

Sustainability Indicators for Boulder



City of Boulder

University of Colorado Boulder

Introduction

Management
Framework

Metrics

Benchmarks

Conclusion





Boulder is a leadership city in Sustainability movement in United States

Questions

- Can performance metrics be used practically and efficiently to improve management and monitoring of urban sustainability issues in Boulder?
- If so, which types of metrics are most effective?
- What processes can be established to guide development and use of metrics?
- How can the University of Colorado collaborate with the city of Boulder in development of sustainability metrics?

Project Background

Methods

- Green infrastructure, CDOT, etc.
- GIS and remote sensing

Funding

- Funding: CIRES, etc
- Boulder and Denver planning schools (Fall studio)

Potential Project for NSF Fund

Participants

□ Faculty

嬪 Brian Muller, Carol Wessman, J ohn Lanteman,
Lynn J ohnson, Nancy Golubiewski,

□ Student/Post-Doctoral Fellows

嬪 Darius Ardalan, Sharanaz Mirzazad, Yang Ran,
Uddhab Bhandary, J ulia ...

What are Metrics?



Examples of Sustainability Metrics

- LEED ND
- Chicago Action Plan
- Growing Cooler
- CNU Network Work Session-Networks and Sustainability
- Sustainable City-Working Toward a Sustainable Future For San Francisco
- Bureau of Planning and Sustainability – City of Portland Oregon

Design Principles

- ❑ Policy/management framework
- ❑ Use of qualitative data/sampling
- ❑ Rollup of outputs: site to city
- ❑ Conceptual and technical integration
- ❑ Analysis of benchmarks
- ❑ Comparability across cities/time

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Method

Step 1

Step 2

Step 3

Step 4

Step 5

Step 6

Step 7

Literature review

Review of applications

Design of metrics

Case study in Boulder

Assessment of case study

Management Frameworks

- ***Boulder Valley Comprehensive Plan***
- Policymaking Process
- Redesign of Zoning/Building Codes
- Project Approval/Site Review

Introduction

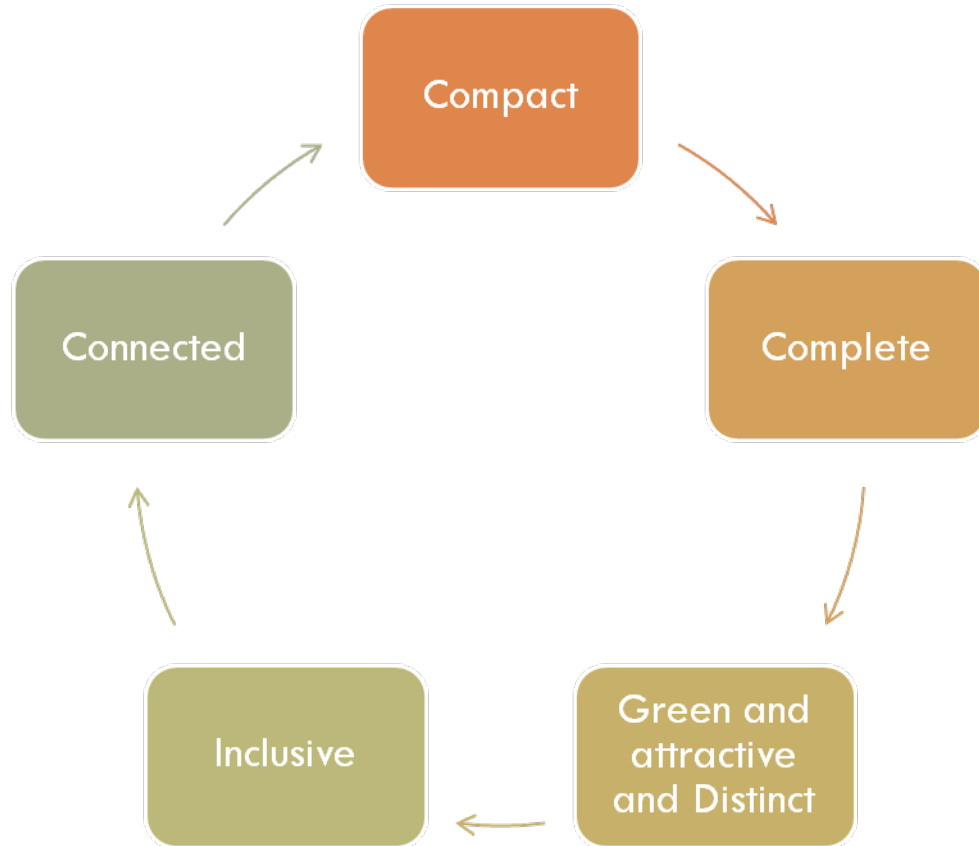
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Policy Framework 1: Boulder Valley Comprehensive Plan - five goal for Sustainable



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Sustainable Urban Form Components

Objective

Goals/Objectives: Boulder Valley Comprehensive Plan

Transport Efficiency

Conserves Resources

Promote Livability

Reduce vehicle miles traveled

Reduce the investment in city infrastructure

Walkable Streets

Access to the nature

Integrated system

Motor Vehicle Mode

Bike Access

Transit Mode

Access to daily needs

Attractive places to live , work and Learn

High quality public realm

Nature friendly environment

Encourage balanced communities

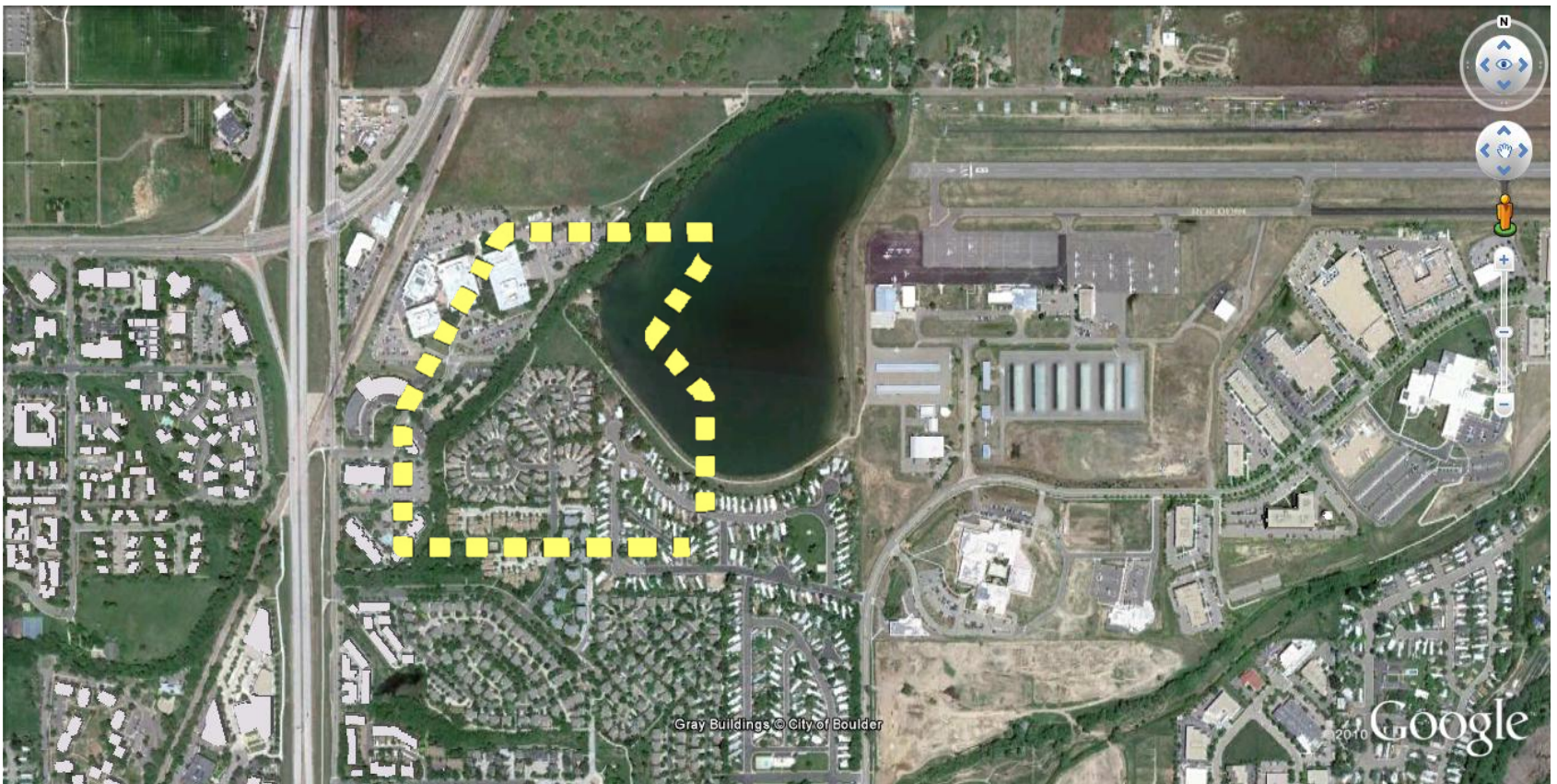
Public space for increased social
interaction

Compact

General Indicators: Boulder Valley Comprehensive Plan

Sustainable Urban Form Components	Objective	Weight	General Indicator
Compact	Transport Efficiency	2	<ul style="list-style-type: none"> Compact Developments in Transit Corridors Highest possible density at TOD up to 63(DU/ACRE) Residential density and 3 (FAR) Non residential density
	Conserve Natural Resources	1	<ul style="list-style-type: none"> Infill Developments Brownfield Developments
	Promote Livability	2	<ul style="list-style-type: none"> Residential density to support the neighborhood activities Non Residential density to provide enough variety to attract people in city
	Reduce		<ul style="list-style-type: none"> Compact Residential development closed to the

Case Study Area



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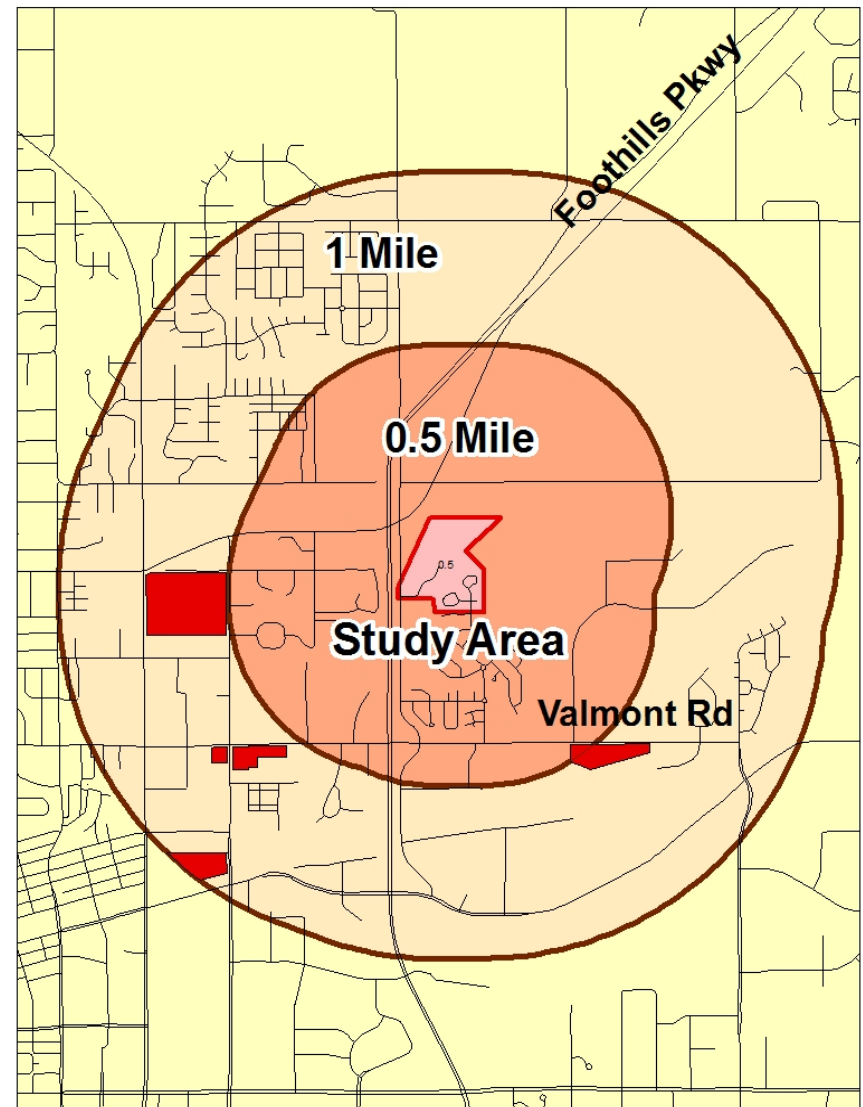


Metrics

- Built Density
- Population Density
- Commercial Accessibility
- Population Accessibility
- Walkability
- Runoff
- Urban Heat
- Carbon Mass

Commercial Density

- Commercial density is determined by calculating the area of Commercial Business (CB) and Special Commercial (SC) land uses within a 0.5 Mile and 1 Mile buffer of the study area.

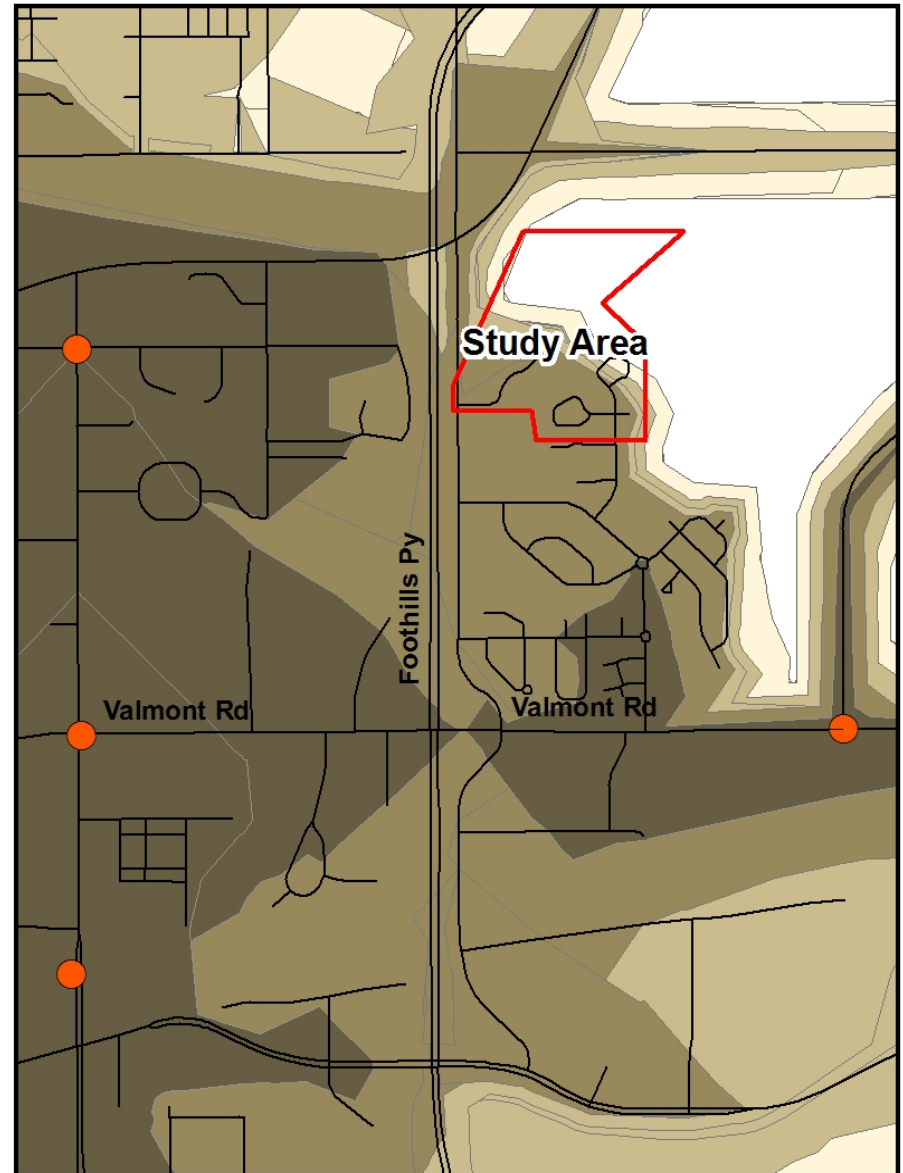


	0.5 Mile Buffer	1.0 Mile Buffer
Com. Area	1.2 acres	47.2 acres
Total Area	863.6 acres	1829.2 acres
Ratio	0.14%	2.58%

Commercial Accessibility

· Calculated using Network Analyst in ArcMap. Commercial centers are taken from intersections which serve Commercial Business (CB) and Special Commercial (SC) Land Use areas. Road distance from commercial centers is calculated using a service area.

Road Miles from Commercial Access	Proportion of Study Area within Distance
0.5	0%
1	45%
1.5	50%
2	55%



Housing Density

- Density is determined by comparing the ratios of building footprint and square footage to various scales of area. This demonstration compares these ratios at the parcel, neighborhood, and acre scales.

Housing Density Ratios	Sample Parcel Area	Total Res. Parcels Area	Sample Acre Area
Building Footprint Area	0.30	0.39	0.31
Building Square Feet	0.45	0.50	0.54



Run off

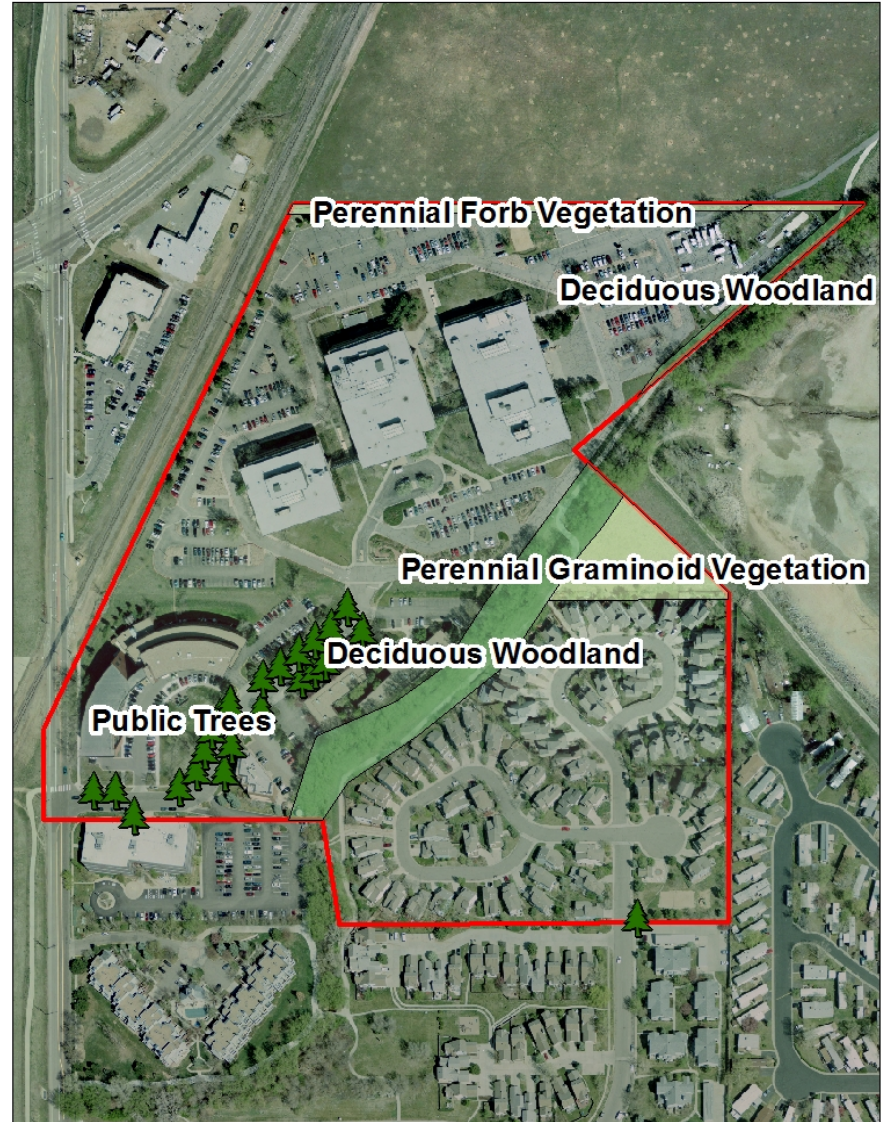
·EPA's SWMM model can calculate water run-off and infiltration volumes using a variety of input parameters including; soil type, slope, impervious surface area and subcatchment area measurements.

·Sample Output:

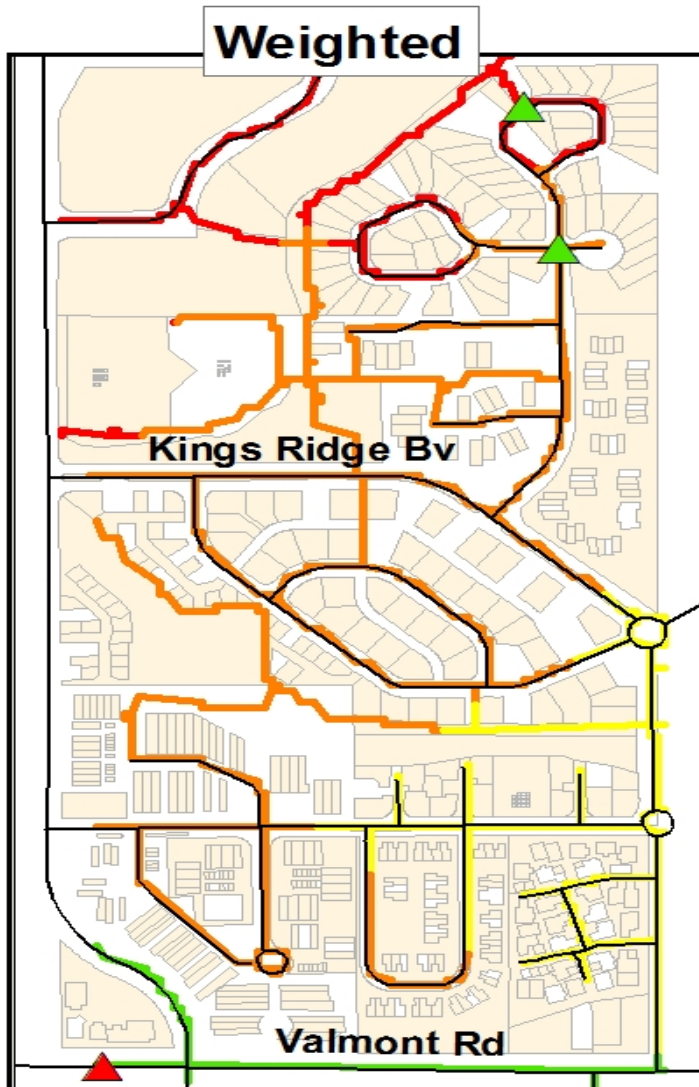
Storm:	Rainfall	Runoff Volume	Runoff Coef.	Peak Runoff
2-yr	.94in.	.51in.	52.3%	46 (cfs)
10-yr	2.13in.	1.15in.	63.8%	87 (cfs)
100-yr	4.63in.	3.35in.	85.7%	238 (cfs)



Vegetation



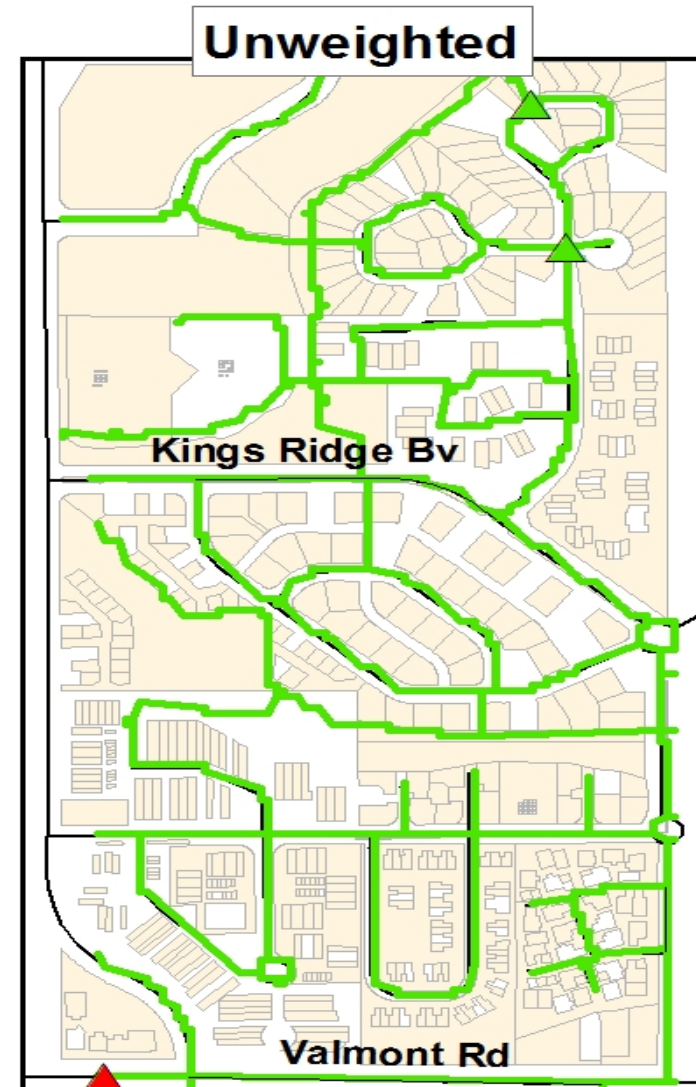
Walkability



·Weighted distance determined by qualitative factors that may negatively affect the pedestrian experience.

·Unweighted distance is the actual distance of travel. The entire residential area is within one mile of the transit stop

·Weighted distance results can lead to identification of parcels which are highly walkable and parcels which are not walkable.



Urban Heat

- Surface density times area yields three dimensional representation of vegetation benefits.
- Individual features classified by height, density, phenology, and type. Environmental benefits such as stormwater mitigation, cooling of urban heat effect, and carbon sequestration.



Carbon Mass



What is the appropriate benchmarks for Boulder? What will happen if we adopt more details from other cities?

Example : Rating system for density at LEED ND

table 1. points for density per acre of buildable land

Residential density (DU/acre)	Nonresidential density (FAR)	Points
> 10 and . 13	> 0.75 and . 1.0	1
> 13 and . 18	> 1.0 and . 1.25	2
> 18 and . 25	> 1.25 and . 1.75	3
> 25 and . 38	> 1.75 and . 2.25	4
> 38 and . 63	> 2.25 and . 3.0	5
> 63	> 3.0	6

DU = dwelling unit; FAR = floor-area ratio.

Boulder Block Density map

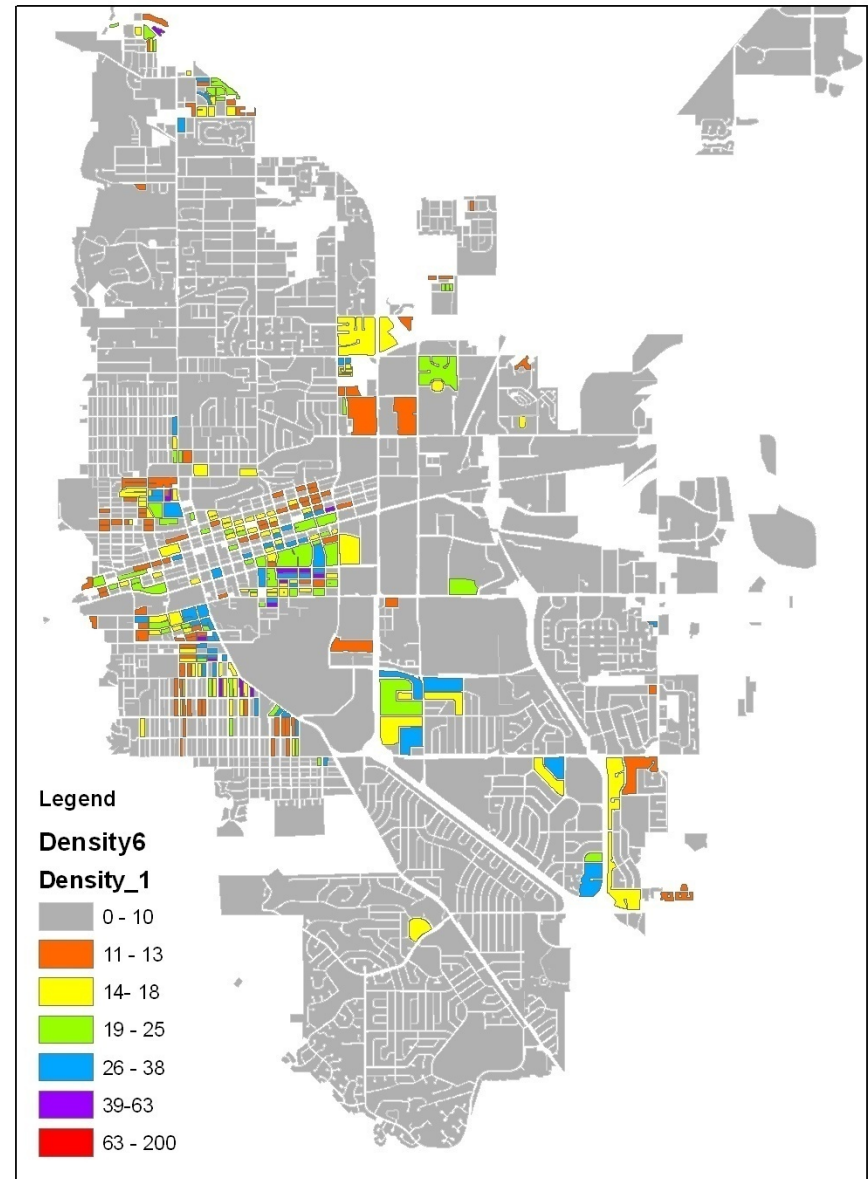
❑ These analysis indicates that most of city blocks have less than 20 dwelling per acre density

❑ The density classification for Boulder is based on 1978 analysis that categorized the density in three category:

Low :2-6 per acre

Medium: 6-14 per acre

High : more than 14



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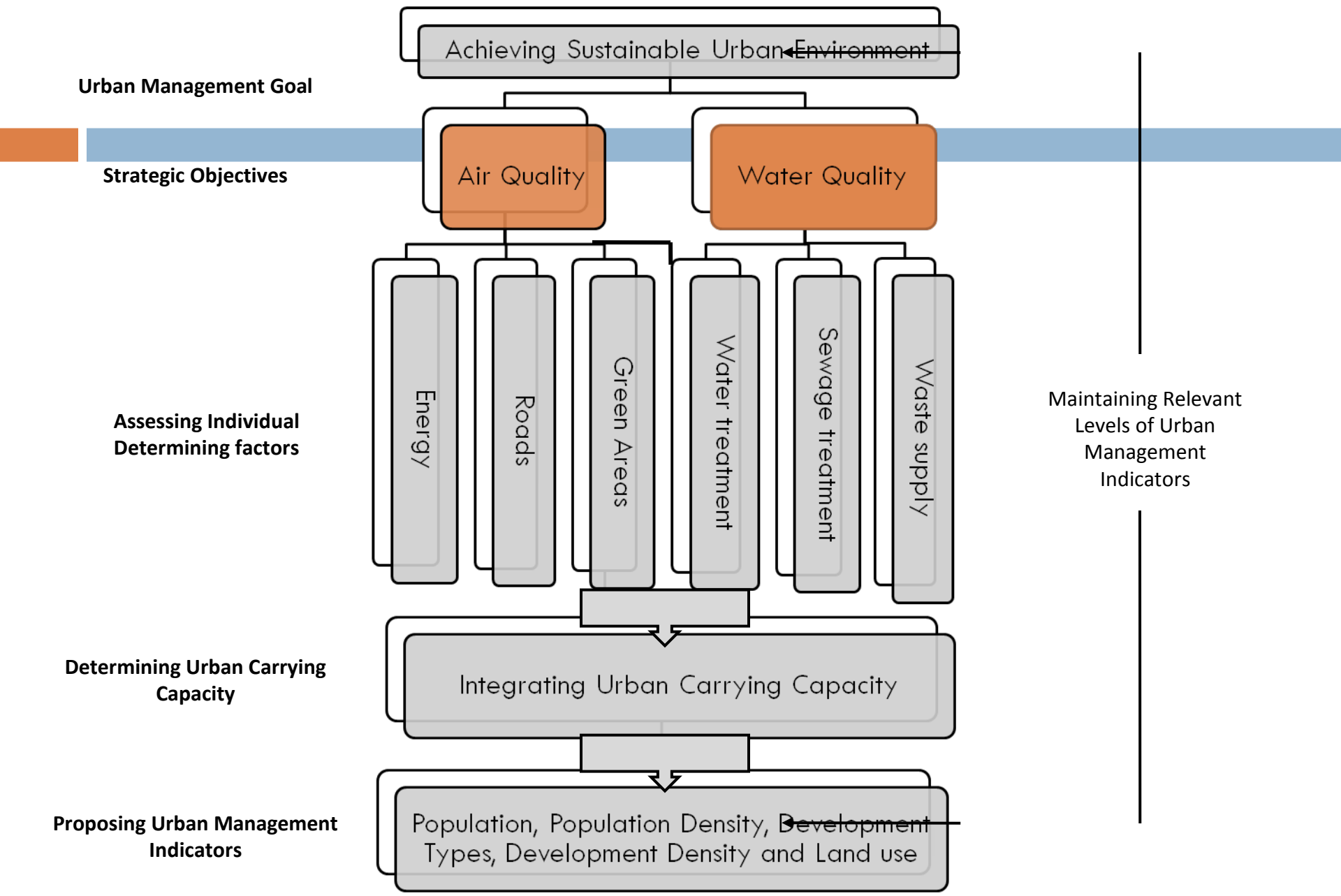
Introducing an example for method to developing benchmarks

Case Study: Density Benchmark

Although there is strong evidence that compactness is greener but there is a threshold to increase density.

❑ The proposed Methodology for assessing the appropriate density for Boulder:

Urban Carrying Capacity Assessment System



Achieving Sustainable Urban Environment

Air Quality

Water Quality

Energy

Roads

Green Areas

Water treatment

Sewage treatment

Waste supply

Integrating Urban Carrying Capacity

Population, Population Density, Development Types, Development Density and Land use



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How should we define the density distribution in city?

Is it possible to increase the density everywhere?

No

The density profile of the city should be developed based on the categories below :

- Urban Demographic Density**
- Urban Land-use Density**
- Urban Mass Density**
- Urban Resource Density**
- Time-Space Density**
- Perceived Urban**

Boulder needs to develop its own Benchmarks based on city socioeconomic context in categories below:

- Appropriate density for Transit corridors ,TOD, support neighborhood activities and variety,
- Distance from pedestrian and biking way
- On street parking limits
- Street trees density
- Distance from transit
- Services(schools , parks) and activity centers accessibility evaluated by walking cost
- The percentage of affordable housing in neighborhoods
- Distance from business
- Housing size variety in neighborhood

Conclusions

- Sustainability metrics can be effective, practical management tools
 - Appropriateness to management needs
 - Data intensity/type
 - Scalability
 - Integrated approach
 - Suitability of benchmarks
 - Comparability (time/place?)
- Scientific justification for metrics varies in strength and documentation

Future Steps

- Strong foundation for further work
 - Current Team
 - Studios, etc.
- Proposals
 - NSF Proposal
 - WWA Proposal

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