Population Forecasting & Allocation

Forecasting
Planning transportation facilities for rapidly growing urban area like the Treasure Valley requires an adequate understanding of future usage. Population, employment, and land use are basic determinants of travel, therefore a first step in assessing transportation needs is to prepare a population estimate and forecast. Communities in Motion was adopted as the regional, long-range transportation plan for southwest Idaho in August 2006. Federal requirements necessitate the update to this plan by August 2010. One of the initial steps to identifying transportation improvements is to realize land use, growth, and subsequent travel demand impacts.

The Communities in Motion update will consider three forecast scenarios: Community Choices, Trend, and Preservation. The Community Choices scenario encourages growth inside city “areas of impact” and emphasizes higher densities and mixed-uses with jobs, shopping, and services closer to housing. Comparatively, the Trend scenario will continue the current land use patterns. The Preservation Scenario will quantify local land use agency plans to determine a buildout population, households, and employment. The Preservation scenario is not limited to an population or employment control total.

COMPASS’ forecasts are used by policymakers and the general public, as well as by public and private agencies throughout the region. Local jurisdictions use the forecasts for general plan updates and capital facilities planning, including environmental impact reports (EIRs), and for local transportation planning. Other agencies such as the school districts, public services, and retail businesses use aspects of COMPASS’ forecasts to develop plans for providing services. COMPASS’ forecasts represent the changes we can anticipate for the region and its communities based upon the best available information at the time the forecast is produced and reputable computer models. They are meant to help policy and decision-makers prepare for the future and are not an expression for or against growth.

A population estimate refers to the current population in a given area. Since 1990, COMPASS has developed population estimates for city and county jurisdictions in Ada and Canyon Counties. COMPASS population estimates are available at: http://www.compassidaho.org/prodserv/demo-current.htm

The terms "projection" or "forecast" refers to the anticipated population in the future. The difference in population and employment between a future forecast and a current estimate is the amount that must be considered in a land use allocation model.

Allocation
A forecast will indicate a rational view of future conditions based on assumptions. However population figures alone do not provide the necessary information to anticipate travel demands. The location, type of land consumption, and location of...
services also dictate future travel conditions and can have different transportation demand impacts.

COMPASS has developed a land use model, UPlan, which is capable of allocating future households and employment to better analyze traffic demand on current and planned roadways. On April 20, 2009, the COMPASS Board approved a 2035 Population Forecast of 1,046,000. This control/constrained total will be allocated to determine future growth according to a Trend and Community Choices scenarios.

**COMPASS Models**

COMPASS uses three models in travel demand and land use forecasting: (1) Econometric model, (2) CUBE, a travel demand model, (3) and Uplan, land use model. All of the models incorporate “best practices” used by Metropolitan Planning Organizations (MPOs) throughout the nation. In addition, COMPASS is continually evaluating and refining its models and incorporating updated techniques and information as necessary.

**Econometric Model**

COMPASS contracted with Idaho Economics for an econometric forecast. The economic forecasting model is based upon historical data and estimated statistical relationships of economic concepts in Idaho to national economic concepts or to other economic concepts within the State of Idaho. The economic forecasts estimated within the model are solved in a step-by-step, block-recursive fashion. The economic model has nearly eighty equations that are solved simultaneously. The results of this model were considered by a COMPASS Demographic Advisory Committee (DAC) in establishing a population control total for Ada and Canyon counties.

**Travel Demand Model**

Travel demand forecast models are not new to the State of Idaho, especially in Ada County. The earliest record of a travel demand model for Ada County is 1975. At this time the model and demographics were developed and managed by Idaho Transportation Department Headquarters. In 1995 Ada County became a “beta test site” for a tour base model and it was one of the first applied by an MPO. After further review of the 1995 model and the tremendous growth occurring to the west, APA decided to develop a two county traditional 3-step model. In 1999, the Ada-Canyon partnership was final and APA became Community Planning Association of Southwest Idaho (COMPASS). A few short years later COMPASS began another update and calibration effort which ended with acceptance of a new model by TMAC in June 2004.

COMPASS uses Cube Voyager and TP+ developed by Citilabs. It has been used in a variety of applications, including Roadway System Deficiencies, Level of Service Analysis, Air Quality Conformity, Long-Range Transportation Planning, Transportation Improvement Programs, Impact Fee Program for Ada County Highway, and Special Studies.¹

¹ 2002 Travel Demand Forecast Model Calibration Report for Ada and Canyon Counties
The Role of Models
Models are reflections of rational views of how the world works and provide a consistent framework for our discussions and analyses. Models must be complex enough to represent a great variety of social, economic, and environmental phenomena and simple enough to have transparency.

Models are valuable tools for consensus building and for making informed planning decisions; however, models do not make policy decisions. Models can be useful for the following:

1. Analysis of past and present growth patterns and travel demand,
2. Projection of land use patterns and conditions (Trend), and
3. Prescription of desired future conditions and requisite policies.2

Various studies have shown that the integration of travel and land use modeling can substantially change the results compared to running a travel model only.3 4 Planners at Portland in Sacramento have completed analysis of their integrated urban models (travel and land use models, run in sequence) with their previous typical analysis, using only their travel model and found that not using a land use model can result in exaggerated projections of congestion, because the effects of congestion on land development are not represented.

Selection & Procurement of Model
The COMPASS evaluation of land use models was patterned after the Environmental Protection Agency Guidebook, “Projecting Land-Use Change: A Summary of Models for Assessing the Effects of Community Growth and Change on Land-Use Patterns.”5 The guidebook provides a summary of 22 computer modeling tools that assess the impacts of community actions and policies on land use, and the reciprocal effect of land-use changes on certain community characteristics. The guide provided information regarding the models’ applicability, data and resource requirements, strengths and limitations, technical and personnel resources, and costs. Criteria were established for selection of a model that met COMPASS needs including cost, applicable GIS Interface, Travel Demand integration, level of difficulty of use, and personnel and computer requirements.6 After initial evaluation, the models search was narrowed to six models which met the COMPASS criteria. After additional research, feedback from the COMPASS Demographic Advisory Committee, and COMPASS Board, UPlan was selected as the land use model for implementation.

The UPlan Land Use Allocation Model is a GIS based model developed by the University of California, Davis, Department of Environmental Science and Policy

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2 UPlan: A Versatile Urban Growth Model. for Transportation Planning TRB Paper 03-2542
3 (Rodier, et al., 2002).
4 (Rodier, Johnston, and Abraham, 2000).
5 faculty.washington.edu/pwaddell/Models/REPORTfinal2.pdf.
6 T:\FY06\600 Projects\647 Land use model Demo. Project\land use model matrix.doc
with funding from CALTRANS, the University of California Transportation Center, the California Energy Commission, U.S. Department of Energy, U.S. Department of Agriculture, and the Mineta Institute of California State University, San Jose. Several agencies have implemented UPlan for a variety of land use, transportation, and environmental pursuits (see sidebar right).

UPlan was selected as the land use model as data needed to accurately run the model was commonly available, is GIS based, can be built within several months, and can be configured to integrate with a travel simulation model. UPlan 2.6 was procured from the University of California at Davis on April 18, 2007.

**Introduction to UPlan**

UPlan is a GIS, micro-scale, land-consumption model, with particular respect to the loss of open space and redevelopment of existing areas. The GIS framework was particularly appealing as spatial relationships commonly used by developers to evaluate building sites, such as the proximity to transportation facilities, existing land uses, political boundaries, and environmentally sensitive areas, are precisely defined in the GIS layers.

UPlan is a GIS based model, which makes the processing and analysis easier. The graphics on the right describe UPlan as a series of equations. UPlan is based on the following assumptions:

1. The population growth can be converted into demand for land-use by applying conversion factors employment and household forecasts. The model requires inputs of population, employment, persons per household, employees per household, square footage per employee, and floor area ratios.
2. New urban expansion will occur in areas primed for development due to their qualities or proximity to attractions for future development.
3. Some areas have different attraction weights because of accessibility to transportation and other infrastructure.
4. Some areas, such as lakes and streams, will not be developed. Other cells, such as environmentally sensitive habitats and flood plains, may be covered by policies to discourage new development.

**UPlan Highlights**

- UPLAN is a GIS-based model for testing urban growth scenarios.
- UPLAN is interactive. As a malleable model it can change the inputs of the model.
- UPLAN uses input data layers that are widely available in the U.S. We operate on 50m grid cells, so small urban infill sites and individual rural residential sites can be represented.
- UPLAN uses transportation and utility services variables as attractiveness factors. It then allocates land uses in order of bidding ability in the market (industrial, commercial high density, residential high density, commercial low density, residential medium density, residential low density).
• The user can set various environmental and social constraints to growth, such as steep slopes, areas with shallow groundwater, wetlands, or surface water bodies with a buffer of any size. One can also specify various levels of land use plan compliance, ranging from none, to using only the industrial designations, to one-way zoning, to two-way zoning.

• Policy tests that can be undertaken include: general plan changes, urban growth boundaries, habitat/open space preserves, riverway/floodplain protection, new freeways and roads, and new rail transit lines.

• The growth impact models work from the urban layer for the future year and other data layers. Models include: habitat damage, erosion potential, costs from flooding, costs from wildfires, and local service costs.

**UPlan Users**

• **Alachua County, Florida:**
  UPlan was used for the characterization of ecological boundaries and strategic ecosystems. It was run as a participatory model.

• **Sacramento, California**
  SACOG, the regional transportation planning agency, used UPlan in iteration with their travel model, to represent the effects of various sets of transportation facilities on land development and study growth scenarios.

• **Merced County, California**
  An EPA and FHWA-sponsored program used UPlan to coordinate local land use planning with state and local transportation planning to test the cumulative impacts of roadway plans.

• **Northern Sierra Foothills**
  Four counties (Sierra, Nevada, Placer, and El Dorado) used UPlan for regional planning for sustainable development and habitat planning.

• **San Francisco Bay Area**
  UPlan was used for projecting urban growth for CalFed, the federal/state water planning organization to assess the effects on conversion of agricultural lands.

• **New Mexico**
  Three counties (Santa Fe, Los Alamos, and Rio Arriba) are using UPlan in regional economic development.

• **Salt Lake City, Utah**
  Graduate students have applied UPlan for academic projects to study the land development effects of a planned new freeway.

• **San Joaquin Valley, California**
UPlan was used to project urban growth with and without a proposed Foothill Freeway (SR 65) and to examine the effects of the proposed High Speed Rail line.

- Ducks Unlimited
  Various projects have used UPlan including waterfowl habitat acquisition; land cover datasets, and to evaluate urban growth impacts on oak woodland habitats.

**UPlan Inputs**

UPlan requires population, employment, and land use inputs for modeling. Land allocation is calculated on user-specified demographic and land use factors. For example, to determine amount of acres allocated to future housing, the user specifies persons per household, percent of households in each density class, and average parcel size for each density class. A similar conversion is done for employment as workers per household, percent of workers in each employment class, and average area per worker (in square feet and acres) are the inputs, are is used to determine acres of land consumed for industrial, retail, office, and government employment.\(^7\)

The base UPlan model forecast to seven land-uses. COMPASS has modified the land-use categories for additional specification and to account for specialized areas not accounted for by the base model. These land uses are converted into additional categories for use in the travel demand model.

**General Plan**

A regional, generalized comprehensive plan layer was created from a composite of the various municipalities plans. These land use categories were generalized and land use categories were grouped into the 10 different land use categories recognized by the COMPASS UPlan model. The composite general plan layer was modified to include all density figures expected for those designated land uses. Analysis and conversion of individual jurisdictional plans was completed so that similar densities matched UPlan land use codes. For example, all densities from 10.0 to 20.0 dwelling units per acre were classified as “Medium Density Residential” per UPlan coding conventions. The existing general plan layer was then converted to grid format.

UPlan allocates growth in compliance with the generalized land use layer. The land use forecast provides an assessment of where our plans of today, if left unchanged, will likely take us over the upcoming decades.

**Attraction, Discouragement, and Mask Layers**

In the UPlan Model, the spatial allocation of new development is driven by “attractors” and “discouragements”.

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\(^7\) S:\PROJECTS\LandUseModel\Uplan\Documents\Manuals\UPlan 2.6 User Manual.doc
**Attractions for Development**
Regional demand for each land use type is then allocated starting with the grid with the highest score. The user can designate the number and size of the buffer intervals and assign an attractiveness weight to each buffer. Buffer specifications are applied to each of the attraction grids and then the grids are overlaid and added together to make a composite Attraction Grid.

For example, residential development is attracted to locations with a good view (hill tops, lake shores) and good access (arterial roadway with low level of service). It is also assumed that the closer a vacant property is to an attraction, the more likely it will be developed in the future. For example, a property that is a quarter mile away from existing development (or any attraction for that matter) is more desirable than one that is a mile away from the same location. Following these assumptions, each development attraction is surrounded by user-specified buffers. The number and size of the buffer intervals and assign an attractiveness weight to each buffer. Buffer specifications are applied to each of the attraction grids and then the grids are overlaid and added together to make a composite Attraction Grid.8

**Discouragements to Development**
Some features such as protected habitats, 100-year flood plains, or prime agricultural land might be developable at a high societal or economic price. These features are called discouragements in UPlan. Any GIS feature, which is judged to discourage development, can be used. Discouragements act similarly and oppositely as attractions as the user specified inputs the degree of development discouragement. Discouragement values are combined with attractions to form a net attraction grid and values of impacted cells in the final attraction grid will be smaller because of the discouragements.

**Exclusions Against Development**
In most scenarios, there are areas that are excluded from development. Exclusions include features such as lakes and rivers, public open space, built-out urban areas, and environmental preserves. Based on user inputs the model adds exclusion grids to generate a “Mask.” The Mask Grid is the composite of the individual exclusion grids.

Urbanized areas are a mask in the model runs. Urbanized areas are those that have existing development are not likely to be redeveloped due to their land use, economic, and land characteristics. Redevelopment and infill locations, those determined to prime for infill due to land use, economic, and land characteristics, are allocated according to the attraction layer established.

**Allocation of Future Growth**
The model overlays the attraction and discouragement grids to determine the net attraction for each grid and then allocates future development starting with the highest valued cells (as determined by attraction, discouragement values. As

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8 S:\PROJECTS\LandUseModel\Uplan\Documents\Manuals\UPlan 2.6 User Manual.doc
higher-valued cells are consumed, the model looks for incrementally lower-valued cells until all the units of projected land consumption are allocated. The model first allocates industrial uses, then proceeds to high-density commercial, high-density residential, low-density commercial, medium-density residential, and finally low density residential. Very low residential are randomly allocated throughout available rural areas to represent the prevalent noncontiguous pattern of exurban rural development.

**Model Results**

**Population & Employment Forecasting**

Current population and employment forecasts are required for accurate UPlan model results. Population estimates for UPlan will be based on COMPASS annual official population figures approved by the COMPASS Board in the spring. Population Forecasts are based on population, household, and employment figures from the Communities in Motion Plan, approved in August 2006.

The update to the *Communities in Motion* transportation plan will be a valley-wide (Ada and Canyon counties) population forecast of 1,046,000 with a horizon year of 2035.

**COMPASS Committees**

Forecasting at COMPASS is a collaborative process. The models, inputs, and results are presented to professionals and policy-makers. For the calibration of the model, COMPASS convenes a Regional Technical Advisory Committee (RTAC), Demographic Advisory Committee (DAC), and Regional Geographic Advisory Committee (RGAC). These committees composed of experts in demography, housing, economics, and other disciplines from state and local agencies, local universities, and the private sector. This committee is responsible for reviewing the regional model structure, data inputs, assumptions, and also evaluates the forecast results. Many of the inputs come directly from jurisdictions and reflect current local policies.
**UPLAN Glossary**

**Airports:** Public airports.

**Annexation:** Legal incorporation of land into a city within the last 12 months.

**Area of Impact:** Area outside of the city’s legal boundaries for which urbanized growth is directed.

**Attractions:** Feature that induces growth to occur nearby.

**Average Square Footage:** These parameters allow the user to define the average amount of building space per employee for each of the employment categories. The default square feet per employee is 333 for office, 400 for retail and 667 for warehousing/distribution based on studies conducted by the U.S. Department of Transportation Federal Highway Administration.⁹

**Average Lot Size:** These settings are used to specify the average size of a lot (in acres) for each of the density classes. The number of units per acre specified in a general plan or zoning ordinance.

**Boise Airport Influence Area:** Area surrounding the Boise Airport which where residential development is discouraged.

**Buffer:** Distance for which the weight applies. For example, a buffer of 500 (from) to 1,000 (to) would give a specific value for that proximity to the feature from 500’ to 1,000’ of the boundary of the feature.

**Capital City Development Corporation Districts:** Locations promoting downtown housing and jobs according to master plans of the Capital City Development Corporation.

**Discouragements:** Feature that restricts growth from occurring nearby.

**Employment Proportion:** The proportion of employees in each of the three categories: The total should be less than or equal to 100%.

**Exempt:** Publically owned land that does not allow for the allocation of growth.

**Feature:** Landmark that induces (*Attractions*), discourages (*Discourager*), or prohibits growth (*Masks*).

**Flood:** Floodplain or floodway.

**Floor Area Ratio –** This is the Floor Area Ratio for each of the employment categories. FAR is calculated by dividing the total square footage of a building by the square footage of its lot.

From: Distance the buffer applies.

Highway: Roadway maintained by the Idaho Transportation Department.

High Capacity Transit Service Corridors: High Capacity Service Corridors planned for service every 15 minutes all day based on Valley Regional Transit’s Treasure Valley in Transit Plan.

High Volume Roadways: Traffic volumes greater than 5,000 ADT.

Industrial Agricultural: Dairies and feedlots which have been licensed by the Idaho Agriculture Department, and other features which may emit odors undesirable in residential areas.

Inexpensive Agricultural Land: Agricultural Land assessed at less than $1,000/acre. This feature was created with the intent of establishing a pseudo-economic dynamic for identifying potential development of agricultural land.

Low Transit: Transit service, planned for every 60 minutes all day based on Valley Regional Transit’s Treasure Valley in Transit Plan.

Major Activity Centers: For purpose of this analysis, regional MACs in this area will focus on three categories and are defined as follows:
   1) Main Activity Centers: Central business districts linked to the interstate, Boise State University, Boise Airport, and Regional Medical Centers
   2) Employment Activity Centers: Employment areas with a density of 5 employees per acre
   3) Commercial Activity Centers: 500,000 commercial square footage within a ¼ mile radius

Major Roads: 1) Principal arterials which serve the major regional centers of activity of a metropolitan area, the higher traffic volume corridors, and the longer trips while carrying a higher proportion of the total urban areas travel on a minimum of roadway mileage. 2) Minor Arterials which interconnect with and augment the principal arterial system and provide service to trips of shorter length at a lower level of travel mobility than principal arterials.

Masks: Layers that prohibit allocation of growth.

Medium Transit: Transit service, planned for every 15-30 minutes all day based on Valley Regional Transit’s Treasure Valley in Transit Plan.

Open Space: Parks, golf courses, cemeteries, and other features that preclude development.

Persons Per Household: household size used to determine amount of housing units and residential land allocated.
**Preliminary Plat:** Land designated for development and receiving preliminary platting entitlements.

**Prime Agricultural Land:** Land determined to be of best quality for growing crops due to the soil characteristics and water supply.

**Residential Ratio:** The proportion of households in each of the four density categories.

**Schools:** Public schools.

**Slope:** Slope greater than 25% which prohibits growth in the model.

**To:** Distance to which the buffer applies.

**Traffic Congestion:** Level of Service of D or worse. Level of Service D is a zone that approaches unstable flow, with tolerable operating speeds, however driving speed is considerably affected by changes in operating conditions.

**Transit nodes:** Locations identified in land use plans for development supportive of high capacity transit.

**Urban Development:** Land considered “built-out.” Residential land was considered built out based on assessed land to building valuation ratio, zoning potential, and land use plan potential.

**Water:** Water bodies which are attractive places for nearby growth (i.e. Boise River, Snake River, Lake Lowell, and Lucky Peak).

**Weight:** Value of the buffer.

**UPLAN:** A GIS-based, proximity-based land use model which forecasts land development based on location and attraction to geographic, political, and pseudo-economic features.