

LANDSCAPE PERFORMANCE EDUCATION GRANT (LPEG) 2016 REFLECTION

Investigator:

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OVERVIEW OF COURSE & LPEG WORK

LPEG work included curriculum changes to a required fourth-year studio course for the undergraduate major in Landscape Design. The studio focuses on site planning and design of landscapes in the public realm, and the teaching approach is structured around a service-learning project. Learning objectives relate to building theoretical and applied knowledge in sustainable site design and gaining advanced skills in design presentations, technical writing, and team collaboration.

The primary goal of curriculum changes was to go beyond simply building knowledge of sustainable site design principles to calculating landscape performance benefits pre- and post-schematic design. In addition, course content and assignments were re-organized around four themes (vegetation and soils, water, materials and energy, human health and well-being) to better integrate with the Landscape Performance Series resources. Finally, to assess learning, a pre- and post-quiz on landscape performance was incorporated into three individual reflection exercises already part of the service-learning methodology.

TOPICS & ACTIVITIES

The course's assignments and key activities are listed in the table on page 2, organized by three modules. The understanding module was meant for students to learn about the importance of landscape performance (LP) and sustainable site design strategies, specifically in our context of the semi-arid Middle Rockies. The teaching approach used more experiential strategies than in the past, but continued to include traditional lecture and discussion activities. The application and communication modules were comprised of activities relating to the service-learning project with the City of Bozeman Water Conservation Division (for a description of the project, see sample assignment). For baseline and schematic design LP assignments, an Excel spreadsheet was developed for the course. The spreadsheet organized and, where possible, automated relevant metrics to improve accuracy and consistency when aggregating performance data among several sites analyzed. As part of the design process, the application module incorporated two in-progress reviews, one with the project partner and one with landscape design colleagues. Interactive team tasks were incorporated throughout the application module to simulate a work environment. For example, students organized and facilitated the partner review. The communication module culminated the service-learning project with a formal, public design presentation.

MODULE	ASSIGNMENTS	ACTIVITIES/DESCRIPTION	%
Participation & engagement (throughout)	Reflection 1 (R1): Strengths and desires for course and personal development; landscape performance pre-quiz R2: Analysis of mid-review presentations, designs, and performance targets R3: Analysis of final presentation, design, and representation; landscape performance post-quiz Engagement: attendance, teamwork, discussion, professionalism		20
Understanding (4 weeks)	Assignment 1(A1): Performance Principles	<ul style="list-style-type: none"> • LAF webinar on LP resources • Textbook readings and discussions • Guest lecture by Dr. Matt Lavin on Montana native plant communities • Guest lecture by City of Bozeman Water Conservation Division on state of local water resources • Field day with Greater Gallatin Watershed Council • Field trip to Westscape native plant nursery • Field tour with local design firm, Design5, on water resiliency projects 	20
Application, service-learning project (8 weeks)	A2: Baseline Performance A3: Schematic Design Mid-Review A4: Design Performance	<ul style="list-style-type: none"> • Site analysis and baseline LP calculations • LP targets and scenarios matrix development • Schematic design development and LP calculations 	40
Communication (4 weeks)	A5: Sharing Solutions A6: Memo	<ul style="list-style-type: none"> • Landscape representation • Final public presentation • Technical research and writing on management and cost estimate 	20

STUDENT PRODUCTS & OUTCOMES

In A1 students produced infographics illustrating principles of LP around the four themes. Many of the infographics also became useful graphic representations for showing design approach and performance benefits in the later communication module. The design process and project description of the service-learning project is described in the included sample assignment sheet. Students collected and calculated landscape performance data for seven representative parcels to establish a broader snapshot of baseline performance of single family parcels across the City. The data was produced using Excel, AutoCAD, Google Earth, City of Bozeman water meter data, and online calculators. The same data was collected and compared for the final schematic designs (see A4 student sample work). Key metrics included vegetation species richness, vegetation descriptive statistics, stormwater collection volumes, irrigation volumes from the EPA Water Budget tool, tree benefits from National Tree Benefits calculator and iTree Design, management time and materials, and human health and well-being opportunities. The process of quantifying and qualifying LP benefits was extremely valuable for students to self-discover the impacts of both the status-quo residential landscape and their design decisions. One student commented, “Looking at landscape from a performance standpoint allowed for a

more in depth understanding of how and why a site functions.” The LP framework and data helped students grasp the extent of sustainable design challenges faced in local ecosystem, especially the use of potable water in the landscape.

Informed by baseline performance, site analyses, and partner goals, students developed performance targets and a scenario matrix for seven different schematic designs (see student work sample). The scenarios featured varying performance goals, design concepts, parcel layout, orientation, and existing features to provide a suite of plug-n-play design ideas for residents to implement. The team collaboration to establish the LP targets, scenario matrix, and final presentations was particularly rewarding for students.

The schematic designs included layout and dimensioning, grading and drainage considerations, planting plans, materials, and limited construction details. A public review culminated the project and included team introductory slides that described the LP approach and scenario matrix, followed by individual presentations for the seven scenarios. The final presentation is expected to be the most professional to date in their curriculum, and to prepare, students recorded practice presentations beforehand. The class worked together to create presentation layout and design, which resulted in very effective cohesion that the partner praised. One student wrote, “as a group it was a good training experience to rely on the work of others to accomplish a combined task. It allowed for independent creativity with a common bond in design concept, which I feel offered the opportunity to push personal limits of presentation standards. We now were not just representing ourselves, we were representing each other.” Reviewer and audience surveys were collected at the final review to provide students a range of feedback and comments, especially from non-design experts.

Following the final review, students produced technical papers (A6) on an operations and management topic of their choosing to research what steps would be necessary for sustainable construction and care of the design scenario. This assignment allowed students to critically analyze and communicate the importance of management for landscapes to perform as intended. In addition, students were required to attach a revised cost estimate for materials. Developing a schematic design cost estimate provided a tangible activity to see the economic impacts of sustainable site design strategies. For example, many students commented how surprised they were to see how much money and resources could be saved by choosing re-used hardscape materials and soils.

INSTRUCTIONAL ASSESSMENT & REFLECTIONS

In the understanding module, experiential activities like field trips and guest lectures were extremely well received and helped students better understand local landscape challenges that were applied in the service-learning project. I think the field activities help students especially visualize underlying materials and performance aspects often overlooked when simply thinking of design as a finished static product. In addition, I think with fewer field-based opportunities in our current curriculum, students were drawn to these practical experiences. Our field trips related primarily to building understanding of LP early in the course, however, in the future I would also plan to tour precedent ideas after site visits as students are in the process of early

design sketching. A1 was designed to be more open ended so that students could chose specific questions to research due to the breadth of landscape performance principles and strategies. For undergraduate students, this ended up being too broad-scoped which led to less shared knowledge among all students. I think it would be ideal to have a separate theoretical and classroom based course that covered these foundations. Alternatively, a test or series of quizzes on each LP theme would more explicitly outline key literature and principles.

The three reflection exercises have been integrated into the course based on service-learning pedagogy, but I think they would be extremely valuable for any studio setting so students assess their own learning and development as designers. Including the LP pre- and post-quiz in the beginning and final reflections was logistically effective, but the quiz questions themselves should have been more specific. Furthermore, I would recommend incorporating small quizzes throughout the course for each LP theme to gauge student understanding throughout the course. Based on the students' answers in the post-quiz, it was clear they grasped the overarching principles. For example, one student responded, "landscapes do not have to be static visually stimulating compositions. We can now see that even a playground can function as a performing landscape." Another student wrote, "to create landscape sustainability, I think the cultural perception needs to change and people need to see that sustainability can be beautiful and hopefully begin to change the norm one lawn and neighborhood at a time." However, their responses did not demonstrate a more in-depth understanding of specific literature or data to support their answers. The LP pre- and post-quiz were closed book, short answer essay questions. In the future, I will likely adjust this to a format with variable question types.

For the service-learning project, students collected/calculated baseline and design landscape performance data by filling out or completing a spreadsheet provided. The spreadsheet listed all calculations and characteristics that were to be catalogued and described, and students were not required to research or determine their own quantitative or qualitative methods to determine LP benefits. This strategy was chosen to better direct student work time and create more consistency among scenarios. For undergraduate students working on LP data for the first time, this worked well to keep students focused with a limited timeframe (8 weeks for the service-learning project). Two of the more significant challenges with LP data were 1) unforeseen varying student ability with Microsoft Excel, and 2) inaccuracy among scenario LP data due to inconsistent input data, mistakes in take-off calculations, and other mathematical errors. Assessing student spreadsheets took considerable time and effort, beyond a typical studio course. Incorporating more in-class activities or assignments for students to cross-check or grade their own work or each other's would be recommended. This challenge was compounded by the fact that the data and design work was for a real partner organization.

The final paper/memo on operations and management is one that is always well received by the students, because they value the opportunity to practice technical writing. In the future, to improve the student's accuracy and robustness of information they write about, I plan to assign additional readings specifically related to installation and management. I find that many current texts on landscape performance and sustainable sites principles are still too overarching and

often more applicable to larger scale sites, and not as relevant to small site installation and maintenance.

Finally, although the partner was a public organization and some of the initial design phases were applied at a community scale, the actual site design scenarios were for private single-family parcels. Typically, this course has focused on public landscapes, like parks, schools, and streets, but because the project partner had identified this as being their primary need, the project sites needed to remain only private residential. Because single family equivalent parcels account for nearly 70% of the City's potable outdoor water use, this approach would have the greatest potential impact.

SUPPLEMENTAL MATERIALS

The following select materials are included:

- Course syllabus
- Sample reflection assignment 1 (R1), includes LP pre- and post-quiz questions
- Sample assignments, application module service-learning project and A6
- Samples of student work from A1, A2, A3 (performance targets and design scenarios), A4, A5 (team introductory presentation and individual presentations)

Glossary

A assignment
R reflection

LAF Landscape Architecture Foundation
LP Landscape Performance

MONTANA STATE UNIVERSITY | HORT 432: ADVANCED LANDSCAPE DESIGN
SYLLABUS, FALL 2016

Class Schedule: Monday 1:10 – 3:00 PM, Wednesday 1:10 – 4:00 PM, Friday 1:10 – 3 00 PM

Location: Linfield Hall 16 (studio), Linfield Hall 232 (computer lab)

Prerequisites: HORT 331, HORT 335, HORT 336; or instructor consent

4 undergraduate credits

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OVERVIEW

This course serves as the capstone studio course for the Landscape Design major. We will focus on site master planning and design that generates ecological and cultural value. Throughout the semester, you will be challenged to integrate the suite of skills acquired in other core courses, including graphics, site engineering, planting design, and construction. In the first part of the course, we will build *understanding* of landscape performance principles and tools through critical examination of lecture and reading materials and field experiences. The primary part of the course will involve *application* of this newly acquired knowledge and skills in a service-learning design project. Through this client-based experience, you will continue to advance your *communication and professional* skills through stakeholder outreach, landscape representation, and verbal and technical written presentation.

LEARNING OBJECTIVES

- Gain an understanding of the principles and processes for measuring value of landscape performance in order to develop sustainable site designs.
- Critically analyze the life cycle of and resources used to design, construct, and manage landscapes.
- Develop skills in planning and design of landscapes at the site-scale, within the public realm.
- Fine-tune design process and unique graphic abilities to respond to and represent a project's environmental, economic, cultural, and aesthetic conditions.
- Apply landscape performance functions to design solutions that regenerate landscape benefits.
- Advance professional skills by working in a work-simulated studio environment, organizing stakeholder collaborations, and presenting design solutions.
- Build technical writing and professional work skills through service-learning activities.

STUDIO STRUCTURE

Module 1: Understanding

Learning goal: Build knowledge of principles and considerations for investigating landscape performance. Critically analyze the life cycle and benefits of designing landscapes.

A variety of class activities will be incorporated by theme, including lectures, readings, reflection questions, and field experiences. Themes explored are vegetation & soil, water, materials & energy, and human health & well-being. Material will also include landscape performance fast facts, benefits toolkits,

and case studies, utilizing the Landscape Performance Series website. In Assignment 1 you will summarize research and learnings through infographics that represent local systems through time and space, as well as a written analysis.

Module 2: Application

Learning goal: Collaborate with project partners to develop design solutions that meet landscape performance goals.

We will be working with the City of Bozeman Water Conservation Division to develop landscape scenarios that will be precedents for how their new Planting and Outdoor Watering guidelines may be implemented by area property owners, as well as meet varying landscape performance goals. This module will follow a more traditional studio course format, with a combination of individual and group research, quick design exercises, iteration, desk critique, landscape performance calculations, and landscape representation.

Module 3: Communication

Learning goal: Practice professional verbal and written communication of landscape performance and design goals and solutions.

During this module, you will share design solutions in a professional venue, with a broader stakeholder audience. The final assignment will focus on writing, to compliment the more visual-heavy public presentation of work. This technical writing challenge will provide a more in-depth analysis and rationale for design choices and landscape performance value.

ASSESSMENT

All assignments will be evaluated using a rubric based on course learning objectives.

<i>Module</i>	<i>Assignments</i>	<i>Points</i>	<i>% Total</i>
Participation & engagement	Reflection Exercises (R1, R2, R3) Engagement	25 each 125	20
Understanding	Assignment 1 (A1): Performance Principles	200	20
Application	A2: Baseline Performance	100	40
Landscape Design Scenarios for Water Conservation in the Middle Rockies	A3: Schematic Design Mid-Review	100	
	A4: Design Performance	200	
Communication	A5: Sharing Solutions A6: Memo	150 50	20
		1000 total	100

Grades

A = Excellent, substantially above expectations	(A 93-100%, A- 90-92)
B = Good, above expectations	(B+ 87-89%, B 83-86, B- 80-82)
C = Average, acceptable, meets expectations	(C+ 77-79, C 73-76, C- 70-72)
D = Marginally acceptable	(D 60-69)
F = Not acceptable	(0-59)

RESOURCES

Required Texts

Venhaus, H. 2012. *Designing the Sustainable Site: Integrated Design Strategies for Small-scale Sites and Residential Landscapes*. John Wiley & Sons, Inc.: Hoboken, NJ.

Recommended Supplementary Texts

LaGro, J.A. Jr. 2013. *Site Analysis: Informing Context-Sensitive and Sustainable Site Planning and Design*. 3rd Ed. John Wiley & Sons, Inc.: Hoboken, NJ.

Booth, Norman K. *Basic Elements of Landscape Architectural Design*

Studio Reference Texts

Calkins, M. 2012. *The Sustainable Sites Handbook: A Complete Guide to the Principles, Strategies, and Best Practices for Sustainable Landscapes*. John Wiley & Sons, Inc.: Hoboken, NJ.

Dee, C. 2001. *Form and Fabric in Landscape Architecture: a visual introduction*. Routledge: New York, NY.

Sustainable SITES Initiative. 2014. *SITES v2: Reference Guide for Sustainable Land Design and Development*. Lady Bird Johnson Wildflower Center of the University of Texas at Austin, the U.S. Botanic Garden, and the American Society of Landscape Architects.

D2L Resources

Additional reading and research sources will be posted on course D2L site.

(POLICIES)

The remaining syllabus topics, including studio culture, participation, academic misconduct, etc. have been omitted.

A6: MEMO

50 points

OBJECTIVE. Write a memo to our project partners, communicating landscape performance considerations for moving this project forward, based on sustainable site construction and management. In addition, you will revise and include the schematic design cost estimate that will be attached to the Memo.

Scenario: You are a landscape design consultant working for the project partner, and assisting in moving the project forward to help the design ideas become more tangible for residents to implement. The goal is to further communicate how the design should be installed/constructed and managed over time to attain the performance benefits that it claims.

- Choose site construction, materials, or management topic(s) to cover: material sources, installation how-to, necessary soil properties and ways to improve soil quality, irrigation considerations and hydrozone details/definitions, maintenance/management tasks through time and space, etc.
- All reference material should be cited using MLA or APA style.
- Create diagrams and figures as needed to illustrate content.
- Cost estimate should be revised or expanded to be most helpful for the end-user. Carefully consider the materials and steps needed to build the project, and consult with the professor as needed. Note what is NOT included.
- Example Memos and Resources are included in the shared BOX > A6_MEMO

REFERENCES

- Calkins, Meg. 2012. The sustainable sites handbook: A complete guide to the principles, strategies, and best practices for sustainable landscapes. Wiley: Hoboken, NJ. Chapter
- Hopper, L.J. 2007. Landscape Architectural Graphic Standards: Student Edition. Wiley: Hoboken, NJ.
- SITES Reference Guide (on D2L)
- Additional resources in BOX > A6_Memo > Resources

DELIVERABLES

2-page, single-spaced written content + diagrams as needed (so, total may exceed 2 pages).

1-page cost estimate.

All references should be included on separate page at the end.

See schedule for DUE DATE. .pdf file posted to Rebekah's BOX > StudentWork_SUBMIT shared folder.
Titled: A6Memo_FirstNameLastName.pdf.

ASSESSMENT

30	Quality of analysis and content based on sustainable site principles; quality of diagrams/figures
10	Thoroughness and accuracy of cost estimate
10	Organization and clarity of writing; citations
50	Total Points

Module 2: Application

Learning goal: Collaborate with project partners to develop design solutions that meet landscape performance goals.

Landscape Design Scenarios for Water Conservation in the Middle Rockies

OVERVIEW

In this service-learning design project you will apply knowledge and skills of landscape performance gained in the first part of the studio course. The studio will work with the City of Bozeman Water Conservation Division to develop a suite of landscape plans that will be precedents for how their new Planting and Outdoor Watering guidelines could be implemented by area property owners. Ultimately, these landscape design alternatives would provide rationale for a paradigm shift of what resilient, regenerative urban landscapes may look like. Through this client-based experience, you will continue to advance your communication skills through stakeholder outreach, landscape representation, and verbal and technical written presentation.

DESIGN CHALLENGE

You will create site designs for a set of representative parcels that meet landscape performance goals. After calculating baseline site performance, the site design scenarios and performance targets will be developed together as a class along with feedback from our project partner. The design work and landscape performance calculations will be a combination of team and individual assignments. Your design solutions should create a *sustainable landscape design*, based on landscape performance criteria and principles outlined in the course texts and LPS website. Following our final design review, module three also includes writing a memo highlighting implementation and management recommendations.

LANDSCAPE PERFORMANCE CRITERIA

To assess existing conditions of “conventional” properties that cumulatively contribute to high potable water use for irrigation, we will begin by calculating a number of landscape performance metrics along with a more traditional site analysis. These baseline figures will provide the rationale for writing landscape performance goals that alternative scenario designs must meet or exceed. The characteristics of scenarios may be organized in numerous ways, and we will work together to develop a matrix that fits best with our partner’s goals and audience. This matrix will differentiate final site plan alternatives.

In addition to setting landscape performance goals, because we have limited time for site testing and design development, there will be some criteria that require transparent assumptions. For example, site specific soil types and chemistry. Identifying and communicating these will be part of the design challenge.

PROCESS (detailed assignment sheets provided separately; refer to course *schedule* for dates)

A2: Baseline Performance	<ul style="list-style-type: none">• Visit sites and produce base map• Characterize existing site and its context• Build 3D site models• Calculate conventional performance• Analyze site challenges & opportunities
A3: Schematic Design Mid-Review R2	<ul style="list-style-type: none">• Set Landscape Performance Goals (team)• Scenario development (team)• Mid-review meeting organization & facilitation• Final schematic site designs
A4: Design Performance	<ul style="list-style-type: none">• Planting design, materials detailing• Scenario design landscape performance• Cost Estimate (may not be until A6)
Module 3: Communication	
A5: Sharing Solutions R3	<ul style="list-style-type: none">• Representation; 3D site model / sketch model• PowerPoint presentation• Boards
A6: Memo	<ul style="list-style-type: none">• Installation/management/maintenance schedules• Brochure

FINAL DELIVERABLES

For the final presentation for partners and reviewers, students will present their design solutions using digital media as well as printed poster format. Students may also be asked to participate in additional presentation opportunities to discuss their work (i.e. City of Bozeman groups, etc.) Site design concepts will be communicated through a range of drawing types, such as, plans, section-elevations, perspectives, 3D-models, collage, photos, written description, and verbal presentation. Following the final presentations, students will also write a brochure highlighting recommendations for site construction, stewardship, and maintenance based on the landscape performance goals and metrics.

MEMORANDUM OF UNDERSTANDING

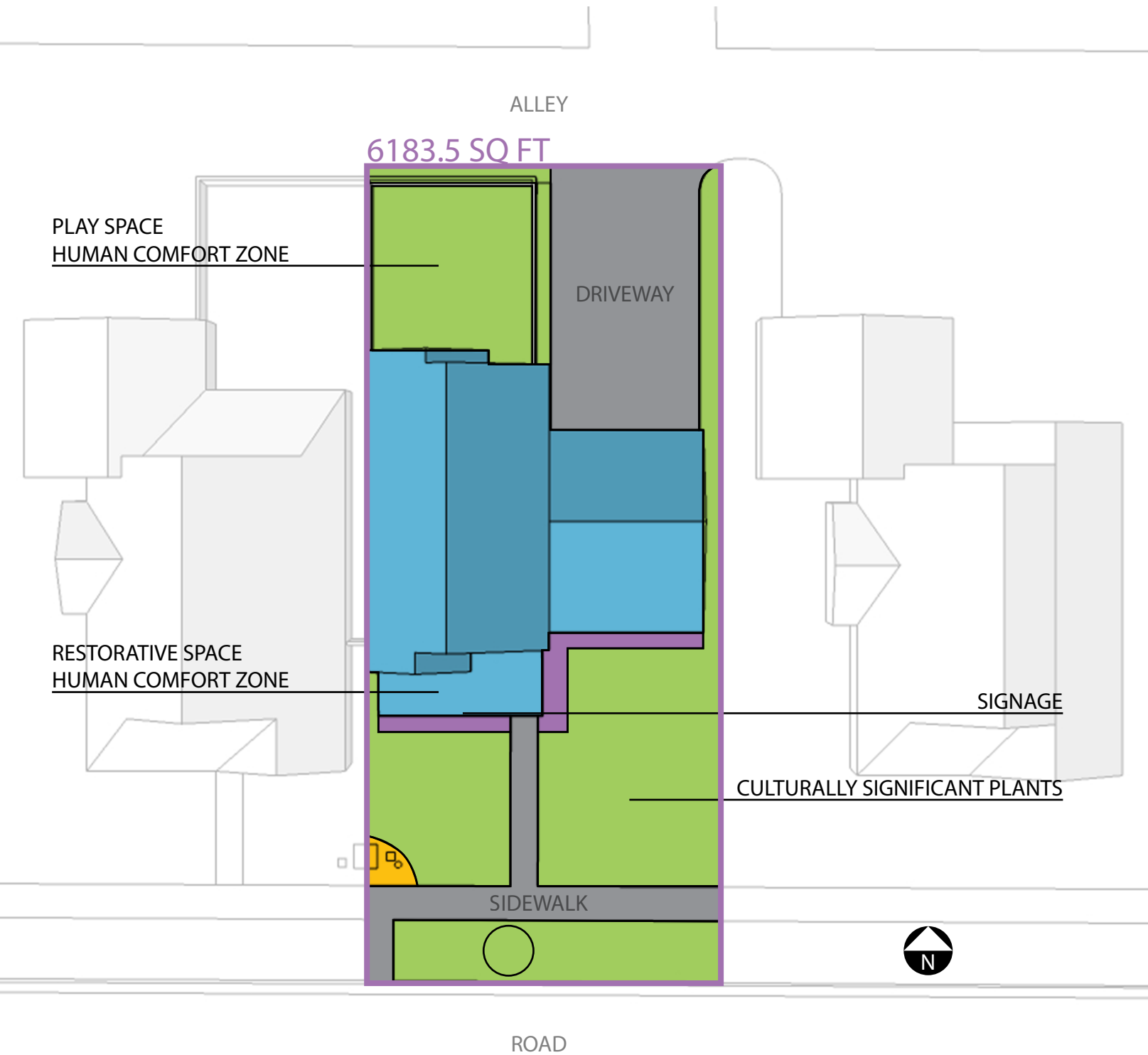
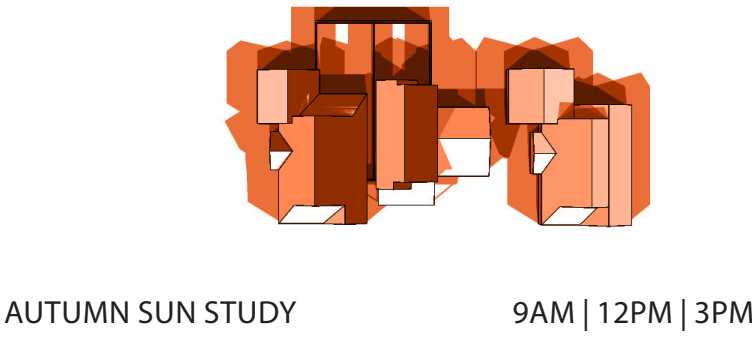
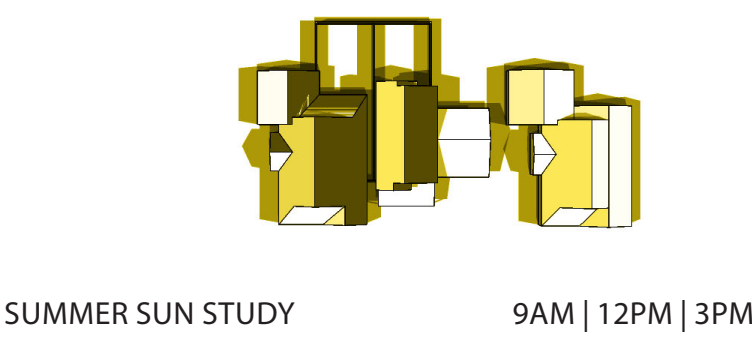
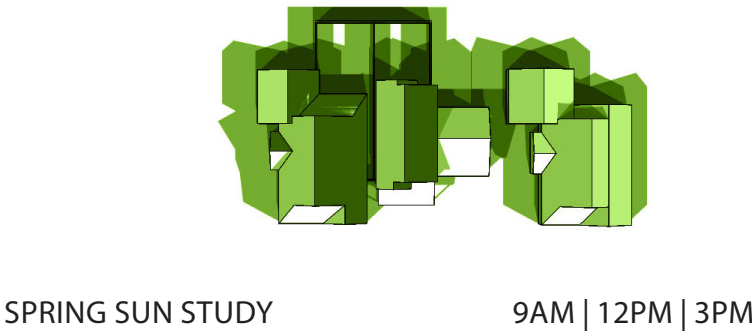
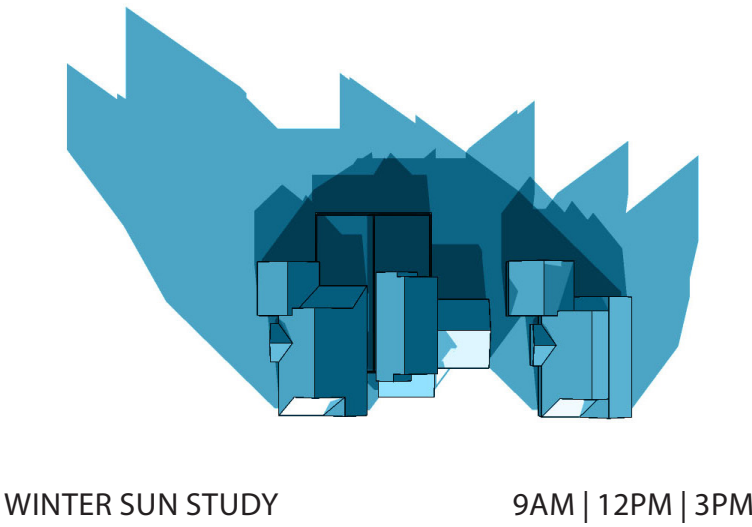
This service-learning project carries a formal Memorandum of Agreement between MSU (faculty and students) and the City of Bozeman. Please refer to this document for work, communication, and ownership expectations.

BOZEMAN SINGLE-FAMILY RESIDENCE STUDY

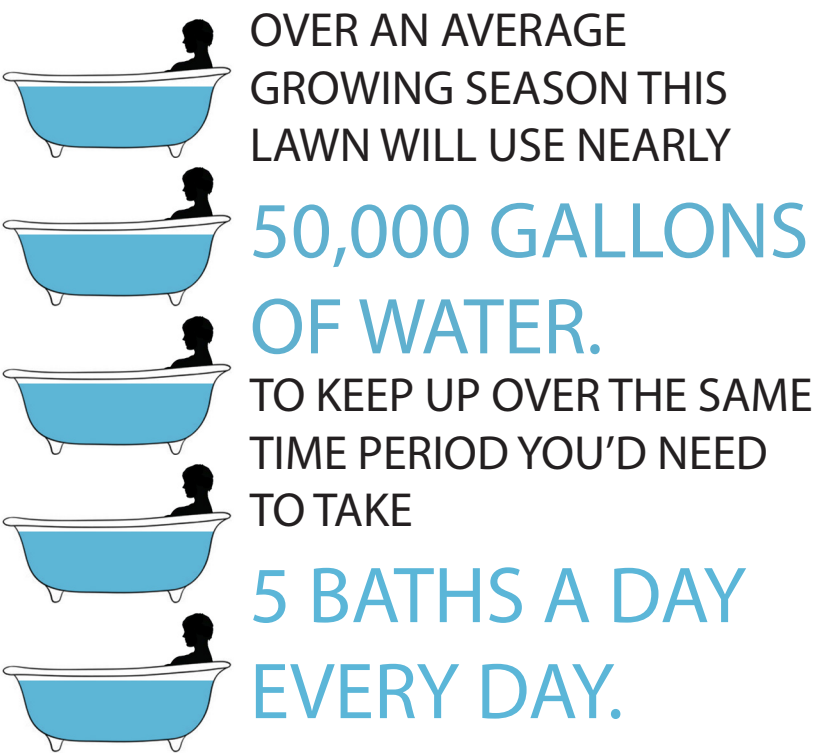
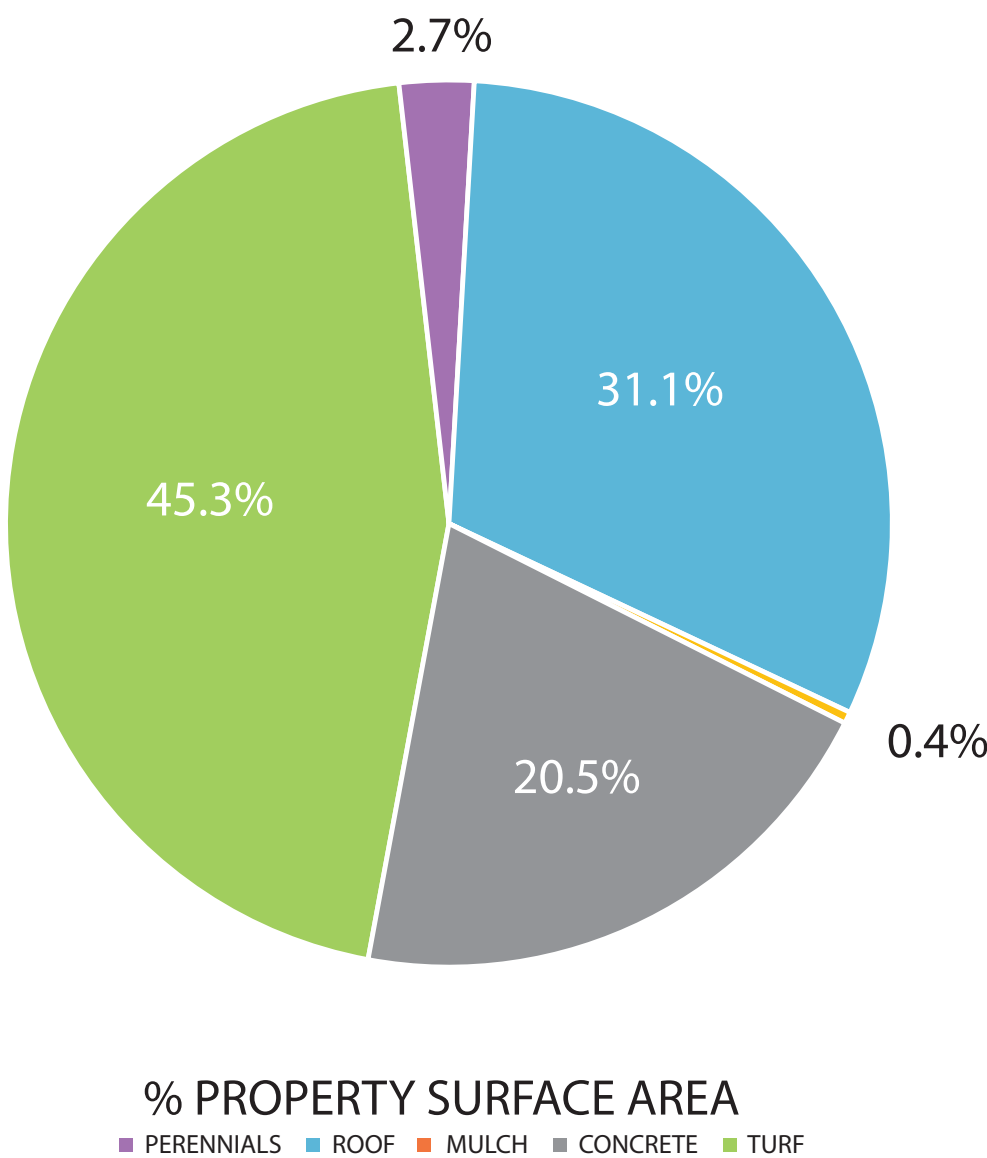
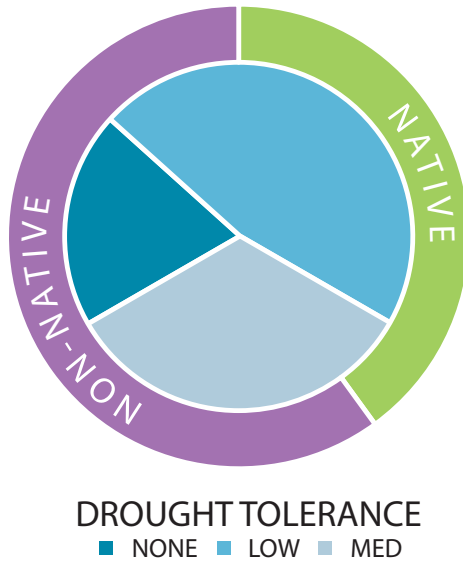
ELIZABETH RITCHIE | HORT 432 | FALL 2016

WHY THIS PROPERTY?

This property, containing on single family home with alley garage access, was selected to be representative of its neighborhood in regards to orientation, programming, and vegetation. Like many of its peers, this property is relatively narrow with very shallow setbacks to the adjoining properties. It is oriented north-south and offers a fairly sized-able front yard compared to its neighbors. However, this means that the fenced-in backyard is rather small in comparison and is planted only with turf. The covered porch and fenced in backyard offer a sense of security and ownership, especially when considering the shallow setbacks. The abundant use of turf is common in this, and most, residential areas and as such has been termed as culturally significant since it would be exceptional if this was not present. The alley-access garage allows for a narrower house profile on the lot, though this particular design does not seem to take advantage of this fact as much as it could have. Interestingly, the developers have chosen to place the utility boxes on the front face of the lots on this street, likely for cost-reduction or access reasons.

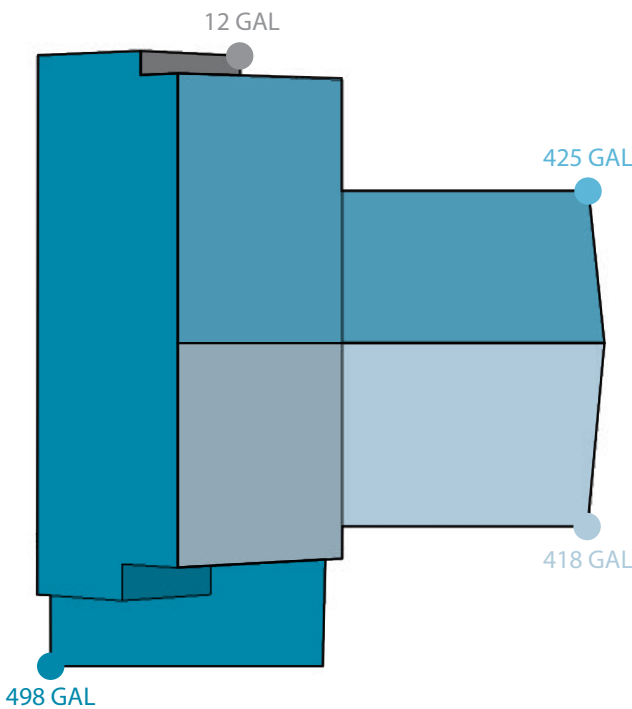


PERENNIAL BEDS



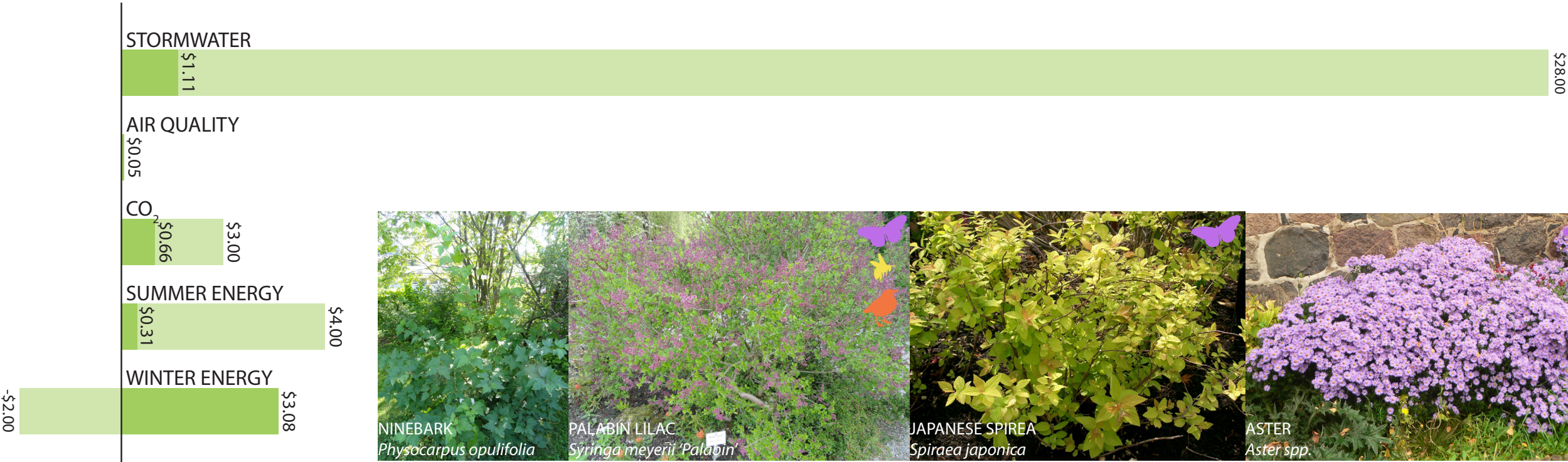
ROOF RUNOFF

AVERAGE MAY-AUG PRECIPITATION



SAVINGS FROM TREE

THIS YEAR LIFETIME

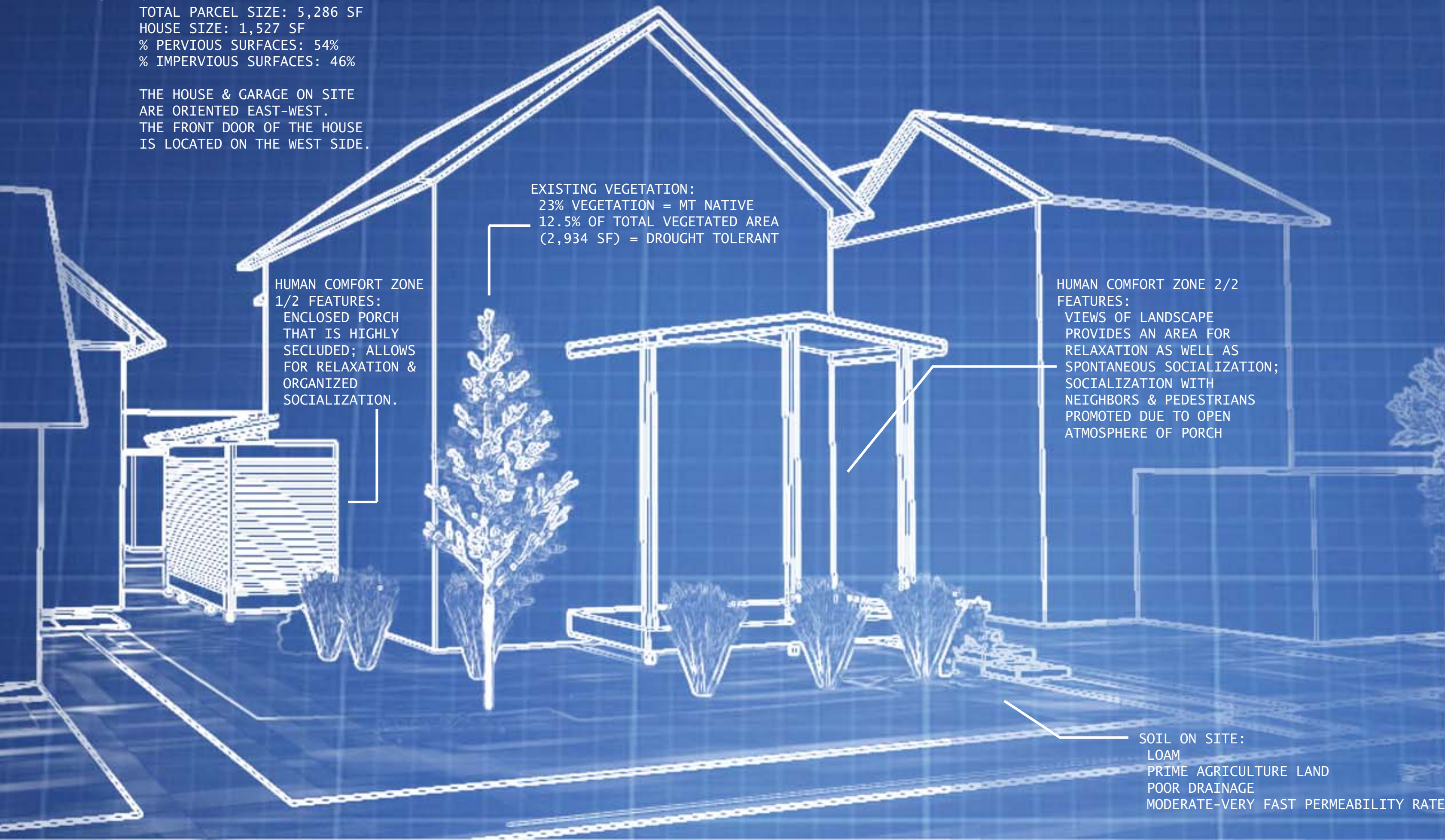


PERENNIALS AND SHRUBS ATTRACT

BUTTERFLIES BEES BIRDS

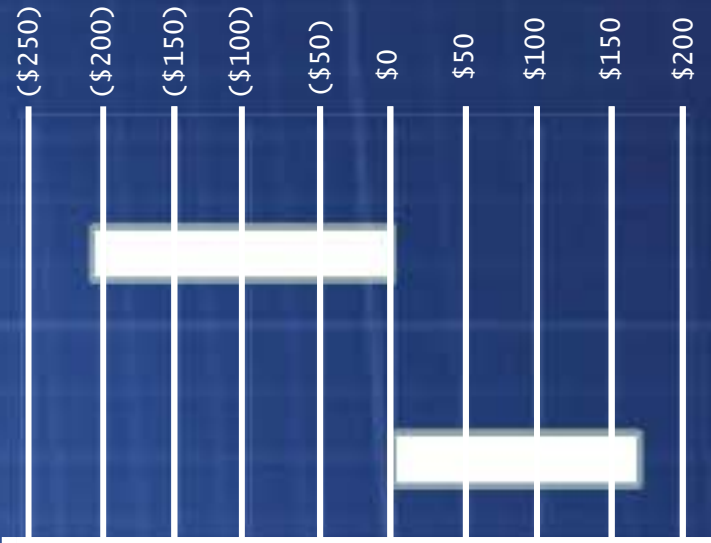
SITE 6:
TOTAL PARCEL SIZE: 5,286 SF
HOUSE SIZE: 1,527 SF
% PERVIOUS SURFACES: 54%
% IMPERVIOUS SURFACES: 46%

THE HOUSE & GARAGE ON SITE
ARE ORIENTED EAST-WEST.
THE FRONT DOOR OF THE HOUSE
IS LOCATED ON THE WEST SIDE.

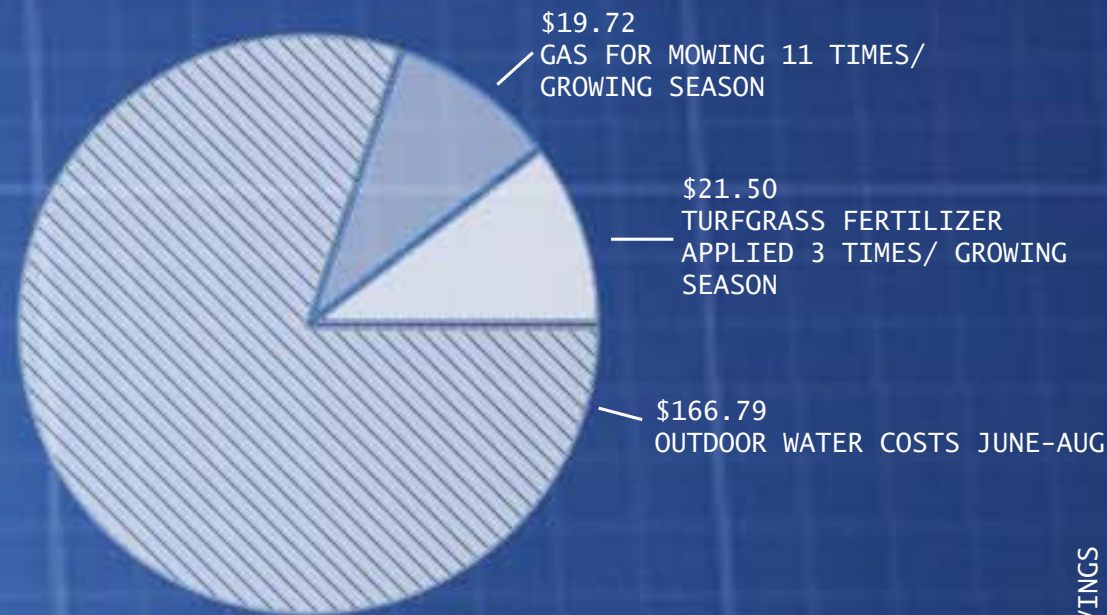


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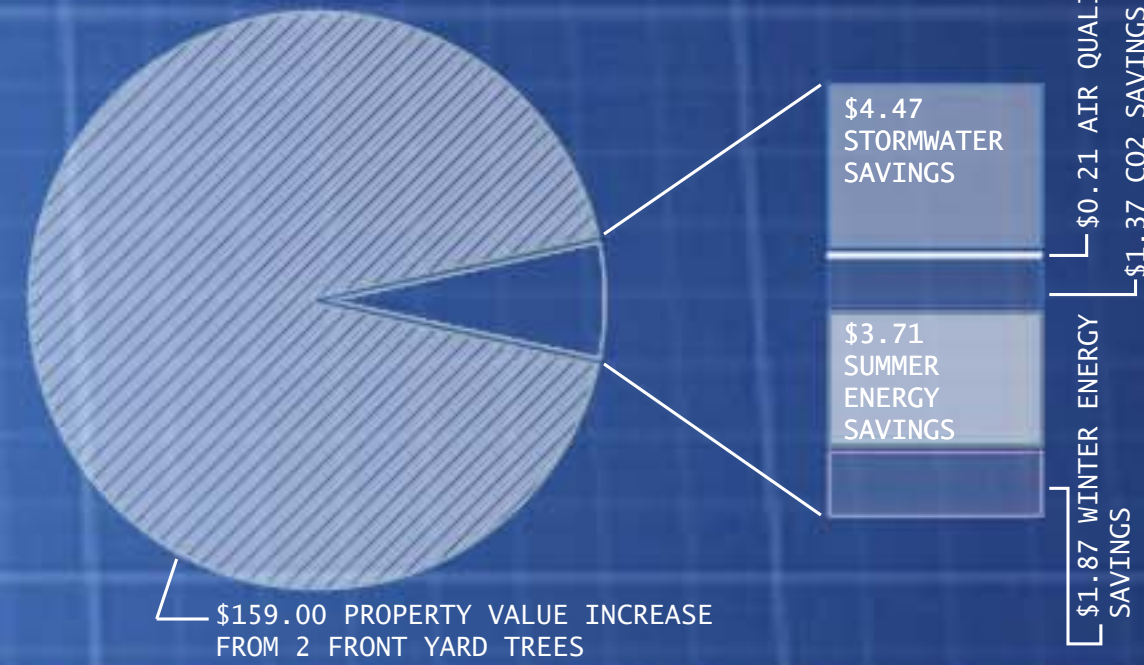
TOTAL ANNUAL
OUTDOOR COSTS
\$208.01



SITE 6: ANNUAL OUTDOOR COSTS



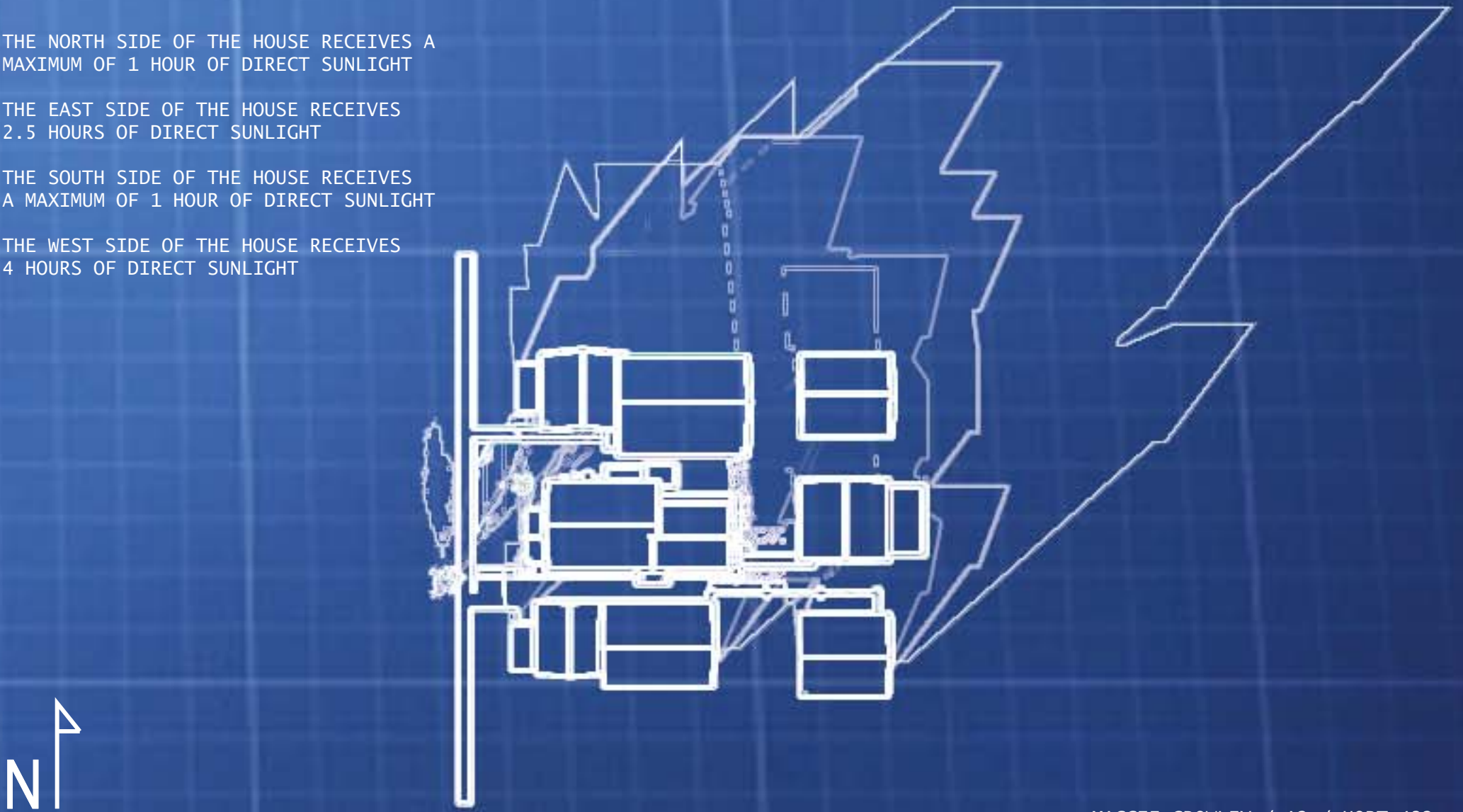
SITE 6: ANNUAL OUTDOOR SAVINGS / GAINS



SUMMER SOLSTICE SUN-SHADE ANALYSIS



WINTER SOLSTICE SUN-SHADE ANALYSIS



Summary Findings

Write a story for what design data compares to baseline data (either parcel averages or specific parcel data). Descriptions should be heavy on data!

THEME	Compare/Contrast Claims between baseline and design
COVERAGES	<div><div>1</div><div>Baseline performance: 98.3% of vegetated area = turf Design performance: 9% of vegetated area = turf. Claim 1/Coverage theme: Urban Farmer design resulted in a drastic decrease in the total % vegetated area covered with turf grass.</div></div> <div><div>2</div><div>Baseline performance: 57.4% of total site area = impervious surfaces. Design performance: 48% of total site area = impervious surfaces. Claim 2/Coverage theme: Urban Farmer design resulted in a nearly 10% decrease of impervious surfaces on site. Only areas on site that are impervious in the Urban Farmer design are the roof and existing patios/sidewalks.</div></div>
VEGETATION & SOIL	<div><div>1</div><div>Baseline performance: .21% of total plants = Human health value - therapeutic, 0% edible/medicinal, 0%(F???). Design performance: 69% of the total plants = edible/medicinal. Claim 1/Vegetation & soil theme: Urban Farmer design resulted in a 68.79% increase of edible plants on site.</div></div> <div><div>2</div><div>Baseline performance: .7% of total plants = bee-friendly. 0% = butterfly friendly. Design performance: 40% of total plants = bee friendly. 46% of total plants = butterfly friendly. Claim 2/Vegetation & soil theme: Urban Farmer greatly improved the habitat needed for pollinators.</div></div> <div><div>3</div><div>Baseline performance: Stormwater interception (National Tree Benefit Calculator)(assuming trees at maturity)- 6,523 gal. Design performance: 7782 gal. Claim 3/Vegetation & soil theme: over 1000 more gallons of water is being intercepted on the Urban Farmer site compared to the baseline site due to the simple addition of 3 fruit trees.</div></div>
WATER	<div><div>1</div><div>25157 gal = total monthly required gallons for baseline. 10134 gal = total monthly required for design performance. Claim 1/water theme: Huge reduction in monthly gallon needs for site.</div></div> <div><div>2</div><div>\$122/ month water costs with baseline site. \$52/ month water costs with Urban Farmer Design. Claim 2/water theme: Money savings when implementing design strategies set forth by Urban Farmer.</div></div> <div><div>3</div><div>Below total monthly allowance (10919 gal) with the urban farmer design. The baseline performance indicates it was above the total monthly allowance however I will need to run the figures on the epa tool to verify.</div></div>
MATERIALS & ENERGY	<div><div>1</div><div>Hours total yearly mowing time - 220 hours spent mowing says the baseline (doesn't seem accurate?) 4.5 hours spent mowing/yr with Urban Farmer Design. Claim 1/materials and energy - Urban farmer greatly reduces the amount of time spent mowing/weed eating the lawn/year.</div></div> <div><div>2</div><div>22 gal of gas consumed to mow the baseline site/yr. 1.3 gal of gas consumed/yr to mow the Urban farmer. Claim 2/materials and energy- great reduction in gas costs associated with mowing the lawn</div></div> <div><div>3</div><div>433 lbs CO2 emitted from mowing the lawn/yr for baseline. 27 lbs CO2 emitted from mowing the lawn/yr for Urban Farmer. Claim 3/materials and energy - huge drop in CO2 emissions /yr from mowing the lawn</div></div>
HUMAN HEALTH & WELL BEING	

- 1

Lounge area under fruiting trees (creates a comfortable outdoor microclimate) in the Urban Farmer Design. Baseline performance provides no area to enjoy the yard within the yard. Claim 1/human health and well being - Urban Farmer provides a place to sit, relax and enjoy the yard.
- 2

Design encourages site users to explore the landscape more fully: smelling & tasting vegetation, listening to birds, feeling sun's warmth, hearing plants rustle. The baseline performance landscape misses out on these experiences due to the lack of species richness & diversity.
- 3

Baseline performance does not provide informal or formal paths to allow for landscape connectivity. Design performance- Formal pathway connecting road to house; informal pathway allowing for conveyance from road to front of house to backyard.

70 sf in turf area

ADDITIONAL OVERALL (as needed)

A4 Design Performance

COVERAGES

STUDENT:

Maggie

Parcel ID:

3

Key:

- included in baseline summary
- automated formula in cell - check for correct range
- manually enter value

SURFACE TYPE (total)	Area (SF)	% of Site
Entire Parcel	9852	100%
Vegetated (all)	4318	44%
Turfgrass	895	9%
Shrub/Perennial Zones (includes vegetable and herb beds (in-ground & raised-beds) that demand high water needs)	832	8%
Waterwise Zones (includes shrub/perennial/edible areas (in-ground as well as raised-beds) that require some additional watering but are fairly drought tolerant)	527	5%
Natural Rainfall/Drought Tolerant Zones (includes native seed mixes and some shrub beds that are exclusively drought tolerant)	2064	21%
Roof(s) (includes house roof and shed roof)	3128	32%
Other paving, concrete, decking, etc.	1591	16%
Pervious paving/hardscape	1892	19%
Pervious total (include pervious hardscape surfaces)	6210	63%
Impervious	4719	48%

Total Parcel Size (SF)	9852
Total Vegetated (SF):	4318

Plant Inventory (list each plant separately)

Total number of plants:	482
unique species (species richness):	54

Type	Scientific Name	Common Name	DBH (in)	Crown Width (ft)	Coverage (SF)	MT Nativity	Drought Tolerance	Wildlife Value	(C-value) we will calc. later as option	Ecological function values	Human health values	Other values (plant ranks)	Pop: Total Qty by species (enter by hand in 1 row/species)	Abundance: Species % by Richness	Sum of Coverage for each species (calc by hand or create formula) SF	Density/Evenness: Species % by Veg Cover (do not calc. for trees)
Trees	Picea pungens	Colorado Spruce	10	14	154	0	1 Bd						1	0%	154	
	Populus tremuloides	Quaking Aspen	10	14	154	1	0 Bd							0%		
	Populus tremuloides	Quaking Aspen	10	14	154	1	0 Bd							0%		
	Populus tremuloides	Quaking Aspen	10	14	154	1	0 Bd						3	1%	462	
	Prunus cerasus 'North Star'	Dwarf North Star Cherr	10	9	64	0	0 Be, Bd, Bf				EM		1	0%	64	
	Prunus domestica 'Mount Ro	Mount Royal Plum	10	9	64	0	0 Bd, Be				EM		1	0%	64	
	Prunus hybrida 'Lydecker'	Black Ice Cherry Plum	10	9	64	0	0 Bd, Be				EM		1	0%	64	
	Prunus pumila v. besseyi	Western Sandcherry	10	16	201	1	3 Bd, Bf				EM		1	0%	201	
	Syringa reticulata	Japanese Tree Lilac	10	16	201	0	3 Bf, Hummingbirds							0%		
	Syringa reticulata	Japanese Tree Lilac	10	16	201	0	3 Bf, Hummingbirds						3	1%	603	
Shrubs	1 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	2 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	3 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	4 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	5 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	6 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	7 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	8 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	9 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	10 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	11 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	12 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	13 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	14 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	15 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	16 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	17 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	18 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	19 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	20 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	21 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	22 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM			0%		0%
	23 Chrysothamnus viscidiflorus	Green Rabbitbrush		3.5	10	1	3 Bf, Dr, Ma				EM		23	5%	230	5%
	1 Philadelphus lewisii	Lewis's Mockorange		6	28	1	3 Dr, Be			EC				0%		0%
	2 Philadelphus lewisii	Lewis's Mockorange		6	28	1	3 Dr, Be			EC				0%		0%
	3 Philadelphus lewisii	Lewis's Mockorange		6	28	1	3 Dr, Be			EC				0%		0%
	4 Philadelphus lewisii	Lewis's Mockorange		6	28	1	3 Dr, Be			EC			4	1%	112	3%
	1 Physocarpus malvaceus	Ninebark		4	13	1	3 Be, Bd, Ma							0%		0%
	2 Physocarpus malvaceus	Ninebark		4	13	1	3 Be, Bd, Ma							0%		0%
	3 Physocarpus malvaceus	Ninebark		4	13	1	3 Be, Bd, Ma							0%		0%
	4 Physocarpus malvaceus	Ninebark		4	13	1	3 Be, Bd, Ma							0%		0%
	5 Physocarpus malvaceus	Ninebark		4	13	1	3 Be, Bd, Ma							0%		0%
	6 Physocarpus malvaceus	Ninebark		4	13	1	3 Be, Bd, Ma							0%		0%
	7 Physocarpus malvaceus	Ninebark		4	13	1	3 Be, Bd, Ma						7	1%	91	2%
	1 Ribes aureum	Golden Currant		4	13	1	3 Bf, Hummingbirds				EM			0%		0%
	2 Ribes aureum	Golden Currant		4	13	1	3 Bf, Hummingbirds				EM			0%		0%
	3 Ribes aureum	Golden Currant		4	13	1	3 Bf, Hummingbirds				EM			0%		0%
	4 Ribes aureum	Golden Currant		4	13	1	3 Bf, Hummingbirds				EM			0%		0%
	5 Ribes aureum	Golden Currant		4	13	1	3 Bf, Hummingbirds				EM			0%		0%
	6 Ribes aureum	Golden Currant		4	13	1	3 Bf, Hummingbirds				EM			0%		0%
	7 Ribes aureum	Golden Currant		4	13	1	3 Bf, Hummingbirds				EM			0%		0%
	8 Ribes aureum	Golden Currant		4	13	1	3 Bf, Hummingbirds				EM			0%		0%
	9 Ribes aureum	Golden Currant		4	13	1	3 Bf, Hummingbirds				EM			0%		0%

Grasses seed seed seed seed seed Other Perennials (include kentucky bluegrass turf in list)	10	Ribes aureum	Golden Currant	4	13	1	3 Bf, Hummingbirds	EM	13	0%	169	0%
	11	Ribes aureum	Golden Currant	4	13	1	3 Bf, Hummingbirds	EM		0%		0%
	12	Ribes aureum	Golden Currant	4	13	1	3 Bf, Hummingbirds	EM		0%		0%
	13	Ribes aureum	Golden Currant	4	13	1	3 Bf, Hummingbirds	EM		3%		4%
	1	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		0%		0%
	2	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		0%		0%
	3	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		0%		0%
	4	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		0%		0%
	5	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		0%		0%
	6	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		0%		0%
	7	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		0%		0%
	8	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		0%		0%
	9	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM	11	0%	77	0%
	10	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		0%		0%
	11	Ribes inerme	Gooseberry	3	7	1	3 Bd	EM		2%		2%
	1	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM		0%		0%
	2	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM		0%		0%
	3	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM		0%		0%
	4	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM		0%		0%
	5	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM		0%		0%
	6	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM		0%		0%
	7	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM		0%		0%
	8	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM	10	0%	50	0%
	9	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM		0%		0%
	10	Rubus spp.	Raspberry	2.5	5	0	0 Bd, Be	EM		2%		1%
	1	Shepherdia argentea	Silver Buffaloberry	7	38	1	3 Bd, Be, Ma, Dr,	EC, windbreak, NF EM		0%		0%
	2	Shepherdia argentea	Silver Buffaloberry	7	38	1	3	EC, windbreak, NF EM		0%		0%
	3	Shepherdia argentea	Silver Buffaloberry	7	38	1	3	EC, windbreak, NF EM		0%		0%
	4	Shepherdia argentea	Silver Buffaloberry	7	38	1	3	EC, windbreak, NF EM	4	1%	152	4%
	seed	Bouteloua gracilis	Blue Grama		202	1	3 Bd, Ma, Dr, Bf	EC	1	0%	202	5%
	seed	Elymus trachycaulus ssp. tra	Slender Wheatgrass		621	1	3 Bd, Ma, Dr	EC	1	0%	621	14%
	seed	Festuca idahoensis	Idaho Fescue		202	1	2 Bd, Ma, Dr	EC	1	0%	202	5%
	seed	Leymus cinereus	Basin Wildrye		419	1	3 Bd, Ma, Dr	EC	1	0%	419	10%
	seed	Pseudoroegneria spicata ssp.	Bluebunch Wheatgrass		419	1	3 Bd, Ma, Dr	EC	1	0%	419	10%
											0%	0%
	1	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM	20	0%	60	0%
	2	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	3	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	4	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	5	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	6	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	7	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	8	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	9	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	10	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	11	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	12	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	13	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	14	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	15	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	16	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	17	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	18	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	19	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		0%		0%
	20	Achillea millefolium	Yarrow	2	3	1	3 Bf, Be	EM		4%		1%
.	1	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	2	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	3	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	4	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	5	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	6	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	7	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
		Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	9	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	10	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	11	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	12	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	13	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	14	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%
	15	Arnica cordifolia	Heartleaf Arnica	2	3	1	1 Bd, Be, Bf, Dr, Ma			0%		0%

Annuals (Biennial grown as annual)	17	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	18	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	19	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	20	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	21	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	22	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	23	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	24	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	25	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	26	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	27	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be				0%		0%
	28	Heuchera cylindrica	Roundleaf Alumroot	2	3	1	3 Be			28	6%	84	2%
	1	Humulus lupulus	Common Hops	3	7	0	1 Bd, Be, Bf, Ma		EM		0%		0%
	2	Humulus lupulus	Common Hops	3	7	0	1 Bd, Be, Bf, Ma		EM		0%		0%
	3	Humulus lupulus	Common Hops	3	7	0	1 Bd, Be, Bf, Ma		EM		0%		0%
	4	Humulus lupulus	Common Hops	3	7	0	1 Bd, Be, Bf, Ma		EM		0%		0%
	1	Levisticum officinale	Lovage	2.5	5	0	0		EM	4	1%	28	1%
	2	Levisticum officinale	Lovage	2.5	5	0	0		EM		0%		0%
	3	Levisticum officinale	Lovage	2.5	5	0	0		EM	3	1%	15	0%
	1	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	2	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	3	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	4	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	5	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	6	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	7	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	8	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	9	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	10	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	11	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	12	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	13	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	14	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	15	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	16	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	17	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	18	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	19	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC			0%		0%
	20	Linum lewisii	Lewis's Flax	2	3	1	3 Bd, Be	EC		20	4%	60	1%
	1	Melissa officinalis	Lemon Balm	2.5	5	0	2 Be		EM		0%		0%
	2	Melissa officinalis	Lemon Balm	2.5	5	0	2 Be		EM		0%		0%
	3	Melissa officinalis	Lemon Balm	2.5	5	0	2 Be		EM	3	1%	15	0%
	1	Nepeta cataria	Catnip	3	7	0	3 Bf, Ma (cats)		EM		0%		0%
	2	Nepeta cataria	Catnip	3	7	0	3 Bf, Ma (cats)		EM	2	0%	14	0%
	1	Poa pratensis	Kentucky Blue Turf		895	0	0		Open Space	1	0%		0%
	1	Vitis riparia	Riverbank Grape	4	13	1	1 Be, Dr, Ma		EM		0%		0%
	2	Vitis riparia	Riverbank Grape	4	13	1	1 Be, Dr, Ma		EM	2	0%	26	1%
		Allium cepa	Onion	1	1	0	0		EM		0%		0%
	2	Allium cepa	Onion	1	1	0	0		EM		0%		0%
	3	Allium cepa	Onion	1	1	0	0		EM		0%		0%
	4	Allium cepa	Onion	1	1	0	0		EM		0%		0%
	5	Allium cepa	Onion	1	1	0	0		EM		0%		0%
	6	Allium cepa	Onion	1	1	0	0		EM		0%		0%
	7	Allium cepa	Onion	1	1	0	0		EM		0%		0%
	8	Allium cepa	Onion	1	1	0	0		EM		0%		0%
	9	Allium cepa	Onion	1	1	0	0		EM	9	2%	9	0%
	1	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	2	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	3	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	4	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	5	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	6	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	7	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	8	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	9	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	10	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	11	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	12	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	13	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	14	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%
	15	Allium sativum	Garlic	1	1	0	0 Bf		EM		0%		0%

(biennial grown as annual)	16	Allium sativum	Garlic	1	1	0	0 Bf	EM	24	0%	24	0%
	17	Allium sativum	Garlic	1	1	0	0 Bf	EM		0%		0%
	18	Allium sativum	Garlic	1	1	0	0 Bf	EM		0%		0%
	19	Allium sativum	Garlic	1	1	0	0 Bf	EM		0%		0%
	20	Allium sativum	Garlic	1	1	0	0 Bf	EM		0%		0%
	21	Allium sativum	Garlic	1	1	0	0 Bf	EM		0%		0%
	22	Allium sativum	Garlic	1	1	0	0 Bf	EM		0%		0%
	23	Allium sativum	Garlic	1	1	0	0 Bf	EM		0%		0%
	24	Allium sativum	Garlic	1	1	0	0 Bf	EM		5%		1%
	1	Allium schoenoprasum	Chives	2	3	0	0	EM		0%		0%
	2	Allium schoenoprasum	Chives	2	3	0	0	EM		0%		0%
	1	Anethum graveolens	Dill	2.5	5	0	0 Be, Bf	EM		0%		0%
	2	Anethum graveolens	Dill	2.5	5	0	0 Be, Bf	EM		0%		0%
	1	Citrullus lanatus	Watermelon	3	7	0	0 Be	EM		0%		0%
	2	Citrullus lanatus	Watermelon	3	7	0	0 Be	EM		0%		0%
	1	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	2	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	3	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	4	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	5	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	6	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	7	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	8	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	9	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	10	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	11	Cucumis sativus	Cucumber	1	1	0	0	EM		0%		0%
	12	Cucumis sativus	Cucumber	1	1	0	0	EM		2%		0%
	1	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	2	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	3	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	4	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	5	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	6	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	7	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	8	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	9	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	10	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	11	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	12	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	13	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	14	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	15	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	16	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	17	Cucurbita pepo	Pumpkin	4	13	0	0	EM		0%		0%
	18	Cucurbita pepo	Pumpkin	4	13	0	0	EM		4%		5%
		Daucus carota var. sativus	Carrot	1	1	0	0	EM		0%		0%
	2	Daucus carota var. sativus	Carrot	1	1	0	0	EM		0%		0%
	3	Daucus carota var. sativus	Carrot	1	1	0	0	EM		0%		0%
	4	Daucus carota var. sativus	Carrot	1	1	0	0	EM		0%		0%
	5	Daucus carota var. sativus	Carrot	1	1	0	0	EM		0%		0%
	6	Daucus carota var. sativus	Carrot	1	1	0	0	EM		0%		0%
	7	Daucus carota var. sativus	Carrot	1	1	0	0	EM		0%		0%
	8	Daucus carota var. sativus	Carrot	1	1	0	0	EM		0%		0%
	9	Daucus carota var. sativus	Carrot	1	1	0	0	EM		0%		0%
	10	Daucus carota var. sativus	Carrot	1	1	0	0	EM		2%		0%
	1	Lactuca sativa	Lettuce	1	1	0	0	EM	10	0%	10	0%
	2	Lactuca sativa	Lettuce	1	1	0	0	EM		0%		0%
	3	Lactuca sativa	Lettuce	1	1	0	0	EM		0%		0%
	4	Lactuca sativa	Lettuce	1	1	0	0	EM		0%		0%
	5	Lactuca sativa	Lettuce	1	1	0	0	EM		0%		0%
	6	Lactuca sativa	Lettuce	1	1	0	0	EM		0%		0%
	7	Lactuca sativa	Lettuce	1	1	0	0	EM		0%		0%
	8	Lactuca sativa	Lettuce	1	1	0	0	EM		0%		0%
	9	Lactuca sativa	Lettuce	1	1	0	0	EM		0%		0%
	10	Lactuca sativa	Lettuce	1	1	0	0	EM		0%		0%
	11	Lactuca sativa	Lettuce	1	1	0	0	EM	11	2%	11	0%
	1	Lycopersicon lycopersicum	Tomato	2.5	5	0	0	EM		0%		0%
	2	Lycopersicon lycopersicum	Tomato	2.5	5	0	0	EM		0%		0%
	3	Lycopersicon lycopersicum	Tomato	2.5	5	0	0	EM		0%		0%
	4	Lycopersicon lycopersicum	Tomato	2.5	5	0	0	EM		0%		0%
	5	Lycopersicon lycopersicum	Tomato	2.5	5	0	0	EM		0%		0%
	6	Lycopersicon lycopersicum	Tomato	2.5	5	0	0	EM	6	1%	30	1%

(Perennial grown as annual)	1	Matricaria recutita	Chamomile	1	1	0	2 Be, Bf		EM			0%		0%
	2	Matricaria recutita	Chamomile	1	1	0	2 Be, Bf		EM			0%		0%
	3	Matricaria recutita	Chamomile	1	1	0	2 Be, Bf		EM			0%		0%
	4	Matricaria recutita	Chamomile	1	1	0	2 Be, Bf		EM			0%		0%
	5	Matricaria recutita	Chamomile	1	1	0	2 Be, Bf		EM			0%		0%
	6	Matricaria recutita	Chamomile	1	1	0	2 Be, Bf		EM			0%		0%
	7	Matricaria recutita	Chamomile	1	1	0	2 Be, Bf		EM			0%		0%
	8	Matricaria recutita	Chamomile	1	1	0	2 Be, Bf		EM			0%		0%
	9	Matricaria recutita	Chamomile	1	1	0	2 Be, Bf		EM	9		2%	9	0%
	1	Origanum vulgare	Oregano	1	1	0	3 Bf		EM			0%		0%
	2	Origanum vulgare	Oregano	1	1	0	3 Bf		EM	2		0%	2	0%
	1	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	2	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	3	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	4	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	5	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	6	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	7	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	8	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	9	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	10	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	11	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM			0%		0%
	12	Phaseolus vulgaris	Pole Bean	4	13	0	0	NF	EM	12		2%	156	4%
	1	Pisum sativum	Garden Pea	1	1	0	0	NF	EM			0%		0%
	2	Pisum sativum	Garden Pea	1	1	0	0	NF	EM			0%		0%
	3	Pisum sativum	Garden Pea	1	1	0	0	NF	EM			0%		0%
	4	Pisum sativum	Garden Pea	1	1	0	0	NF	EM			0%		0%
	5	Pisum sativum	Garden Pea	1	1	0	0	NF	EM			0%		0%
	6	Pisum sativum	Garden Pea	1	1	0	0	NF	EM			0%		0%
	7	Pisum sativum	Garden Pea	1	1	0	0	NF	EM			0%		0%
	8	Pisum sativum	Garden Pea	1	1	0	0 Bd, Bf, Be, Ma	NF	EM	8		2%	8	0%
	1	Salvia officinalis	Sage	2	3	0	3 Bf		EM			0%		0%
	2	Salvia officinalis	Sage	2	3	0	3 Bf		EM	2		0%	6	0%
		Solanum tuberosum	Irish Potato	2	3	0	0		EM			0%		0%
	2	Solanum tuberosum	Irish Potato	2	3	0	0		EM			0%		0%
	3	Solanum tuberosum	Irish Potato	2	3	0	0		EM			0%		0%
	4	Solanum tuberosum	Irish Potato	2	3	0	0		EM			0%		0%
	5	Solanum tuberosum	Irish Potato	2	3	0	0		EM			0%		0%
	6	Solanum tuberosum	Irish Potato	2	3	0	0		EM	6		1%	18	0%
	1	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	2	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	3	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	4	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	5	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	6	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	7	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	8	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	9	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	10	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	11	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	12	Spinacea oleracea	Spinach	1	1	0	0		EM			0%		0%
	13	Spinacea oleracea	Spinach	1	1	0	0		EM	13		3%	13	0%
	1	Thymus vulgaris	Thyme	1	1	0	3 Bf		EM			0%		0%
	2	Thymus vulgaris	Thyme	1	1	0	3 Bf		EM	2		0%	2	0%
	1	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	2	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	3	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	4	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	5	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	6	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	7	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	8	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	9	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	10	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	11	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	12	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	13	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	14	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	15	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	16	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	17	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM			0%		0%
	18	Zea mays var. saccharata	Sweet Corn	2	3	0	0		EM	18		4%	54	1%

Descriptive Stats									
Nativity	Freq	% of total plants		% coverage of veg area					
# of plants=0		225	47%	60%					
# of plants=1		257	53%	91%					
# of plants=2		0	0%	0%					
Drought Tolerance	Freq	% of total plants		% coverage of veg area					
# of plants=0		173	36%	51%					
# of plants=1		26	5%	6%					
# of plants=2		98	20%	10%					
# of plants=3		181	38%	84%					
Wildlife Value	Freq	% of total plants		Key Reference					
# of plants=Bd	172	36%	Bd						
# of plants=Bf	221	46%	Bf						
# of plants=Be	193	40%	Be						
# of plants=Dr	82	17%	Dr						
# of plants=Ma	92	19%	Ma						
Ecological Funct.	Freq	% of total plants		Key Reference					
# of plants=EC	33	0.06846473	EC						
# of plants=NF	24	0.049792531	NF						
# of plants=BT	0	0	BT						
other?	53		?						
Human Health	Freq	% of total plants		Key Reference					
# of plants=EM	332	0.68879668	EM						
# of plants=F	0	0	F						
# of plants=TH	0	0	TH						
other?	333		?						
FQI									
Floristic Quality Index									

Summary of Tree and Shrub Benefits based National Tree Benefits Calculator:									
(Need to retroactively run these values for all existing/baseline trees)									
		Yearly Benefits	Yearly Benefits						
		DBH (use 10" to calc. benefits for what is considered "established" life stage). You could also run calculator with install							
Tree Species	Existing/Baseline (B) or Added/Design (D)		Overall Benefits Notes	Storm Water Interception (gal)	Property Value (\$)	Energy - Conserves Electricity for cooling (kilowatt)	Energy - Reduces consumption of oil/natural gas (therms)	Air Quality Notes	CO2 - Reduces atmospheric carbon (lbs)
Picea pungens	B		10	\$117	1,626	90	42	4.95 \$0.35 Large avoidance of NO2 due to this tree's presence.	203
Populus tremuloides	B		10	\$113	1,000	87	71	7.59 \$0.50 avoidance NO2	304
Populus tremuloides	B		10	\$113	1,000	87	71	7.59 \$0.50 avoidance NO2	304
Populus tremuloides	B		10	\$113	1,000	87	71	7.59 \$0.50 avoidance NO2	304
Prunus cerasus 'North Star'	D		10	\$69 \$	299.00	57	35	3.6 \$0.48 deposition of O3	194
Prunus domestica 'Mount Royal'	D		10	\$22 \$	661.00	8	26	3.14 \$0.60 deposition of O3	90
Prunus hybrida 'Lydecker'	D		10	\$69 \$	299.00	57	35	3.6 \$0.48 deposition of O3	194
Prunus pumila v. besseyi	B		10	\$113 \$	1,000.00	87	71	7.59 \$0.50 NO2 avoidance \$0.48 deposition	304
Syringa reticulata	B		10	\$69 \$	299.00	57	35	3.6 \$0.48 deposition of O3	194
Syringa reticulata	B		10	\$69 \$	299.00	57	35	3.6	194
Syringa reticulata	B		10	\$69 \$	299.00	57	35	3.6	194
TOTALS				7,782 \$	731.00	527 \$	56.45		2479
baseline only				4,626	351	255	28	0	1,115

Soils

Communicate any information related to soil conditions necessary for design features/areas/plant communities to be sustainable
Tips for soil amendments, drainage, nutrients, etc.

Current soil type:		
Meadowcreek Loam		
Category:	Value	
Slope	0-4%	
A	11"	loam
Bg	14"	silt loam
2C	35"	gravelly sand
pH	Generally higher than 6.5	
Surface Permeability	Mild	

VEGETABLES / HERBS

Vegetables and herbs often require extensive soil prep in order to achieve a fruitful harvest.

The following highlights requirements for soil based on Guide to Rocky Mountain Vegetable Gardening by Robert Gough and Cheryl Moore-Gough. ©2009.

- Onion (Allium cepa) - onions grow best in rich soil high in organic matter and nutrients; work in composted manure & compost & broadcast preplant fertilizer
- Garlic (Allium sativum) - softneck garlic enjoys soil that is loose & rich; heavy soils cause irregularly shaped bulbs (cosmetic issue)
- Watermelon (Citrullus lanatus) - nothing specific on soil; receive enough fertilizer to sustain uninterrupted growth throughout the season
- Cucumber (Cucumus sativus) - respond well to a handful or two of manure (per plant); broacast preplant fertilizer and sidedress once
- Pumpkin (Cucurbita pepo) - grow well when supplied with high amounts of organic matter & moisture; add a spadeful of composted manure or compost to base of each hill
- Carrot (Daucus carota var. sativus) - light, sandy soils produce early crops; stone-free soils produce most uniformly shaped roots; compacted soils cause roots to grow short and curve
- Lettuce (Lactuca sativa) - NA
- Tomato (Lycoperiscon lycoperiscum) - respond well to moderately high fertility but excess nitrogen delays maturity & results in vineyness
- Pole Bean (Phaseolus vulgaris) - NA

Garden Pea (Pisum sativum) - well-drained soil high in organic matter
Irish Potato (Solanum tuberosum) - need well-drained, well-aerated soil
Spinach (Spinacea oleracea) - does well in moist soil; ideal pH 5.5-6.5; best with high fertility-spread manure
Sweet Corn (Zea mays var. saccharata) - fertile soil; doesn't tolerate flooding or drought

**The following highlights requirements for
soil based on MSU EXTENSION-Herbs for
Montana Gardens**
store.mstuextension.org/publications/YardandGarden/MT200003AG.pdf

Catnip (Nepeta cataria) - well-drained soils
Chives (Allium schoenoprasum) - NA
Dill (Anethum graveolens) - NA
Lemon Balm (Melissa officinalis)- moist soil
Lovage (Levisticum officinale) - moist, fertile well-drained
Oregano (Origanum vulgare) - well-drained; neutral-slightly alkaline pH
Sage (Saliva officinalis)- well-drained soil
Thyme (Thymus vulgaris) - NA

KEY

MT Nativity: Not native to MT = 0; MT native= 1; exotic/invasive =2

Drought Tolerance: 0=no drought tolerance, 1=low drought tolerance, 2=medium drought tolerance, 3=high drought tolerance

Wildlife Value: Bd = bird, Bf = butterfly, **Be** = bees, **Dr** = deer, Ma = Mammal (General)

Ecosystem Function Values: BT = bioremediation ability, EC = erosion control, NF = nitrogen fixer,

Light Needs: **F** = full sun, **PS** = partial sun, **PSh** = partial shade, **Sh** = shade

Light Needs: F = full sun, PS = partial sun, PSh = partial shade, Sh = shade

Soil Moisture (the dominant condition is shown first): D = dry, DM = dry to moist, MD = moist to dry, M = moist, MW = moist to wel, WM = wet to moist, W = wet, WMD = plant can do all three conditions

Bloom Time: Jn = January, F = February, Mr = March, A = April, My = May, Jn = June, Jl = July, Ag = August, S = September, O = October, N = November, D = December

Bloom Color: B = blue, Br = brown, G = green, L = lavender, O = orange, P = pink, Pr = purple, R = red, Ro = rose, S = silver, W = white, Y = yellow, Cr = Cream

Other: Info to save until there enough data to warrant additional columns

A4 Design Performance

Water

Total Parcel Size (SF)	9852
Total Vegetated Area (SF)	4318
Total Landscape Area (SF)	6210

****Irrigation Required - EPA Water Budget Tool. Save Report!**....this will be the key irrigation metric we compare/contrast between baseline and design**

Name/Location (Hydrozone, plant community, area)	Area (SF)	Plant Type (Zone/Feature)	Water Demand (high, med, low; current or assume long-term, post establish.)	Irrigation Type (need to make assumptions! You can play with these assumptions in design scenarios)	Monthly Req. Water (gal./month). (Tool will calculate)		
						Total Monthly Allowance	Above/Below Allowance
Turfgrass		895 Kentucky Blue Grass Edibles, vegetables, pollinators in shrub/perennial beds and raised beds	High	Rotor	4687	21,053 Below allowance: 10,919	
Shrub / perennial beds		832 Waterwise Zones (includes shrub/perennial/edible areas (in-ground as well as raised-beds) that require some additional watering but are fairly drought tolerant)	High	Drip (standard)	3781		
Waterwise Zones		527 Natural Rainfall/Drought Tolerant Zones (includes native seed mixes and some shrub beds that are exclusively drought tolerant)	Med	Drip (standard)	1666		
Drought tolerant areas		2064 pervious paving / hardscape	Low	No irrigation	0		
Permeable hardscape			NA	NA	0		
					Total (gal.month)	10,134	
					Equivalent 16 oz. water bottles	81072	
					~Seasonal Req. Total (4.5 months)	45603	

Roof Re-use Volumes & Rain Garden Sizing

Design storm criteria/assumptions: City of Bozeman Stormwater Ordinance: LID use, 1/2" rain, recommendation for lots over 1 acre.

Downspout Outlet Location	Catchment Area (SF)	1/2" Rainfall Volume (cf)	Surface Area for 12" Deep Rain Garder	Surface Area for 9" Deep Rain Garden	Surface Area for 6" Deep Rain Garden
North	1,600.00	63.35	63.35	95.03	126.70
South	1,800.00	71.27	71.27	106.90	142.54
East	100	3.96	3.96	5.94	7.92
		0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00
Totals		3500	138.5785853		
Totals (gallons)			1036.639879		

Water Utility Costs

Base on EPA Water Budget Tool Total Water Required Monthly for baseline and design.

DESIGN

		Gal	HCF (1 HCF/748 gal)				
EPA Water Budget. Total Monthly Water Required for DESIGN		10134	13.548	1283			
COB WATER UTILITY RATES					Monthly Utility Bill - design		
						~Total Yearly Cost for Outdoor Water Required (4.5 months)	
Year		Service Charge for 5/8" pipe	Rates /HCF. (0-7)	Rates /HCF. (8-15)	Rates/HCF (>15)	ONE MONTH	
	2016	15.39	2.5	2.69	3.17	\$ 51.83	233.2550936

BASELINE

		Gal	HCF (1 HCF/748 gal)				
EPA Water Budget. Total Monthly Water Required for Baseline		25175	33.6564171				
COB WATER UTILITY RATES					Monthly Utility Bill - baseline		
						~Total Yearly Cost for Outdoor Water Required (4.5 months)	
Year		Service Charge for 5/8" pipe	Rates /HCF. (0-7)	Rates /HCF. (8-15)	Rates/HCF (>15)	ONE MONTH	
	2016	15.39	2.5	2.69	3.17	\$ 122.08	549.3637901

A4 Design Performance

Materials & Energy

Fertilizer Use Per Year

Turfgrass Veg Zone Area (SF)	895
Fertilizer Applied/Year (lbs)	5.37
Total Yearly Fertilizer Costs (\$)	8.592

Mowing and Energy

Turfgrass Veg Zone Area (SF)	895
Total Yearly Mowing Time (15 min/1000sf; 20x)(hrs)	4.475
Mowing Gas Consumed (gal) Honda self propelled GCV190 Engine	1.3536875
Yearly CO2 Emissions from Mowing (lbs)	26.62703313

Tree Benefits Atmospheric Carbon Reduction - Equivelancy to Burning Gasoline Emissions

Total CO2 Reduction from trees on parcel, from calculator (lbs/year)	\$ 2,479.00
Total CO2 Reduction from trees on parcel, from calculator (metric tons)	1.2395
Equiv. CO2 released by burning # gallons of gasoline (gallons)	126.0294865

Maintenance & People Energy

Task	Estimated Yearly Time (hrs)	Year/Season = 20 weeks
Weed management until establishment of drought tolerant grass mixes	20	
Mow strip around perimeter of grass mixes and to define paths	1	
Design of in-ground veg beds / season (crop rotation)	5	
In-ground veg beds & raised-herb bed prep at beginning of season	5	
Planting of vegetables	5	
IPM	5 to 10	
Mowing + weed eating of turf area in back yard	5 to 7	
Harvesting fruit from fruiting trees and shrubs	10	
Harvesting of vegetables	5 to 10	
Harvesting of herbs	1 to 5	
Pruning trees and shrubs	0 to 20	
Reseeding (if necessary)	1 to 2	

Reference Values (LPS, Capitol Valley Methodology)

CO2 Emissions/gallon of gasoline (metric tons)	0.00892
CO2 Emissions/gallon of gasoline (lbs)	19.67
lbs/ton	2000
Turfgrass fertilizer/1000 SF (lbs)	2
Turfgrass fertilizer applications/year	3
Turfgrass fertilizer, average Home Deport (\$/lb)	\$ 1.60

Restorative Spaces

List features/spaces

Lounge area under fruiting trees (creates a comfortable outdoor microclimate)	70 sf in turf area
View of natural landscape settings (especially "meadow") from indoor windows	Dependent on location/view from window
Opportunities to view wildlife throughout entirety of site due to the creation of habitat for wildlife. As well as sources of food, shelter, and water	Entire site - species dependent (where the mammals/ birds will go)

raised bed by back porch accompanied with in-ground beds with varying plant heights - to create a sense of enclosure design encourages site users to explore the landscape more fully: smelling & tasting vegetation, listening to birds, feeling sun's warmth, hearing plants rustle	located in back yard off of concrete patio
ease of movement defined with clear pathways	found throughout entire site
	formal pathway connecting road to house; informal pathway allowing for conveyance from road to front of house to backyard

Culturally Significant Plants

List features/spaces

Green Rabbit brush - sage brush steppe plant	occurs mainly at view of front of house
Bluebunch Wheatgrass = State grass	419 sf (dispersed sporadically in tall native grass mix)
Native shrubs that have edible fruit	Occuring mainly in backyard of site

Signage; Learning Opportunities

List features/spaces	Frequency
"Tea Time" Plug and Play DIY	Occurs at front of house, right of drive way
Raised herb bed (yet to be named) Plug and Play DIY	Occurs at junction of back porch/patio/entrance to southside of house
Work area - including DIY compost tumb	Occurs near shed on site

"Strawberry Side Salad" DIY

Mixed in with in-ground bed of native edible shrubs

Human Comfort Zones

List features/spaces

Front porch - private140 sf

Back porch - enclosed entertainment area that connects to the vegetable area, workspace area and the open turf area200 sf in back yard. Off of bottom right-hand corner of house.

Social interaction with passers-byUsers can sit on front porch (140 sf w/ moveable seating) and engage in conversation with people on sidewalk

Work area - allows for hobbyists and DIYArea located with shed in lower left corner of site

All edible areas - relaxation / hobby to work on vegetable bedslocated in back yard of house

Play Spaces/Features

List features/spaces

Open turf area - conducive area for children and pets. Turf area is located in an area visible from within the house/ outdoor patio.895 sf

Mosaic of vegetation used to encourage versatile play and opportunities for exploration, creativity, and improved motor fitnessentire site

Landscape attracts wildlife and allows for children to interact and learn from the wildlifeentire site

A4 Design Performance						MATERIAL COSTS ONLY. Should not include demolition, irrigation retrofits, or installation labor costs.		
Cost Estimate								
DESIGN NAME: Urban Farmer								
Date: 11/07/16								
IN GENERAL:note: Blake Nursery = higher end costs. Cashman Nursery = mid costs. Westscape Nursery = low costs.								
TAKE-OFFS						COST ESTIMATE		
PLANTS/PLANT ZONES						Refer to '\$Reference'. All applicable costs will likely not be referenced. Accurate estimates will also mean making some local phone calls on material pricing.		
			Units or Size (sf/ac/lf/sy/caliper)		Notes (candidate plants; symbol, abbreviation, manufacturer/supplier, etc.)			
Botanical name	Common name	Qty		Stock Type		Unit Cost	Total Item Cost	
<u>Trees</u>								
Prunus cerasus 'North Star'	Dwarf North Star Cherry	1	5'	Bare root	ref: Cashman Nursery	\$ 39	\$ 39	
Prunus domestica 'Mount Royal P	Mount Royal Plum	1	5'	Bare root	ref: Cashman Nursery	\$ 39	\$ 39	
Prunus hybrida 'Lydecker'	Black Ice Cherry Plum	1	5'	Bare root	ref: Cashman Nursery	\$ 39	\$ 39	
							\$ -	
							\$ -	
							\$ -	
<u>Shrubs</u>								
Chrysothamnus viscidiflorus	Green Rabbitbrush	23	#5	Pot	ref: Cashman Nursery, Blake Nursery, Westscape Nursery	\$ 40	\$ 920	
Philadelphus lewisii	Lewis's Mockorange	4	#5	Pot	ref: Cashman Nursery, Blake Nursery, Westscape Nursery	\$ 40	\$ 160	
Physocarpus malvaceus	Ninebark	7	#5	Pot	ref: Cashman Nursery, Blake Nursery, Westscape Nursery	\$ 40	\$ 280	
Ribes aureum	Golden Currant	13	#5	Pot	ref: Cashman Nursery, Blake Nursery, Westscape Nursery	\$ 40	\$ 520	
Ribes inerme	Gooseberry	11	#1	Bare root	ref: Cashman Nursery	\$ 15	\$ 165	
Rubus spp.	Raspberry	10	#1	Bare root	ref: Cashman Nursery	\$ 5	\$ 50	
Shepherdia argentea	Silver Buffaloberry	4	#5	Pot	ref: Blake Nursery, Westscape Nursery	\$ 40	\$ 160	
<u>Perennials, Grasses, Other</u>							\$ -	
Short Native Mix - Festuca Idahoensis, Bouteloua gracilis,								
Elymus trachycaulus ssp. trachycaulus	Idaho Fescue, Blue Grama, Slender Wheatgrass	3	lb	Seed	ref: Blake Nursery, Circle S Seed	\$ 17	\$ 51	

Tall Native Mix - Pseudoroegneria spicata ssp. spicata, Leymus cinereus, Elymus trachycaulus ssp. trachycaulus	Bluebunch Wheatgrass, Basin Wildrye, Slender Wheatgrass	6	lb	Seed	ref: Blake Nursery, Circle S Seed	\$	17	\$	102
Achillea millefolium	Yarrow	20	#1	Pot	ref: Cashman Nursery, Blake Nursery, Westscape Nursery	\$	9	\$	180
Arnica cordifolia	Heartleaf Arnica	20	#1	Pot	ref: Cashman Nursery, Blake Nursery, Westscape Nursery	\$	9	\$	180
Aster laevis	Smooth Aster	30	#1	Pot	ref: Cashman Nursery, Blake Nursery, Westscape Nursery	\$	9	\$	270
Aquilegia coerulea	Colorado Blue Columbine	28	#1	Pot	ref: Cashman Nursery, Blake Nursery, Westscape Nursery	\$	9	\$	252
Echinacea angustifolia	Pale Purple Coneflower	34	#1	Pot	ref: Cashman Nursery, Blake Nursery, Westscape Nursery	\$	9	\$	306
Escobaria missouriensis	Pincushion Cactus	2	4"	Pot		\$	5	\$	10
Escobaria vivipara	Pincushion Cactus	2	4"	Pot		\$	5	\$	10
					ref: Blake Nursery (Fort Laramie ever-bearing strawberry) ref: Cashman	\$	1	\$	29
Fragaria spp.	Strawberry	27	#1/1yr	Bare root		\$	9	\$	252
Heuchera cylindrica	Roundleaf Alumroot	28	#1	Pot		\$	5	\$	20
Humulus lupulus	Common Hops	4	#1	Bare root	ref: Cashman Nursery	\$	4	\$	4
Levisticum officinale	Lovage	1	seed packet	seed	ref: Burpee	\$	5	\$	90
Linum lewisii	Lewis's Flax	20	4"	pot	ref: Westscape Nursery	\$	4	\$	4
Melissa officinalis	Lemon Balm	1	seed packet	seed	ref: Burpee	\$	4	\$	4
Nepeta cataria	Catnip	1	seed packet	Seed	ref: Burpee	\$	17	\$	34
Vitis riparia	Riverbank Grape	2	#1/2yr	Bare root	ref: Cashman Nursery	\$	25	\$	25
Allium cepa	Onion	1	bunch	plant	ref: Burpee	\$	16	\$	96
Allium sativum	Garlic	6	bulb	bulb	ref: Burpee	\$	7	\$	14
Allium schoenoprasum	Chives	2	plant	plant	ref: Burpee	\$	5	\$	5
Anethum graveolens	Dill	1	seed packet	seed	ref: Burpee	\$	5	\$	5
Citrullus lanatus	Watermelon	1	seed packet	seed	ref: Burpee	\$	6	\$	6
Cucumis sativus	Cucumber	1	seed packet	seed	ref: Burpee	\$	4	\$	4
Cucurbita pepo	Pumpkin	1	seed packet	seed	ref: Burpee	\$	4	\$	4
Daucus carota var. sativus	Carrot	1	seed packet	seed	ref: Burpee	\$	7	\$	7
Lactuca sativa	Lettuce	1	seed packet	seed	ref: Burpee	\$	4	\$	4
Lycoperiscon lycopersicum	Tomato	1	seed packet	seed	ref: Burpee	\$	4	\$	4
Matricaria recutita	Chamomile	1	seed packet	seed	ref: Burpee	\$	5	\$	5
Origanum vulgare	Oregano	1	seed packet	seed	ref: Burpee	\$	4	\$	4
Phaseolus vulgaris	Pole Bean	1	seed packet	seed	ref: Burpee	\$	4	\$	4
Pisum sativum	Garden Pea	1	seed packet	seed	ref: Burpee	\$	6	\$	6
Salvia officinalis	Sage	1	seed packet	seed	ref: Burpee	\$	20	\$	20
Solanum tuberosum	Irish Potato	1	pack	tuber	ref: Burpee	\$			

Spinacea oleracea	Spinach	1	seed packet	seed	ref: Burpee	\$	6	\$	6	
Thymus vulgaris	Thyme	1	seed packet	seed	ref: Burpee	\$	5	\$	5	
Zea mays var. saccharata	Sweet Corn	1	seed packet	seed	ref: Burpee	\$	7	\$	7	
								\$	-	\$ 4,401
FURNISHINGS										
Lounge area furniture		1	NA	Chair, chair & table, etc.	Purchase from second hand store or make base out of wood pallets and furnish with cushions and pillows made by hand or found at secon hand store	\$	150	\$	150	
Compost tumbler		1		base - varies. Tumbler - old garbage can	reuse old metal garbage can or buy one for cheap at local hardware store. Drill holes into it. Base = optional ref: Home Depot	\$	40	\$	40	
Rebar for Staking Vining Vegetables		38	10' x 1/2" diam		(ALTERNATIVELY, visit a scrap metal yard or use rebar you have that isn't being used otherwise) Cut 10' rebar into lengths appropriate for plant it is supporting ref: reuse! Buy a table or old dresser from a second hand store and convert it into a workable plant bench. Cheaper: utilize scrap wood and pallets to make your work bench. Choose the aesthetic appropriate for you and your yard.	\$	6	\$	228	
Plant work bench		1	6-8' long x 2-4' wide			\$	100	\$	100	
Raised "Tea Time" bed	onlinemetals.com	1	2' ht x 3' w x 27' long	reclaimed / reused wood veneered with scrap metal	Reuse fencing wood or other types of lumber to make your own raised raspberry bed. Ref: Home Depot or local lumber yard for common board costs~ \$10/8'x6"x1" board. Façade: scrap metal or metal/ aluminum color or rust color	\$	1,400	\$	1,400	

[illegible]

TOTAL MATERIALS
ESTIMATE

\$ 9,433

Summary Findings

Write a story for what design data compares to baseline data (either parcel averages or specific parcel data). Descriptions should be heavy on data!

THEME	Compare/Contrast Claims between baseline and design
COVERAGES	<div>1 The total pervious vs. impervious surface percentages were not changed from the baseline design.</div> <div>2 Vegetated coverage was shifted from primarily turf to primarily drought-tolerant native plantings.</div>
VEGETATION & SOIL	<div>1 The percent native plants went up from 21% in the baseline design to 80% in the new design.</div> <div>2 The drought tolerance rating of the plants present in the design has essentially shifted up a degree from the baseline.</div> <div>3 84% of the plants used in the new design have edible or medicinal characteristics, up from 0% in the baseline.</div>
WATER	<div>1 The water budget for the site has gone from 4700 gal/mo over the monthly allowance to 5097 gal/mo under.</div> <div>2 The roof catchment area was reevaluated, resulting in more downspout locations and, somehow, less overall catchment square footage.</div> <div>3 A total of 416gal would be produced by roof runoff in a 1/2" rain event, dispensed mostly at the north-east corner of the house, where the most water-intensive plants have been placed.</div>
MATERIALS & ENERGY	<div>1 Total yearly mowing time is reduced five-fold from the baseline deign in the new design; down from 10 to 2 hours over the course of the season.</div> <div>2 Yearly CO2 emmissions are reduced from 162lbs to 11.5lbs.</div> <div>3 The trees added to the site bring the atmospheric carbon reduction of the site (only from trees) up from 155lbs to 1,882lbs.</div>
HUMAN HEALTH & WELL BEING	<div>1 Engagement and learning opprutunities are present throughout the design concept.</div> <div>2 Human Comfort and Restorative Spaces were preserved and enhanced.</div> <div>3 Existing Culturally Significant Plants were kept in a more limited capacity while others were added to the mix.</div>
ADDITIONAL OVERALL (as needed)	

A4 Design Performance

COVERAGES

STUDENT:

Elizabeth Ritchie

Parcel ID:

6

Key:

included in baseline summary

automated formula in cell - check for correct range

manually enter value

SURFACE TYPE (total)	Area (SF)	% of Site
Entire Parcel	5484.1284	100%
Vegetated (all)	2503.45	46%
Turfgrass	388.4	7%
Shrub/Perennial Zones	158.2	3%
Waterwise Zones	427.25	8%
Natural Rainfall/Drought Tolerant Zones	1529.6	28%
Roof(s)	2006.6	37%
Other paving, concrete, decking, etc.	413.9	8%
Pervious paving/hardscape	1025.4	19%
Pervious total (include pervious hardscape surfaces)	3528.85	64%
Impervious	2420.5	44%

[illegible]

[illegible]

[illegible]

# of plants=1	388	80%	124%	hm...
# of plants=2	0	0%	0%	

Drought Tolerance	Freq	% of total plants	% coverage of veg area
# of plants=0		2	0%
# of plants=1		45	9%
# of plants=2		209	43%
# of plants=3		228	47%

# of plants=Bf	5	1%	Bf
# of plants=Be	209	43%	Be
# of plants=Dr	0	0%	Dr
# of plants=Ma	32	7%	Ma

Ecological Funct.	Freq	% of total plants	Key Reference
# of plants=EC	36	0.074226804	EC
# of plants=NF	0	0	NF
# of plants=BT	0	0	BT
other?	36	?	

# of plants=F	0	0%	F
# of plants=TH	32	7%	TH
other?	438	?	

FQI	
Floristic Quality Index	

Summary of Tree and Shrub Benefits based National Tree Benefits Calculator:

(Need to retroactively run these values for all existing/baseline trees)		Yearly Benefits							
Tree Species	Existing/Baseline (B) or Added/Design (D)	Yearly Benefits DBH (use 10" to calc. benefits for what is considered "established" life stage). You could also run calculator with install size, 1.5-2.5" to compare)	Overall Benefits Notes	Storm Water Interception (gal)	Property Value (\$)	Energy - Conserves Electricity for cooling (kilowatt)	Energy - Reduces consumption of oil/natural gas (therms)	Air Quality Notes	CO2 - Reduces atmospheric carbon (lbs)
	Ash, Green		B	10	\$ 1,043.00	154	76	8	329
	Aspen, Quaking		B	10	\$ 1,000.00	87	71	8	304
	Aspen, Quaking		D	10	\$ 1,000.00	87	71	8	304
	Aspen, Quaking		D	10	\$ 1,000.00	87	71	8	304
	Chokecherry, Common		D	10	\$ 299.00	57	35	4	194
	Chokecherry, Common		D	10	\$ 299.00	57	35	4	194
	Chokecherry, Common		D	10	\$ 299.00	57	35	4	194
	Chokecherry, Common		D	10	\$ 299.00	57	35	4	194
	Chokecherry, Common		D	10	\$ 299.00	57	35	4	194
TOTALS			4,495	\$ 546.00	388	44		1,882	
			2,043	\$ 241.00	147	16	0	633	

Soils

Communicate any information related to soil conditions necessary for design features/areas/plant communities to be sustainable
Tips for soil amendments, drainage, nutrients, etc.

More organic matter is recommended, generally.
Better drainage can be achieved through the addition of organic matter and sand.

KEY

MT Nativity: Not native to MT = 0; MT native= 1; exotic/invasive =2

Drought Tolerance: 0=no drought tolerance, 1=low drought tolerance, 2=medium drought tolerance, 3=high drought tolerance

Wildlife Value: Bd = bird, Bf = butterfly, **Be** = bees, **Dr** = deer, Ma = Mammal (General)

Ecosystem Function Values: BT = bioremediation ability, EC = erosion control, NF = nitrogen fixer,

Light Needs: **F** = full sun, **PS** = partial sun, **PSh** = partial shade, **Sh** = shade

Light Needs: F = full sun, PS = partial sun, PSh = partial shade, Sh = shade

Soil Moisture (the dominant condition is shown first): D = dry, DM = dry to moist, MD = moist to dry, M = moist, MW = moist to wel, WM = wet to moist, W = wet, WMD = plant can do all three conditions

Bloom Time: Jn = January, F = February, Mr = March, A = April, My = May, Jn = June, Jl = July, Ag = August, S = September, O = October, N = November, D = December

Bloom Color: B = blue, Br = brown, G = green, L = lavender, O = orange, P = pink, Pr = purple, R = red, Ro = rose, S = silver, W = white, Y = yellow, Cr = Cream

Other: Info to save until there enough data to warrant additional columns

A4 Design Performance

Water

Total Parcel Size (SF)	5484.1284
Total Vegetated Area (SF)	2503.45

****Irrigation Required - EPA Water Budget Tool. Save Report!**this will be the key irrigation metric we compare/contrast between baseline and design**

Name/Location (Hydrozone, plant community, area)	Area (SF)	Plant Type (Zone/Feature)	Water Demand (high, med, low; current or assume long-term, post establish.)	Irrigation Type (need to make assumptions! You can play with these assumptions in design scenarios)	Monthly Req. Water (gal./month). (Tool will calculate)
Turf		388 Turfgrass	High	Fixed Spray	2060
Shrub/Perennial Bed		158 Shrubs & Grasses	Medium	Drip (standard)	468
Water-wise Beds (including vegetable beds)		424 Perennials & Annuals	Low	Micro-spray	424
Drought-Tolerant Beds		1530 Perennials & Shrubs	None	None	0
Total (gal.month)					2952
Equivalent 16 oz. water bottles					23616
~Seasonal Req. Total (4.5 months)					13284

Roof Re-use Volumes & Rain Garden Sizing

Design storm criteria/assumptions: City of Bozeman Stormwater Ordinance: LID use, **1/2" rain**, recommendation for lots over 1 acre.

Downspout Outlet Location	Catchment Area (SF)	1/2" Rainfall Volume (cf)	Surface Area for 12" Deep Rain Garden	Surface Area for 9" Deep Rain Garden	Surface Area for 6" Deep Rain Garden
Front Right	69.33	2.75	2.75	4.12	5.49
Front Left	80.15	3.17	3.17	4.76	6.35
Right Flipper	24	0.95	0.95	1.43	1.90
Left Flipper	17.87	0.71	0.71	1.06	1.42
Left Main	409.96	16.23	16.23	24.35	32.46
Everything Else	803.36	31.81	31.81	47.71	63.62
Totals	1404.67	55.61633753			
Totals (gallons)		416.0391252			

Water Utility Costs

Base on EPA Water Budget Tool Total Water Required Monthly for baseline and design.

DESIGN

		Gal	HCF (1 HCF/748 gal)				
EPA Water Budget. Total Monthly Water Required for DESIGN			2952	3.94652406			
COB WATER UTILITY RATES					Monthly Utility Bill - design		
						~Total Yearly Cost for Outdoor Water Required (4.5 months)	
Year		Service Charge for 5/8" pipe	Rates /HCF. (0-7)	Rates /HCF. (8-15)	Rates/HCF (>15)	ONE MONTH	
	2016	15.39	2.5	2.69	3.17	\$ 25.26	113.6533957

BASELINE

		Gal	HCF (1 HCF/748 gal)				
EPA Water Budget. Total Monthly Water Required for Baseline			14647	19.5815508			
COB WATER UTILITY RATES					Monthly Utility Bill - baseline		
						~Total Yearly Cost for Outdoor Water Required (4.5 months)	
Year		Service Charge for 5/8" pipe	Rates /HCF. (0-7)	Rates /HCF. (8-15)	Rates/HCF (>15)	ONE MONTH	
	2016	15.39	2.5	2.69	3.17	\$ 77.46	348.5858222

A4 Design Performance

Materials & Energy

Fertilizer Use Per Year

Turfgrass Veg Zone Area (SF)	388.4
Fertilizer Applied/Year (lbs)	2.3304
Total Yearly Fertilizer Costs (\$)	3.72864

Mowing and Energy

Turfgrass Veg Zone Area (SF)	388.4
Total Yearly Mowing Time (15 min/1000sf; 20x)(hrs)	1.942
Mowing Gas Consumed (gal) Honda self propelled GCV190 Engine	0.587455
Yearly CO2 Emissions from Mowing (lbs)	11.55523985

Tree Benefits Atmospheric Carbon Reduction - Equivelancy to Burning Gasoline Emissions

Total CO2 Reduction from trees on parcel, from calculator (lbs/year)	\$ 1,882.00
Total CO2 Reduction from trees on parcel, from calculator (metric tons)	0.941
Equiv. CO2 released by burning # gallons of gasoline (gallons)	95.67869853

Maintenance & People Energy

Task	Estimated Yearly Time (hrs)	Year/Season = 20 weeks
Weeding	60	
Pruning	10	
Harvest	12	
Deadheading	30	
Mowing	2	

Reference Values (LPS, Capitol Valley Methodology)

CO2 Emissions/gallon of gasoline (metric tons)	0.00892
CO2 Emissions/gallon of gasoline (lbs)	19.67
lbs/ton	2000
Turfgrass fertilizer/1000 SF (lbs)	2
Turfgrass fertilizer applications/year	3
Turfgrass fertilizer, average Home Deport (\$/lb)	\$ 1.60

Restorative Spaces

List features/spaces	Area
Backyard forage zone w/ gently meandering path	back yard continuing to alley
Enclosed patio	north of house, accessable by walk
Front porch	west side of house, overlooking front yard

Culturally Significant Plants

List features/spaces	Area
bitterroot	state flower of Montana, by the garage
turfgrass	common, used sparingly

Signage; Learning Opportunities

List features/spaces	Frequency
address	front of house, mailbox
exploration opportunities in forage and food production	througout the entire design

Human Comfort Zones

List features/spaces	Area
Enclosed patio	north of house, accessable by walk
Front porch	west side of house, overlooking front yard

Play Spaces/Features

List features/spaces	Area
exploration opportunities in forage and food production	througout the entire design
engagement with food production in various ways	througout the entire design

A4 Design Performance

Cost Estimate

DESIGN NAME:

Date:

MATERIAL COSTS ONLY. Should not include demolition, irrigation retrofits, or installation labor costs.

TAKE-OFFS						COST ESTIMATE			
PLANTS/PLANT ZONES						Refer to '\$Reference'. All applicable costs will likely not be referenced. Accurate estimates will also mean making some local phone calls on material pricing.			
Botanical name	Common name	Qty	Units or Size (sf/ac/lf/sy/ caliper)	Stock Type	Notes (candidate plants; symbol, abbreviation, manufacturer/supplier, etc.)	Unit Cost	Total Item Cost		
<u>Trees</u>									
Populus tremuloides	Aspen, Quaking	2	6-8'	BR	Cashman's	\$ 42	\$ 84		
Prunus virginiana	Chokecherry, Common	5	6'	BR	Cashman's	\$ 49	\$ 245		
<u>Shrubs</u>							\$ -		
Amelancier alnifolia	Serviceberry	2	12"	BR	Cashman's	\$ 17	\$ 34		
Ribes aurum	Currant, Golden	16	6"	BR	Cashman's	\$ 13	\$ 208		
<u>Perennials, Grasses, Other</u>							\$ -		
Calamagrostis x acutiflora 'Karl Fo	Karl Foerster	7	1 gal	pot	Blackfoot Native Plants	\$ 13	\$ 91		
Nepeta cataria	Catmint	32	1 gal	pot	Blackfoot Native Plants	\$ 13	\$ 416		
Heuchera cylindrica	Round-leaf Heuchera	121	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 726		
Viola canadensis	Canadian Violet	140	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 840		
Arctostaphylos uva-ursi	Kinnickinnic	6	1 gal	pot	Blackfoot Native Plants	\$ 13	\$ 78		
Mimulus lewisii	Lewis Monkeyflower	20	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 120		
Fragaria vesca	Wood Strawberry	19	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 114		
Achillea millefolium	Yarrow	1	1 gal	pot	Blackfoot Native Plants	\$ 13	\$ 13		
Balsamorhiza sagittata	Arrowleaf Balsamroot	3	1 gal	pot	Blackfoot Native Plants	\$ 13	\$ 39		
Solidago missouriensis	Goldenrod	6	1 gal	pot	Blackfoot Native Plants	\$ 13	\$ 78		
Sedum stenopetalum	Stonecrop	6	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 36		
Lewisia rediviva	Bitterroot	32	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 192		
Origanum vulgare	Oregano	1	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 6		
Thymus vulgaris	Thyme	1	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 6		
Rosmarinus officinalis	Rosemary	1	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 6		
Lavandula angustifolia	Lavender	1	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 6		
Basil	Ocimum basilicum	2	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 12		
Broccoli	Brassica oleracea var. italica	8	3.5"	pot	Blackfoot Native Plants	\$ 6	\$ 48		
Cabbage	Brassica oleracea var. capitata	8	3.5"	pot	Blackfoot Native Plants	\$ 0	\$ 0		
Turnip	Brassica rapa subsp. rapa	20	1	seed packet	Burpee	\$ 0	\$ 1		
Onion	Allium cepa	20	1	seed packet	Burpee		\$ -	\$ 3,399	
MATERIALS/PAVING/HARDSCAPE									

Crusher Fines	34.4917	cy	Cashman's	\$	26	\$	896.78
						\$	-
						\$	-
						\$	-
						\$	-
						\$	-
						\$	-
SOIL & MULCH (Cut - Fill; soil amendments likely; Mulch)							
Soil pep mulch, @ 3" depth	139.28	cy		\$	45	\$	6,268
Shredded Hardwood Mulch, @ 3" depth	153.84	cy		\$	45	\$	6,923
Straw, @ 3" depth	8	bale	Cashman's	\$	7	\$	56
Topsoil, @ 16" depth	219.373	cy	Cashman's	\$	30	\$	6,581
						\$	-
OTHER							
						\$	-
Edging	138.17	lf		\$	3	\$	415
						\$	-
						\$	-
						\$	-
						\$	-
						\$	-
						\$	-
				TOTAL MATERIALS ESTIMATE		\$	24,538

HORT 432 Advanced Landscape Design Studio

LANDSCAPE DESIGN SCENARIOS FOR WATER CONSERVATION IN THE MIDDLE ROCKIES



Project Partner:



1 Understanding

2 Application

3 Communication



LANDSCAPE PERFORMANCE SERIES

by the
Landscape Architecture Foundation

landscapeperformance.org

Sustainable SITES Initiative

sustainablesites.org

main. TIME	1	INVOLVEMENT				
	that means you!				High Med Low	
Comments	EVERYONE VOTE!!	themes	performance targets	M+E	N+E	H-N-L FINAL
	*	W	water (irrigation) ↓ %	90/60/30	50, 90%	50/75/100
	*	HH/VS	edible/med/therapeutic %	30/20/10		75/75/75
combine?	*	VS	natives %	90/60/30	↑ 50, 90%	100/50/66 75
Separate?	*	? HH/VS	pollinators %	90/60/30	25, 50	25
combine	*					
	④ !	HH	open space % Active Playspace (Usable)	75/50/25	related to turf %	50/80/80
	* Δ	E ?	cost (upfront)	\$/\$\$/\$\$\$		\$ \$ \$
	④	VS	turf % left on property * be combined with natives?		10, 75	50, 20, 0
combine	Δ	E	energy ↓ %		50, 90%	
heating/cooling	?	HH	multi-use spaces %		25%	50%?
define ?	X	W/HH	permeous/impermeous		50, 90%	50%/100
materials?	X	HH	community enhancement			
quantify?	④					



show it. Montana showcases over 50 unique ecological systems throughout the state (MTNHP, 2015). Each system boasts a wide variety of plant materials that together create beautiful scenes in the Montana landscape. Explore the option of landscaping your own piece of Montana in a fashion that is true to Montana by rewilding your own back yard with these plants.

Credit: Maggie Crowley



DESIGN APPROACH

Making a case using landscape performance

WATER

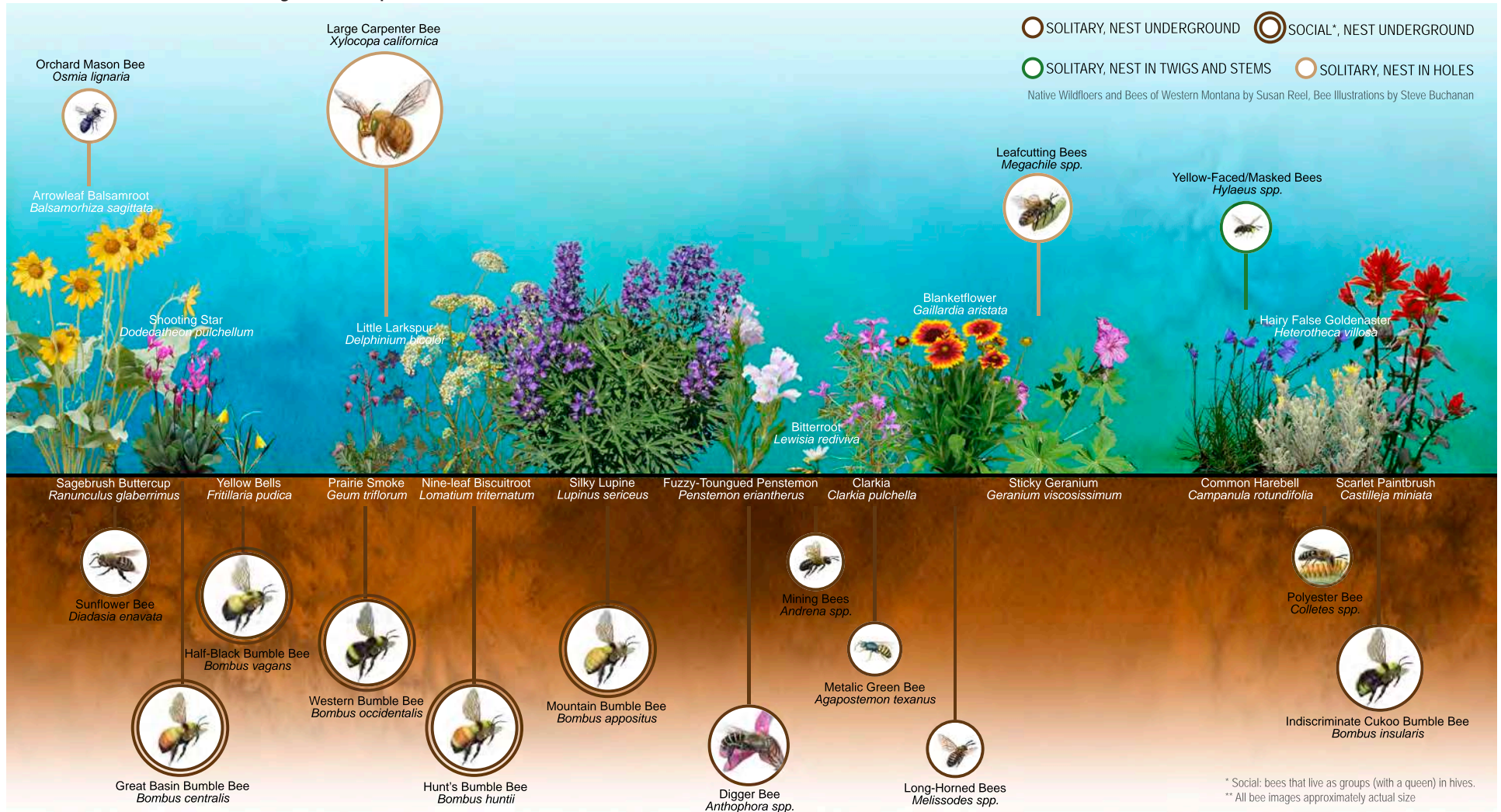
- Problem: water quantity is declining within the Bozeman watershed every year
- Sustainable Sites Approach: use of rain water that falls on the site; use of plant selection
- In 2015, consumption for single family homes from June - August was 540 million gallons of water
- Compared to September - May where 317 million gallons of water were used



Credit: Elizabeth Ritchie

VEGETATION & SOILS

- Problems: bee population is going down by 40-50% (in 2015 according to the USDA) an loss and compaction of productive top soil
- Sustainable Sites Approach:
 - use of native and drought tolerant plants to conserve water
 - create diverse habitat that contributes to seasonal interest
 - create stability for top soil



Credit: Elizabeth Ritchie

VEGETATION & SOILS

MORE THAN JUST GRASS GREEN...

TURF GRASS

SPRING



FALL



FULL/PART SUN

SPRING



FALL



PART SUN/SHADE

SPRING



FALL

Credit: Haley Craven

HUMAN HEALTH & WELL BEING

- Problem: there is not enough focus on restorative and stimulating spaces within landscapes
- Sustainable Sites Approach: aim to not just be aesthetically pleasing
- CASE STUDY: Elmer Avenue Neighborhood Retrofit, California
 - increased neighborhood satisfaction by 90%
 - increased property values and curb appeal
 - saved residents \$120-\$360 annually by being a self watering site
 - improves water quality by reducing concentrations of lead by 60%, copper of 33%, and total suspended solids by 18%



BEFORE



AFTER

Credit: landscapeperformance.org

MATERIALS & ENERGY

- Problem: the energy used for material acquisition and disposition deserves more thought

Going 500 miles to get materials requires 15 trees to sequester the amount of carbon produced by emissions...



Going 200 miles requires about 5 trees...



Going 50 miles requires about 2 trees...



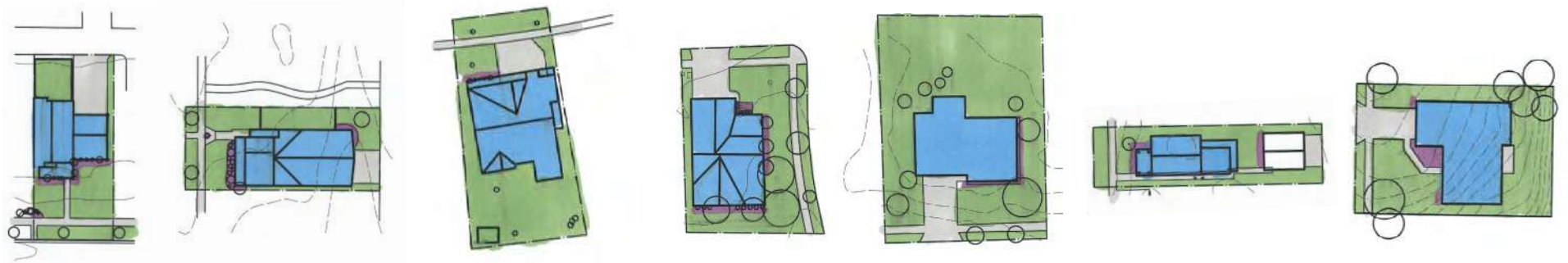
- Sustainable Site Approach:
 - Reduce the distance of where materials are coming from
 - Reuse materials on site
 - Use of recycled materials

BASELINE PERFORMANCE

METHOD

Analyzed Parcels

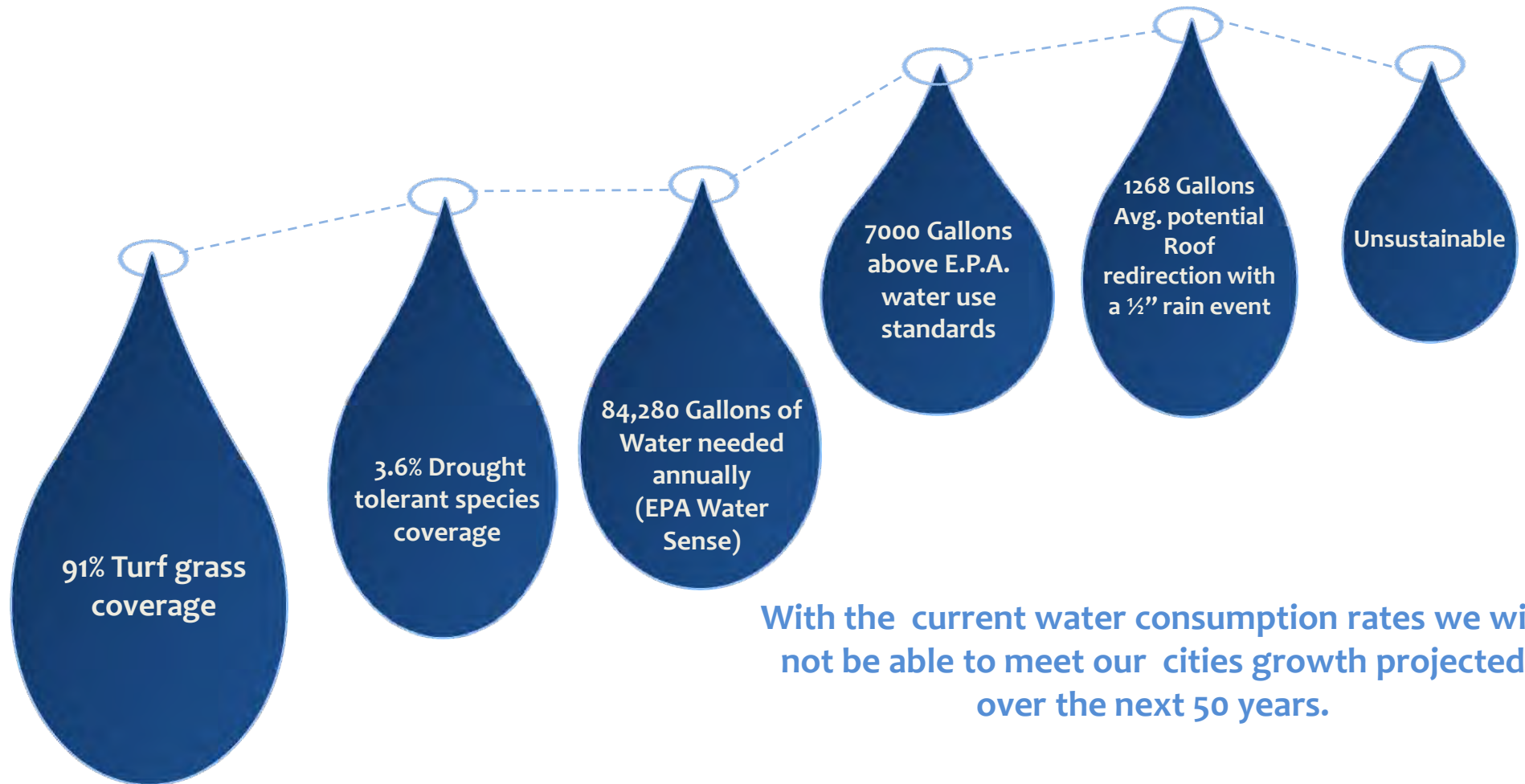
- Single Family Equivalent (SFE) properties
- Geographic variability in City of Bozeman
- Parcel layout typology - orientation, alley/street garage
- Median home value (\$350,000)



Data Collection

- On-site survey
- Mapping & drafting software
- Microsoft excel for four performance themes

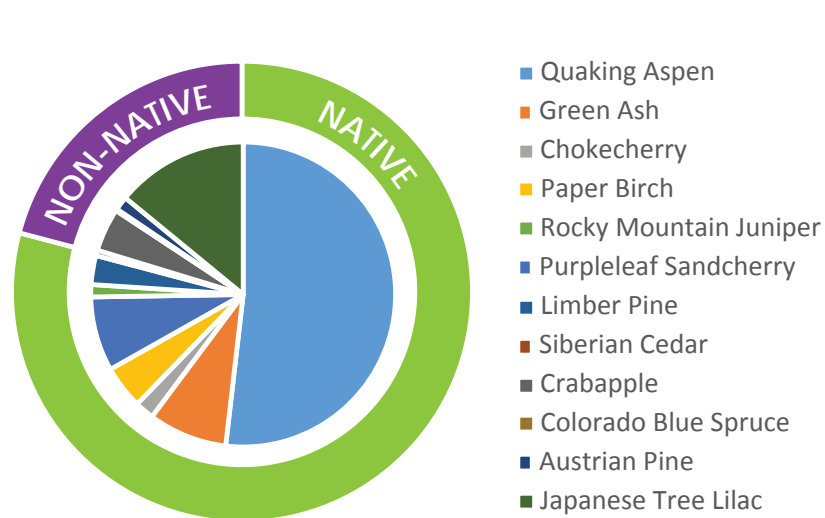
WATER



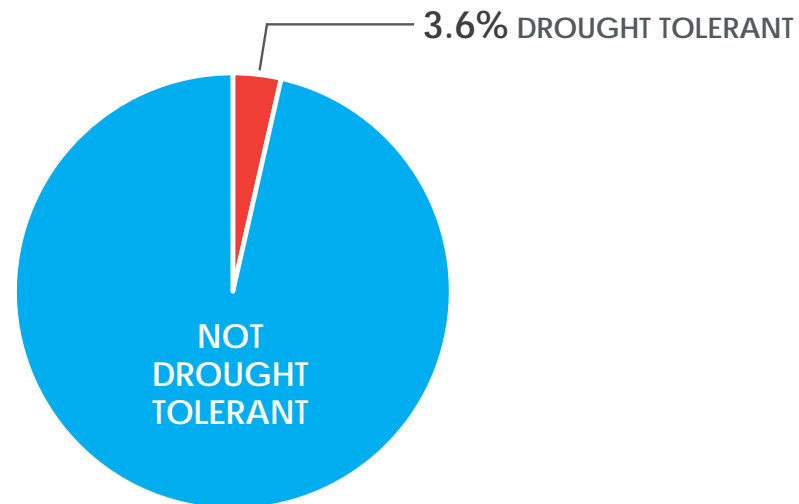
With the current water consumption rates we will not be able to meet our cities growth projected over the next 50 years.

We need a more “sustainable solution”.....

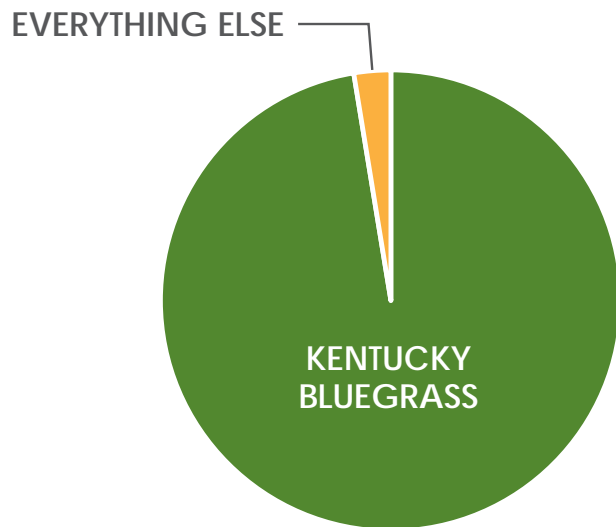
VEGETATION & POLLINATORS



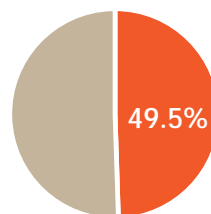
TREE COVERAGE PER SPECIES



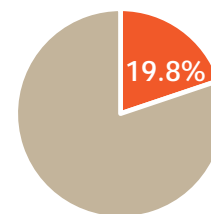
PERCENT OF TOTAL VEGETATIVE COVER THAT CAN **WITHSTAND DROUGHT**



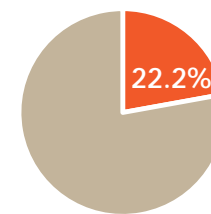
OTHER VEGETATIVE COVERAGE



BIRDS



BUTTERFLIES



BEEES

PERCENT OF TOTAL PLANTS INVENTORIED* WITH **WILDLIFE VALUE**

Human Health & Well-Being

Avg. property value increase due to trees in the front lawn is currently **\$344** (National Tree Benefits Calculator)

Year-round sensory experiences are **low** due to the extremely high amounts **turf** (97%)

Restorative spaces are **limited**. Primary engagement with landscape is through mowing & limited play






















Therapeutic & medicinal properties are limited due to the **uniformity** of turf



Jungles, Raymond. 1100 Block of Lincoln Road Mall. Digital image. Landscape Performance Series. N.p., 2010. Web. 30 Nov. 2016.

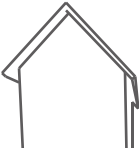


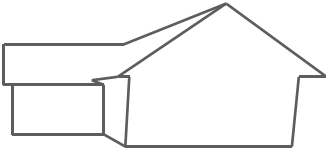
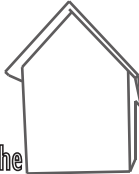
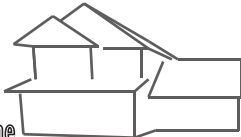
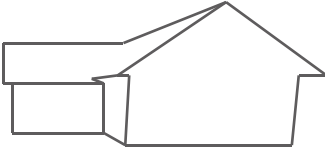



























PERFORMANCE TARGETS & SCENARIO DEVELOPMENT

SCENARIO

THRESHOLD	FEATURES & PERFORMANCES						
HIGH	 % of water use reduction (gallons / season)	 % use of native plants as increase (square feet)	 % use of pollinator-friendly plants as increase (total cover - square feet)	 % use of edible/medicinal plants (total cover - square feet)	 total open space reduction (hardscape / turf) (square feet)	 post-establishment maintenance time (hours / week)	 average cost of new vegetation (dollars / square foot of plants)
MEDIUM	 % of water use reduction (gallons / season)	 % use of native plants as increase (square feet)	 % use of pollinator-friendly plants as increase (total cover - square feet)	 % use of edible/medicinal plants (total cover - square feet)	 total open space reduction (hardscape / turf) (square feet)	 post-establishment maintenance time (hours / week)	 average cost of new vegetation (dollars / square foot of plants)
LOW	 % of water use reduction (gallons / season)	 % use of native plants as increase (square feet)	 % use of pollinator-friendly plants as increase (total cover - square feet)	 % use of edible/medicinal plants (total cover - square feet)	 total open space reduction (hardscape / turf) (square feet)	 post-establishment maintenance time (hours / week)	 average cost of new vegetation (dollars / square foot of plants)
NOTES							
HIGH	90+	90+	90+	50+	75+	10+	2.50 - 4.00
MEDIUM	60+	60+	60+	35+	50+	4-10	1.30 - 2.50
LOW	30+	30+	30+	10+	25+	1-3	0 - 1.30

SCENARIO TRESHOLDS

FEATURES & PERFORMANCES

 <u>THE SURVIVOR</u>	 <u>URBAN</u> <i>farmer</i>	 <i>native beauty</i>	 KEEP MT <i>wild</i>	 <u>the minimalist</u>	 <i>the entertainment zone</i>	 FAMILY VALUES
						
						
						
	 					

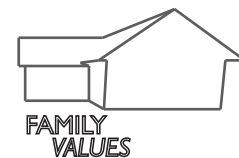
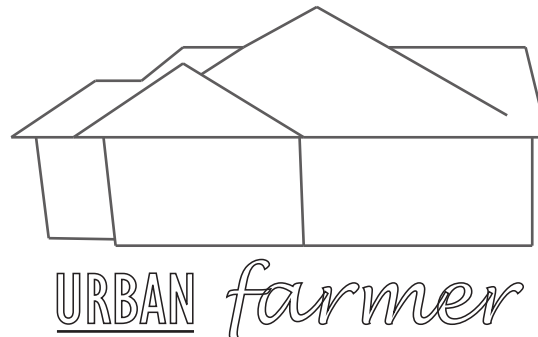
URBAN FARMER

"An edible yard that brings the
pollinators home"

Maggie Crowley

December 02, 2016

MSU / Plant Biosciences Building / Room 108



Performance



High use of edible plants

69%



High use of pollinator - friendly plants

63%

(118%)



High maintenance

5-7
hours



Low water use reduction

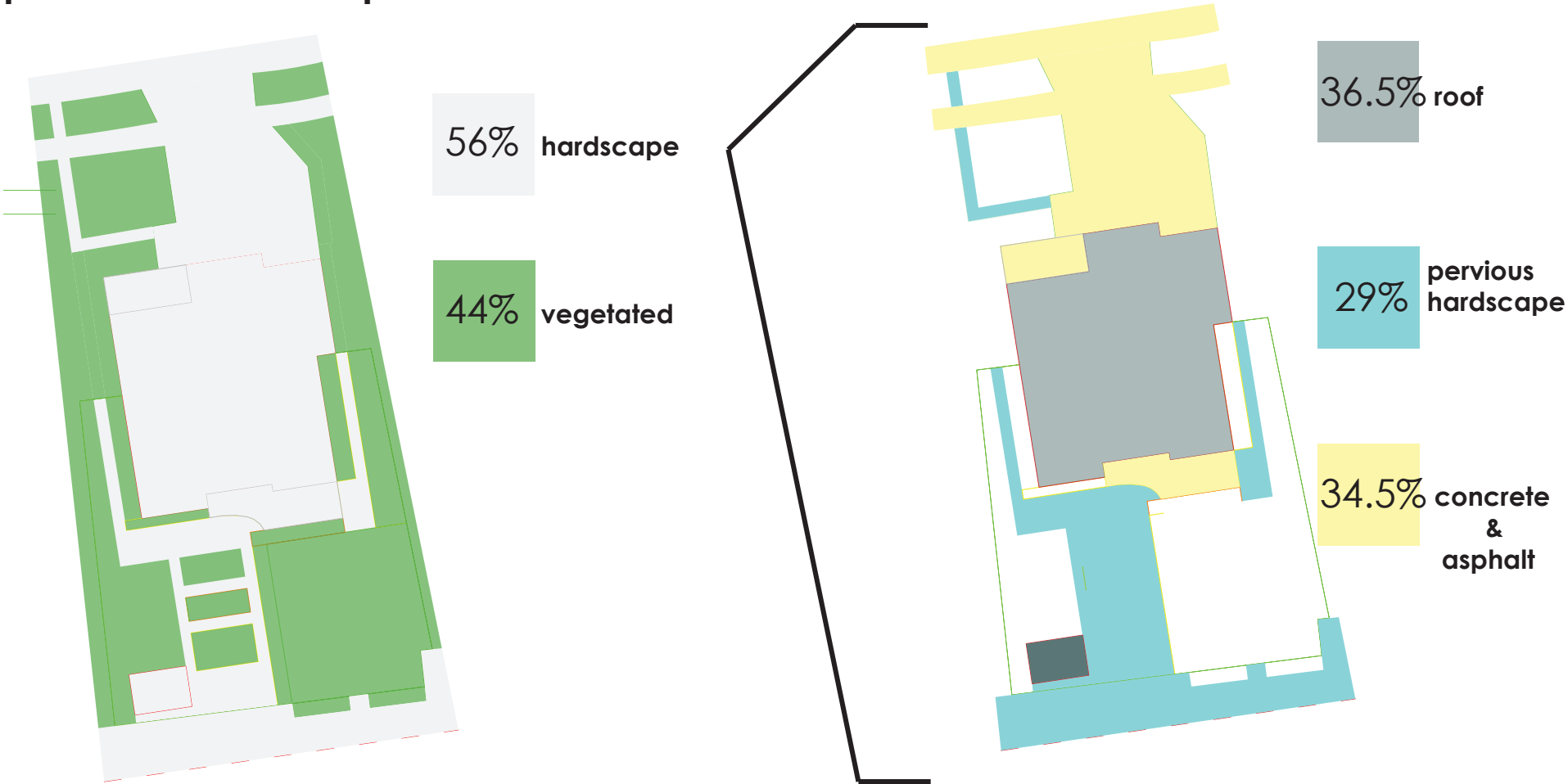
40%

Schematic Plan

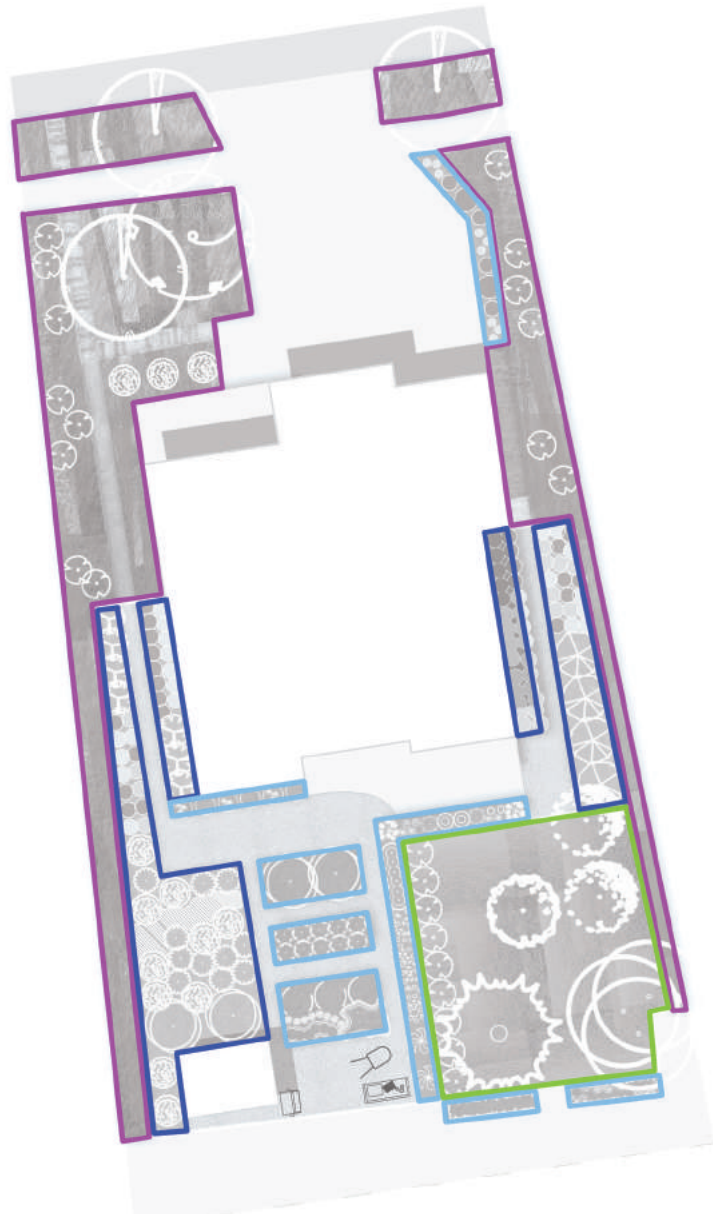


Surface Type Diagram

parcel size: 9852 square feet



Vegetation Diagram



MT native grass mix



Shrub / perennial

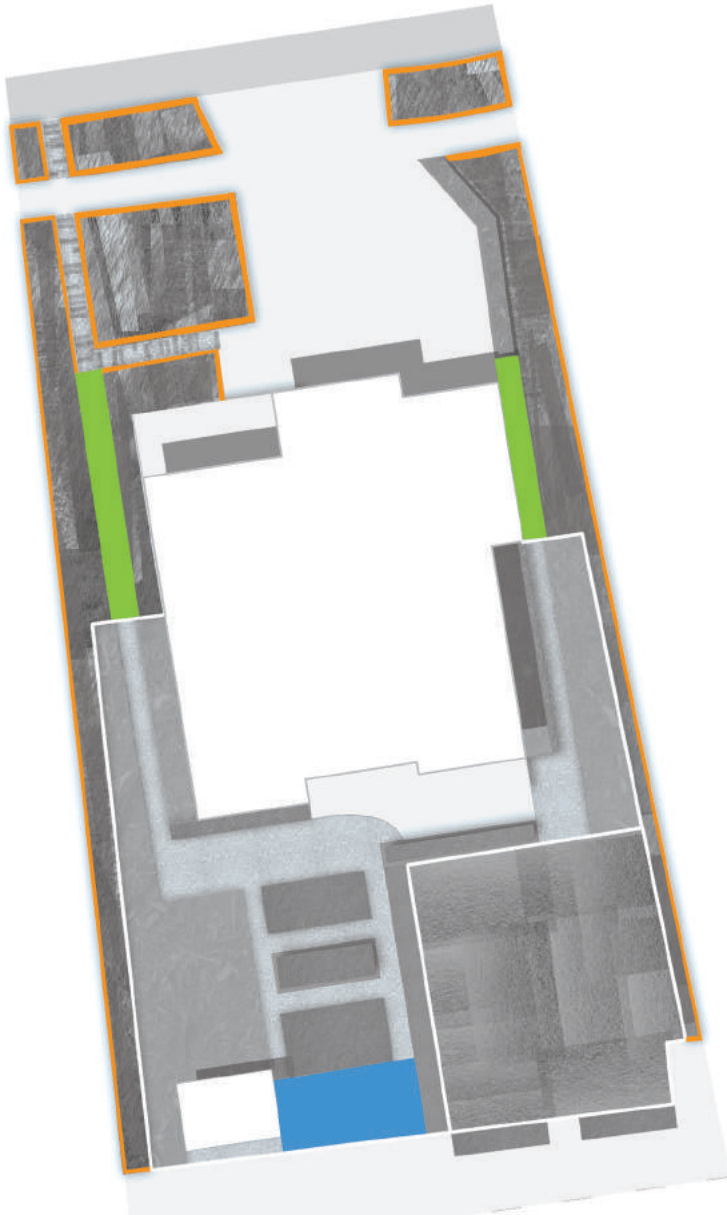


Edible / herb



Turf

Cues to Care Diagram



Thin mow-strip



Mow strip used as informal path

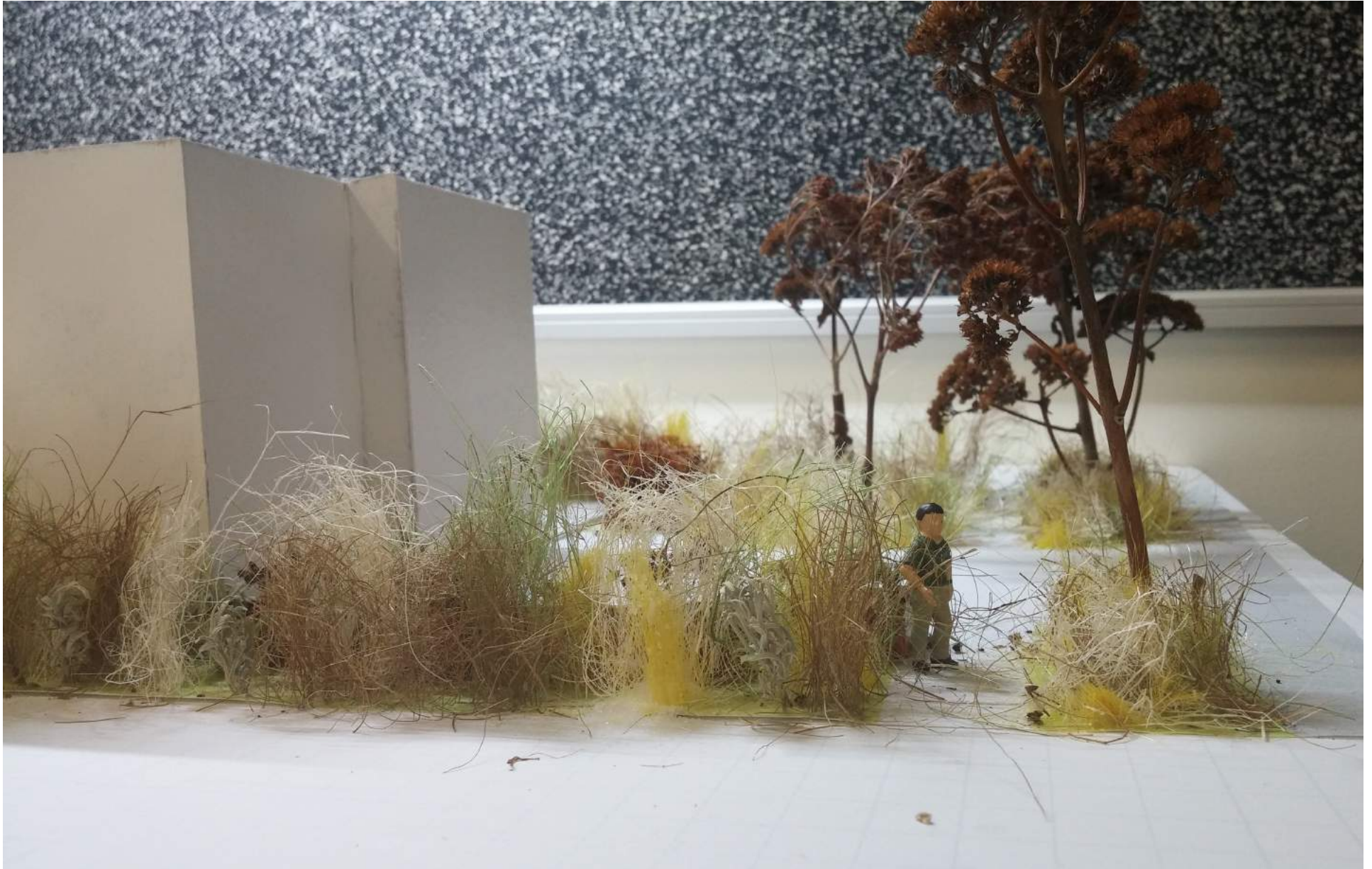


Workstation

other cues to care observed:

- fences
- mown turf
- visible, crisp edges defining borders of patches
- colorful flowers

Model - front yard



Model - back yard



Model - side yards



Tea Time



N↑



STREET

SIDEWALK

Tea Time is an aesthetically-pleasing, functional raised bed. Entertain your guests with a fresh cup of tea, straight from the garden. (\$300-\$1400)



Catnip
(*Nepeta cataria*)

- attracts bees & butterflies
- drought tolerant
- soothing herbal tea, minty



Chamomile
(*Matricaria recutita*)

- attracts bees & butterflies
- calming herbal tea, sweet



Pale Purple Coneflower
(*Echinacea angustifolia*)

- attracts butterflies
- drought tolerant
- immune system - boosting tea, floral taste

Strawberry Salad Patch



N↑



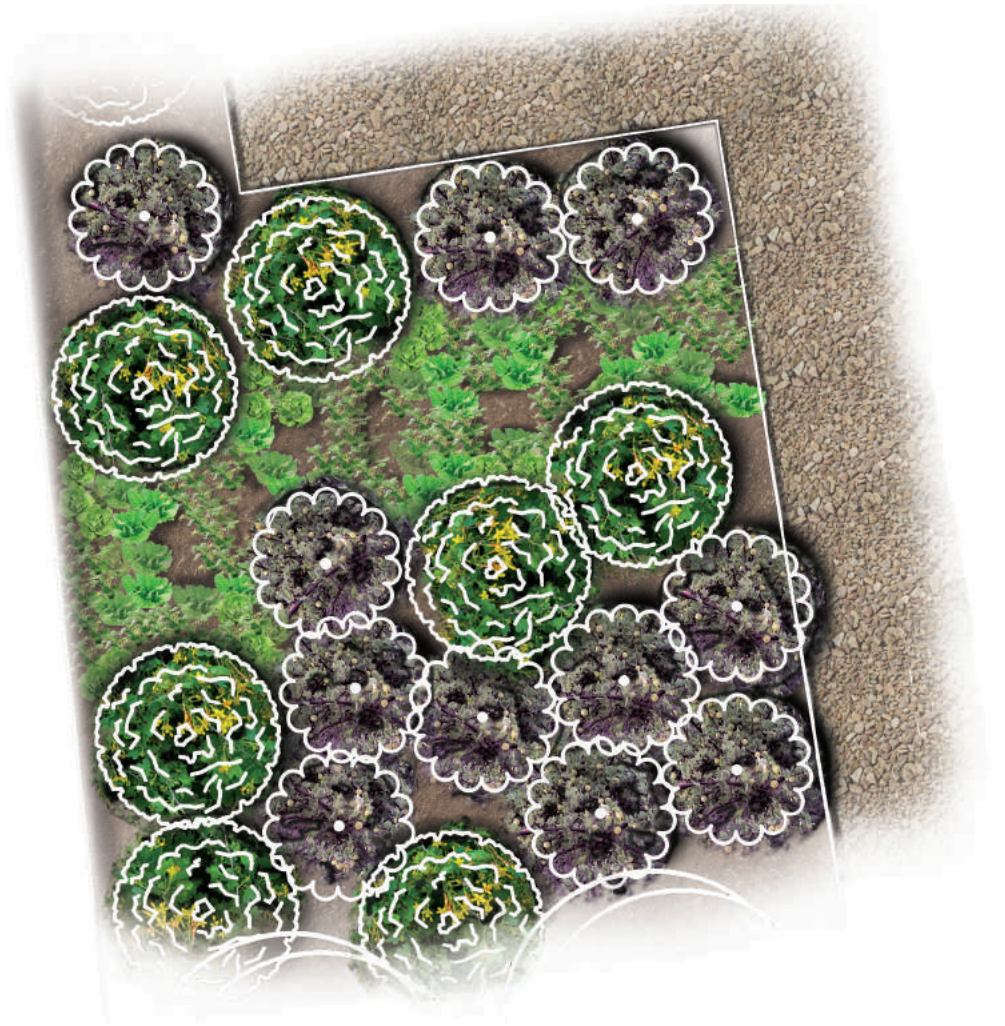
Lettuce (*Lactuca sativa*)



Spinach (*Spinacea oleracea*)



Strawberry (*Fragaria spp.*)



Strawberry Salad Patch is a great alternative to traditional groundcovers that gets your kids interested in homegrown foods.

(\$40-\$100)

Exploratory Path



N↑

Exploratory path... more than just a shortcut to the house.

(\$100-\$300)



PATH

DRIVEWAY



1. DIY path



2. Yarrow

(*Achillea millefolium*)



3. Idaho Fescue

(*Festuca idahoensis*)



5. Lewis's Flax

(*Linum lewisii*)



4. Blue Grama

(*Bouteloua gracilis*)

6. Slender Wheatgrass

(*Elymus trachycaulus* ssp. *trachycaulus*)



7. Pale Purple Coneflower

(*Echinacea angustifolia*)



8. Bluebunch Wheatgrass

(*Pseudoroegneria spicata* ssp. *spicata*)



9. Basin Wildrye

(*Leymus cinereus*)



10. Smooth Aster

(*Aster laevis*)

Comparing Performance - Water

Performance	Baseline	Urban Farmer
gallons / month used	25,200	10,100
gallons / month over or under allowance	4,150	10,950
cost / month for irrigation	\$122	\$52

Comparing Performance - Vegetation / Soil

Performance	Baseline	Urban Farmer
total vegetated coverage = edible	0%	69%
total vegetated coverage = pollinator-friendly	19%	63%
property value increase / year	\$260	\$730
gallons of stormwater interception / year	600	7,800

Comparing Performance - Human Health & Well-Being

Benefit	Baseline	Urban Farmer
Restorative spaces	covered porches	view from windows covered porches raised beds
Culturally significant plants	turfgrass	MT native plants Bluebunch Wheatgrass turfgrass
Learning opportunities	none	Plug-and-plays
Human comfort zones	covered porches turf area	covered porches work area turf area edible area
Play spaces	turf area	turf area nature playground

Comparing Performance - Materials & Energy

Performance	Baseline	Urban Farmer
pounds of fertilizer applied to turf / year	25	5
hours / year spent mowing turf	20	4.5
yearly CO ₂ emissions from mowing turf (lbs)	433	27

Making Urban Farmer a reality

Upfront plant costs



Maintenance



Soil



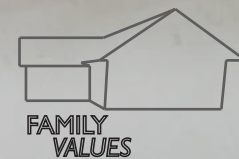
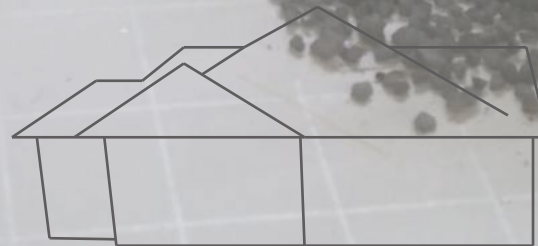
Pollinator homes



Urban Farmer

"An edible yard that brings the pollinators home"

THANK YOU
QUESTIONS? / COMMENTS?



THE MINIMALIST

"Spend less time and money taking care of your landscape and simply enjoy it."

Haley Craven

December 2, 2016

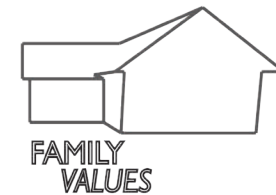
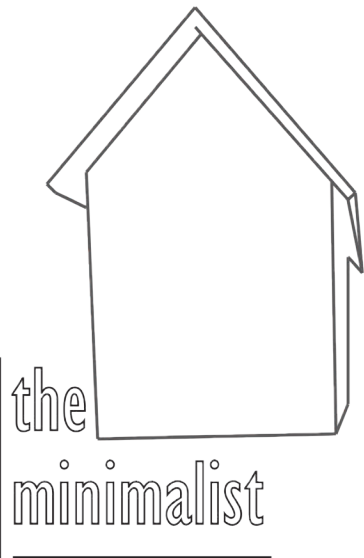
MSU / Plant Bioscience Building / Room 108



Design Concept:

This design is based upon the rotation of seasons throughout a landscape and having seasonal interest every direction you look.

It uses curvilinear form to create the idea of the cycle through the different seasons.



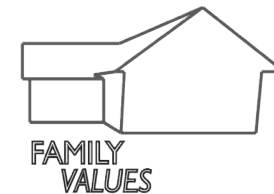
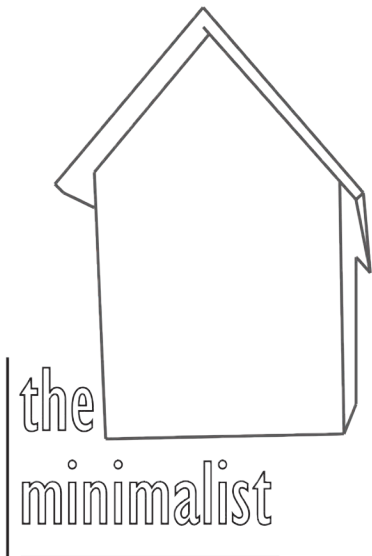
PERFORMANCE

THE MINIMALIST

goals and benefits



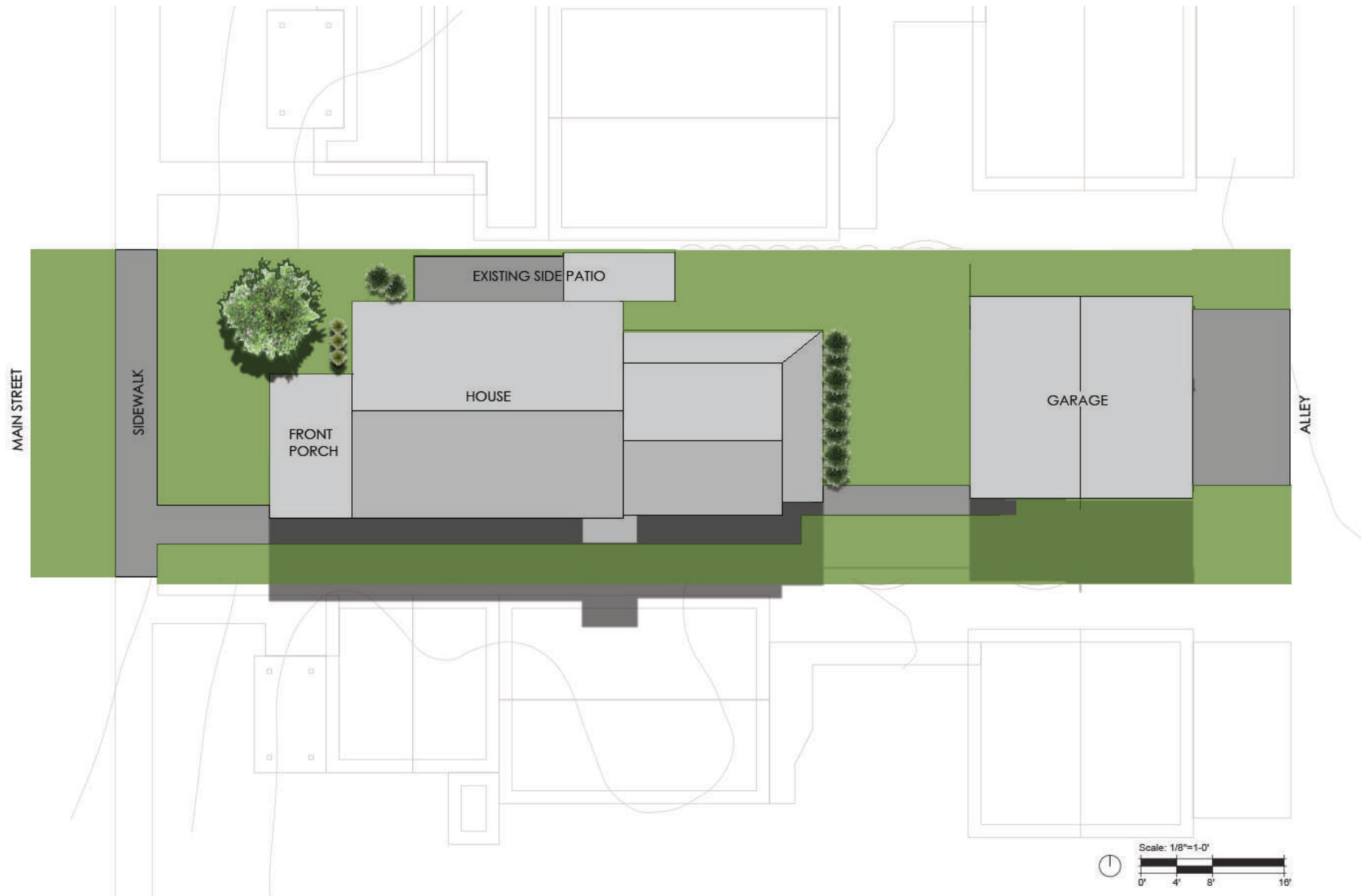
- Site management through plant diversity
- Drought tolerant plant species
 - Most found in the City of Bozeman Planting and Outdoor Watering Guide
- Small but high impact on human senses



EXISTING plan view

THE MINIMALIST

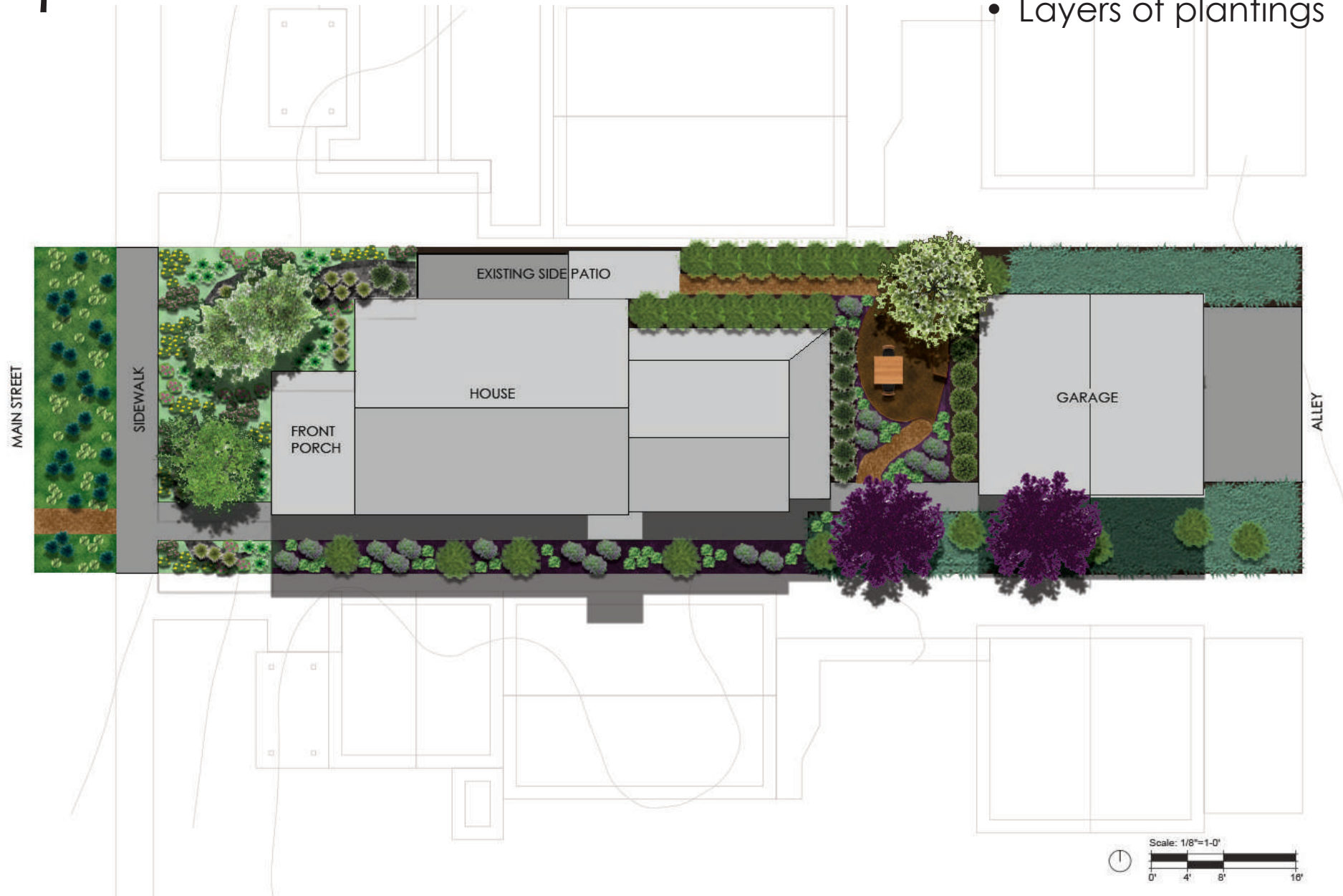
- No biodiversity
- Alley loaded
- Small setbacks



PROPOSED plan view

THE MINIMALIST

- 100% turf reduction
- Human function
- Layers of plantings



PROPOSED schematic design

- ## THE MINIMALIST
- Curvilinear design
 - On ground plane, tree placements, hardscape



PROPOSED

THE MINIMALIST

design performance

BEFORE

- 46540 gallons of water used a month
 - Over EPA Water Budget monthly allowance by 38659 gallons
- Existing tree benefits
 - 1700 gallons storm water intercepted/year
 - 470 lbs of CO2 reduction
 - Increases property value \$94.22
- 170 square feet of relaxation space in front yard/side of house

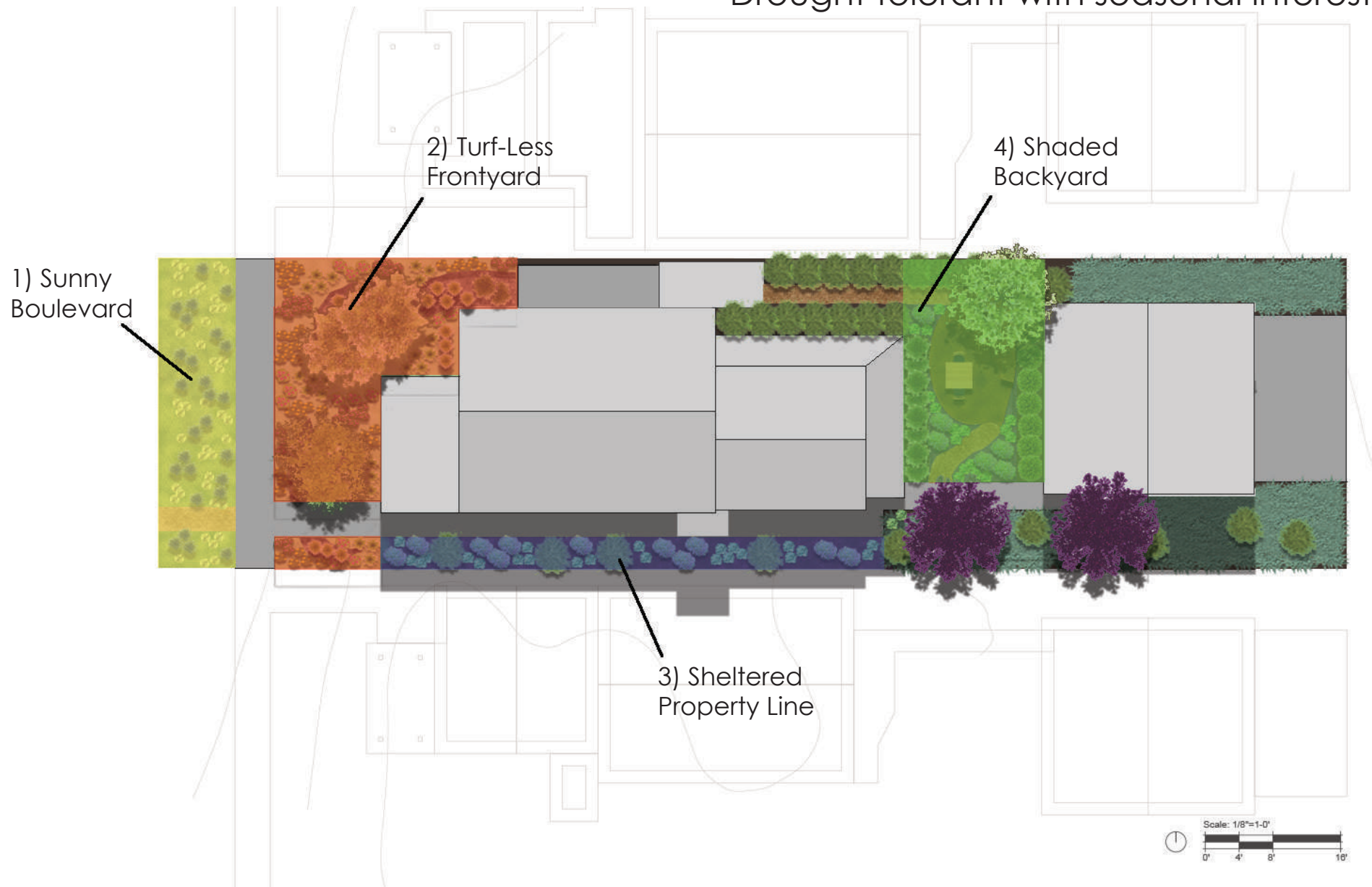
AFTER

- 1892 gallons of water used a month
 - Under EPA Water Budget monthly allowance by 5989 gallons
- New tree benefits
 - 1900 more gallons storm water intercepted/year
 - 886 more pounds of CO2 sequestration
 - Increases property value \$258.31
- Additional 137 square feet of relaxation space in back yard

APPLICATION ideas

THE MINIMALIST

- Plug into own landscape
- Sun levels, locations, area sizes
- Drought tolerant with seasonal interest



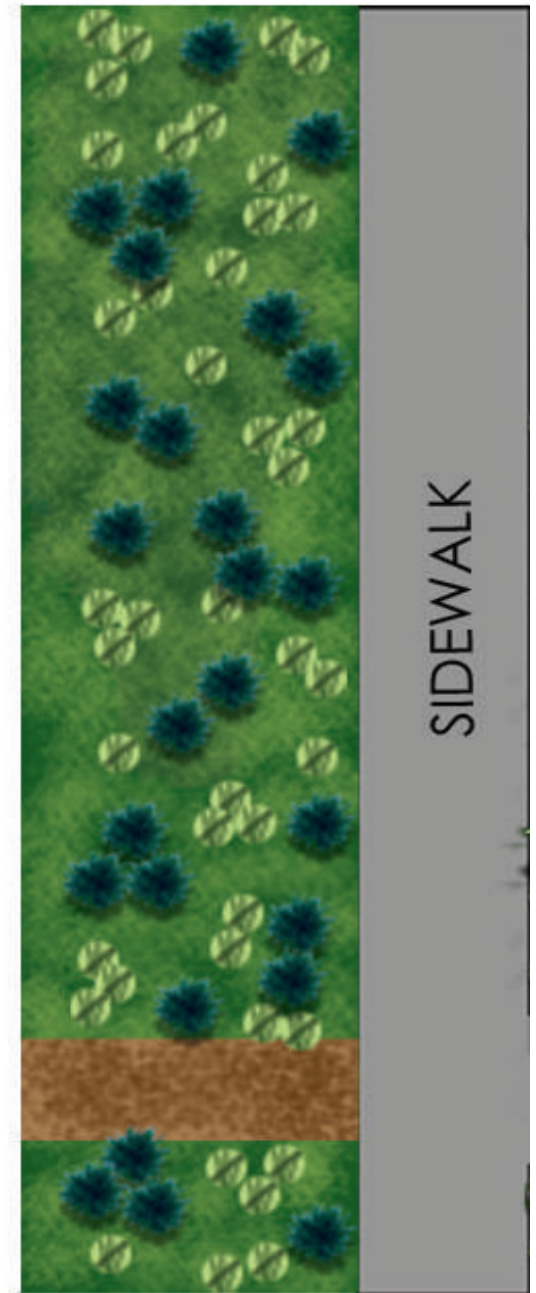
1) SUNNY

boulevard WINTER

THE MINIMALIST



- Low maintenance
- Can still shovel snow
- Still “grassy” boulevard



2) TURF-LESS frontyard SPRING



THE MINIMALIST

- Continual flowering
- Creates privacy
- Plant layers
- Conventional plants in different way



3) SHELTERED

property line

SUMMER

THE MINIMALIST

- Collaboration with neighbors
- Shade tolerant
- Low growing



4) SHADY backyard FALL

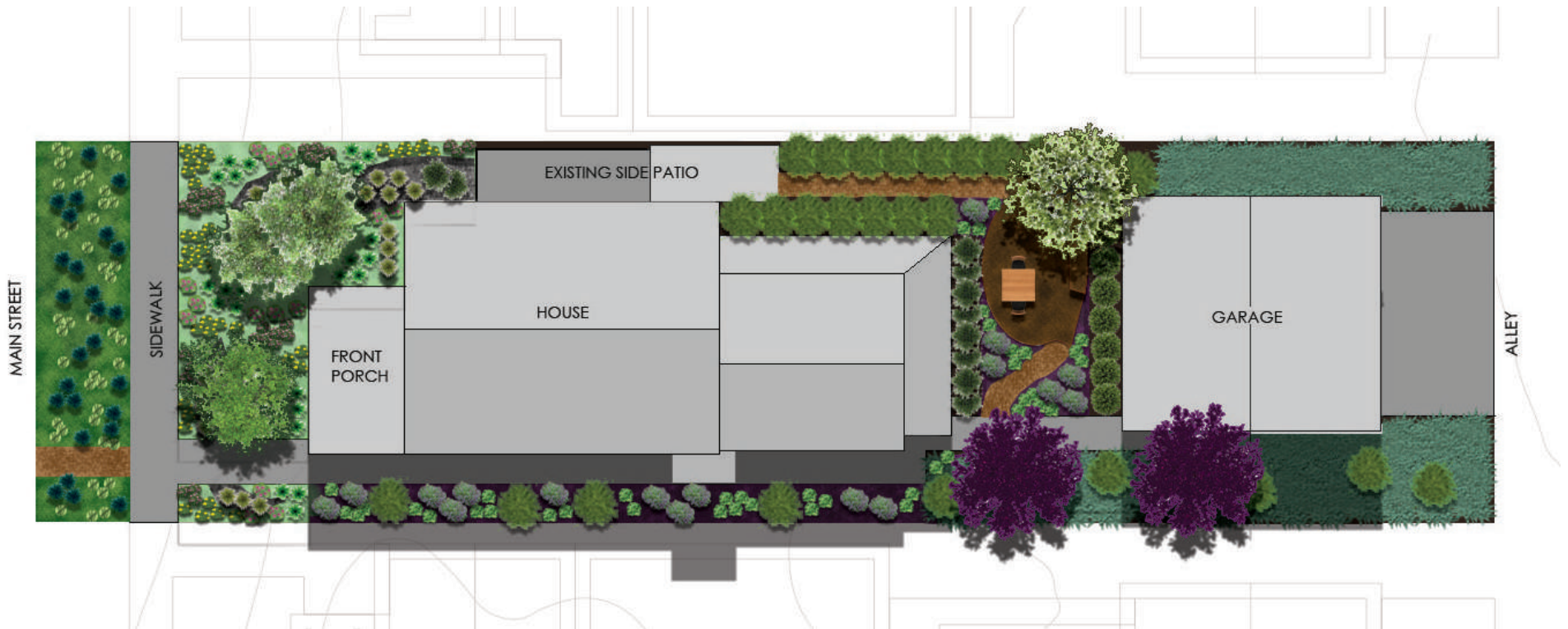


THE MINIMALIST

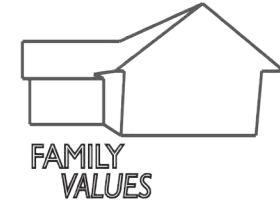
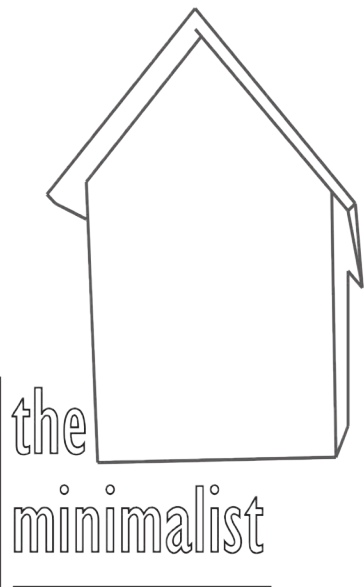
- Added privacy
- Trees help with seclusion
- Low maintenance and more usable
- Always shaded



THE MINIMALIST



THANK YOU!

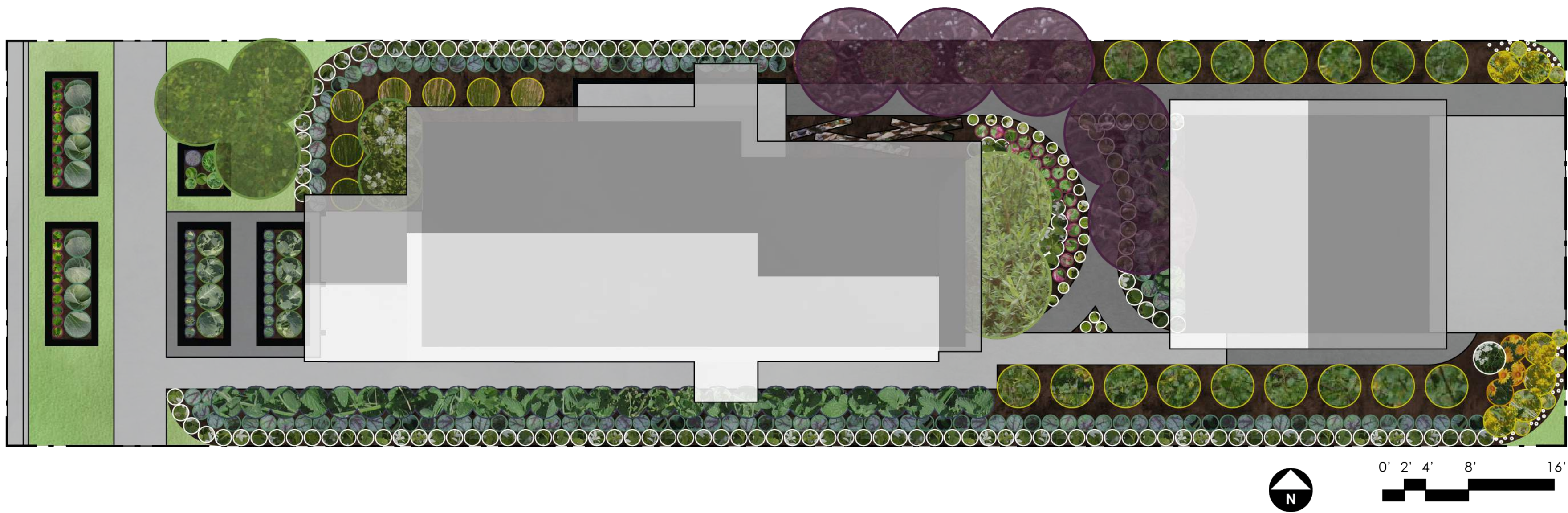


THE SURVIVOR

SUSTAINABILITY | INDEPENDENCE | CONSERVATION

Elizabeth Ritchie
HORT 432
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MSU
Plant Biosciences Building
Room 108



The survivor is a design concept meant to allow the homeowner the ability to produce food and medicinal plants on their property with minimal water consumption and labor input. Native plants are prioritized over non-natives in the spirit of creating a more region-specific urban forage experience.

The homeowner should have the ability to produce their own food but not feel constrained by the need to.

Fun, exploratory elements such as a mushroom garden, or forage patio can be implemented as site conditions allow but do not directly contribute to the central themes of independence and sustainability.

PERFORMANCE TARGETS

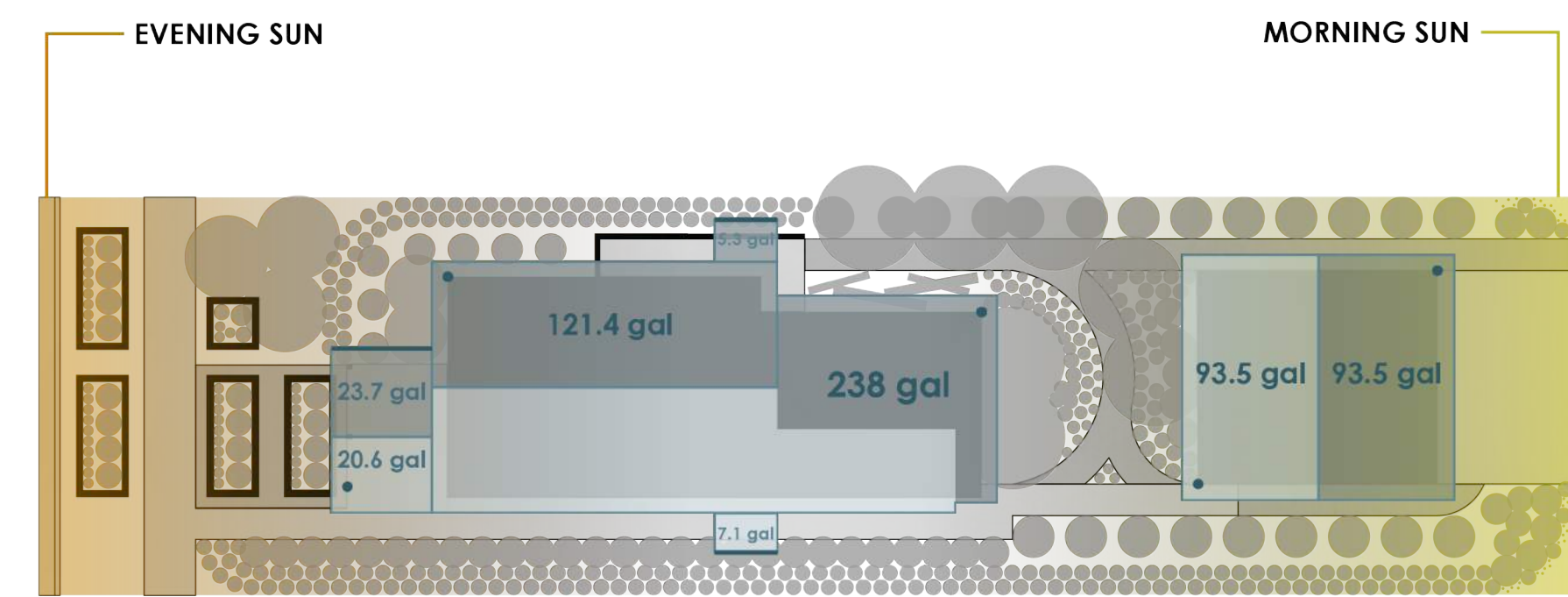
The design performance targets for this scenario were set with the central themes in mind. Water usage is kept at a minimum while pollinator friendly and edible plants were maximized to support sustainability and resource independence. Maintenance needs are minimized so that the urban food production efforts didn't take over the home-owner's life, leaving no room for other activities.

- high water use reduction (81%)
- high edible vegetation (84%)
- 6+ hours / week maint.

SITE OPPORTUNITIES

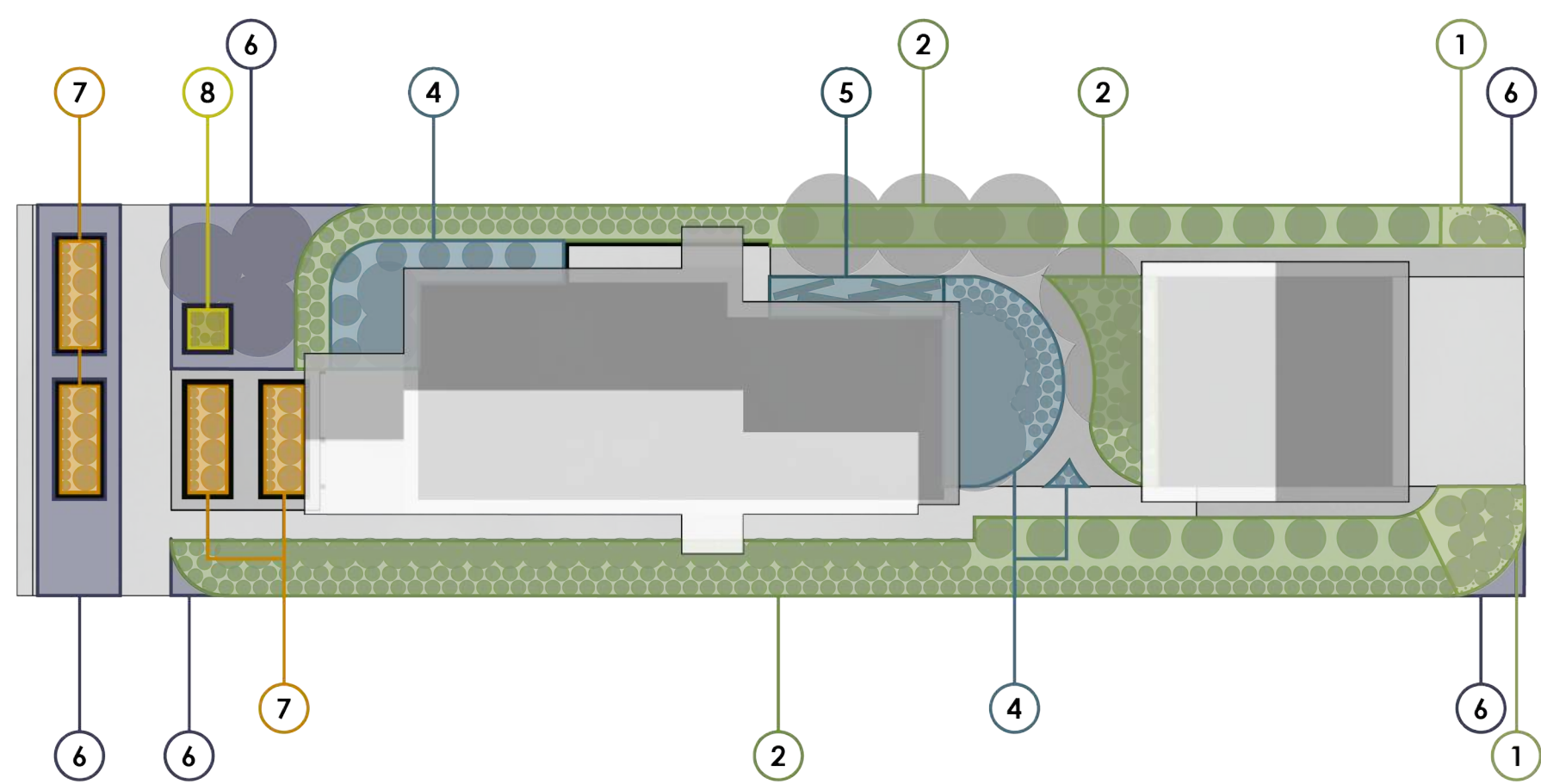
This site is generally very shaded, being a narrow parcel between two other two story houses. However, it does get a large amount of morning and evening sun at its East and West ends, respectively.

Another noteworthy characteristic is the roof runoff, most of which is put out on the two northern downslopes of the structure. The figures below are representative of the volumes expected from a .5" rain event.



HYDROZONES

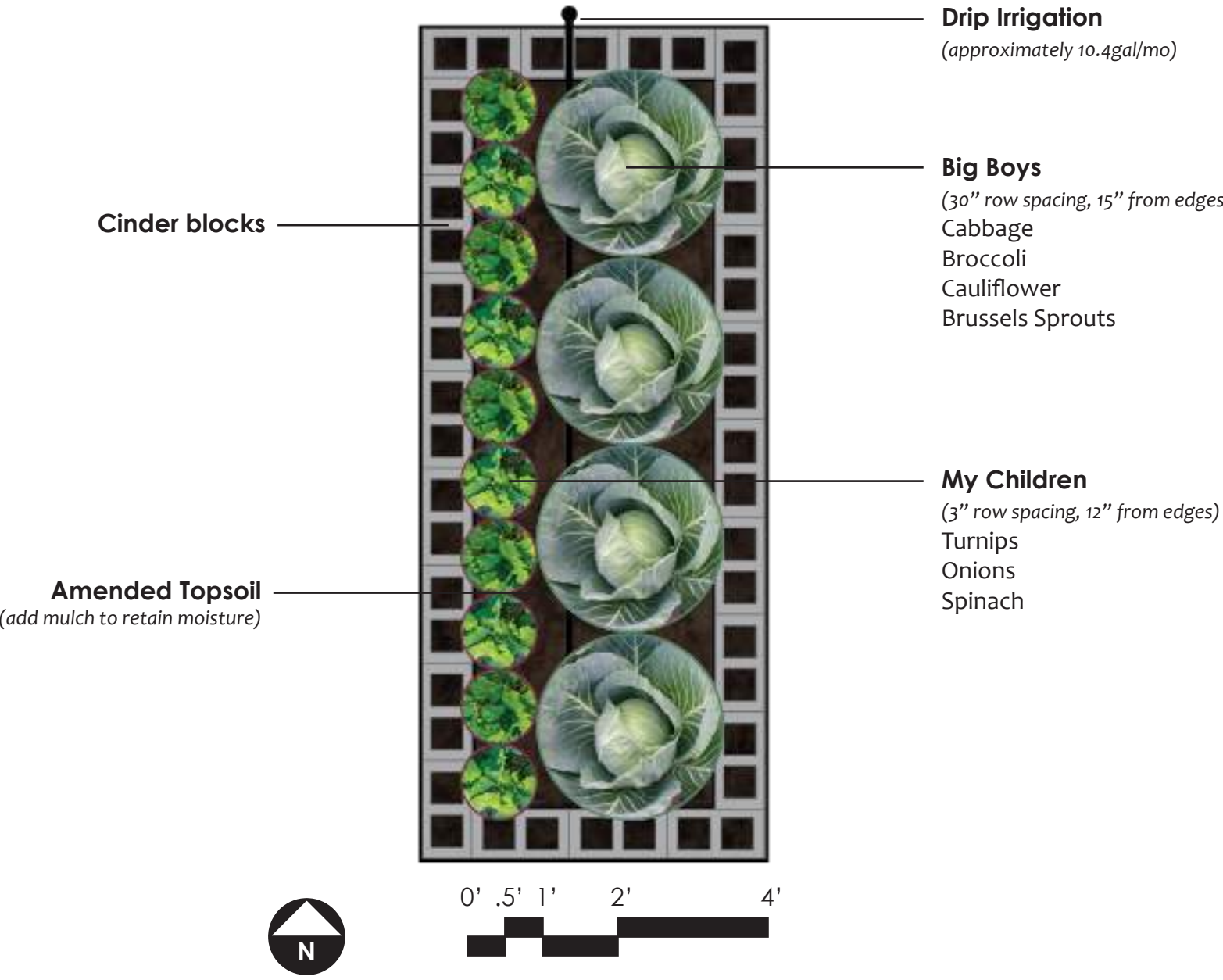
The Plant Pallet and hydrozone layout were informed by the site opportunities, specifically the amount of sun and availability of water. Some zones were created for exploratory purposes or to tie in with the surrounding aesthetic vernacular.



PLANT PALLET

	DROUGHT TOLERANT	WATER SMART	CONVENTIONAL
FULL SUN			
PART SHADE			
FULL SHADE			

WATER SMART VEGETABLE BOXES



Raised or in-ground vegetable boxes are a simple and effective way to integrate vegetable production into the urban landscape while still maintaining a clean and put-together aesthetic.

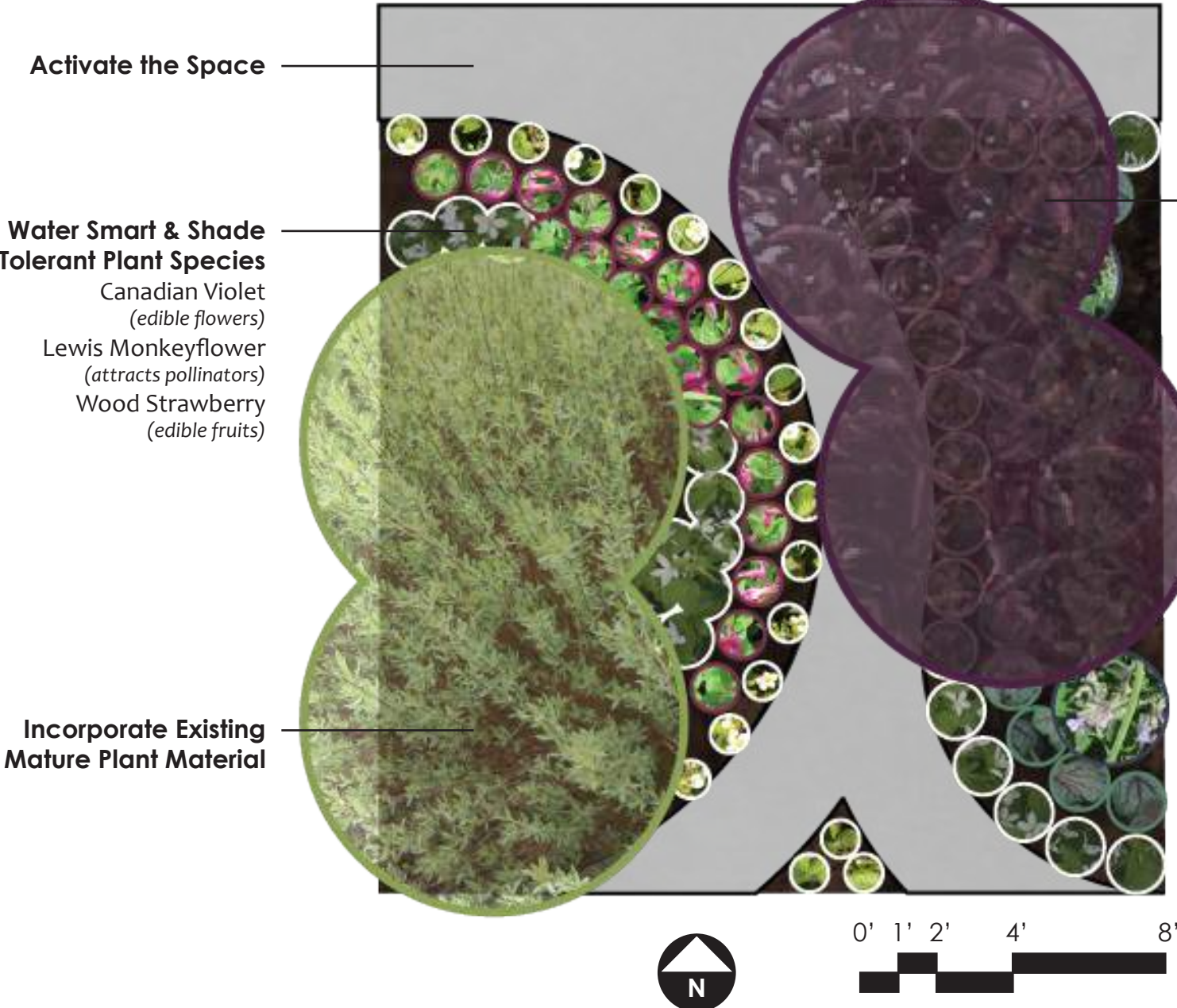
This vegetable box design uses easily accessible materials and a more water-conscious and easily maintained plant pallet to keep costs to the homeowner down while still looking good.

You will need: 4'x11' of space, 44 9x18 cinder blocks, 2 yd³ of topsoil, vegetable seeds or transplants, 10' of drip irrigation line, and approximately 41.6 gallons of water per growing season.

For best sunlight penetration make sure the rows go north-south and, if you have a variety of crops, to plant smaller/shorter crops closer to the direction the sun is mostly coming from (in this case, the west).



URBAN FORAGE BACKYARD



Drought & Shade Tolerant Plant Species
Canadian Red Chokecherry (edible fruits)
Canadian Violet (edible flowers)
Round-leaf Heuchera (medicinal properties)
Catnip (attracts cats)

The design of this element strives to provide a place where people can move through at their leisure and peruse some of the more easily accessible edibles.

Existing plant material was used as much as possible to reduce the extra irrigation required during establishment and the need to weed the area left for the plant to attain maturity.

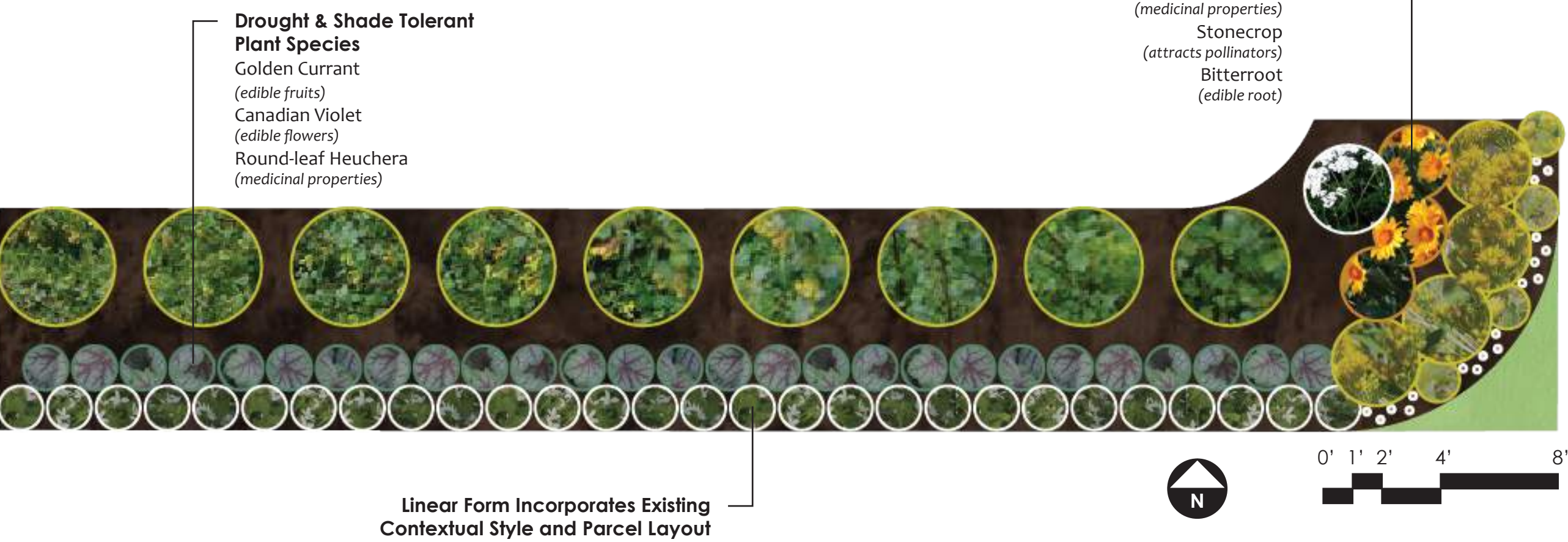
Adding tree cover, even in shaded areas will help to reduce water needs of the plants below.



URBAN FORAGE SIDEYARD

These perennial bed strips along the side of the house provide some additional privacy to the homeowner as well as aesthetic cohesion with some of the other typical plantings in the area, albeit applied to a larger area.

Colorful endcaps to the strips take advantage of the more plentiful sun in addition to providing a pop of brightness.



Drought & Shade Tolerant Plant Species
Golden Currant (edible fruits)
Canadian Violet (edible flowers)
Round-leaf Heuchera (medicinal properties)

Drought Tolerant Plant Species
Yarrow (attracts pollinators)
Arrowleaf Balsamroot (edible root)
Goldernod (medicinal properties)
Stonecrop (attracts pollinators)
Bitterroot (edible root)

