultural and historical essence. In order to minimize the sprawl and revitalize connectivity with the city center, Tucson desires for open space design strategies. These include new mixed-use and urban infill sites with compatible new buildings, through selected nodes having the maximum potentiality to grow into vibrant public activity centers accommodating functions that include (retail, office, housing, restaurants, hotels), recreational facilities (parks & waterfront developments), outdoor gathering spaces for both small and large events, pocket parks and courtyards. Encouraging infill and mixed land-use, and introducing a variety of transportation choices (trolley, bicycle and pedestrian-friendly street networks) reduce auto dependency and thus aids in slowing down urban sprawl.

Methods

This paper will respond to the existing urban sprawl by designating a potential site and proposing a cohesive master plan concept for Tucson focusing three areas within the selected site for re-development that expresses and nurtures Tucson's unique natural landscape, cultural heritage, the rich history and community values with the appropriate functions to interlink the developed areas with mixed use functions and infill developments. There is further a desire to make the connectivity through the Congress Street and the 4th Avenue shopping street stronger with the introduction of alternative modes of transportation.

A suitable site comprising the important landmarks of Tucson is selected and view shed analysis, archetype analysis, existing vegetation, solid-void relationships, open space uses and building uses are thoroughly studied.

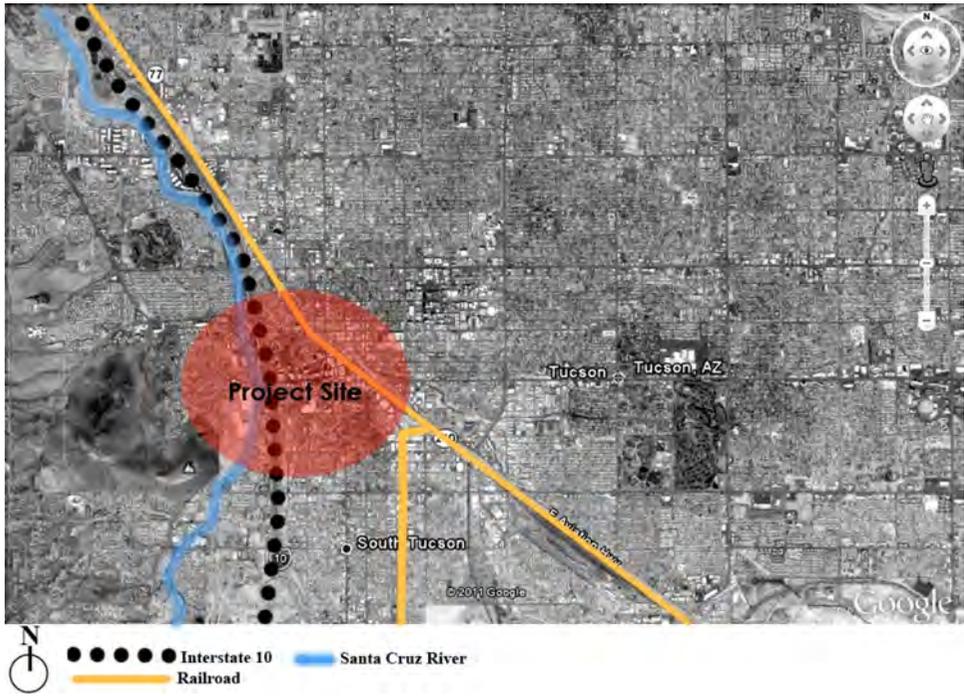


Figure 1: Selected Project Site Showing the Interstate 10, Santa Cruz River and the Railroad

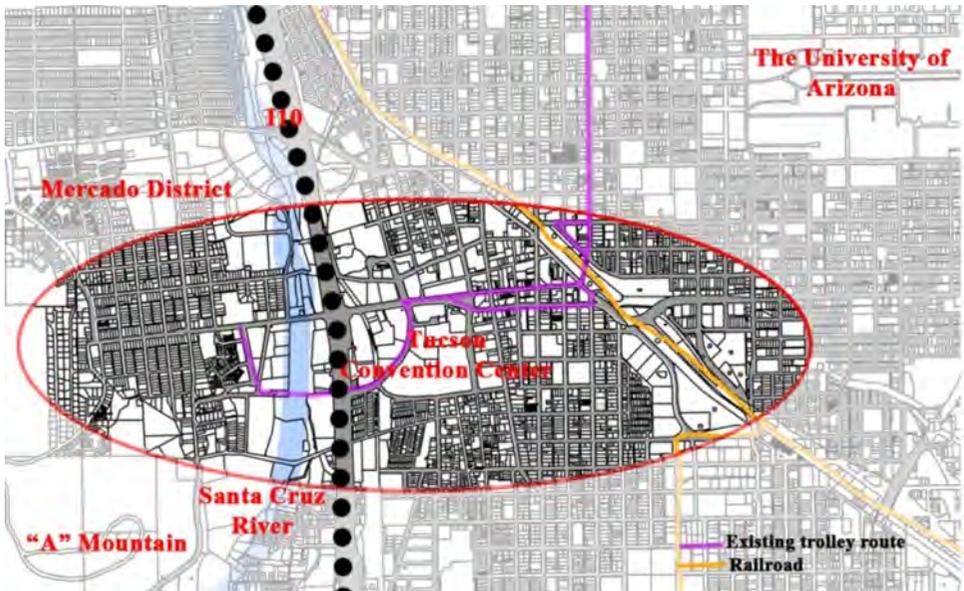


Figure 2: Selected Project site comprising the existing landmarks of Tucson

Figure 1 illustrates the current situation of urban sprawl in Tucson, where the necessity of re-development within the urban fabric to connect the community is vivid. Based on the current

situation of Tucson, there is an extensive need to revitalize the downtown area, promote economic and cultural vitality while implementing the design practices of *New Urbanism* and *Smart growth*; linking the city along the east-west axis to minimize the sprawl further. The chosen site for the new development encompasses the *Downtown area (Central Business District)*, the *railroad, 4th avenue shopping district* on the eastern part of the city; *Interstate-10 and underpass, Santa Cruz River, Mercado district* and the “*A*” *Mountain* on the west side of the city connected by West Congress Street. The Santa Cruz River flows from the north of the site and has potentiality to attract public from all over the city, thus enhancing the connectivity with the community.

Figure 2 shows the existing landmarks within the site and the trolley route that currently runs from the east to the west of Tucson. There is a need to propose a new trolley route that links the new designed activity areas to maximize public uses and facilitate public movement with an increased non-motorized use and pedestrianisation. The land use analysis for the chosen site recommends three areas of focus referred as *nodes of influence* ideally suited to be re-developed and transformed into vibrant activity centers accommodating mixed land use like retail, commercial, residential and infill developments with entertainment hubs for civic life.

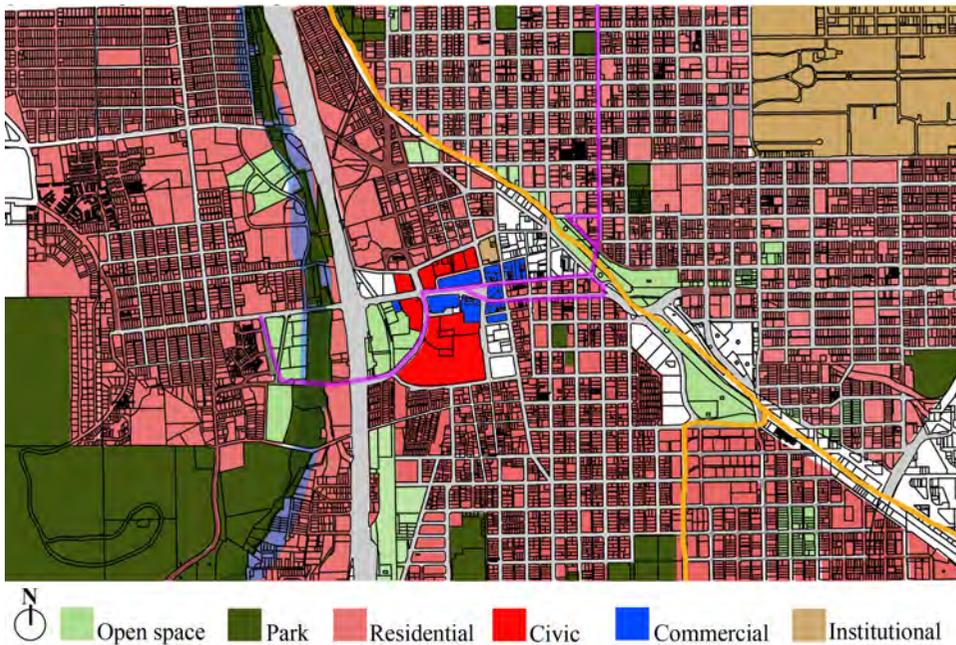


Figure 3: Project Site with the Land-use Analysis, Open Space Uses and Building Uses

The above diagram shows the land-use analysis, open space uses and building uses for the chosen site. There is a substantial amount of open space in relation to the built environment. The existing open space and park areas illustrate potentiality for new developments and the diagram addresses the possible connections between the existing open spaces in relation to one another and to the existing building uses. The low-rise residential areas with little pocket parks or open space demand for more mixed-use facilities with activity centers for the users throughout the city. The existing trolley currently runs from the University of Arizona, 4th avenue shopping district, Tucson Convention center and through the underpass to the west of the city. The existing route opens up possibilities to propose a new trolley route that connects the east

and west of Tucson, promoting walkability and mass transportation to create a continuous and cohesive circulation pattern throughout the city, making it livable.

Results & Discussion

Table 1: Showing the Three Nodes of Influence and why they are Chosen for Further Redevelopment

Nodes of Influence	Reasons for choosing the selected nodes
1. The node by the railroad and 4 th avenue	Due to close proximity to The University of Arizona and the 4 th avenue shopping district. This land has potential to grow into mixed-use developments with designed green areas to attract users.
2. Tucson Convention Center area and its adjacent land	Tucson Convention center acts as the central attraction for the city with existing recreational facilities, designed landscaped area. The adjacent land has bland parking lots and unused open spaces having opportunities to be developed into infill developments and mixed use activity centers. This land in turn connects the west through the underpass and the Interstate 10.
3. West bank of Santa Cruz River and Interstate 10 Underpass.	The existing open spaces by the Santa Cruz River provide opportunities to be developed into linear parks and recreational facilities; underpass currently dividing the city could be redesigned to connect the east and west developments.

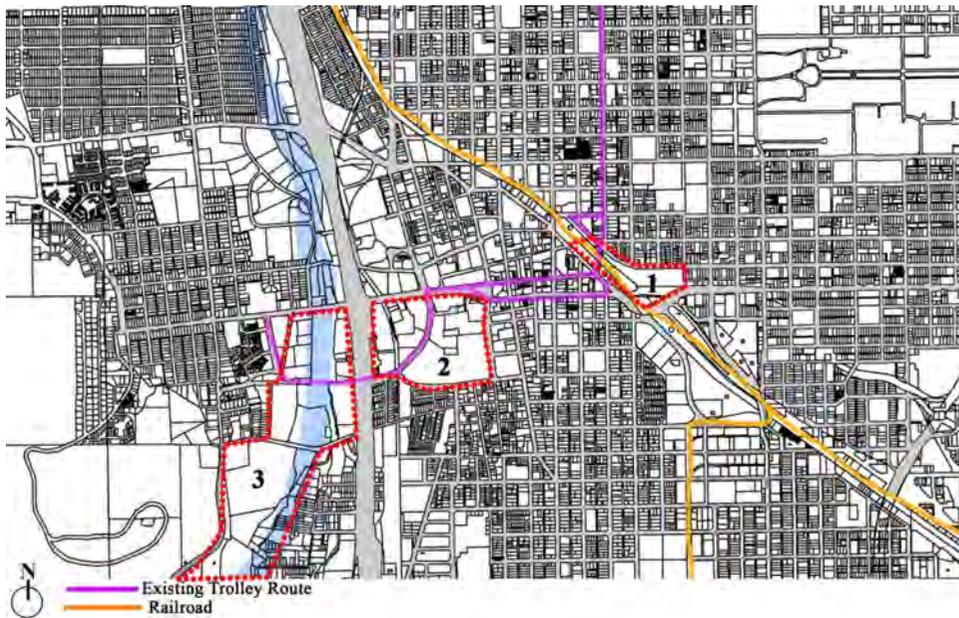


Figure 4: Identifying the Three Areas of Focus Considered as the Nodes of Influence for Redevelopment

Table 1 further illustrates the selection of three areas of focus termed as the *nodes of influence* after analyzing the site due to the potentiality to grow into mixed-use and infill developments. The three nodes are further analyzed with site visits, photographs, interviews, and relevant case study analysis. The nodes hold ample opportunities to accommodate public and recreational facilities, encouraging the use of pedestrian friendly streets, street cars and bicycles. The available open space and parks at each of the nodes are conceptualized to be transformed into linear parks with landscape design strategies that can house large and small public gatherings. As each node is unique in character, every design should respond accordingly. In order to formulate appropriate design responses, each node is then analyzed with a series of relevant case studies, and theory based literature reviews to produce several concept alternatives. The best concepts are then synthesized into one overall master plan concept for Tucson. Finally the incorporation of alternative modes of transportation (pedestrian friendly streets, trolley systems and bicycle paths) links the redeveloped nodes, promote economic and cultural vitality while implementing the design practices of *New Urbanism* and *Smart growth* in an east-west axis to minimize further sprawl.

First Node of Influence

The Node by the Railroad & 4th Avenue

The close proximity to the 4th avenue shopping district, the University of Arizona, the railroad and the existing neighborhood make the railroad node a suitable place for new development and a hub for responsive activity center. This piece of land comprising an existing garden with Tucson's native drought tolerant plants opens up possibilities for outdoor activity spaces and green courtyards for social interactions. Urban design elements and practical amenities like seating walls, waste receptacles, food vendors, community oriented public art give the designed space a sense of vibrancy inviting people to spend a quality time and relax from the daily life stress.



Figure 5 (a): Proposed Plan for the Railroad Node of Influence

As shown in Figure 5 (a) the proposed design for the railroad node includes new mixed-uses; retail, restaurants, and higher density (i.e., two to three stories) married student housing and ample green space for social gatherings and outdoor activities. The accessibility from the east and north entrances through pedestrian friendly streets and bicycle paths facilitate easy movement to the designed node. Outdoor activity spaces with shading devices and cooling towers, interconnected pathways, linear green parks by the railroad, views of the Catalina, Tucson Mountains on the north and east, and downtown buildings add a sustainable environmental quality to the node attracting visitors from all parts of the city. The use of turf grass and pervious materials for paving make the node more appealing to people and an excellent zone for public gathering with mixed-use and infill developments.



Figure 5 (b): 4th Avenue Street

Figure 5 (c): Table Games at the Outdoor Tables Fair

The above figures highlight the possible activities that make the node more attractive and useable to the users. The 4th avenue Street fair in Tucson, Arizona can be an excellent example that can accommodate large social gatherings which can continue from the 4th avenue to terminate at the node by the railroad having mixed-use functions and public activity spaces. The accessibility from the snake bridge across the street on the south of the site and the bicycle path bring people from south Tucson and thus creating a strong connection within the community. Outdoor activities may include table games that help to bring people together while enjoying the vibrant space.

Second Node of Influence

Tucson Convention Center & its Adjacent Land

The culturally and historically rich essence of the downtown has been accentuated by transforming the Tucson convention center and its adjacent land in to a vibrant public space with infill developments, mixed land use and green urban landscape. The node by the Tucson convention center and its adjacent land comprises new mixed-use developments within the existing infrastructure, including commercial, residential, recreational and public activity areas. The node acts as a connection to the third node by the Santa Cruz River and with the new underpass design, facilitates the pedestrian movement through the activity centers. The introduction of new street car/trolley route through the designed area allows maximum public activities making the space vibrant. The use of turf grass and pervious concrete on public plazas illustrate sustainable materials and in turn reduce the heat island effect. The vegetation also acts as a noise barrier from the existing Interstate traffic making a useful space for entertainment and social gatherings. The underdeveloped open spaces and the vacant bland parking lots at the node if designed in to mixed land use will provide economic benefits by raising local tax receipts.



Figure 6 (a): Proposed Design for the T.C.C. Node with the Proposed Trolley Route

- | | |
|---|---------------------------|
| 1 Green courtyard | 7 Recreational facilities |
| 2 Retail & Restaurant | 8 Existing Built forms |
| 3 Mixed-use Building (Commercial & Residential) | 9 Amphitheater |
| 4 Existing parking | 10 Trolley stop |
| 5 Hotel | 11 Underpasses |
| 6 Outdoor shaded activity area for large public gathering | |

The proposed functions as shown in Figure 6 (a) consist of retail, office, restaurants, hotels, housing, civic plazas, and amphitheatres for holding large and small public events, outdoor activities and live concerts. The functions are made accessible to the users with the introduction of a new trolley route and pedestrian friendly streets. As a relevant case study, the *Pioneer courthouse square* in Portland, Oregon shows considerable similarities that hold public events to encourage social interactions. The introduction of trolley systems into the designed space and pedestrian road networks make the mixed-use developed zones an economically viable area with income generating from sponsorships and special events. Another successful example is the *16th street mall* at Denver, Colorado; where by incorporating recreational facilities close to the downtown area and by providing a perfect blend of tree lined pedestrian Friendly Street and the trolley system the site is made more functional and vibrant.



Figure 6 (b): Alternative Modes of Transportation and Figure 6 (c): the Tree Lined Pedestrian Street at the 16th Street Mall, Denver, Colorado



Figure 6 (d): Outdoor Movie Theatre at the Pioneer Courthouse Square, Portland, Oregon



Figure 6 (e): Farmer's market at the Pioneer Courthouse Square, Portland, Oregon



Figure 6 (f): Light Rail System at the Pioneer Courthouse Square, Portland, Oregon

The above figures show the proposed activities at the designed area. As the tree lined Pedestrian Street seen at the 16th street, South Granada Street in Tucson can be made pedestrian friendly by rerouting the traffic linking the convention center and the adjacent civic plaza that can accommodate large public events. Urban design elements like monuments, water features, seating areas, vegetation used as a noise barrier from the high volume traffic as seen at *Campus Martius Park* at Detroit, Michigan; give the place a sense of vibrancy inviting people to spend a quality time and appreciate the rich culture of Tucson.

Interstate-10 & Underpass Design

The Interstate-10 underpass that currently divides the city has been transformed in to a well-lit lively activity space comprising functions like artifact shops, display of arts, coffee shops and food vendors. The new design connects the east and west of Tucson with a proposed trolley route, bike path and pedestrian friendly street that facilitate movement through the activity area while enjoying the vibrancy of the space. This new design acts as a bridge and is integrated with the Tucson Convention Center node and the west bank of Santa Cruz River node to allow maximum public uses. Introduction of skylight adds lightness to the designed space and the variety of functions makes it a successful area for social interaction. The native plants of Tucson are arranged along the Interstate-10 to minimize the excessive vehicular noise and the vegetation makes the space more attractive and usable to the public, increasing walkability. The sports

facilities, the adjacent mixed use and infill developments encourage maximum public participation, thereby making the connection through the underpass stronger.



Figure 7: Plan for the Interstate 10 & Underpass Linking the East and West of Tucson

Third Node of Influence

West Bank of Santa Cruz River Node

The west bank of Santa Cruz river node accommodates public plazas with recreational and sports activities, that bridge the disconnection due to the Interstate-10 and acts as an anchor for the city. The green linear park with Tucson's native plants by the river, bike trails, exhibition space, T.C.C expansion area, sports facilities like baseball fields and basketball courts, civic plazas with pervious materials and the famous Santa Cruz River farmers' market provides a remarkable experience. As illustrated in Figure 8, the new developments are linked with a proposed trolley route, pedestrian friendly streets and the turf grass areas for social interaction. As seen at the *Emerald Necklace park system* at Boston, Massachusetts, where the river acts as a linkage that opens up possibilities for bike trails connecting several civic plazas and parks with tree shaded walks, Santa Cruz River is transformed to a space for recreation. Housing, hotels, retail spaces and restaurants add economic viability to the undeveloped open spaces. The new underpass design with public activity spaces and incorporation of skylights, coffee shops, art exhibits, and food vendors makes it a lively place for the pedestrian. The proposed street car route runs through the underpass and connects with the new development of the Santa Cruz River node. The linear green park with Tucson's native trees and shrubs, seating walls, plazas holding functions like farmer's market, social gatherings together create a perfect environment for recreation.



Figure 8 (a): Proposed Design for the West Bank of Santa Cruz River Node



Figure 8 (b): 4th of July Fireworks show by the Santa Cruz River



Figure 8 (c): Santa Cruz River Farmers' Market

The above images show some possible activities at the node, making it a strong anchor for the users travelling from all over the city.

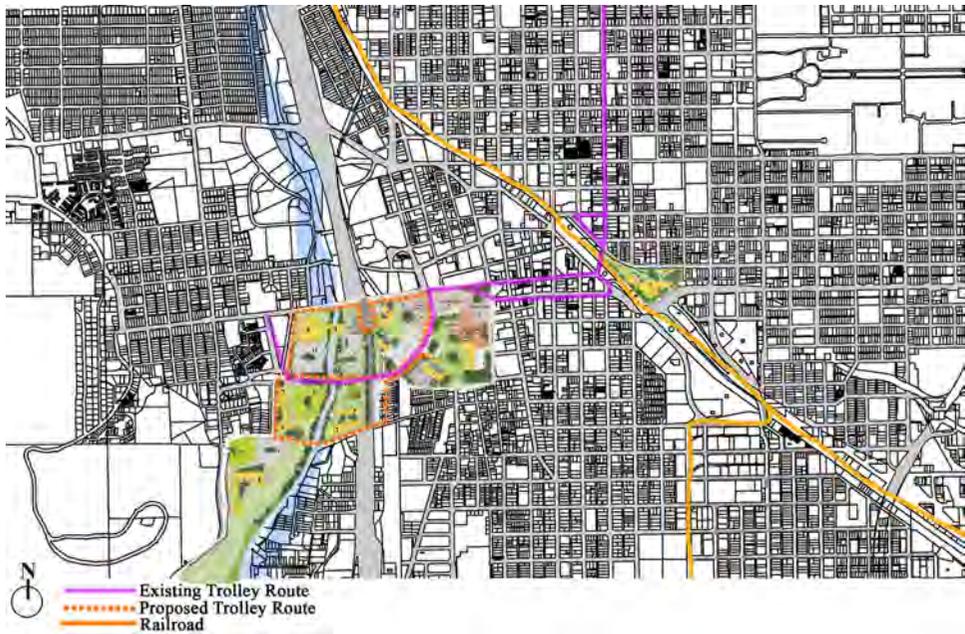


Figure 9: Final Synthesized Master Plan of the Three Selected Nodes of Influence

The final master plan design is created after a synthesis of the three selected nodes. This synthesis produced a master plan that adequately responds to the current need to revitalize the connectivity within the city of Tucson, Arizona with redevelopments and a variety of transportation choices. The proposed trolley route in addition to the existing route creates a smooth flow of public through the designed nodes and in turn establishes a strong connection making the community sustainable and livable.

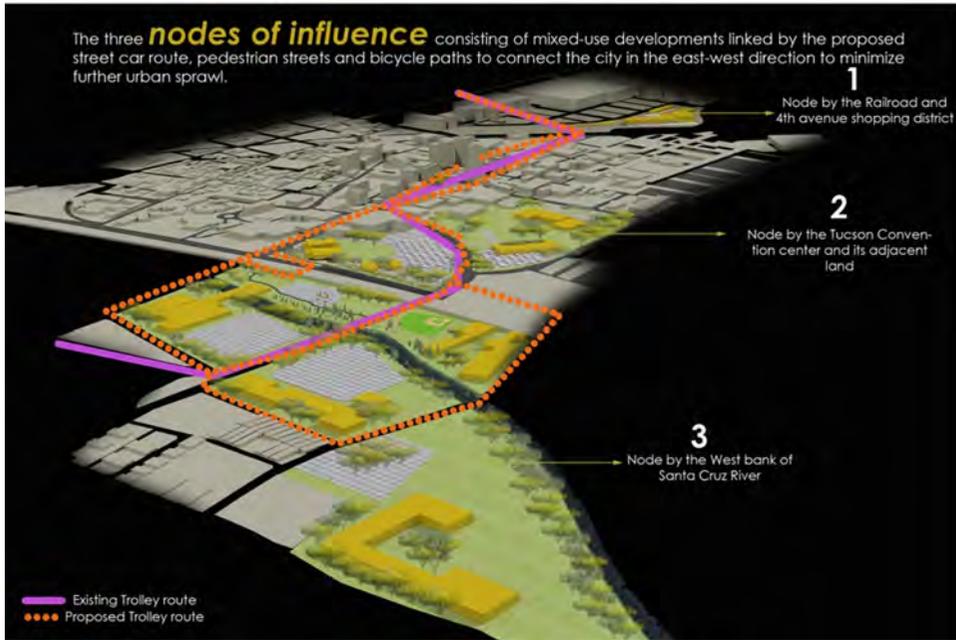


Figure 10: View of the Three Nodes Connected with the Existing and Proposed Trolley Routes

Conclusion

This paper responded to the existing urban sprawl problems by presenting a master plan concept with three potential sites redeveloped that encourages a broad range of recreational and public uses that utilize the available facilities and infrastructure. An environmental overlay of the various components of the master plan design reveal a variety of strategies including rainwater harvesting, appropriate site orientation, location for the proposed architecture and an adequate balance between natural preservation and proposed vegetation. Adequate gathering spaces coupled with tranquil walking work together to create a pleasant, pedestrian friendly environment where social meetings are encouraged. The three nodes comprising mixed-use and infill developments ensure maximum public uses integrating open spaces and link the functions through alternative modes of transportation (streetcar, bicycle and pedestrian friendly streets) in the east-west direction offering a continuous urban environment within the city. In an attempt to create a connection with the city center, the master plan suggested in the paper if implemented to the current situation provides possibilities in building up an attractive, sustainable and walkable community that increases social interaction and preserves Tucson's natural landscapes and the rich cultural heritage, discouraging urban sprawl.

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