Evaluating the Impact of Build-out on Stormwater in Concord, MA

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Projection: NAD 1983 State Plane Massachusetts Mainland FIPS 2001

Introduction

Stormwater runoff is generated when precipitation flows over land or impervious surfaces without percolating into the ground. As the runoff travels over these surfaces, it accumulates debris, chemicals, sediment and/or other pollutants that could adversely affect water quality if the runoff is discharged untreated (U.S. EPA). Generally, the quantity of stormwater runoff is proportional to the amount of impervious surface. As cities develop, the density of impervious surface increases, leading to increased stormwater flow.

A build-out analysis employs current zoning regulations to estimate future conditions when all parcels are built to the maximum extent allowable. The amount of impervious surface at build-out can be estimated and used to calculate future stormwater volumes. Using a build-out analysis, cities can develop plans for managing the increased stormwater flow. One option for stormwater management is to change zoning regulations to require Low Impact Development (LID) technologies to control the additional stormwater created by development.

The objective of this poster is to conduct a build-out analysis of Concord, MA to estimate the increased volume of stormwater at build-out. Additionally, the best locations for LID technology implementation are highlighted.

Methodology

1) Examine current conditions (*current conditions use data layers developed in 1996)

The zoning, building footprint, road and edge of pavement data were used to estimate the area of impervious surface in Concord.

2) Create new layers of already built-out land

For residential areas, any parcel less than twice the minimum lot size was designated as currently built-out.

Residential Zoning Designation	Min Lot Size (sq. ft.)	Selection Criteria (sq. ft.)
(>80,000 sq. ft.)	80,000	< 160,000
(40,000-79,999 sq. ft.)	40,000	< 80,000
(20,000-39,999 sq. ft.)	20,000	< 40,000
(5,000-14,999 sq. ft.)	5,000	< 10,000

All industrial, and limited business parcels were examined individually to determine which could be further developed.

3) Determine buildable land

Using the erase tool, the already built-out parcels were erased from the original zoning data set. The erase tool was then used to erase protected open space, roads, easements, hydrography, wetlands, and floodplains.

4) Calculate the area of impervious surface at build-out

Using the ratio of impervious surface to land area of the already built-out layers created in step 2, the additional amount of impervious surface at build-out was estimated.

5) Calculate the effects of build-out on stormwater flow

Approximately 90% of stormwater pollutants are in the "first flush" of a storm event (the first 0.5 in. of precipitation). Therefore, the impervious surface estimates were used to calculate the amount of "first flush" stormwater flow generated at current conditions and at build-out.

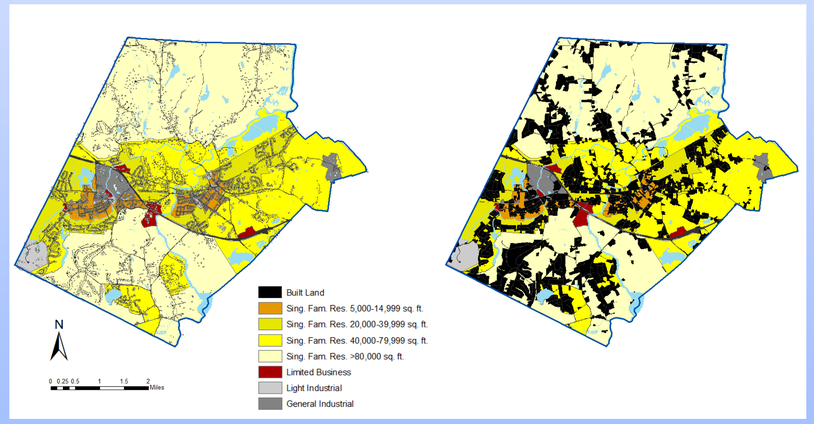
6) Assess possible locations for LID implementation

LID technologies that infiltrate water directly into the subsurface need to be constructed on soils that can absorb and transmit the stormwater. Soil drainage data was used to determine the drainage capabilities of the buildable land. Any land that is poorly drained or created from urban fill was deemed unacceptable for LID infiltration technologies.

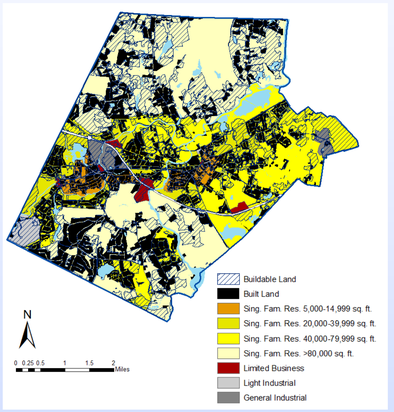
Results

Current Conditions

- Concord is zoned as 94.7% residential, 1.0% limited business and 3.7% industrial.
- Analysis of parcel area determined that 25.3% of Concord is already built-out.
- 7.3% of the land surface is impervious.



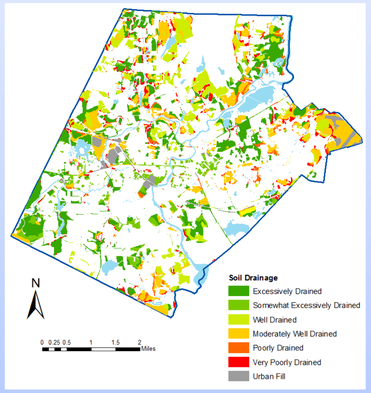
Zoning Designation	% Of Land Area	% Built-out	% Buildable
5,000-14,999 sq. ft.	3.9	48.8	24.7
20,000-39,999 sq. ft.	12.7	37.3	28.9
40,000-79,999 sq. ft.	28.2	19.9	25.8
> 80,000 sq. ft.	49.9	24.3	29.4
Limited Business	1.0	1.3	51.8
Light Industrial	1.7	42.9	60.2
General Industrial	2.0	12.9	65.0



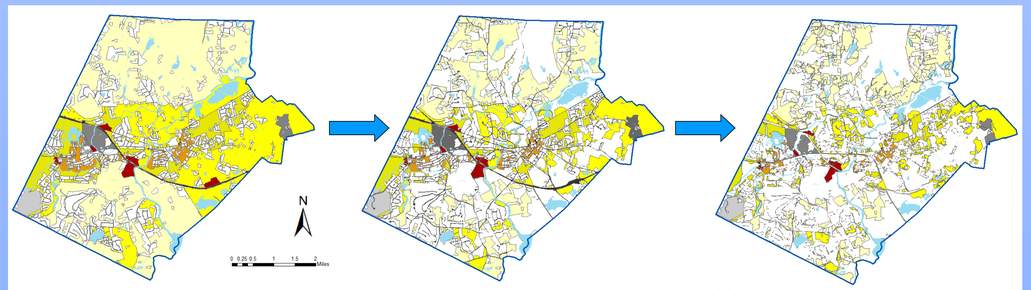
- The build-out analysis shows that 29.5% of the land in Concord is still available for development.
- According to current zoning regulations, 54.8% of the land in Concord will be fully developed at build-out.
- At build-out, 12.7% of Concord will be impervious surface.

Stormwater and LID Analysis

- According to the "first flush" analysis, the 1.9 square miles of impervious surface currently Concord produces 2.2 million cubic feet of stormwater.
- The additional impervious surface at build-out will create an further1.6 million cubic feet of stormwater, a 42.3% increase of stormwater.
- Water quality can be preserved at current levels if LID technologies are included on new development sites to manage the additional stormwater created.
- According to the soil drainage map, 84.8% of the buildable land in Concord is able to transmit enough water to support LID technologies that directly infiltrate stormwater back into the ground.



Build-out Analysis



Erase already built-out areas

Erase protected open space

Erase roads, easements, wetlands, and floodplains

Conclusions

- A GIS based build-out analysis was used to show the areas of Concord, MA that are still open for development and to calculate increased stormwater volume at build-out.
- Concord's zoning regulations allow for 54.8% of the town to be developed at build-out.
- The impervious surface at build-out will approximately double the amount of stormwater that needs to be managed.
- 84.8% of the buildable land in Concord has appropriate drainage characteristics for LID infiltration technologies, making LID a promising method for controlling the stormwater.