A Democratic Approach To Land Use and Transportation Planning for the Albuquerque Metro Region

20 February 2006

> *"Planning is where democracy meets engineering. If we are going to get really good at planning transportation, we have to be good at both democracy and engineering, and do them separately. Democracy sets up the parameters and goals and engineering finds the best way to meet all the goals within the parameters. Democracy is general participation; engineering is expert participation. We should not let experts define the problem or let the general public design the solution."*

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Guiding Principles

If you listen to enough people talk about what they want Albuquerque to be, certain themes are repeated again and again, and they are listed in all the main planning documents. Generally, these themes are

1. **Safety**, including safety from crime, traffic safety, and feeling good about sending our kids to school.
2. **Vitality**, including preserving and building special and unique places, whether commercial, residential, or recreational, where people want to be; historic preservation; and preservation of distinct cultures – or simply, *building a city that we love and are proud of.*
3. **Serenity,** including peace and quiet at home, and the beauty of the views of the mountains, river, and volcanic escarpment.
4. The **economy**, including a good environment for small and large businesses to operate, job security, and access to jobs.
5. The **environment**, including clean water and air, wildlife habitat, and the wise use of the aquifer and surface water.
6. **Access** to the things we need by car, walking, and transit, in a reasonable amount of time at a reasonable cost.

It is easy to see how some places excel in these six areas more than others. You can probably think of one place that you love, that captures these ideals quite well, and you can think of other places that fail miserably. Clearly, if we as citizens and governments have made places at these two extremes before, then our actions today can make the difference between a bright future and a dismal one.

The biggest public expense we make in creating our urban form is in our transportation investments. It is the highways and major arterial streets that are the skeleton that shapes the city today. It is the biggest stream of money that the public controls, and possibly the most effective instrument to effect policy. For that reason, this paper focuses mostly on the transportation skeleton and its funding. By steering the billions we will spend on transportation over the next decades to the best possible use, we can build places that excel in the six principles above.

Planners and thinkers who are recognized as national leaders have almost unanimously declared that in order to make the best urban places, they need to be walkable, oriented and scaled to people instead of cars, while still allowing for cars. The concepts of transit oriented developments and walkability are prominent in this report because they are the most important strategies available to excel at the six principles listed above. Most people who think about a place that they love that captures these principles well, will be thinking of a place that is human scaled and walkable, not a place that is accessed by a large parking lot.

Mistakes That Were Made

In our metro region, we have already built public infrastructure whose value is in the tens of billions, and private real estate valued on the order of 100 billion dollars. (Any proposal for change has to work around the facts of what is already there.)

But, mistakes were made, which generally were not apparent at the time of construction. Here are the main mistakes that have become more apparent in hindsight:

Mistake #1. Annexing

We have annexed land in various chunks towards the west, and permitted development without the infrastructure to support it. Consequently, the west side arterials and river crossings are overburdened. This mistake was made possible partly because the long range transportation plan is written by the COG without having control over what land will be developed within the time frame of the plan. Also, the city, who controls the development, has rules that allow permitting development that does not conform to the COG plan or even the city's own plans. There is no evidence that we are changing this behavior, even though the evidence is clear that the behavior has been destructive.

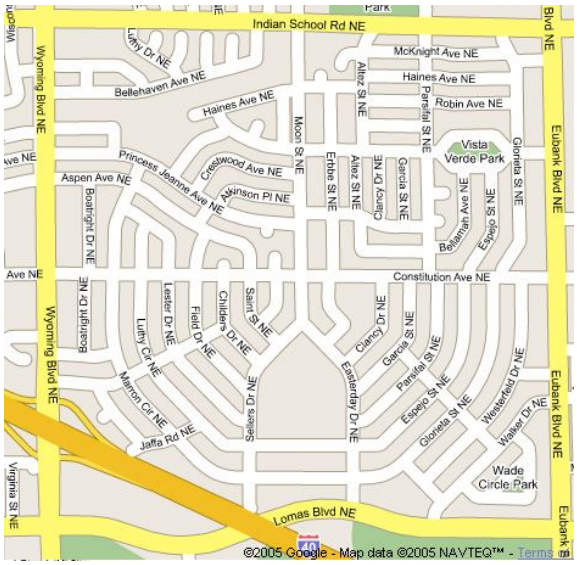
Mistake #2. Car-oriented

Development since the 1960's has been exclusively car-oriented. Each business or row of storefronts has its own parking lot, and there are large spaces between commercial buildings, which are used for roads and parking. Residences and commercial areas are strictly separated. This makes it less practical to travel by any other means, particularly by walking. Drivers typically have to re-park for each destination. The consequences of this urban pattern is that additional driving is forced on us, and public transit is much less effective.

Mistake #3. Loss of agriculture

The river valley has gradually changed away from agricultural uses. There is a very limited supply of agricultural land, while there is a virtually unlimited supply of land for other purposes, so it would have made sense to use the valley land mainly for agriculture. Agriculture is important to the public as a whole for a local food supply, air quality, open space and environmental preservation. However, the city made a series of small decisions that benefited private owners by allowing more development, without any policy to ensure that total agricultural acreage was preserved.

Mistake #4. Collector streets



We have built neighborhoods that have few or no through streets, and designed the traffic patterns to collect all traffic on arterials, such as San Mateo and Montgomery. Arterials are clogged at rush hour, while the neighborhood streets (where most of the miles of roads exist) are of no help. Decisions made to reduce traffic on neighborhood streets are beneficial to those particular residents, but the sum of many such decisions have debilitated the whole system.

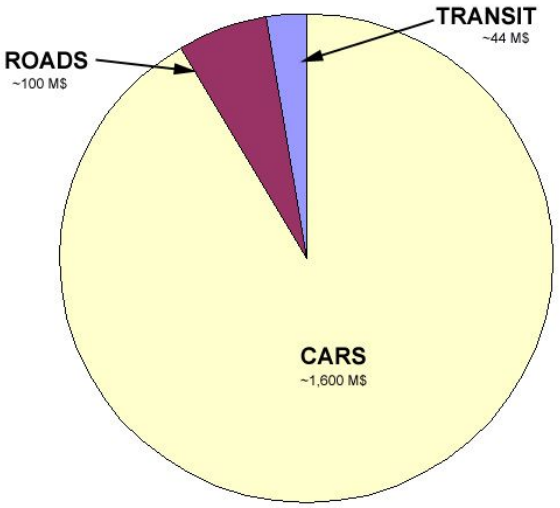
Mistake #5. Lack of open space connections

We have failed to take advantage of the beautiful and varied natural features as recreational connections to neighborhoods. While the total open space acreage may be large, it is not within walking distance from a majority of neighborhoods. We could have had finger parks along the natural arroyos that connect mountain to river, and served all neighborhoods. Instead, we have the concrete arroyos.

Mistake #6. Lack of segregated transit rights of way

We failed to reserve adequate rights of way for grade-separated transit. Consequently, our transit system has to share the roads with cars, and cannot go any faster than cars. To acquire new rights of way in developed places is very costly, but it would be feasible to acquire transit rights of way for future use in the places that are developing today. However, we continue to repeat the same mistake in those places.

Counting the Money



Metro Albuquerque Transportation costs, sum of public and private expenditures.

Projections

The figures on this page are rough projections and are not adjusted for present value, and should be used *only* to understand the magnitudes of money involved in transportation.

[The whole report excludes NPV (Net present value) calculations; perhaps an economist could comment on this.]

First, what are we planning to spend? The Council of Governments published these numbers in the MTP 2025, showing projected public expenses over 23 years: [or 25?]

roads	1,278	M$
maintenance	693	M$
transit	996	M$
other	423	M$
TOTAL	3,390	M$

That's 43 M$ per year on transit and 104 M$ on other transportation (mainly roads). Privately, we spend something like 1.6 B$ (1,600,000,000) per year in the metro region – an estimate that takes into account the cost of cars, gas, maintenance, and insurance. [This was included in a COG report; is there a more accurate way to measure this?] So, 92% of the costs of transportation are carried by the consumer and only 8% by government.

Here is a chart showing how the transit portion of the total costs compare with the other costs.

	Public	**Private**	**Total**
Transit	43 M$	~1 M$	44 M$
All other	104 M$	1,6xx M$	1,7xx M$
Total	147 M$	1,6xx M$	1,7xx M$

How much does transit cost compared to its benefits? Government spends about 29% of all transportation expense on transit, while private expenses on transit are negligible. Combining public and private expenses, we spend about 2.5% of all transportation money on transit. Currently transit carries about 1% of trips in the metro area.

Interpretations

People will "spin" the above numbers different ways. People who favor more money for transit tend to emphasize that the costs of roads and cars are not fully accounted for in an analysis like this one. For example, some portion of the total costs of health care are devoted to auto accidents, and we didn't include that cost. There are many other examples, such as the land requirements for roads and parking, and environmental costs to be paid by our children. On the other side of the coin, those who want to cut transit funding point to the fact that 29% of public money goes to transit while it only carries 1% of the trips.

Alternatives

Trying to determine the right way to count the money would set off a never-ending argument that will not help us arrive at a solution. Instead, let's try to invent a solution that costs less in total, *and* avoids the mistakes we made in the past, *and* is better guided by the guiding principles at the beginning of this report.

Here is a thought-provoking scenario: Suppose that we build a fantastic transit system that carries thirty times more trips than our current one, or about 30% of all trips. Your first thought might be "too expensive", but let's look at the numbers again to see what it would be worth. If we cut down on car trips by 30%, then we might be able to cut down on total expenses for cars and roads by about 30%. That reduction in cost would come from families needing to own fewer cars, people driving fewer miles, and the government not needing to build additional road capacity. So, we would be saving 500 M$ per year right there.

If we put that savings into transit at the rate of a billion dollars every two years (just for the Albuquerque area!), that suggests the high value of such a fantastic transit system. In other words, a transit system that attracted 30% of all trips would be worth 500 M$ per year.

Furthermore, if the transit system is built and operated locally using some of our locally produced electricity from wind, then the investment would circulate in the local economy, which multiplies the benefits. In our current transportation economy of cars and roads, most of the money spent immediately leaves our area.

Planning Framework

We recommend using the planning framework that is explained in the next few pages, or at least the aspects of it that are feasible to use given the existing constraints.

A quick summary of the framework is: (1) Coordinate the plan of the different transport modes and scales, from the neighborhood scale up to the intercity scale; (2) Plan land use and transportation together; (3) Use a process that includes the steps of setting goals, design to meet the goals, evaluation of how well the designs meet the goals, and choosing the best design.

Scale and modes

The table below shows five "scales" of transportation planning (A-E, from smallest to biggest) and four "modes" (road, transit, bicycle, and walking). Notice that some of the cells are labeled "N/A", which suggests that few people will walk more than a half mile and few will bike more than 5 miles.

	Scale	1. Cars/Roads	2. Transit	3. Bike	4. Walk
E	**Intercity** trips to destinations outside Albuquerque metro area. speed 50+ mph	limited-access highways	Grade-separated intercity transit	*N/A*	*N/A*
D	**Metropolitan Region** speed 25-50 mph distance 5-45 mi	limited-access highways	Grade-separated regional transit	*N/A*	*N/A*
C	**Area** speed 15-20 mph distance 2-5 mi	boulevards	(Partially) grade-separated transit	Long distance bike lanes and paths	*N/A*
B	**Sector** speed 10-15 mph distance 0.5-2 mi	avenues/connectors	Local transit	Short-distance bike lanes and paths	*N/A*
A	**Neighborhood** distance 0-0.5 mi	connectors/residential roads for cars, bike, and walking			

The intercity (E) planning process is handled more at the state and federal levels. The Area and Sector levels, C and B, correspond with existing planning areas in Albuquerque. The neighborhood level (A) is defined as walking distance, and therefore is probably too small to have its own separate planning process. The regional level (D) is primarily where we need to focus more energy in our region.

It is a natural consequence of speed and distance that the higher level facilities need to be more single-use than the lower levels. For example, major highways are walled off from other traffic and all other uses, while neighborhood streets are multi-use surfaces. In the table, the neighborhood scale (A) has all modes combined in one cell, which suggests that the same road surface will support all modes. But at the top levels, the modes need their own rights of way. Transit works this way too; the only way to obtain the speeds necessary for long distance transit is by routing it on its own track or lane that has few or no crossings with other traffic.

Speeds and distances are suggested for each level, but a specific transportation facility may not fit exactly in one of the levels. The table is meant to be a framework for planning, not a prescription for the results.

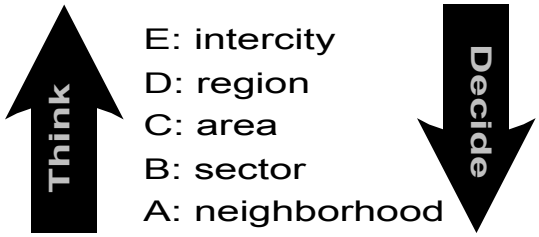
Overview of steps

The suggested planning steps are as follows.

1. Set goals
2. Design several systems, ideally contributed from several different sources. The design should cover all modes and should try to meet as many of the goals as best as possible.
3. Evaluate the extent to which *each* design meets *each* goal, using computer modeling as a tool.
4. Choose the design that is predicted to best meet the goals at the lowest cost.

Planning is where democracy meets engineering. If we are going to get really good at planning transportation, we have to be good at both democracy and engineering, and do them separately. Democracy sets up the parameters and goals and engineering finds the best way to meet all the goals within the parameters. Democracy is general participation; engineering is expert participation. We should not let experts define the problem or let the general public design the solution. That is a big reason for these four steps: the first and last steps (goal setting and decision making) are public processes determined by elected officials with public input, while the middle two processes (design and evaluation) are expert processes. The design is a creative distributed process with many players (some private sector), while the evaluation is a centralized public-sector process.

It is not feasible to plan all aspects of a whole metro region in detail in one process, so it has to be broken up somehow. We do NOT recommend breaking it up by subject area, because the interrelationships between land, housing, transportation, and other location-oriented subjects is too fundamental to break apart. Instead it should be broken up by scope as delineated in the table above. It is helpful to think through the goals in local-to-regional order (explained below), but do evaluation and decision making in top down (regional-to-local) order.



Since transportation itself occupies land, the that land has a designation A-E. The land that is adjacent to transportation facilities also has a scope designation, which is elevated by the designation of the facility. Goals about the land and facility can be planned at that level. For example, the downtown bus and train station are intercity level (E) because they occupy land serving intercity transportation. The transit facilities and regional shopping malls are regional (D). Commercial uses along major roads of levels C and B would have the same designation as the road. Intercity (E) goals and decisions should have the highest priority, so that lower levels have to work around level E. Level D has the next priority and so on. (However, historical mistakes can't be erased this way, so preexisting local limits sometimes have to overrule the requirements of the higher levels.)

Regional transportation and land use aspects should be planned together for the whole metro area, by a regional government unit having jurisdiction and authority to implement plans. For each lower level, the planning boundaries should ideally correspond with political jurisdictions, so that there is a governmental body with the planning, spending, and zoning authority to carry out and execute the plans that it makes.

A word about innovation

It is abundantly clear that rebuilding an interchange or *merely doubling* transit spending will do practically nothing about regional traffic problems. Trying to keep up with traffic growth just by building more and more suburban lane-miles does not work, because while it alleviates a local jam, it also contributes to the situation that

caused the traffic problem in the first place. As Einstein has often been quoted as saying, “Problems cannot be solved at the same level of consciousness that created them.”

When governments spend money on transportation projects, the project specifics are usually conceived and announced before any goals are established, and any goal-setting that does occur tends to justify the selection of the preconceived project. This reduces the public dialog to a yes/no question on the project. The way to move beyond today’s transportation problems is to think more creatively, and a great way to unlock that creativity is to separate out the goals from the methods used to achieve the goals.

Goal setting

What makes a good goal

Goal setting is a democratic process that helps abstract and formalize the reasoning behind policy choices, and promote better outcomes. As elaborated below, a good goal for public expenditure or policy is *justified, abstract, measurable,* and *accountable.*

A goal should be plainly **justified** by common sense, which means it is related to basic human needs such as safety, time, affluence, or peace. Not everyone will agree on priorities, but almost everyone will agree on a goal that is put in terms of human needs (at least in the area of land and transportation). For example, a goal to reduce time spent in traffic is clearly agreeable to the large majority of people, because it is a goal about time. Even if people don’t all agree on how important that is relative to other goals, or how much money it is worth to solve it, it is justified by a basic human need.

A goal should be **abstract** enough so that there is more than one possible way to achieve it. For example, building a bridge is too specific of a goal; reducing the time it takes to access jobs and services is the actual goal behind building a bridge. When goals aren’t abstracted, innovation is less likely. Government is not generally innovative; advancements come from the private sector. In order to harness American ingenuity for the public good, government has to back off of the specifics of how to achieve public goals and allow the private sector to propose solutions.

A goal must be **measurable** enough so that we know if we have reached it, or to what extent. There are different ways a goal can be measurable. One way is using a target number of something, such as a number of tons of carbon monoxide emissions per year in an area. Another way is sometimes called “asset based”, which is to list a number of assets that a population would have, and set a target number of assets of the list that should be had to meet the goal. Another method is using surveys of beliefs or perceptions, which makes those things quantifiable. The target number, regardless of what kind of measure is used, should not be watered down to what is perceived to be practical, but should instead be the ideal. For example, the target for traffic fatalities is zero, even if that will never be achieved.

Finally, a goal should be "**programmatic"** enough so that we know if the program, policy, or expenditure that was supposed to meet the goal was responsible for meeting it. For example, the goal about increasing civic pride would not be programmatic, because after money was spent towards the goal, and the measure of civic pride changed by some degree, it would be impossible to know whether that particular expense was responsible for the change in perception. So, we would have to focus it more by geographical boundaries, population group, or some more specific aspect of the problem to solve.

Transportation is inherently about land, so the set of goals for this kind of planning should include goals about protection of land, such as agriculture and water quality, and protection of plant and animal species. Transportation is also inherently about economic productivity, so economic goals should also be included.

Goal kings

There are a large number of goals that could be written. The set of goals should be boiled down to the essentials, so one isn’t the little brother of another one. That is, if there are two goals and one is automatically met when the other is met, then we only need the more general one. For the group, we only need a small group of “Goal Kings” that, when met, automatically meet all the other goals. All the goals are important, but only a few need to be chosen to evaluate designs against. Example: All detailed environmental goals can probably be met by just one or two goal kings in the

environmental realm. The goal of the lowest carbon fuel use could stand as a goal king for other goals such as low air emissions and low soil contamination.

Example goal

"Fair access to goods and services to residents of the UNM area who don't drive, as measured by the time it takes to reach typical destinations; non-drivers should be able to access typical destinations in 125% of the time or less as compared to drivers."

This goal is *justified* by fairness, a basic concept about which people generally agree.

The goal is *abstract* because it doesn't talk about any particular transportation solution.

The goal is *measurable* because travel surveys and computer modeling can help determine the ratio of travel time between driving and alternatives.

The goal is *programmatic* because it has a geographical limit (UNM), which makes it possible to determine which improvements in that area are responsible for any changes in the measure.

More notes about setting goals

- Goals are naturally less divisive than individual spending items. Working on goals across constituencies and jurisdictions could build more common ground between parties with some opposing interests. A specific proposal can be evaluated against goals, and this provides objective input towards resolving conflicts.
- Goal setting provides an effective arena for public participation. Nonprofessionals can understand the process and terminology of the goals, but they may not be able to participate in design or evaluation.
- The scales of planning (A-E) have different goals. Set a goal at the lowest level (the smallest area) that it *can* be solved at.
- Don't tie yourself in mental knots over "vision", "mission", "goals", and "objectives". These concepts are overlapping.

Designing solutions

A solution is some application of land, money, technology, policy or process that is claimed to meet one or more goals. There doesn't need to be any control over how solutions are designed; they can come from any source. Any design meeting administrative submission guidelines should be accepted and evaluated by the planning agency. If there is a shortage of ideas, the agency can sponsor a design contest and submit its own.

There is a difference between a *technology* and an *application* of technology. For example, there is a difference in the optimal cost of operating a bus and the actual cost; there is a difference between maximum capacity of a train, and actual demand. The proponents of a particular technology should design the application of that technology, since they will generally understand how to apply it in the most cost effective and beneficial way. A solution should not be considered complete until it is sufficiently detailed to have a price assigned: it needs specific land and routes.

Evaluating potential solutions

The basic idea behind evaluation is that it is done by experts as free of political bias as possible, and without any authority to decide on a system, or to change it or to change the goals. For transportation solutions, the evaluation results in a numerical measure of the design against each goal king.

Some of the measures will require computer modeling. For example, this can determine the demand of a roadway or transit link, leading to estimates of congestion and emissions. Please see Appendix A for some information on computer modeling, and technical recommendations for the modeling software.

The evaluation process must be transparent, which means publishing the software algorithms, data sets, assumptions and other inputs. Proponents of a particular solution can then check whether the evaluation fairly accounted for the intended effects of their design.

In addition to transportation engineers evaluating transportation solutions, large scale infrastructure projects should be evaluated by all departments of government at all affected levels.

Along with analyzing benefits, the evaluation should also result in the cost of each project or solution, where each solution is costed with the same assumptions, so that the costs are apples-to-apples. The cost should include land, capital, interest, operations, and maintenance. The present value of future costs should be calculated with a justified and uniformly applied discount rate.

Both costs and benefits entail risk: the relative uncertainty that the costs and/or benefits will be close to the prediction. The uncertainties should also be part of the results of the evaluations.

Decision making

If all goes well in this process so far, decision makers will have good information with which to make good decisions: well thought out goals, and a number of potential projects, each of which is measured against each goal king. Making the decision entails choosing the set of projects that best meets the goals with the best use of money.

It makes sense to choose projects as the last step of *each* planning process; if the goals are divided into A-E level (neighborhood, sector, area, region, intercity), the submitted projects and evaluations would be done for one of those geographical boundaries, and the decision making would also happen for each place in question.

There are deeper and less quantifiable questions a decision maker can ask to help prioritize and choose. Does the expense address the fundamental issues or is it a band-aid approach? Is it fair and just? Does it help those who need it most? Is it a move towards a democratic or authoritarian future? Does is mend or tear apart rifts between ethnic and other social groups? Does it build local capacity, such as economic resilience and the skill base? If there is a lot of risk, do the potential benefits justify the risk? (Is the amount of money at stake an acceptable loss?) Is the way of meeting goals for one department or place helpful, neutral, or counterproductive towards the goals of another department or place?

Best use of money

The simplest "best use" of money is the least cost, and that is probably the most important criterion. Creating jobs at taxpayer expense is probably *never* a good reason to break the least cost rule. (However, it could be consistent with one of the goals to employ local labor when there is a choice.)

We may wish to account for costs inclusive of future environmental and health costs, but there is no accurate way to count that money. Instead we suggest that when measuring cost, we only count the actual money spent for a project. The goals should have included environmental and health goals, so the information about how well solutions meet those goals should be available to decision makers.

However, both public and private costs should be included in data available to decision makers. Our car/road transportation system, for example, is ~90% privately funded; a proposed policy that changed the ratio of public to private costs could only be understood if you know both sides of the cost. Also, specific avoided costs or returns on investments should be included.

Risk

Innovation carries risk – uncertain costs or unintended consequences. On the other hand, business as usual promises to continue a pattern of failure in areas where our actions have failed in the past. As with investing money in a balance between high-risk/high-reward and low-risk/low-reward, we need to take some wise risks in public projects in order to get the high rewards.

Ways to minimize risks include lowering the budget to a level of acceptable loss (a pilot project) or splitting the risk with the private sector. Also, instead of an outright purchase, the government can permit and/or incentivize private-sector actions.

What's missing from the current planning framework

Our region (like many others) suffers from these problems in transportation and land planning:

- Goals play a small role or are altogether omitted.
- Land and transportation are not planned together; transit and roads aren't even planned together.
- Investments in infrastructure are often disconnected from adopted plans.
- There is no system of welcoming creative ideas from outside the planning agencies.
- The proposed strategies are not backed by analysis of predicted change in performance measures towards goals. The computer models are not up to date (see Appendix A). The modeling results are routinely ignored by decision makers.
- There are too many jurisdictions. The regional planning area (MRCOG) is not a jurisdiction at all, and it does not include the whole commuting area.
- There is no rule or pattern of choosing the least-cost alternative method for achieving goals.
- Decision makers have far too little information with which to make an educated decision.
- In transit system procurement, the setting of goals, the design, the evaluation, permitting, and spending are all wrapped into the same, mostly non-transparent process, ensuring that no innovation occurs. (Public investment in transportation technology has been extremely risk-averse in recent decades, and the technology has changed very little. Compare with a period of big changes: 1900-1950. Appendix B lists a better framework for permitting.)

The plan to enhance transit on Central Ave illustrates most of these points. The project started with no goals. The planning has been done as a partnership with an outside company (Parsons-Brinkerhoff). The longer it takes to plan and the bigger the procurement is, the more they get paid. No alternative ideas were solicited. There is no way to determine which alternative might have been better, since there were no goals. At public expense, the mayor has propagandized a very large expense that has no clear relationship to increased ridership, using non-analytical reasons and claims that cannot be backed by modeling. To counter the argument that the proposed system may have zero or negative impact on congestion, it has been claimed that the system (LRT or streetcars) is "part of a larger plan", but the larger plan has yet to be revealed.

This demonstrates that the *process* is flawed. (The technology and route may or may not be a good choice, which is not the argument being made here.)

Design approach for sub-metro scale

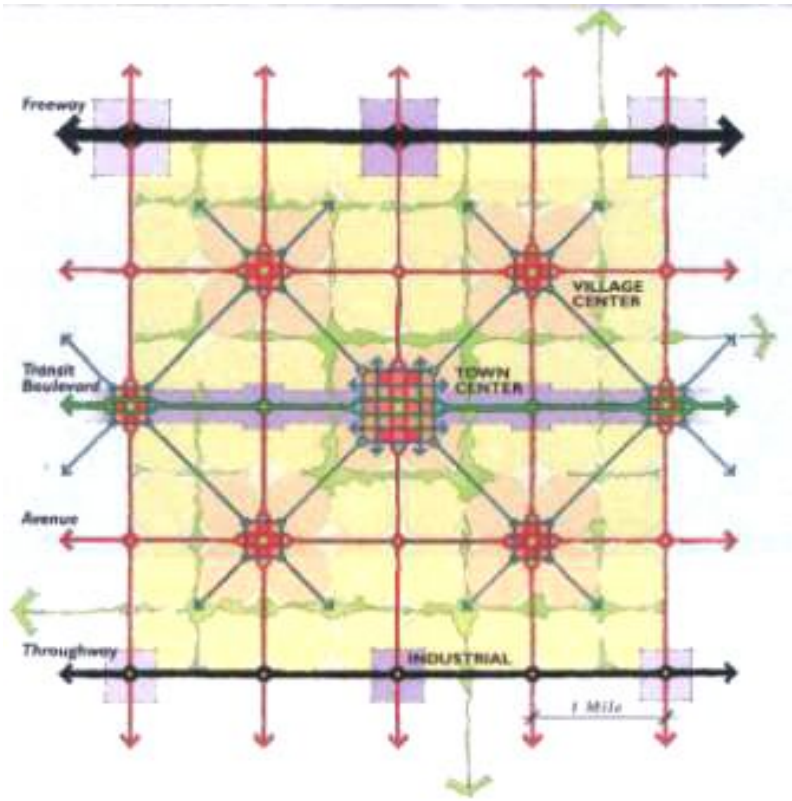
The scale and mode table (see Planning Framework) listed scales A, B, and C as the and Neighborhood, Sector, and Area scales. We are not proposing specific goals for these sub-metro planning sizes. The goals could be different for each place.

Efficiency as a central approach

Travel is usually not a purpose in itself, but rather a necessary inefficiency or side effect of some other pursuit. After paying for transportation, you have nothing more than when you started. It is an expense with no returns, so it is not an investment. Even though it is sometimes enjoyable, we still minimize our travel by taking the shortest route. The approach to urban design should, among other things, help us minimize travel.

A good way to do this is to meet our needs as close to home as possible. Any goals that can be met at the E level (neighborhood) should be met there. All goals should be met at the lowest levels, to the extent possible.

Driving trips often contain so little walking that we overlook the fact that all trips start and end walking (or rolling, if you use a wheelchair). An efficient and healthy way to travel is to combine walking, biking, and/or transit, in a way that minimizes the cost of motorized travel while maximizing the health benefits of walking.



Urban design concept from Peter Calthorpe (calthorpe.com)

Conceptual development pattern

How do people get around? And: Where are businesses located in relation to residences? These questions are closely related because most travel occurs between ones residence and a business, either a workplace or a store.

On the one extreme, we have strictly separated residential areas and commercial areas in many parts of the city. We have collections of big box stores such as the Montano/Renaissance area, where everything is accessible only by car. The travel pattern in this scenario is to leave home by car, park separately at each big box store (or workplace) and return home by car. This pattern violates the guiding principles presented early in this report, so we don't support this pattern as the norm.

On the opposite extreme, one might imagine a city that has different land uses evenly mixed throughout – industries, stores, and houses all together. But people don't want their houses close to sources of noise and traffic, and businesses generally need to be located near other businesses, so this extreme is obviously not viable either.

Instead of these extremes, we support multiple higher-intensity centers surrounded by lower density housing. This idea is already supported by the Comprehensive Plan. There has been a lot written about transit oriented development (TOD), and "New Urbanist" development. Those kinds of concepts will clearly be essential in meeting the community's goals. Some design points follow. (See Congress for the New Urbanism for more information at www.cnu.org.)

- The centers may include a variety of commercial uses and compact housing, usually in the form of apartments and townhouses.
- The centers can be accessed from all housing by walking, and the center area is walkable.
- The design and architecture of the center promotes a sense of identity, is inviting, and has civic functions, rather than just being a shopping plaza.
- The housing surrounding the center feels like it belongs to the center, so that the whole area is identified as one neighborhood. This is supported by naming, using natural or existing built boundaries, or creating boundaries.
- The specific development styles can differ from place to place.
- The centers are connected by corridors, which *may* include store-lined lower-speed streets, higher-speed boulevards, limited-access highways, and dedicated transit links.

Extreme walkability

While a minimum level of walkability can be provided by safe crossings and sidewalks, a more comprehensive and systematic approach is possible, particularly in new development. Walking routes do not have to be limited to roads. They can cut between properties to connect roads to other trails. Our unique system of urban irrigation ditches and drains could all be opened as walking routes, as well as being part of an interconnected park/open space system. The detailed design of streets can encourage or discourage walking. If the walking environment is like "a walk in the park" then people will combine talking a walk with getting a few things done around town.

Some sources of ideas on walkable design are available at: americawalks.org and greatstreets.org.

Other design points

- Transportation facilities should serve as many goals as possible, not just access; however, access goals should not be lost in the attempt to make roads be "all things to all people".
- Goals of public health and safety can be substantially met by urban design.
- It is better to have more than one way to do things and get places. More than one route, and more than one mode.
- The quest for change can sometimes overtake the wisdom to "leave well enough alone". Neighborhoods that are already built out should generally not be targeted for infill or rezoning or any kind of new facility, even if the original design was not so great. Reports like this one can raise fears about ones neighborhood being suddenly changed. The kinds of goals proposed are best reached in commercial areas and new development, not by changing existing residential areas.

Suggested Goals for the Metropolitan Region

The table below lists 15 goal kings that effectively stand for a variety of public goals relating to land use and transportation. The categories are the same as th guiding principles at the beginning of this report.

These goals should ideally be set by a more involved public process; for the purposes of this draft, the goals are suggested by the author based on informally listening to what has been said on email lists and public meetings.

Category	Goal King	Target
Health & Safety	**1. Safe roads** transportation fatalities on regional scale facilities, per year, per 1,000 people	0
	2. Safe walks incidence of crimes against persons committed on public land, per 1,000 people	0
Vitality	**3. Recreational vital sign** housing units within 3000 feet of open space of at least 10 acres, percent	100
	4. Agricultural vital sign portion of the river valley acres which were adjacent to an irrigation ditch in 2000, that are either in active agricultural use or are fallow, percent	50
Serenity	**5. Quiet city** number of incidents of noises greater than x dB [TBD] in 10 selected residential locations [TBD], per year	0
	6. Dark sky number of stars visible on a clear night from Civic Plaza	1000
	7. Scenic views housing units from which at least one natural feature of the following list is visible, percent *List: top edge of escarpment against the sky, top of one of the volcanoes, cottonwood trees within the bosque state park, any point on sandia crest*	100
	8. Sharper image regional transportation facilities, as judged by survey on a scale of attractiveness of 1-10 (where the scores are normalized for a set of control images)	10
Economy	**9. Safety net** number of people stranded from employment or education due to transportation cost or availability, by survey, per 1,000 people	0
	10. Local economy public expenditures (allocated in *this* process) that go to individual workers in the form of earned income, who live in the boundary of the planning area, in percent of all expenditures allocated in this process	100
	11. Efficient transport total of personal income in the region going to transportation, percent *(The more income that goes to generative or lasting investments like housing or education, the better)*	0
Environment	**12. Clean air** sale of fossil fuel in the region (gallons)	0
	13. Filled aquifer The aquifer is measurably more recharged than it was in the previous year.	Yes

Access	**14. Short commute** Average commute time, by survey, in minutes. *The goal value is not zero because it is reasoned that some small commute time is optimal; people usually don't want to live next door to work.*	10
	15. Choices for everyone the end-to-end travel time (including walking) it takes to use the fastest available *non*-driving mode, averaged for selected trips, expressed as a percent of the time it takes to drive (lower is better) *Note: 30% of the population does not drive. The goal is set at 125% instead of 100% because at the 125% level, it is reasoned that this is close enough so that no further efforts would need to be made just for the sake of equity.*	125

What is success?

The goals are not meant to have *realistic* targets. They have *ideal* targets. Success is progress towards those ideal targets.

Why these goals?

These particular goal kings were selected because (1) they relate to all the guiding principles, and are easily justified by common sense, (2) they are all measurable, (3) none of them require a specific solution – they are all open to creativity, and (4) they are a small set of indicators of a more comprehensive set of goals.

In the Vitality category, a measure of vitality of commercial areas was intentionally left out, because it is hard to measure, and it is sure to be met if the walking safety and economic goals are met. Health is left out because it is furthered (to the extent possible in this context) by the goals of clean air, choices for everyone, safe walks, and recreation. Other environmental goals besides air and water would be likely be met if the air and water goals are met. Non-commute trips are not measured because an improvement in commute times is certain to improve *all* travel times.

You probably would prioritize these goals differently than someone else. For example, one person may consider the dark sky goal to be as important as commute times, while someone else may consider dark skies to be irrelevant. But, these goals are not meant to be the *highest* priorities; they are meant to be *inclusive* of all generally shared priorities. The assignment of priorities is meant to be done in the decision making, not in the goal setting step.

If these goal kings are measured repeatedly over time, it will admittedly be difficult to tell which expenditures were responsible for the change in the measurement. This would be less of a problem on a smaller scale, where fewer changes occur per year. Because this is on a metropolitan scale, it may be necessary to take measurements more frequently and/or by sub-area, in order to capture effects of spending and policy changes, when there may be many such changes in one year.

Goals reprinted from the MTP 2025 report

For comparison, here are the goals from the Metropolitan Transportation Plan for the year 2025. Notice that most of the goals are not easily measurable, so it is not feasible to determine whether they are met, or whether an expenditure or policy was helpful towards the goals or not. They often are goals about activities, sometimes only "promoting" something, so even if those activities do occur, it doesn't necessarily mean anyone's life got any better. Source: Mid-Region Council of Governments (mrcog-nm.gov)

One: Existing System Preservation

To protect, maintain, and promote the use of the existing transportation investment including pedestrian facilities, bicycle facilities, transit facilities, and roadways. By:

- Increasing maintenance activities on the existing physical infrastructure.
- Identifying and remedying current system deficiencies.

- Improving the existing network and correcting system deficiencies.

Two: Preservation of the Physical and Social Environment

To protect and enhance the social, cultural, and physical environment; promote environmental justice; and promote energy conservation to enhance the quality and livability of neighborhoods and community places. By:

- Reducing and minimizing automobile pollution.
- Respecting cultural, traditional, and neighborhood sensitivities.
- Being sensitive to our natural and cultural environment when planning network expansions.
- Reducing negative impacts on parks, public open space, natural areas, and rural areas from noise, visual impacts, and physical segmentation.
- Reducing the per capita vehicle miles of travel growth rate so that VMT growth approaches the population growth rate.
- Encouraging the use of alternative modes of travel.
- Promoting the use of alternative fuels in both public and private sectors.
- Increasing the aesthetic attractiveness of the transportation system with particular emphasis on completion of landscape design for all existing medians in the urban area.

Three: Urban Form

To support the urban form and land use patterns adopted in local plans and guidance set forth in the approved Focus 2050 Regional Plan. By:

- Promoting a balance of jobs and housing within communities and major sub-areas of the region to help reduce the number and length of trips.
- Serving jobs and residences in designated corridors and centers with high quality transit service.
- Serving new growth near existing developed areas to limit the cost of extending transportation facilities.
- Promoting more mixed land-use development in order to decrease travel distances.

Four: Multimodal and Intermodal Integration

To provide an integrated multimodal transportation system that increases accessibility and mobility options for goods and people of all incomes, ages, and physical conditions, and enhances the connectivity of all the elements of the transportation network: roadways, transit facilities, bikeway facilities, and pedestrian facilities. By:

- Offering efficient and accessible alternatives to auto travel.
- Increasing the utilization of transit, biking, and walking.
- Ensuring that these are viable from a safety, convenience, and travel time perspective.
- Developing and optimizing intermodal connections to minimize waiting times and walking distance.
- Promoting the provision of new multimodal transportation services and facilities to occur concurrently with the construction of new developments.

Five: Safe, Efficient and Reliable System

To increase the safety, reliability, and dependability of the transportation system for all travelers and goods, including those traveling by foot, bike, bus, train, truck, and auto. By:

- Addressing unsafe situations caused by the condition of the physical infrastructure of the network (potholes, street lighting, etc).
- Coordinating and cooperating with local law enforcement and emergency response.

- Ensuring that the use of transit, bicycle and pedestrian facilities, and roads is a safe experience.
- Promoting and supporting activities by both the public and private sectors that enhance the efficiency of the transportation system and its operation for all modes of travel.
- Promoting the extension of the transportation network to existing developed areas which are currently underserved.

Six: System and Demand Management

To improve the movement of people and goods by promoting ways to manage the demand on the transportation system as well as ways to enhance its efficiency. By:

- Implementing Intelligent Transportation System technologies.
- Promoting travel demand management strategies.
- Promoting transportation system management strategies.
- Maximizing corridor efficiency prior to making expansions within the corridor.
- Developing a procedure for estimating or accounting for generated traffic.

Seven: Economic Development

To support the economy of the metropolitan area by developing an efficient, effective, and attractive transportation system that strengthens global competitiveness, productivity, and efficiency. By:

- Improving mobility of people and goods.
- Expanding job opportunities, especially within and along Centers and Corridors.
- Supporting the efficient movement of people and goods.
- Coordinating transportation enhancements to mutually support community development and functions of transportation facilities.
- Implementing the Job Access Transportation Plan.
- Supporting a clean, efficient mass transit system.
- Supporting opportunities for beneficial private investments which strengthen urban form as set out in the Focus 2050 Regional Plan.

Design Approach for the Metropolitan Region

Design constraints

An initial inspection of the goals yields a few major design constraints, which narrow the choices considerably.

1. Open space boundaries

It is difficult to reach a moving target, and likewise, the region cannot both meet all these goals and continue to expand haphazardly in all directions. A shift towards **definite boundaries** is needed in order to be able to plan for success and predict the effects of projects (particularly the demand of transportation systems). In order to accommodate the projected population growth, there will need to be development in new places, but those new places will also need definite boundaries. Thus, the boundaries are not about limiting the supply of land, but about growing in a way that the edges of each development and the open spaces between them are set in advance of the building.

The "recreational vital sign" goal suggests that the boundaries should be **convoluted,** not straight lines, in order to maximize the housing that is close to open space. When we buy a house near the edge of the city, near open space, we want to be assured that the open space will continue to be there. The more convoluted the edge is, the more properties can be near the edge.

The "scenic views" goal is possible to meet if the boundaries and open spaces are known in advance of the building. The "agricultural vital sign" goal is helped by definite boundaries for similar reasons. The goals of "efficient transport" and "short commute" are also helped by having definite boundaries, because the capacity of the transportation infrastructure can more easily be planned for a known demand, not a constantly growing demand.

Examine the map of one small part of Vienna, Austria. The green space is the famous Vienna Woods. The blue line labeled "Neuwaldegger Strasse" is an urban street with a streetcar, lined by medium density apartments and single family houses. Just in this small area, thousands of Vienna residents are within walking distance of the open space. The land abutting the public open space is especially valuable and those owners would not want any more development to occur.

The same dynamics already occur in our region, notably in the Sandia foothills. We can also create convoluted edges of the Albuquerque west side and Rio Rancho. Room for future

development can be done by extending peninsulas of development or creating islands of development within the "ocean" of public land.

The separate blocks of private developed land can be different jurisdictions, or they can be different boroughs within one regional government.

2. Reduction of motorized trips

The two alternatives to motorized trips are walking trips, and not needing to make a trip at all. The more efficiently the city is laid out, the fewer trips we have to make to get the things we need. All of the following goals are furthered by the elimination of motorized trips: "Safe roads" (fewer miles traveled means fewer accidents), "Safe walk" (the fewer people driving, the more are walking, and the more people on the streets, the safer and more healthy they are), "Quiet city" (fewer miles traveled means less noise), "Efficient transport" (fewer miles traveled means less cost), "Clean air" (fewer miles traveled means less emissions), and "Choices for everyone" (less need for motorized travel helps those who don't drive.)

3. Transit share

The worst transportation bottleneck in the region is the river crossings. MRCOG has estimated that at current growth rates, a new river crossing lane would be needed every 18 months in order to keep the congestion level the same. Clearly we can't do that. This represents a limit to the system we have in place today. We may be able to build a few new bridges, but certainly not at the rate needed to maintain the current performance of the system.

Currently the region has about 1% transit share, meaning 1% of all trips in the region use transit. Increasing the transit share to a much higher level, like 30 or 40%, would be a key strategy for meeting at least half of the goals. Transit, no matter what kind, promotes walking (which furthers health and safety goals), so it helps meet the "Safe walk" goal.

Transit potentially meets the goal of "Efficient transport" because most forms of transit can be more efficient than cars, if the load factors are high. (If heavy vehicles carry only a few people, then transit could be *less* efficient than cars. But if the transit share rises dramatically, the load factors will probably be favorable to efficiency.)

The "Safety net" goal is obviously well met by high transit share; fewer people would be stranded from work. The "Short commute" goal would be helped *if* transit share were so high that road congestion was reduced. The "Choices for everyone" goal could be more easily met by a more significant transit system.

An increased transit share *could* also help meet these goals: "Quiet city" (if the transit were quieter than highways), "Clean air" (depending on the fuel used), "Sharper image" (depending on the visual design), and "Local economy" (if the transit supplier is local).

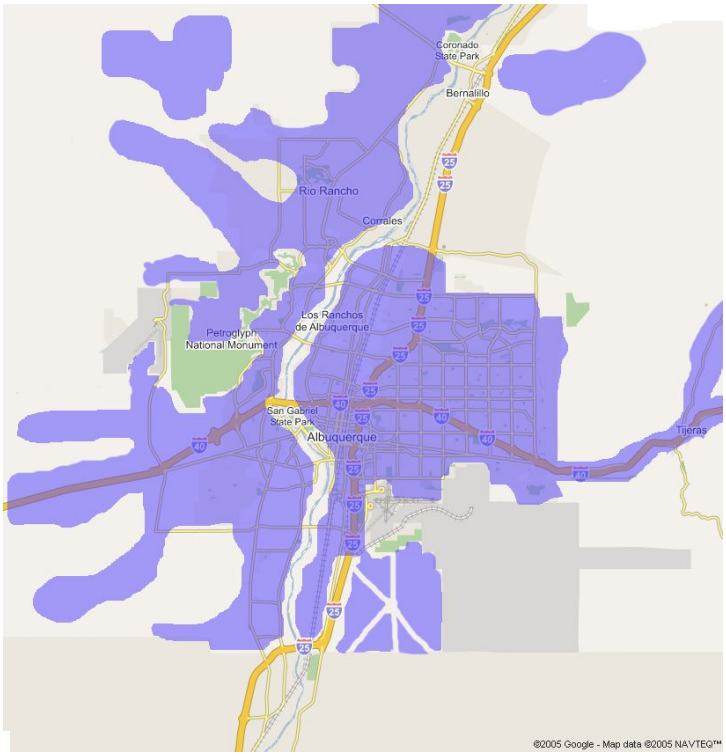
What intensity of transit would be required to move towards these goals? Clearly a doubling or tripling of ridership would be almost unnoticeable regionally: 97% of trips would still be by car. A increase by a factor of 20, combined with elimination of motorized trips and establishing development boundaries, would probably go a long way towards all of these goals.

What kind of transit could be that good? Transit use depends primarily on how it compares with driving. Although there is a small transit-dependent population, getting the high ridership will depend on attracting the large middle class, who have a choice. They will consider the relative costs (gas, parking, fare), the relative door to door travel time, and the utility of being at the destination without a car. Generally speaking, transit can work if these conditions are met:

- There is a way to walk to the transit origin from housing, and that walk is considered safe and attractive, and not too far.
- The service is close to the convenience of driving: particularly speed and frequency of service.
- The traveler experience is acceptable, in terms of the cleanliness, comfort and safety of the vehicles.
- The destination is a walkable place, so that the commuter who has to get through the work day without a car is not inconvenienced.

- The return trip is guaranteed, so that the user is not stranded without a car after service hours.

Accommodating growth and the urban shape



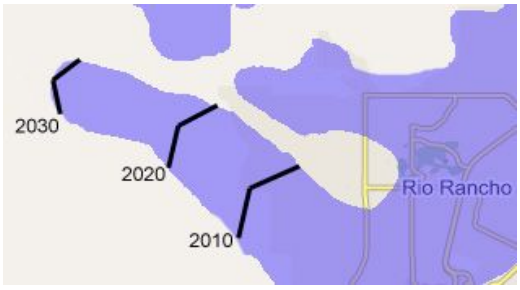
A map is shown here, on which the blue shaded area shows a concept of the future expanded shape of the city. We don't have the resources to determine each parcel's ownership and all the thousands of constraints that would need to be researched to make this plan real. Details could easily be changed while in keeping with the overall idea, so please don't be too concerned about the specific location of each boundary shown. In fact, the boundary shown is just conceptual. It includes several peninsulas and an island of development surrounded by open space.

The expected population growth can be accommodated in areas as follows:

Area	New population accommodated
Existing residential neighborhoods	No change proposed
Commercial & mixed-use infill along Albuquerque corridors	30%
Commercial & mixed-use infill along Rio Rancho corridors	15%
Mesa del Sol	15%
Volcano Heights (Paseo del Norte & Unser)	15%
Westland near I-40	15%
Tijeras, Bernalillo, Los Lunas and neighboring communities	10%
TOTAL	100%

[The percentages have been chosen quite arbitrarily for this draft; it would be helpful to include more basis for the choices, such as the actual potential along Albuquerque corridors.]

This *population* distribution is not the crux of this plan; the important thing is the concept that new growth will be bounded by open space and reachable by transit.



The idea of boundaries is sometimes believed to be a strategy to limit the overall supply of land for development. However, in this context, the meaning is to plan boundaries for current development, that can be extended in a planned way for future development. This zoom-in of a theoretical "wing" of Rio Rancho shows that a peninsula of development may be built out to a certain point by 2010, then continued out to 2020, and so on. This shape allows for a main transportation corridor to serve the area in a way that doesn't overburden it as more development progresses, and it plans for enough open space.

The amount of land along existing underused corridors that can be redeveloped into higher value, transit-oriented places is more than meets the eye. If you look at some areas along East Central, for example, you will see some empty lots. But as importantly, there are underused parcels, mainly single story with most of the land devoted to parking, whose owners would benefit from building more on their land. Once a transit corridor and parking reductions are implemented in one place, there is a cascading effect, which makes neighboring parcels more eager to redevelop. That brings more people, which raises the value, and cascades to more redevelopment.

Since some of that redevelopment can be residential, we will house people while also raising the commercial density. It is difficult to predict numerically just how far the cascading effect will go.

The type of residences that go with mixed use infill are smaller, including rental and owner-occupied apartments and townhouses. It has been estimated that roughly 60-75% of the market demand is for single family houses, so there is a significant demand of at least 25% for the type of housing that would be available along redeveloped transit corridors.

Transit backbone - Area (C) and Regional (D) levels

Recall from the proposed planning framework that planning level D is the metropolitan region. At this scale, a network of D-level roads and D-level transit is needed to move among the far corners of the metro region. The transit must be fully grade separated, and operate independently of the roadways, in order to achieve high service levels. (This requirement can be relaxed for levels C and lower.) Regardless of the technology, the transit network for level D should consist of corridors with relatively few required stops, designed for high speed along straight routes.

Area (C) transit should make the connection from level D to within 1-2 miles of most developed areas. Level C service is more widespread, not as fast, and may have more frequent stops.

In the Albuquerque region, level D and C service can get to within 1-2 miles of all developed areas using about 100-150 miles of service routes.

Currently Albuquerque has one level C service - Rapid Ride. There is no level D service.

The last mile - Neighborhood (A) and Sector (B) levels

Levels A-B is also known as the "last mile problem". The "last mile" (which is not necessarily a mile) is the distance from the origin (say, your house) to the nearest level-C transit stop. The *problem* is that the last mile adds up to much more distance than all the other transit service combined, and so it would be fantastically expensive to provide transit services to everyone's street at reasonably frequent intervals.

Local buses, arranged on half-mile grids, provide service to roughly within a quarter mile of each point, which is the distance most people will find reasonable to walk, according to a planning rule of thumb. It would take at least 400 miles of routes to reach within a quarter mile of all locations in the developed region around Albuquerque. (That service would be level B service; the walk from a house to the service would be level A.)

There is a tradeoff between how close to provide service, and how frequent, given a certain level B budget. There is also a tradeoff between concentrating more funding in level D and C, and distributing it to level B. Today, the funding is distributed to relatively slow, infrequent, but widespread service. This type of transit system does not attract many riders. It could take 30-60 minutes to get to the next bus, and that long again to make a connection, so most people find another way to travel.

The quarter-mile walking distance "rule of thumb" is actually a variable that depends on the travel attractiveness at the boarding station. Put simply, if the station gives you quicker access to all parts of the city, then it is worth a longer walk. A station that has infrequent and/or slow service is only worth a shorter walk. This is because the longer walk combined with a shorter transit travel time may result in a shorter end-to-end trip time.

If there is no traditional bus service to provide level A-B coverage, or it is very infrequent, here are some other options that would appeal to different kinds of people:

- Walking, even up to a mile or more
- Rolling, using a bicycle, electric bicycle, electric scooter, or wheelchair. (Note: electric scooters are now available for under $150, and can go a mile in about five minutes.)
- Taxi (including jitney and group taxi, similar to airport shuttles)
- Getting a ride from a family member, or using park-and-ride.
- Public paratransit service (for qualified disabilities, or expanded for the general public)

Going the last mile is NOT a "one size fits all" problem, because different people have very different inclinations regarding these options. And, when traveling with children or groceries, several of these options are not as practical.

Because all of these options would be far cheaper than frequent transit service, it is important to accommodate all of them. The personal devices that would be used need to be accommodated in the level C/B transit vehicles. That is, a large fraction of the riders may be arriving with an electric scooter, bicycle, or wheelchair. For that reason, there needs to be a lot of open floorspace in each transit vehicle, and all doors should support level boarding or ramps.

If a very high quality regional and area-level service existed, with service every 3-5 minutes, then many people would use these alternate last mile solutions, even if level B bus service also existed. For that reason, level B buses will *never* attract high ridership. And therefore, it may not be worth it to provide level B service with traditional bus routes at all.

There are some people with milder disabilities, who don't qualify for paratransit service, but who cannot make their way the last mile, and cannot afford a taxi and cannot get a ride. This population could be empowered to travel by subsidized taxi fare, up to some weekly limit.

Preliminary Recommendations

The recommendations are "preliminary" because the goals have not been created by a public consensus process, and the recommendations have not been checked against those goals. After this planning process gets more backing, the recommendations can be improved and prioritized using these as the starting point.

Government structure

☑ In order to plan transit, land, roads, and schools all together, we need a regional planning *authority*. MRCOG should be more than an advisory body. However, the regional level government should only have authority over regional matters, not local matters. The specific change in the mandates for MRCOG is a topic for further study.

☑ Government should become more immune to the influence of private interests. Ethics laws should prohibit landowners with a large stake in public decisions from holding office. When private interests are allowed to make public decisions, the process is less democratic.

☑ Governing jurisdictions and other boundaries (schools, neighborhoods, legislative, etc) should become more aligned with each other, to simplify government processes and make public involvement more practical. These boundaries should also be aligned with the physical boundaries of developed areas separated by open space, to contribute to the sense of identity of a place.

Consider the view of this anonymous government employee about the dim prospects for improvement within the current structure:

> *One of the many federal requirements for [the Metropolitan Transportation Plan] is that it must be based on reasonable land use assumptions as reflected in municipal and county policies, comprehensive land use plans, and zoning regulations. So, at the end of the day, despite whatever comparative advantages there are to more compact, mixed-use, smart growth patterns, the land use scenario we must follow is one based on the implemented plans and policies within Albuquerque, Rio Rancho, Bernalillo County, Los Lunas, etc. To date, [I] can discern little movement, planning- or policy-wise, to adopt development patterns too different than those spreading across the western mesa today. [MRCOG] has assumed some infill mixed-use development, primarily in central Albuquerque, but frankly it's dwarfed by the scale of the development around the fringes of the metro area.... Under current New Mexico land use law, the MRCOG enjoys no authority to establish land use or development policies different than the cities and counties.*

Planning process

☑ Use the planning approach outlined in this report. Do not plan for transportation after planning for land use. Instead, plan them together in the same process. Following this recommendation will mean changes in several areas of government. The following bullets list part of what would have to be done to implement this planning process.

☑ The City-County Comprehensive Plan should be binding instead of just advisory, and should encompass the metro region. All other plans should be brought into compliance with it, and all building permits and infrastructure projects should be done only when scoped by the plan.

☑ To further the democratic public involvement in planning, public projects, meetings, and public involvement opportunities should be encouraged and simplified through an on-line system of posting every project with its classification, goals, status, expenditures, time line, milestones, originating agency, detailed design and

construction documentation, and public comments. The system should also allow anyone to sign up for email receipt of new projects, changes to selected projects, and notices and deadlines.

Money

☑ Stop the public subsidy of land speculation. Tax the added value of land that is created through public investment, at a level sufficient to fund the development. This leaves the market economy in place, but removes the commonwealth as a funding source of private profits.

☑ Use transportation money, including impact fees, for transportation of any kind, in a way that best serves public goals. Do not limit the use of road impact fees for roads and separate funding sources for transit.

Other Regulations

☑ Update permitting requirements to legalize and establish public review procedures for new innovative transit systems operation, whether the operator is a public or private entity. (See Appendix B) This recommendation will make it possible for a private for-profit operator to provide transit services with no subsidy, while protecting the public from any negative effects of that activity.

Brookings institution recommendations

We support these recommendations, developed by the Brookings Institution; *Reprinted from The Boston Globe, May 14, 2005.*

☑ Transparency. …disclose programs and spending decisions in a transparent, accessible, frequent, and continuous manner.

☑ Accountability. At a time of economic uncertainty and fiscal stress, transportation spending must be held to a higher standard of managerial efficiency, programmatic effectiveness, and fiscal responsibility. To that end, reform efforts should establish a new framework for accountability that includes improved performance measures and rewards for exceptional achievement.

☑ Integration. Congestion is a product of many factors: dispersed development, employment decentralization, shifting consumption patterns, market restructuring, and accidents.

☑ Metropolitan governance. Congress should recognize the primacy of metropolitan areas where eight out of 10 Americans live and align the geography of transportation decision making with the geography of metro regional economies, commuting patterns, and social reality. To this end, it should devolve greater responsibility and resources to metropolitan entities.

☑ Market dynamics. The mounting transportation pressures occur at a time of severe fiscal constraint, pervasive frustration with congestion, and increasing opposition to road expansion. As in Europe, this requires a firm national commitment to make maximum use of existing road capacity and expand transportation alternatives. Efforts for using state-of-the-art communications technology to encourage market approaches to congestion relief, including road pricing should be augmented.

Appendix A: Computer Modeling

Why do we need computer modeling?

Computer modeling is a valuable component in planning if used wisely. It is difficult to tell intuitively what kind of public investments are the most beneficial and where to focus the spending. Our intuition about transportation often turns out to be wrong. For example, widening a stretch of road would seem to be a good strategy to reduce traffic congestion, but this strategy might actually have no effect or worsen the problem, depending on the circumstances. For example, it could shift the congestion from one intersection to another one, or it could increase the accident rate, which would in turn cause more congestion. A computer model can predict the effect of the change better than intuition alone. Today when we face rapid growth on the west side, and there are already bad traffic conditions, computer modeling is especially valuable on the regional scale to help make the best decisions about the long term regional transportation structure.

What is modeling?

The basic idea of a model is that you encapsulate general or statistical knowledge obtained from other sources, and apply it to particulars. For example, you could use a model to predict car buying choices of a population, based on observed past behavior. You might want to predict the percent of SUV's that will be purchased if gas prices continue to rise. Start by obtaining car buying data from the past and looking for correlations. If you find a correlation between past gas prices and past SUV sales, then you can encapsulate this information as a simple mathematical *function*. You can then apply this function to a range of inputs (potential future gas prices) to get a range of outputs (predicted SUV purchases). This model can be done in a spreadsheet. It would probably not be very accurate because we know that there are multiple factors that go into car buying decisions, not just the price of gas. However, it could be useful as part of a larger model.

Another more complex kind of model simulates individual behaviors over time based on conditions that change over time. An example is a model that predicts the movement of the planets around the sun. We know so much about the laws of gravity that we can predict with great accuracy the position of all the planets at any time in the future. Here is a simplified way to do this: First record the initial state at t=0 (the starting time). The initial state is the collection of position, mass, and velocity for each planet. Then, advance the time to t=1 (one second or one minute, or some other time period). Then calculate the new position and velocity of each planet at that time, based on the position and mass of *all* planets at t=0. So, the *entire* database of states at any given moment in time can influence the behavior of *each* individual at the next moment in time. The idea is still the same as the car-buying model: we are applying general knowledge in the form of mathematical functions to individual behavior. The planetary model can be written in less than a page of computer code.

How can transportation be simulated?

For the purposes of transportation simulation modeling, the model predicts the behavior of people instead of planets, and there are many more data points. But the concept is the same. We have a state database at t=0, which consists of all the existing people, their origins (housing), their destinations (jobs, school, shopping, etc.), and the available links (roads and transit). Since this is a lot of information, the models are simplified by the use of aggregate information, where one data point represents more than one person. Some of the initial state information has to be estimated; for example, instead of typing in each person's place of employment, we apply general information about employment distribution over the region and let the model apportion people's place of employment based on the general knowledge. If this simplification is done well, the model remains accurate; but if it is oversimplified, then the model is no longer accurate.

One goal of transportation modeling is to predict the usage of each link at each time of day. For this, we would choose a short time span, like one minute. So for t=1 (one minute later), the model would calculate a new

exact position for each person (or aggregate person), based on the state of the links and other people's positions at t=0. And then the simulation would repeat for each minute of the day, and as a result you could predict the usage of each link at each time during the day.

Simulation models can iterate over short intervals (seconds) to predict instantaneous driver decisions, medium intervals (minutes to days) to predict daily travel behavior, or long intervals (years) to predict settlement patterns and choice of destinations. In the long term models, the available links can change over time. In these models, it is not a case of transportation causing land use, or vice versa, but rather a continuous cycle of cause and effect in both directions.

What model should we use?

Any model has "independent variables" that the modeler chooses, such as the assumptions inherent in the behavior functions, the land available for development, and the available transportation links. These independent variables are not changed by the model itself, but they can be explicitly changed over time by the analyst. For example, if a new road is projected to be finished in 2012, the model can make use of it starting in that year.

Models also have "interdependent variables" (or dependent variables), which are the states that change with each model iteration. Ideally a model should include all choices made by individuals as interdependent variables, although this is not always done.

Modelers have created a four-step process that predicts changes over time in these four classes of interdependent variables:

1. generation – where do people live?
2. distribution – where do people go?
3. mode split – how to people get there? (car, bus, etc)
4. assignment – what specific route do they take? (This provides congestion data.)

All four variables are potentially affected by the other three. For example, people will either move closer to their job or get a new job if the time it takes to commute becomes unbearable. People will buy things at the most convenient location, so a new shopping center will result in shorter trips for some people. People will take transit if it is faster and cheaper than driving (and sometimes if it is just faster, and sometimes if it just cheaper). People will adjust their route to shorten their trip time. There are behavior functions for all of these kinds of choices.

The planning horizon for transportation is typically 25 years. The groups of inputs are called scenarios, and so each scenario produces a 25-year prediction of travel conditions. That is to say, for each set of assumptions about future land development and transportation infrastructure, the model can predict the future travel conditions that result from those assumptions. The predicted travel conditions must be evaluated against measurable statistics that include speed, per-capita miles traveled, pollution, and access by non-drivers. A good modeling process will run many scenarios and keep adjusting the scenarios to find the best possible results. So in effect, the inputs are not entirely independent, since they represent collective public choices. The overall result of the modeling process can be a recommendation to elected officials to pursue what was found to be the most beneficial scenario.

Specific recommendations

Modeling that uses current or historical spatial or travel data can inadvertently "predict the present" when the intent is to predict the future. In order to make accurate projections, all the input data sets have to be modified to suit the projected future conditions.

The kinds of scenarios that should be run include the trend scenario, the no-build scenario (no new links over 25 years), and various other scenarios that are purposefully created to achieve certain results. For our region, the creative scenarios should make tangible the planning concepts that are in the Comprehensive Plan, such as transit-oriented developments (TOD), infill, and restricted edge growth.

Individuals and groups including students should be given the specific scenario formats, so that they can fill in the inputs and the COG can run them at a minimum of administrative cost. The COG should publish an explanation of how the model works, both for the public and internal use.

The simulation modeling capability of the COG should be expanded so that all four classes of interdependent variables are truly interdependent and are calculated together in the same model.

The behavior functions that are used should be based on the best available national research, not on local data. Using local data precludes behavior that has not been observed locally in the past, even though it may be viable in the future.

Each simplification that is introduced should be modeled to show that it does not skew the results.

The COG should report in the Metropolitan Transportation Plan, the measurable goals and evaluation framework, the model formulas, the simplifications, each scenario run including the data details in an appendix, the scoring for each scenario, and the scenario recommended by the analysts with justification.

Appendix B: Public permitting of transit

A transit system must be permitted by a government process. In order to exploit American ingenuity without taking on undue public risk: (1) The permit should be issued under the same rules, whether it is a public or private operator. (2) The only requirements that should be included in the permitting process are those that pertain to public rights and safety, not those that deal with financial matters or level of service. (3) The decision to issue a permit is a different process from the process of setting goals or deciding how to spend public money; so permitting should not be connected to spending.

This approach allows a private operator to take on *all* the risk. The public permit should be designed solely to protect the public. The private company is responsible for itself.

The bulleted requirements below are divided into sections to show how the requirements relate to public rights and safety. Some are minimum requirements, and others are preferences, which could be used to either subjectively or quantitatively qualify systems for permitting. For example, a permitting agency could decide to issue a permit for a system that meets any five out of ten preferences.

Protection of urban form and character

- System fits into urban form aesthetically, at least as well as roads and other existing transit. (preference)
- The skyprint (cross sectional extent of visual blockage) of any elevated portion of guideway is less than 3 m (absolute) and preference given if under 2 m, and strong preference if under 1 m.
- The system should minimize real or perceived barriers dividing neighborhoods. (preference)
- The system should be planned in a way that is sensitive to changes in future land use based on new transportation options. The best systems should be movable to new areas and removable in areas where city growth has made them obsolete. (preference)

Protection of existing uses of public property

- System fits into existing street rights-of-way without eliminating a traffic lane or a lane of on-street parking. (preference)
- Stations can be building-integrated or stand-alone. (strong preference)
- The system should not impede other transportation, e.g. roads. (strong preference)
- Impact to historic structures should be avoided. (preference)

Protection for private property

Protections for private property parallel those for public property and urban form. Additionally:

- Established rights of solar access, visibility, or noise must be honored or compensated. (However, the private property owner may specifically wish to provide a station and an easement for the system.) (absolute requirement)
- Construction impacts should be minimal. (preference)

Safety

(All safety items are minimum requirements.)

- No deaths should occur in the first 10^9 pas-km of operation. Death should be demonstrated to be less than one case in 1×10^9 km thereafter.

- Minor injury should be demonstrated under test operation to be less than one case in 1 x 10^6 km.
- A safety methodology must be developed and published by the operator, prior to the first passenger served, and an ongoing proof of safety must be conducted during operations.
- The safety methodology should be validated by an independent firm to confirm that the above accident rates are realistic.
- Structural members are engineered properly for local conditions (such as earthquake zone).
- Vehicles must permit emergency egress.
- Egress must be available from all points, whether by walkways, ladders, helicopters, or rescue vehicles.
- Vehicle must be fire resistant.
- The system must not impose hazards on people outside the system; for example, a high speed system right-of-way must be fully protected from other uses by being elevated, fenced off, or otherwise protected.
- Civil structures located near roadways must resist the force of a crash of the heaviest vehicle permitted on the roadway, OR must be built to withstand impacts according to the local regulations.
- When a danger condition occurs, such as an impassible guideway, it must be detected, and the system must be designed to prevent any more than ten passengers or one vehicle from entering the danger zone from each direction after the condition occurs. (This requirement limits the number of passengers unnecessarily thrown into a danger situation, but does not limit the size of the original event.)

Equity

- System is wheelchair accessible, and offers an equivalent level of service to wheelchair users. (absolute requirement)
- System must make provision for use by the blind and the deaf.

Environmental protection

- Energy use less than average car with single occupant (SOV). (preference)
- Noise (external) no more than SOV. (preference)
- Impact to wetlands or other sensitive land should be avoided. (preference, or as required by applicable laws)

Protection of public expense

- Complete construction is funded according to the funding plan, and nothing is left to public expense to clean up, such as resurfacing affected roads, environmental mitigations, etc. (preference)
- Multiple manufacturers must be available from which to procure components; therefore, the manufacturing specifications must be available to the operator. (This requirement protects the public from one class of operating failure that could conceivably force public expense to dismantle an inoperable system.) (preference)
- Inoperable vehicles do not disable the whole system, and can be removed from the guideway without demolition. (absolute requirement)