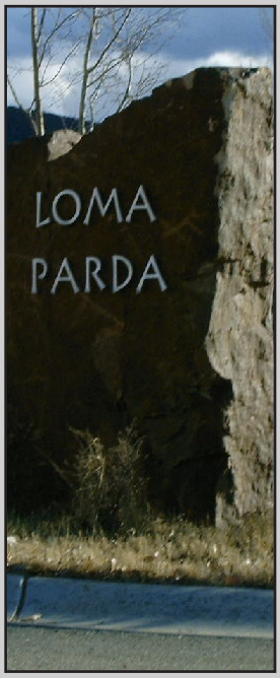
Prepared for:

Chamisa Verde Traffic Study



Final Report - December 2008

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Chamisa Verde Traffic Study
Draft Report – November 13, 2008

Introduction

This report documents the traffic impact analysis undertaken for the Chamisa Verde Neighborhood Plan, a new kind of "traditional neighborhood development" in Taos. The traffic analysis was conducted to consider all travel modes and to explore the relationship between traditional neighborhood development, personal mobility, and travel patterns.

Background

To assist with implementation of the purposes and objectives of the Vision 2020 Master Plan, the Town of Taos has calibrated and adopted the SmartCode Version 9.0 to meet its needs.

In the Vision 2020 process, the Taos community established a series of goals – including protecting landscape and resources, preserving architectural character, and providing walkable and bikable scale and access – which were not well supported by the Town's existing zoning ordinance. The SmartCode offers an option to the Town Code that adds a new zoning classification of Traditional Neighborhood Development (TND) District. This new TND district will allow land that has an adopted Traditional Neighborhood Plan to be rezoned to the mixed-use Transect zones of the SmartCode.

The Chamisa Verde Neighborhood Plan, a proposed mixed use and affordable housing subdivision located behind the Youth and Family Center on Paseo del Cañon (NM 585), represents the first such plan adopted by the Town Council. The plan was prepared by PlaceMakers LLC in June 2008 as a pilot project for implementing the SmartCode as infill development.

Review of the Chamisa Verde Infill TND application under SmartCode requires the same traffic impact assessment (TIA) process as for more conventional projects. The TIA process, which quantifies a project's traffic impacts and mitigation opportunities, is mandated by the New Mexico Department of Transportation for all new major development projects.

Driving – especially driving alone – has become the primary and necessary means of travel, even for short distances due to lack of viable travel choices and development patterns that support a full range of travel options. The conventional TIA process has focused almost exclusively on ensuring that proposed developments do not overload the community's roadway network and without consideration of walking, bicycling, or transit use. Under this conventional process, the solution is usually larger roadways and bigger intersections to accommodate a projected increase in cars. This process is often referred to as "project-and-provide," for allowing development projections to shape continual roadway widenings rather than considering desired travel choice investments first and how development can support those choices.
Given Chamisa Verde's status as a TND/SmartCode pilot project, the Town of Taos is interested in a more sophisticated TIA process that recognizes the benefits of a TND project on traffic flow, vehicle congestion, and non-vehicle trips.

This report summarizes findings of the Chamisa Verde TIA, with emphasis on how traffic assessments differ under SmartCode as compared to conventional subdivision design. The TIA and this report were prepared by Charlier Associates, Inc. and Terry Brown, P.E., the Town's transportation planning and engineering consultants for this project.

Understanding the Site Context

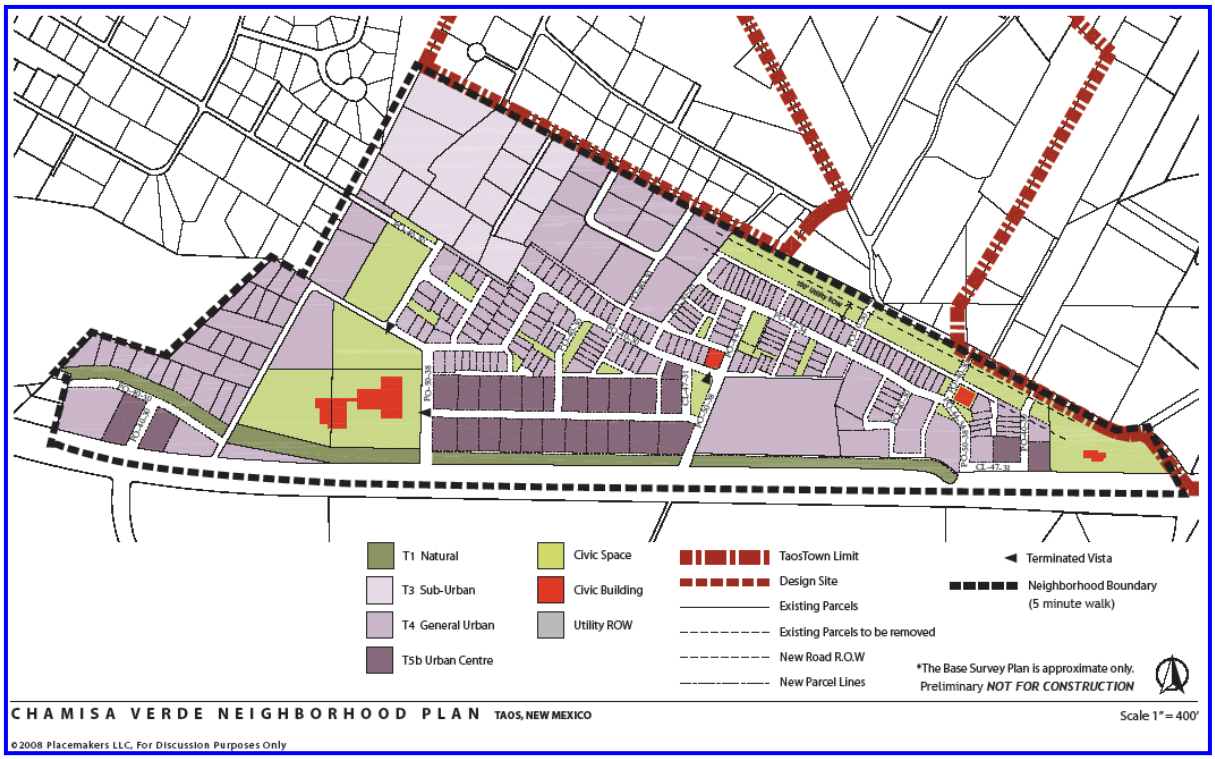
The external roadway network serving the Chamisa Verde Neighborhood consists primarily of NM 585/Plaza del Cañon East, which connects NM 68/Paseo del Pueblo Sur and US 64. Two secondary roadways – Cruz Alta Road and Gusdorf Road – provide the only through connections to the major transportation arteries.

NMDOT is currently widening NM 585 into a four lane divided highway with turning lanes, and multi-lane roundabouts at three intersections adjacent to Chamisa Verde. Two of these (Lower Weimer Road and Camino de Colores) are located along the boundary of Chamisa Verde, but only the Camino de Colores roundabout will provide access north into the neighborhood. The Lower Weimer Road roundabout is being designed to provide future access north into the project, consistent with the Chamisa Verde concept plan. Additional features of the NMDOT project include bike lanes, pedestrian crossing flashers and street lighting, and other safety improvements. Future project phases will upgrade the highway to a two lane urban cross-section. This study therefore examines the impact of the proposed Chamisa Verde Neighborhood on the ongoing NMDOT project.

The neighborhood boundary is based on the concept of a pedestrian shed; land uses are per the SmartCode's Transect zones. The Neighborhood Plan includes an area within a five-minute walk from a proposed Urban Centre (T5), which is located off of Camino de la Cruz. Most of the neighborhood is proposed to be developed as General Urban (T4), with limited Sub-Urban (T3) and Civic/Natural (T1) uses at its edges. Part of this area is comprised of existing parcels, interwoven with a new SmartCode-based layout of lots and streets.

The Chamisa Verde Neighborhood is bordered along its northeastern edge by properties located outside of Town Limits and/or identified as Rural (T1) on the SmartCode Regulating Plan. Sub-Urban (T3) and Civic Space Transects are located to the west of the site. NM 585 forms the southern neighborhood edge, with the potential for another large neighborhood to the immediate south. This neighborhood has been previously proposed as General Urban (T4) with an Urban Centre (T5) located within easy walking distance (less than ¼ mile) of the Chamisa Verde center.

Both urban zones proposed in the Taos Regulating Plan will have substantial pedestrian presence. The T4 Zones will be a mix of houses, compounds, townhouses and duplexes, with scattered commercial activity. The T5 Zone will consist of a concentration of shops mixed with courtyard houses, townhomes, apartments, offices, workplaces and civic buildings.



Purpose and Intent

In considering the potential traffic impacts of the proposed Chamisa Verde project, it is important to revisit the purpose of implementing the SmartCode at the community/neighborhood level. Per Taos SmartCode 9.0, the intent is implementation of the following policies:

a. TNDs shall be compact, pedestrian-oriented and mixed use.
b. TNDs should be the preferred pattern of development and that districts specializing in a single use should be the exception.
c. Ordinary activities of daily living should occur within walking distance of most dwellings, allowing independence to those who do not drive.
d. Interconnected networks of thoroughfares should be designed to disperse and reduce the length of automobile trips.
e. Within neighborhoods, a range of housing types and price levels should be provided to accommodate diverse ages and incomes.
f. Appropriate building densities and land uses should be provided within walking distance of transit stops.
g. Civic, institutional, and commercial activity should be embedded in town centers, not isolated in remote single-use complexes.
h. Schools should be sized and located to enable children to walk or bicycle to them.
i. A range of open space including parks, plazas and playgrounds should be distributed within neighborhoods and town centers.

With these desired outcomes, it becomes critical that a traffic analysis must not be conducted to "project-and-provide" for the needs of automobile traffic, but to reflect the multiple objectives of TND development addressing travel choice options and personal mobility.

Planning Process & Assumptions
It is important to understand the process undertaken and assumptions made in this traffic study for Chamisa Verde. Regarding the planning process, the budget and schedule were very limited, with a project timeline of only two weeks for technical analysis and initial documentation. This meant focusing on a critical path of priority tasks and relying primarily on already available data to conduct the analysis.

Regarding Chamisa Verde, it should be emphasized that TND/SmartCode projects are inherently based on Transects, which allow for multiple and mixed uses and that Chamisa Verde itself is a concept plan, not a defined development program. Since the TIA process relies on estimating trip generation by specific land use category (such as single family residential or fast food restaurant), certain assumptions were made by staff and the consultant regarding how the project would develop over time, particularly the amount, mix, intensity, and character of individual land uses. These land use development assumptions are documented in the Appendix.

Traffic Impact Analysis Process
A conventional traffic impact analysis (TIA) assesses a particular development's vehicle traffic impacts on the community's major roadway network as well as potential mitigation measures to address the impacts. TIA studies quantify the "new" traffic generated by a particular project at its full buildout during various times of day (in combination with increases in non-project traffic over time corresponding with the project's buildout timeframe), and how this additional traffic impacts congestion and traffic flow on adjacent roadways and intersections.

Conventional TIA studies typically do not quantify impacts or benefits to other travel modes, such as transit, walking, and biking. Such studies also do not consider how urban design characteristics, mixed land uses, internal street networks, and other hallmarks of TND change travel patterns and potentially reduce congestion impacts. Accordingly, the conventional TIA process is a challenging fit for a TND/SmartCode project like Chamisa Verde. As such, the planning process documented in this report included a more sophisticated transportation assessment that examined the travel mobility characteristics of connectivity, modal split, and trip reductions resulting from traffic retained internally (on-site), particularly via non-auto modes, within TND developments like Chamisa Verde.

The following summarizes the Chamisa Verde TIA process, including the impact that the considerations above are estimated to have on the neighborhood's traffic patterns. Additional planning and design considerations are also included that may further reduce vehicle trips to and from the site and/or future TND developments within the Town of Taos. All calculations and assumptions involving the parameters below are shown in the Appendix.

1. Trip Generation
The first step in the TIA process is to estimate the gross number of vehicle trips generated by each land use within the project. This calculation is based on the *Institute of Transportation Engineers Trip Generation Handbook* which contains vehicle trip rates by specific land use category (such as single family residential) for daily and morning/evening rush hour conditions. While ITE is the *de facto* and nationally-accepted standard for land use trip rates, it should be noted that ITE rates are national and suburban in nature, and are not specific to

Taos. However, because local trip rate data is not available, ITE rates provide a reasonable approximation.

The next step is to convert the gross vehicle trip generation into net new vehicle trips using the following four factors: internal capture, transit trips, walk/bike trips, and pass-by trips.

a) Internal Capture
Internal capture is the concept that many trips in a vibrant, mixed use neighborhood occur entirely within the project's boundaries and do not affect the external roadway network. Live/work units, walking to the corner store, or even driving to an on-site restaurant are all examples of internal capture trips.

National research has documented significant internal capture and overall trip reductions in TND neighborhoods like Chamisa Verde. The most important trip reduction factors are a robust mix of complementary land uses (residential, retail, service, employment) in close proximity, and meaningful provision of multiple travel modes (walking, biking, transit) connecting land uses.

As with traditional trip rates, there are no local data to quantify internal capture rates for a project like Chamisa Verde. To be conservative, the analysis presumed 10 percent for internal capture, a rate proportionally consistent with the national research.

b) Transit Service
As in most communities, Taos residents primarily rely on their cars for most trips, even short-distance trips. As more cars fill Taos roadways, travel time increases and quality of life decreases. Yet, driving continues to be a necessary part of daily life, so more (and wider) roadways/intersections are constructed, more houses are built in isolation from jobs and services, and fewer people walk, bike, or use transit (and doing so becomes more difficult and dangerous). The cumulative result becomes counter to the desired Vision 2020 established by the community.

In contrast, the Taos SmartCode, through its form-based standards for block size, thoroughfare assemblies and public frontages, is designed to inherently create built environments that support all modes of transportation.

Frequent and convenient transit service has been shown to contribute to vehicle trip reductions in TND neighborhoods like Chamisa Verde. However, the mere presence of transit service is not sufficient – such service must be so frequent and convenient as to present a viable alternative to driving for at least some trips (such as work trips).

Limited public transit service is currently provided by the Taos Chile Line, which runs primarily north/south along Paseo Del Pueblo Sur and Camino de la Placita. The route deters east onto NM 585, with stops at Weimer Road and the Youth and Family Center. The bus runs every 30-45 minutes for about 12 hours during the day.

This level of service, while reasonable for a community the size of Taos, will not result in meaningful vehicle trip reduction for Chamisa Verde, particularly with such short trip distances into town or other major destinations which make it more difficult for transit service to be competitive given its need to make frequent stops along the way.

The most beneficial transit investment to service Chamisa Verde would be a route that operates every 10-20 minutes for 16 hours a day (to capture more commuting trips) with fast travel times to major destinations. Transit service is most successful with strategic depth rather than broad breadth in service coverage. That is, transit should serve the few most productive areas very well rather than provide minimal service across a broad area.

One transit asset within Chamisa Verde is that the existing bus stop at the Youth and Family Center is within a quarter-mile (five minute walk) of much of the development. Depending on the scale and intensity of future development on the south side of NM 585, a second transit stop should be considered at the Camino de la Cruz intersection to serve both projects.

Given the current level of transit service, a 0.5 percent transit mode share was presumed for Chamisa Verde. This is proportionally consistent with larger communities, where transit mode share typically ranges between one and five percent (10 percent or more in very large urban areas).

c) Walk/Bike Trips

TND projects are inherently designed to, and depend on, facilitating safe and convenient walking and biking. In particular, much of the trip reductions attributable to TND projects are due to increased walking within the neighborhood. While walk trips are also factored into the internal capture rate discussed above, it is worth considering walk (and bike) trips as a separate category, such as kids going to school, recreational walking, and other pursuits beyond traditional internal capture considerations. An additional five percent trip reduction was provided for walk/bike trips, a figure that in combination with the 10 percent internal capture reduction, is in line with Census (Journey to Work) data for Taos that show an 11.6 walk/bike travel mode share for commute trips.

d) Pass-By Trips

As their name implies, pass-by trips are those that travel to a destination primarily en route to a primary final destination. For example, people tend to stop at gas stations, banks, convenience stores, and other similar land uses on their way to other places, and will not typically deviate much from their route to do so.

This distinction is important because these uses tend to generate a significant number of trips throughout the day. Yet, as pass-by destinations, they do not "cause" the trips they generate. So for example, a driver stopping to buy gas along her route to work was already traveling to work – the gas station did not create that trip.

Pass-by rates typically apply primarily to commercial/retail land uses. Rates vary, and generally decrease, for larger or more intense uses. Grocery stores, for example, have lower pass-by rates than convenience stores. Upscale restaurants have lower pass-by

rates than fast food restaurants. As with trip generation rates, ITE provides pass-by rates for individual land uses, and these were used to further adjust the Chamisa Verde trip generation rates.

Once the four trip reduction factors were applied – internal capture, transit, walk/bike, and pass-by – the remaining trip generation figures are considered net external vehicle trips. It is these data that are used in the remaining TIA steps described below.

2. Trip Distribution

Net external vehicle trips were distributed, or allocated, to intersections along NM 585 to assess traffic and congestion impacts along the highway. Trips were distributed based on a variety of factors, including logical travel paths and ingress/egress points, existing traffic distribution, etc. Trip distribution allocations are included in the Appendix.

3. Background Traffic

So-called "background traffic" is the growth in through trips, regional traffic, and other trips over time that are not attributable to Chamisa Verde but are not present today. As the Taos region continues to grow in terms of residential, retail, employment, and tourist traffic over time, background traffic will also increase regardless of the development of Chamisa Verde. Even so, background traffic will continue to be only a small portion of total roadway traffic.

There are no default standards for determining background traffic growth rates, particularly for the 2028 planning horizon chosen for this study, though such rates typically range from one percent to five percent (applied annually). For example, the NM 585 study presumed a three percent background growth rate. In consultation with local staff, a four percent annual background growth rate was chosen for this analysis. This was viewed as a compromise to reflect a more impactful growth scenario in terms of potential congestion/LOS impacts without overstating the issue. Background traffic is an important factor in LOS analysis because greater background traffic reduces remaining available capacity to absorb project trips before congestion thresholds are reached.

Traffic Assessment/Level of Service Analysis

The traffic assessment is also known as a Level of Service (LOS) analysis as it quantifies the LOS (congestion) impacts of new project vehicle trips on the major roadway network. It is intersection-based because most roadway congestion, delay, and traffic flow issues occur at intersections.

1. Overview

Two LOS analysis scenarios were conducted to analyze Chamisa Verde's net traffic impacts. The first scenario incorporated the trip reduction factors described above; the second scenario assumed no travel mode trip reductions, treating the gross vehicle trip generation as net external project traffic. The objective of this approach was to illustrate the LOS and congestion improvements of the trip reduction factors. More broadly, it was to compare the relative traffic impacts of a TND/SmartCode-based development pattern with a conventional suburban development pattern.

Both LOS scenarios were analyzed at the intersection level using the 2028 forecast turn movement volumes modeled within Synchro software (version 7), produced by Trafficware, Ltd. In general, the 2000 Highway Capacity Manual (HCM) is the standard for analysis of signalized and unsignalized intersections in the United States. Although Synchro software deviates from the 2000 HCM methods in some areas, its output results are generally accepted by NMDOT to be comparable to those based on the 2000 HCM in most cases.

The four intersections analyzed for both LOS scenarios along NM 585/Paseo del Cañon are:

- NM 68/Paseo del Pueblo Sur (Signalized)
- Lower Weimer Road (Roundabout)
- Camino Colores (Roundabout)
- Camino de la Cruz (Unsignalized)

As noted previously, NMDOT is currently reconstructing NM 585 from NM 68 east beyond the Camino Colores intersection. This project will result in a four lane facility with new roundabouts at the intersections of Weimer Road and Camino Colores. These roundabouts will be initially implemented as single circulation lanes, but are designed and constructed to easily convert to two circulation lanes as traffic warrants. Given the 2028 horizon planning year for this study, two lane roundabouts were presumed for the LOS analysis. For the standard intersections, the through and turn lane additions being implemented as part of the NM 585 expansion are incorporated in the analysis.

It should also be noted that the United States is in the process of developing standards for capacity evaluation of roundabouts. Roundabouts, and the larger traffic circles and rotaries, have been used extensively for many years in Europe and Australia, but are a relatively new phenomenon in this country. The current industry standard for capacity evaluation of a roundabout is the software program Sidra (or aaSidra), produced by Akcelik & Associates Pty. Ltd. In Australia. For purposes of this analysis, Sidra (version 3.1) was used to provide more detailed capacity analysis only if the initial Synchro 7 results demonstrated insufficient capacity at a roundabout.

2. Analysis Results

Table 1 below shows the results of the traffic analysis for both scenarios in the AM and PM peak hour periods for the 2028 planning horizon year. Results compare traffic conditions with and without the Chamisa Verde project as both a TND/SmartCode project (including trip reductions) and as a more conventional project (excluding trip reductions). Backup materials documenting the analysis are included in the Appendix.

As shown, most intersections operate acceptably with or without the project, with the major exception being the NM 585/NM 68 intersection, which is congested even without the project. Adding project traffic assuming a TND/SmartCode-based development does cause congestion along NM 585 at the Lower Weimer Road roundabout and at two approaches to the Camino de la Cruz intersection. However, considering the project as a more conventional development significantly increases congestion at these locations while also causing congestion at the Camino Colores roundabout.

It is important to note that several capacity additions, such as additional turn lanes, were tested for their effectiveness in reducing congestion. These additions largely had marginal benefit, particularly considering the potential cost involved in implementing them. An exception is the eventual conversion of the NM 585/Lower Weimer Road intersection into a signalized intersection, which the analysis shows would be warranted by 2028. Another exception is the conversion of the NM 585/Camino de la Cruz intersection into a roundabout, which could significantly improve traffic flow. However, as a primary pedestrian corridor, particularly if additional TND development occurs south of NM 585, balancing the needs and optimizing the safety of all travel modes should be paramount in considering future design changes to this intersection. In terms of additional turn lanes at intersections, the Town of Taos should consider that creating wide intersections does not solve traffic congestion in the long term, but does significantly decrease vehicle and pedestrian safely while creating adverse environments and conditions for walking, biking, and transit use.

Table 1

Intersection LOS Analysis Results (2028 Planning Horizon Year)

Intersection	AM Peak		PM Peak		
	No Project	With Project	No Project	Project (Traditional)[4]	Project (Conventional)[5]
Signalized Intersection[1]					
NM 585/NM 68	E-62.8	E-67.1	F-249.2	F-280.0	F - 301.0
Roundabouts[2]					
NM 585/Lower Weimer Road					
Eastbound	0.70	0.88	0.82	1.04	1.43
Westbound	0.57	0.88	0.75	1.19	1.90
Northbound	0.58	0.70	0.99	1.25	1.92
Southbound	N/A	0.07	N/A	0.11	0.26
NM 585/Camino Colores					
Eastbound	0.31	0.51	0.46	0.73	1.09
Westbound	0.46	0.72	0.30	0.62	0.92
Northbound	N/A	N/A	N/A	N/A	N/A
Southbound	0.08	0.34	0.18	0.46	0.76
Unsignalized Intersection[3]					
NM 585/Camino de la Cruz					
Eastbound	A-0.6	A-2.8	A-0.4	A-3.7	A - 9.5
Westbound	A-0.0	A-0.0	A-0.0	A-0.0	A - 0.0
Northbound	B-13.0	C-24.7	C-21.3	F-90.2	F - 724
Southbound	B-11.0	F-108.5	B-12.9	F-598.3	F - err

Notes

1. Signalized Intersection LOS is measured by vehicle delay in seconds.
2. Roundabout LOS is measured by vehicle volume to roadway capacity ratio. A ratio greater than 1.00 indicates congestion.
3. Unsignalized intersection LOS is measured by vehicle approach delay in seconds.
4. Traditional: TND/SmartCode development with trip reduction factors.
5. Conventional: "Typical" development with no trip reduction factors.

3. Results Context

There are several critical points to considering these results in context:

- Future traffic will grow significantly and become more congested with or without Chamisa Verde.
- The magnitude of additional traffic impact from Chamisa Verde is relatively small.
- A TND/SmartCode-based project is the best type of project to implement at this location, which is targeted for infill development and affordable housing.
- If a TND/SmartCode project is not built at this location due to traffic concerns and instead built farther away, its traffic impacts would be worse because its greater distance from the core of Taos would result in more and longer vehicle trips.
- Similarly, as the LOS results emphasize, if a conventional-based (suburban-style) project is constructed at this location instead, this would significantly increase traffic and congestion impacts.
- The LOS results point to poor transportation connectivity at a regional level – significant vehicle traffic is being concentrated at a limited number of intersections. These regional connectivity issues are neither caused by nor can be fully remedied by the Chamisa Verde project. More regional street connectivity is needed to diffuse traffic across multiple travel paths and intersections, reducing LOS/congestion impacts at individual locations.
- However, the comparison results clearly demonstrate the value of TND/SmartCode based development and its inherent trip reduction benefits and increased connectivity. These factors help significantly reduce the project's additional vehicular traffic impact.
- Travel mobility should be measured by more than just intersection delay. The project's unique ability (as a TND) to capture some trips on-site and to increase travel choice options while reducing external vehicle trips (compared to a more conventional project) should be supported. These factors increase personal mobility and community livability and provide regional benefit beyond the project's boundaries.
- Even considering only intersection delay, these results apply only to peak hours (primarily the PM peak hour) – typically the "worst" hour of the day. Average traffic conditions throughout the entire day are likely much better. As a matter of policy, does it make sense to guide transportation investments (particularly adding roadway capacity) and development policy exclusively or primarily by traffic conditions for a single hour or throughout an entire day?
- Roadway congestion occurs over time and reflects cumulative decisions made about development character, travel choices, and transportation network investments. A project like Chamisa Verde should be considered in this larger context, not denied reflexively because of other conditions and decisions made over time separate from the project.

- Finally, transportation and land use policy objectives should support reducing vehicle trips, shifting vehicle trips to other modes, and reducing the frequency, distance, and duration of vehicle trips. As a TND infill project, Chamisa Verde addresses and implements these objectives.

These points are not intended to advocate for Chamisa Verde, but rather to consider the LOS analysis in a more comprehensive technical and policy context.

Connectivity Assessment

A "connectivity assessment" was also undertaken as part of this report. Such an assessment measures how developed and connected the local street network is within the project. The TND concept calls for a dense network of highly connected streets. Connectivity of the local street layout measures the quality of the street network and influences accessibility, circulation and mobility. While not affecting the project's traffic generation directly, connectivity has a critical bearing on net traffic distribution and impacts. Well-connected street networks diffuse traffic and congestion along multiple travel paths rather than concentrating traffic in a few locations. Multiple travel routes also provide greater mobility for driving, walking, and biking, and help reduce congestion.

A network that offers multiple routes to a destination has a higher level of connectivity than a network with a single option. A well-connected community offers the following additional benefits:

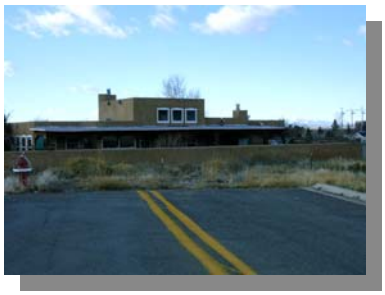
- Decreasing traffic on arterial and collector streets by increasing traffic capacity and dispersing traffic patterns.
- Providing greater emergency access and reduced response time, and, conversely, providing multiple routes of evacuation in case of disasters.
- Increasing efficiency of utility connections, maintenance, and transport-based community services.
- Providing for continuous and more direct routes that facilitate more efficient transit service and short-distance travel by the non-motorized modes of walking and bicycling.
- Enhancing quality of life and accessibility to daily needs.

The Chamisa Verde Neighborhood Plan proposes a highly-connected grid pattern with narrow streets, low traffic volumes and reduced speeds. Such transportation network design will promote civic spirit, allow walking, biking and transit to become convenient travel alternatives, create places where it is safe for children to travel and play outside, and foster a sense of community where residents can know their neighbors and enjoy access to daily conveniences within the neighborhood.

Connectivity Measures

Street connectivity can be measured in several ways: block size, block length, block perimeter, intersection density, route duplicity, and an overall connectivity index. The following summarizes the connectivity of the proposed street network for the conceptual Chamisa Verde Neighborhood Plan as prepared by PlaceMakers. Comparative information is provided for model communities that have street connectivity ordinances designed to increase connectivity in new subdivisions, as well as for the street network found in Old Town Taos.

When using connectivity measures, it is important to combine calculators to measure desired outcomes. For example, a town using the connectivity index alone may create a grid-like street network, but if the block lengths are over 700 feet long, it is unlikely that it will become a walkable, pedestrian friendly community. Likewise, using only block length or size as a connectivity measure can lead to a disconnected street network with dead end streets and cul-de-sacs that limit circulation and access options.



Measurements used in a connectivity assessment of the proposed Chamisa Verde Neighborhood include the following, and are documented in the Appendix:

a) *Block Size*
Block size is a key indicator of connectivity as it directly influences trip distance, which influences choice of transportation mode. It is based on two dimensions of the block, either the block's perimeter, or width and length.

SmartCode 9.0 regulates block size by perimeter block length. Recommendations are context-sensitive, meaning they vary by Transect zone. Recommended maximum lengths are 3,600 feet (T3), 3,000 feet (T4), and 1,600 feet (T5). The Chamisa Verde plan does a good job of providing smaller than maximum block sizes, averaging 2,980 feet (T3), 1,063 feet (T4), and 1,480 feet (T5). For comparison, Old Town Taos has a grid system with blocks approximately 1,300 feet in circumference. Overall, the Chamisa Verde Neighborhood block perimeters average 1,369 feet.

b) *Block Length*
Block length is measured from street centerline to street centerline along the block. It is used to supplement block size measurements, since not only size, but also configuration, influences connectivity. In areas developed with long blocks, trips become circuitous and it is unlikely that people will walk due to the distances involved. Some communities, like Portland and Beaverton, OR, for example, have regulated that blocks be designed less than 530 feet in length to create a higher level of connectivity. Proposed block lengths in the Chamisa Verde neighborhood vary, ranging from 100 to 400 feet. By comparison, Old Town has a grid system with blocks approximately 200 to 700 feet in length. In suburban areas, intersections along major streets are typically spaced at distances of 1,000 feet or more.

c) *Intersection Density*
Intersection density is the number of intersections per mile or square mile. Improving connectivity in a network not only makes trip origins and destinations closer to each other, but also increases traffic capacity. The greater the number of intersections provided in Traditional Neighborhood Design the more the traffic is able to disperse in a more uniform manner throughout the community. Therefore, only a small portion of the overall traffic volume concentrates at a particular intersection.

The lack of access points in a conventional street layout, where many "loops and lollipops" feed onto a few main streets, causes large volumes of traffic to meet at a few intersections. This concentrates traffic – and congestion – along a limited number of travel routes, leading to overly-wide roadways that are more unsafe for cars and pedestrians and limit or preclude other travel modes. Congestion concentrates at intersections, leading to wider intersections, more delay, and more accidents.

In contrast, a large number of intersections reduces turning movement load at all intersections and provides individual drivers with numerous locations to make a turn. Spreading traffic throughout the network in this manner creates acceptable gaps in traffic, which in turn makes turning movements easier at non-signalized locations. Repeated, smaller intersections also enhance the walking environment by providing shorter pavement crossing distances at more frequent intervals.

For example, Portland, OR has regulated that all new developments have 10 to 16 intersections per mile, even along arterial streets. As a local arterial example, NM 68/522 in Old Town is approximately a mile long, and has seven intersections. Chamisa Verde is planned to have four intersections per mile along NM585, and six intersections along Cruz Alta Road. Internally on the local streets, both Old Town and Chamisa Verde have closer to 16 intersections per mile.

d) *Route Redundancy*

A final way of looking at network connectivity measures vehicular circulation in terms of the number of connections provided within a subdivision to the surrounding collector and arterial streets. Communities such as Cary, NC, and Fort Collins, CO, have adopted ordinances to improve vehicular circulation, control the use of cul-de-sacs, and to require the provision of street stubs to adjoining properties.

Requirements typically include that all developments must have at least two ways of exiting to a minor arterial. This offers traffic dispersion benefits, as previously described, as well as emergency access and service efficiencies. Emergency medical service, trash collectors, police, and other government service providers are typically strong supporters of greater connectivity provided by route duplication. Trash collectors and police find that "doubling back" on dead ends adds significant time and cost to their service. Emergency services find that, in cul-de-sac developments in particular, the first vehicle on the scene is blocked in by subsequent arrivals, which has led to larger minimum required street widths to allow two large emergency vehicles to pass each other.

Communities that have increased their connectivity have simultaneously changed their codes to enable or require narrower streets. Many have adopted an 18' width as the acceptable minimum standard necessary to provide an acceptable level of accessibility for fire trucks when multiple routes are available, believing that a narrower but interconnected street system is easier and faster to navigate than wide layouts with circuitous streets. In Chamisa Verde, most lots will have at least two and often more than four ways of access from both streets and rear lanes.

e) *Overall Connectivity Index*

The connectivity index is calculated by dividing the number of street links in a development (street sections between intersections, including cul-de-sacs) by the number of street nodes (intersections and cul-de-sacs). It does not include existing adjacent streets, but requires close spacing of connections to ensure a level of external connectivity. In this manner, it can be thought of as an overall numerical measure of street connectivity.

A perfect grid system has a connectivity index of 2.0. Typically, an index of 1.4 or greater indicates a well connected neighborhood. Preferred minimum connectivity indexes in model communities using this system include Cary, NC (1.2), Middletown, DE (1.4), and Orlando, FL (1.4). Chamisa Verde, as proposed, has a connectivity index of 1.27, scoring slightly higher than Old Town Taos (1.14).

Limitations and Opportunities

Internally, the Chamisa Verde street network provides good connectivity that will serve multiple modes of travel. While there are existing constraints, TND connectivity may be further enhanced over time if connections to surrounding dead-end streets can be made, particularly to the north and west. Where street connections are not possible, bicycle/pedestrian connections may be more feasible and can also provide significant connectivity benefits, particularly in a TND setting.

Route Directness

The final measure analyzed for this report, related to connectivity, is known as route directness. This measure illustrates how much of the development is accessible within a five minute walk from key locations on-site.

Using PlaceMakers' Chamisa Verde concept map, five minute walk networks were mapped from the center and from each geographic edge of the neighborhood. The analysis indicates that the geographic center and the Youth and Family Center are most accessible. This is particularly important because the five minute walk (quarter mile) distance is the primary focus area for transit accessibility for the transit stop at the Youth and Family Center. Conversely, the edges of the development, particularly to the west and northwest, are the least accessible. While geographic distance is comparable, route directness is not, primarily due to existing structures, lot boundaries, and other barriers.

Overall Conclusions

The proposed Chamisa Verde neighborhood is a valuable contribution to addressing the Town of Taos' transportation, development, livability, and sustainability objectives. While not perfect, the project has measurable traffic, connectivity, and mobility benefits consistent with the Vision 2020 Master Plan and the recently-adopted SmartCode. The project and its associated development code amendment is an important step to creating more livable neighborhoods in Taos.