Sprawl Dynamics

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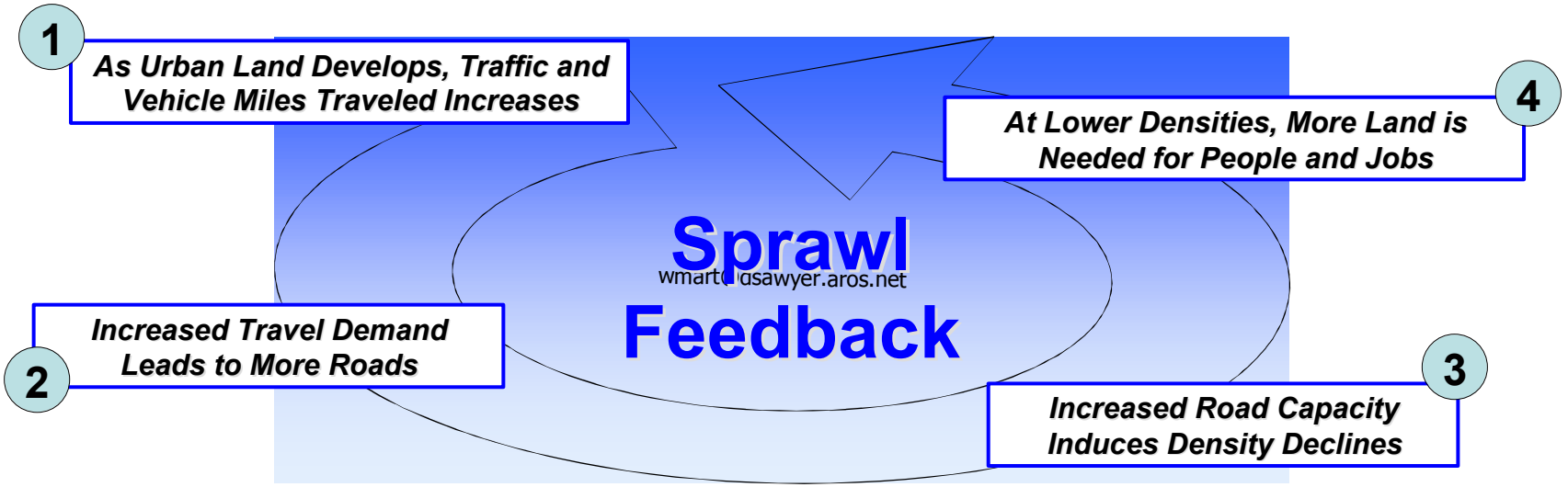
RailVolution 2005

SimTropolis

- Dynamic yet Radically Simplified
- Metro-Regional Scale
- Integrated Urban Land Use & Transportation Scenario Generator
- For the Exploration of Alternative Urban Futures

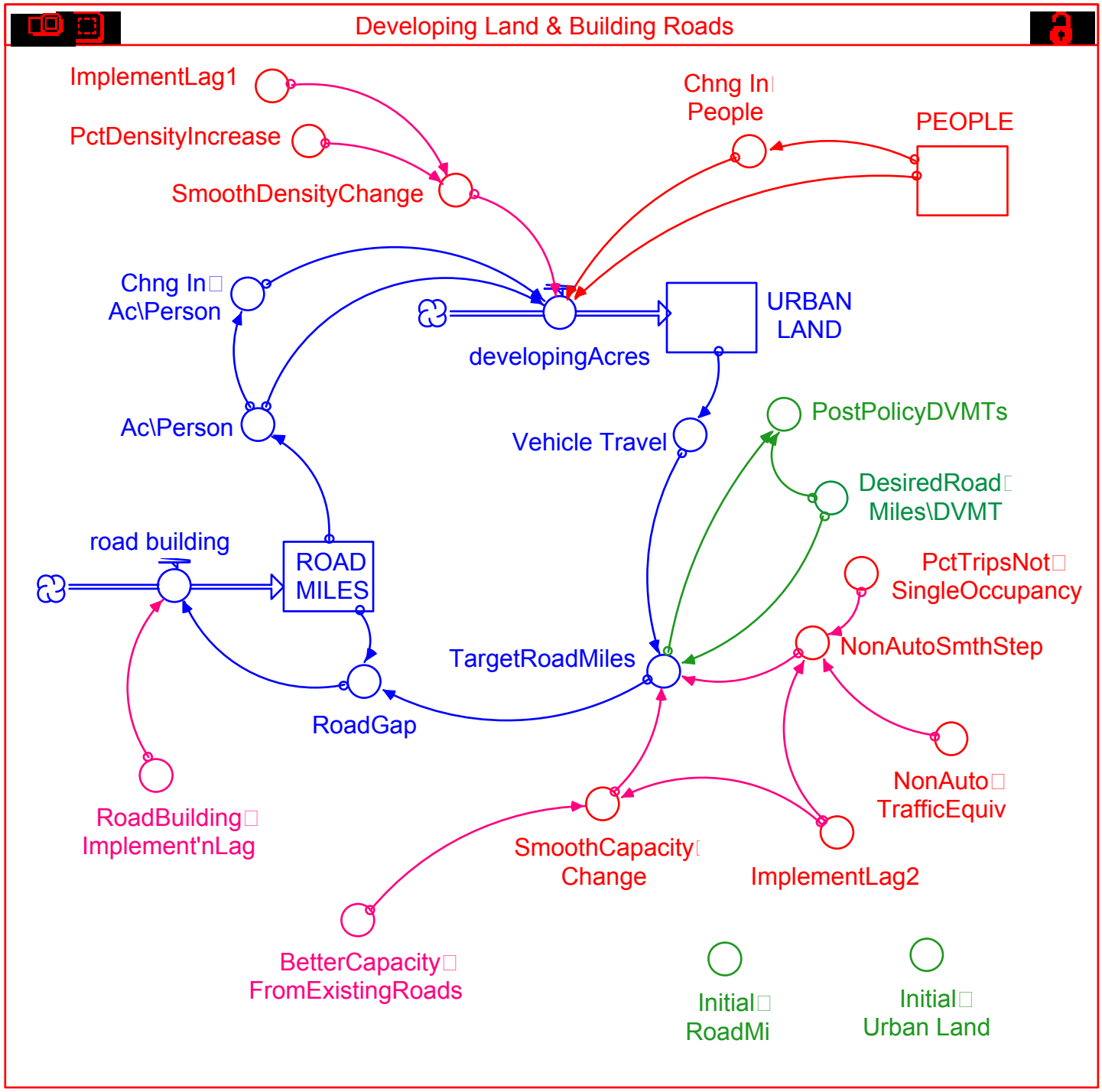
The Self-Reinforcing Relationship between Urban Land Development and Urban Road Building



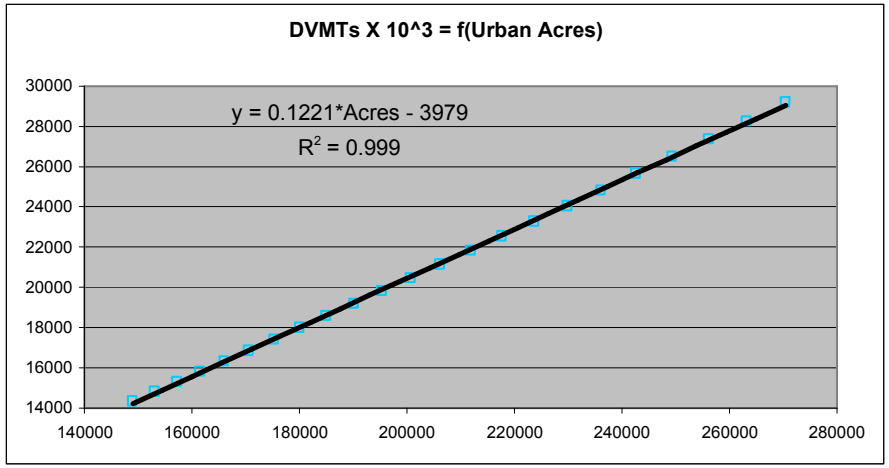
A Reinforcing Feedback Loop

Study Area and Time Horizon

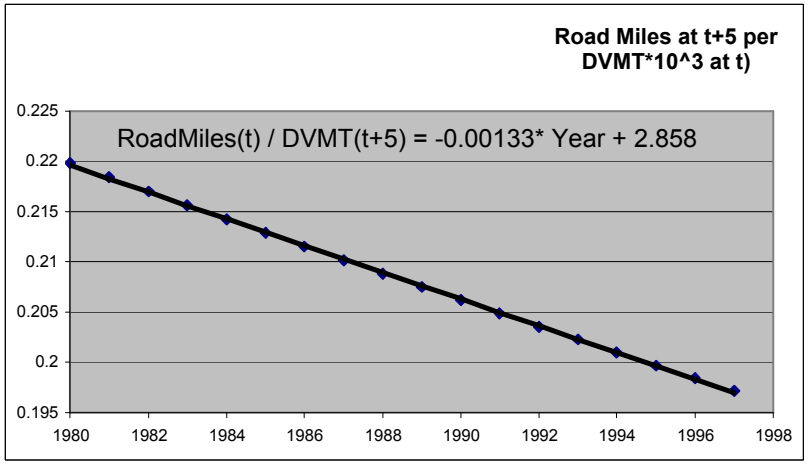
- **Urbanized Portions** of the Salt Lake, Davis and Weber Counties
- Initialized with 1980 data
- Model calibration data: 1980 - 2000
- Validation experiments
  - Calibration: 1980 - 1992.
  - Project and compare with 2002 observations
- Projection and policy horizon: 2030


Developing Land & Building Roads
ImplementLag1
PctDensityIncrease
SmoothDensityChange
Chng In People
PEOPLE
Chng In Ac\Person
developingAcres
URBAN LAND
Ac\Person
Vehicle Travel
PostPolicyDVMTs
DesiredRoad Miles\DVMT
road building
ROAD MILES
PctTripsNot SingleOccupancy
NonAutoSmthStep
TargetRoadMiles
RoadGap
RoadBuilding Implement'nLag
NonAuto TrafficEquiv
SmoothCapacity Change
ImplementLag2
BetterCapacity FromExistingRoads
Initial RoadMi
Initial Urban Land

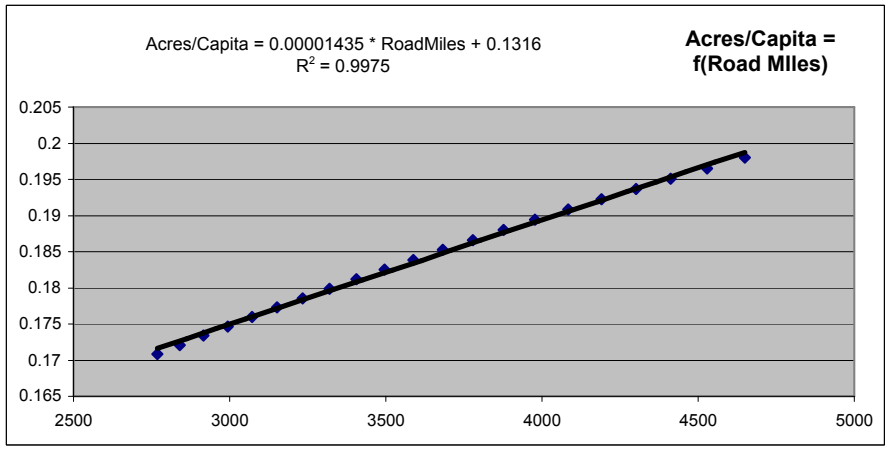
System Equations



DVMTs= 0.12214 * (URBAN_LAND) – 3979



DesiredRoadMiles\DVMT= -0.00133 * TIME+ 2.858



Ac\Person = 0.00001435 * ROAD_MILES + 0.1316

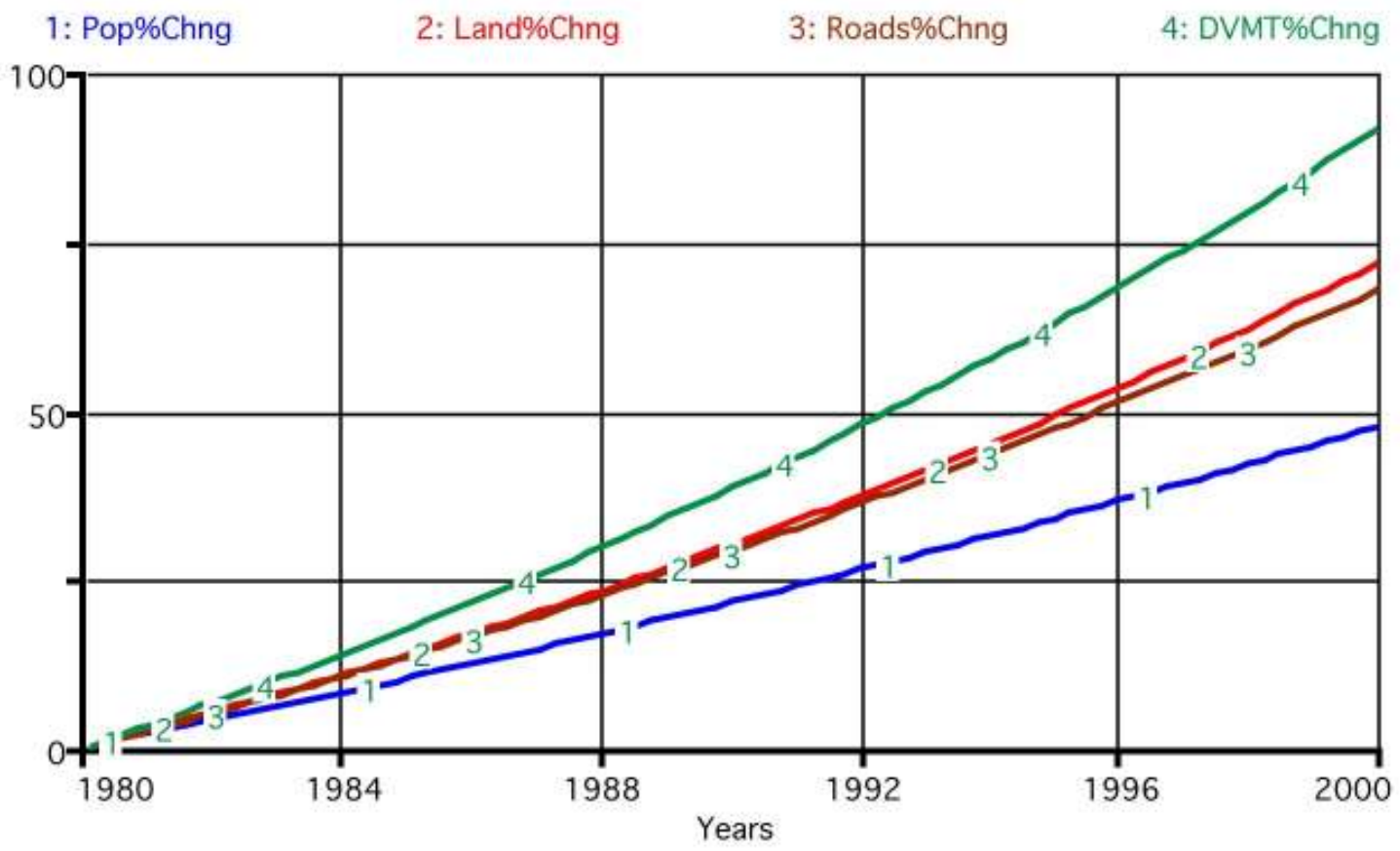
TargetRoadMiles = DesiredRoadMiles\DVMT * DVMTs

RoadGap = (TargetRoadMiles - ROAD_MILES)

road_building = (RoadGap / RoadBuilding_Implement'nLag)

developingAcres = (PEOPLE *Chng_In_Ac\Person) +
(Ac\Person * Chng_In_People)

Percent Change in Urban Performance Indicators, 1980 - 2000

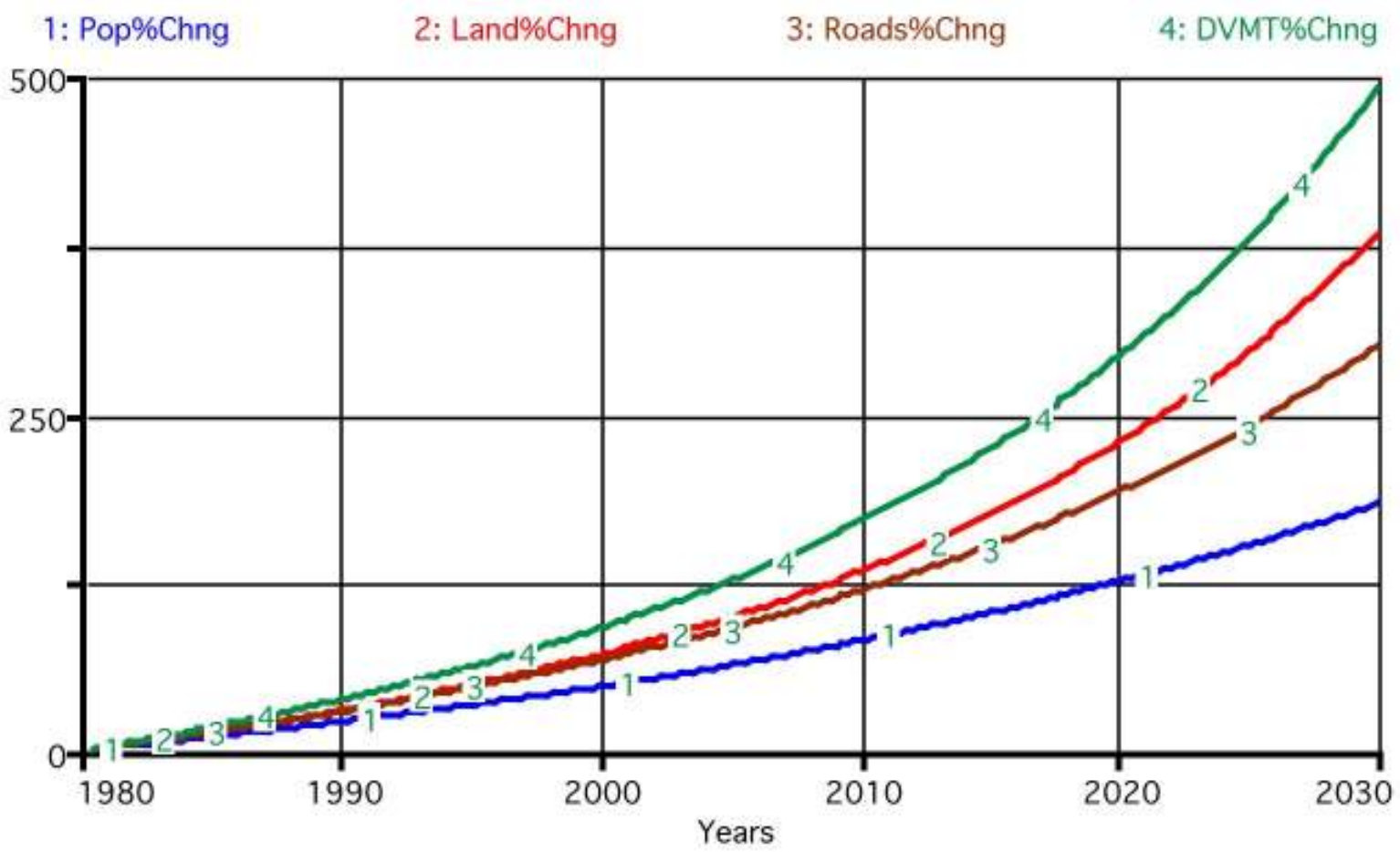


Percent Changes in Urban Performance Indicators

Validation Experiments

- Divide the 1980 - 2002 data set into 2 halves
- Calibrate the model on data from 1980-1992
- Project to 2002, compare with 2002 observations and note the errors
- Find the RMS error of the projections for:
  - Urban Land, VMTs, Road Miles & Density
- RMS Error is found to be less than 2%
- This lends confidence to the use of the model as a learning environment

Percent Change in Urban Performance Indicators, 1980 - 2030

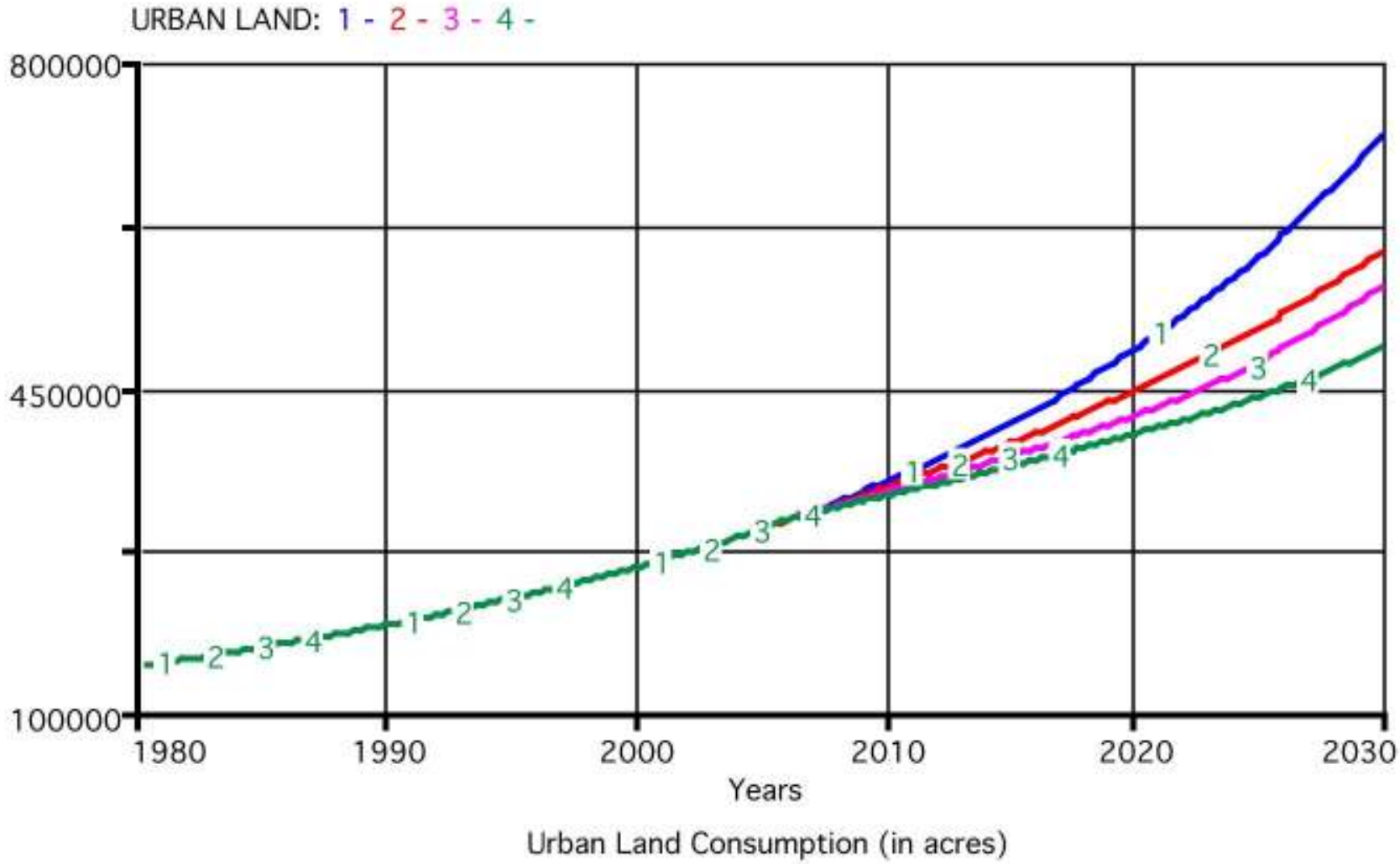


Percent Changes in Urban Performance Indicators

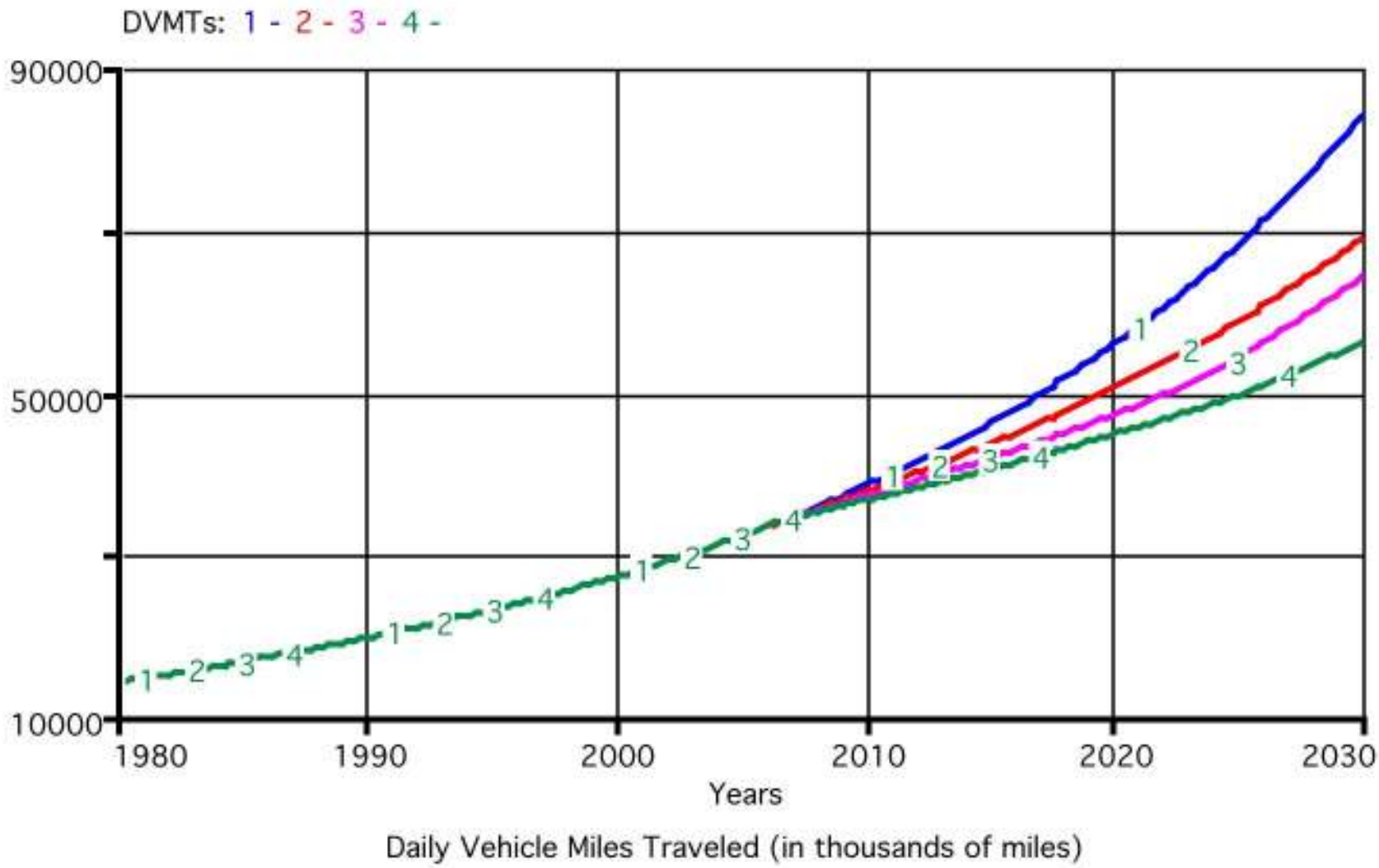
Four Alternative Future Scenarios

1. Baseline: an extension of historic practice
2. Land Use:
   - Increase new development densities by 20%
3. Transportation:
   - Reduce single-occupancy vehicle trips to 80% of total
   - Increase existing road capacity by 12%
   - Speed up TIP implementation from 5 to 3 years
4. Combine Land use & Transportation

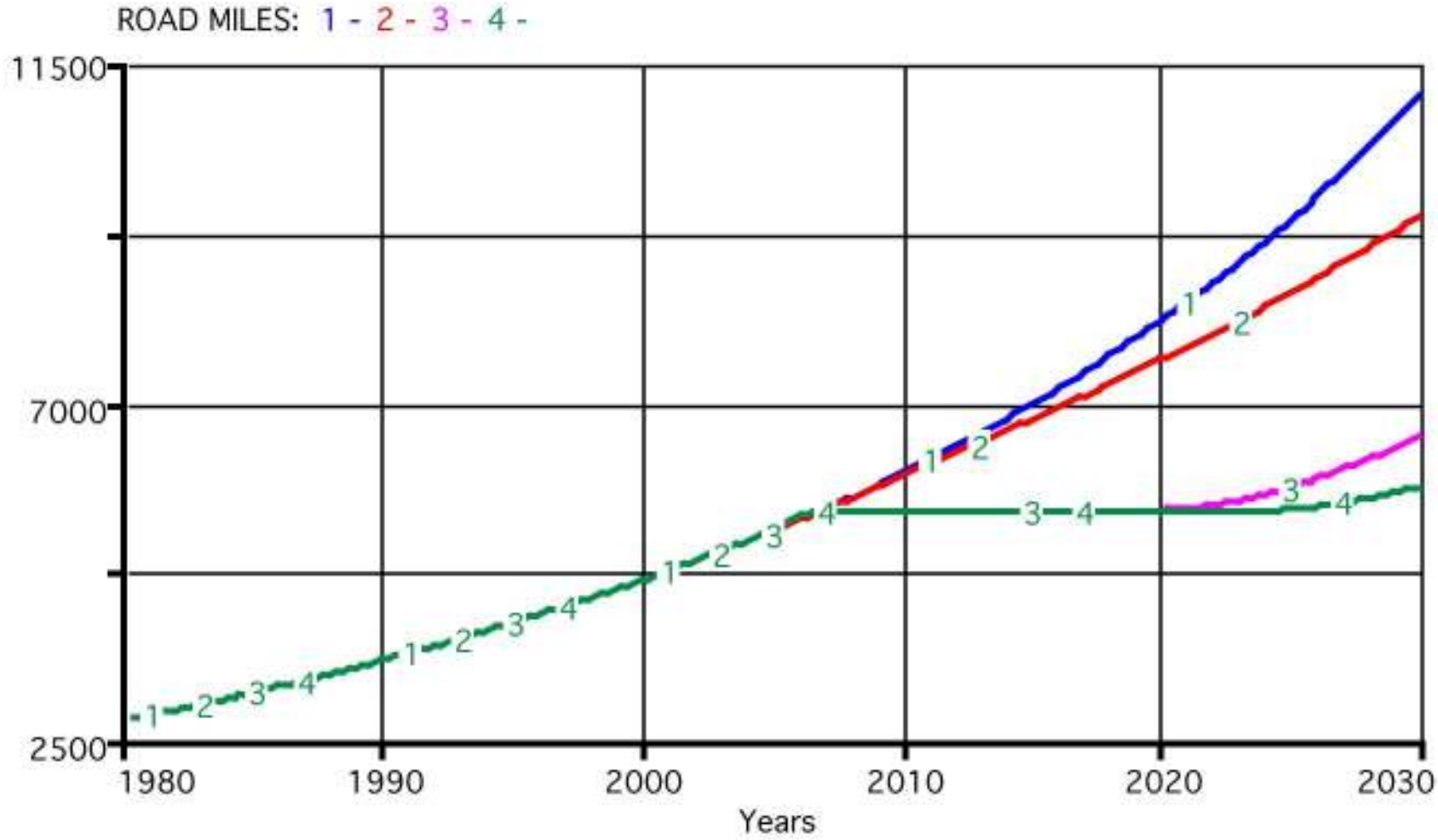
Urban Land Consumption: Four Scenarios



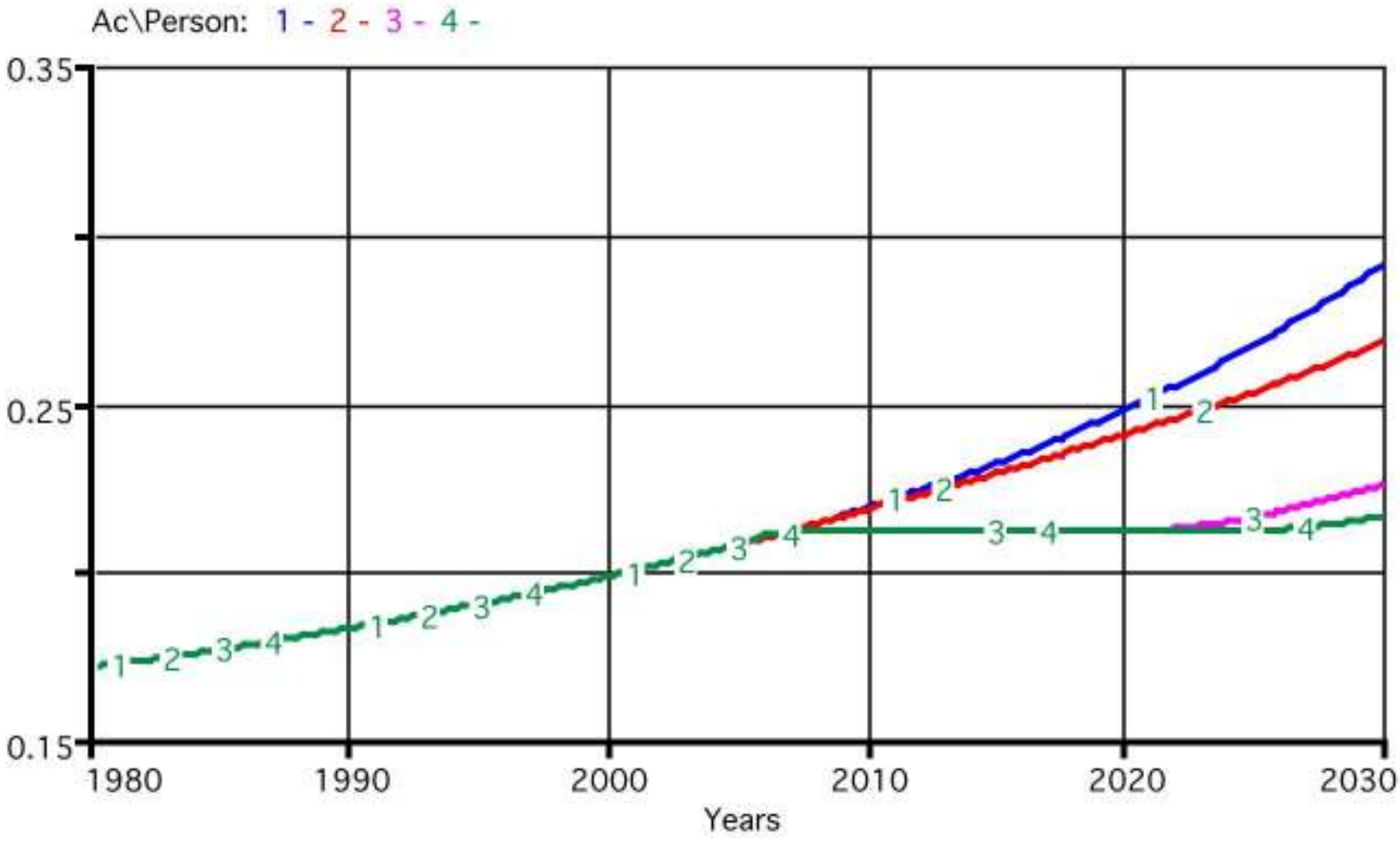
Daily Vehicle Miles Traveled



Road Miles

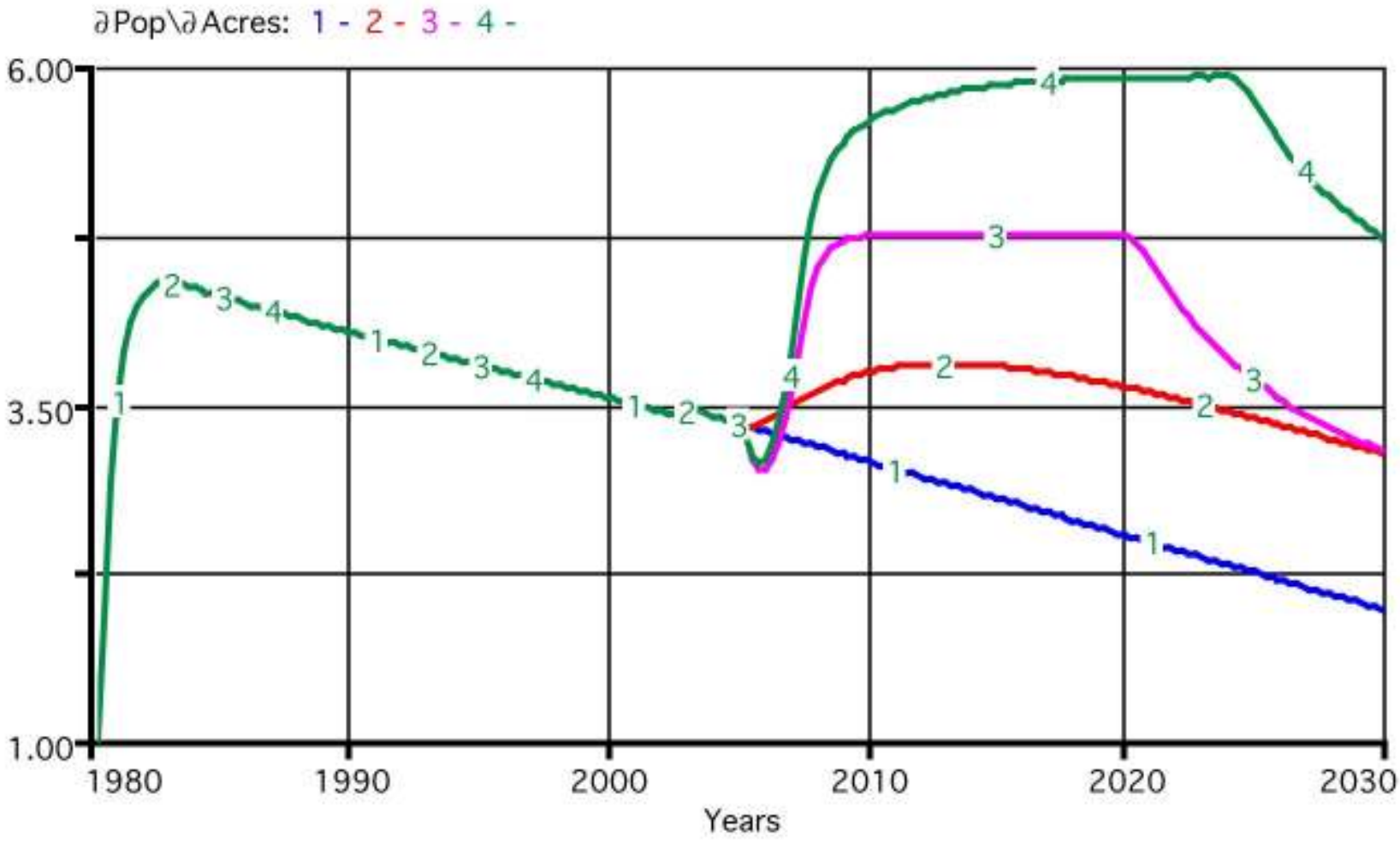

ROAD MILES: 1 - 2 - 3 - 4 -
11500
7000
2500
1980
1990
2000
2010
2020
2030
Years
Total Length of All Roads Built in the Region (in miles)

Intensity of Land Use

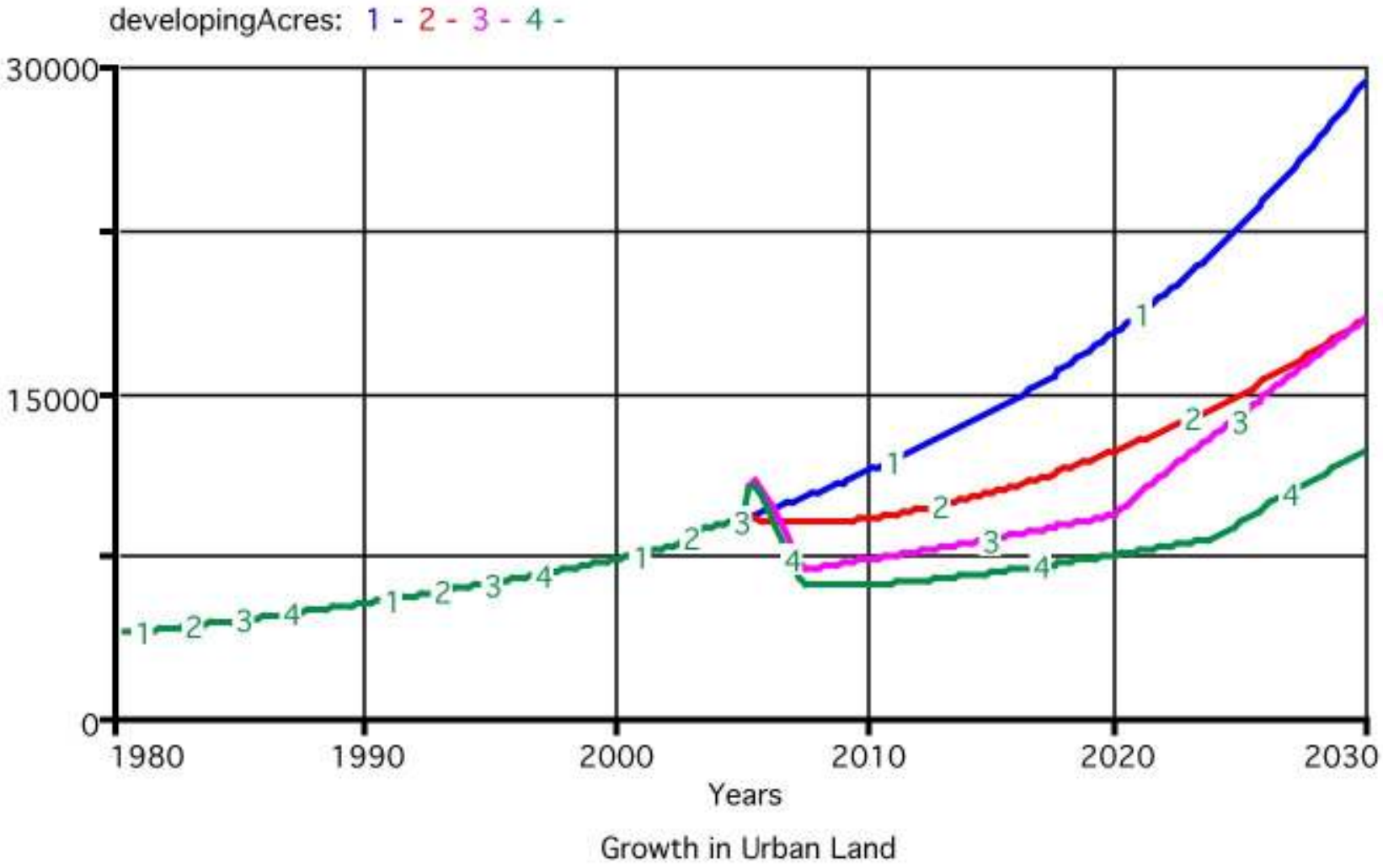


The Intensity of Urban Land Occupancy (in acres per capita)

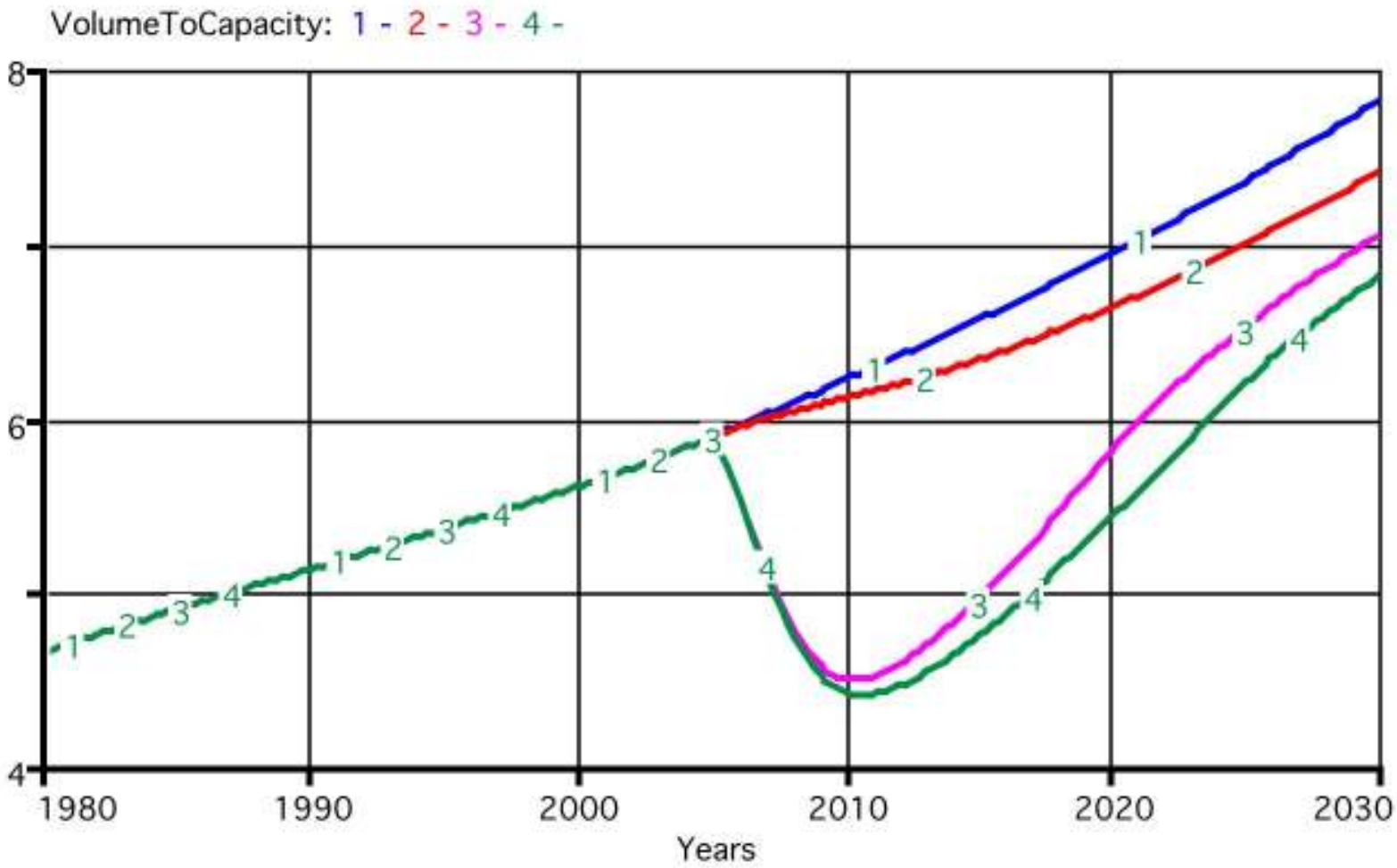
The Density of New Development



Acres Developed Per Year



Crude Road Congestion Index



Extensions

- Agricultural land preservation
- Water use and conservation
- Urban forest and canopy cover
- Vehicle fuel and energy use
- Carbon dioxide emissions
- Criteria air pollutants

Conclusions about Urban Dynamic System Models

- They are simple to understand
- They are highly accurate
- They are easy to manipulate
- They illustrate dynamic complexity
- They generate alternative policy scenarios
- They facilitate learning about policy options
- They might facilitate policy negotiation