Central New Mexico Climate Change Scenario Planning Project

Revised Draft Task 4.4 Memo: Revised Scenario Evaluation and Resiliency

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1 INTRODUCTION

This memo evaluates three year 2040 regional land-use and transportation planning scenarios developed by the Mid-Region Council of Governments (MRCOG) for the second scenario planning workshop as part of the Central New Mexico Climate Change Scenario Planning Project. A project team composed of staff from Ecosystem Management Inc. (EMI) and the University of New Mexico (UNM) evaluated the scenarios for their resiliency to a range of potential future climate conditions and how well they address regional transportation planning goals. Within the central New Mexico region, population is expected to grow by 460,000 to 1,362,000 (a 52 percent increase) by the year 2040. MRCOG developed the scenarios in response to comments received from the first workshop, which largely favored the "emerging lifestyles" scenario to accommodate this growth. This scenario focused on increasing mixed use development in activity centers and other developed areas. Workshop participants also provided comments that asked for a refined scenario that better addressed the goal of improving the jobs/housing balance in the emerging lifestyles scenario. Furthermore, several comments suggested that the scenarios should go further by producing larger positive changes in the performance measures (discussed in more detail later in this report) from the existing trend and the other alterative scenarios.

In response, MRCOG developed two preferred scenarios, one financially constrained and one financially unconstrained, which aim to improve the jobs/housing balance and also increase mixed use development in existing activity centers and other developed areas. The two preferred scenarios have the same land-use assumptions but differ in their assumptions about the amount of future transportation funding and therefore the extent of the transportation network. A third scenario represents a continuation of existing trends which is similar to the "allowable uses" scenario but reflects today's actual zoning rules rather than a simplified representation of these rules, which was used previously.

The project team evaluated each scenario for its resiliency to future climate conditions that could include more extreme heat and precipitation. The project team evaluated climate change resiliency across five dimensions: urban heat, drought, flooding, wildfire, and crucial wildlife habitat. The project team also evaluated each scenario for how well it addressed regional transportation planning goals. MRCOG developed a comprehensive set of transportation performance measures that consider several dimensions of regional accessibility and mobility as well as greenhouse gas (GHG) emissions. The project team compared the resiliency and transportation performance of each scenario to current conditions (the 2012 baseline scenario) and to a year 2040 trend scenario. These two points of comparison help determine how much better or worse off the region is expected to be under each alterative scenario compared with today and to a future that develops from a continuation of today's policies and plans. The results generally find that in large part due to anticipated significant population growth, the region is expected to be less resilient to climate change than today under any of the future scenarios; however, the alterative scenarios are relatively more resilient than the trend.

1.1 Modeling Process

Each of the 2040 scenarios, along with a year 2012 baseline scenario, were modeled using the UrbanSim agent-based land-use simulation model and a regional 4-step travel demand model (implemented in CUBE). Each scenario was specified in UrbanSim by defining different zoning layers that indicate the allowable uses and intensity of use for each parcel in the region. Additionally, for the preferred scenarios, the probability of development occurring near key activity centers, transportation corridors, and transit stops was increased to reflect the influence of policy measures that are expected to incentivize development in these areas. These policy measures were not explicitly defined but could include reduced development fees, streamlined permitting procedures, reduced parking requirements, and investments in public infrastructure.

UrbanSim provides parcel level output that includes basic socio-economic data and land-use attributes. These data provide information about the type and extent of development within the metropolitan area. To determine how different development patterns will affect travel and greenhouse gas (GHG) emissions, the

UrbanSim outputs are also used as inputs to MRCOG's regional travel demand model. The regional travel demand model estimates the production and attraction of trips to and from 900 travel analysis zones (TAZs) across the metropolitan area. The trip production and attraction rates for each TAZ depend on output from UrbanSim including population, household size, income, employment, and presence of a school. The travel demand model matches trips produced by a TAZ with trips attracted to other TAZs, and then determines the likely mode for these trips and which routes through the transportation network they will take. The travel demand model provides output that includes the number of vehicle and transit trips and their speed along each roadway link in the regional transportation network. These data are used to estimate common transportations system performance metrics and also used for estimating GHG emissions.

The preliminary scenarios considered in the first workshop only considered changes in land-use; each of the three future scenarios had the same street and transit networks from the 2035 long-range transportation plan. The output of the travel demand model varied because of the different TAZ-level population and land-use data output from the three scenarios that were modeled in UrbanSim and differentiated by defining different land-use zoning layers. The scenarios presented in the second workshop consider changes in both land-use and the transportation system as shown in Table 1. Additionally, the land-use model and travel demand model were allowed to interact during an intermediate year 2025 modeling step. The purpose of this interaction was to allow the land-use model to consider updated traffic forecasts before continuing to model land-use development though the year 2040. This is an important step in accurately reflecting how land-use responds to traffic. The land-use model considers the travel time to and from each parcel when determining the location and intensity of land-use development. As travel time to and from a parcel increases, that parcel becomes less attractive for development. Modeling in the first workshop predicted land-use development using current year 2012 traffic conditions, which are generally less congested than expected future conditions in most areas of the city. This modeling limitation likely resulted in predictions of more urban fringe development, holding all other factors constant.

Table 1 describes the differences between each scenario for the intermediate year 2025 step and final year 2040 step. The trend scenario assumes no change in current land-use plans, a full build out of the 2040 road network, and a transit system where a new Bus Rapid Transit (BRT) line replaces the Central Avenue rapid ride bus. The preferred scenario assumes municipalities will adopt new land-use plans and policies that allow and encourage infill, mixed use, and transit oriented development; a full build out of the 2040 road network; and an expanded transit network with a higher level of service. The constrained scenario contains the same land-use plans and policies as the preferred scenario but assumes a slower pace of roadway construction and fewer transit investments; representing a possible future where federal transportation funding continues to decline.

Table 1. Definition of Workshop 2 Scenarios.

	Scenario		
	Trend	**Preferred**	**Constrained**
Year 2025			
Land-Use	Existing Plans & Policies	Zoning Changes & Development Incentives	Zoning Changes & Development Incentives
Road Network	2025 Network	2025 Network	Existing
Transit System	Existing	2025 Network & Service Plan	Existing
Year 2040			
Land-Use	Existing Plans & Policies	Zoning Changes & Development Incentives	Zoning Changes & Development Incentives
Road Network	2040 Network	2040 Network	2025 Network
Transit System	Existing + Central BRT[a]	2040 Network & Service Plan	2025 Network & Service Plan

[a]Bus Rapid Transit

The three different transportation networks used in the travel demand model are shown in Figure 1. The 2025 network represents the existing network and committed (i.e., funded) transportation projects. The 2040 network represents a more extensive network that includes important projects identified by municipal governments but which are not currently committed.

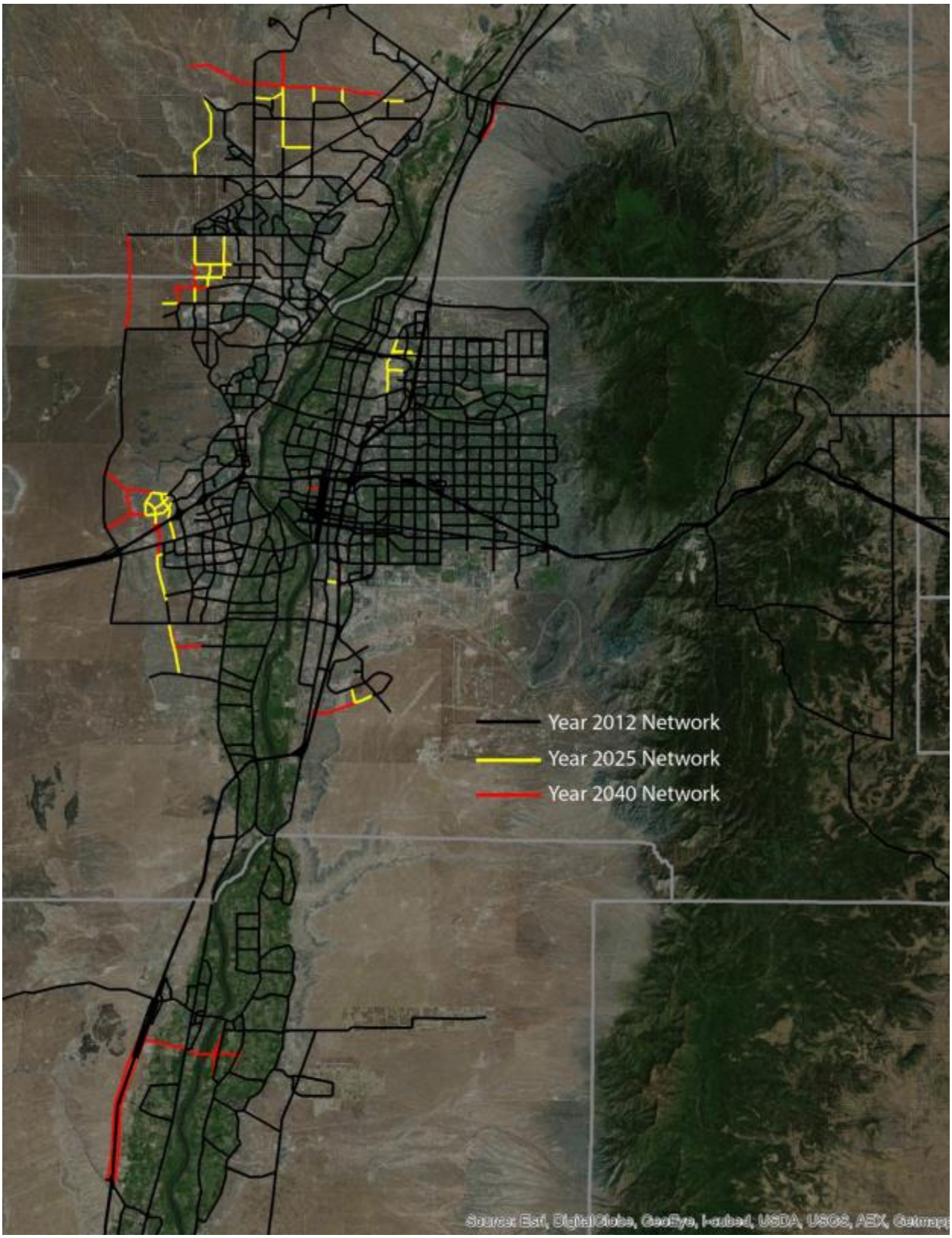


Figure 1. Network Map.

The service characteristics of the three different transit systems used in the travel demand model are described in detail in Table 2. The 2040 trend transit system is the same as today's except that it includes a Bus Rapid Transit (BRT) line in place of the current Central Avenue rapid ride line. The 2025 transit network adds to the trend network three additional BRT lines, one each along Coors Blvd., Paseo del Norte, and the UNM-Sunport corridor, and also increases service levels on some routes. The 2040 transit network adds to the 2025 transit network several additional bus and rapid line routes and improves service levels on most routes. Like the roadway network, the transit network in the constrained scenario is assumed to be limited by available funding. The transit network and service plan in the preferred scenario would require an increase in the local taxes. Transit services are currently funded with a one eighth percent gross receipts tax that could be increased to one half percent without further action from the state legislature; however, any increase would need voter approval.

Table 2. Scenario Transit System Service Characteristics.

		2012		2025		2040	
Route Type	**Route Name**	**Headway (min)**	**Service Hours**	**Headway (min)**	**Service Hours**	**Headway (min)**	**Service Hours**
Bus Rapid Transit	Central Ave. BRT	15*	16*	5	18	5	18
Bus Rapid Transit	Coors Blvd. BRT	17*	16*	17	16	10	18
Bus Rapid Transit	Paseo del Norte BRT			20	18	15	18
Bus Rapid Transit	UNM-CNM BRT			15	18	15	18
Primary	Bridge-Westgate (54)	45	16	30	18	15	18
Primary	Central Ave. (66)	15	19	15	18	15	18
Primary	Coors Blvd. (155)	33	17	20	18	15	18
Primary	Lomas Blvd. (11)	20	15	15	18	15	18
Primary	Menaul Blvd. (8)	20	16	20	18	15	18
Primary	Montano Blvd.-Uptown-KAFB (157A)	20	17	15	18	15	18
Primary	Montgomery Blvd.-Carlisle Blvd. (5)	20	17	15	18	15	18
Primary	San Mateo Blvd. (140/141)	15	16	15	18	15	18
Rapid Ride	Lomas Blvd. RR					15	18
Rapid Ride	Montgomery Blvd.-Carlisle Blvd. RR					15	18
Rapid Ride	San Mateo RR					15	18
Secondary	Airport-Downtown-Mesa del Sol (50)	30	13	30	13	20	16
Secondary	Eubank Blvd. (2)	30	13	30	16	20	16
Secondary	Isleta Blvd. (53)	45	14	45	14	20	16
Secondary	Juan Tabo Blvd. (1)	25	12	25	16	20	16
Secondary	North 4th St. (10)	25	15	25	15	20	16
Secondary	Rio Bravo Blvd.-Sunport-KAFB (222)	65	12	65	12	20	16
Secondary	Rio Rancho					20	16
Secondary	Wyoming Blvd. (31)	45	15	30	16	20	16
Tertiary	12th St.-Rio Grande Blvd. (36)	60	12	60	12	30	15
Tertiary	ABQ-Rio Rancho-NMRX Connection (251)	30	14	30	14	30	15
Tertiary	Alameda Rd.					30	15
Tertiary	Atrisco Dr.-Rio Bravo Blvd. (51)	60	13	60	13	30	15
Primary	Montano Blvd.-Uptown-KAFB (157B)					30	15
Tertiary	NM 528					30	15
Tertiary	SW-Unser Blvd. (198)	30	16	30	16	30	15
Tertiary	Zuni Rd. (97)	60	13	60	13	30	15

*Currently Rapid Ride Routes

The output from the travel demand model is also used to estimate the quantity of GHGs produced from each scenario. Vehicle emissions are estimated with United States Environmental Protection Agency's (US EPA) Motor Vehicle Emission Simulator (MOVES) model. The main factors affecting vehicle emission rates are traffic volume and speed as well as the type of vehicles that compose the regional vehicle fleet. Traffic volume and speed data are provided by the travel demand model output. Currently, there is no local information to define a regional vehicle fleet for the MRCOG region or New Mexico. As

a substitute for this local information, the Austin, Texas, metropolitan area vehicle fleet is used. The Austin vehicle fleet was chosen based on consultation with the City of Albuquerque's Environmental Health Department, which has used this dataset in its previous regional air quality studies. The dataset was created by Sonoma Tech for the city to evaluate the air quality impact of its vehicle inspection and maintenance program[1]. The MOVES model was run to provide output that includes the gram per mile emission rate for carbon dioxide (CO_2), methane (CH_4), nitrogen dioxide (N_2O), and black carbon (BC) for a range of speeds for each roadway type (limited access/unrestricted access rural and urban roadways) for typical winter and summer weather conditions. The summer and winter modeling results were averaged to estimate annual average emission rates. The MOVES model output was formatted into a lookup table. Based on roadway type and average speed, emission rates from the lookup table were matched to each roadway link in the travel demand model output and multiplied by each link's traffic volume to calculate the total daily quantity of emissions for each roadway link. Finally, the link level emissions were summed up to calculate a regional emission inventory.

2 SCENARIO EVALUATION AND COMPARISONS

The project team evaluated each scenario against a wide range of performance measures (see Appendix A). The project team also evaluated the change in each performance measure against the base year (2012) and the trend scenario to illustrate how the region is expected to change from today and to highlight the differences between the future scenarios. The following sections discuss the main findings for each category of performance measure defined by MRCOG and several additional performance measures developed by the University of New Mexico (UNM). A complete listing of performance measures and their values is provided in Appendix A.

2.1 Accessibility

Accessibility was measured as the proximity of households to various amenities including activity centers, bicycle paths, transit, and schools; the jobs to housing ratio within activity centers; and the non-motorized mode share. Figure 2 compares five of these performance measures with the 2012 baseline. There are generally only small differences in accessibility between the scenarios. Not included in Figure 2 is the difference in the number of households located near premium[2] transit, which increases 959 to 1,112 percent. The large increase in households located near premium transit is due to the expansion of the transit network, an increase in service frequency, and more development near existing transit stops. The large percentage increase in households located near premium transit is also due to a very low 2012 baseline of just 1,358 households located near premium transit. Figure 3 shows differences in these indicators relative to the trend scenario to highlight the differences between the alterative scenarios. The main difference between the alternative scenarios is that the constrained scenario has fewer households located near premium transit stops. This is expected since the constrained scenario has a smaller transit network. Compared to the trend scenario, both alterative scenarios increase the number of households located near activity centers and bicycle paths; increase non-motorized mode share; and improve the jobs to housing ratio with small declines in the number of households located near schools. Overall, both alternatives perform similarly with regard to accessibility except for transit access where the preferred scenario performs best.

[1] Sonoma Tech Inc. (February 18, 2014) Technical Memorandum, Re: Inspection and Maintenance (I/M) Program Analysis. Prepared by Yuan Du and Stephen Reid, Sonoma Tech for Fabian Macias, Albuquerque Environmental Health Department.

[2] Premium transit is defined by MRCOG as a transit node where at least 250 buses pass per day or is a BRT or Rail Runner stop.

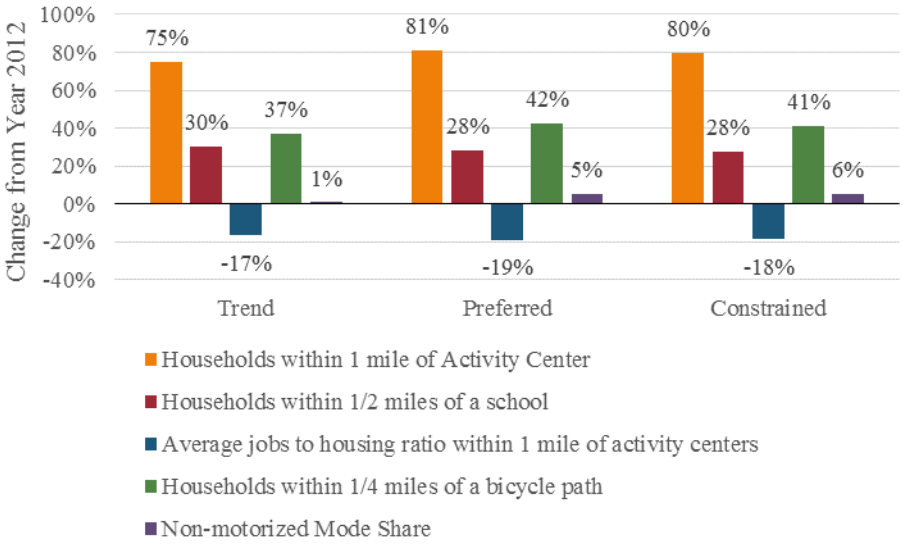


Figure 2. Accessibility Performance Measures—Comparison with Base Year.

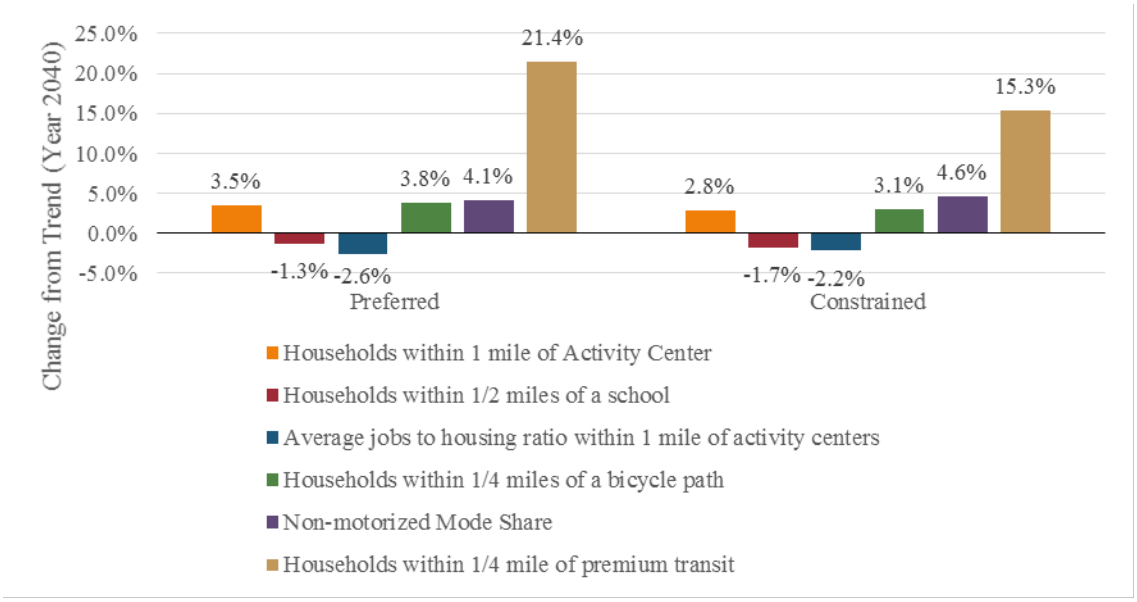


Figure 3. Accessibility Performance Measures—Comparison with Trend Scenario.

2.2 Land-Use

The project team measured land-use by the change in roadway lane miles and the acres of land developed. As Figure 4 indicates, the region's population growth results in a large increase in developed land area for all scenarios. The alterative scenarios, which incentivize and allow more infill development, result in five percent less land development and 15 to 17 percent greater population density in the newly developed areas. Overall, the trend scenario results in a reduction in the region's average population density from today's 5.5 persons per acre to 5.2 persons per acre while the two alternative scenarios would maintain population density at 5.5. The trend and preferred scenarios also result in a five percent increase in roadway lane miles while the constrained scenario limits roadway growth to just two percent. Interestingly, the preferred scenario, which has greater roadway expansion than the constrained scenario, results in less land consumption and greater population density. This result may be driven by the larger

and higher quality transit network in the preferred scenario or be a spurious modeling result since the modeling system allows development to occur even where roadways are not explicitly defined in the models (e.g., local roads not represented in the modeling network are assumed to exist). One additional limitation of this analysis is that these data do not indicate what amount of this development occurs on currently undeveloped land and what amount may be redevelopment.

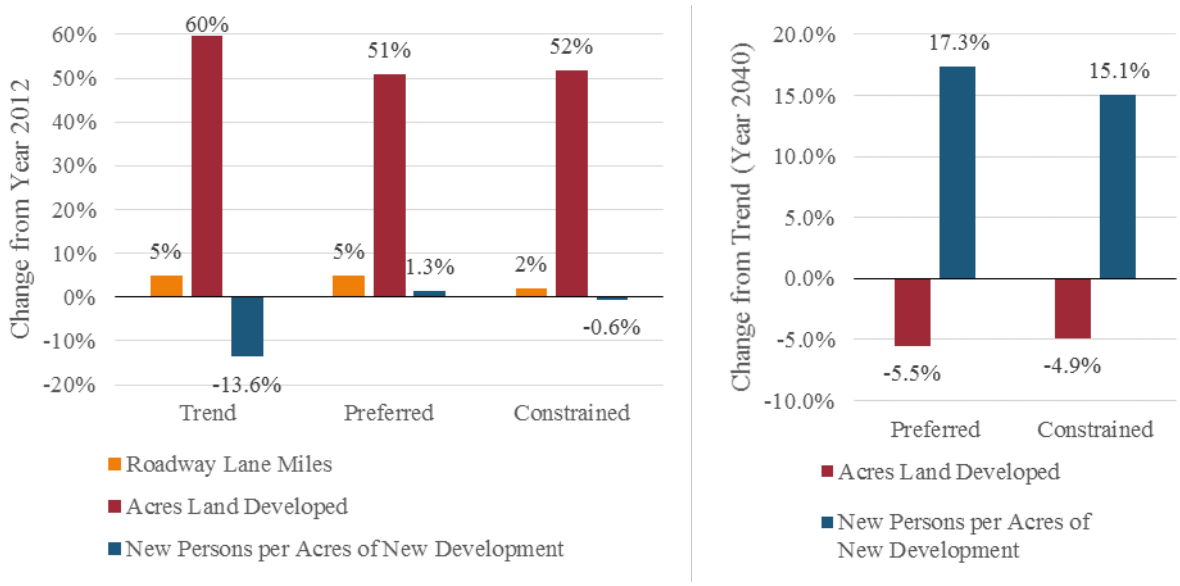


Figure 4. Land-Use Performance Measures.

2.3 Mobility

Mobility was measured by three categories of performance measures: roadway performance, transit ridership, and river crossings. Each is discussed in turn below.

2.3.1 Roadways

Roadway traffic volume is expected to increase significantly by 2040 (Figure 5). Most of this growth is expected on the west side of the Rio Grande, the Journal Center area, and Mesa del Sol. Figures 6 and 7 identify how traffic volumes vary under each of the alterative scenarios. In the preferred scenario, traffic volume is significantly reduced in many areas of Albuquerque's west side, Rio Rancho, Mesa del Sol, and the I-25 corridor south of Albuquerque to Belen. Traffic volumes increase in the Journal Center area and Rio Rancho's town center area. The constrained scenario, which has less roadway development on the far west side, results in somewhat less traffic volume on the far west side and more traffic to roads closer to the Rio Grande on the west side. These differences are more easily seen in Figure 8. In sum, Figure 6-Figure 8 demonstrate how changes in both land-use and the transportation system can affect traffic patterns. The most notable result is that the preferred scenario results in generally less traffic in the already congested west side than the trend. Most of the reduction is likely driven by differences in land-use zoning and policy since the roadway networks are the same. The preferred scenario does have a larger transit network than the trend, but most of the improvements are on Albuquerque's east side.

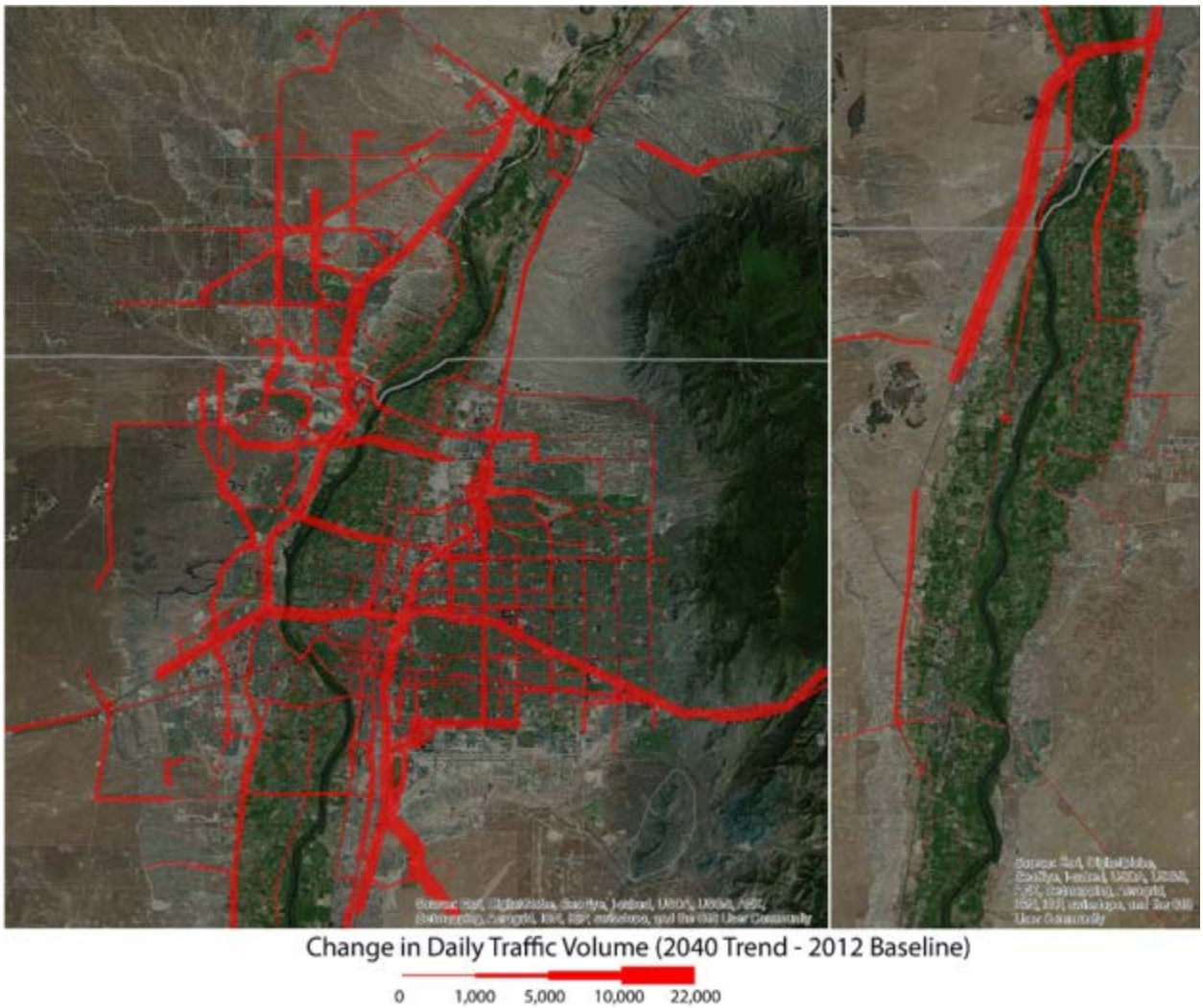


Figure 5. Increase in Daily Traffic Volume Between 2012 and 2040 Under the Trend Scenario.

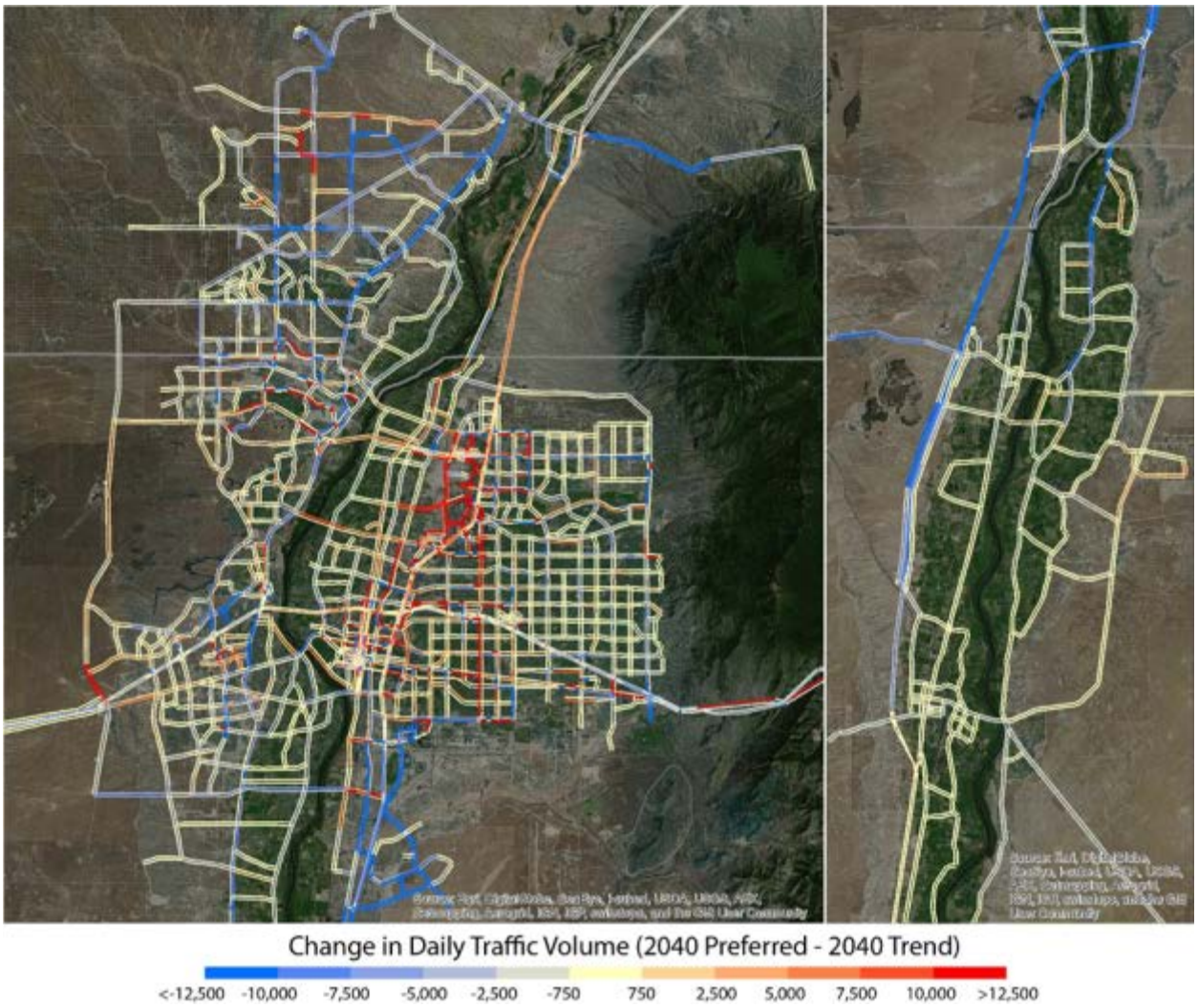


Figure 6. Difference in Traffic Volume between the Preferred and Trend Scenarios.

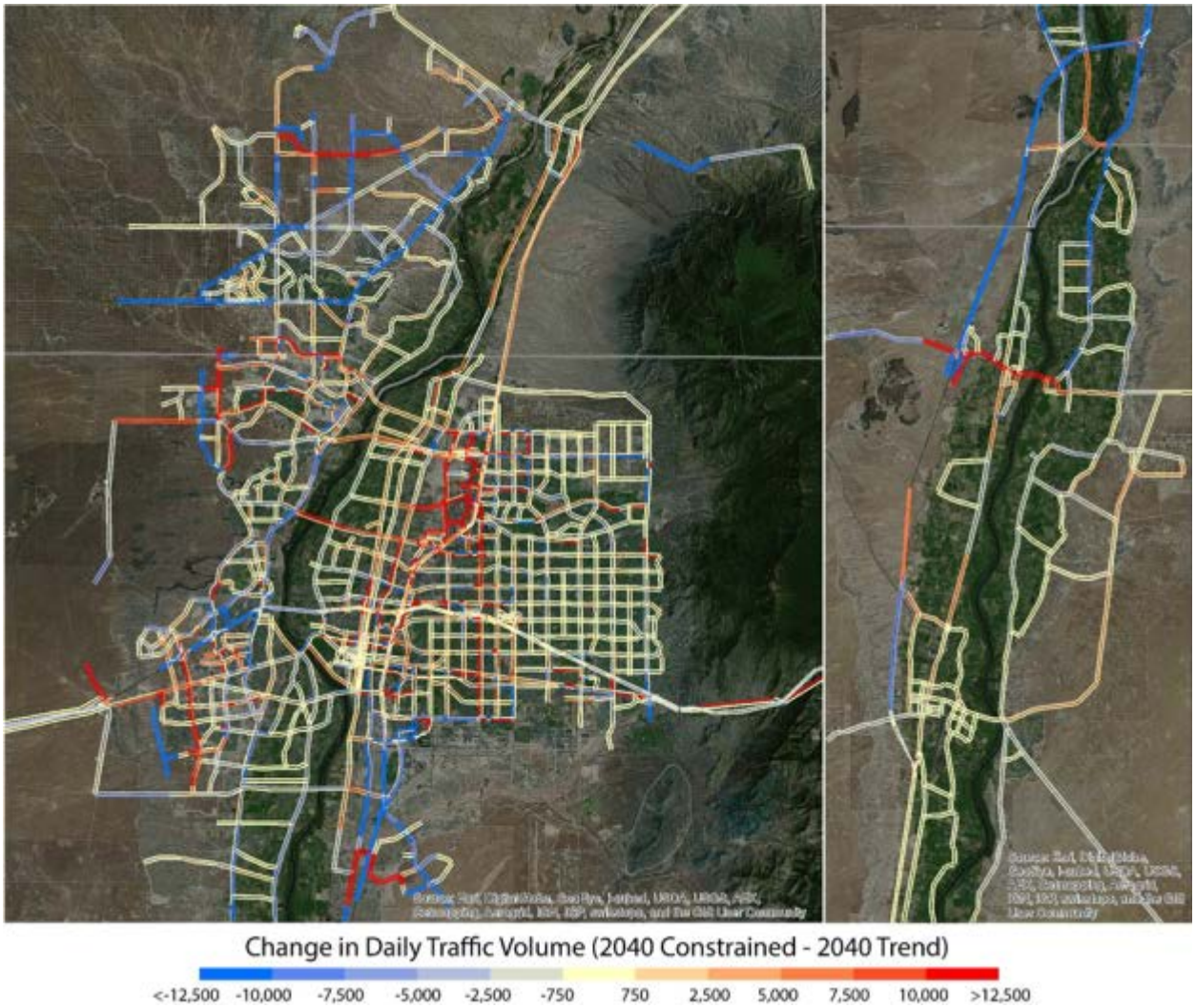


Figure 7. Difference in Traffic Volume between the Constrained and Trend Scenarios.

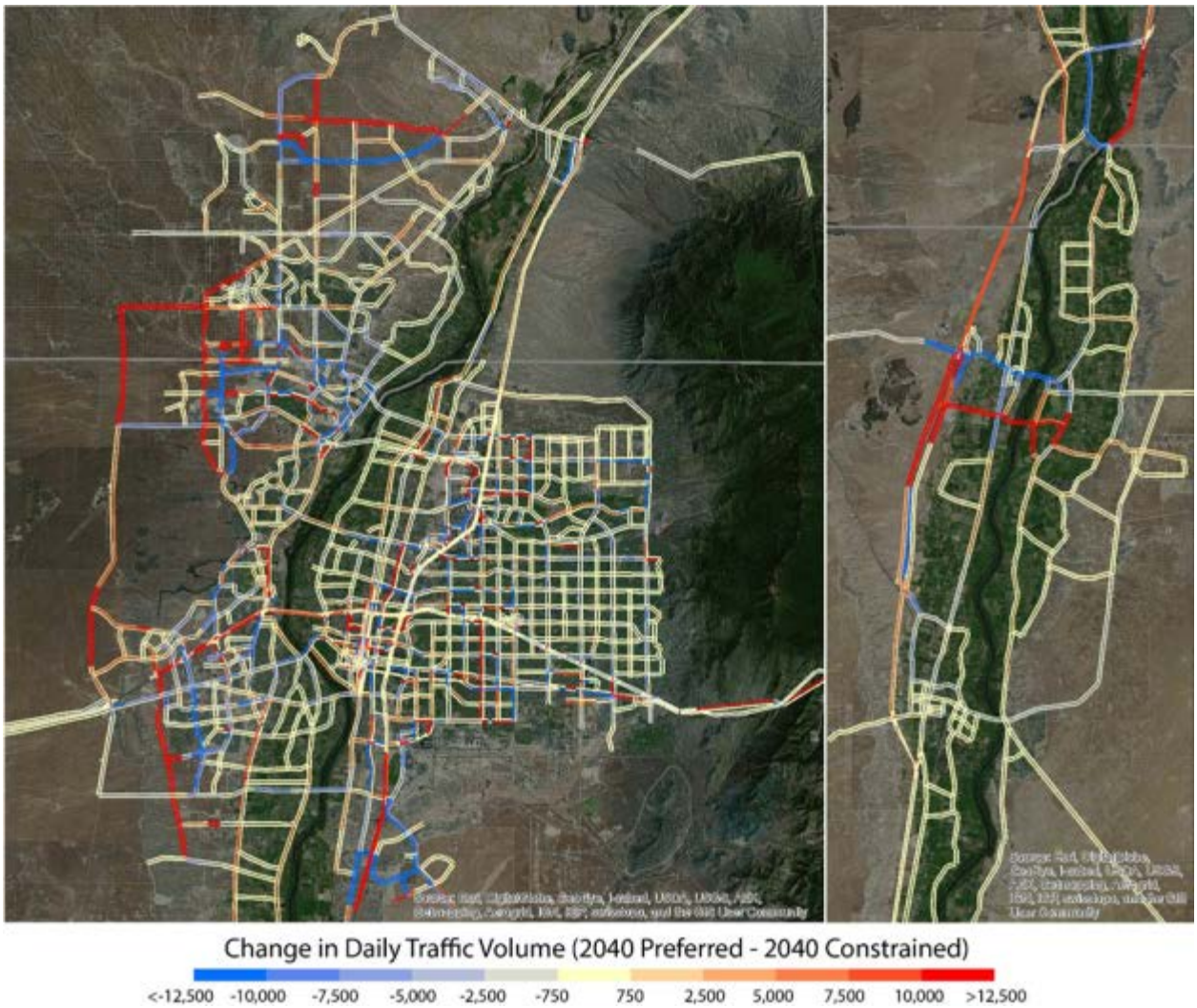


Figure 8. Difference in Traffic Volume between the Preferred and Constrained Scenarios.

The project team evaluated overall roadway network performance based on congestion levels and amount of driving. Seven roadway performance measures were estimated; the three performance measures shown in Figure 9 summarize the differences between each scenario and the 2012 baseline (the full set of performance measures are available in Appendix A). Each scenario indicates a large increase in the amount of driving and congestion over the 2012 baseline. This increase is expected given a 52 percent increase in population. The preferred scenario performs the best out of the future year scenarios, resulting in less traffic volume growth and higher average peak period speeds.

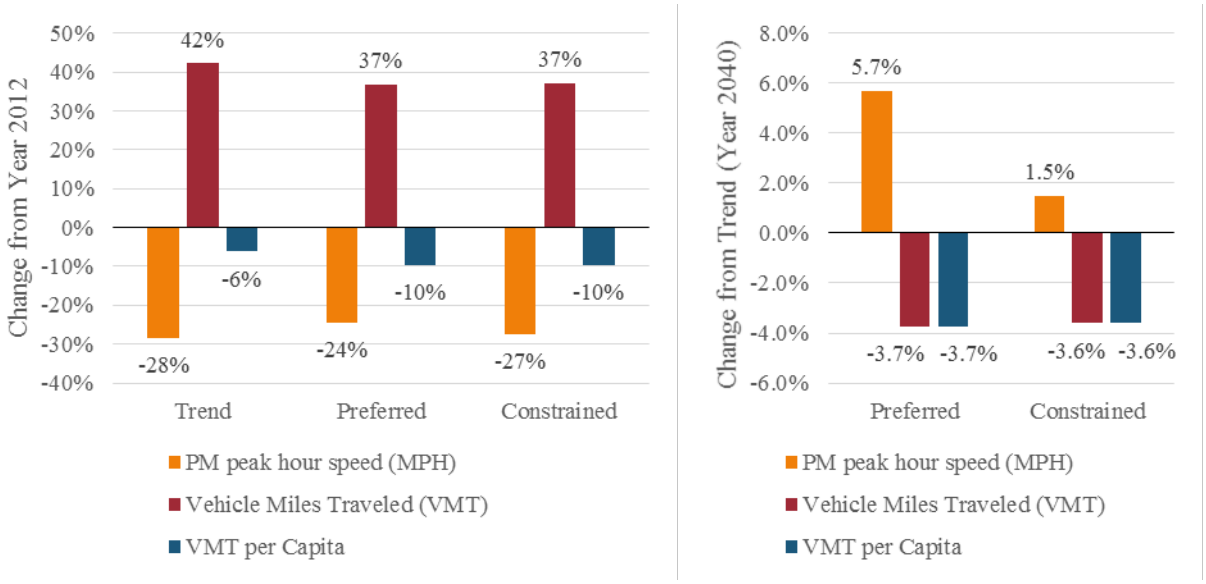


Figure 9. Highway Performance Measures.

While the preferred scenario performs the best, all of the scenarios, including the trend, result in less per capita miles driven than today. The results from the previous workshop indicated that only the emerging lifestyles scenario resulted in a per capita reduction in driving. The difference in results between the first and second workshop is not only due to differences in modeling land-use and transportation network assumptions, but the way that the project team completed the modeling. The interaction step that was implemented for the modeling completed for the second workshop, as explained in section 1, further incentivized infill development by increasing travel costs in the land-use model since more congested 2025 traffic conditions were used rather than 2012. The modeling system improvements appear to have behaved as anticipated: as traffic worsens, central locations become more favorable for development and the growth in driving is reduced.

2.3.2 Transit

The project team evaluated transit performance based on transit ridership, transit passenger miles traveled, and transit mode share (the percentage of trips made using transit). In each scenario, transit ridership and passenger miles traveled increased substantially over year 2012 levels; however, transit mode share only increases in the alterative scenarios (Figure 10). The combined effects of more infill and mixed use development along with greater investment in transit results allows the preferred scenario to achieve a 60 percent increase in transit ridership and 44 percent increase in transit mode share over the trend scenario. While these are notable improvements, overall transit mode share in the preferred scenario is still only about 1 percent. The effects of less transit investment are also clearly seen in the reduced ridership and mode share in the constrained scenario.

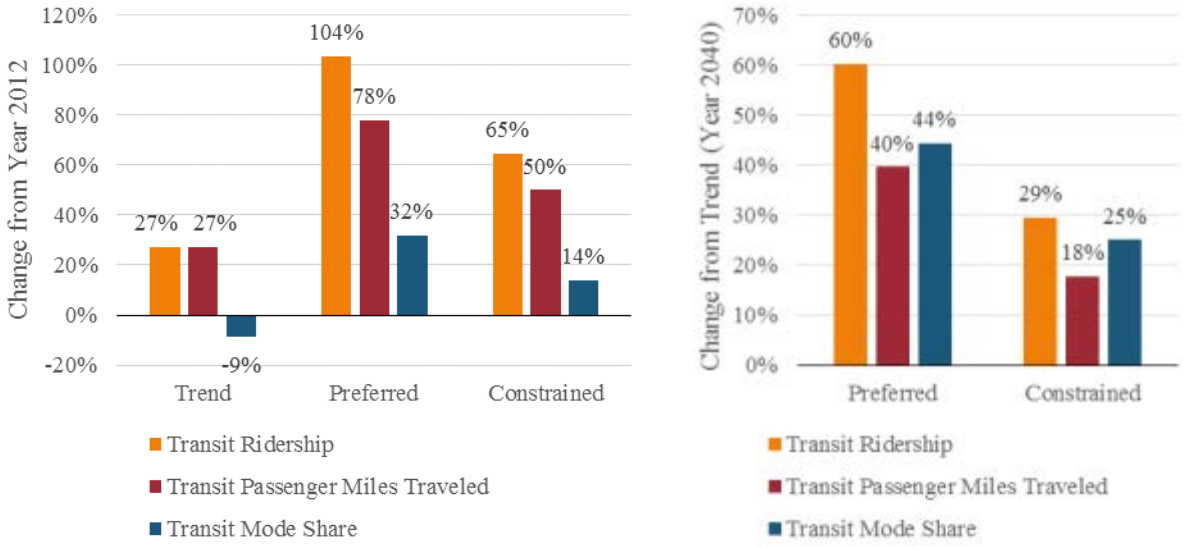


Figure 10. Transit Performance Measures.

2.3.3 Rio Grande River Crossings

The number of trips crossing the Rio Grande, a major bottle neck due to a limited number of bridges, is expected to increase by approximately 156,000 to 183,000 trips per day, a 26 percent to 31 percent increase over year 2012 crossings (Figure 11). This increase in river crossings will result in a large increase in congestion on the river crossings with average volume to capacity ratios (v/c ratios) nearing one for each future scenario during peak commuting times. Severe congestion can be expected as v/c ratios approach or exceed one. The preferred scenario has the fewest river crossings, but the differences between scenarios are relatively small

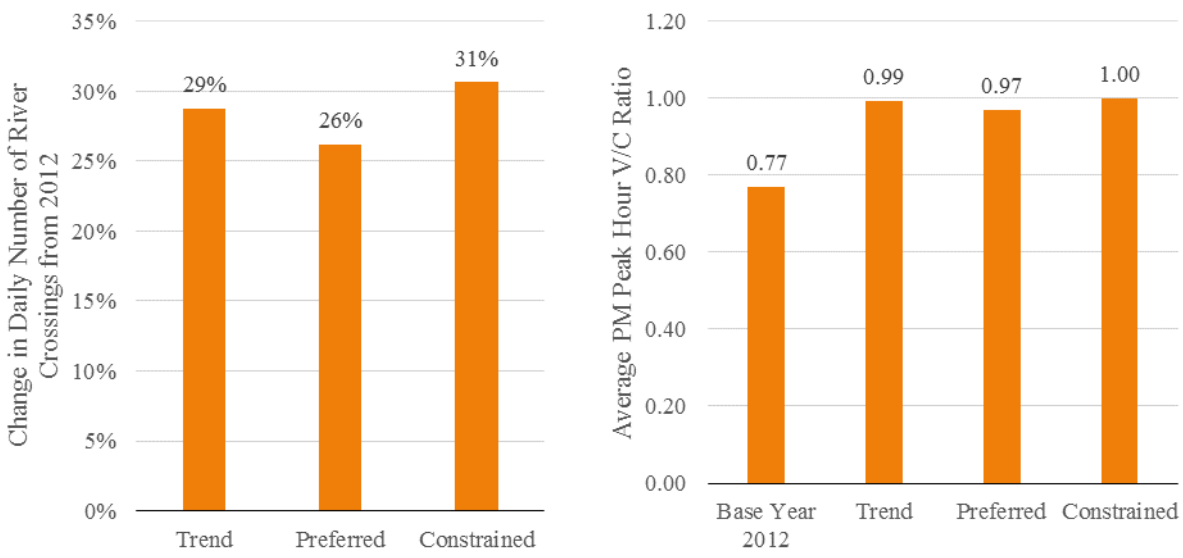


Figure 11. River Crossing Performance Measures.

2.4 Safety

Safety was evaluated as the crash rate (crashes per 100 million VMT). The modeled crash rate for 2012 is 369. The crash rate is not expected to change significantly for any of the future scenarios (a less than 2

percent increase is modeled) according to the modeling results. The small difference in crash rates between scenarios may also reflect limitations in MRCOG's crash model. The number of crashes predicted by MRCOG's crash model are largely a function of VMT and roadway type[3]. The model is not expected to show large differences since each scenario's roadway network is very similar (Figure 1) and the results are reported as the number of crashes per VMT. MRCOG's crash prediction model also does not distinguish between the severity or the type of crashes.

2.5 Sustainability

The project team evaluated several categories of performance measures related to environmental sustainability. These are discussed in turn below.

2.5.1 Greenhouse Gas Emissions

The project team modeled emissions of GHGs, (CO_2, CH_4, and N_2O) for each scenario. CH_4 and N_2O emissions were then converted to CO_2 equivalents (CO_2-eq) using 100 year global warming potentials (GWP) from the United Nations Framework Convention on Climate Change[3]. BC emissions were also modeled; however, GWPs do not exist for these relatively short lived particles and there is still uncertainty about their net climate forcing affect[4]. Given these uncertainties about BC emissions, the project team does not consider them in this analysis.

There is a large increase in GHGs from current levels for each of the future scenarios. Increases range from 18 percent to 24 percent (Figure 12). While the total quantity of GHGs increases, GHG per capita declines significantly in each scenario. The decline in per capita GHG emissions is driven largely by the expected increase in average vehicle fleet fuel efficiency over the next 28 years (13 to 14 percent decrease in gram per mile GHG emission rates[4]) and also the reduction in VMT per capita (six to 10 percent reduction). While still representing a large increase in GHG emissions, the preferred scenario results in the lowest amount of GHG emission among the future scenarios (five percent less than the trend scenario and one percent less than the constrained scenario).

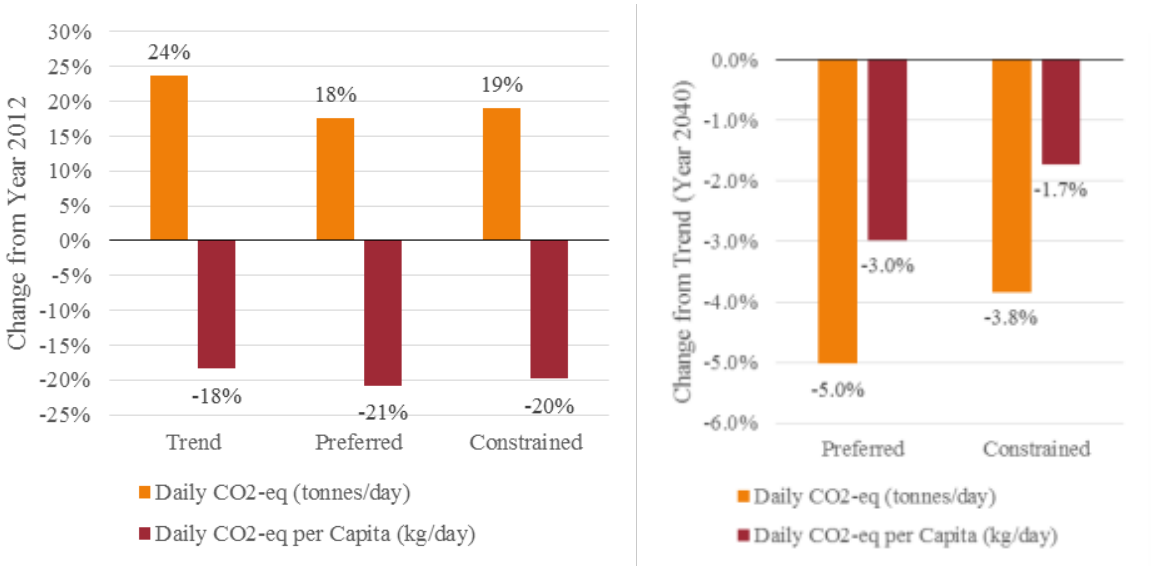


Figure 12. Change in GHG Emissions.

[3] According to a memo descripting the crash model formulation provided by MRCOG to the project team, roadway segment length, traffic volume, and roadway type have the largest marginal impacts on the number of predicted crashes. Other variables have relatively small marginal impacts.

[4] Fleet average fuel efficiency is calculated by dividing each scenario's estimated daily CO2-eq emissions by daily VMT. CO2-eq was estimated by MOVES and considers changes in the vehicle fleet, distribution of VMT by roadway type, and traffic speed. VMT was estimated by MRCOG's travel demand model.

2.5.2 Water Consumption

Water consumption is expected to be influenced by changes in land-use; however, the project team currently only has data from UrbanSim that provides the number of multi-family and single-family dwelling units. The project team does not have information about the change in the extent of commercial, industrial, and agricultural land-use. Furthermore, while the project team has information about the type and number of residential dwelling units, two important factors in determining residential water consumption remain: the project team does not have consistent information about the size of each residential parcel or any information about the size of the undeveloped, and presumably landscaped and irrigated, area of each residential parcel.

Regardless, the project team conducted some preliminary analysis of residential water consumption based only on changes in the number of single family and residential dwelling units (Figure 13). The project team has assumed that water consumption rates decline by 8.9 percent from year 2013 levels based on projections from the ABCWUA 2024 Water Conservation Plan[5] and the project team has not accounted for any net changes in water consumption that would occur when a parcel is converted from an existing land-use that consumes water to a residential land-use (e.g., from agriculture to single family). Single-family and multi-family water consumption rates are based on the project team's analysis of the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) year 2013 water use calculator that was provided to the project team by MRCOG. The project team's analysis, considering these limitations, finds that residential water use will increase by about 45 to 48 percent over year 2012 levels. The alterative scenarios achieve a two percent reduction in residential water use over the trend, which is driven by a greater number of multi-family homes.

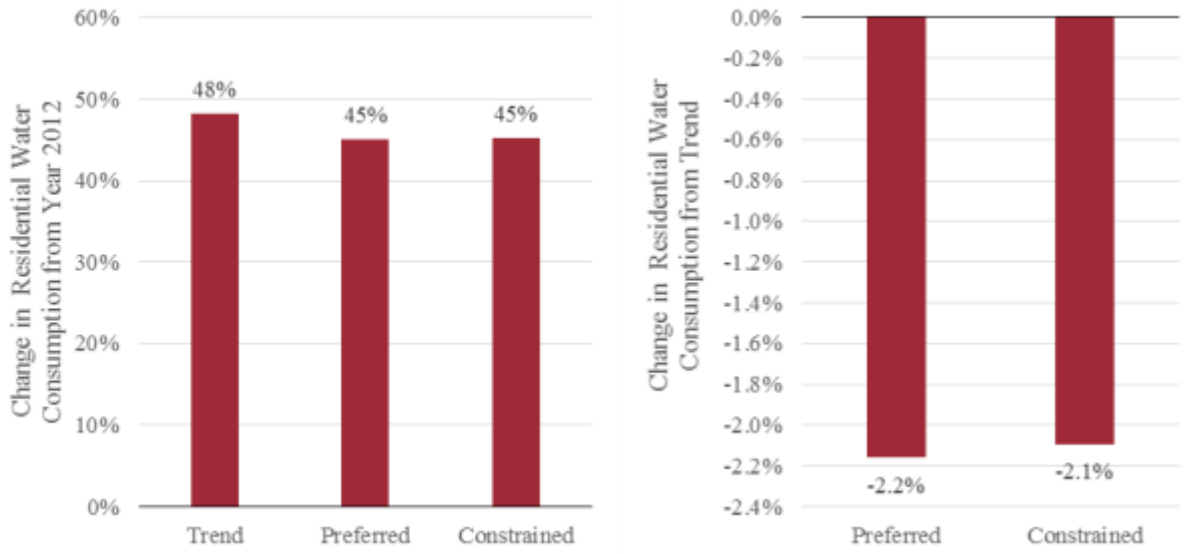


Figure 13. Change in Residential Water Consumption.

2.5.3 Flood Risk

Flood risk was evaluated by mapping the FEMA 100-year floodplains and areas where development could occur within the floodplains under each scenario. To create the change in development layer, the project team used the outputs from each scenario—Trend, Preferred, Constrained—at the data analysis zone level. The project team combined household population and employment attributes to use the number of people as the base unit. The changes in development between the 2040 scenarios can be seen in Figures 14 to 19.

The project team evaluated the development in each scenario by creating Table 3, which is shown below. The households, household populations, employment, single family units, multi-family units, non-

residential square feet and buildings in floodplains for each of the different scenarios is shown below in Table 3. The three different scenarios are: Trend scenario, Constrained scenario, and the Preferred scenario. The project team compared the three scenarios against the 2012 Summary and the percent change is shown in the table. The biggest percent change can be seen in the multi-family unit category with a percent change in the seventies. The smallest changes can be seen in the employment category with changes in the twenties.

All scenarios will add more development to the floodplains. Overall the Trend scenario will add the most development in all the categories and the preferred scenario has the least development occurring within floodplains. For a more in depth analysis of the floodplain with additional tables and graphs, please refer to Appendix B.

Table 3. Scenario Development in Floodplain vs. 2012 Percent Change.

Scenario	Households	Household Population	Employment	Single-Family Units	Multi-Family Units	Non-residential Square Feet	Buildings
Trend	40.1%	38.9%	25.0%	34.8%	76.5%	44.8%	30.2%
Constrained	36.8%	35.5%	28.2%	27.9%	78.4%	35.9%	25.4%
Preferred	36.4%	35.0%	25.0%	28.0%	77.3%	29.6%	25.3%

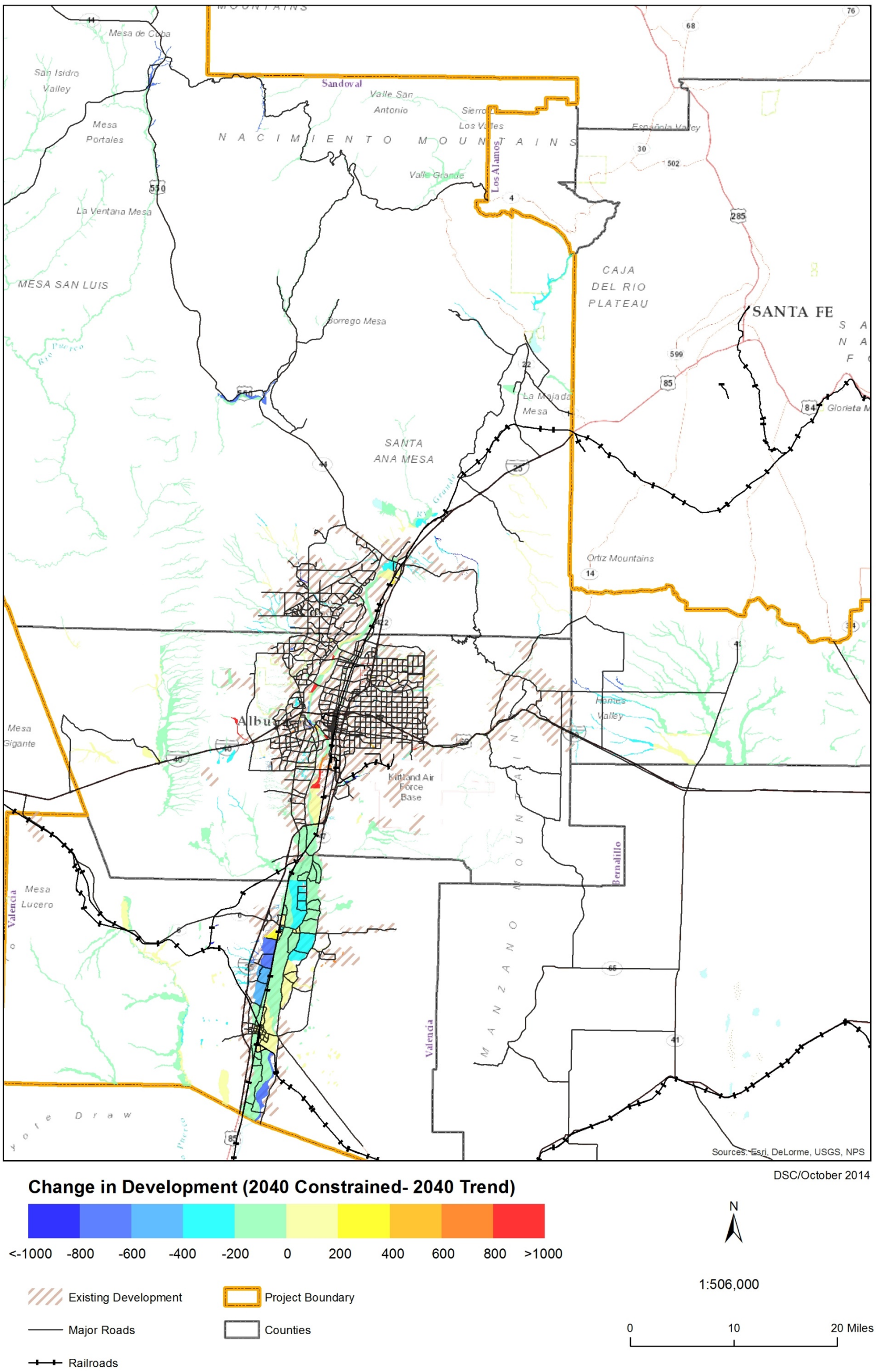


Figure 14. Floodplains Constrained vs. Trend Map.

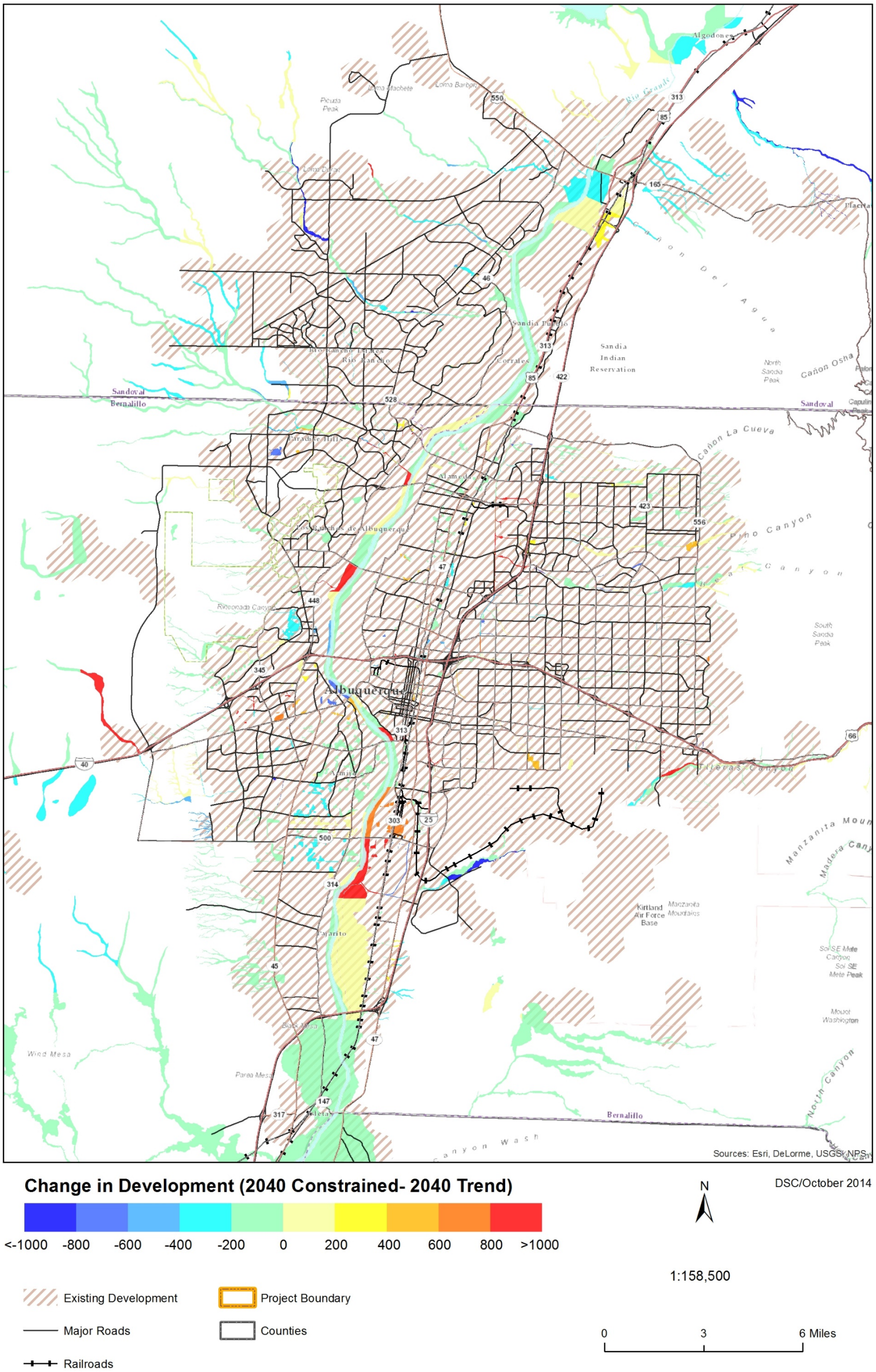


Figure 15. Floodplains Constrained vs. Trend Map Focusing on Albuquerque, NM.

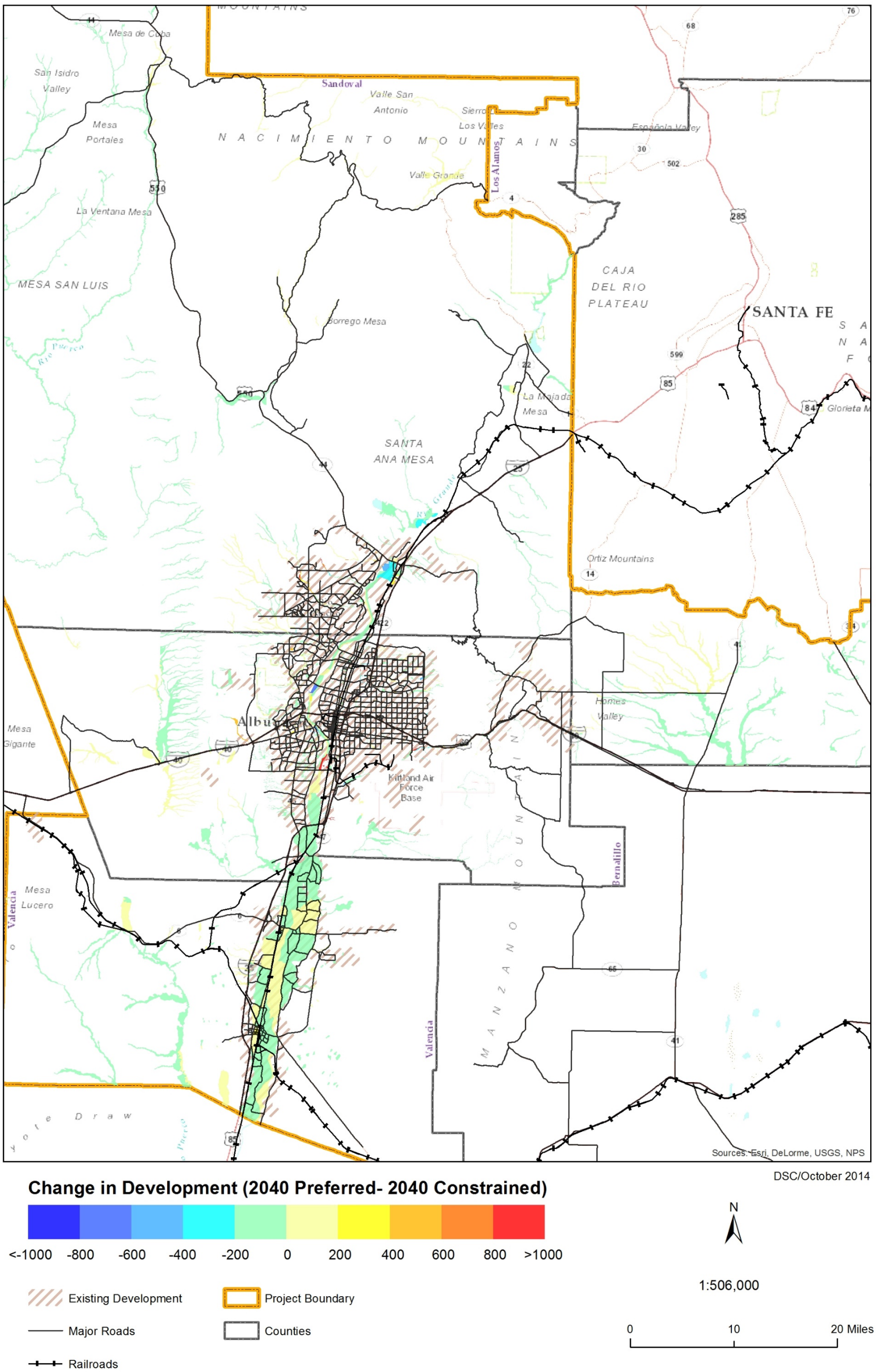


Figure 16. Floodplains Preferred vs. Constrained Map.

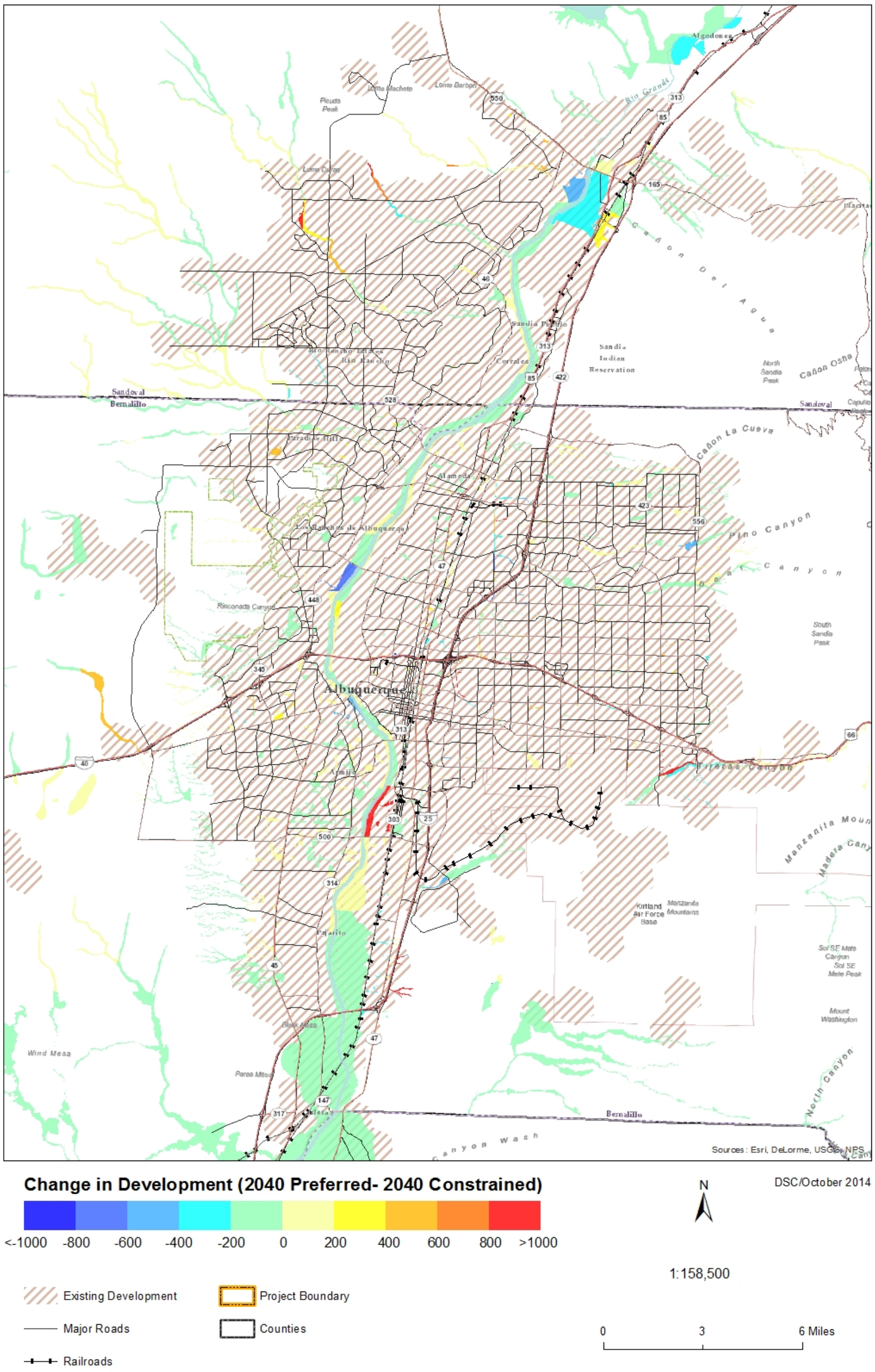


Figure 17. Floodplains Preferred vs. Constrained Map Focusing on Albuquerque, NM.

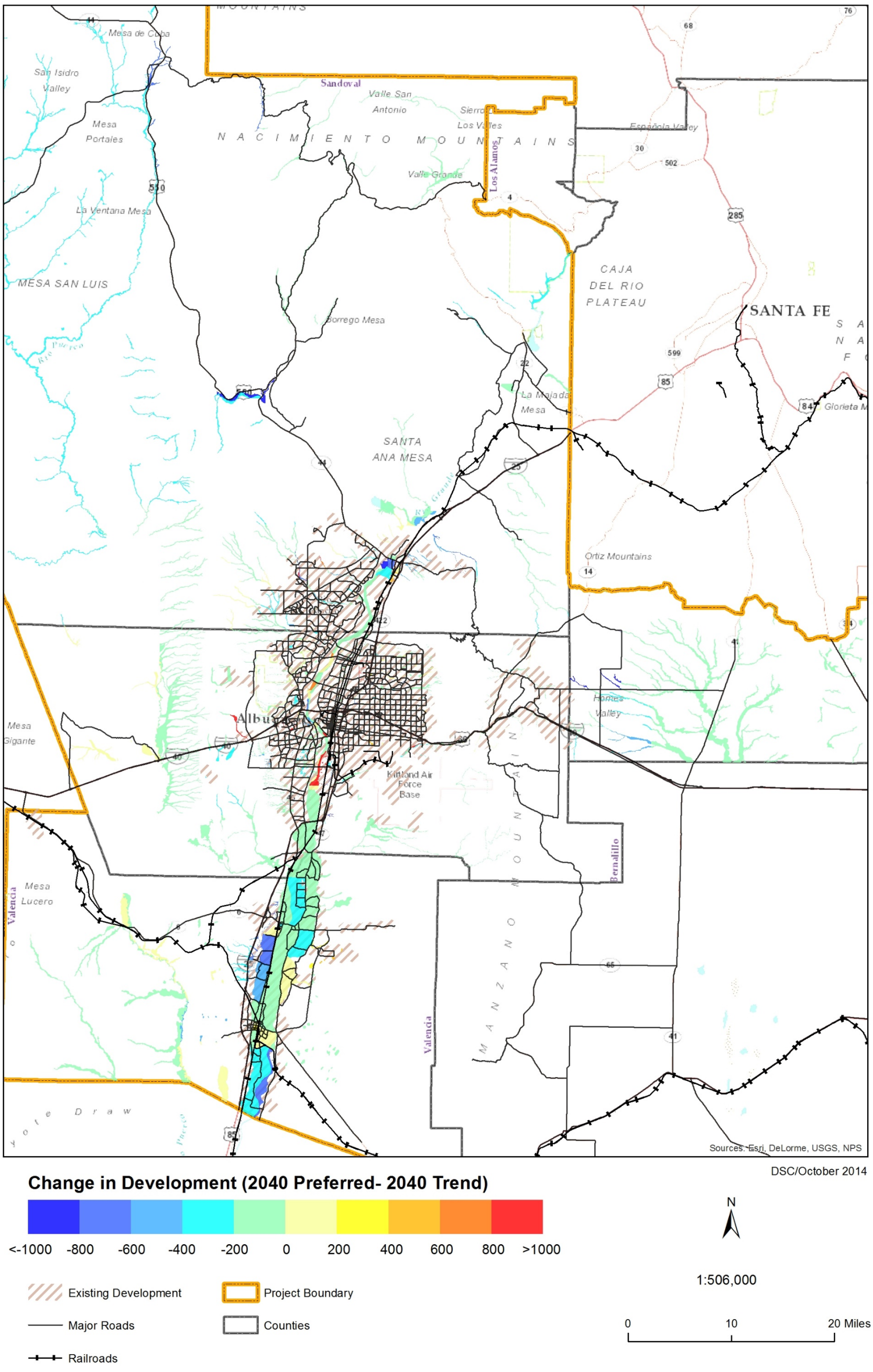


Figure 18. Floodplains Preferred vs. Trend Map.

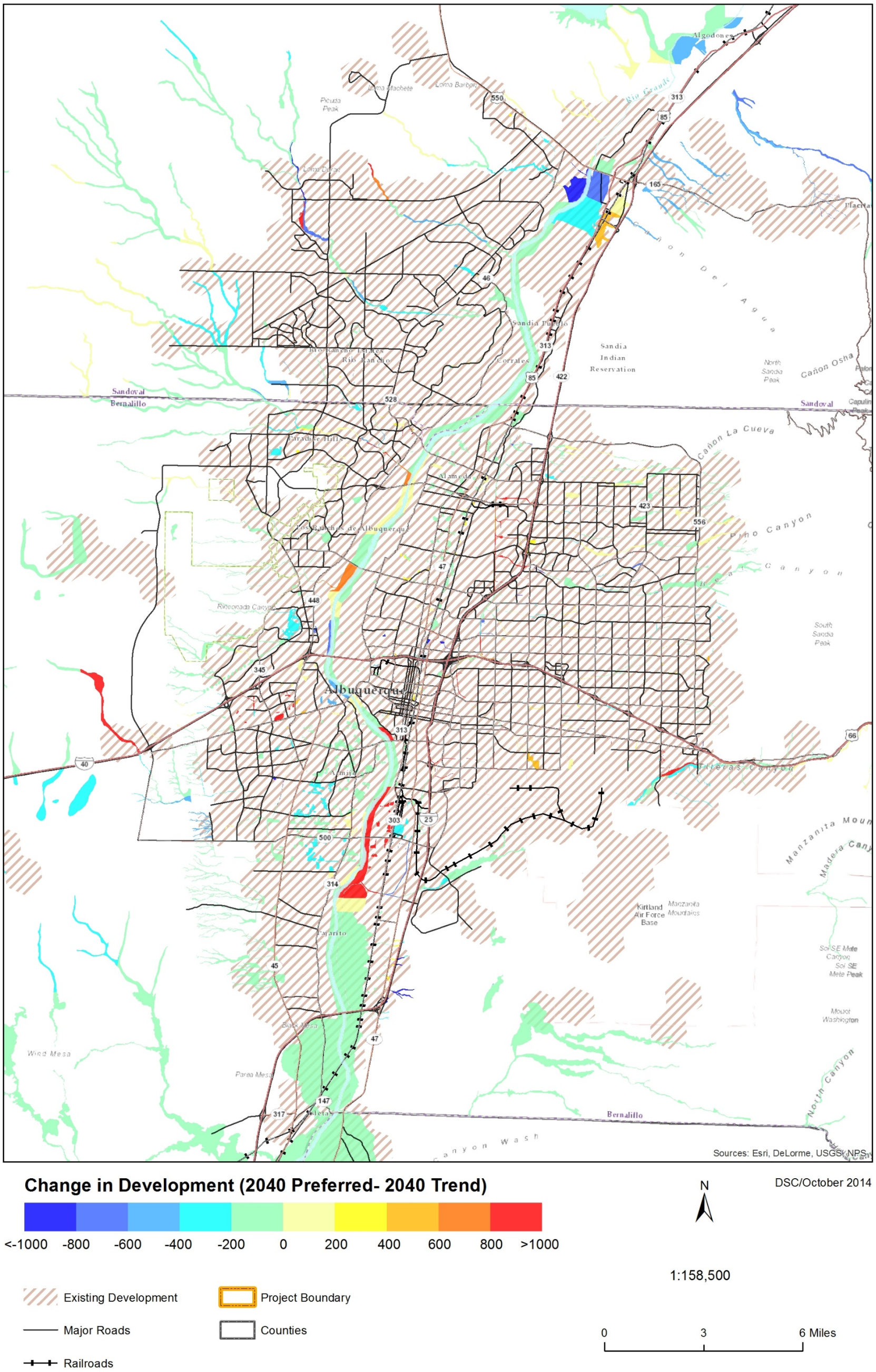


Figure 19. Floodplains Preferred vs. Trend Map Focusing on Albuquerque, NM.

2.5.4 Wildfire Risk

The project team used the wildfire risk model/GIS data developed by the New Mexico Nature Conservancy for the statewide natural resource assessment. The model/GIS data combined three modeled fire behavior parameters (rate of spread, flame length, crown fire potential) and one modeled ecological health measure (fire regime condition class) with wildland urban Interface (WUI) areas and ignition probability. The fire behavior parameters were modeled using FlamMap; fire regime condition class was modeled using the Fire Regime Condition Class tool, wildland urban Interface areas were created combining the USFS Silvis Lab WUI and the county level community wildfire protection plans within the state, and ignition probabilities were derived using fire history locations from 1987–2008. For a detailed description of each parameter, refer to the data atlas found at All about Watersheds information Clearinghouse (http://allaboutwatersheds.org/).

The maps identify wildfire risk areas ranked from low to high and the WUI within the Central New Mexico Climate Change Scenario Planning Project area. The intent of these maps is to identify where areas of wildfire risk are located in proximity to development changes and the change of development within the WUI. The project team defined the unit used to analyze the change in development as the sum of the number of household population and employment for each scenario. The USFS Silvis Lab WUI area used for this analysis is based on a study from Radeloff et al. (2005). Radeloff et al. (2005) categorized the WUI into WUI intermix and WUI interface zones. WUI intermix zones are areas with more than one housing unit per 40 acres where wildland vegetation dominates the landscape, while WUI interface zones are areas with higher density housing adjacent to areas with heavy vegetation (1.5 miles of a large, contiguous block of wildland vegetation). In other words, the interface is where wildland vegetation is adjacent to houses or other developments and the intermix is where houses and wildland vegetation intermingle.

Figures 20 to 25 show the development change within both the WUI interface and intermix areas and areas at high wildfire risk (pink and red areas). The units describing the development change in the WUI are at the subzone level, which are geographical units that are created by MRCOG to analyze the future travel demand in the region as well as land use planning. The preferred scenario has the least amount of development occurring within the WUI compared to the trend scenario (Tables 4 and 5). Additionally, under the preferred scenario increased development in the WUI occurs primarily within the existing road network in already developed areas of Albuquerque and within low/medium to medium wildfire risk areas (Figure 23). Overall, there is a decrease in development or no development in high wildfire risk areas for the constrained and preferred scenarios compared to the trend scenario (Figures 20 to 23).

Scenario development for the WUI Interface and Intermix is shown in Table 4 and Table 5 respectively. Both of the tables show the number of households, household population, employment, single-family units, multi-family units, non-residential square feet, and the number of buildings in the WUI Intermix or WUI Interface areas for each of the different scenarios. The project team compared the three scenarios—trend, constrained, and preferred—against the 2012 Summary and the percent change is shown in each table. Table 4 shows that the trend scenario has the most development in the WUI Intermix area in each development category. The preferred scenario shows the least amount of development in all categories. Table 5 shows that the trend scenario has the most development in the WUI Interface area in most of the development categories. The preferred scenario shows the least amount of development by leading in only one category, which is the non-residential square feet category. WUI areas not modeled as a high wildfire risk area (with red blocks) are still at risk to wildfire, albeit to a lower degree. Overall, less development in the WUI areas will decrease the potential wildfire risk to people, buildings, and infrastructure.

The values in both tables do not vary greatly within the different columns. For example, there is only a 5 percent difference between all three values in the households category in Table 4. This can be seen in the rest of the categories for both tables where the difference within columns is typically between 1 and 10

percent. For a more in depth analysis of the Scenario Development for WUI Intermix and Interface, refer to the tables and graphs in Appendix C.

Table 4. Scenario Development in WUI Intermix vs. 2012 Percent Change.

Scenario	Households	Household Population	Employment	Single Family Units	Multi-Family Units	Non-residential Square Feet	Buildings
Trend	43.3%	41.1%	60.1%	39.1%	71.2%	61.7%	35.0%
Constrained	39.2%	37.0%	53.7%	35.4%	71.1%	55.3%	32.3%
Preferred	39.1%	36.9%	50.3%	35.1%	69.8%	52.0%	31.8%

Table 5. Scenario Development in WUI Interface vs. 2012 Percent Change.

Scenario	Households	Household Population	Employment	Single Family Units	Multi-Family Units	Non-residential Square Feet	Buildings
Trend	20.5%	18.8%	27.0%	16.4%	31.4%	17.7%	13.9%
Constrained	17.8%	16.0%	26.0%	13.4%	30.9%	17.8%	12.4%
Preferred	17.5%	15.7%	26.7%	13.2%	28.9%	18.9%	12.1%

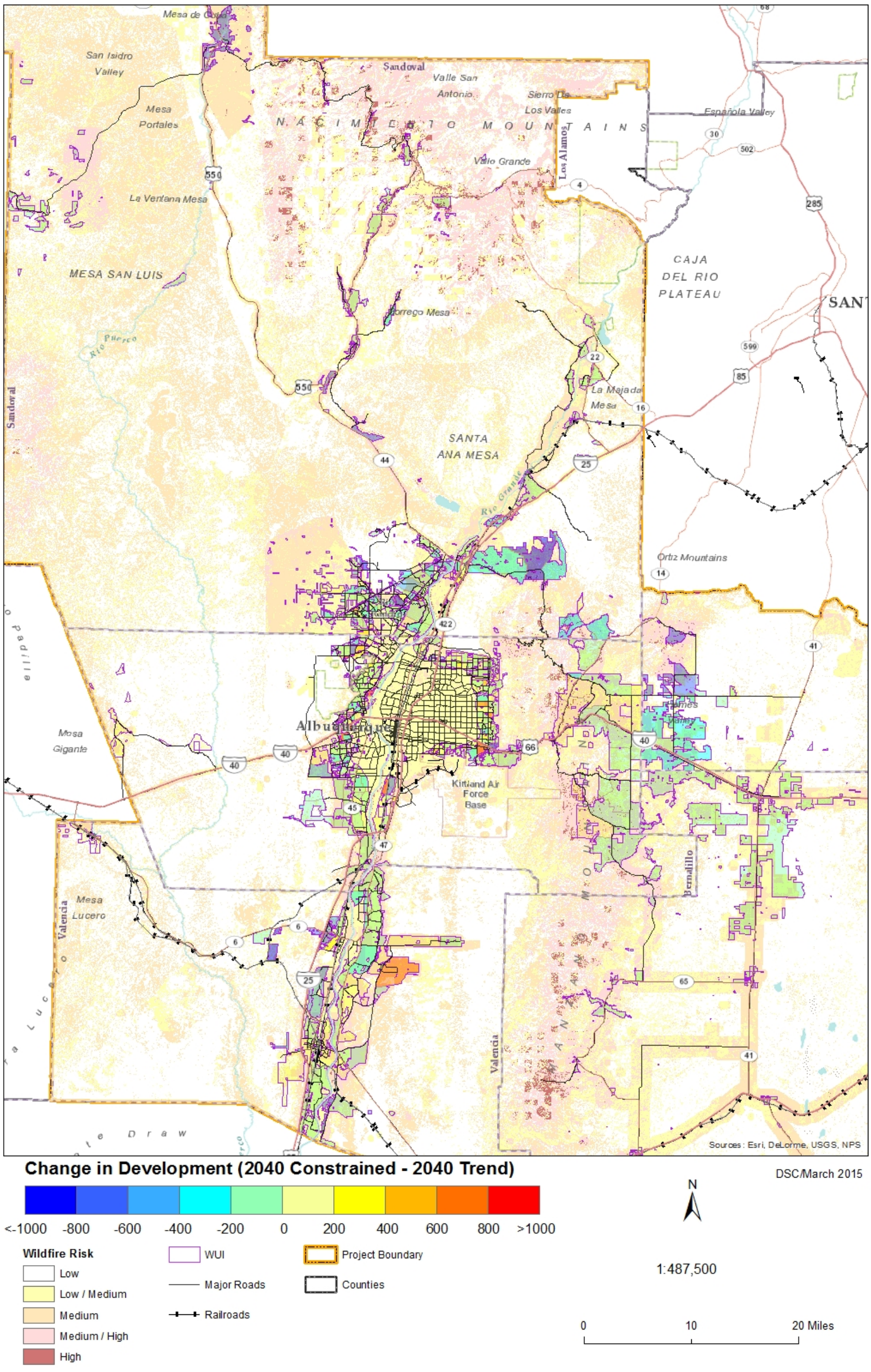


Figure 20. WUI Constrained vs. Trend Map.

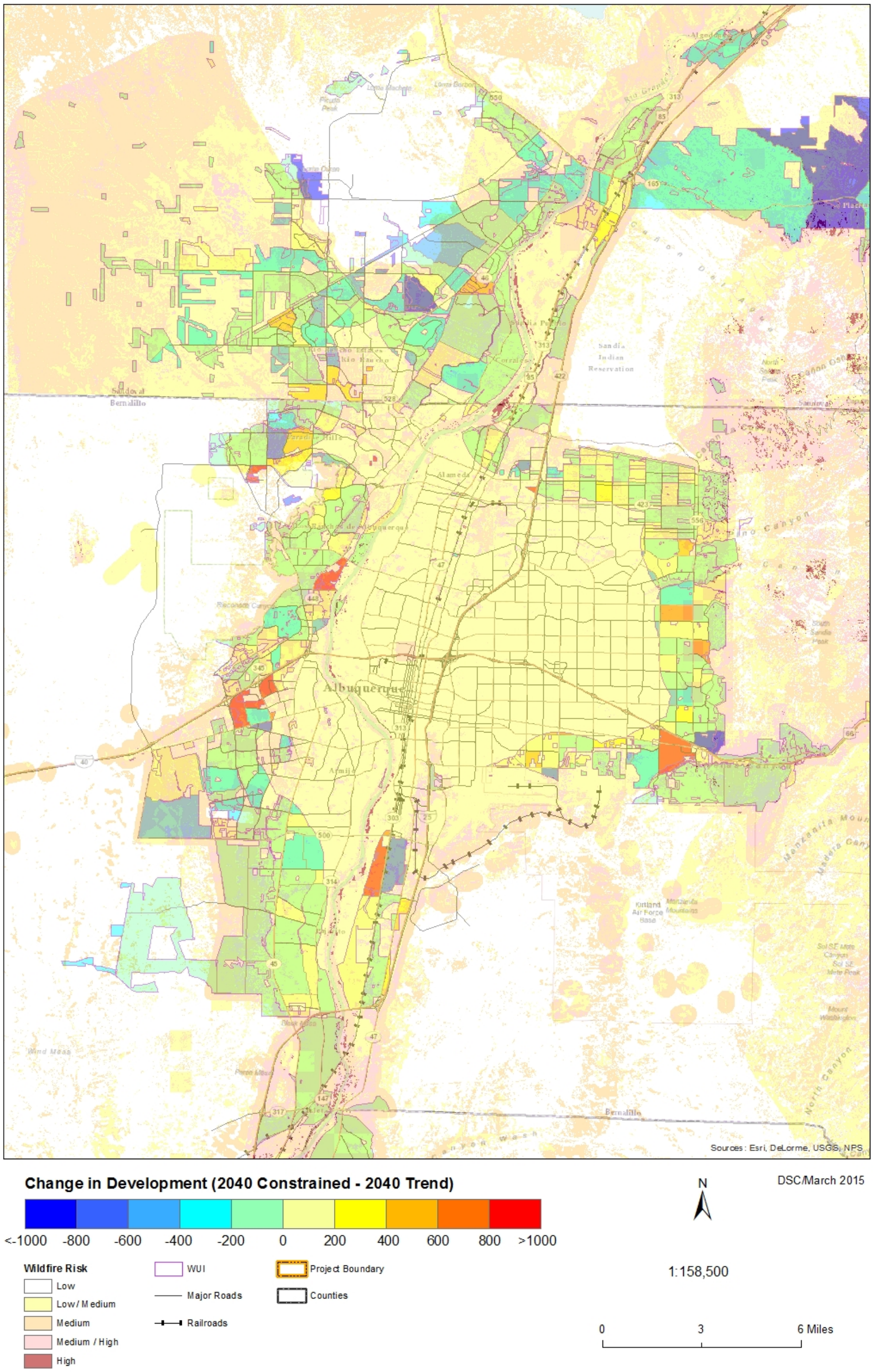


Figure 21.WUI Constrained vs. Trend Map Focusing on Albuquerque, NM.

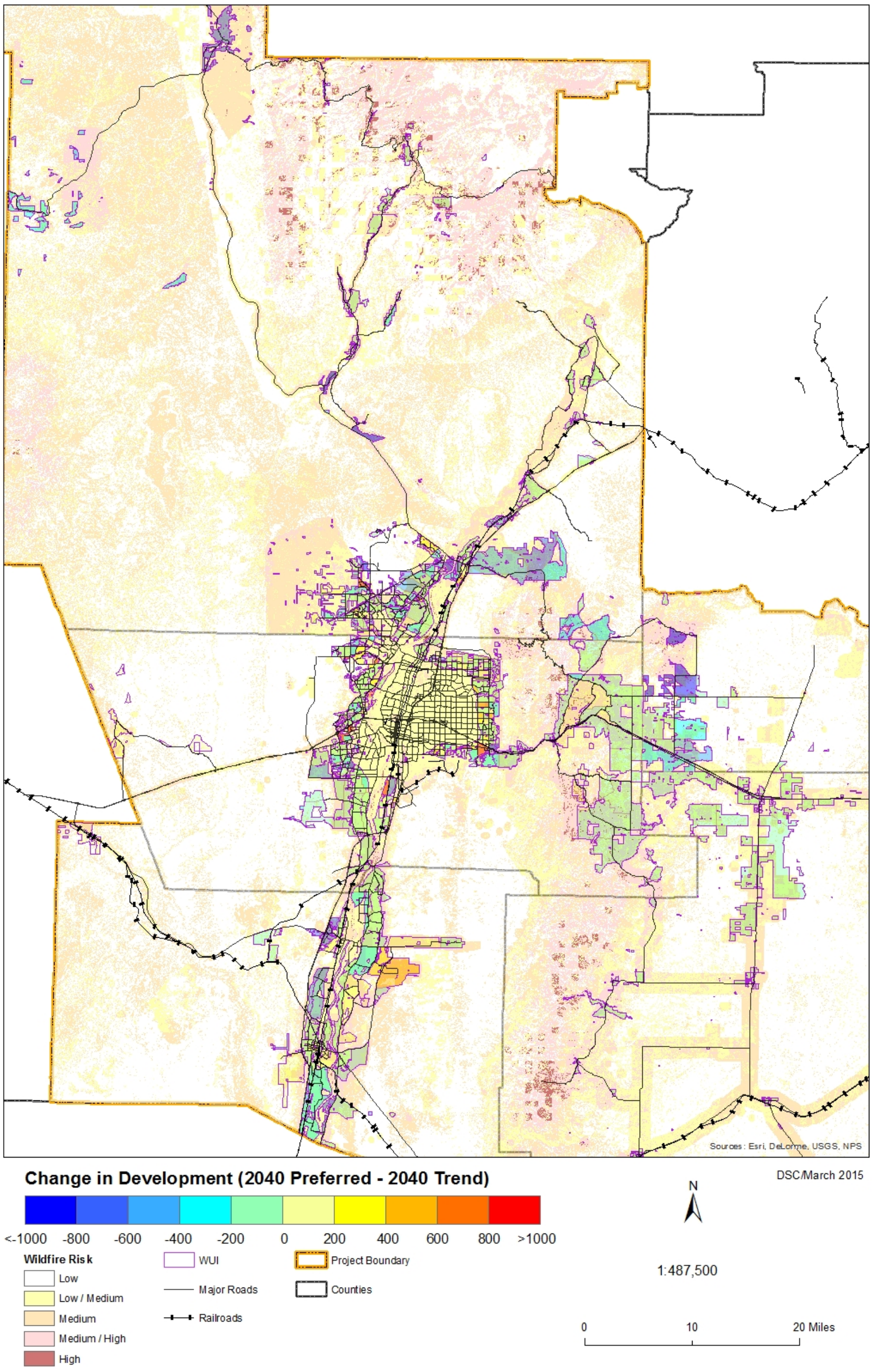


Figure 22. WUI Preferred vs. Trend Map.

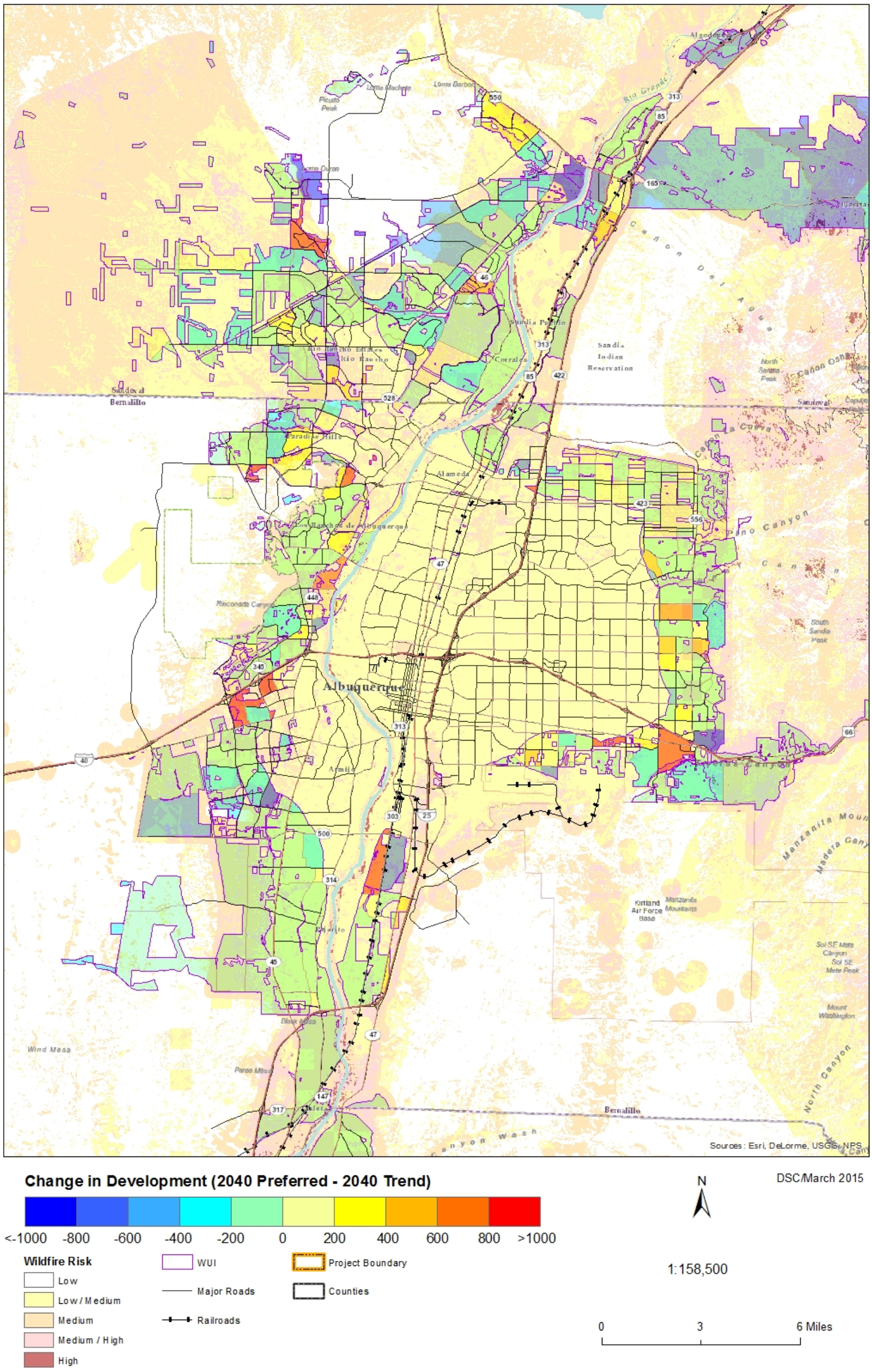
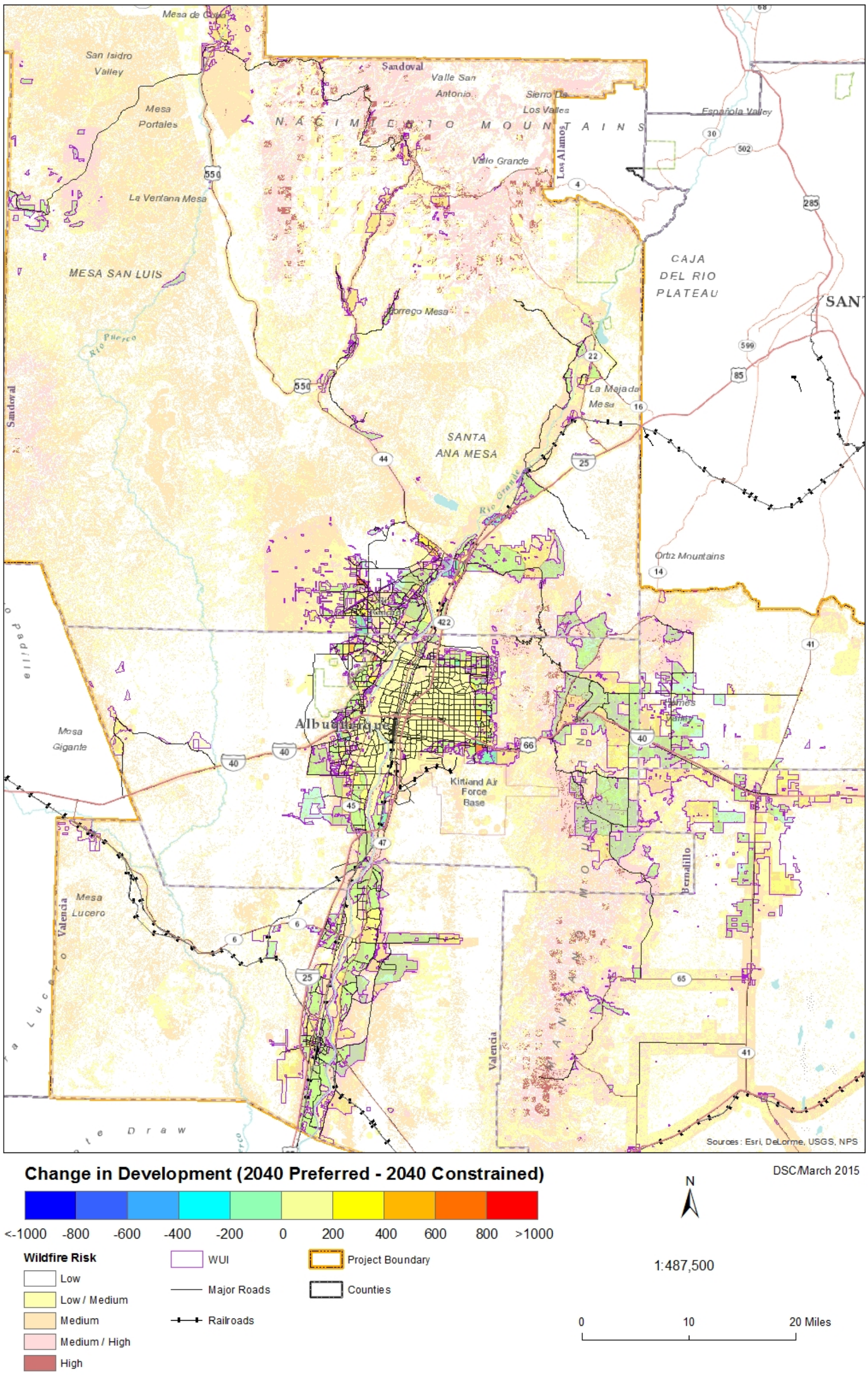


Figure 23.WUI Preferred vs. Trend Map Focusing on Albuquerque, NM.



Change in Development (2040 Preferred - 2040 Constrained)

DSC/March 2015

<-1000 -800 -600 -400 -200 0 200 400 600 800 >1000

Wildfire Risk

- Low
- Low / Medium
- Medium
- Medium / High
- High

- WUI
- Major Roads
- Railroads
- Project Boundary
- Counties

N

1:487,500

0 10 20 Miles

Figure 24. WUI Preferred vs. Constrained Map.

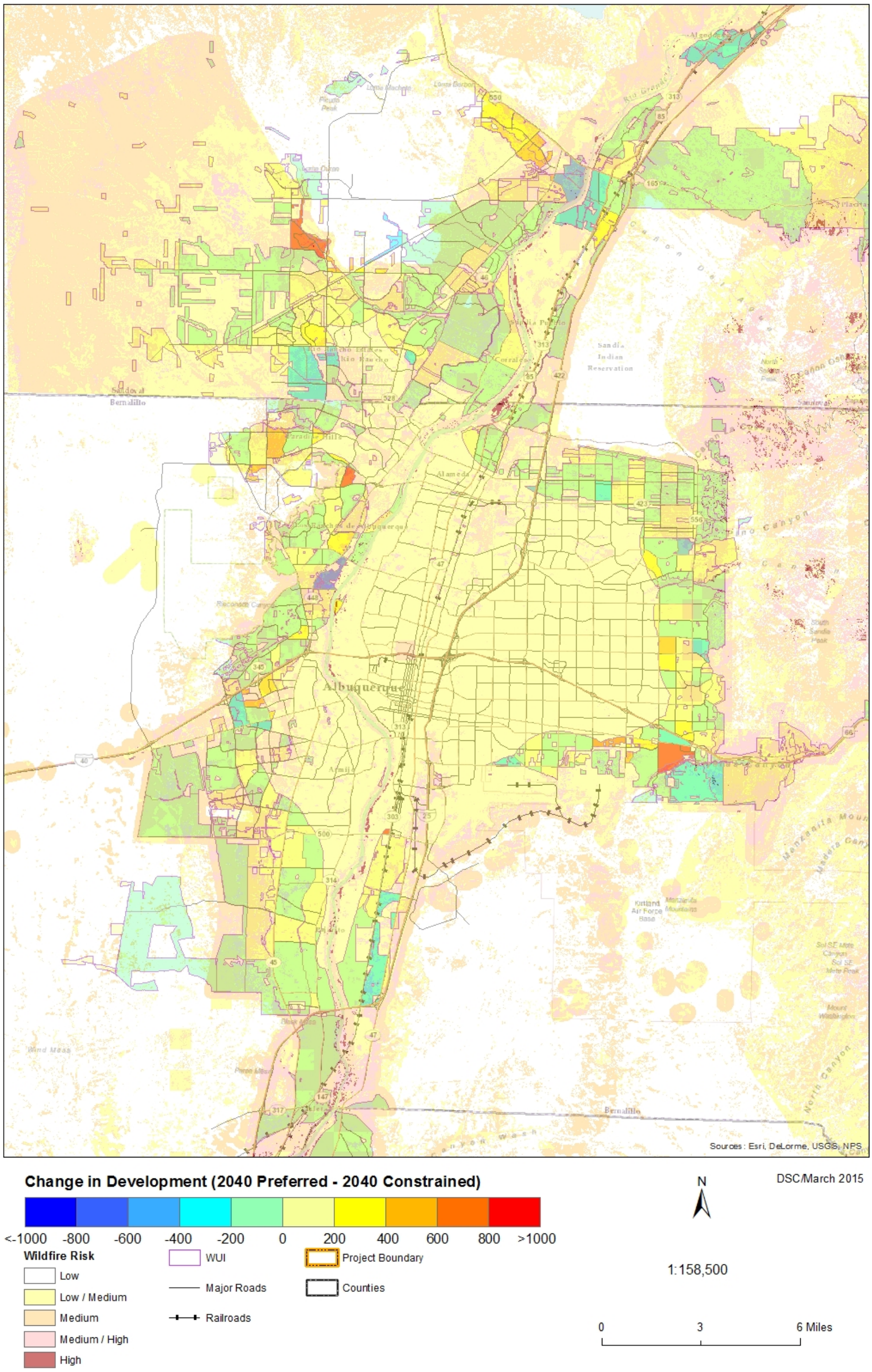


Figure 25.WUI Preferred vs. Constrained Map Focusing on Albuquerque, NM.

2.5.5 Crucial Habitat Areas

Crucial habitat is ranked on a relative scale of 1–6: areas most likely to contain natural resources that contribute to crucial habitat are ranked 1 on the scale with 6 representing areas considered least likely to contain those resources. The project team created a weighted score by taking the sum of the households and population in each category for ranks 1–3 and multiplying the sum by a value (3x for rank 1; 2x for rank 2; 1x for rank 3). A crucial habitat rank at a square-mile scale is based on:

- Species of concern (animals and plants)
- Wildlife corridors
- Terrestrial species of economic and recreational importance
- Aquatic species of economic and recreational importance
- Freshwater integrity (watershed status)
- Large natural areas
- Natural vegetation communities of concern

The project team overlaid data layers of crucial habitat, obtained from the Western Governors' Association, with the change in development layer. Areas of crucial habitat at risk for each scenario are show in Figures 26–31. Both the preferred and constrained scenarios have more development within crucial habitat compared to the trend scenario (Figure 26 and Figure 30). Table 6 shows the households (HH) + employee (Emp) categories/ranks for the CHAT (Crucial Habitat Assessment Tools) for each of the different scenarios. The ranks for CHAT range from 1 to 6 as it is seen below.

The project team compared three different scenarios—trend scenario, constrained scenario, and the preferred scenario—against the 2012 Summary Baseline and the percent change is shown in the table. The trend scenario has the most development in one rank (rank 4). The constrained scenario, however, has the most development in four ranks (rank 1, rank 3, tied in rank 5, and rank 6). Finally, the preferred scenario has the most development in two ranks (rank 2 and tied in rank 5). For a more in depth analysis of the CHAT Total Preferred Scenario against the 2012 Summary Baseline percentage change, refer to the tables and graphs in Appendix D.

Table 6. CHAT Total Preferred Scenario vs. 2012 Summary Baseline.

Scenario	HH+Emp Rank 1	HH+Emp Rank 2	HH+Emp Rank 3	HH+Emp Rank 4	HH+Emp Rank 5	HH+Emp Rank 6
Trend	26.9%	24.9%	59.6%	45.5%	41.4%	31.5%
Constrained	27.9%	24.9%	63.7%	39.4%	42.3%	31.8%
Preferred	27.2%	25.6%	62.8%	1.0%	42.3%	31.2%

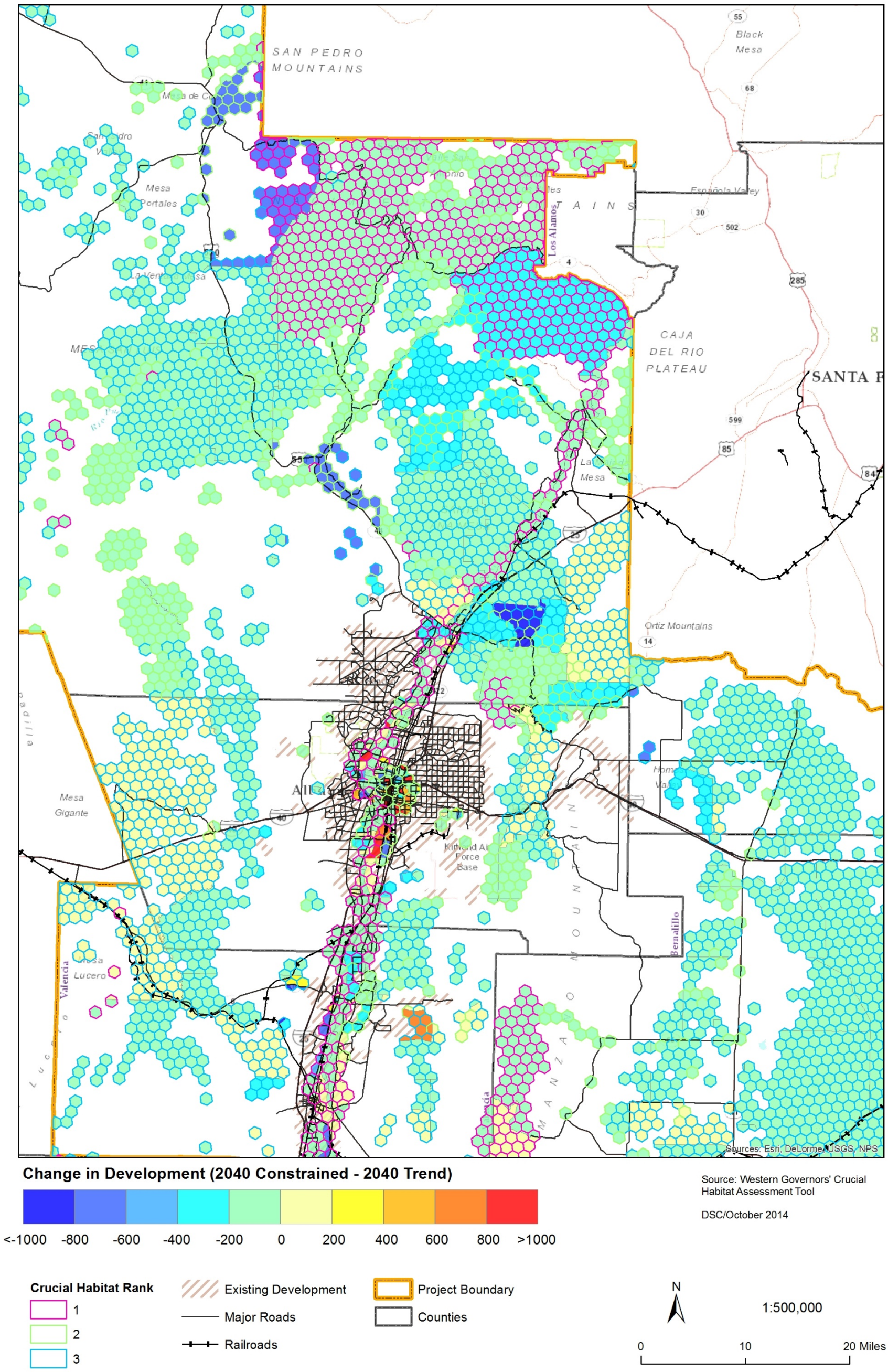


Figure 26. CHAT Constrained vs. Trend Map.

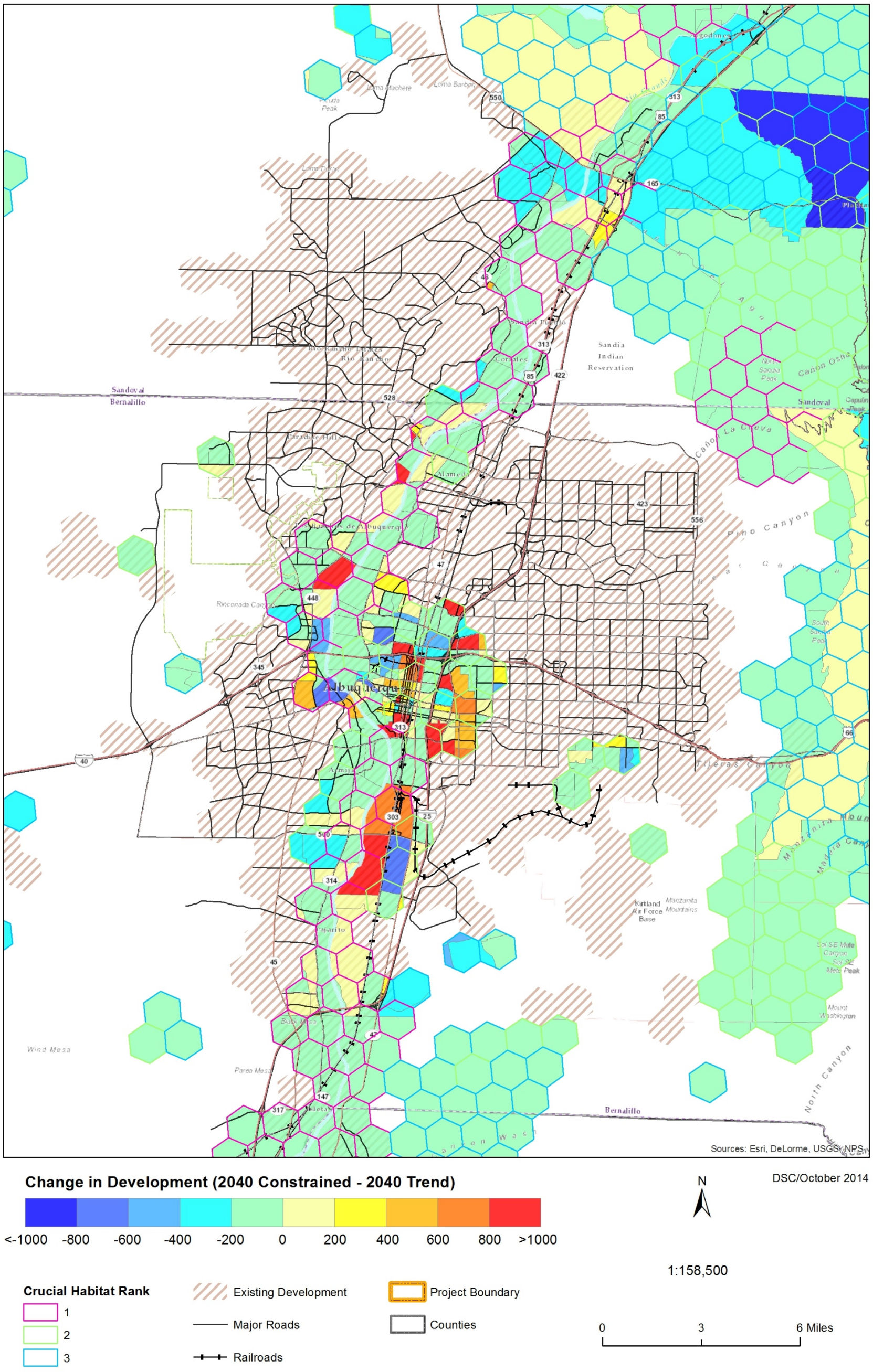


Figure 27. CHAT Constrained vs. Trend Map Focusing on Albuquerque, NM.

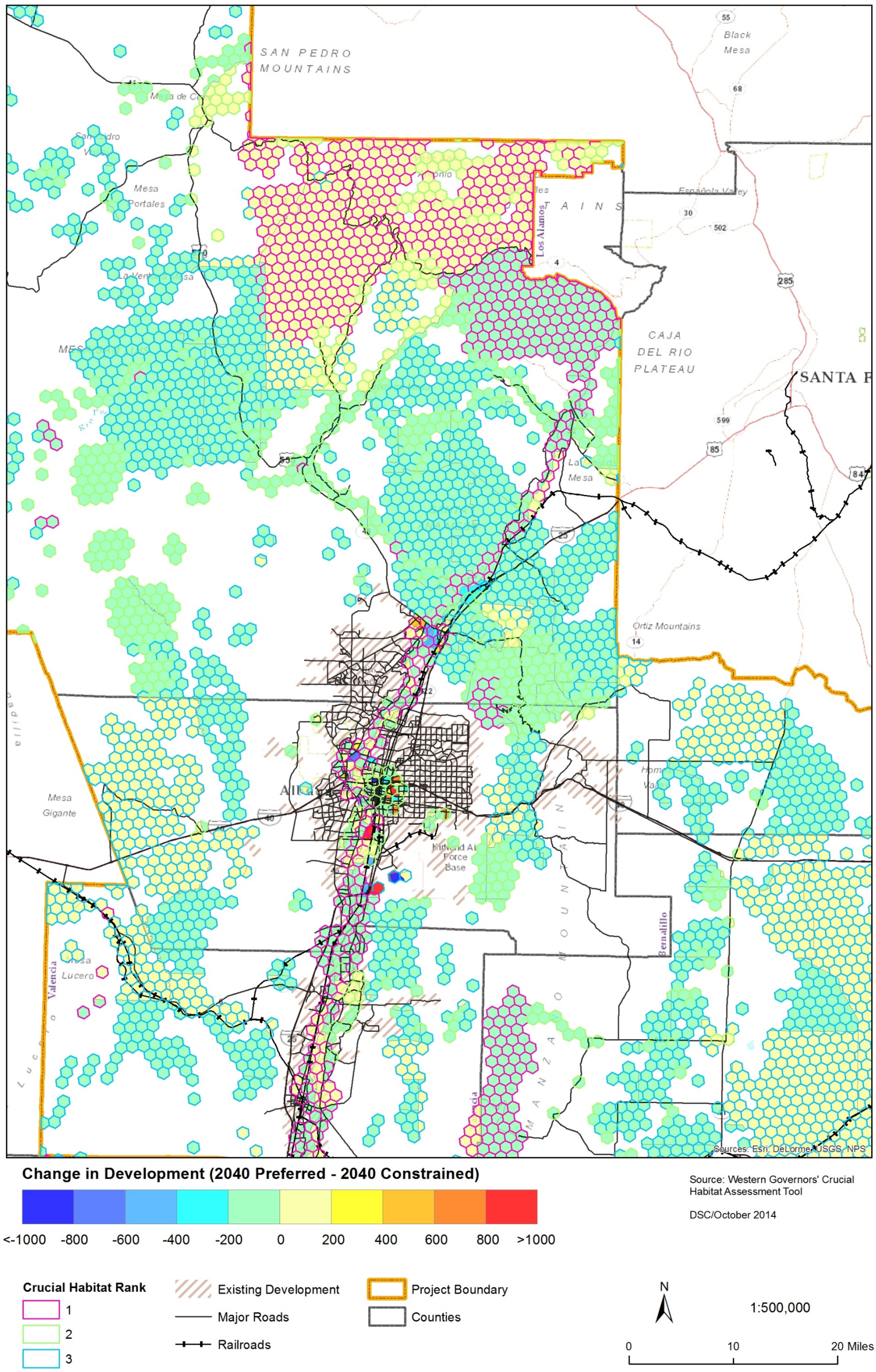


Figure 28. CHAT Preferred vs. Constrained Map.

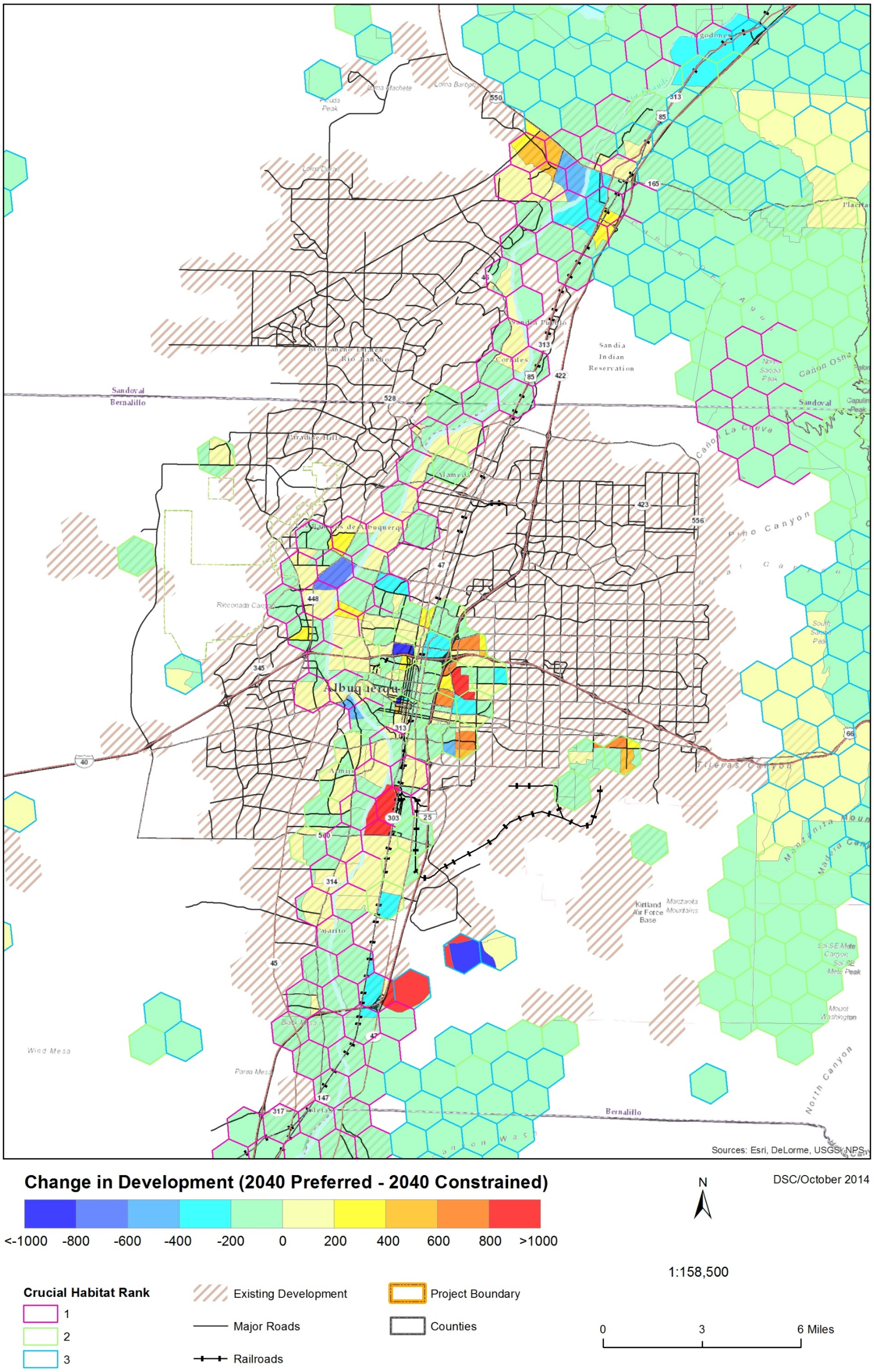


Figure 29. CHAT Preferred vs. Constrained Map Focusing on Albuquerque, NM.

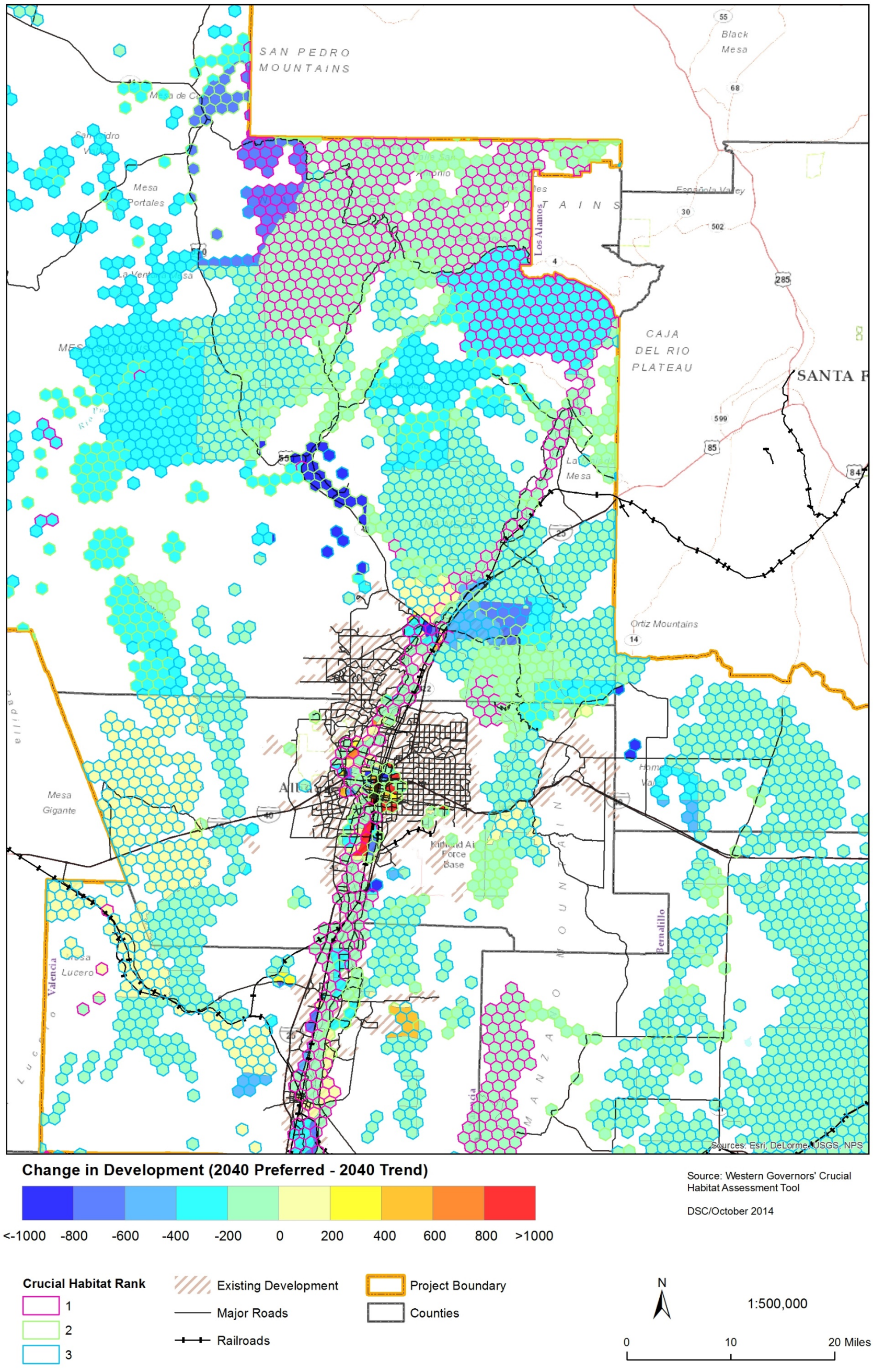


Figure 30. CHAT Preferred vs. Trend Map.

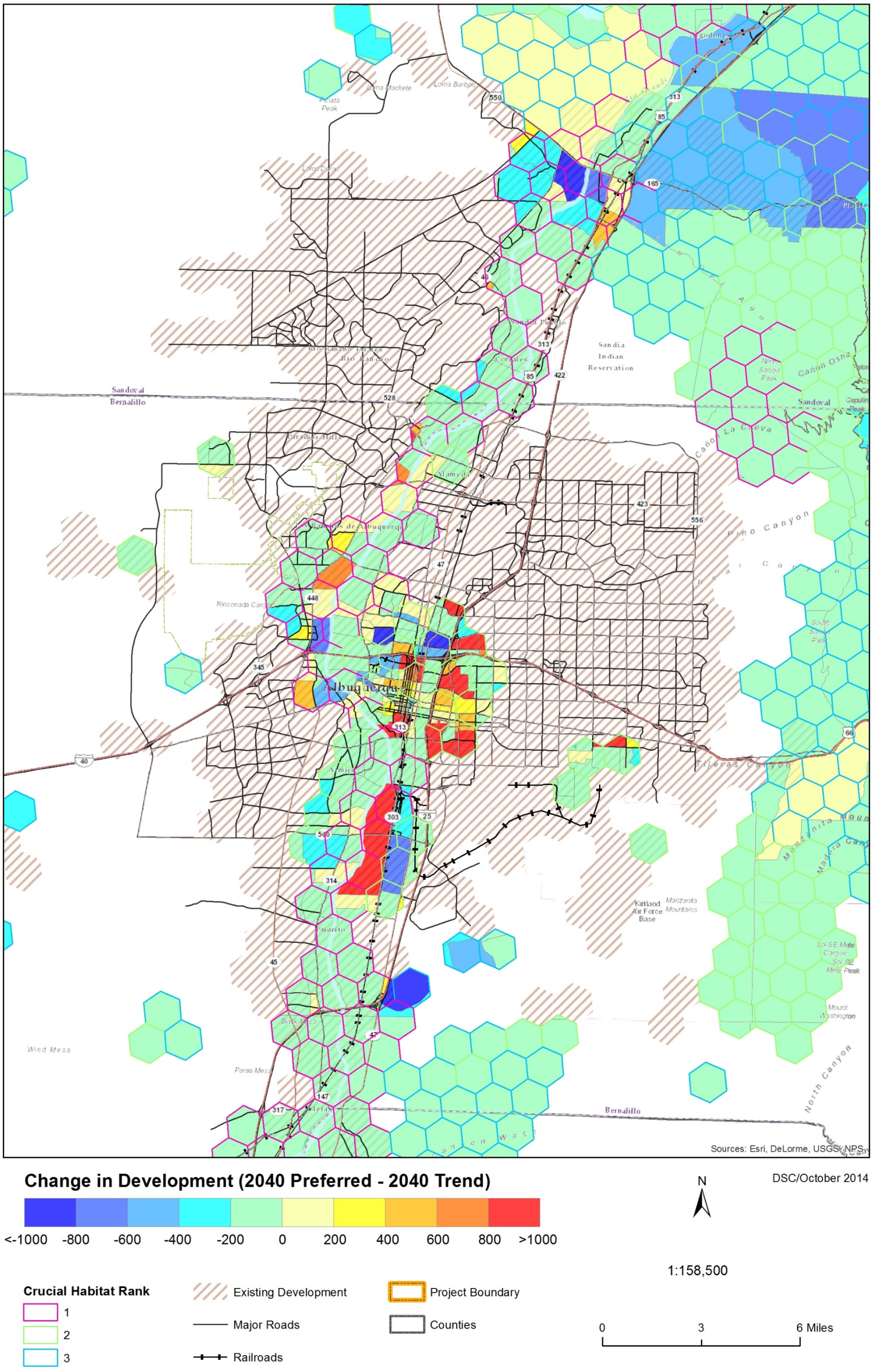


Figure 31. CHAT Preferred vs. Trend Map Focusing on Albuquerque, NM.

2.6 Resiliency

Resiliency refers to the ability of a system to withstand a shock. A recent executive order defines resiliency to climate change more specifically as the "…ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions."[5]. The task 1.1 and 1.2 memos discuss the various threats posed by a changing climate in central New Mexico and the resiliency of various natural and engineered systems. For this task, the project team analyzed the relative resiliency of each future land-use scenario. While the task 1.2 memo provides a long list of resiliency considerations only a subset are considered here. The reason for this limited assessment of resiliency is that the three scenarios are largely conceptual and do not provide detail about specific design considerations that may make particular scenarios more or less resilient to climate change. For example, the scenarios do not indicate if permeable pavements will be used to reduce runoff and improve ground water recharge or if new bridges may be designed to withstand larger floods. The resiliency analysis in this section only considers changes in the performance measures discussed above or included in Appendix A.

The project team considered the resiliency of each scenario with respect to the expected change in the metropolitan area's climate. The Volpe Center provided analysis based on downscaled coupled model intercomparison project phase 3 (CMIP3) climate data that indicates the region is likely to become warmer with more frequent and longer heat waves. The modeling was less certain about precipitation. The region is slightly more likely to receive less precipitation but also expected to become drier even if there is more precipitation because of higher temperatures, which will increase evapotranspiration. Greater precipitation could, however, still increase flood risk even if it does not increase water supply. Figure 32 shows five potential climate futures based on downscaled global climate model runs for the region.

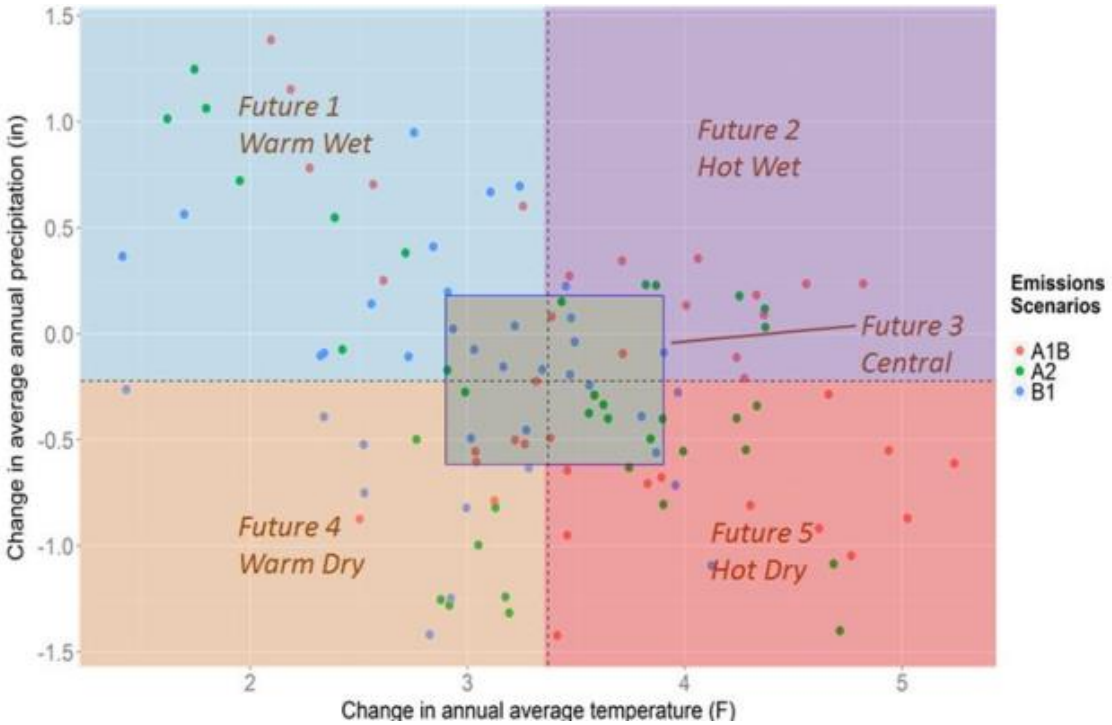


Figure 32. Summary of Global Climate Model Runs for the Year 2040 for Central New Mexico (Volpe Center).

[5] 11/1/2013 Executive Order --Preparing the United States for the Impacts of Climate Change

Each land-use scenario was evaluated for its resiliency to an expected increase in temperature and the potential for a drier climate where there will be prolonged drought and also the potential for greater precipitation which could increase flood risk. Resiliency was considered along five dimensions: urban heat, drought, flooding, wildfire, and crucial wildlife habitat.

Footprint

The alterative scenarios, which incentivize and allow more infill development, result in five percent less land development (Table 7) and 15 to 17 percent greater population density in the newly developed areas compared to the trend scenario. Figures 33 to 38 show how the development footprint differs between scenarios. A more compact city has a smaller spatial footprint. Urban sprawl is extremely expensive to service and maintain; the amount of land, roads, pipes, and infrastructure required per capita is disproportionately large compared to a compact, mixed-use urban environment, which is far more efficient in its demand for municipal services and infrastructure requirements (Heimlich and Anderson 2001, Bhatta 2010). Truly resilient cities choose not subsidize inefficient forms of development (e.g., building roads and assuming operating costs) and instead prioritize city patterns and built forms that have a reduced footprint on the environment and a reduced burden on municipal resources (e.g., directing growth to where services exist, i.e., infill). A smaller urban footprint results in less development costs and fewer miles of roads, utilities, and other infrastructure. Furthermore, studies show that in a compact urban footprint, people will spend less time in vehicles and bike and walk more often and public transportation may be more accessible. This means that larger outlying green areas can be preserved. More green space generally means more vegetation, which can in turn act as a carbon sink for offsetting urban emissions.

Table 7. Change in Regional Development Footprint

Scenario	Development Foot Print (acres)	Change from 2012	Change from Trend
2012 Baseline	162,788		
Trend	259,934	97,146 (60%)	
Preferred	245,584	82,796 (51%)	-14,350 (-6%)
Constrained	247,201	84,413 (52%)	-12,733 (-5%)

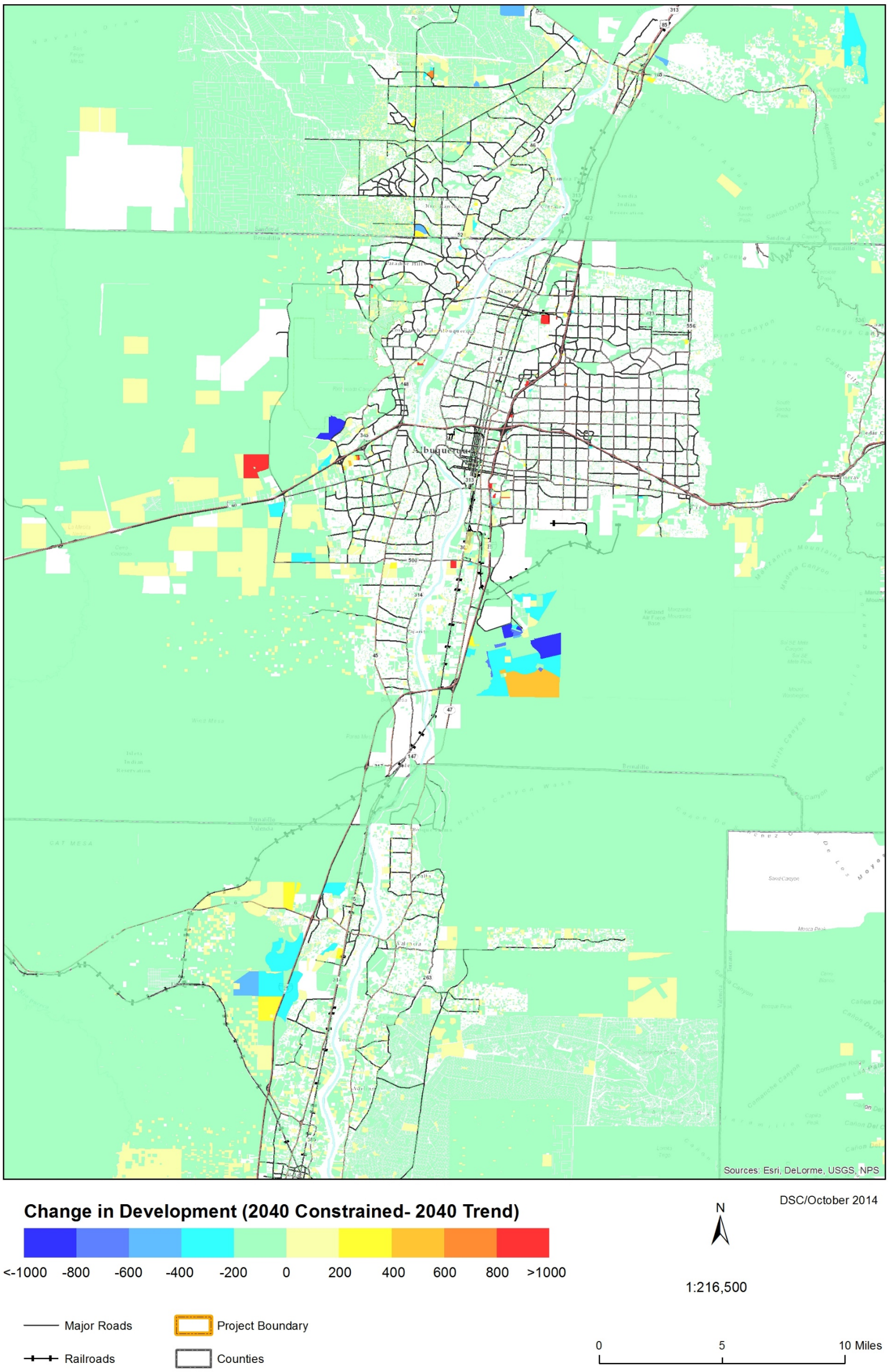


Figure 33. Footprint Constrained vs. Trend Map.

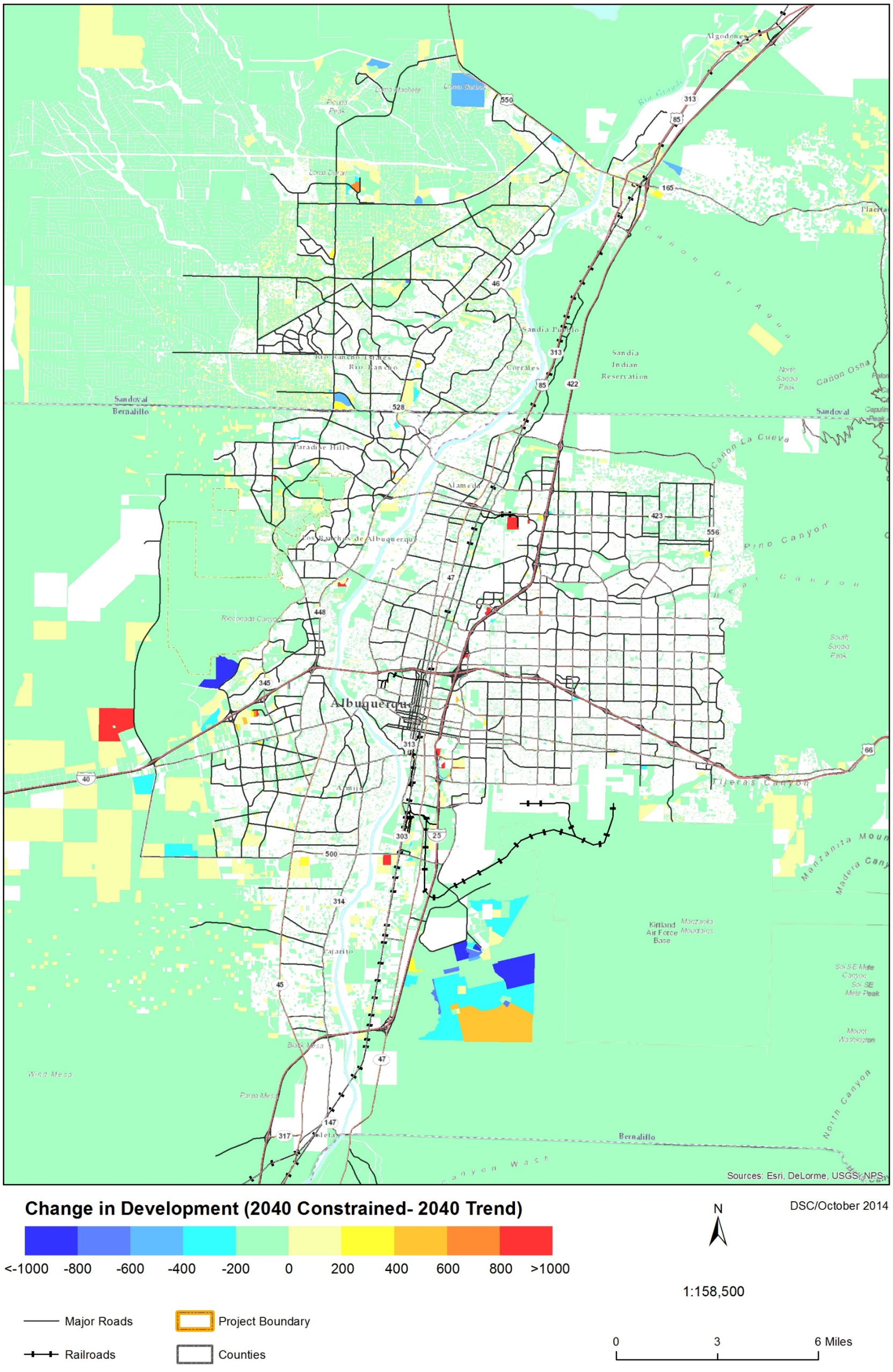


Figure 34. Footprint Constrained vs. Trend Map Focusing on Albuquerque, NM.

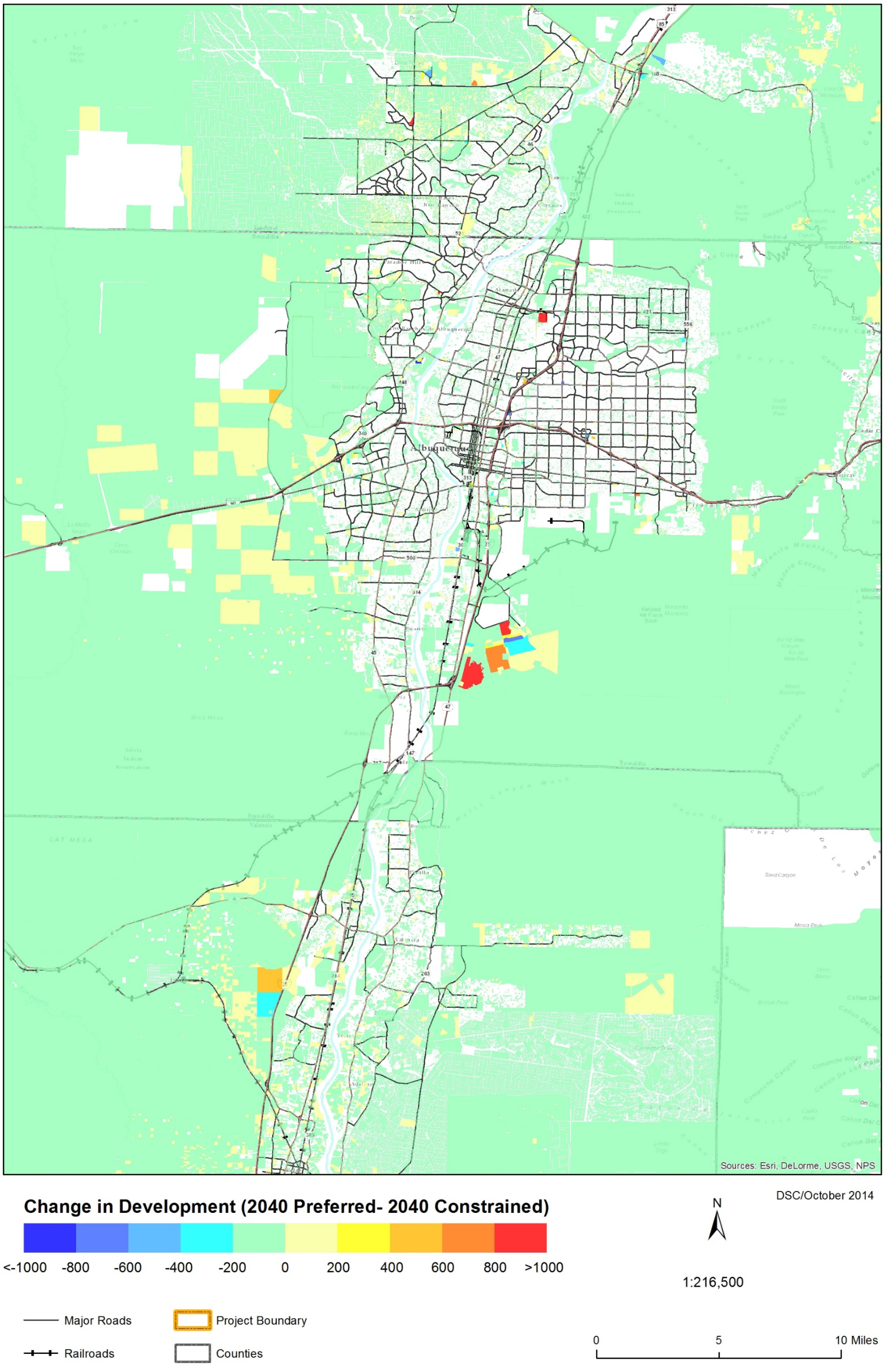


Figure 35. Footprint Preferred vs. Constrained Map.

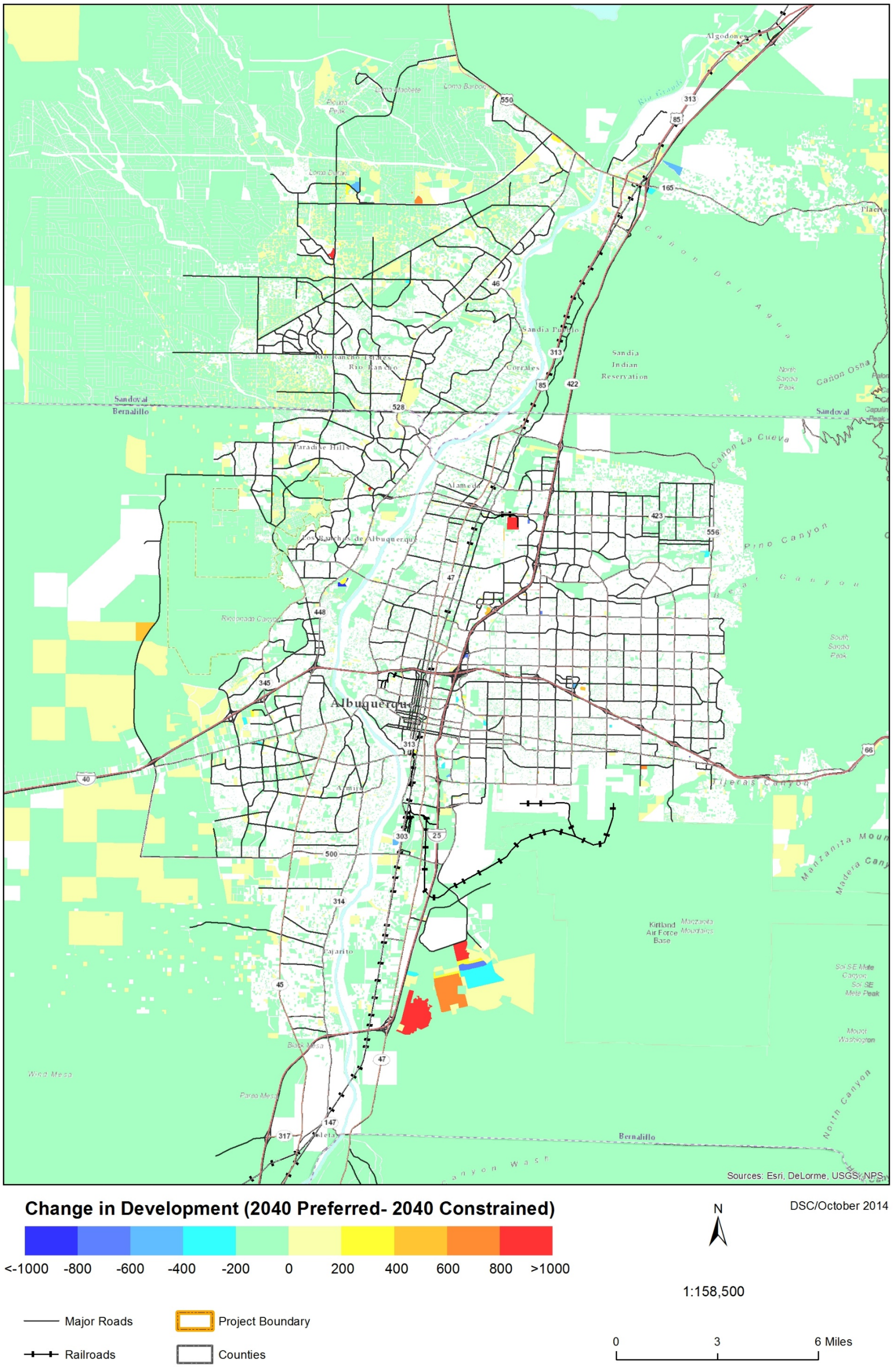


Figure 36. Footprint Preferred vs. Constrained Map Focusing on Albuquerque, NM.

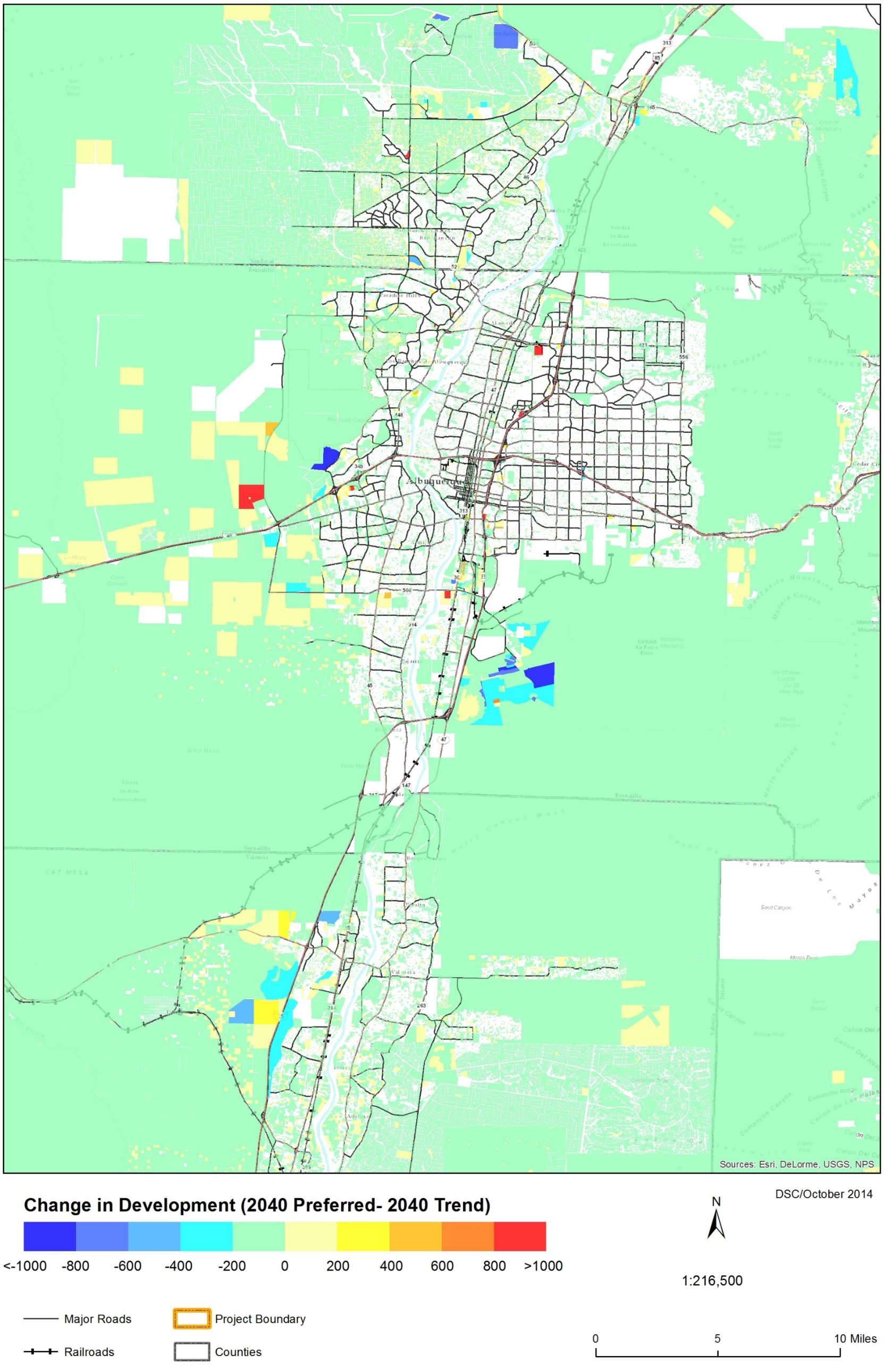


Figure 37. Footprint Preferred vs. Trend Map.

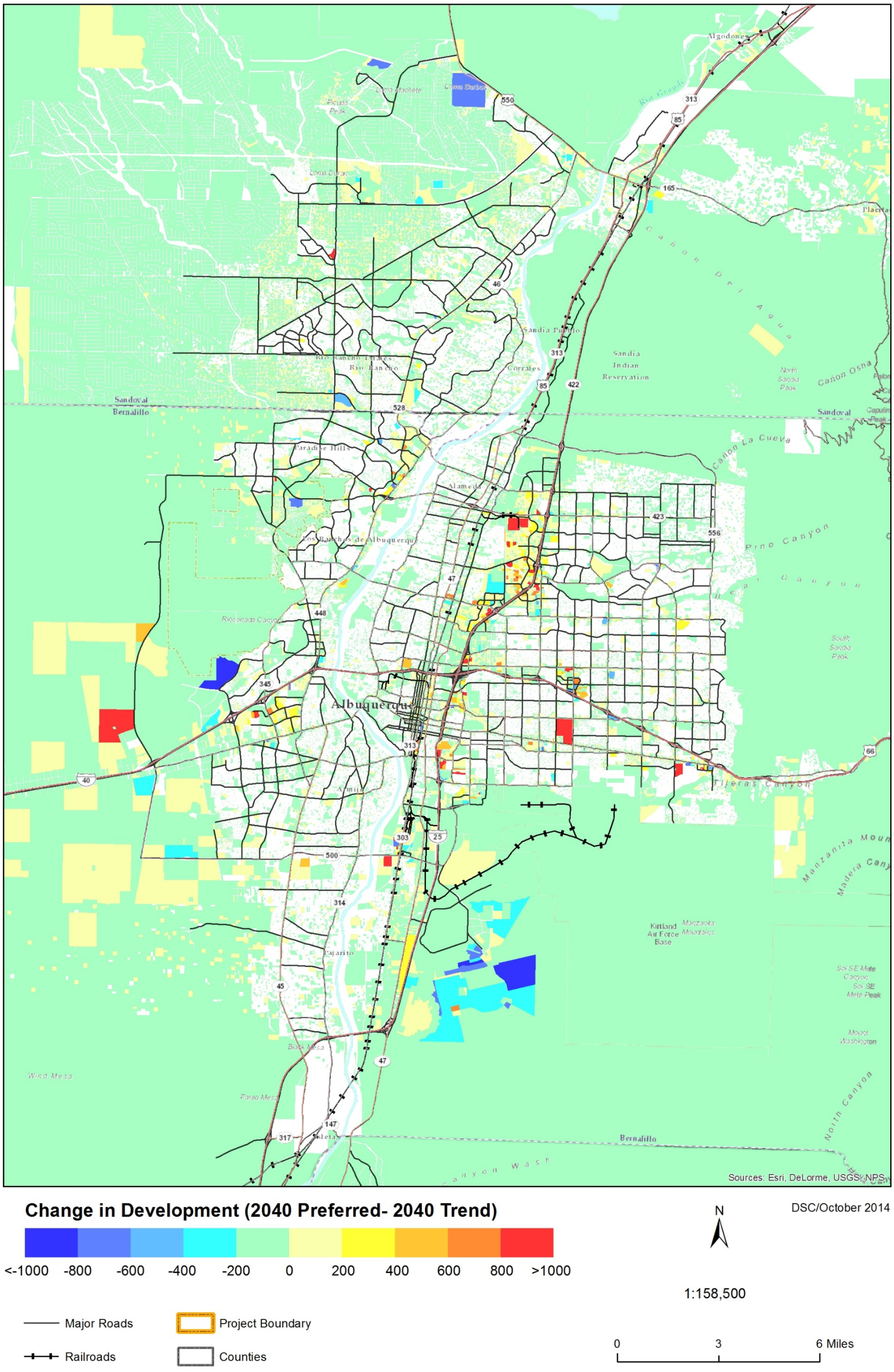


Figure 38. Footprint Preferred vs. Trend Map Focusing on Albuquerque, NM.

2.6.1 Urban Heat

Two factors are expected to drive increasing temperatures: climate change driven by increasing concentrations of GHGs and an increasing urban heat island driven by development of currently undeveloped land. Each of the future scenarios will increase the region's development footprint by 50 percent to 60 percent over year 2012 levels (Table 7) and each scenario also includes an increase in roadway lane miles. This represents a large increase in development and is likely to lead to a larger and more intense urban heat island in the greater Albuquerque area. The relatively small 5 percent difference in the amount of development between the trend and alterative scenarios will help slow the increase in urban heat, but the effect will be relatively small. Maintaining present levels of urban heat or further slowing its growth will require additional mitigation measures (see textbox).

Mitigation Strategies

- Develop more compactly
- Plant vegetation along roads and parking lots
- Minimize roadway length and width
- Remove unused parking lots, minimize new parking lot demand
- Use reflective/white roofs on buildings

One of the main threats of increasing urban heat is public health. Extreme temperatures and prolonged heat waves are associated with an increase in deaths and other negative health outcomes[6]. Each of the scenarios will result in increased urban heat and therefore an increased threat to public health. Since each scenario is expected to experience similar increases in urban heat and each scenario has the same population, the difference in the population's resiliency to urban heat health impacts between trend and alterative scenarios will be small.

The other main threat of urban heat is damage to transportation infrastructure. Increasing temperatures can cause failure (buckling) of railway tracks and accelerate the deterioration of roadway and parking lot pavements. The failure of railway tracks and deterioration of pavements represents an increase in transportation infrastructure maintenance costs. Since each of the future scenarios are expected to increase urban heat, transportation system maintenance costs are expected to increase over today's level. The alterative scenarios may be slightly cooler and therefore be slightly more resilient to increasing temperature.

2.6.2 Drought

While less precipitation is slightly more likely than more precipitation in future years, increasing temperatures are likely to increase drought conditions and limit water availability under any of the potential climate futures. These conditions occur since higher temperatures will increase evaporation which can offset water gained by any increase in precipitation. Each of the future land-use scenarios can be evaluated for their resiliency to drought in two ways, their effect on water supply and their effect on water consumption. The main factor affecting water supply is the development footprint of the metropolitan area. Impervious surfaces such as buildings and paved roadways decrease the amount of land-area available for rain water to penetrate the surface and replenish ground water resources. As discussed in section 2.2 and shown in Figure 2, the amount of paved roadways and developed land increases for all future scenarios. This increase will reduce the amount of land area available for rain water to recharge ground water resources. The alterative scenarios will result in a 5 to 6 percent smaller development footprint than the trend (Table 7), and the constrained scenario will additionally have fewer roadways, therefore decreasing run off and increasing ground water penetration.

Mitigation Strategies

- Use permeable pavements
- Design roads and storm water infrastructure to slow water run off speeds
- Landscape with native , drought tolerant, vegetation

The main factor affecting water consumption is land-use. Commercial, industrial, agricultural, and residential land-uses consume more water than unirrigated range lands and undeveloped land. As discussed in section 2.5.2, the necessary data to fully evaluate how each scenario will affect water consumption is currently not available, but will be in time for the final analysis. The preliminary analysis of residential water consumption indicates a 45 to 48 percent increase in residential water consumption over the 2012 baseline (Figure 13). The alterative scenarios result in two percent less water consumption than the trend.

Since water consumption is expected to increase and water supply is expected to decrease, the metropolitan region under any of the scenarios will be less resilient to drought in the future. The alternative scenarios will be slightly more drought resilient then the trend due to less new land being developed, which decreases runoff, and a greater share of multi-family homes, which use less water. A more detailed analysis of water consumption will provide a more robust drought resilience analysis. The current analysis does not consider the amount of irrigable land (undeveloped land) on each lot or what type of land-use occurs on non-residential lots. There are also many available methods to capture and re-use storm water in developed areas (see textbox), which have not been considered since the project team has only evaluated regional scale changes in land-use plans, the roadway network, and the transit system.

2.6.3 Flooding

As the climate changes, flood frequencies and severity may worsen in central New Mexico as more extreme precipitation events are possible. All scenarios will add more development to the floodplains. Overall, the trend scenario will add the most development in all the categories (Table 3). Higher density development placed in any of the problematic locations will be likely to increase the magnitude of damage incurred, as more structures and lives are at risk. On the other hand, developing higher density housing and commercial areas well outside of future flood risk zones could reduce the need for additional paved areas as lower density development would likely require more paving.

Decisions about the location of development and the design of transportation facilities and buildings in addition to the density of development will affect flood damages and therefore flood resilience (see textbox). Flooding in Albuquerque, the most populous part of the region, originates from the Rio Grande and/or from high-intensity short-duration thunderstorms, which create relatively high peak flows but low volumes of water (New Mexico Floodplain Managers Association 2003). Flood risks in Sandoval and Torrance Counties are also generally related to extreme rainfall events. Valencia County had historical problems caused by the Rio Grande, but these have been resolved following levee construction. Development and infrastructure in the existing floodplains may be at greater risk from flooding where there is no protection from levees.

Bridge assets are also at particular risk under increasingly severe climate scenarios due to “bridge scour” where high velocity flows can remove soil at bridge piers resulting in weakened supports. Culverts are at risk of being washed out, exceeding capacity, or being plugged by debris and vegetation during large storm events, resulting in localized flooding. According to the New Mexico Floodplain Managers Association, “many bridges and culverts are not designed to carry the 100-year frequency flood flows, which causes raised water levels upstream whenever their capacities are exceeded. Overflow of channels and flooding results” (New Mexico Floodplain Managers Association 2003). Under-design for some structures has resulted in flooding events in the past, indicating that in the future even larger culvert designs may be need to accommodate the larger storm events predicted to result from climate change. Drainage infrastructure is also designed for a one in 20 year storm or a one in 50 year storm based on risk tolerance, type of roadway (interstate versus county road), and other factors. Structures may not accommodate more frequent and intense storms.

Mitigation Strategies

- Prohibit or limit development in the floodplain.
- Acquire land or conservation easements to allow for stormwater absorption and arroyo channel adjustments.
- Direct mitigation of peak flows and volumes using stormwater retention (wet ponds), detention (dry ponds), and subsurface stormwater storage.
- Increase the number of communities participating in the Community Rating System (CRS). The CRS reduces flood insurance rates in exchange for a community conducting certain flood hazard reduction activities that are beyond the minimum national standard for floodplain management.
- Reduce fuel loads in critical watersheds to lessen frequency and severity of wildfires that cause floods and debris flows that enhance flooding.
- Utilize green infrastructure techniques including permeable pavements, bioswales, and downspout connections
- Plant vegetation that can tolerate inundation.
- Repair bridges, culverts, and levees

2.6.4 Wildfire

Some analysts predict that a temperature increase of 1.8° Fahrenheit due to climate change will result in a 470 percent increase in acreage burned by wildfires in the New Mexico foothills of the Rockies and a 656 percent increase in acreage burned in the southern Rockies of New Mexico (Funk et al. 2014). With warmer weather and extended growing seasons predicted, there will be a continuing increase of combustible biomass, including invasive species. The change in vegetation patterns will alter the occurrence, severity, and distribution of wildfires. As seen over the past several years, there will continue to be an increase in wildfire size, severity, and frequency. Under all scenarios, development in the WUI will increase compared to the current state, thus, the region will be less resilient to wildfires under all scenarios since development located in the WUI is at a higher risk of wildfire than development that is not. The preferred scenario is the most resilient with a seven percent decrease of development in the WUI compare to the trend scenario, which will help increase resiliency of infrastructure to wildfires. Resiliency of infrastructure in the WUI will depend on implementing mitigation strategies that reduce fire behavior, spread, and severity (see textbox).

Wildfires can greatly increase runoff and erosion rates. Wildfires increase the risk of debris flows, flooding, and impaired water quality. The cities of Albuquerque and Santa Fe stopped using river water for municipal needs for 40 and 20 days respectively due to debris flows and flooding resulting from the 2011 Las Conchas wildfire in the Jemez Mountains, demonstrating the significant impact of wildfire and post-fire debris flow on municipal water users. Post-fire rehabilitation treatments, such as seeding and mulching, are commonly applied to severely-burned areas to reduce post-fire runoff and erosion.

Mitigation Strategies

- "Defensible space": Requirements for buffer zones between development and wildland areas. These requirements could include recommendations for "firescaping," which involves surrounding the building with vegetation that is less likely to combust.
- Reduce combustible fuels around critical facilities such as power stations, power lines, transformer sites, major transportation routes, and critical watersheds.
- Produce a Community Wildfire Protection Plan and Homeowners Guide and distribute to residents.
- Allow free greenwaste disposal and free assistance to move brush away from houses.
- Facilitate greenwaste removal by picking up and hauling away slash.
- Encourage participation of local neighborhoods with Firewise. Firewise is a program that involves homeowners, local leaders, developers, agricultural producers, and others for an effort to protect people, property, and natural resources from wildfires.
- Provide defensible space workshops.
- Deed restrictions or covenants placed on new developments that require the establishment of defensible space.
- Vegetation management plans: Site-specific analyses of vegetation and other features including schedules for fuel removal and cleanup.
- Special attention to fuel located downhill of houses sited on a slope.
- Do not locate transportation infrastructure in the WUI zone beyond what is needed to provide mobility and evacuation needs for existing WUI residents.
- Proper signage and multiple wide, well-maintained ingress and egress points for a development for both evacuation and emergency services purposes.
- Ephemeral flooding in depressions in the bosque within the fuel breaks to encourage growth of less-flammable native riparian and wetland vegetation species.

2.6.5 Crucial Habitat

Preserving natural habitat is an important part of ecological resiliency to both urbanization and climate change. Climate change is poised to impact a number of ecological communities and species in New Mexico, especially those which have already been affected by historic development of the Upper Rio Grande. Like other regions of the Southwest, Central New Mexico is expected to experience large temperature increases, increased severity and duration of drought periods, increased wildfire activity (both in size and severity), insect outbreaks and overall reduction in river and stream flows. Slightly more development would occur under the preferred or constrained scenarios than the trend. However, this development would occur mainly in already developed areas on a small number of parcels. Development on already disturbed urban areas would provide a more compact urban footprint by accommodating additional residential or commercial uses within an existing or previously developed parcel. Development to already disturbed areas would prevent further fragmentation or encroachment of crucial habitat and wildlife corridors. Thus, the biodiversity of species within crucial habitat and the integrity of the crucial habitat would be maintained and more resilient to climate change than the trend scenario. Other mitigation strategies can also be adopted to improve the resiliency of crucial habitat to climate change in the region (see textbox).

Most of the highest ranked crucial habitat is located in the Middle Rio Grande, bosque, the Sandia Mountains and the Jemez Mountains. The Rio Grande is a regulated river and management of water deliveries will be important to increase resilience of the riparian vegetation and river which provide habitat to species of concern including the southwestern willow flycatcher and the Rio Grande silvery minnow. Crucial habitat and resilience measures are described in more detail in Memo 1.2.

Mitigation Strategies

- Coordinate Rio Grande water management activities to support and improve the bosque's riverine and terrestrial habitats, with special emphasis on mimicking typical natural hydrographs.
- Implement measures to allow fluvial processes to occur within the river channel and the adjacent bosque to the extent possible.
- Protect, extend, and enhance the structure of aquatic habitat to the benefit of native communities.
- Integrate management of nonnative and native fish species in all aquatic environments in the Middle Rio Grande riparian ecosystem including wetlands, canals, and drains.
- Protect the geographic extent of the Rio Grande bosque and avoid further fragmentation of the riparian ecosystem and component habitats.
- Protect, extend, and enhance riparian vegetation in noncontiguous areas in the floodplain.
- Manage the buffer zone of the contiguous bosque to protect ecosystem processes, enhance wildlife habitat values, and maintain rural and semirural conditions.
- Prevent unmanaged fires in all reaches of the bosque.
- Use native plant species and local genetic stock in vegetation establishment and management efforts throughout the bosque.
- Protect, enhance, and extend (create) wetlands throughout the Middle Rio Grande riparian zone.
- Sustain and enhance existing cottonwood communities, and create new native cottonwood communities wherever possible throughout the Middle Rio Grande riparian zone.
- Contain the expansion of existing large stands of nonnative vegetation in the Middle Rio Grande riparian zone.
- Modify storm water outfalls to function as wetlands, increasing diversity of habitat.
- Install moist soil willow swales that would serve a dual purpose of reestablishing connectivity between the bosque and the river, as well as providing shrub, mid-canopy habitat.
- Clear exotic species in the bosque and replant areas with native species of cottonwood riparian gallery forest.
- Reduce fuel loads and develop wildfire fuel breaks to reduce risk of severe wildfires.
- Remove debris from floods and wildfires from streams and arroyos.
- Create refugia for species such as the Rio Grande silvery minnow.
- Preserve and protect wildlife corridors.

3 SUMMARY AND CONCLUSIONS

Generally, the three land-use and transportation scenarios developed by MRCOG result in a similar outcome. Due in large part to needing to accommodate a 52 percent increase in the region's population by the year 2040, a large amount of new land is consumed by development and traffic congestion and GHG emissions increase significantly. While the differences between scenarios are small, they can have substantial impacts. In sum, the alterative scenarios perform better than the trend in almost every performance measure and would place the region on a more sustainable and resilient development path. Overall, the preferred scenario is the highest performing in this analysis and when compared to the other scenarios developed for the first workshop. The greater development in core activity centers and increased transit investments under the preferred scenario result in the least amount of driving and the smallest urban footprint, in-turn leading to less congestion and fewer GHG emissions than other future scenarios. If funding constrains the development of the preferred scenario, the constrained scenario also performs notably better than the trend and the scenarios from the previous workshop.

It should be noted that UrbanSim and the travel demand model each produce point estimates. While there is likely a great deal of imprecision and inaccuracy in each model and the data supplied to them, this has not been evaluated in the current modeling analysis. Such an evaluation would require a lengthy investigation which is outside the scope of the current work. However, these uncertainties should be kept in mind when comparing relatively small differences in performance measured calculated from these model output.

The results indicate that each scenario is less resilient than today, mainly because more land and infrastructure are developed. The increasing land development increases urban heat, reduces water supply while increasing water demand, and pushes more development into inappropriate places at higher risk for floods and wildfire and where crucial habitat is encroached upon. If one scenario is to be selected as the most resilient it would be preferred scenario. The preferred scenario has the smallest development foot print and least amount of vehicle traffic. The preferred scenario could be further improved by controlling the amount of development in high fire and flood risk areas and crucial habitat areas, which could be accomplished with more restrictive zoning.

While GHG emissions rise in each scenario, the reductions achieved over the trend are notable in that they are only a result of changes in land-use zoning and the transportation network. A wide range of additional mitigation strategies, technological, regulatory, and market based, can achieve additional reductions. Additional mitigation strategies were identified in the Task 2.1 memo and will be evaluated in detail in this project's final report.

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APPENDIX A. PERFORMANCE MEASURE SUMMARY TABLE

Performance Measure Category	Performance Measure	Unit of Analysis	Absolute Value				Percent Change from 2012			Percent Change from Trend	
			Base Year 2012	Trend	Preferred	Constrained	Trend	Preferred	Constrained	Preferred	Constrained
Accessibility	Proximity to Recreation Sites	Households within 5 miles	n/a[a]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Proximity to Activity Centers	Households within 1 mile of Activity Center	50,616	88,555	91,694	91,032	75	81	80	3.5	2.8
	Proximity to Transit	Households within 1/4 mile of premium transit	1,358	14,380	17,460	16,586	959	1186	1121	21.4	15.3
	Proximity to Bicycle Facilities	Households within 1/4 miles of a bicycle path	110,421	151,360	157,070	156,037	37	42	41	3.8	3.1
	Proximity to Schools	Households within 1/2 miles of a school	129,690	168,659	166,444	165,742	30	28	28	-1.3	-1.7
	Non-motorized Mode Share	% Trips bike or walk	5.8%	5.8%	6.1%	6.1%	1	5	6	4.1	4.6
Land Use	Jobs/Housing Mix in Activity Centers	Average jobs to housing ratio within 1 mile of activity centers	2.76	2.30	2.24	2.25	-17	-19	-18	-2.6	-2.2
	Proximity to Key Corridors	Employment within 1000 feet of key corridors	92,613	133,409	130,139	127,854	44	41	38	-2.5	-4.2
	Lane Miles	Roadway Lane Miles	8,113	8,502	8,502	8,279	5	5	2	0.0	-2.6
	Land Developed	Acres Land Developed	162,788	259,934	245,584	247,201	60	51	52	-5.5	-4.9
	Population Density	Persons per Acre of Developed Land	5.5	5.2	5.5	5.5	-5.1	0.4	-0.2	5.8	5.2
	Population Density of New Development	New Persons per Acres of New Development		4.7	5.5	5.4	-13.6	1.3	-0.6	17.3	15.1
	Taxable Land Value	Dollars	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mobility: Highway	Systemwide Speed	PM peak hour speed (MPH)	35.8	25.6	27.1	26.0	-28	-24	-27	5.7	1.5
	VHD - Vehicle Hours of Delay	PM peak hour: congested travel time - free flow travel time (hours)	9,648	47,450	21,337	22,525	392	121	133	-55.0	-52.5
	VHT - Vehicle Hours Traveled	PM peak hour: total travel time (hours)	51,876	104,470	94,492	98,677	101	82	90	-9.6	-5.5

Performance Measure Category	Performance Measure	Unit of Analysis	Absolute Value				Percent Change from 2012			Percent Change from Trend	
			Base Year 2012	Trend	Preferred	Constrained	Trend	Preferred	Constrained	Preferred	Constrained
	Vehicle Miles Traveled (VMT)	Total vehicle miles traveled per day	19,722,826	28,055,982	27,006,046	27,043,141	42	37	37	-3.7	-3.6
	VMT per Capita	Average vehicle miles traveled per person	22.1	20.8	20.0	20.0	-6	-10	-10	-3.7	-3.6
	Percentage of Network in Congested Conditions	PM peak hour: % of network exceeding capacity (v/c > 1)	2.0%	6.9%	6.1%	6.8%	251	211	243	-11.3	-2.1
	Congested Conditions along Freight Corridors	PM peak hour: % of freight network exceeding capacity (v/c > 1)	5.0%	17.4%	15.0%	15.5%	252	203	212	-14.0	-11.3
Mobility: Transit	Transit Ridership	Daily number of transit trips	41,033	52,153	83,589	67,507	27	104	65	60.3	29.4
	Transit Passenger Miles Traveled	Daily passenger miles traveled	147,369	187,772	262,171	221,037	27	78	50	39.6	17.7
	Transit Mode Share	% Trips by Transit	0.8%	0.7%	1.0%	0.9%	-9	32	14	44.4	25.0
Mobility: River Crossings	River Crossing - Congested Conditions	PM peak hour: average volume to capacity ratio (v/c ratio)	0.77	0.99	0.97	1.00	29	26	30	-2.3	0.6
	River Crossing Trips	Daily number of vehicle trips	598,018	770,235	754,444	781,283	29	26	31	-2.1	1.4
Economic Competitiveness	Proximity to Employment Sites	Households within 1 mile of employment	33,729	49,573	59,886	60,608	47	78	80	20.8	22.3
	Average Commute Time	Minutes	17.48	20.94	19.42	19.77	20	11	13	-7.3	-5.6
	Economic Value of Network Efficiency	Gross Regional Product (billion dollars)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Economic Value of Network Efficiency	GRP per Capita	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Safety	Crash Rate	Crashes per 100 million VMT	369	373.7	376.4	374.3	1	2	1	0.7	0.2
Sustainability & Resiliency	GHG Emissions	Daily CO2-eq (tonnes/day)	11,358	14,058	13,352	13,519	24	18	19	-5.0	-3.8
	GHG Emissions per Capita	Daily CO2-eq per Capita (kg/day)	12.7	10.4	10.1	10.2	-18	-21	-20	-3.0	-1.7

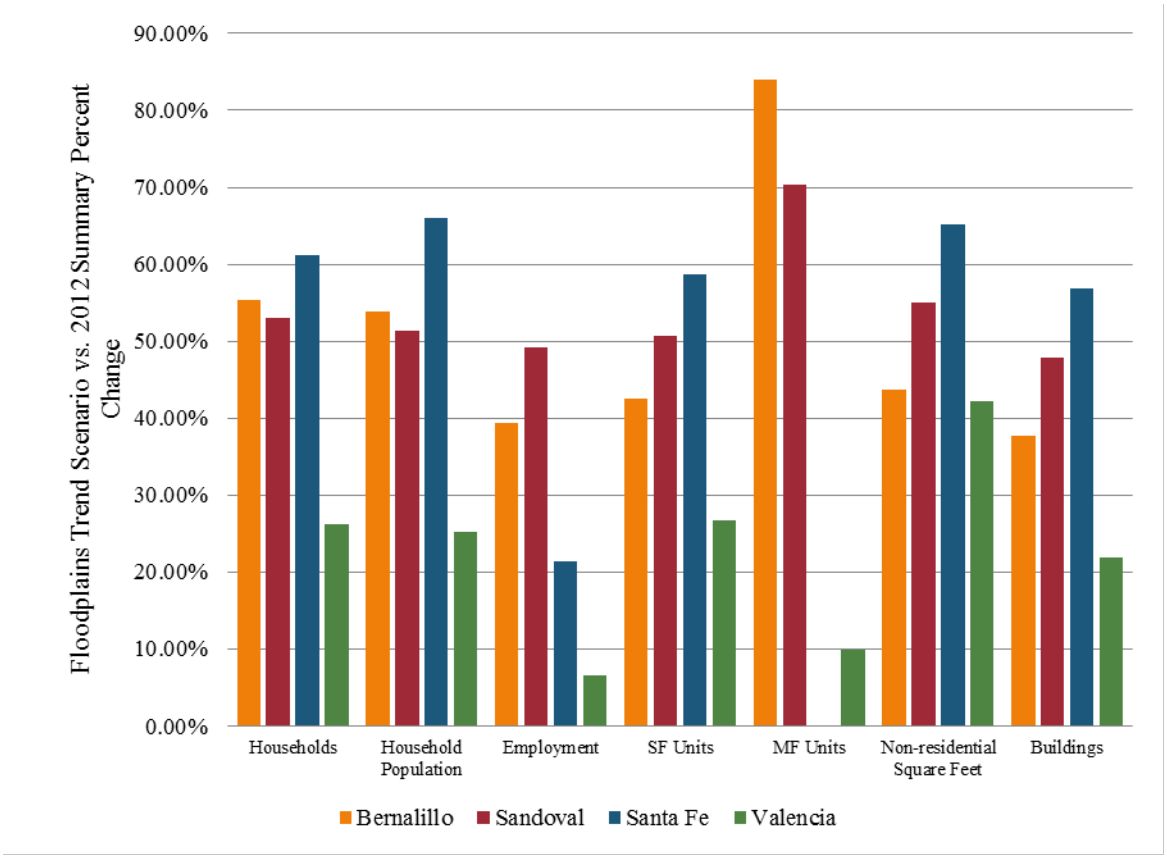
Performance Measure Category	Performance Measure	Unit of Analysis	Absolute Value				Percent Change from 2012			Percent Change from Trend	
			Base Year 2012	Trend	Preferred	Constrained	Trend	Preferred	Constrained	Preferred	Constrained
	Residential Water Consumption	Million gallons per year	25,107	37,224	36,420	36,444	48	45	45	-2.2	-2.1
	Development in High Flood-Risk Areas	Employment + Dwelling Units in 100 year Flood Plains	34,470	52,755	50,782	51,853	53	47	50	-3.7	-1.7
	Development in Forest Fire Risk Areas	Weighted value based on emp + housing in wildland-urban Interface areas	3.14	4.85	4.53	4.57	54	44	46	-6.6	-5.8
	Development in Crucial Habitat Areas	Weighted value based on emp + housing in priority ranking areas	5.73	7.65	7.71	7.70	34	35	34	0.8	0.7

[a] n/a = data not available from MRCOG

APPENDIX B. GRAPHS AND TABLES FOR THE FLOODPLAINS

Floodplains Trend Scenario vs. 2012 Summary Percent Change.

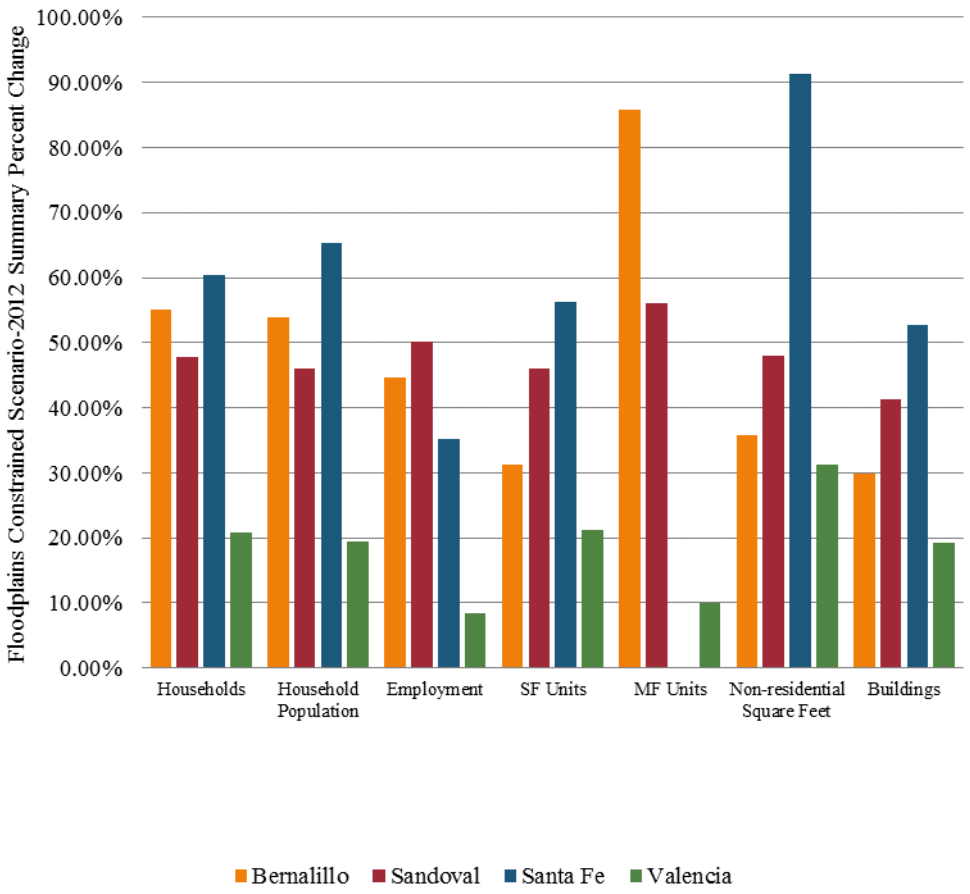
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	55.3%	53.9%	39.3%	42.5%	83.9%	43.7%	37.8%
Sandoval	53.0%	51.3%	49.2%	50.6%	70.3%	55.1%	47.8%
Santa Fe	61.2%	66.0%	21.4%	58.7%	0.0%	65.1%	56.8%
Valencia	26.2%	25.2%	6.6%	26.8%	9.9%	42.1%	21.9%
Total	40.1%	38.9%	25.0%	34.8%	76.5%	44.8%	30.2%



Floodplains Trend Scenario vs. 2012 Summary Percent Change Graph

Floodplains Constrained Scenario vs. 2012 Summary Percent Change.

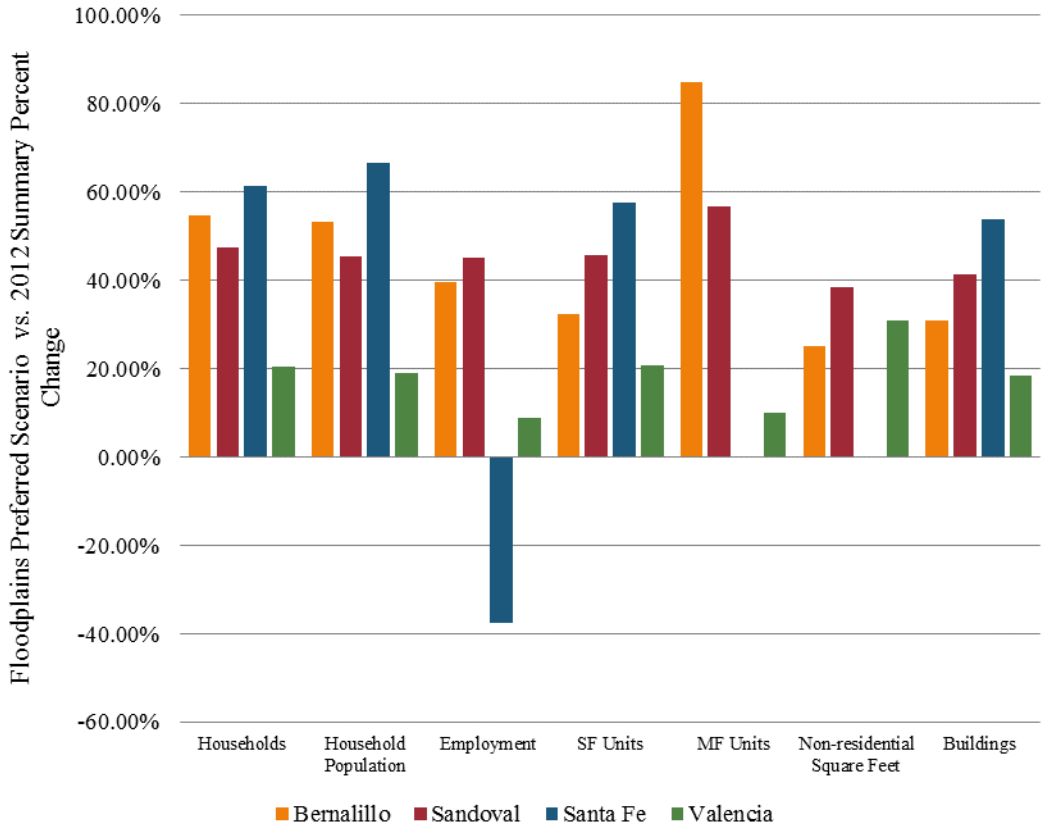
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	55.1%	53.9%	44.7%	31.3%	85.8%	35.9%	29.8%
Sandoval	47.9%	46.1%	50.1%	46.0%	56.0%	48.0%	41.4%
Santa Fe	60.5%	65.3%	35.3%	56.3%	0.0%	91.4%	52.7%
Valencia	20.9%	19.4%	8.4%	21.2%	9.9%	31.3%	19.3%
Total	36.8%	35.5%	28.2%	27.9%	78.4%	35.9%	25.4%



Floodplains Constrained Scenario vs. 2012 Summary Percent Change Graph.

Floodplains Preferred Scenario vs. 2012 Summary Percent Change.

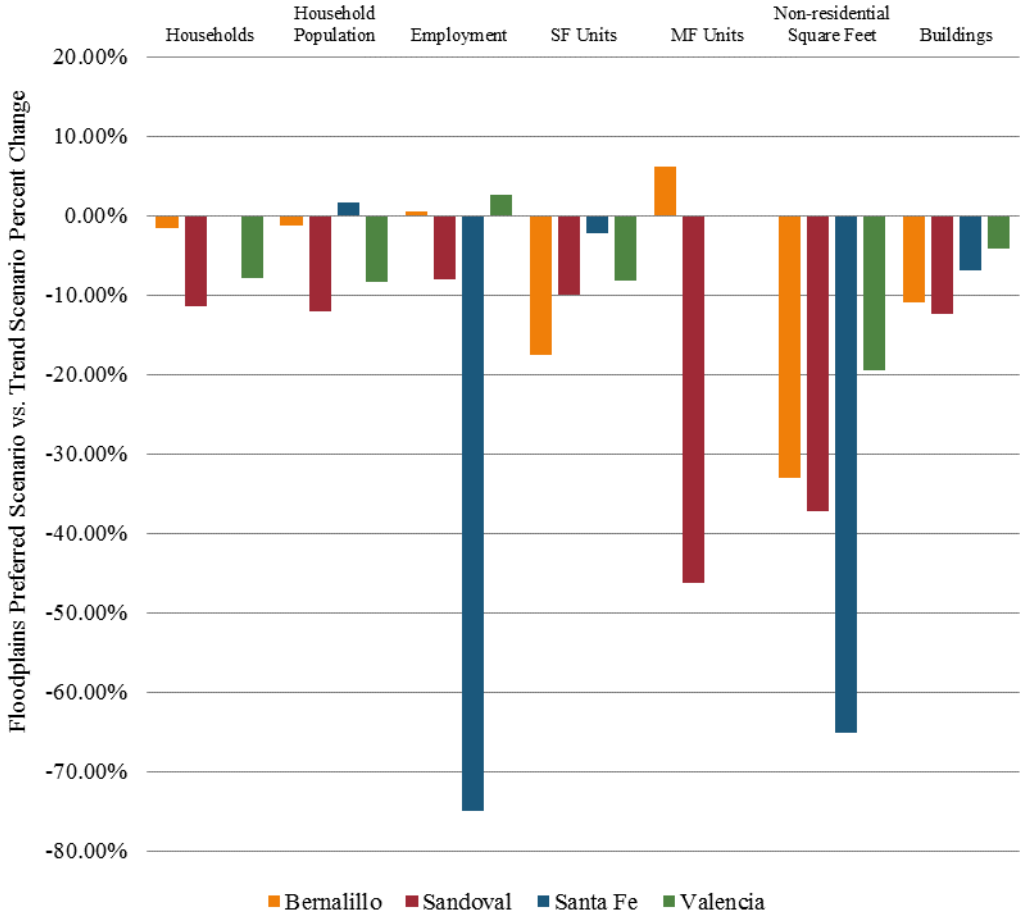
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	54.6%	53.3%	39.6%	32.4%	84.9%	25.1%	30.9%
Sandoval	47.6%	45.4%	45.1%	45.7%	56.6%	38.4%	41.3%
Santa Fe	61.2%	66.6%	-37.5%	57.7%	0.0%	0.0%	53.8%
Valencia	20.4%	18.9%	9.0%	20.8%	9.9%	30.8%	18.6%
Total	36.4%	35.0%	25.0%	28.0%	77.3%	29.6%	25.3%



Floodplains Preferred Scenario vs. 2012 Summary Percent Change Graph.

Floodplains Preferred Scenario vs. Trend Scenario Percent Change.

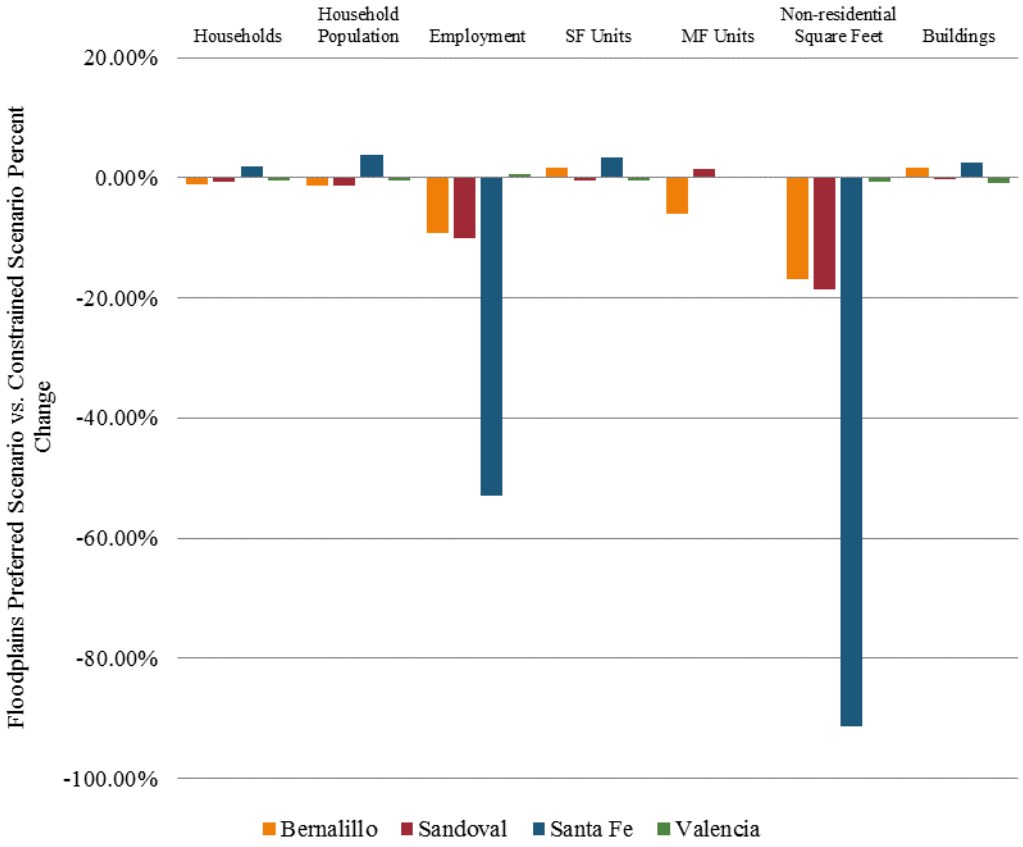
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	-1.6%	-1.2%	0.5%	-17.6%	6.1%	-33.1%	-11.0%
Sandoval	-11.5%	-12.0%	-8.1%	-10.0%	-46.2%	-37.2%	-12.4%
Santa Fe	0.0%	1.7%	-75.0%	-2.3%	0.0%	-65.1%	-6.9%
Valencia	-7.8%	-8.4%	2.6%	-8.1%	0.0%	-19.5%	-4.2%
Total	-6.2%	-6.4%	0.0%	-10.5%	3.4%	-27.4%	-7.1%



Floodplains Preferred Scenario vs. Trend Scenario Percent Change Graph.

Floodplains Preferred Scenario vs. Constrained Scenario Percent Change.

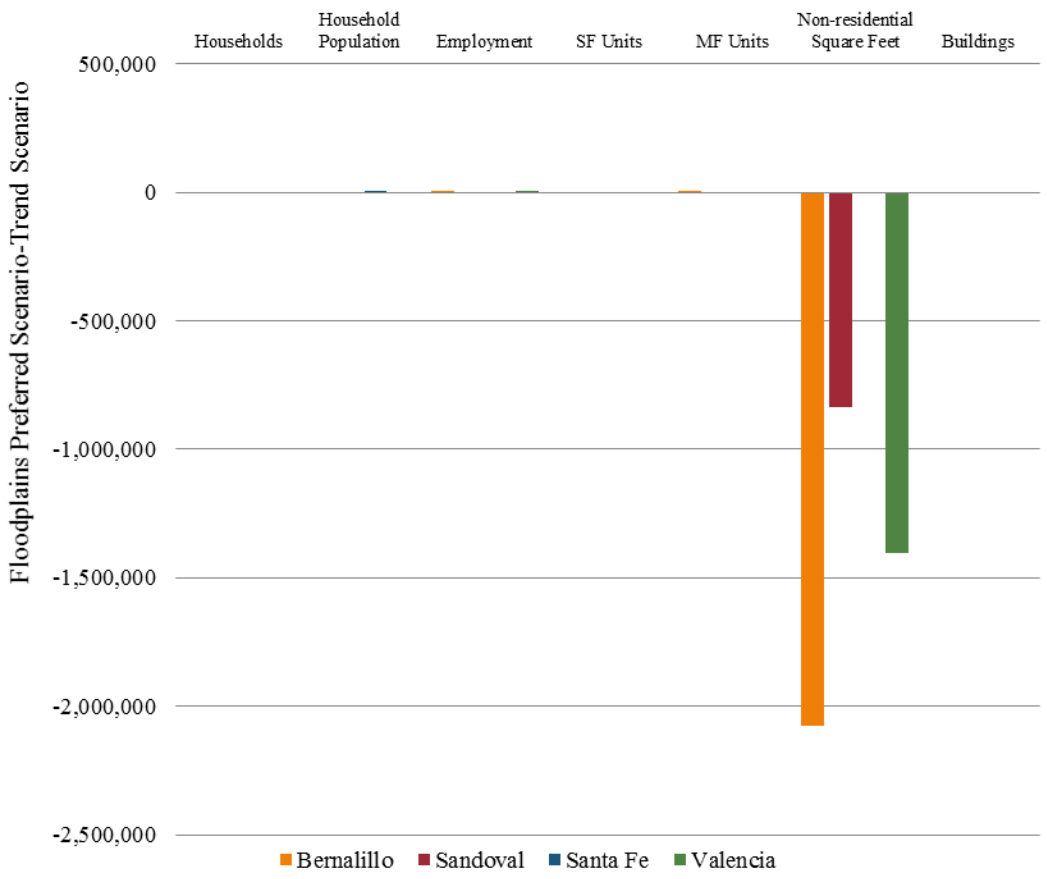
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	-1.1%	-1.2%	-9.2%	1.6%	-6.0%	-16.8%	1.6%
Sandoval	-0.6%	-1.2%	-10.0%	-0.5%	1.4%	-18.5%	-0.1%
Santa Fe	1.9%	3.9%	-52.9%	3.4%	0.0%	-91.4%	2.4%
Valencia	-0.6%	-0.5%	0.6%	-0.5%	0.0%	-0.6%	-0.9%
Total	-0.7%	-0.8%	-4.4%	0.0%	-5.2%	-9.7%	-0.2%



Floodplains Preferred Scenario vs. Constrained Scenario Percent Change Graph.

Floodplains Preferred Scenario – Trend Scenario.

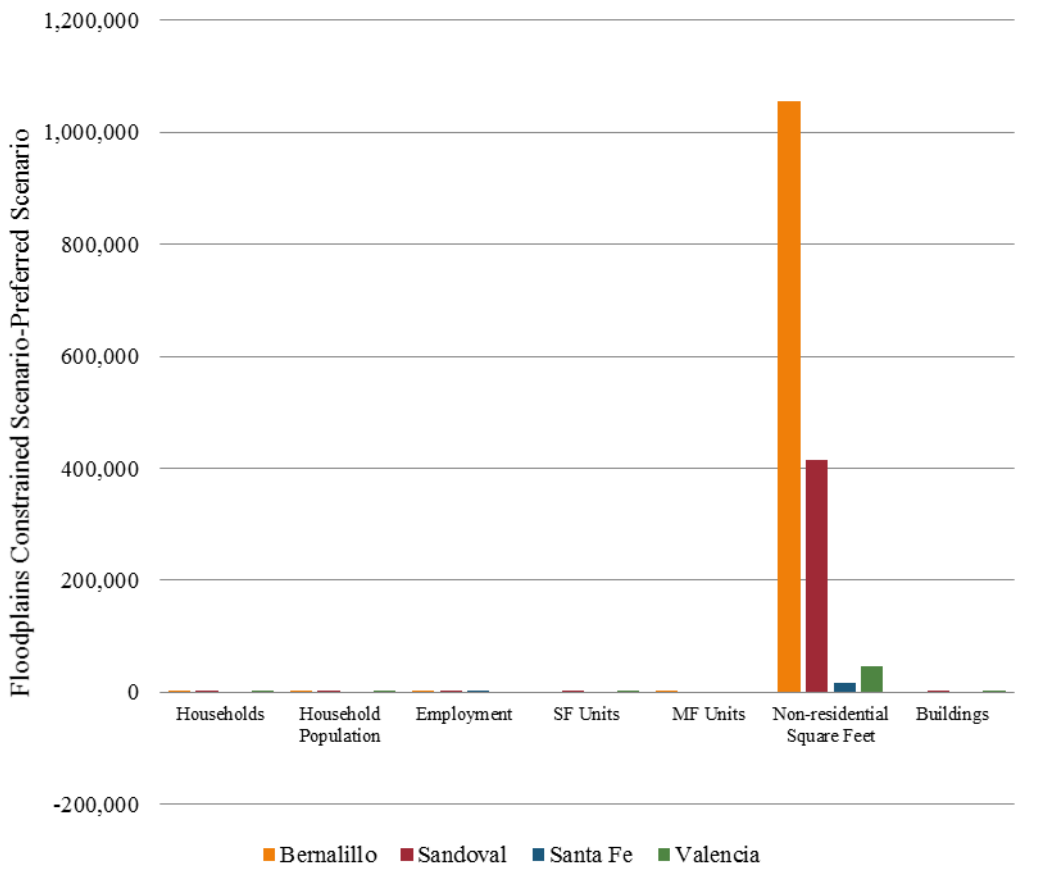
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	-178	-342	27	-1,146	366	-2,074,386	-766
Sandoval	-533	-1,439	-273	-470	-129	-834,991	-578
Santa Fe	0	12	-6	-6	0	-2,816	-17
Valencia	-1,259	-3,430	249	-1,377	0	-1,404,677	-767
Total	-1,970	-5,199	-3	-2,999	237	-4,316,870	-2,128



Floodplains Preferred Scenario – Trend Scenario Graph.

Floodplains Constrained Scenario – Preferred Scenario.

County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	123	344	544	-105	358	1,055,348	-111
Sandoval	29	146	338	23	-4	415,930	5
Santa Fe	-5	-27	9	-9	0	16,000	-6
Valencia	90	220	-57	82	0	45,769	167
Total	237	683	834	-9	354	1,533,047	55

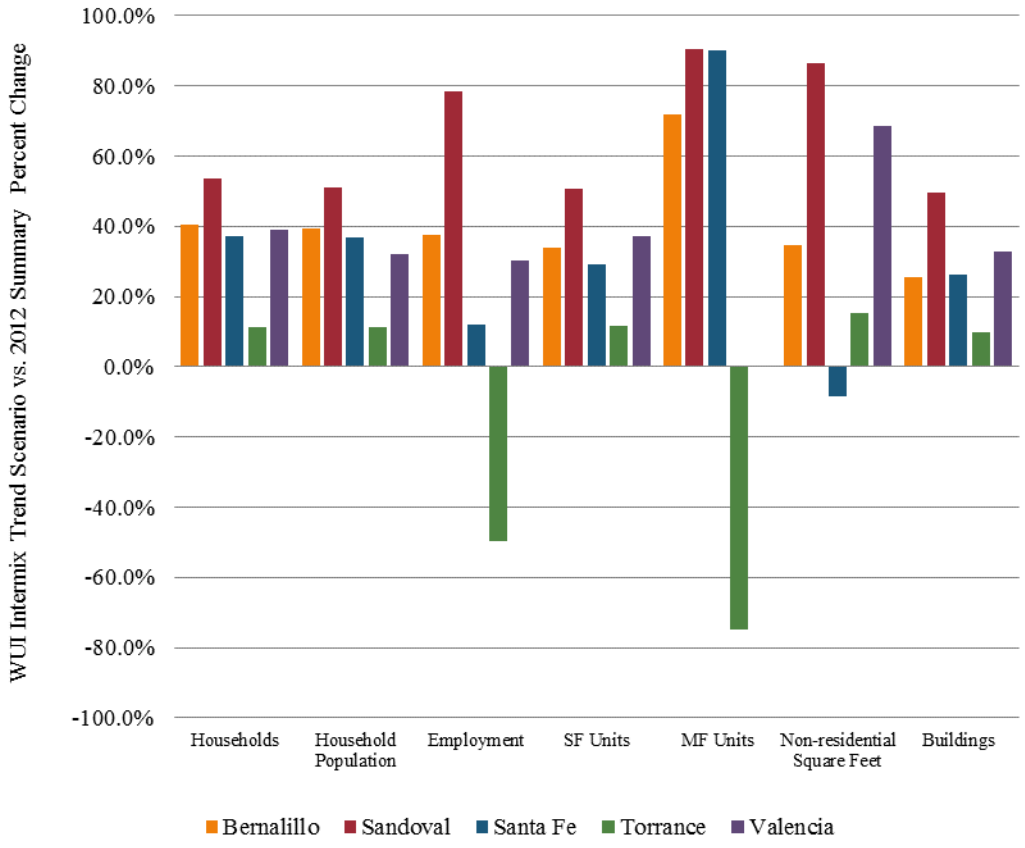


Floodplains Constrained Scenario – Preferred Scenario Graph.

APPENDIX C. GRAPHS AND TABLES FOR WILDFIRE

WUI Intermix Trend Scenario vs. 2012 Summary Percent Change.

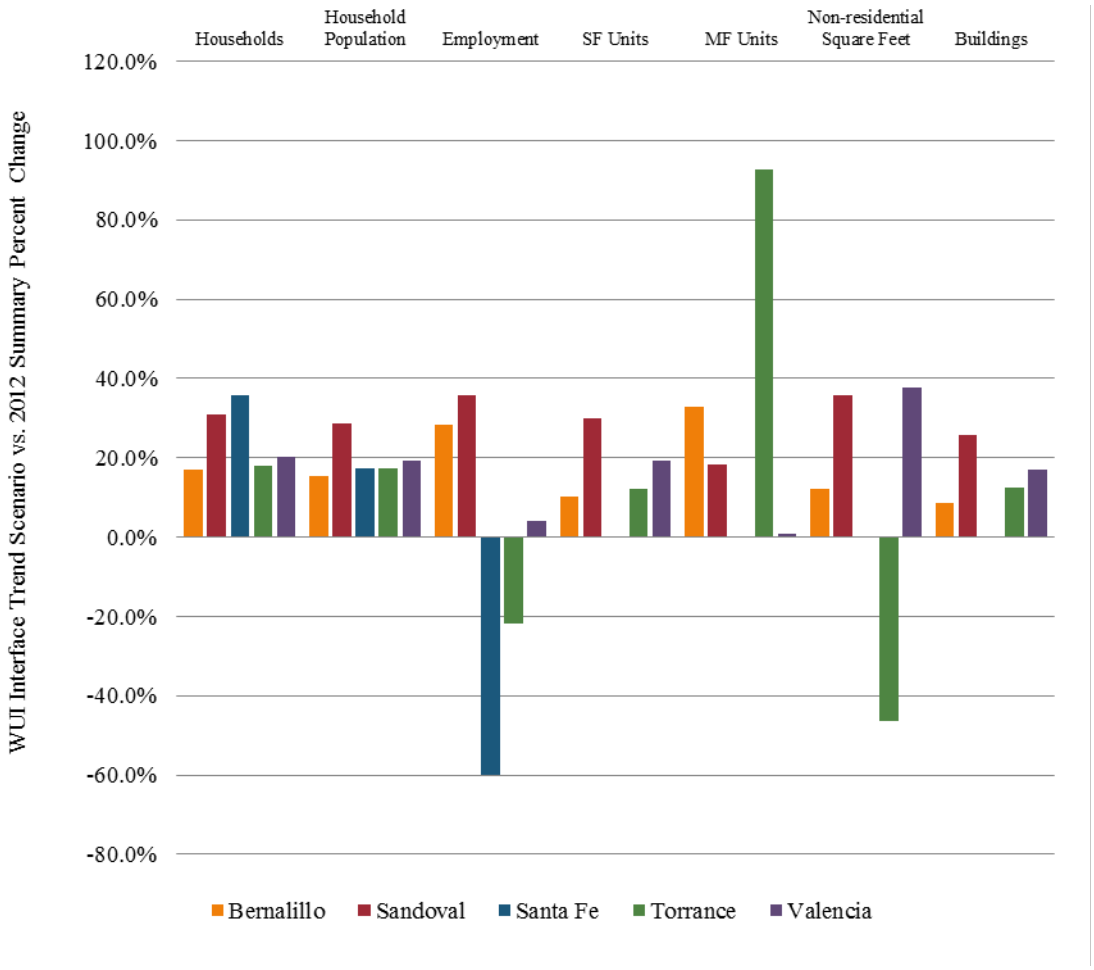
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	40.3%	39.4%	37.4%	33.9%	72.0%	34.6%	25.6%
Sandoval	53.7%	51.1%	78.6%	50.7%	90.4%	86.5%	49.5%
Santa Fe	37.0%	36.9%	12.0%	29.0%	90.0%	-8.5%	26.3%
Torrance	11.2%	11.4%	-49.7%	11.6%	-75.0%	15.2%	9.7%
Valencia	38.8%	31.9%	30.1%	37.2%	0.0%	68.7%	32.8%
Total	43.3%	41.1%	60.1%	39.1%	71.2%	61.7%	35.0%



WUI Intermix Trend Scenario vs. 2012 Summary Percent Change Graph.

WUI Interface Trend Scenario vs. 2012 Summary Percent Change.

County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	17.0%	15.5%	28.5%	10.2%	32.7%	12.0%	8.5%
Sandoval	31.1%	28.7%	35.7%	30.0%	18.4%	35.8%	25.8%
Santa Fe	35.7%	17.2%	-60.0%	0.0%	0.0%	0.0%	0.0%
Torrance	17.8%	17.3%	-21.9%	12.0%	92.7%	-46.5%	12.4%
Valencia	20.3%	19.3%	4.0%	19.1%	0.9%	37.8%	16.9%
Total	20.5%	18.8%	27.0%	16.4%	31.4%	17.7%	13.9%



WUI Interface Trend Scenario vs. 2012 Summary Percent Change Graph.

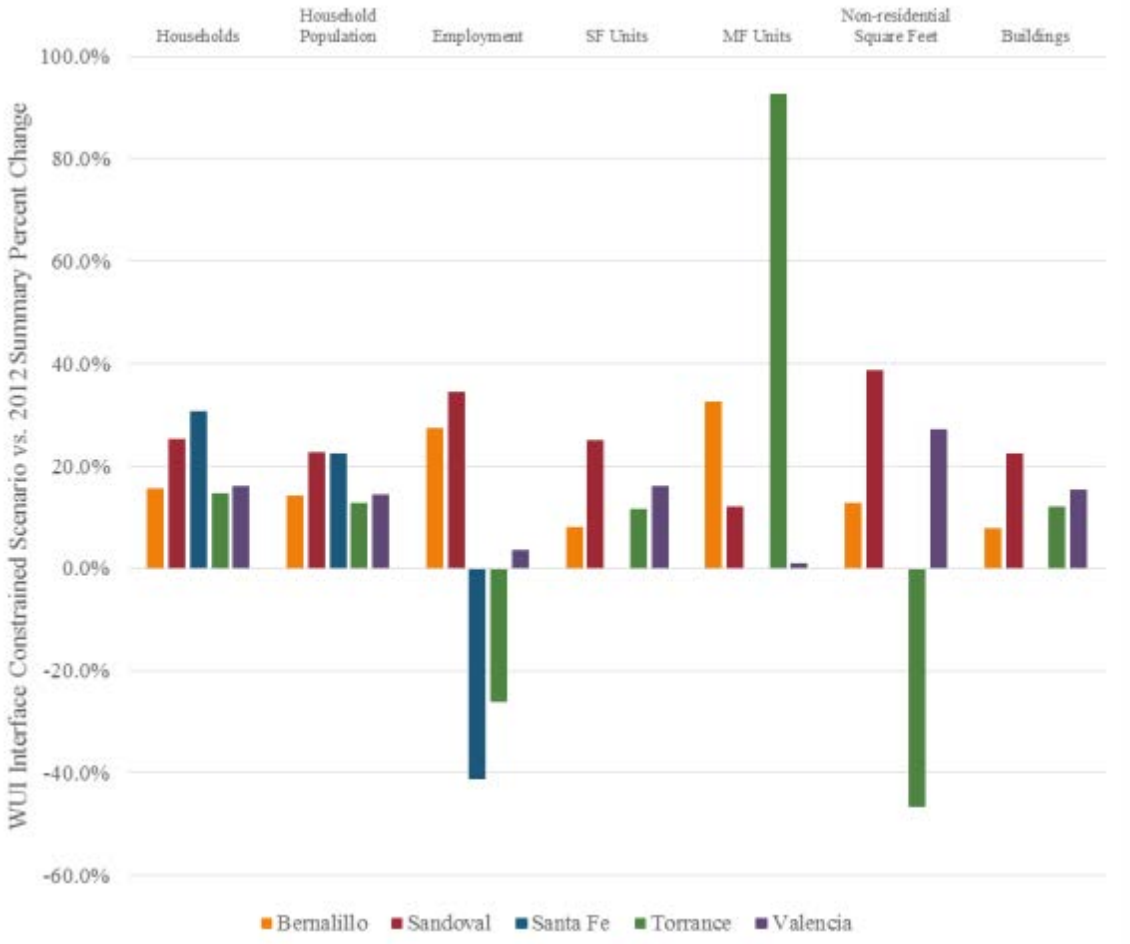
WUI Intermix Constrained Scenario vs. 2012 Summary Percent Change.

County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	35.9%	34.9%	44.1%	30.1%	71.8%	36.7%	24.7%
Sandoval	49.4%	46.9%	69.9%	46.5%	90.4%	79.8%	45.4%
Santa Fe	32.5%	32.3%	14.0%	23.9%	90.0%	2.8%	22.8%
Torrance	6.9%	7.0%	-49.5%	11.4%	-75.0%	14.0%	9.6%
Valencia	36.7%	30.4%	39.2%	35.6%	0.0%	75.8%	31.6%
Total	39.2%	37.0%	53.7%	35.4%	71.1%	55.3%	32.3%

WUI Intermix Constrained Scenario vs. 2012 Summary Percent Change Graph.

WUI Interface Constrained Scenario vs. 2012 Summary Percent Change.

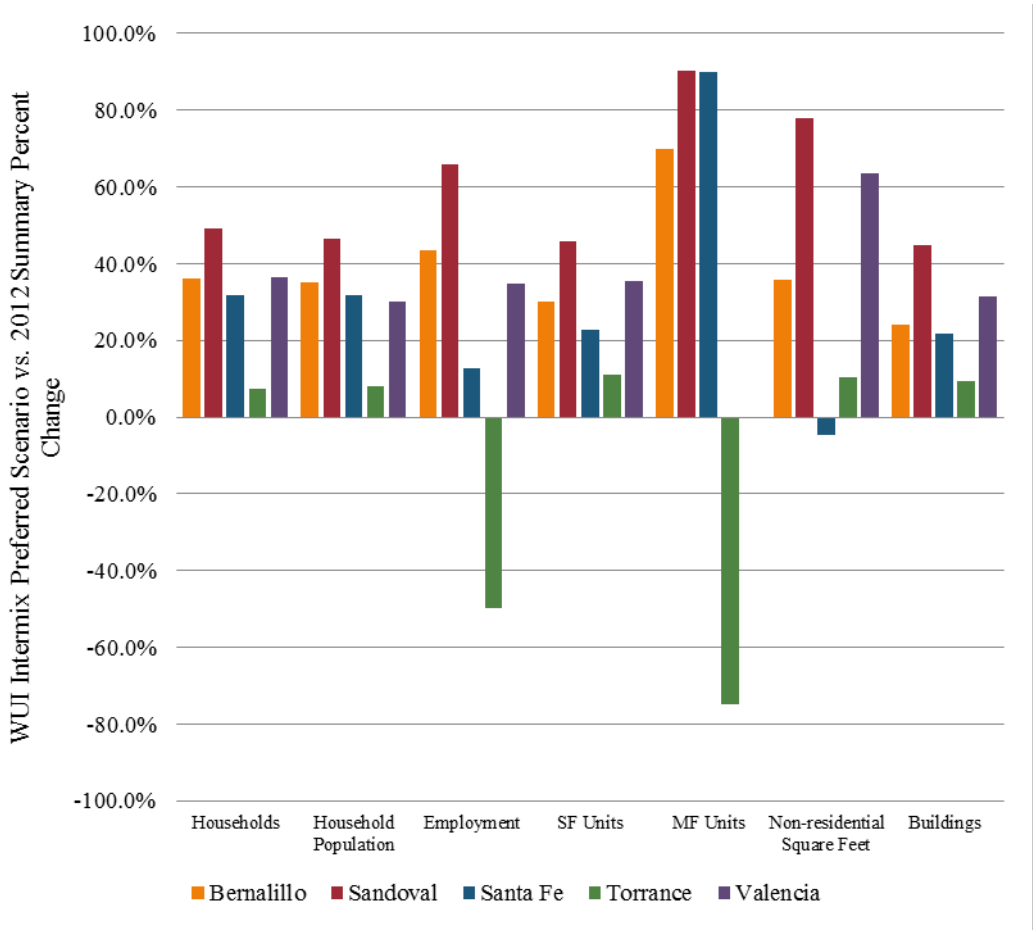
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	15.7%	14.2%	27.4%	8.1%	32.5%	12.8%	7.8%
Sandoval	25.3%	22.7%	34.6%	25.1%	12.2%	38.8%	22.5%
Santa Fe	30.8%	22.6%	-41.2%	0.0%	0.0%	0.0%	0.0%
Torrance	14.7%	12.9%	-26.2%	11.6%	92.7%	-46.5%	12.1%
Valencia	16.1%	14.4%	3.6%	16.2%	0.9%	27.3%	15.4%
Total	17.8%	16.0%	26.0%	13.4%	30.9%	17.8%	12.4%



WUI Interface Constrained Scenario vs. 2012 Summary Percent Change Graph.

WUI Intermix Preferred Scenario vs. 2012 Summary Percent Change.

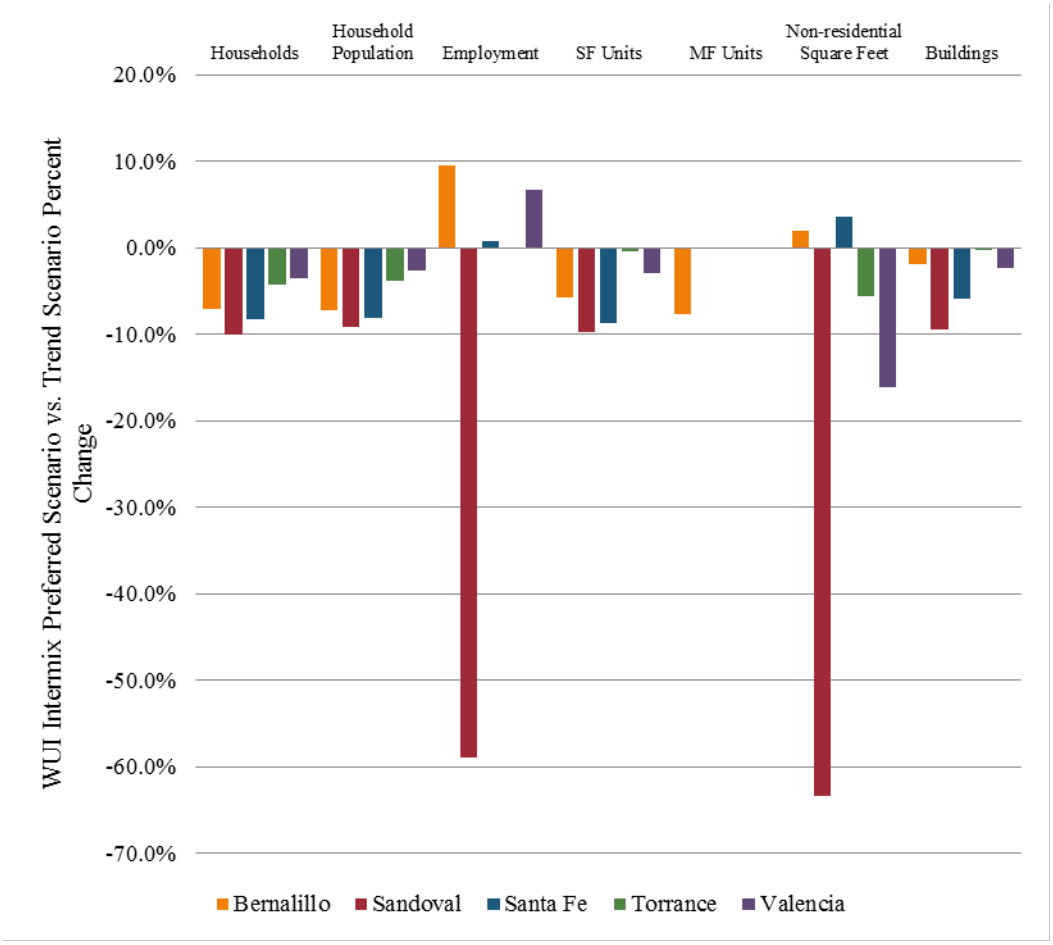
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	36.0%	35.1%	43.3%	30.1%	69.8%	35.8%	24.2%
Sandoval	49.1%	46.6%	66.0%	45.8%	90.4%	77.9%	44.7%
Santa Fe	31.8%	31.8%	12.7%	22.8%	90.0%	-4.6%	21.9%
Torrance	7.4%	8.0%	-49.7%	11.2%	-75.0%	10.5%	9.4%
Valencia	36.6%	30.1%	34.8%	35.4%	0.0%	63.7%	31.3%
Total	39.1%	36.9%	50.3%	35.1%	69.8%	52.0%	31.8%



WUI Intermix Preferred Scenario vs. 2012 Summary Percent Change Graph.

WUI Intermix Preferred Scenario vs. Trend Scenario Percent Change.

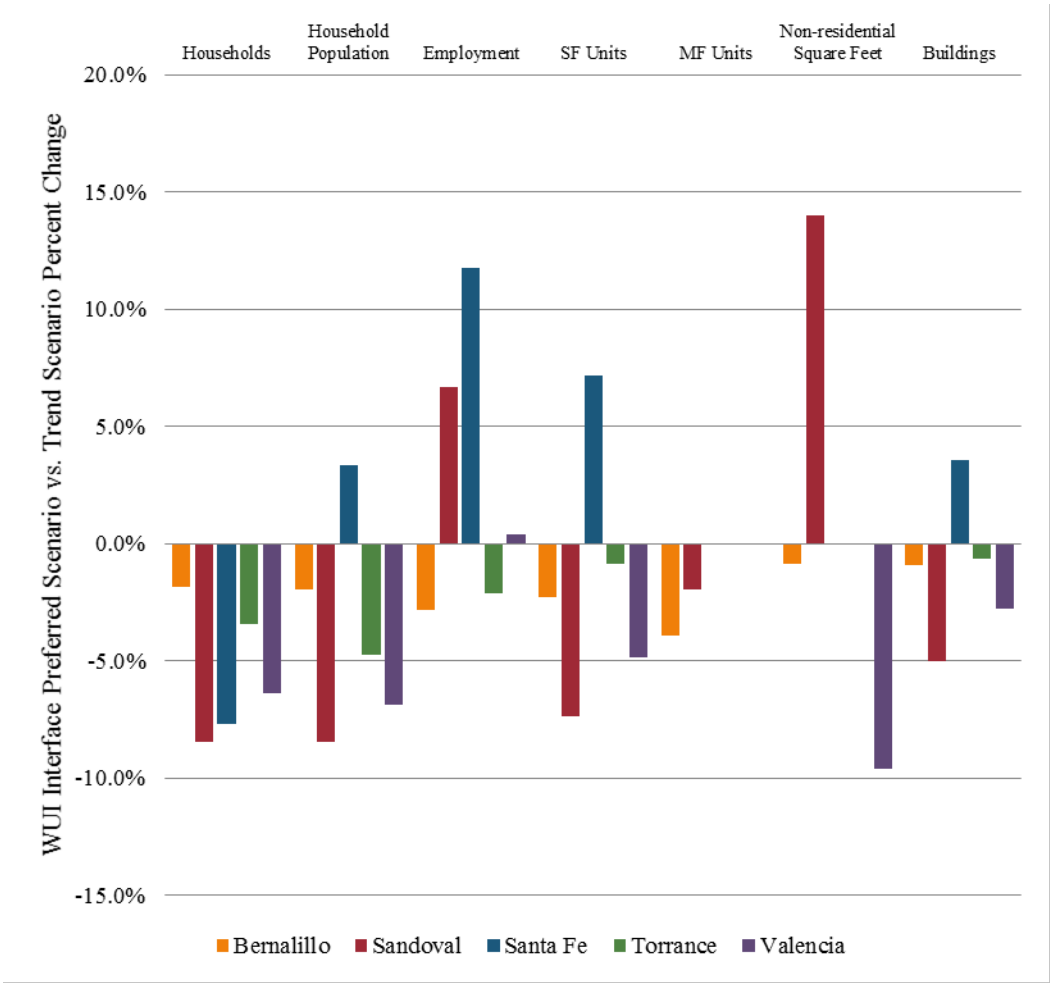
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	-7.1%	-7.2%	9.5%	-5.8%	-7.6%	1.9%	-1.9%
Sandoval	-10.1%	-9.1%	-58.9%	-9.8%	-0.1%	-63.4%	-9.4%
Santa Fe	-8.2%	-8.1%	0.8%	-8.7%	0.0%	3.6%	-5.9%
Torrance	-4.3%	-3.8%	0.0%	-0.4%	0.0%	-5.6%	-0.3%
Valencia	-3.6%	-2.6%	6.7%	-3.0%	0.0%	-16.1%	-2.3%
Total	-7.5%	-7.0%	-24.5%	-6.6%	-4.8%	-25.3%	-4.9%



WUI Intermix Preferred Scenario vs. Trend Scenario Percent Change Graph.

WUI Interface Preferred Scenario vs. Trend Scenario Percent Change.

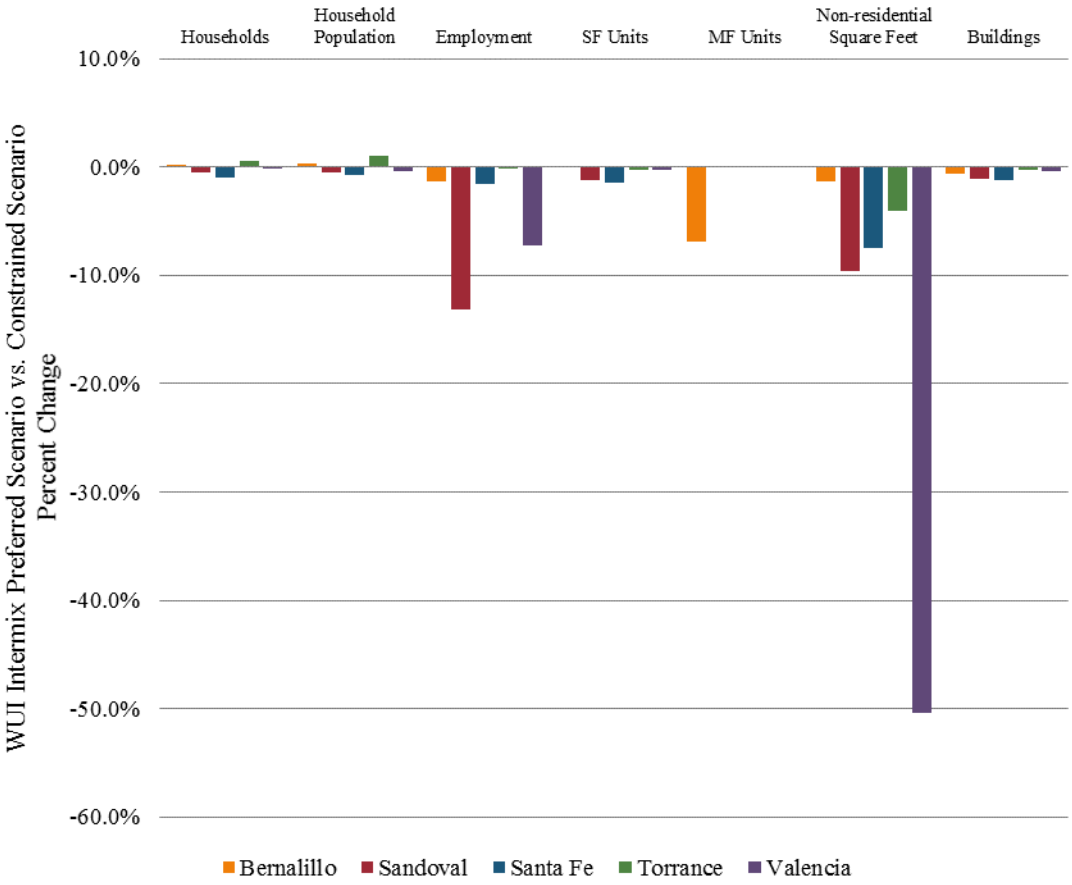
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	-1.8%	-1.9%	-2.8%	-2.3%	-3.9%	-0.8%	-0.9%
Sandoval	-8.5%	-8.5%	6.7%	-7.4%	-2.0%	14.0%	-5.0%
Santa Fe	-7.7%	3.3%	11.8%	7.1%	0.0%	0.0%	3.6%
Torrance	-3.4%	-4.8%	-2.1%	-0.9%	0.0%	0.0%	-0.7%
Valencia	-6.4%	-6.9%	0.4%	-4.8%	0.0%	-9.6%	-2.8%
Total	-3.7%	-3.9%	-0.4%	-3.9%	-3.7%	1.4%	-2.2%



WUI Interface Preferred Scenario vs. Trend Scenario Percent Change Graph.

WUI Intermix Preferred Scenario vs. Constrained Scenario Percent Change.

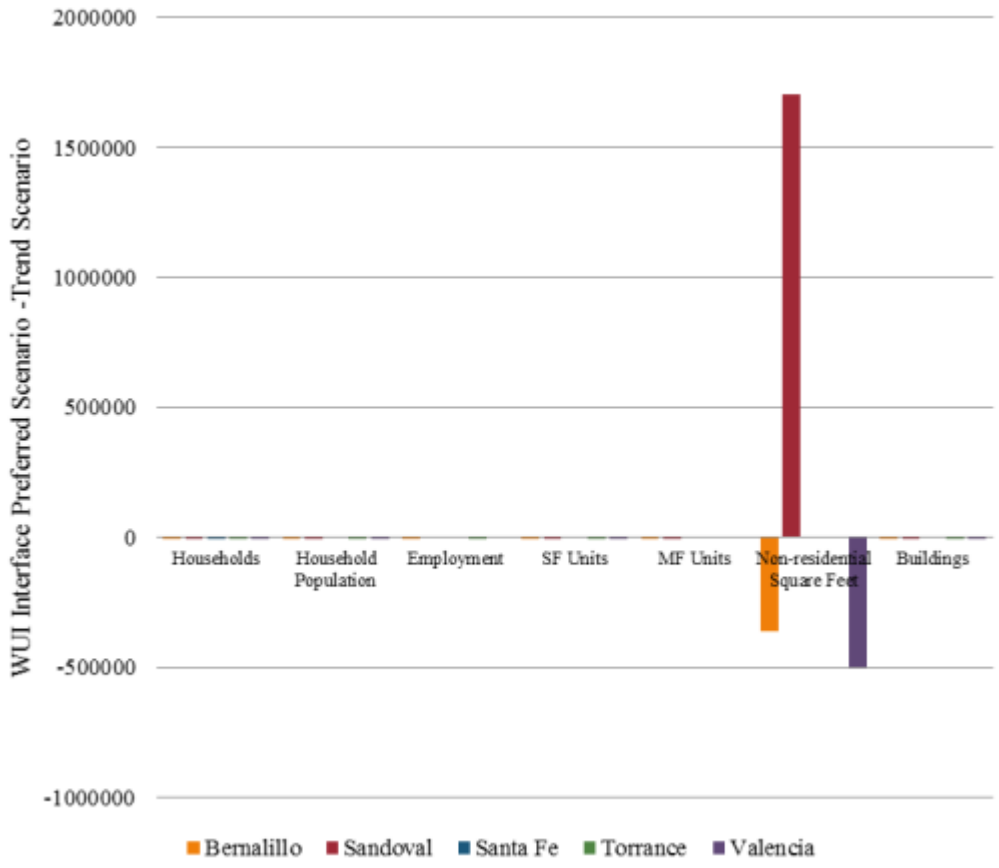
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	0.2%	0.3%	-1.4%	0.0%	-6.9%	-1.4%	-0.6%
Sandoval	-0.5%	-0.5%	-13.1%	-1.2%	0.0%	-9.6%	-1.1%
Santa Fe	-1.0%	-0.7%	-1.6%	-1.4%	0.0%	-7.5%	-1.2%
Torrance	0.6%	1.0%	-0.1%	-0.3%	0.0%	-4.1%	-0.3%
Valencia	-0.1%	-0.4%	-7.3%	-0.3%	0.0%	-50.4%	-0.4%
Total	-0.2%	-0.1%	-7.4%	-0.6%	-4.3%	-7.3%	-0.8%



WUI Intermix Preferred Scenario vs. Constrained Scenario Percent Change Graph.

WUI Intermix Preferred Scenario – Trend Scenario.

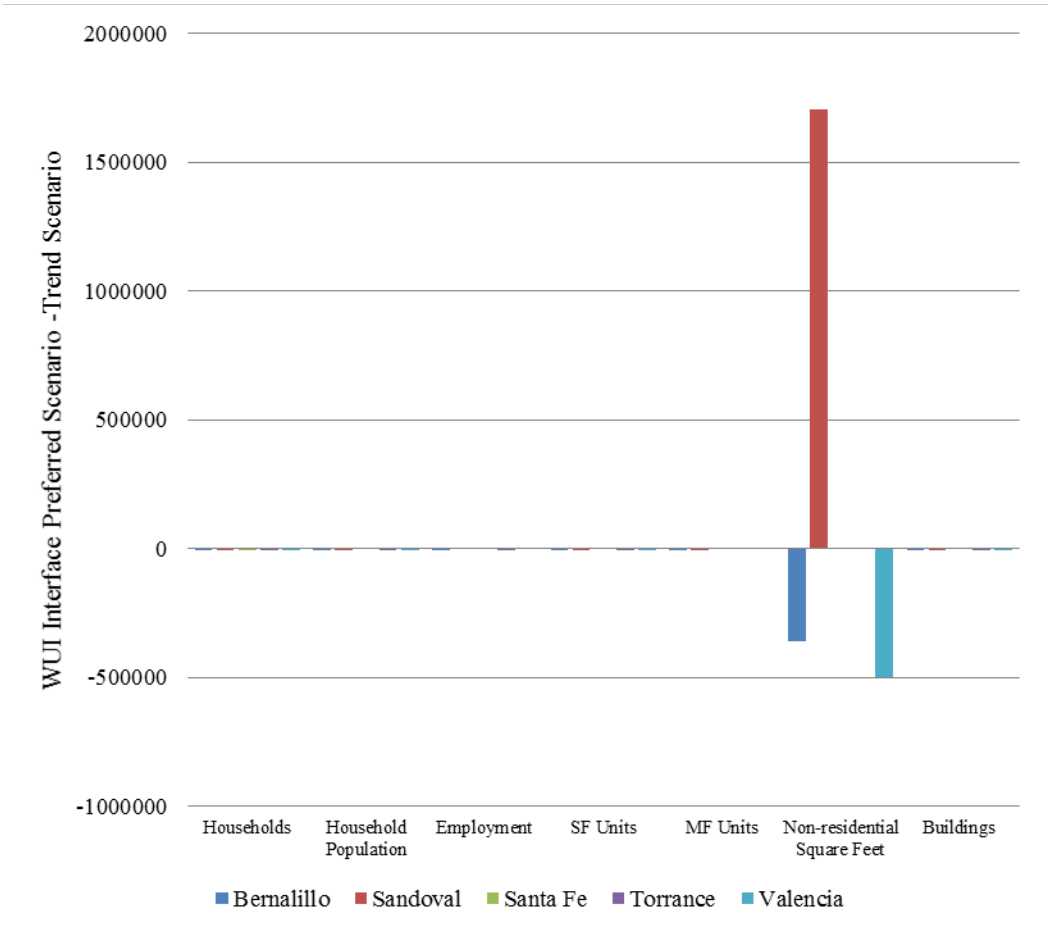
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	-2130	-5452	1105	-1631	-271	262207	-505
Sandoval	-2693	-6357	-8379	-2713	-1	-7114747	-2628
Santa Fe	-387	-983	6	-394	0	19336	-271
Torrance	-153	-338	0	-20	0	-70098	-16
Valencia	-424	-828	120	-363	0	-225883	-272
Total	-5787	-13958	-7148	-5121	-272	-7129185	-3692



WUI Intermix Preferred Scenario – Trend Scenario Graph.

WUI Interface Preferred Scenario – Trend Scenario.

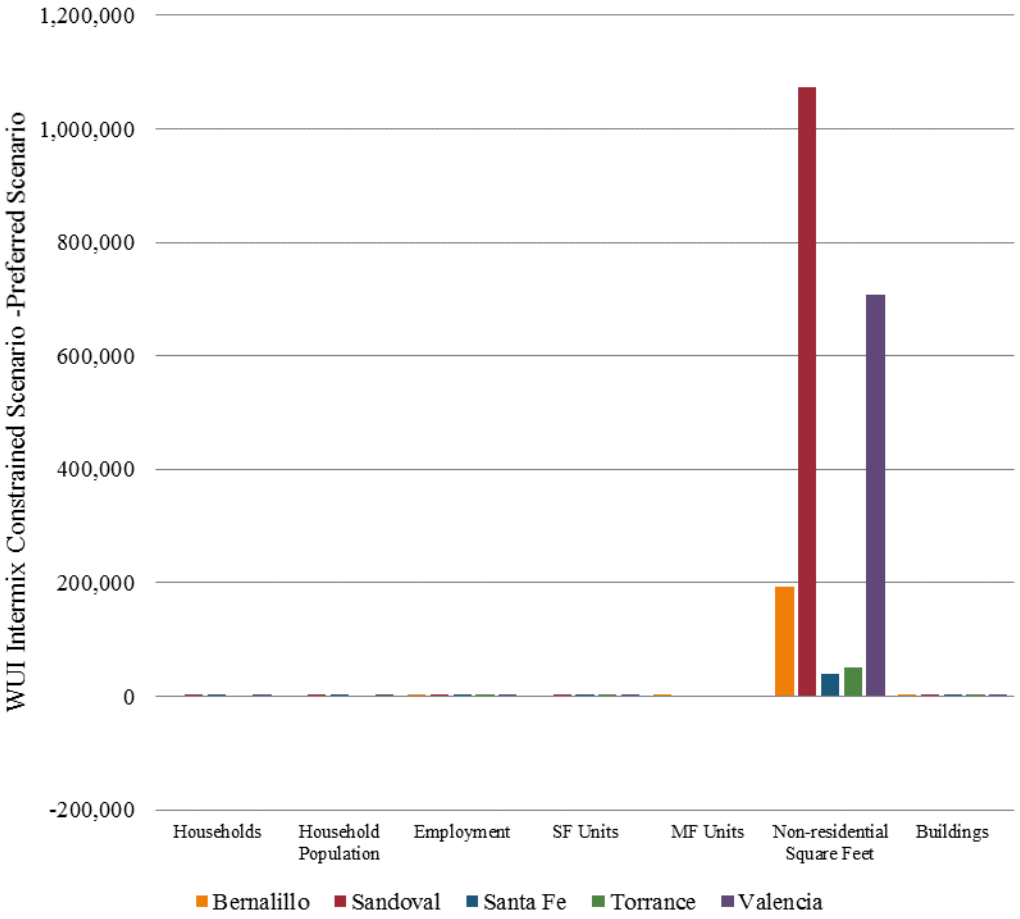
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	-2070	-5561	-1444	-1999	-1195	-360831	-844
Sandoval	-2956	-7700	1123	-2591	-41	1703366	-1773
Santa Fe	-1	1	2	1	0	0	1
Torrance	-39	-129	-19	-12	0	0	-11
Valencia	-1038	-2837	30	-823	0	-499254	-513
Total	-6104	-16226	-308	-5424	-1236	843281	-3140



WUI Interface Preferred Scenario – Trend Scenario Graph.

WUI Intermix Constrained Scenario – Preferred Scenario.

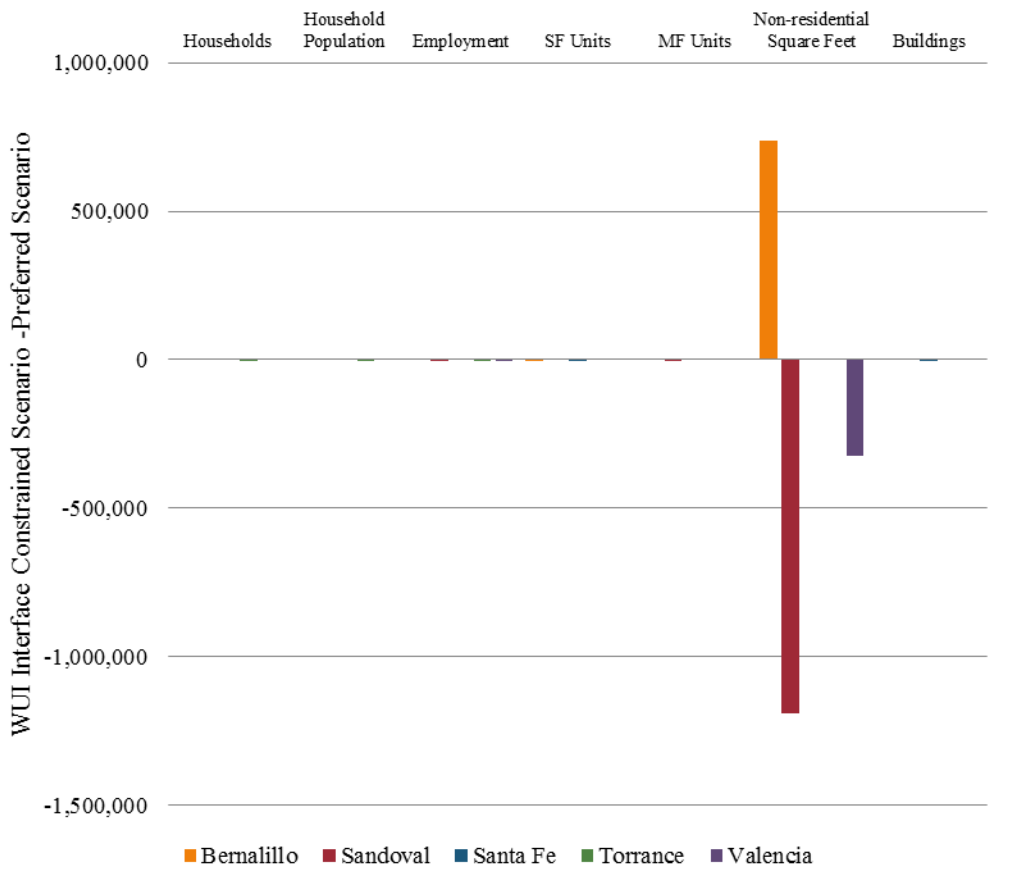
County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	-46	-226	157	-2	243	192,474	161
Sandoval	147	370	1,869	324	0	1,073,490	312
Santa Fe	47	86	12	65	0	40,220	53
Torrance	-22	-89	1	13	0	51,158	14
Valencia	16	113	131	33	0	707,267	46
Total	142	254	2,170	433	243	2,064,609	586



WUI Intermix Constrained Scenario – Preferred Scenario Graph.

WUI Interface Constrained Scenario – Preferred Scenario.

County	Households	Household Population	Employment	SF Units	MF Units	Non-residential Square Feet	Buildings
Bernalillo	356	1,166	697	-61	1,110	739,164	123
Sandoval	11	6	-1,389	153	-110	-1,190,197	173
Santa Fe	0	1	0	-1	0	0	-1
Torrance	-4	-15	-12	6	0	0	6
Valencia	169	359	-60	197	0	-324,574	193
Total	532	1,517	-764	294	1,000	-775,607	494

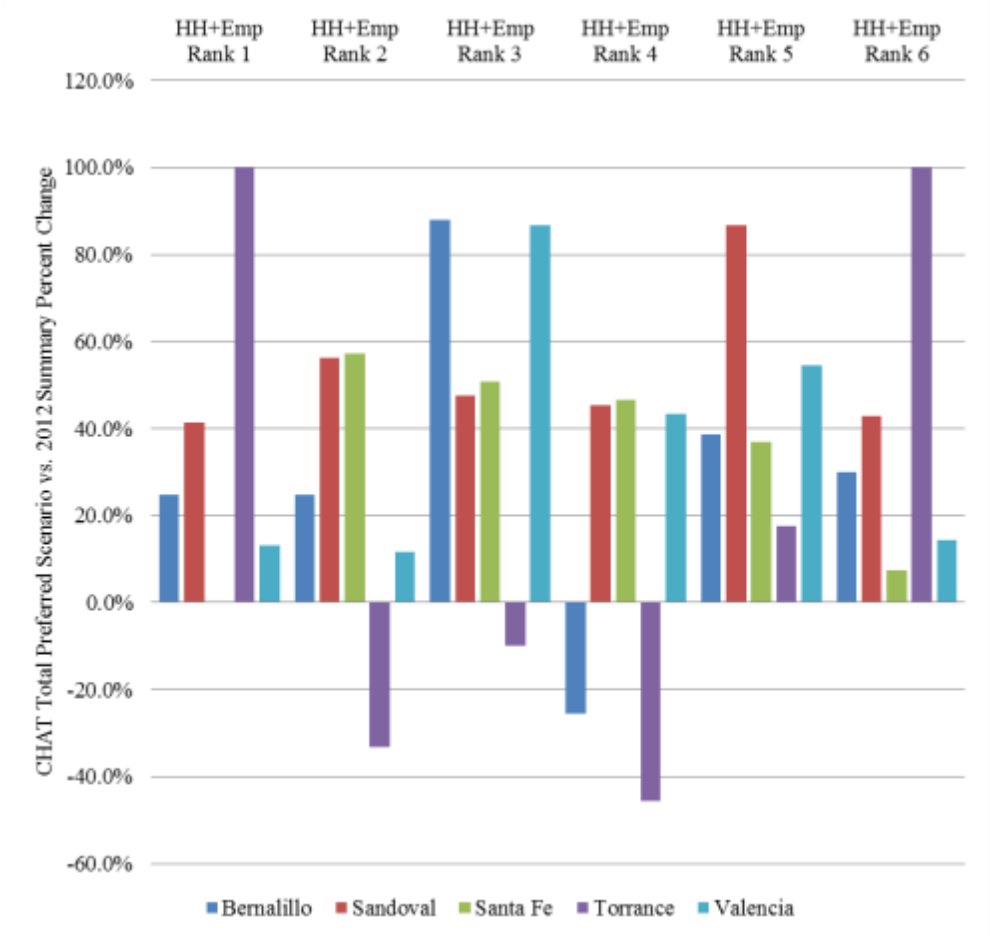


WUI Interface Constrained Scenario – Preferred Scenario Graph.

APPENDIX D. TABLES AND GRAPHS FOR CRUCIAL HABITAT

CHAT Total Preferred Scenario vs. 2012 Summary Percent Change.

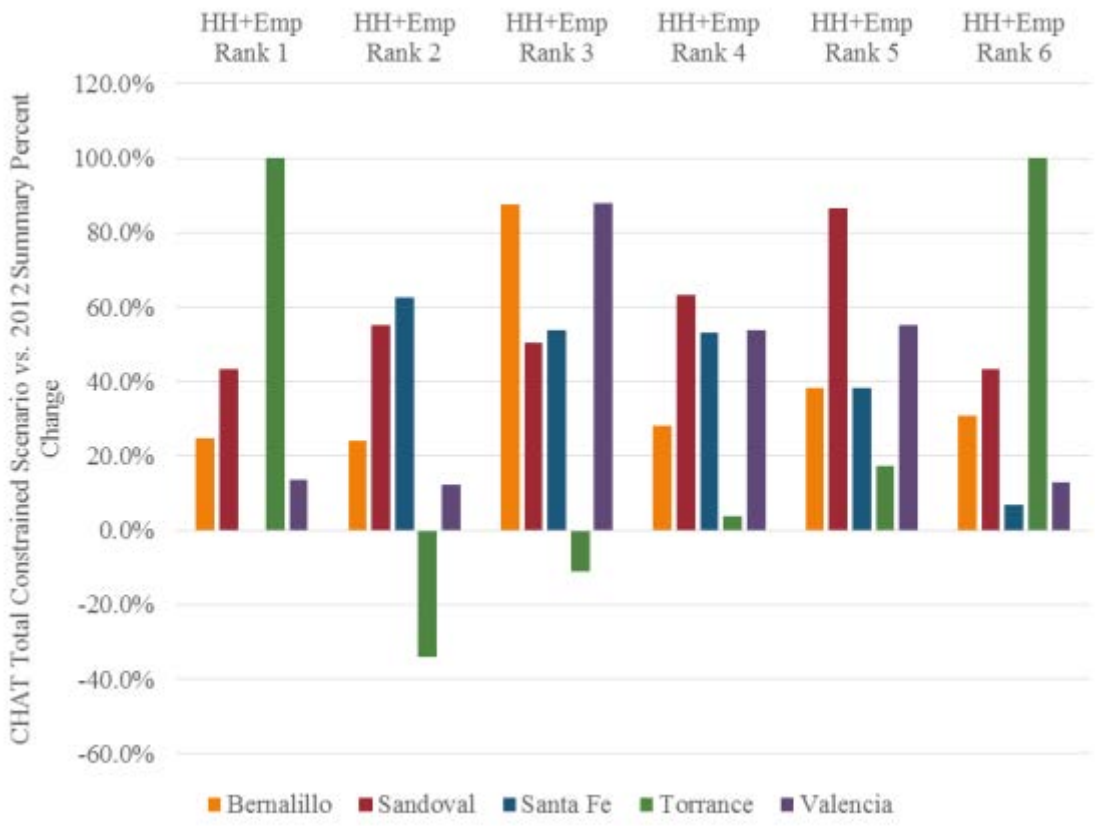
County	HH+Emp Rank 1	HH+Emp Rank 2	HH+Emp Rank 3	HH+Emp Rank 4	HH+Emp Rank 5	HH+Emp Rank 6
Bernalillo	24.4%	24.2%	84.9%	32.0%	34.0%	30.2%
Sandoval	40.1%	54.4%	47.0%	70.4%	88.8%	44.2%
Santa Fe	0.0%	68.4%	52.1%	57.1%	41.6%	8.1%
Torrance	0.0%	-34.5%	-15.3%	9.6%	20.2%	0.0%
Valencia	17.5%	14.4%	685.8%	59.2%	57.0%	16.5%
Total	26.9%	24.9%	59.6%	45.5%	41.4%	31.5%



CHAT Total Preferred Scenario vs. 2012 Summary Percent Change Graph.

CHAT Total Constrained Scenario vs. 2012 Summary Percent Change.

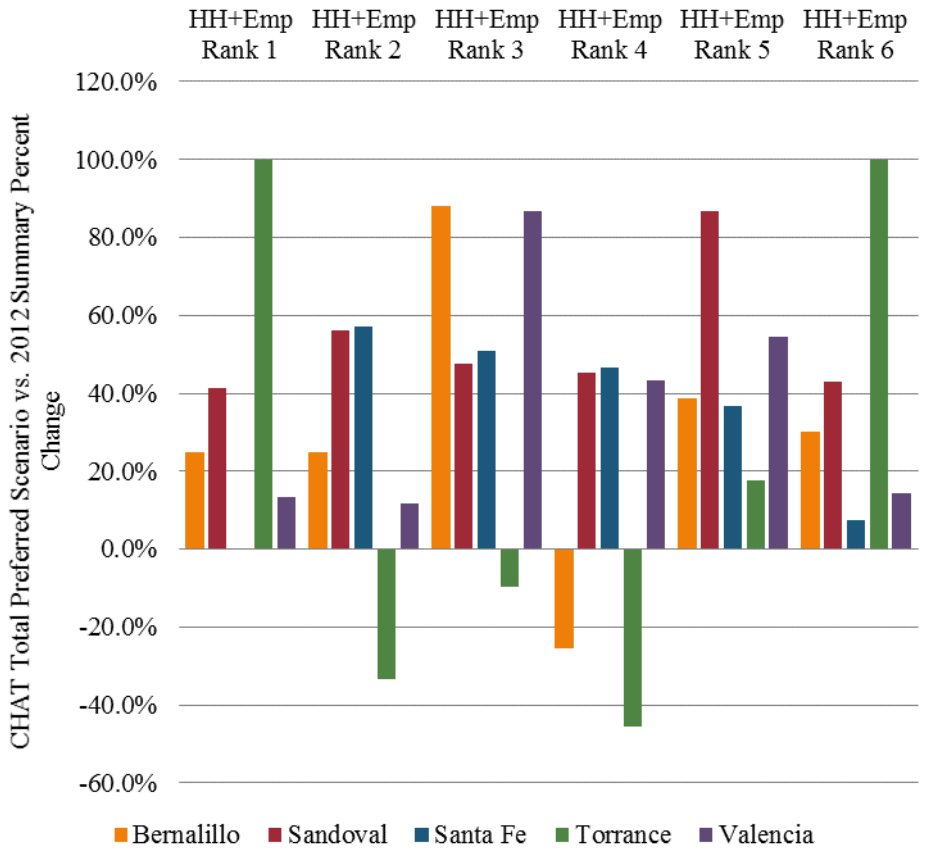
County	HH+Emp Rank 1	HH+Emp Rank 2	HH+Emp Rank 3	HH+Emp Rank 4	HH+Emp Rank 5	HH+Emp Rank 6
Bernalillo	24.6%	24.1%	87.6%	28.2%	38.4%	30.7%
Sandoval	43.4%	55.1%	50.3%	63.3%	86.5%	43.4%
Santa Fe	0.0%	62.5%	53.8%	53.3%	38.1%	6.8%
Torrance	100.0%	-34.0%	-11.0%	3.7%	17.4%	100.0%
Valencia	13.7%	12.1%	87.9%	53.7%	55.2%	12.8%
Total	27.9%	24.9%	63.7%	39.4%	42.3%	31.8%



CHAT Total Constrained Scenario vs. 2012 Summary Percent Change Graph.

CHAT Total Preferred Scenario vs. 2012 Summary Percent Change.

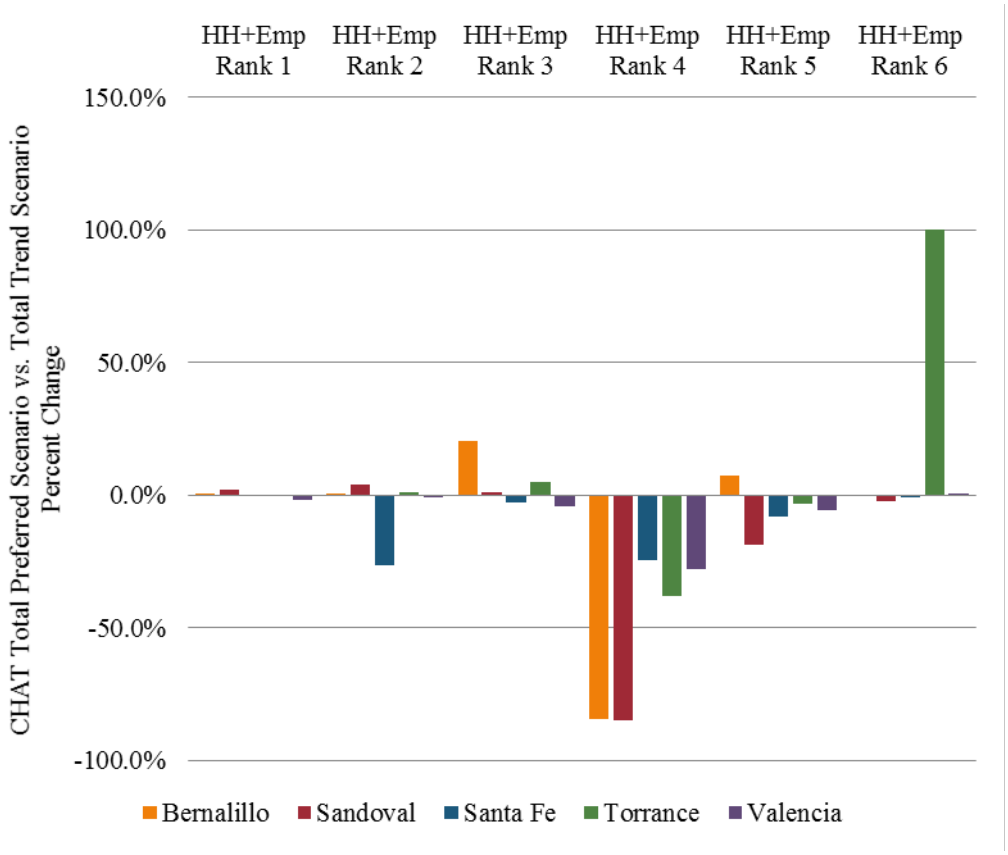
County	HH+Emp Rank 1	HH+Emp Rank 2	HH+Emp Rank 3	HH+Emp Rank 4	HH+Emp Rank 5	HH+Emp Rank 6
Bernalillo	24.8%	24.9%	87.9%	-25.6%	38.8%	30.0%
Sandoval	41.3%	56.2%	47.7%	45.3%	86.7%	42.9%
Santa Fe	0.0%	57.1%	50.8%	46.6%	36.8%	7.5%
Torrance	100.0%	-33.2%	-9.8%	-45.5%	17.7%	100.0%
Valencia	13.2%	11.7%	86.7%	43.2%	54.5%	14.3%
Total	27.2%	25.6%	62.8%	1.0%	42.3%	31.2%



CHAT Total Preferred Scenario vs. 2012 Summary Percent Change Graph.

CHAT Total Preferred Scenario vs. Total Trend Scenario Percent Change.

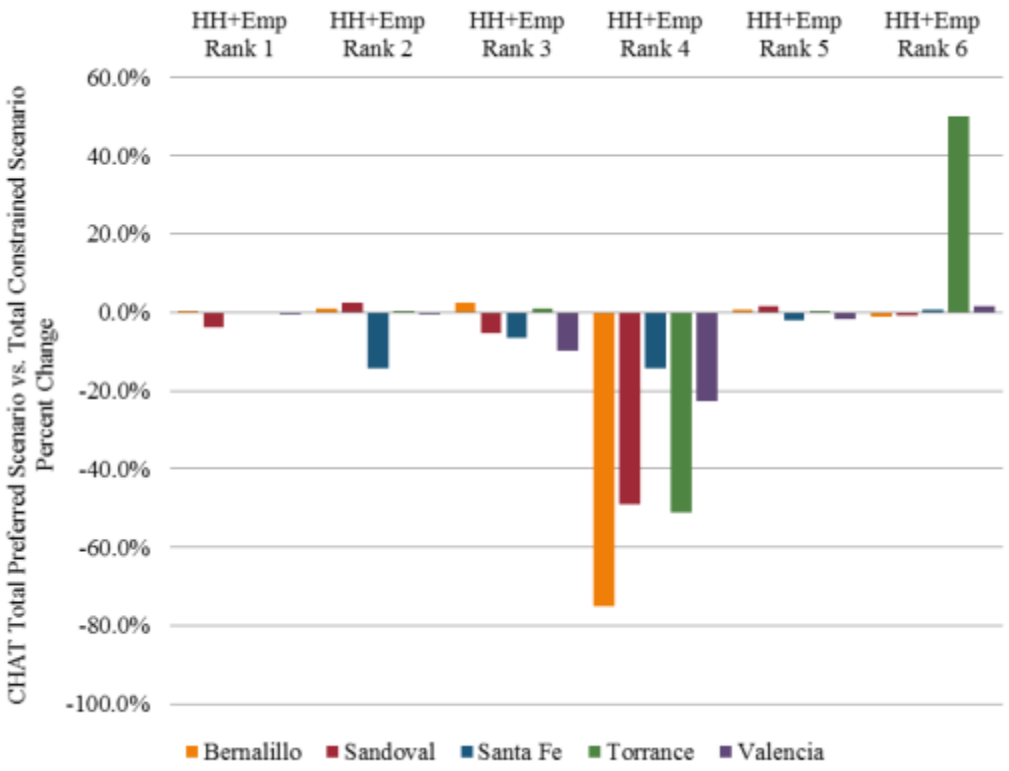
County	HH+Emp Rank 1	HH+Emp Rank 2	HH+Emp Rank 3	HH+Emp Rank 4	HH+Emp Rank 5	HH+Emp Rank 6
Bernalillo	0.5%	0.8%	20.3%	-84.6%	7.2%	-0.3%
Sandoval	2.0%	3.9%	1.3%	-85.1%	-18.7%	-2.3%
Santa Fe	0.0%	-26.3%	-2.7%	-24.6%	-8.2%	-0.7%
Torrance	0.0%	0.9%	5.0%	-37.9%	-3.0%	100.0%
Valencia	-1.9%	-1.0%	-4.1%	-28.0%	-5.7%	0.1%
Total	0.5%	0.9%	7.9%	-81.9%	1.4%	-0.5%



CHAT Total Preferred Scenario vs. Total Trend Scenario Percent Change Graph.

CHAT Total Preferred Scenario vs. Total Constrained Scenario Percent Change.

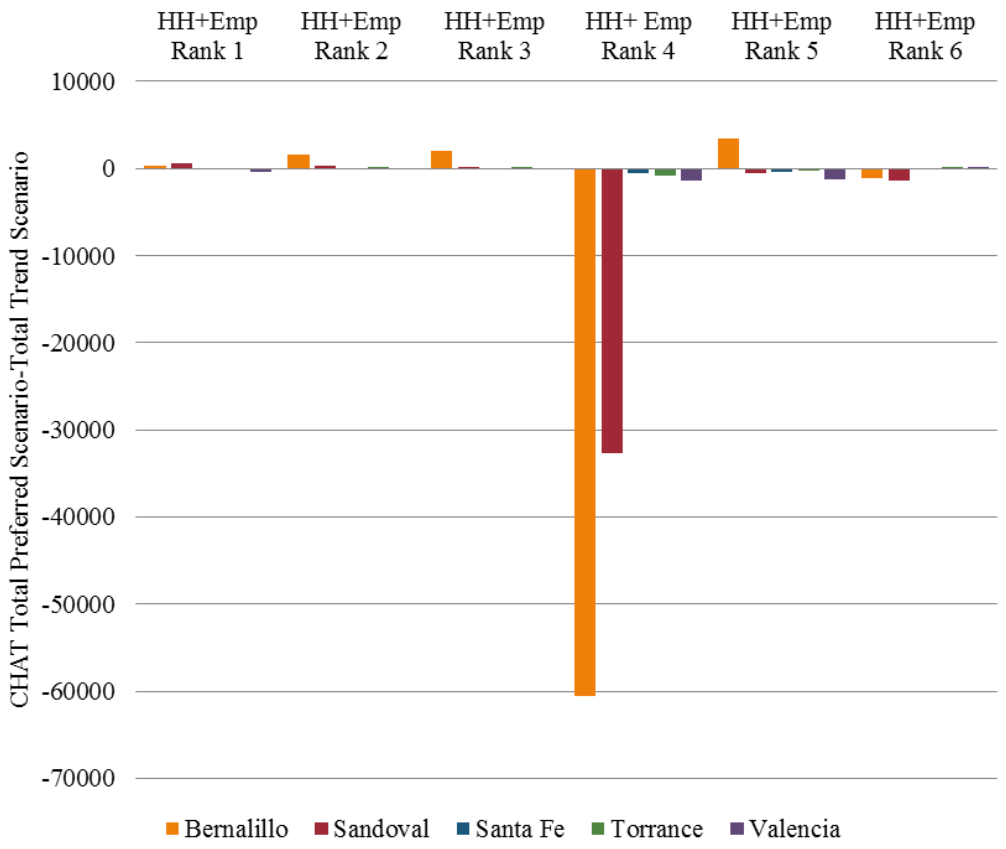
County	HH+Emp Rank 1	HH+Emp Rank 2	HH+Emp Rank 3	HH+Emp Rank 4	HH+Emp Rank 5	HH+Emp Rank 6
Bernalillo	0.3%	1.0%	2.6%	-75.0%	0.6%	-1.0%
Sandoval	-3.6%	2.4%	-5.4%	-48.9%	1.5%	-0.8%
Santa Fe	0.0%	-14.3%	-6.4%	-14.3%	-2.1%	0.7%
Torrance	0.0%	0.6%	1.1%	-51.1%	0.4%	50.0%
Valencia	-0.5%	-0.5%	-9.7%	-22.5%	-1.8%	1.6%
Total	-0.9%	1.0%	-2.4%	-63.3%	-0.1%	-0.9%



CHAT Total Preferred Scenario vs. Total Constrained Scenario Percent Change Graph.

CHAT Total Preferred Scenario – Total Trend Scenario.

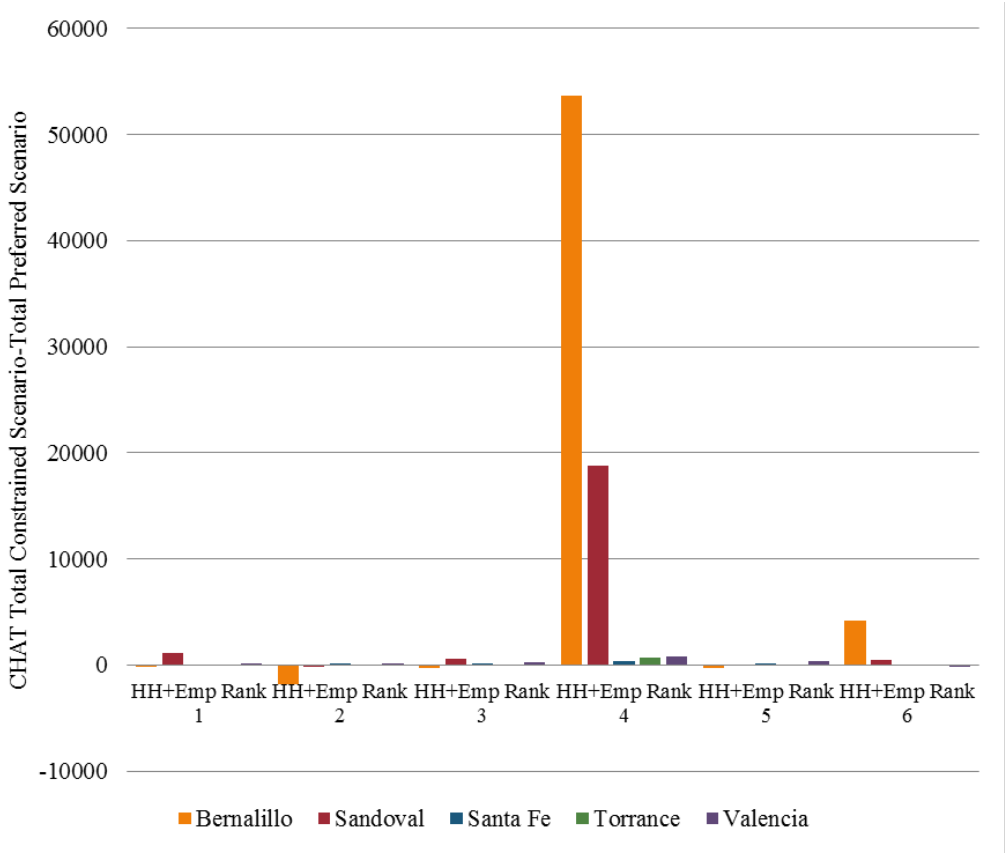
County	HH+Emp Rank 1	HH+Emp Rank 2	HH+Emp Rank 3	HH+Emp Rank 4	HH+Emp Rank 5	HH+Emp Rank 6
Bernalillo	316	1623	1966	-60502	3434	-1078
Sandoval	631	342	138	-32705	-466	-1364
Santa Fe	0	-5	-36	-550	-402	-2
Torrance	0	10	78	-841	-197	2
Valencia	-400	-44	-99	-1442	-1190	14
Total	547	1926	2047	-96040	1179	-2428



CHAT Total Preferred Scenario – Total Trend Scenario Graph.

CHAT Total Constrained Scenario – Total Preferred Scenario.

County	HH+Emp Rank 1	HH+Emp Rank 2	HH+Emp Rank 3	HH+Emp Rank 4	HH+Emp Rank 5	HH+Emp Rank 6
Bernalillo	-177	-1856	-249	53638	-305	4163
Sandoval	1164	-206	588	18814	-38	471
Santa Fe	0	2	87	320	103	-2
Torrance	0	-6	-18	705	-25	-1
Valencia	111	19	227	833	348	-197
Total	1098	-2047	635	74310	83	4434



CHAT Total Constrained Scenario – Total Preferred Scenario Graph.