

Low Impact Development ordinances: how are they influencing landscape design?

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Introduction

The US Environmental Protection Agency identifies Low Impact Development as “an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product.”

The LID ordinance (32C-110) in effect since June 2012 in the city of Phoenix states that *The City Manager shall where reasonable and practical encourage low impact development or the use of green methods or structures to control the release of pollutants into the storm drain system (Fig. 1).*

Figure 1: Storm drain system adjacent to residential property.



Phoenix is said to begin enforcing new LID ordinances to all new development or re-development within the next five years.

I therefore examined residential properties in different settings across the Phoenix area to identify if and how they are following LID ordinances. Specifically, comparing percentages of ground cover permeability and materials used in the landscape design that manage stormwater close to its source and compare between different property characteristics (city, density, income, and housing age).

Research Questions

- Are residential properties in Phoenix, AZ following Low Impact Development ordinances in their landscape design?
- What is the relationship between residential property characteristics and ground cover permeability (rock or grass)?

Integrative Methods

- Eleven residential properties from a previous CAP LTER project were chosen randomly for this study.
- I investigated the residential landscape designs looking for any existing stormwater management practices (rain gardens, permeable pavement, rain barrels, planter boxes or dry wells).
- After testing my estimations in three different landscapes and comparing to exact yard area until I reached a <5% error, I visually quantified ground cover percentages in front yards.

Figure 2: Permeable Rock vs. Impermeable Concrete



- I compared ground cover percentages of permeable materials (rock and grass) and impermeable materials (concrete) (Fig. 2) between four different property characteristics: city, density, income, and housing age.

Ground Cover Permeability/ Materials

Figure 3a: Permeability by City: Buckeye(n=1) and Gilbert(n=1) are leading with highest permeable ground cover, Tempe(n=1) has the least amount of permeable surfaces.

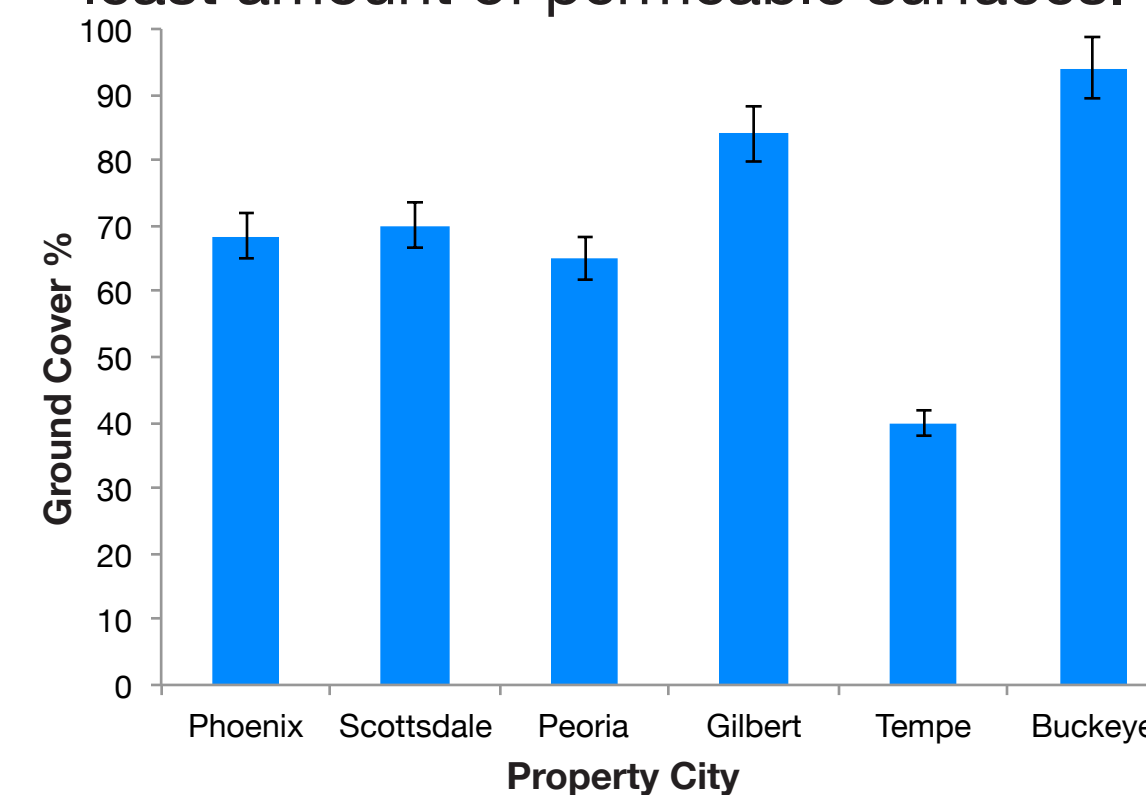


Figure 3b: Materials used by City: Tempe has greater amount of concrete, Buckeye & Gilbert the least. Peoria has most rock material.

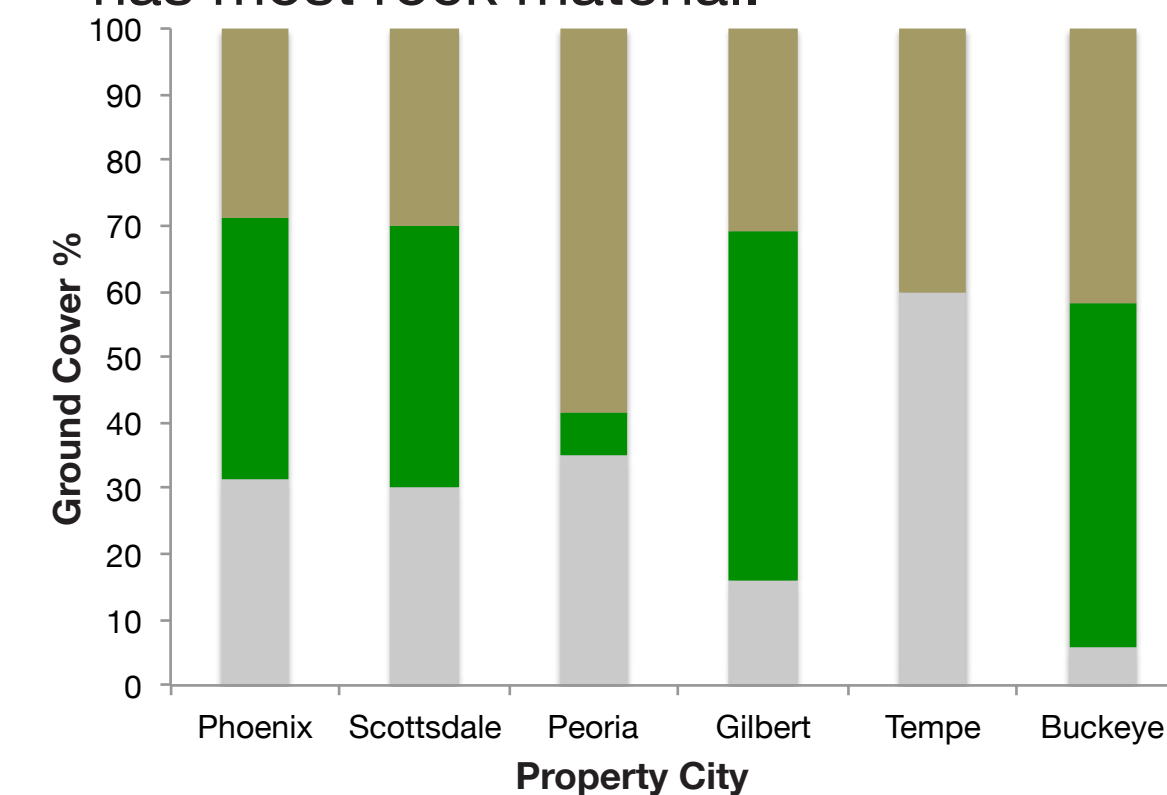


Figure 4a: Permeability by Density: Suburban properties(n=4) have the least permeable ground cover area, while Exurban properties(n=4) has the largest amount of permeability.

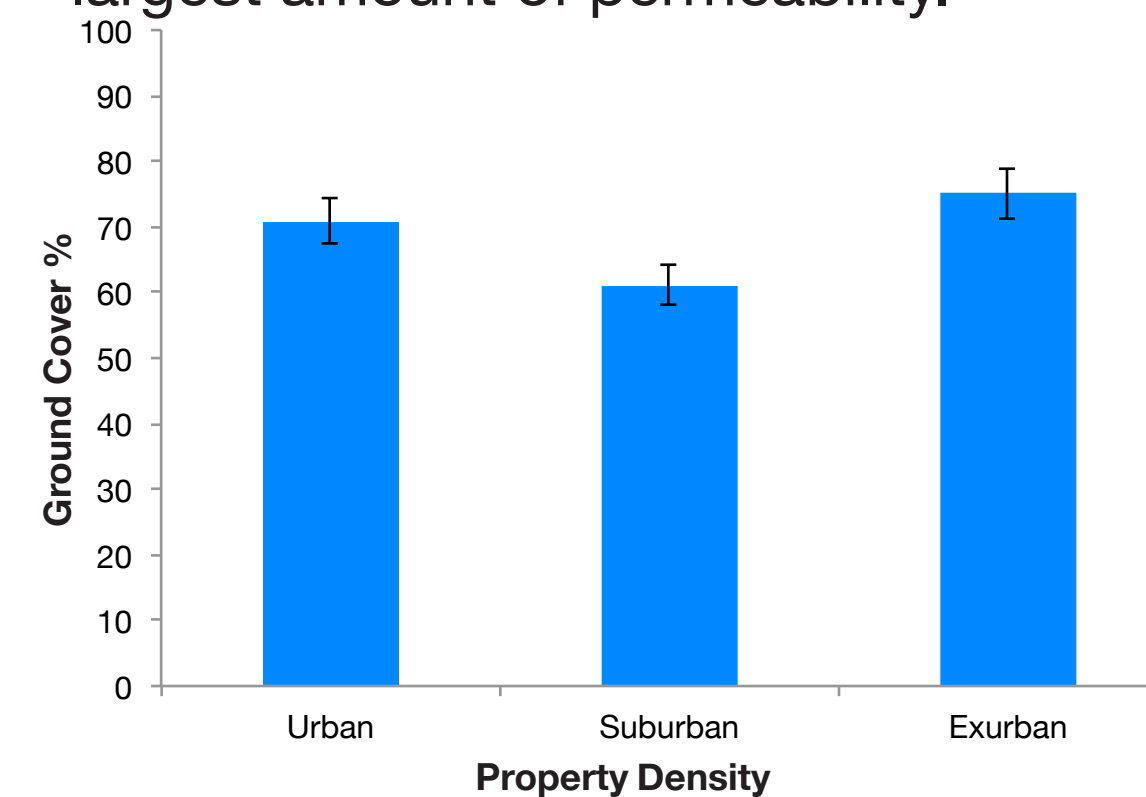


Figure 4b: Materials used by Density: Urban areas have greater amounts of grass cover, Suburban areas have greater concrete ground cover.

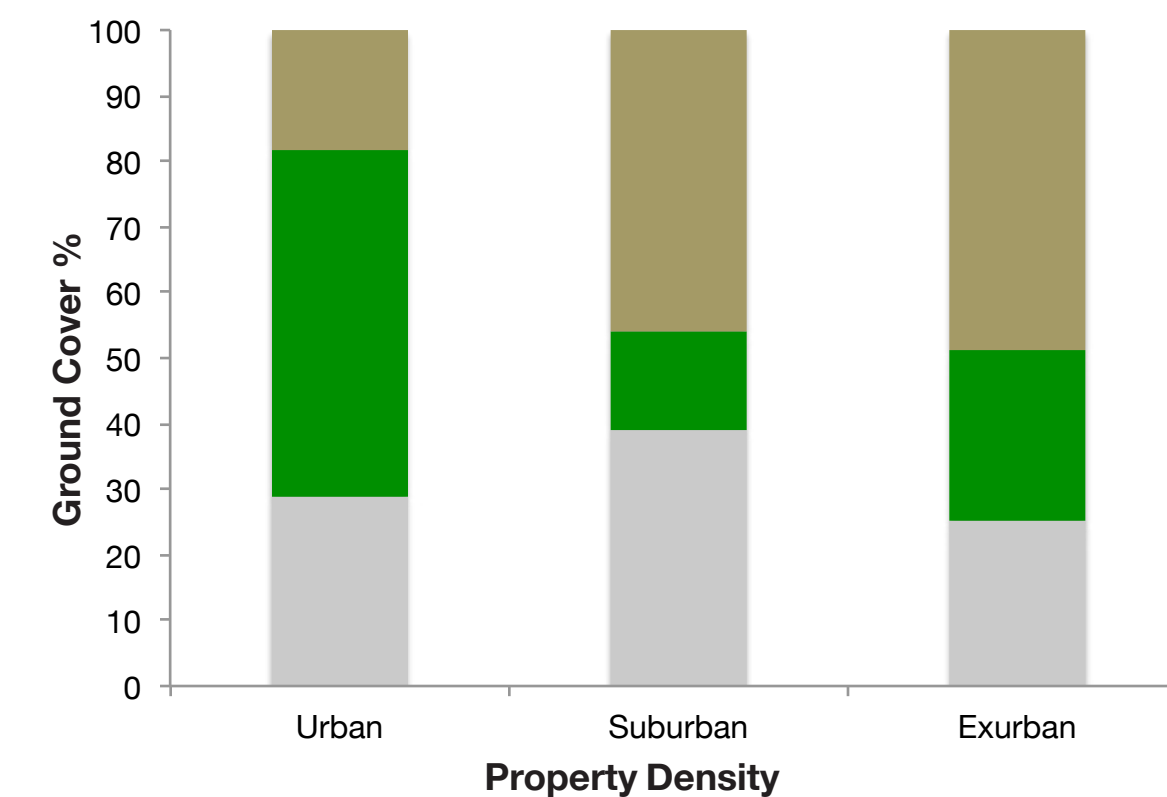


Figure 5a: Permeability by Income: Middle income properties(n=2) have a greater amount of permeable ground cover areas compared to high income properties(n=9).

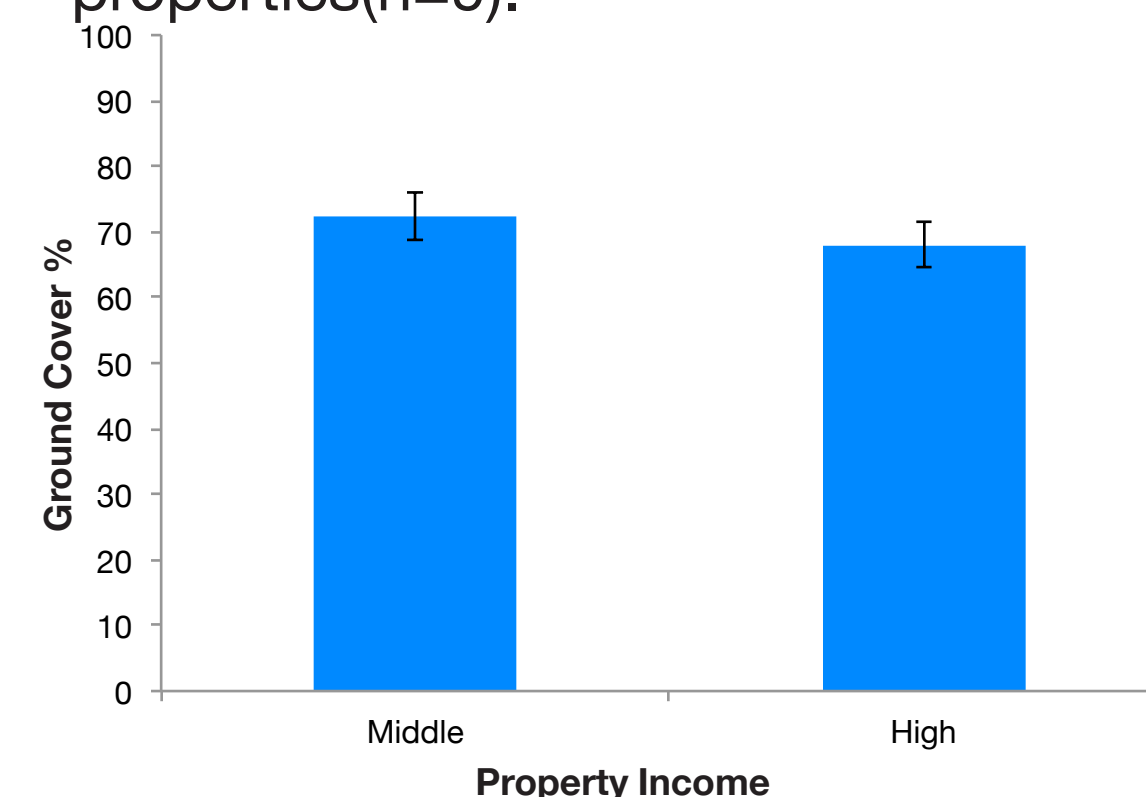


Figure 5b: Materials used by Income: Middle income properties are using more grass ground covers, while high income properties show greater amounts of impermeable concrete.

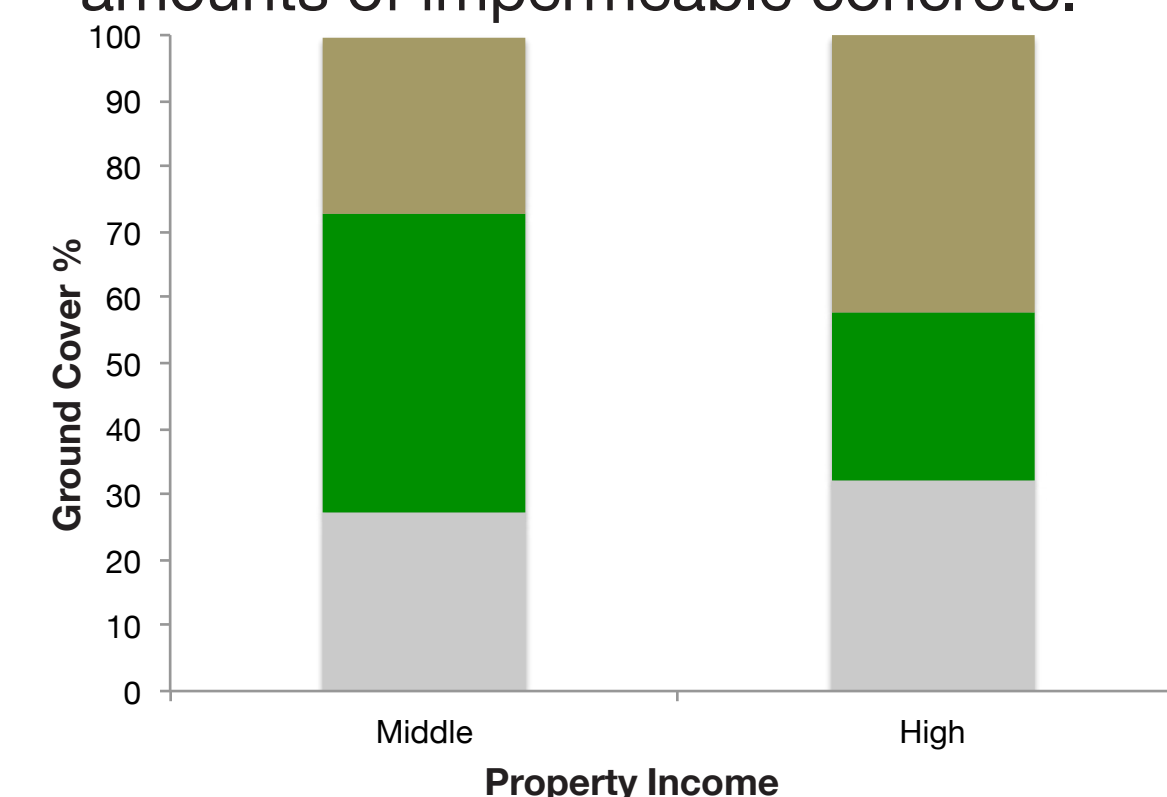


Figure 6a: Permeability by Age: Older than 55 year old homes(n=3) have greater percentages of permeable ground cover compared to 15-35 year old homes(n=7), and <15 homes(n=1).

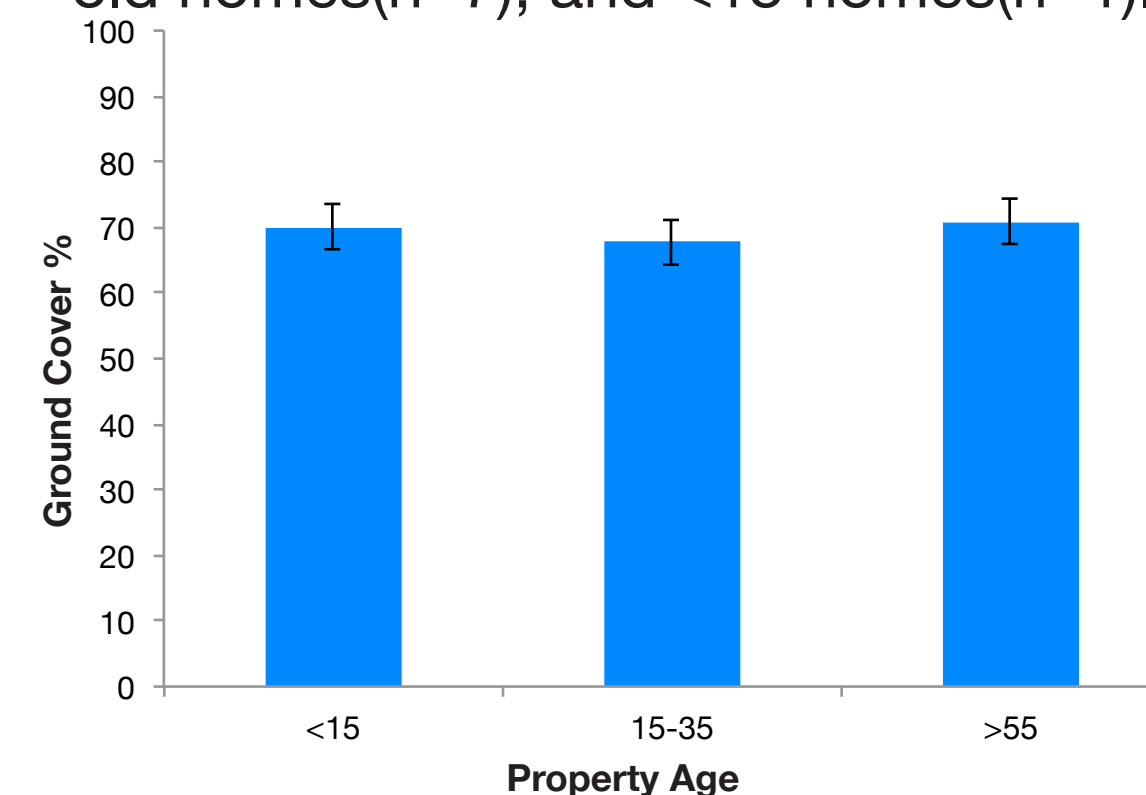
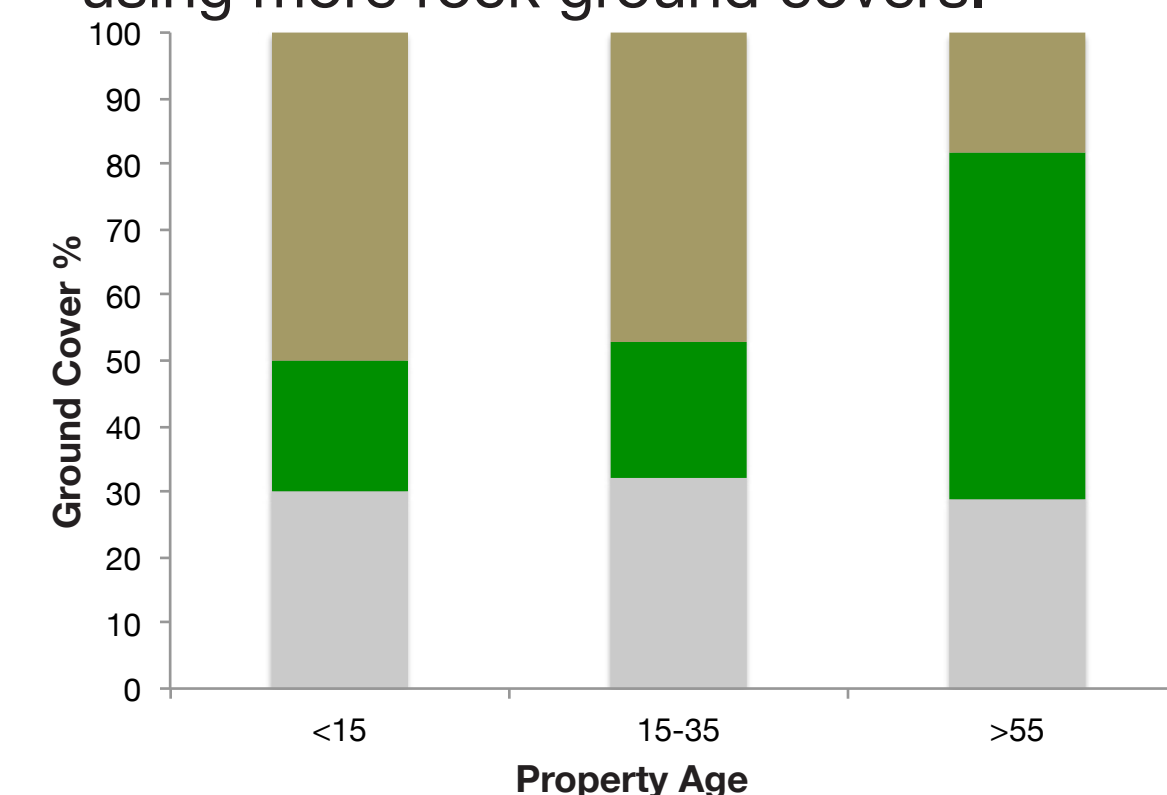


Figure 6b: Materials used by Age: Properties older than 55 years old have greater permeability due to large amounts of grass, newer homes are using more rock ground covers.



Landscape Design Structures

Figure 7a: Phoenix, urban, middle income, >55 years old



Figure 7b: Peoria, suburban, high income, <15 years old



Figure 7c: Buckeye, exurban, high income, 15-35 years old



Figure 7d: Phoenix, exurban, high income, 15-35 years old



- Residential properties used for this study did not appear to have any stormwater management practices in their landscape design. However, there was one middle income property in Phoenix that had a planter box (Fig. 7a), which is an LID Best Management Practice.

- Newer high income developments have less amounts of grass used in their landscape design and higher rock material percentages (Fig. 7b).

- Properties that handled stormwater management more efficiently are more recent urban developments and exurban locations (Fig. 7c) by having less impervious surfaces than older urban/suburban properties (Fig. 7d). One reason could be that properties are larger in Buckeye in comparison to bigger cities like Phoenix, but they still have an equal area of ground covered by concrete (driveway).

Conclusions & Next Steps

- My research will contribute to the effectiveness of future Low Impact Development ordinances by understanding how residential properties are currently managing stormwater.
- Data gathered during this study will be useful for landscape planners when future ordinances take effect in Phoenix, AZ.
- Next steps involve understanding the extensiveness of Low Impact Development ordinances in the United States. Comparing different ordinances between different cities and how they being enforced by the state, city or country.

Acknowledgments

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