Landscape Research Record

Editor-in-Chief
Charlene M. LeBleu, FASLA, Auburn University

Co-Editors
Karen Wilson Baptist, University of Manitoba
Elizabeth Brabec, University of Massachusetts
Terry Clements, Virginia Polytechnic Institute and State University
Christopher Ellis, University of Maryland
Paula Horrigan, Cornell University
Mintai Kim, Virginia Polytechnic Institute and State University
Byoung-Suk Kweon, University of Maryland
Charlene LeBleu, Auburn University
Patrick Mooney, University of British Columbia
Galen Newman, Texas A&M University
Joni Palmer, University of Colorado
Madis Pihlak, Penn State University
Deni Ruggeri, University of Oregon
Bo Yang, Utah State University

Editorial Assistant
Elizabeth Matthews, Auburn University

CELA Board
Ming-Han Li, President
Kenneth McCown, Past President
Katya Crawford, First Vice President-President
Charlene LeBleu, Vice President Research & Creative Scholarship
Hala Nassar, Second Vice President
Judith Wasserman, Secretary
Paul Voos, Treasurer
Linda Ashby, Region 1 Representative
Lauri M. Johnson, Region 2 Representative
Jun-Hyun Kim, Region 3 Representative
Matthew J. Kirkwood, Region 4 Representative
Ryan Hargrove, Region 5 Representative
Chuo Li, Region 6 Representative
Elizabeth Brabec, Region 7 Representative
Linda Corkery, Region 8 Representative
Beth Faragan, Student Regional Director

CELA Executive Office
Pat Taylor, Interim Executive Director
Dee Solco, Interim Business Manager

© 2015 Council of Educators in Landscape Architecture.
All Rights Reserved.

ISSN 2471-8335
# TABLE OF CONTENTS

**FOREWORD**

**REVIEWERS**

**THE OUTSTANDING PAPER**

COUNTY CEMETERIES AND CHURCHYARDS: ENDURING CULTURAL LANDSCAPE IN APPALACHIA
Elizabeth (Lisa) Orr .............................................................. 119

**COMMUNICATION AND VISUALIZATION**

SOCIAL MEDIA AS A VISUALIZATION TOOL: MAPPING THE URBAN LANDSCAPE
Aidan Ackerman and Beth Lundell Garver ..................................... 2

**DESIGN EDUCATION AND PEDAGOGY**

FACTORS IMPACTING STUDENTS’ DECISIONS TO STAY OR LEAVE THE DESIGN STUDIO: A NATIONAL STUDY
Benjamin George and Simon Bussiere ...................................... 11

A CASE STUDY COMPARING CHINESE AND AMERICAN INTRODUCTORY DESIGN STUDIO PEDAGOGY
Sun Jing, Juanjuan Liu and Iain M Robertson ............................... 22

INTEGRATED PROJECT EXPERIENCES AND STUDENT PERCEPTION
Sean Rotar and David Barbarash ............................................. 33

PROMOTING COGNITIVE PLAY BEHAVIORS THROUGH CHILDREN’S ACCESS TO NATURAL LOOSE ELEMENTS IN OUTDOOR PRESCHOOLS
Zahra Zamani ................................................................. 45

**DESIGN IMPLEMENTATION**

VEGETATION IN DRYLAND BIORETENTION SYSTEMS
Reid Coffman, Darren Graves, Jason Vogel and Glenn Brown ............ 58

**HISTORY, THEORY AND CULTURE**

THE FORCE OF THINGS: LANDSCAPE DESIGN AND THE PANAMA CANAL
Brett Milligan, Rob Holmes, and Brian Davis ............................... 73

ARBORETUM ON THE NATIONAL MALL: A STUDY OF TREE LABELING
Nathan Heavers ............................................................... 84

MATERIAL FAILURE AND ENTROPY IN THE SALTON SINK
Rob Holmes and Justine Holtzman ........................................... 95
ROBERTO BURLE MARX AND THE CONSERVATION OF THE BRAZILIAN FOREST
Catherine Seavitt Nordenson.................................................................111

COUNTY CEMETERIES AND CHURCHYARDS: ENDURING CULTURAL LANDSCAPE
IN APPALACHIA
Elizabeth (Lisa) Orr...........................................................................119

LANDSCAPE PLANNING AND ECOLOGY.........................................................137

THE STATE OF HERITAGE TREE PROGRAMS IN
THE ROCKY MOUNTAIN/INTERIOR PLAIN PROVINCE

EFFECTS OF LANDSCAPE CHANGE IN URBANIZING COASTAL ECOSYSTEMS
Charlene M. LeBleu.............................................................................150

STRUCTURES OF COASTAL RESILIENCE: DESIGN STRATEGIES FOR STORM RISK REDUCTION
AT JAMAICA BAY, NEW YORK
Catherine Seavitt Nordenson.................................................................161

PEOPLE-ENVIRONMENTAL RELATIONSHIPS..................................................171

WHEN THE WELL RUNS DRY
Erin Colwel, Reid Coffman and Richard Ryan.......................................172

YOUNG CHILDREN’S COGNITIVE PLAY PREFERENCES FOR NATURAL, MIXED, OR
MANUFACTURED SETTINGS IN OUTDOOR PRESCHOOL
Zahra Zamani......................................................................................183

RESEARCH METHODS..................................................................................193

UNDERSTANDING HOW STUDENTS APPROACH DESIGN; A QUALITATIVE INQUIRY
Charles H. Klein....................................................................................194

NATURE DISCOURSES: META-PARADIGMS IN LANDSCAPE ARCHITECTURE
Richard P. Perron.................................................................................203

MAPPING SEA LEVEL RISE AND STORM INUNDATION BY 3Di HYDRODYNAMIC MODEL IN THE
SAN FRANCISCO BAY AREA AND ITS IMPLICATIONS FOR FUTURE PLANNING AND DESIGN
Yang Ju and John Radke........................................................................211

IMPROVING COMMUNITY WALKABILITY THROUGH UNIVERSITY OUTREACH,
TECHNOLOGY AND CROWDSOURCING
Christopher Seeger..............................................................................223

SERVICE LEARNING AND COMMUNITY ENGAGEMENT.................................229

TOGETHER WE DESIGN: LANDSCAPE ARCHITECTS OFFER THEIR BEST TECHNIQUES
FOR TRANACTIVE FORM-MAKING
David de la Pena, Randy Hester, Jeff Hou, Diane Allen Jones and Laura Lawson.................................230
SUSTAINABILITY

IS CHANGE NEEDED: WHY DO THE UNITED NATION’S SUSTAINABLE DEVELOPMENT GOALS SOUND SO FAMILIAR?
Lauren Stubbs Sosa

245

URBAN DESIGN

INVESTIGATING COMMERCIAL PEDESTRIAN SPACES BASED ON FORM-BASED CODES
Dan Chen, Bo Zhang and Shengquan Che

259

SUSTAINABLE URBAN DESIGN STRATEGIES FOR HISTORICAL URBAN LANDSCAPES:
CASE STUDY OF IZNIK CITY (TURKEY)
Canan Cengiz and Bulent Cengiz

270

BIO-CENTERS: ECOLOGICAL SANITATION AND RENEWABLE ENERGY HARVESTING IN INFORMAL SETTLEMENTS
Andrea Godshalk and Eric Zencey

286
Welcome to the fourth issue of *Landscape research Record*, published by the Council of Educators in Landscape Architecture (CELA). In 2013, the CELA Board approved and adopted a procedure to become fully responsible for publishing peer-reviewed conference papers annually and named the publication *Landscape Research Record* (LLR). LLR is a post-conference publication and published online only.

This fourth issue of LLR is a collection of peer-reviewed papers presented at CELA 2015 hosted by Kansas State University, with the theme “Incite – CHANGE – Insight.” The conference called to reflection that “when we teach, design and serve, we incite change. When we observe change, it informs our insight; deepening understanding and broadening application of acts, processes, representations and the results of creating difference.” We were called to ponder: “How do you incite change? How do you change insight?”

This issue contains 25 quality peer-reviewed papers resulting from the conference. We hope you find them to be a collection of provocative and insightful research that enriches CELA’s dialog of research and creative inquiry on the processes of change.

Charlene M. LeBleu, FASLA
Auburn University
CELA Vice President of Research and Creative Scholarship
Editor-in-Chief, *Landscape Research Record*
Christopher Sass  Ken Brooks  Rachel Berney
Allan Shearer  Beverly Bass  Cynthia Girling
Simon Kilbane  Simon Bussiere  Katherine Melcher
Sohyun Park  Noah Billig  Claudia Bernasconi
Jon Calabria  Mark Lindquist  Randy Hester
Robert Brzuszek  Taner R. Ozdil  N. Claire Napawan
Margaret Livingston  Linda Ashby  Caroline Westort
Rebecca Oneal Dagg  Conor O'Shea  Peter Summerlin
Kelly Curl  Scott Melbourne  Jennifer Britton
Lee-Anne Milburn  Ryan Wright  Ebru Ozer
Catherine Seavitt Nordenson  Archana Sharma  Gary Austin
Christopher Marlow  Brian Davis  Heather Whitlow
Joe Ragsdale  Tom Woodfin  Charlene LeBleu
Bruce Dvorak  Mira Engler  Galen Newman
Anna Thurmayr  Rob Holms
Catherine Harris  Michael Seymour
M. Elen Deming  David Hopman
Mike Barthelmeh  Herb Gottfried
Karen Wilson Baptist  Sean Rotar
Carlos Licon  Ken McCown
Brian LaHaie  Canan Cengiz
Phoebe Lickwar  Dan Chen
COMMUNICATION AND VISUALIZATION

Edited by Joni Palmer
SOCIAL MEDIA AS A VISUALIZATION TOOL: MAPPING THE URBAN LANDSCAPE

ACKERMAN, AIDAN
School of Landscape Architecture & Director of Digital Media, Boston Architectural College, Boston, MA
aidan.ackerman@the-bac.edu

GARVER, BETH LUNDELL
Director of Foundation Instruction in Practice, Boston Architectural College, Boston, MA
beth.lundell-garver@the-bac.edu

1 ABSTRACT
The primary goal of this project was to test the potential of social media as a format for capturing and cataloging information about urban spaces and landscapes. For this project, social media applications were used by groups of students to collect site-specific data such as location coordinates, date and time, and other location information. This data collection and mapping process was presented and analyzed, along with the resulting visualizations. Final output demonstrated that commonly-found digital devices such as smartphones could be used to collect and broadcast data attached to spatial location and experience. This workflow and its results may incite further dialogue into patterns of visitation and usage of urban landscapes, building a deep and diverse knowledge base of information to draw upon as part of the design process.

1.1 Keywords
Social media, site-specific data
2 INTRODUCTION

Cartographic mapping tools have evolved over millennia to reflect the changing picture of the urban landscape. As humans have planned and developed land use and spatial configurations of towns, cities, and regions, the tools used to navigate and understand these spaces have become continually more complex. Mapping platforms have graduated from ancient engraved clay tablets, papyrus, wood, and paper prints using devices such as the compass, quadrant, vernier, telescope, and aerial photography. New digital cartography comprises satellite imagery, global positioning systems (GPS) and geographic information systems (GIS). Mapping tools are used to describe extents, landmarks, and other physical characteristics belonging to the place it represents, allowing people to successfully traverse its spaces; yet, “the map is more than merely a passive representation of the territory.” With the introduction of digital technology that can track and aggregate human movement and activity in real time, user-generated maps reveal instantaneous sociological behavior, emphasized by new patterns, relationships, and realities revealed through data visualization. In Network Nations, Ben Schouten and Yuri Engelhardt propose that “Our well-developed visual processing skills – such as the ability to detect patterns, search quickly for specific visual details, or make visual comparisons – are hindered when data is presented in text, tables or databases.” They suggest that comparative exploration and abstraction of data is more easily understood when given a ‘visual structure’ composed of conceptually significant shapes, colors, or spatial relationships.

While the history of cartography and nature of changing mapping tools are widely researched, this project aimed to explore the use of new digital cartography and social media as an educational tool for teaching beginning design students how to represent their collective experience in the urban landscape. Social media comprises technologies which allow individuals and groups to create and share information and ideas using digital technology devices such as WiFi and GPS on a computer or smartphone. As part of a first semester core course at the Boston Architectural College (BAC), new design students participated in an experiment using social media as a mapping tool during a field-based module called CityLab Intensive.

Of importance is the notion that social media is a catalyst for popularizing user-generated content particularly because it promotes equal access to the exchange of ideas upon usage of these devices. With 83% of American adults between ages 18 and 29 owning a smartphone in 2014 over 92% of householders between ages 15 and 44 with a computer in 2013, both of these devices may soon be ubiquitous. One might consider them more common than the aforementioned cartographic tools — and perhaps even a pencil in the 21st century design school.

The CityLab Intensive experiment sought to introduce students to methods of mapping their urban explorations using the digital armature of the smartphone, in conjunction with more traditional pencil sketching assignments. Faculty had observed that those students who entered the program with few digital skills eventually gained these skills as a result of digital media classes during the foundation year, yet continued to exhibit lack of confidence in applying this knowledge. The experiment encouraged mapping as more than mere documentation, but rather, an introduction to the process of site analysis, data collection, and design narrative using a digital device with which students were familiar.

During CityLab Intensive, all newly enrolled students at the Boston Architectural College begin their design education with a four-day immersive experience in Boston’s urban landscape. In this context, ‘the field’ is understood as the territory of the City and its application as ‘the lab’ or classroom for introducing multidisciplinary design inquiry, discovery, and collaboration. Student teams are led by teacher/design practitioners who conduct a series of hands-on and reflective activities centered on developing a critical reading of urban space at a range of scales — from the design of a park bench to the regional expanse of a public transit network. The course situated the City as a foundational tool for staging the conceptual framework of design education and communication.

As a primer to concurrent design education at the BAC and full-time work in the design industry, CityLab Intensive used concepts of mapping — point, line, polygon, and orthographic drawings — that highlight set ‘design lenses’ or topics including human comfort, mobility, open space, built form, and culture. The course sought to acknowledge that even digitized maps represent a curated reality reliant upon a set of affected human assumptions or scripts. A primary objective of the course was to allow students to embrace discovery and analysis using familiar digital media, while reminding them that the process of mapping, like design thinking, can be equal parts subjective and objective.
3 OVERVIEW AND GOALS OF THE PROJECT

Using social media as a tool for visualizing collaboration, emergent design intelligence, and human experience of urban space, the hands-on project encompassed several major goals. The project included two pieces, a student assignment and a faculty research project. The larger goal of the faculty research project was to test the potential of social media for mapping urban spaces. The student assignment was focused on having students familiarize themselves with mapping and analysis concepts, with the goal of having students use commonly-found digital tools which did not require a high level of training and expertise.

The first and primary goal of the project was to familiarize students with concepts of data mapping and analysis. CityLab students are a diverse group, including both graduate and undergraduate students, and four degree programs including architecture, interior architecture, landscape architecture, and design studies. The faculty involved in the development of this project wanted to introduce the research and application of created data as a common element across disciplines. Additionally, their aim was to introduce mapping and data analysis as products which have the potential to inform spatial design at a range of scales and hierarchies.

The next project goal was to demonstrate that large-scale information about a site's context has value when juxtaposed with smaller human-centric scales of observation and analysis. During the four days that students spend in CityLab, they traverse the city in groups drawing, sketching, and photographing their experience. Much of the information that is recorded is subjective observation; students are learning to critically read the city with fresh eyes and to observe otherwise inconspicuous details about patterns of use and activity within the city's buildings, open spaces, and infrastructure. Each recorded observation, each sketch is a conscious decision to capture notable information and reflect on it in the moment. Part of this experimental exercise was to request that students also contribute more uniform or possibly more objective data -- like time of day, altitude, or location -- to be analyzed at the end of their trip. The experiment proposed that students would be able to extract meaningful information simply from the visual patterns established from the data itself; wherein, to create new or otherwise unseen realities. This realization was intended to fundamentally introduce students to the validity and purpose of capturing, gathering, and representing spatial data as constructed or uncovered narrative.

An important component of the project was allowing all students to become comfortable with digital workflows from the first day of the semester. In past courses, faculty observed that students entering the program with few digital skills eventually gained them as a result of subsequent digital media classes, yet they continued to exhibit reluctance in applying their knowledge of digital media to their design process. Through participation in this assignment, one goal was that faculty could introduce the concept of digital tools as essential, meaningful, and accessible. One desired outcome was that students would feel comfortable re-using the digital mapping workflow they had learned through this assignment. To help with this, significant time was dedicated to thoroughly documenting the step-by-step process for capturing, downloading, mapping, and outputting the data so that students could apply this exact workflow to future projects throughout their design education.

Of the many intended outcomes of the experiment, the first and most primary was that the students would successfully navigate the many steps of the digital workflow and create a successful final product. CityLab students were new to design school having just entered the program, and faculty knew from prior experience that students entered the program with a range of digital skills from novice to expert. For this reason, it could not be assumed that every group would be able to complete all of the steps of the assignment.

Beyond the primary intended outcome of completing the work, there were several secondary targeted accomplishments of the experiment. One of these targets was for students to embrace data-driven visualization workflows and recognize their value in the design process. Furthermore, as part of this intended outcome it was hoped that the end result would facilitate students’ awareness of large-scale patterns of human movement, particularly in dense urban areas. In comparison with a single site visit made by one person, the aggregation of many students’ visits over a length of time was hoped to yield more complex and revealing information about the students’ activity. A single site visit captures a single moment in time, and largely reflects the observational patterns of the visitor. A single site visit may also be shaped by unrelated elements such as weather, month, day, time of day, other events happening in the city, etc. While a larger data set generated by multiple contributors still reflects these individual
patterns to a degree, recurring patterns of observation, use, movement, and hierarchy should emerge. By using visualization as a tool to show a physical location where an individual student made a decision to stop and photograph their surroundings, and by combining all photographed locations into a large map, it is possible to capture a series of these isolated incidents and present them as a whole. The faculty was hopeful that this would facilitate students’ understanding of visualization as a tool which can aid the viewer in deriving meaning from simple data. In allowing participants to view each photograph as one among many, perhaps it might be possible for the participant to comprehend, by observing the visual density of thumbnail images, which locations in the city contained something which a student felt was worth capturing.

The final goal of this experiment was to test the smartphone as an information capture tool. Some proposed strengths of the smartphone included: the ability to quickly capture, geotag, and upload data; the ability of the smartphone to use cellular network data signals to share captured information with other users in real time; and perhaps most significantly, to allow the user to act most naturally throughout the process of capturing their environment over time, in turn producing more authentic results. Because the smartphone is a device which is already used throughout daily activity by the user, it is suggested that the spontaneous information captured by the smartphone’s camera is more authentic than with another device such as a digital camera alone. It is assumed that prior to CityLab, most students had already been carrying their smartphones with them to most places, and already were using them to take photographs – and that fewer students regularly carried around digital cameras and used them every day. Because of this, the smartphone had a greater likelihood of being a familiar device which already was used frequently and most easily as part of the student’s daily routine. An additional proposed benefit of using the smartphone was that students would be able to use it in future data capture and analysis scenarios beyond the CityLab Intensive and in subsequent courses as Visual Thinking, Design Representation, or disciplinary studios.

4 RESEARCH METHODOLOGY
The framework of this research included two parts. The first part was the digital information-gathering process, where several groups of students individually documented physical areas of the city and uploaded them to social media sites as photographs and written text. The second part was the information aggregation process, which involved sorting through the entire group’s photographs and text, creating an image map indicating the location where each photograph was taken. In this specific iteration of the methodology, students spent a total of 4 days traversing the city, using their smartphones to take photographs and upload written observations. Social media apps Instagram and Twitter were used to collect these observations along with site-specific data such as location coordinates, date and time, and other location information. At the end of the 4 days, each group used a workflow which allowed them to overlay their geo-located photographs on a digital map, with each photograph appearing the physical location where it was taken. Students were given complete freedom regarding the location, time, and quantity of their photographs and were not instructed on what to photograph. However, students were given some guidance in terms of how to interact with and observe urban areas throughout the exercise, and faculty section leaders would often prompt students to notice and inspect elements, reflect on experiences, and question assumptions. While students were largely autonomous in deciding what to record, faculty did play a role in supporting and guiding the students’ process and in reminding them to actively use their smartphones as tools, in addition to their pencils. Students were not instructed when, where, or what to photograph, as a key assumption was that students would photograph more meaningful or significant elements. Within the CityLab experience, a photograph might be used to capture something visually important, but it may also be used to capture a less significant spot where a significant conversation, interview, or other exchange occurred.

Along with the visual information captured in the photograph, the students’ smartphones also recorded the date, time, and approximate location where the photograph was taken. Most smartphones are accurate within approximately 8 meters; while this does not pinpoint the exact location of the user, for the purposes of this project it establishes the approximate location to a satisfactory degree. At the end of the four days, students were instructed on how to upload and digitally organize their photographs. Students did not upload every photograph that they took; because of time constraints they only selected the photographs they judged to be the most significant. Google Drive was used to upload and host the photographs, and Picasa was used to automatically position small thumbnail images of the photographs
on top of an aerial map of Boston. The final image map was printed out on a large scale plotter for a critique, displayed alongside printouts of each selected photograph, as well as the group’s sketches, diagrams, and notes from their experience observing the city.

Rather than introduce an unfamiliar digital tool such as a handheld GPS, the students’ own smartphone was used, using the phone’s built-in settings and camera software. An assumption was that the use of a familiar tool, one that was owned by the student and used frequently, would ensure that the tool was used frequently by the student, and that the student would not greatly alter their patterns of usage. By keeping changes to the student’s phone setup minimal, this ensured that the student used it in as close as possible to their usual manner. This was essential for two reasons. First, the overarching goal was for students to remain immersed in the CityLab experience, not focused on using technology. Second, this allowed for more authentic data, since the student was not changing their regular patterns of phone usage. The digital mapping workflow relied on using established tools such as Google Drive, Picasa, and Flickr, tools which were likely familiar to students who were new to design. Advanced, more complex software such as GIS and image editing applications were avoided, since many students voiced apprehension about their ability to utilize such software without prior experience. A key challenge which faculty anticipated was striking a balance between the difficulty of the workflow and the visual quality of the final product. It was important to have students’ produce a visually compelling final product, while simultaneously keeping the workflow as simple as possible.

5 FINDINGS AND SUMMARY

At the completion of the experiment, the experiment was evaluated both on the success of the workflow as well as on the success of the visuals produced by the students. Most students were able to complete the mapping workflow successfully, although some did have significant assistance by faculty. These were largely students with little-to-no prior experience in mapping and digital image creation. Since existing web-based tools with user-friendly interfaces were used, students were not required to learn specialized software to map their images. The workflow itself fit seamlessly with the overarching goal of the CityLab Intensive, which was to facilitate students’ exploration of Boston. Since students were only required to adjust a single setting on their smartphones the first day of the experiment, once the setting was changed the smartphone collected location and time/date information without any further input from the student. At the end of the experiment, many students used the final image map as a central organizing element with which to locate and anchor their other notes, sketches, and photographs.

Figure 1. CityLab student using photograph map to geographically reference work. Photo by author
This was seen as a positive outcome, since the map allowed students to geographically locate and reference work other than what was captured on their smartphone, building a richer set of imagery with which to tell a story about their experience. Many baseline assumptions were proven correct: commonly-used digital devices can be used to collect spatial and visual data without modifying the device or using special software; early design students can successfully apply a specific digital workflow to create a map which displays information collected over a period of time; and the map which was created indicates patterns of human movement and engagement with urban spaces.

However, while the overall visual impact of the final product was sufficient to communicate the data, it did not create a more refined reading of the data through creation of visual hierarchy. Additionally, since each map represented a range of one or several persons’ data from a student team, the experiment resulted in several finalized maps but no one map which included data from all groups. Therefore, all groups’ captured images were not able to be read in aggregate, preventing larger-scale evidence from emerging. Since each map relied on the same tools and workflows, each map used the same visual language. While this allowed them to be compared side by side, it detracted from the end product since no team was able to create a distinct visual identity.

With respect to the actual workflow employed, there was concern that students would focus more on satisfying the specific steps of the workflow than on broader concepts regarding the use and value of the mapping exercise. In some student teams, this was the case. Additionally, another more unexpected issue was discovered. Since faculty did not manage or otherwise have control over the set of web-based tools used in the workflow, if any of the tools were to be removed or even slightly altered, the documented workflow instruction ceased to function. Overall, given the aforementioned conditions of the experiment, the final visual product of the mapping was less successful than the students’ active engagement in the data creation process.

In constructing this experiment, much of the emphasis was on ensuring that an accessible workflow could be given to the students for both current as well as future use. Both because of the inability to manage web tools, as well as the shift in focus towards the workflow, faculty decided to make some modifications for the next iteration of the project. The focus of the experiment has shifted away from presenting students with a specific data visualization workflow, and it has moved towards emphasizing the process of using social media to create an informative dataset for generation of more graphically sophisticated maps composed after the end of the course. Students will collectively capture, tag, and upload their images using specific hash tags or keywords in Twitter or Instagram. Instead of having each student create a single map of their own data, the faculty will be able to access these hash tags to gather and visualize all CityLab activity by members of the entire group. This is predicted to create a more meaningful final image, one which more accurately represents the behavior of the students as a whole.

Figure 2. Social media posts created by BAC CityLab students. Photo by author.
Further applications of this workflow and its results would be beneficial to understanding the potential of social media as a mapping tool. Expanding the use of this workflow to cover longer periods of time, a wider range of settings (both urban and otherwise), and broadening its use to include longer investigations such as design studio or research projects will all provide further insight into its effectiveness. Moreover, further dialogue about the use of social media for analysis of urban spaces is critical in understanding how students, faculty, and professionals might use these tools in the design process. It is clear that there is potential for using social media as a mapping tool; information can be quickly and efficiently gathered without much advance preparation, and large amounts of information generated by others already exist and are easily accessible. Yet it is not quite clear how this easily-captured information leads to next steps within analysis and design. Some questions to discuss include: Is the educational experience of seeing, recording, and mapping information the justifiable end goal of the experiment, or should students derive insight from the results? Does the information gathered through this mapping workflow provide information that can be used in the design process? Is there other information embedded in social media posts which can be analyzed, such as geometry, lighting, camera angle, or word usage? How can we generally improve and expand the use of social media as a mapping tool?

Today, the BAC’s CityLab Intensive experiment continues to test ways of introducing tools of mapping to beginning design students through use of readily accessible digital technology and user-generated data. As Paul Virilio suggested “Trajectory is identity;” new patterns, identities, and realities continue to be sought by capturing and recording human behavior through use of the smartphone as a discovery device employed throughout Boston’s urban landscape. More than simple documentation, the experiment will continue to explore the mapping process and its implications of analysis as design agency.

6 ENDNOTES

2 Raisz, Erwin, *General Cartography* (New York, 1948).
5 Holmes, Brian. *Counter Cartographies in Else/Where: Mapping New Cartographies of Networks and Territories*
6 Abrams, Janet. *Else/Where: Mapping New Cartographies of Networks and Territories*
7 Pew Internet Report
8 U.S. Census Report
9 Schank, Roger C. “What We Learn When We Learn By Doing.” (Northwestern University, 1995).
10 U.S. National Library of Medicine Community Health Maps
11 "Exit", by Diller Scofidio + Renfro, based on an idea of Paul Virilio | Fondation Cartier, 2008.

7 REFERENCES

DESIGN EDUCATION AND PEDAGOGY

Edited by Terry Clements
FACTORS IMPACTING STUDENTS’ DECISIONS TO STAY OR LEAVE THE DESIGN STUDIO: A NATIONAL STUDY

GEORGE, BENJAMIN
Utah State University, benjamin.george@usu.edu

BUSSIERE, SIMON
Ball State University, sbussiere@bsu.edu

1 ABSTRACT

It has been suggested in recent years that student studio culture has experienced significant changes, and that contemporary design students generally spend less time in studio than their predecessors. In order to preserve the value and legacy of the studio in landscape architecture education, it is important to identify what factors students consider in determining their use of the studio. To address this question, the authors conducted a survey of students at accredited North American graduate and undergraduate landscape architecture programs to identify and correlate social, spatial, pedagogical, temporal, and access factors that contribute to a student’s decision to stay or leave the academic design studio. Several important findings resulted from the survey, including the existence of different motivating factors for studio use by traditional and non-traditional students. Technology access and instructor feedback during desk critiques, along with temporal factors, such as approaching deadlines, are critical factors for being present in the studio for the majority of students. The survey results also show that student ownership of individual space in the studio and the fostering of a sense of community are highly correlated to students’ decision to stay in studio. Because the study takes a student-centric perspective, it provides instructors and administrators with the likely consequences that may arise from social, spatial, pedagogical, temporal, and accessibility factors related to planning the studio environment.

1.1 Keywords

Studio education, student studio use, design education
2  INTRODUCTION

The studio seems too often be in dire standing as an educational and creative space. According to Wouter Davids and Kim Paice, in their book *The Fall of the Studio* (2009), the studio has suffered a series of tragic blows, first becoming an easy target of critique in the mid-twentieth century, and more recently through the loss of its mythical stature and traditional prominence in design culture due to emerging technology. The design studio has been discussed widely for decades, for better or worse, as a space of creativity, learning and production. It has also been problematized by countless environmental design disciplines from art to architecture and engineering. In 1968, Robert Smithson wrote, “deliverance from the confines of the studio frees the artist to a degree from the snares of craft and the bondage of creativity” (Smithson, 1996). In 1985, Richard Serra recounted how he chose “on-the-road extended studios” – steel mills, shipyards and other large industrial spaces – as the grounds for the creation of his massive scale sculptures as early as the 1960s (Davits & Paice, 2009). Elements of the very same restrictions that Smithson and Serra felt in the studio continue to affect the quality and type of work that can be produced in the contemporary design studio.

Adding to the long history of artists and environmental designers leaving the romantic and yet constricting studio enclosure, major global shifts have been observed in higher education more broadly, from increased demands on students and teacher performance, to greater systematic efficiency (Brown, Bull, & Pendlebury, 1997; Altbach, Reisberg, & Rumbley, 2009). With economics often driving core educational decisions, teachers and school administrators are witnessing a summative learning-based education model supplanting traditional formative learning methods – a model that places a greater emphasis on outcomes over a student-centric learning process (Cohen & Kisker, 2009; Altbach, Gumport, & Berdahl, 2011). By extension, contemporary students themselves are working more remotely, and in more nuanced ways than ever before to balance work and life responsibilities. Students are reacting both positively and negatively to alternative educational environments, including the flipped classroom model, hybrid and online learning, and other venues that foster asymmetrical learning. (Hinshaw, 2014)

Despite these undercurrents of change, research in both design education, as well as general educational and learning theories, supports the concept and value of the studio model. Schön’s (1985) seminal work outlines the value of the teacher-student relationship, and this research has been supported by learning theories, such as legitimate peripheral participation, which suggest isolated student learning is problematic for both the act of learning and the act of enculturation into a field of practice (Lave & Wenger, 1991). Further restrictions arise due to rapid technological advances that provide faster delivery of refined content - as well as an enrollment shift toward larger percentages of non-traditional students with significant responsibilities outside of studio - have added to such isolation and dislocation from the studio environment. The technological advances have also enabled students to spend an increasing amount of time on site, spending greater time working with clients and users, where students can immerse themselves in the milieu of the project. And yet, while design practitioners, educators, and students may have begun to question the value of the studio, the studio model has been adopted and adapted by educational researchers through pedagogical practices such as project and problem-based learning (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palinscar, 1991; Barron, Schwartz, Vye, Petrosino, Zech, & Bransford, 1998).

Through a representative cross-section of contemporary landscape architecture students, the authors illustrate a set of existing conditions in studio that help us understand why students are choosing to stay or leave studio, particularly when they are approaching deadlines. This paper departs from an exclusively post-studio narrative to outline specific corollary data that aids ongoing critical discourse on the studio in the hopes that a long held studio culture may be restored. In the paper’s central argument, the authors discuss several observed trends and highlight specific ongoing changes, both in higher education more broadly and in the design studios of accredited landscape architecture programs. The authors conclude by suggesting some best practices to help encourage student use of the studio learning space and faculty engagement and accountability.

3  METHODS

The authors conducted focus groups with landscape architecture students from their home institutions, Ball State University (BSU) and Utah State University (USU), which identified several relevant factors impacting student use of the studio. The authors interviewed two senior and two junior landscape architecture faculty members at these institutions to help the authors determine questions for the student
focus groups. Student participants were recruited to the focus groups via email and posted flyers in the studio spaces.

Both hour-long focus groups followed a similar format. While the researchers acted as facilitators and provided the broad topic of “what factors impact a student’s decision to stay or leave the studio,” the conversation was non-structured and student-led. During the focus groups, students identified and discussed potential studio use factors, while the researchers took written notes of the conversation. The researchers strived to remain separate from the conversation, only interjecting when it was necessary for clarification or to keep the group on task. The researchers’ primary goal in the focus group was for the students to organically develop any number of factors impacting student studio attendance.

Eighteen students participated in the focus group at BSU, and twenty-three students participated in the focus group at USU. A demographic description of the focus group participants is shown in Table 1.

Table 1: Focus group demographics.

<table>
<thead>
<tr>
<th>Location</th>
<th>Total</th>
<th>Gender</th>
<th>Degree-seeking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>Ball State University</td>
<td>18</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Utah State University</td>
<td>27</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The candid responses from students during the focus groups directly informed the creation of categories and subsequent survey questions. The researchers synthesized the factors identified during the focus groups to create a list of 30 factors, divided into the six thematic categories of social, spatial, pedagogical, temporal, access, and facilities. The synthesis process was simpler than was anticipated, as students in both focus groups expressed very similar feelings about the studio environment. For instance, both groups identified problems with accessing the necessary technology, annoyance with noise and distractions in the studio, the value of social interactions to their learning, and numerous other observations. The consistency in responses from independent groups of students validated the findings of the focus groups and provided justified the decision to go forward with a formal survey.

From the information gathered in the focus groups, the survey was created and distributed online using Qualtrics. An email was sent to the department head of every accredited landscape architecture program in the United States with a link to the survey, along with a request to distribute the survey link to their students. A follow-up email was sent two weeks after the initial solicitation, and the survey was kept open for two months. The survey listed each factor (grouped together thematically), and students were asked to use a Likert-scale (1 = more likely to leave studio, 4 = no impact, 7 = more likely to stay in studio) to rank to what degree a factor encouraged or discouraged them from staying in the studio. In addition to the studio use factors, a demographic section was appended to the end of the survey.

4 RESULTS

4.1 Sample Demographics

A total of 190 surveys were completed, with responses from 21 states. Demographic data collected from the study is shown in Table 2:
Table 2. Demographics of survey respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level</th>
<th># of Respondents</th>
<th>% of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>18-21</td>
<td>54</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>22-25</td>
<td>64</td>
<td>35.6</td>
</tr>
<tr>
<td></td>
<td>26-30</td>
<td>35</td>
<td>19.4</td>
</tr>
<tr>
<td></td>
<td>31-40</td>
<td>20</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>40 &lt;</td>
<td>7</td>
<td>3.9</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>66</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>110</td>
<td>62.5</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Caucasian</td>
<td>145</td>
<td>81.9</td>
</tr>
<tr>
<td></td>
<td>Hispanic or Latino</td>
<td>9</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>Asian</td>
<td>18</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>Black or African</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>American Indian/Alaska</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Native Hawaiian/Pacific Islander</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Marital Status</td>
<td>Single</td>
<td>150</td>
<td>83.3</td>
</tr>
<tr>
<td></td>
<td>Married</td>
<td>27</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Separated</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Divorced</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Widowed</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Degree</td>
<td>BLA</td>
<td>116</td>
<td>64.4</td>
</tr>
<tr>
<td></td>
<td>MLA</td>
<td>59</td>
<td>32.8</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>5</td>
<td>2.7</td>
</tr>
</tbody>
</table>

4.2 Factors
The list of factors were ranked using the mean score of the survey responses. Based on the Likert-scale applied, factors with a mean score higher than four indicates a factor that is more likely to encourage a student to stay in the studio, while a factor with a mean score lower than four indicates a factor that is more likely to encourage a student to leave the studio. The complete rankings of factors are shown in Table 3.
Table 3. Ranking of studio attendance factors

<table>
<thead>
<tr>
<th>Mean</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.39</td>
<td>Having access to necessary technology</td>
</tr>
<tr>
<td>6.37</td>
<td>If I have my own private desk in the studio</td>
</tr>
<tr>
<td>6.25</td>
<td>If a project is due soon</td>
</tr>
<tr>
<td>6.14</td>
<td>If I feel a sense of community in the studio</td>
</tr>
<tr>
<td>5.89</td>
<td>Receiving critiques from professors</td>
</tr>
<tr>
<td>5.77</td>
<td>Teachers have informal critiques with groups of students</td>
</tr>
<tr>
<td>5.73</td>
<td>If the studio is clean and well-maintained</td>
</tr>
<tr>
<td>5.72</td>
<td>If there are many spaces that I can collaborate with other students in the studio</td>
</tr>
<tr>
<td>5.70</td>
<td>If my friends stay in studio</td>
</tr>
<tr>
<td>5.56</td>
<td>Teachers promote self discovery in the design process</td>
</tr>
<tr>
<td>5.40</td>
<td>The opportunity to socialize with other students</td>
</tr>
<tr>
<td>5.49</td>
<td>If the studio layout is open (can see and interact with other students easily)</td>
</tr>
<tr>
<td>5.46</td>
<td>If there is a lounge space in or near the studio</td>
</tr>
<tr>
<td>5.42</td>
<td>If furnishings in the studio are new</td>
</tr>
<tr>
<td>5.05</td>
<td>Lectures are given in the studio prior to work time</td>
</tr>
<tr>
<td>4.98</td>
<td>If the professor moves around the studio regularly</td>
</tr>
<tr>
<td>4.82</td>
<td>Having a sign up list for critiques</td>
</tr>
<tr>
<td>4.69</td>
<td>If there is nearby access to distraction facilities (food, lounges, game room, etc.)</td>
</tr>
<tr>
<td>4.67</td>
<td>If studio classes are in the morning</td>
</tr>
<tr>
<td>4.41</td>
<td>Teachers regularly alter the routine that happens in studio</td>
</tr>
<tr>
<td>4.36</td>
<td>If the studio environment is sterile</td>
</tr>
<tr>
<td>4.34</td>
<td>If my work can be done on a computer</td>
</tr>
<tr>
<td>4.00</td>
<td>NO IMPACT - Neither stay nor leave</td>
</tr>
<tr>
<td>3.80</td>
<td>If the professor is not in the studio</td>
</tr>
<tr>
<td>3.47</td>
<td>If studio classes are in the evening</td>
</tr>
<tr>
<td>3.26</td>
<td>If the studio layout is closed (students work in cubicles or shielded work stations)</td>
</tr>
<tr>
<td>2.98</td>
<td>If it is difficult to find parking or transportation to the studio</td>
</tr>
<tr>
<td>2.85</td>
<td>Teachers present long lectures</td>
</tr>
<tr>
<td>2.84</td>
<td>If the studio is crowded</td>
</tr>
<tr>
<td>2.72</td>
<td>Desire to spend time with family</td>
</tr>
</tbody>
</table>

5 ANALYSIS

5.1 Spatial

Four spatial factors have been identified as playing a significant role in a student’s decision to stay in the studio. “If I have my own private desk in the studio” (6.37) was recorded as one of the most important factors in the study, revealing that students continue to have significant interest in maintaining distinct work spaces. Individual desks offer students the ability to develop ownership and accountability over their learning and work experience. In terms of collaborative and student-to-student learning, “If there are many spaces that I can collaborate with other students in the studio” (5.72) was identified as another major factor influencing students to stay. Students preferred an open studio layout that allowed for and encouraged communication between studio members (5.48) and preferred a lounge area near the studio (5.46). These factors demonstrate that contemporary design students are interested in a democratized space. There was a significant correlation between student age and preference for the open studio layout ($r = -0.229$, $p < 0.001$), as well as those students who commute shorter distances by bicycle or skateboard. These students appear less willing to stay in a “top-down” studio environment – one in which they feel less control in their ability to shape the space. Rather, they have an interest in claiming territory in the studio space. This has far reaching implications in the potential for both teacher-learner and learner-learner modes of interaction.
Two distinct factors reveal that students will tend to leave the studio strictly due to spatial constraints: “If the studio layout is closed (students work in cubicles or shielded work stations)” (3.26), and “If the studio is crowded” (2.84). These may indicate a need to respond with more options for open studio layouts, as well as looking for ways to make the space feel less crowded, perhaps through optimum density levels for studio spaces during different phases of the design process. Desk space should be abundant, and various breakout spaces should be provided, from small kitchens and eating spaces, to lounges or more comfortable areas for rest or informal social gathering.

5.2 Access

“Having access to necessary technology” (6.39) was identified as the highest-ranking factor in the entire study. Students' responses have demonstrated a desire for consistent, safe, and flexible access to technology at nearly all stages of the design process. This undergirds a paradigm shift that has been taking place over the last few decades in the classroom -- one that is moving away from a “sage on the stage,” or professor-centric model, to one that embodies a student-centered focus (Van Dusen, 1997; Elton, 2008). Technology, in many facets of education, is allowing students to take charge of their education, in terms of not only knowledge transfer, but also workflow, communications, and production -- key factors in knowledge synthesis. The principal effort of this ongoing change has been consistent attempts to create an ideal learning environment for students and to see the transitional role of the professor from lecturer to facilitator. Professors are utilizing the learning environment in new ways by capitalizing on new technologies and allowing for enhanced access to student choices (Van Dusen, 1997; Prensky, 2001). Survey participants indicated that, “If the professor moves around the studio regularly” (4.98), “If my work can be done on a computer” (4.34), and “If the professor is not in the studio” (3.80), as having little or no significant impact. Conversely, “If it is difficult to find parking or transportation to the studio” (2.98) was revealed to substantially contribute to a student's decision to leave studio.

Expanding student accessibility to, and training in, the most current technologies, as well as developing students’ critical professional development habits and techniques, will empower students to have greater degrees of control and intellectual engagement with educational and professional technologies (Van Dusen, 1997). Simply adding more computers to the studio or a lab does not always make them accessible; educators may instead look deeper to find ways to invite students to better collaborate through technology by working in more heterogeneous groups and on more problem-solving-based projects that elicit higher-order thinking skills and educational processes.

5.3 Facilities

Despite so many recent technological shifts in higher education, the traditional classroom (or studio) continues to serve as the locus for much of what a student will learn. In both traditional and contemporary college classrooms, the dominant mode of teacher-student interaction continues to be the lecture, or lecture and discussion (Van Dusen, 1997). However, it is clear that new forms of asymmetric learning and hybridized classrooms are changing key aspects of this interaction as well as the shape and structure of the learning environment itself (Hinshaw, 2014). This shift is changing both the aesthetics and the structure of the studio environment, as well as the ways in which students are learning content and synthesizing knowledge. According to our survey results, students strongly preferred a “clean and well-maintained” studio (5.73) with new furnishings (5.42). These results help explain ongoing national trends to update studio and classroom furniture. However, new investment in furniture should carefully consider ways to foster pedagogical strategies that include peer-teaching, cooperative learning, and opportunities for motivational feedback into the studio or classroom ecology. “If the studio environment is sterile” (4.36) had little or no impact on student willingness to stay, indicating that many students perceive the studio to be a creative, haptic, workspace filled with the products of learning and testing, including: failed or iterative studies, a concatenation of coffee pots and sofas, and tack spaces filled with precedent images and design images under review. A sterile space is often produced when new furnishings are introduced. However, sterility can be mitigated in new studio spaces through the inclusion of informal gathering spaces intended for small groups, and with the combination of both semi-permanent and temporary (or moveable) pin-up areas. Community desk spaces, a variety of lighting conditions, and outdoor views could also positively impact students’ willingness to stay in studio.
5.4 Social

Three key social factors influenced students to remain in the studio. “If I feel a sense of community in the studio” was the highest-rated social factor, and fourth overall (6.14). This is unsurprising, as learning theory has suggested that students who participate in a strong social community learn quicker and perform better (Lave & Wenger, 1991; Hutchins, 1995). That this factor was more highly rated than “If my friends stay in the studio” (5.70) and “The opportunity to socialize with other students” (5.49) further suggests that students inherently value a learning community, as opposed to simply valuing social interactions with their more intimate peers.

A desire for this social interaction is not altogether lacking in students, as the most likely factor for a student to leave the studio was a desire to spend time with family (2.72). Unsurprisingly, there was a strong negative correlation between this factor and marital status, with married students responding significantly lower ($r = -.232, p = .001$). However, even single students rated this factor as most likely to leave (2.84).

Based on these results, faculty and departments should encourage students to build a strong learning community in the studio. Research on apprenticeship and community learning theories would suggest that such a community is more likely to develop when students are given the opportunity to frequently observe and interact with more advanced peers, as well as the opportunity to mentor and instruct less advanced peers (Lave & Wenger, 1991; Hutchins, 1995; Gee, 2004). This would suggest that certain cohorts of students will more likely develop a sense of community based on the makeup of skills and competencies of the individual students. The more homogenous a cohort is in skills and competencies, the less likely that cohort is to develop a learning community, as they offer less in the way of reciprocal mentoring opportunities. Conversely, more heterogeneous cohorts will have more opportunities to participate in reciprocal mentoring, and are therefore more likely to see value and invest in the development of a learning community within the studio. With more homogenous cohorts, a vigorous learning environment might still be created through a combination of careful studio arrangement and planned collaboration in course designs. Departments could also explore the use of vertically-integrated studios to guarantee that a broad spectrum of skills and competencies are represented in studio spaces.

How to mitigate for a desire to spend time with family is a difficult proposition. A viable strategy may be coordination between courses to ensure that students have ebbs and flows in their workload to provide periods where they can spend more time with family (and close friends). Providing these slower workload periods as social releases during the course of the semester may encourage students to spend more time in the studio during critical design phases, knowing that they will then have a period where they can spend more time away from the studio without negatively impacting their design work. Additionally, encouraging students to live as close to the studio as possible can also help to mitigate for this, as there is a strong correlation between commute length, marriage status, and the desire to spend time with family, where the closer a student lives to the studio, the less impact this factor has on their decision to stay or leave the studio. However, it is likely that this factor will remain stubbornly difficult to mitigate for by departments.

5.5 Pedagogical

Two of the top six factors that encourage a student to stay in the studio are pedagogical factors, and both are related to critiques. These high rankings for “Receiving [one-on-one] critiques from professors” (5.89) and “Teachers have informal critiques with groups of students” (5.77) both illustrate the value that students place on receiving critical guidance from instructors. These were more important than the traditional pedagogical factors related to teaching style and method: “Teachers promote self-discovery” (5.56) and “Teachers regularly alter the routine that happens in studio” (4.41). This supports Schon’s (1985) theory of studio learning, wherein students view the instructor as a valued mentor to help decipher and learn the design process, as well Lave and Wenger’s (1991) theorization of the master-apprentice relationship wherein the apprentice greatly benefits socially and intellectually by frequent instruction from the master. Therefore, of all the pedagogical decisions an instructor makes, prioritizing critiques and interactions with students is most critical. Because students rated the impact of individual critiques and group critiques closely together, faculty may find it more time effective to utilize group critiques to engage with more students more often than is possible via individual critiques.
Teachers presenting long lectures negatively influenced student studio attendance (2.85). This is likely related to learner fatigue and course schedules. While valuable for sharing knowledge, in some ways lectures run counter to the design process. While the design process is concerned with the synthesis of information and convergence upon a design solution, lectures are a method of information conveyance that may not always promote synthesis, or the convergence of ideas, as the formal structure of a lecture does not encourage these communication goals (Dennis & Valacich, 1999). In contrast to long lectures, teachers could promote self-discovery -- a learning process that facilitates synthesis and convergence activities -- a factor that was highly rated as encouraging a student to stay in the studio (5.56). Rather than providing information in a long lecture format, instructors might provide information to students in smaller packets in the studio, where students are able to immediately evaluate and apply the information in their design activities.

5.6 Temporal

Unsurprisingly, the temporal factor of a project being due soon was highly rated as encouraging a student to stay in the studio (6.25). In the period immediately before a project is due, the student is more likely to be engaged in a high level of activity and will benefit more from access to their studio work space, the knowledge of their peers, and university facilities. There was a negative correlation between this factor and age \( (r = -0.237, p = <.001) \), with older students increasingly less likely to rate this factor highly. While the median of this factor for students aged 18-21 was 6.50, for students aged 31-40 it was only 5.60, and for students aged 40 or older, it was 4.00. This may be a generational divide, or this may also be partially explained by social and technological factors. Older students are both considerably more likely to be married and to have a desktop computer. It is possible that these factors might combine to encourage older students to spend the long work hours before a project is due at home, where they are more likely to have access to the necessary technology and are able to more easily spend time with family.

While holding class in the morning had little impact on studio attendance (4.67), holding studio classes in the evening had a negative impact on a student staying in the studio (3.47). Most likely this is related to fatigue, where a student will have already spent several hours in other classes on campus, and to competing responsibilities such as work, family responsibilities, or other extracurricular activities. When possible, departments should schedule their studios earlier in the day to encourage higher studio attendance.

5.7 Key Correlations

During the analysis of the results, a significant correlation was discovered related to age and studio layout. As indicated by both social and spatial factors, a life/work balance is more difficult for non-traditional or older students, (ages 26+) whose responses indicate that they face a generally longer commute, combined with greater responsibilities at home, thus pointing to a greater desire to focus and work independently when in studio -- both in terms of their spatial and social interactions, and their interactions with facilities and technology. The study indicates that students over the age of 26 are more interested in getting work done while in studio, then returning home, rather than socializing and forming bonds as is the case with younger students. More traditional students (18-26 year olds) tended to favor an open studio environment, or one in which they feel they can adapt through some degree of individualized modification. This corresponds to numerous benefits of integrated and adaptable environments that promote self-discovery over prescription (Hinshaw, 2014).

In analyzing the data from the survey, an important interaction was found between marital status and commute time. Married students tend to commute to studio by driving from a longer distance, and once there, as the study's results show, prefer to work in a closed studio environment. These results again suggest that these students seek privacy, peace, and quiet in their preferred studio layout.

6 CONCLUSION

When the median scores for the factors are graphed, a natural break occurs in the distribution after both the fourth and ninth factors. Based on this, it was decided to consider the top nine factors as those most critical for departments to consider in order to encourage studio attendance. Thematically
categorizing the nine most significant factors illuminates the diverse concerns impacting studio attendance as all six categories are represented amongst the critical factors (see table 4).

### Table 4. The critical barriers and their associated category

<table>
<thead>
<tr>
<th>Mean</th>
<th>Factor</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.39</td>
<td>Having access to necessary technology</td>
<td>Access</td>
</tr>
<tr>
<td>6.37</td>
<td>If I have my own private desk in the studio</td>
<td>Spatial</td>
</tr>
<tr>
<td>6.25</td>
<td>If a project is due soon</td>
<td>Temporal</td>
</tr>
<tr>
<td>6.14</td>
<td>If I feel a sense of community in the studio</td>
<td>Social</td>
</tr>
<tr>
<td>5.89</td>
<td>Receiving critiques from professors</td>
<td>Pedagogical</td>
</tr>
<tr>
<td>5.77</td>
<td>Teachers have informal critiques with groups of students</td>
<td>Pedagogical</td>
</tr>
<tr>
<td>5.73</td>
<td>If the studio is clean and well-maintained</td>
<td>Facilities</td>
</tr>
<tr>
<td>5.72</td>
<td>If there are many spaces that I can collaborate with other students in the studio</td>
<td>Spatial</td>
</tr>
<tr>
<td>5.70</td>
<td>If my friends stay in studio</td>
<td>Social</td>
</tr>
</tbody>
</table>

### 6.1 How can educators respond?

The study finds that there is no single factor that is keeping students from participating in studio. Educators cannot employ a singular approach, rather the solutions should be viewed strategically and as multi-faceted and diverse as the students we are serving. While useful and in many ways immediate, a studio space redesign alone is only one step in the effort to increase the identified problems surrounding the waning of contemporary studio attendance. As designers and design educators, we may tend to think that we can design our way out of things, but we simply can not in spatial terms alone. One thing is clear from the study -- that contemporary design students are interested in a democratized, adaptable, and tailored space. A one-size-fits-all model is outdated and harmful to studio function and attendance. The study results demonstrate that today's design students are less willing to participate in a top-down studio environment – one in which they feel less control.

Educators too easily leap to the notion that students are to be blamed for not showing up to studio, for not appearing engaged, or for not being more proactive when it comes to the interactive qualities of their educational experience (American Institute of Architecture Students, 2004; Vowels, Low, & Doron, 2012). We may trace this blame back to generational comparisons, and often misremember our own experience as one in contrast to the ways our current students interact and engage in studio. Through the critical factors highlighted in this paper, we instead see that students find many parts of the traditional and the contemporary (or virtual) studio engaging, as much as previous generations of design students, and the study shows that students admire and appreciate many long-held aspects of studio culture more broadly. Our students expect a balance between a place to get work done and a place to socialize, and they expect a more active role in shaping their own unique sense of ownership over their studio experience.

### 6.2 Suggestions for implementation to improve studio attendance

The study fin The following list collects key recommendations from the study. Some items being put forward from the results of the study are “top-down” or educator-driven, including revisiting curriculum goals and reinterpreting modes of knowledge or content delivery, while other solutions suggested come from the understanding that in many instances, students will choose to stay in studio because of their own agency and through what might be called “bottom-up” interfaces, including informal gathering, peer mentoring, and other modes of collaborative learner-learner engagement. This is not meant to represent an exhaustive list of best-practices, but rather the beginning of an effort to isolate best-practices to help students remain active and engaged in studio-based learning.

1. Of all the pedagogical decisions an instructor may make, prioritizing critiques and interactions with students is most critical. Because students rated individual critiques and group critiques similarly, faculty could more regularly rely on group critiques to increase regular mentoring contact with students.
2. Faculty coordination between courses provide for ebbs and flows in student’s workload across the course of the semester and provide opportunities for students to socially recharge in their private social life.

3. When possible, departments should schedule their studios earlier in the day.

4. Faculty should focus on providing information to students in a shorter, more directed, and just in time format, rather than providing information through a lengthy lecture.

5. Heterogeneity should be encouraged in studio cohorts through the use of intra-class and cross-class collaborations. Vertical studios may be a better option for encouraging and maintaining heterogeneity within studios.

6. Furniture upgrades are tangible and can make an immediate difference in the appearance of the studio, and also in the structure of student-student and teacher-student exchanges and interactions -- with significant overlap among the social factors in this regard. However, any new furniture should foster important studio pedagogical impacts, such as peer mentoring, cooperative learning and motivational feedback.

7. Studio spaces should not be sterile. Sterility can be mitigated through the inclusion of informal gathering spaces intended for small groups, and with the combination of both semi-permanent and temporary (or moveable) pin-up areas. Extended individual desk space is highly desirable and encourages students to take ownership of their own spaces, thereby adding a greater level of life to the space.

8. Students positively respond to open studio layouts with optimum density levels and built-in flexibility for transitioning the space through key phases of the design process. Personal desk space should be abundant, community desk space should be available, and various breakout spaces should be provided, from small kitchens and eating spaces, to lounges or more comfortable areas for rest or informal social gathering.

6.3 Future Research

This study raised several questions that need additional research. How can departments balance the competing preferences of traditional and non-traditional students in creating studio spaces so that the learning environment does not disadvantage one group of students? Based on the critical factors identified, what would an ideal studio space look like, and how might it function? Similarly, how might accepted studio pedagogy change to better encourage student participation in the studio?

7 REFERENCES


A CASE STUDY COMPARING CHINESE AND AMERICAN INTRODUCTORY DESIGN STUDIO PEDAGOGY

SUN, JING
School of Architecture & Urban Planning, Huazhong University of Science & Technology, Wuhan, China
sunjing_jj@163.com

LIU, JUANJUAN
School of Geographic and Environmental Sciences, Guizhou Normal University, Guiyang, Guizhou Province, China liujuanj@hotmail.com

ROBERTSON, IAIN M.
University of Washington, Seattle, WA iainmr@uw.edu

1 ABSTRACT
This paper compares Chinese and American introductory landscape architecture studios at Huazhong University of Science & Technology, China and the University of Washington, USA. The authors, two Chinese and one American, co-taught studios as visiting scholars at these institutions over a three-year period. We highlight the influences of physical environments and socio-cultural contexts on studio pedagogy in each country and compare and contrast the curricula, pedagogical methods and learning objectives of introductory design studios in these two institutions. Student work from Chinese and American studios is used to illustrate the main conclusions of the study and in-class student reflections and reflections of Chinese students two years after completing a co-taught introductory studio provided insight into the motives, attitudes of mind, and practices of Chinese students. Large increases in the numbers of Chinese graduate and undergraduate students attending American universities make it increasingly important to understand the differing pedagogical practices and goals of American and Chinese institutions and how these are manifested in teaching methods, styles and curricula. The paper draws general conclusions about the similarities and differences between Chinese and American first year design studio pedagogy.

1.1 Keywords
Chinese and American design studio pedagogy, design studio curricula & assessment.
2 INTRODUCTION

This paper describes the experiences of three design faculty, two Chinese and one American, who co-taught and participated in introductory landscape architecture studio courses at Huazhong University of Science and Technology (HUST) and the University of Washington (UW) over a three-year period. Extensive involvement in each other's classes and long discussions of design pedagogy gave us deep insights into the similarities and differences between the curricula, pedagogical methods and learning objectives of Chinese and American introductory design studios. Co-teaching studios also provided insight into the motives, attitudes of mind, and practices of Chinese and American students. Specifically, Sun Jing and Liu Juanjuan, faculty from HUST were visiting scholars at UW during academic years 2014-15 and 2010-11 respectively, and Iain Robertson, a UW faculty member, co-taught two three-month long classes at HUST while on sabbatical in 2012-13. Our understanding of introductory design studios draws on the work of Tammy Tasker, Ph.D. whose dissertation examined teaching methods and goals used in UW introductory landscape architecture studios.

Introductory studios are a crucial step in design students' education as they not only introduce design skills, theories and practices which are new to students but significantly they employ methods of instruction that are often very different from those that students are familiar with from other classes. In addition, design studios have a radical goal of turning students into "designers", i.e. they introduce new attitudes of mind, ways of observing, ways of living in the world, and ways of being. (Tasker, 2011)

We begin by comparing the institutional and campus contexts of the two programs and how these affect studio teaching and briefly sketch their socio-cultural, historic and environmental contexts to suggest how these larger societal contexts influence studio pedagogy, curricula, faculty and students. We then describe and compare some of the characteristic practices in these studios, recognizing that the programs are constantly evolving in response to changing internal and external circumstances, opportunities and needs. We use students' work to illustrate these larger points and end with general conclusions about the programs.

The sources of information for this paper come from the experiences of three visiting scholars/faculty co-teaching and observing introductory design studios in each other's country; from lengthy discussions among us before, during and after classes; from the work of students in these studios (typically 28-30 students/studio); and from HUST student reflections made during the 2012-13 course at HUST and two years later.

3 CONTEXT

HUST, one of China's top 10 technical universities, is located in Wuhan, an industrial city with a population of 11 million, on the Yangtze River in the center of eastern China. UW is a similarly sized university, located in Seattle, a city of 650,000, in the Pacific Northwest of the USA. Both universities are large research institutions with well-regarded landscape architecture programs located in units with allied design disciplines. An imposing statue of Mao Zedong greets arrivals at HUST and an equally magisterial statue of George Washington looks westward from the entrance to the UW campus.
Compared with Seattle, the scale of Wuhan is, in every respect, vast. HUST’s main entrances face onto a large and busy road with an enormous shopping mall close by. In comparison, the adjacent shopping street to UW, “The Ave.”, is a narrow street with small two to four story buildings and store-fronts along its
length. Without hyperbole, the entire commercial extent of UW's "University District" could be lost in the streets and circle of HUST's shopping mall (Figures 1 and 2).

Both campuses are extensive and contain many open spaces that may be used for teaching, (i.e. they provide opportunities for observation and study and sources for design ideas and inspiration), although the UW campus is more varied in the qualities and characters of spaces than the gridded HUST campus with uniform Platanus street trees throughout and blocks of monoculture tree plantations.

UW's campus and adjacent urban environments are more immediately and conveniently accessible and provide more diverse opportunities for use as outdoor learning environments than do HUST's campus and surroundings. As a result UW studios tend to use more parts of their campus for studio project sites, and make more frequent visits to campus and urban locations for study, than is common at HUST.

Despite unprecedented development and growth in recent decades, China still does not enjoy the depth and breadth of wealth that is taken for granted in the USA. Thus space, furnishings and technical facilities available for UW studios are more extensive and abundant than those at HUST. Specifically, UW introductory studios provide each student with a dedicated desk for the entire year and easy access to computing facilities in several labs, while HUST studios take place in classrooms with small desks that are available to students only during class time. UW studios meet for 12 contact hours per week, over three days in 11-week quarters. HUST studios meet for 8 hours per week, over two days in 15-week semesters. UW's longer and more frequent meeting times allow for a wider range of activities during any single studio session although its shorter terms limit the length of design projects. On a daily basis Chinese faculty and students successfully surmount, without complaint, obstacles that Americans would find intolerable and unacceptable impediments.

4 STUDENTS

Students in HUST and UW studios are dramatically different. HUST students are recent high school graduates and are very similar in age; although they come from many parts of the vast and enormously varied country of China and may exhibit some ethnic diversity, they are all Chinese. It would be unusual to walk into a contemporary American university classroom and not encounter enormous racial diversity and varied countries of origin. UW design studios are typical in this respect, their students exhibiting diversity of race, country of origin and social background, not to mention diverse economic and marital status. The UW introductory studio we co-taught comprised graduate and undergraduate students thus exhibiting a much wider age range (typically 20s and 30s but not infrequently students in their 40s and 50s) than the uniformly youthful Chinese students of the HUST studios. As a result the enormous variety and depth of experience that exists in UW studio populations--and that can be drawn upon to enrich understanding and perspectives on design--is lacking in HUST studios.

What HUST students lack in diversity of experience they make up for in the intensity of effort expended to get admission to the university and program. Harvard University's 6% offer rate to undergraduates in the "class of 2018" may be taken as a measure of how difficult it is to gain admission to one of America's most exclusive schools. This figure pales in comparison with the intensity of the competition to gain access to a top Chinese school such as HUST.

Students taking the national gao kao exam in China endure years of intense study throughout high school. Those who succeed in gaining a place at HUST are among the best students in a country with a population of over 1.3 billion. These facts are significant because the background, diversity of life and education experience, passion and intelligence, work ethic, etc. of the students in a design studio materially affect the success of the class, what is learned, how it is learned, and how deeply it is learned.

Chinese students have endured competition that is more fierce, unrelenting and competitive than American students have experienced and know that the stakes for failure are higher. Having gained admission to university, however, Chinese students may experience fewer financial concerns than do many American students who incur debt to pay for ever-rising tuition and living expenses, adding economic tension that may adversely affect their education. Similar economic concerns may be experienced by Chinese students studying in America.

Teaching studios with students of similar backgrounds is very different from studios in which students differ in age, education experience, life histories, race, language, nationality, etc. What the former gain in cohesion, and mutual understanding, they lose in diversity of viewpoints, thus education
experiences differ. Although this will likely change in the future, Chinese students are less widely-traveled than their American counterparts further reducing the variety of life experiences that are brought to the studio and into design work.

The commonality of Chinese students' backgrounds and the intensity of competition for admission to university leads to a greater desire to stand out from the crowd and to do something unique or different with their designs. As a result Chinese students' design proposals are often radical and fanciful in ways rarely found in American students' work. The balance between competition and cooperation, always an important consideration in studio pedagogy, may play out differently in China and America and also among students from different countries in American studios.

5 WORLD-VIEWS AND DIVERSITY OF EXPERIENCE

Before we discuss the two programs it is important to place them in their larger socio-cultural and historic contexts as these have profound influences on institutions, programs, students and faculty and affect attitudes toward questions of how?, why? and what? in design. It would not be unreasonable to assert that Chinese and American students live in, and are therefore the products of, radically different worlds and that these influences affect all aspects of their lives including their performance in design studios.

Americans' self-image of their country is of a fast-paced, flexible society at the cutting edge of technological and cultural development. However, in comparison with the monumental, not to say revolutionary, changes that China has experienced since Deng Xiaoping's economic reforms began 1978 (i.e. throughout the lifespans of students in our programs) change in America has been slow and incremental. Relative to China's turbulent 20th century history, the evolution of America has been steady. The pace, scale and depth of change to China's society and the transformation of its urban and rural environments throughout the 20th century have been monumental. Chinese students have grown up in a period of unprecedented economic development and change whose scope is literally unparalleled in human history. By contrast, American students have grown up in relative security and comfort in one of history's wealthiest civilizations. What is normal to each group is fantastical to the other. Quite naturally, each group regards the conditions in which they live as "normal" and bring to design programs attitudes of mind and world-views shaped by, and developed in, these conditions. Cultural backgrounds inevitably and fundamentally shape students' world-views and influence how they receive their education in general and specifically how they respond to studio design exercises.

Although only superficially sketched here, this point has profound implications for how design is taught in each country. For example, the prolonged construction boom in China (whether "real" or a "bubble" need not concern us here) has resulted in enormous amounts of work and huge demand for design program graduates and for the development of new programs throughout China. (International design firms have also seen this boom as a huge and lucrative opportunity for work.) What this means for Chinese students is that there is a huge demand for them on graduation and they must be able to "hit the ground drawing" and expect to work rapidly for long hours. The USA has experienced recent construction booms, too, notably in Seattle, but the scale and transformative effects of even the most ambitious of these are modest in comparison with what has happened, and continues to happen, throughout China. Boston's "big dig" is but a prod compared with the transformation of city like Chongqing. HUST's urban doorstep provides a potent example of the results of China's economic boom. What was farmland two or three decades ago is now an urban environment with mid- and high rise buildings extending as far as the eye can see through the polluted air. Immediately adjacent to the HUST campus is a huge traffic circle containing a newly-opened subway line and surrounded by high rise offices, hotels and a shopping mall that boasts a "Spanish Street" and a replica of Florence's Il Duomo, none of which is more than 10 years old. It is hardly surprising that students growing up in such contexts may conceive of their job as designers as one of proposing designs of monumental scale and that it is not just permissible but obligatory to copy examples of famous designs from around the world.

Chinese students, products of a mass society changing at break-neck speed, must differentiate themselves to be visible in the crowd and to gain admission to prestigious schools. Not surprisingly, the attitudes of mind that ensure success in this competition carry over into, and color, their design studio work. American students familiar with a more stable society have developed different perceptions of the meaning, purpose and possibilities of design and bring these perceptions and preconceptions to their
studio work. As a result, and making a very broad generalization, the work of Chinese students in UW studios often seems bold, or fantastical, to American sensibilities while the work of American students seems restrained and conventionally dull to Chinese eyes. "How could you propose these outrageous changes?" vs. "How could you be so timid in your proposals?"

6 COMPARATIVE STUDY

We discuss each of the aspects of studios found in Table 1 separately but begin with the assumption that both HUST and UW introductory studios possess the same fundamental goal: they seek to introduce students to design thinking in ways that provide a robust foundation for their subsequent studies and professional careers. We also acknowledge that introducing students to design thinking can be a confusing and frustrating experience because design processes and goals are more ambiguous and subjective than other topics students have studied throughout their education. We recognize that, while we seek to reduce the ambiguity of learning design thinking, ambiguity is, nevertheless, inherent in the kinds of problems designers address and cannot be entirely eliminated.

Table 1. Comparison of main characteristics of UW and HUST introductory design studios.

<table>
<thead>
<tr>
<th></th>
<th>UW</th>
<th>HUST (old system)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching methods</td>
<td>From experience to design</td>
<td>From abstract knowledge to design</td>
</tr>
<tr>
<td>Course structure</td>
<td>Exercises → projects</td>
<td>Skill → composition → design training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>exercise project</td>
</tr>
<tr>
<td>Use of time</td>
<td>Shorter &amp; quicker</td>
<td>Longer time</td>
</tr>
<tr>
<td></td>
<td>More efficient use of class time</td>
<td>Students spend more time on products</td>
</tr>
<tr>
<td>Relationships between people</td>
<td>More cooperation</td>
<td>More competition</td>
</tr>
<tr>
<td></td>
<td>Teamwork &amp; individual work</td>
<td>Individual work</td>
</tr>
<tr>
<td></td>
<td>Learn from each other</td>
<td>Learn from teacher</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Focus on process (thinking)</td>
<td>Focus on products</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(graphic skills)</td>
</tr>
<tr>
<td>Design process</td>
<td>Site analysis (reasonable)</td>
<td>Big ideas (sometimes seem crazy)</td>
</tr>
<tr>
<td>Learning Objectives</td>
<td>Think like designers</td>
<td>Demonstrate graphic design skills</td>
</tr>
<tr>
<td></td>
<td>Acquire basic skills</td>
<td></td>
</tr>
</tbody>
</table>

The problems all students face in introductory design studios are similar: they are learning not just a new language but a new way of looking at and understanding the world—a "designer's perspective". This is an integrative view that combines understanding of diverse perspectives—social, cultural, ecological, economic, etc.—and technical skills of design and communication. These cannot be taught all-at-once and must be approached one part at a time. Thus students in introductory design studios learn "pieces" of the puzzle of synthesizing designs but do not yet have a command of the whole picture. Not surprisingly, confusion is common until students learn to synthesize design solutions, i.e. see the whole picture, rather than just analyse problems. All introductory design studios face the same dilemma but they differ in how they try to minimize the confusion that characterizes the first steps in teaching design. For example, teaching students graphic competency—i.e. tangible skills with demonstrable outcomes of skillful drawings—may provide them with confidence as they learn to design. Focusing on learning the design process through repeated, short, simple trial and error iterations is far less tangible but may make students comfortable with using the "design process". Regardless of whether we focus on first acquiring skills, or teaching theory, or engaging in a process of learning by trial and error, building robust self-confidence and self-understanding remains an important goal for all introductory studios—even if this goal is more often implicit rather than explicitly stated.

6.1 Teaching Methods—Experience vs Theory/Precedents as Foundation

HUST and UW studios are grounded in fundamentally different assumptions: HUST students proceed from abstract knowledge to design understanding while UW students proceed from personal
experience to design understanding. HUST students are provided with design theories at the outset and are encouraged to study successful historic and contemporary designs as precedents to emulate. UW students are encouraged to observe their everyday environments and use their own experiences as sources of design ideas. HUST students are provided with ideas and exemplary examples in the belief that this will reduce the chance of them making mistakes in their initial designs. UW students are encouraged to "jump in", with admittedly limited knowledge and understanding, and try something, on the assumption that they will make mistakes and learn from these experiences. This characterization is, perhaps, overly simplistic; HUST students cannot but draw from their life experiences as they learn to design and UW students are encouraged to look for "precedents" that may inspire their work from visiting projects, published work or internet sources.

UW's method assumes that students will learn & develop their ideas primarily from their own experiences while HUST's methods assume that students can best learn by studying and copying the processes and approaches of experts and the work of teachers. Initially, HUST faculty provide students with knowledge through lectures and subsequently they discuss ideas with students individually. UW faculty provide minimal theory at the outset preferring to let design understanding arise out of practicing the process and encouraging students to discuss their work and process after completing design exercises. Discussion is an integral part of learning to design in UW studios, thus UW students, unlike their HUST counterparts, frequently talk more than teachers. Initial designs created by Chinese students tend to be more uniformly competent than American student's work, which may range from excellent to incompetent. The goal of UW studios is to develop the design thinking process not the product. The goal of HUST studios is to master and apply theoretical or abstract understanding. Students at UW are encouraged to learn for themselves and teach each other. One of our authors, Sun Jing, describes her experience of adopting a different approach at HUST:

"I taught [introductory architecture studio] classes several time but students didn't know the graphic rules for how to draw plans and sections correctly. [I tried to teach these] Finally I realized that it is no use to teach rules first as they don't understand them because they have no context within which to understand them."

6.2 Course Structure--Practice vs Skills

Another fundamental difference between Chinese and American studios is the relative emphasis placed on learning graphic communication skills and practicing the process of design--i.e. the focus on skills vs. design thinking. At HUST it is assumed that graphic competence leads to design confidence: students who possess strong graphic communication skills will not only be better prepared to express design ideas but will be more confident about exploring design ideas. At UW student confidence is developed through repeated trial and error practice of the design process on the assumption that increasing familiarity with the process will result in growing competence which will build confidence. The relative importance of hand-drawing graphic skills compared with computer generated drawings will continue to change and these changes will affect the content and emphases of work in introductory design studios.

In general, students at HUST are provided with a pre-existing and prescribed design process that they learn to apply, while at UW students are encouraged to develop their own design process. Again in very general terms, we may say that HUST faculty attempt to reduce the messy, mistake-filled and confusing aspects of learning to design by teaching students theory and developing competence in communication skills while at UW students are asked to embrace, or at least tolerate, ambiguity, mistakes, confusion and messiness as they are thrown into simple design problems with minimal skills. We may characterize these philosophies in general terms as teaching students everything they need to know to become designers in HUST and requiring students to discover things for themselves through a series of structured exercises at UW. These different teaching philosophies result in different structures for studio exercises and different relationships between faculty and students and among students.
6.3 Equations Use of Time--Length of Exercises

A typical UW introductory studio begins with a series of short (1-3 day) and simple exercises with different focuses--seats, steps, paths, social spaces, entrances, etc. All emphasize careful observation, drawing on personal experience, and an iterative analysis/synthesis/presentation process. They encourage self-expression, or group conclusions, and minimize the importance of products. Exercises are followed in the second half of the quarter by two longer and more complex design projects where the quality of graphic presentations becomes more important. Although high quality graphic products are significant in final projects, the primary objective of introductory studios remains the process.

HUST introductory studios start with skill training exercises and theory, such as abstract knowledge about space. These are integrated with composition exercises in which students learn rules of space composition and conduct case studies of famous designs. They are followed by design projects that tend to be longer than typical UW projects, in part because their semesters are longer than UW quarters. HUST projects more closely follow the direction of teachers and place greater emphasis, and longer time, on production of high quality products.

The short, focused exercises used at UW result in frequent deadlines which ensure a steady workload and diminish opportunities for slacking off that may occur in the middle of longer projects, followed by a spike in workload at the end. A consistent workload leads to better learning of how to design and encourages healthy work habits. Short exercises also tend to be less stressful for students because assessment and explanation cycles happen faster and less time is invested in the exercise so students are less concerned about making mistakes.

6.4 Relationships between People--Participant Structures/Discussions

In her study of UW introductory design studios, Dr. Tammy Tasker identified a wide variety of "participant structures", i.e. contexts and situations within which students interact with teachers and with each other. (Tasker, 2014) These ranged from meeting around a central table for class discussions, or presentations, to small student group meetings and individual desk crits. The also included much less formal interactions outside the classroom such as casual conversations while "hanging out" over the balcony, meeting in the coffee shop, or talking in vans or on site during field trips. In each of these situations the roles and responsibilities of students and faculty change. Her study suggested that the ways in which students learn in UW studios is fluid and opportunistic and that this leads to a richness and variety of learning opportunities. It also means that UW faculty play different roles and adopt a different attitude to their relations with students that may range from formal instruction through mentoring and critiquing to learning together. Seen through this lens, UW studio reviews (both internal during the studio and with external professionals and other faculty) are simply continuations of the learning process rather than formal presentations and judgments by expert reviewers.

The expectation at HUST is that students learn primarily from their teachers, established authority figures, and only secondarily from each other. Roles are more formal, defined and hierarchical and students are less comfortable engaging in back and forth discussions with teachers and with critiquing each other's work than is typical at UW. The ways exercises are structured and the frequency of informal in-class reviews at UW also provides more time for students to talk about their work and critique each other's efforts than is common at HUST. The lingering effects of the intense competition to gain entry to university means that HUST students may be predisposed to adopt competitive rather than cooperative relationships with each other unless studio teachers make strong efforts to encourage group work, collaboration and peer to peer critiques.

In both China and America some students are more comfortable talking than others and some are more open to receiving critiques of their work than others. At UW students are required to sign up for individual in-class crits during some studio sessions. At HUST students may avoid receiving advice on their work by not participating in crits; this would be unacceptable at UW.

6.5 Evaluation--Process vs. Product

A quick comparison of the products of HUST and UW studios would leave UW students' work wanting in comparison with the skilled graphic presentations of HUST students. However, the issue is more complex if one considers success in learning the design process as well as success in generating beautiful products. In most HUST studio presentations students are expected to present finished designs
that meet polished and high professional standards. Expectations differ at UW depending on the kind of review. Informal in-class reviews of work in progress encourage UW students to present "working" models or "in-process" drawings while final studio reviews establish higher standards and expectations.

Although the goal of developing competent and skilled designers is the same at both HUST and UW, the balance between concern for learning the process and producing high quality products are different in introductory design studios in part because of different understandings of what constitutes competent, professional designers.

6.6 Design Process--Site/Program Inspiration vs. Big Conceptual Ideas

A HUST introductory design studios tend to consist primarily of in-class work rather than on going outside and learning from local environments or visiting exemplary designs. In part this is because, as noted above, the campus is relatively uniform and provide a limited range of educational opportunities in comparison with UWs richer and more varied campus and surrounding district. Travel to places of interest in and beyond the urban environment is easier in Seattle, a much smaller and more compact city than Wuhan. There are other reasons for this difference: HUST emphasizes traditional design, which is focused on the creation of physical objects and spaces suitable for human use while UW design is increasingly influenced by ecological and environmental considerations. These considerations lead to a view of landscape design, at UW, as the creation of (living) systems as well as the giving of form to tangible objects. Living systems can best be understood by observation of them in the field rather than studying them in the classroom. The ecological perspective also emphasizes the necessity of being sensitive to the sites on which designs are created. Visiting sites and studying them in detail is an important studio activity that occupies considerable time at UW. Students' designs are expected to be responsive to site conditions and site conditions may be stronger influences on spatial and formal design solutions than abstract compositional and conceptual considerations.

The idea that students may learn about design in any context, not just in the studio, is fundamental to the philosophy of introductory design studios at UW and relates to the idea of "lifelong learning" that is a goal of American higher education. Successful designs in UW studios are ones that arise out of and respond to site conditions and program needs, while successful designs at HUST may express the bold visions of their designers.

6.7 Learning Objectives

Both programs recognize that the process of reflection is an essential step for students to demonstrate understanding of what they have learned and to make the lessons their own by integrating them with other experiences. Thus they both require students to reflect on their work following the completion of exercises and projects. This may take the form of written notes with diagrams submitted to teachers each week or at the conclusion of a project, or keeping a journal throughout the quarter. In addition, UW faculty meet with each student following the final studio review to reflect together on the successes and problems of the quarter. For faculty and student reflections can be and important way to assess whether lessons have been adequately learned and assimilated.

7 THE CHANGING NUMBERS OF CHINESE STUDENTS IN AMERICAN PROGRAMS

Figure 3 illustrates a trend that has occurred not only at UIUC but in Universities and Colleges throughout the USA: a huge, sudden, and recent increase in the number of mainland Chinese students enrolling in their programs. The Chronicle of Higher education reports (Neuman, 2014) that more than a quarter of a million Chinese students hold US visas in 2014 and that three of the five US universities with the most foreign students in 2012 are private--University of Southern California having the largest number of foreign students at 10,487 (26%) while Columbia has the largest percentage of foreign students at 35% (9,201). A similar increase has occurred at the UW and six of the twenty-eight students in the UW's Autumn Quarter 2014 introductory design studio were undergraduates from mainland China. In comparison with this "flood" only a trickle of American students enroll in Chinese universities. Part of our study included comparing the experiences of these Chinese students with those of native-born American students (many of whom are of Asian origin) in the UW introductory design studio. This was the first UW studio in which two visiting Chinese scholars (one this paper's prime author) both of whom had
participated in the studio throughout the quarter conducted some intermediate and final studio presentations in Chinese.

![Figure 3. Total Chinese Student Enrollment at University Of Illinois Urbana Champaign (Redden, 2015)](image)

Figure 3. Total Chinese Student Enrollment At University Of Illinois Urbana Champaign (Redden, 2015)

Whether the numbers of Chinese students enrolling in American universities continue at current levels or not, there is no doubt that increasing globalization of design services make it desirable for more communication between faculty American universities and Chinese universities. American faculty and students need to know more about China and vice versa.

8 CONCLUSION

“That is what learning is. You suddenly understand something you've understood your whole life, but in a new way.” Doris Lessing

Lessing's point is pertinent and apposite: our conclusions, based on three years of co-teaching and participating in each other's introductory design studios, are in many respects trite clichés. However, in other respects they reflect a far deeper understanding of the complex predicament of learning about other cultures and students and how we introduce the design process to students in different programs. Individual cultural preconceptions, the product of a lifetime of experience, run deeper than the individual; they are embedded in the long and tangled histories of countries and societies. Cultural preconceptions are manifested in the physical and organizational structures of institutions and in the content and methods of delivery of curricula. Thus any one-on-one interaction between a faculty and student from different cultural traditions is fraught with the potential for misunderstanding and miscommunication.

One-on-one instruction through crits is a fundamental aspect of design studio education and "knowing" where a non-native student is "coming from" in a crit is essential to successful communication. When a Chinese student at UW, for example, produces a design that to American eyes seems ludicrously inappropriate, out of scale with the site, and insufferably grandiose in expression, it is necessary to step back and consider that the path that this student has traversed to this point. That path includes competing and succeeding in the brutally competitive *gaokao* exam, standing out in a vast crowd, and growing up in an environment of incessant and monumental change and development, at a scale and pace inconceivable to American experience. Further, the skyline of cities such as Shanghai (2013 population
approx. 24 million) that are the touchstones of contemporary Chinese design expression, are replete with buildings more extravagant, by orders of magnitude, than most student's work.

Contrast that scenario with the experience of a Chinese faculty looking at an American student's work in which the graphics are grotesquely incompetent, the design proposals timidly deferential to the features of an insignificant little site, and the whole having not the slightest chance of standing out in a crowd and withstanding the intense development pressures of contemporary China. This student has imbibed, from birth, contemporary American aspirations for a "sustainable" society and environment and the work on the desk is a distillation and product of all of these influences. The goal for the work of an American student may be to fit in, while that of a Chinese may be to stand out. Where does one begin these crits? While posed in rather extreme ways, these scenarios nevertheless capture the essence of the predicament of transcultural design studio teaching and learning: navigating design fits and misfits, and trying to provide students with useful advice about how to proceed. Context, (and contextual appropriateness) we concluded, is crucial both for defining meaning and for the meaning of design. Designs that fit in one context may be misfits in other contexts.

9 REFERENCES

INTEGRATED PROJECT EXPERIENCES AND STUDENT PERCEPTION

ROTAR, SEAN  
Purdue University, srotar@purdue.edu

BARBARASH, DAVID  
Purdue University, dbarbara@purdue.edu

1 ABSTRACT

Professional projects in landscape architecture require a broad spectrum of knowledge and skills for their successful execution. In particular, design theory, sociology, grading and drainage, plant materials, and construction are vitally interrelated in the creation of successful spaces. Realizing students’ struggle to integrate knowledge from these several sources within the confines of a typical curricular structure, the authors have embarked on an innovative strategy to foster the connection of knowledge areas. Beginning in 2012 faculty at Purdue University began to address the shortcomings of a traditionally structured curriculum by leading juniors in an integrated project experience: the integration of several course topics in our junior-level curriculum through a single, encompassing, iterative project. This single problem asks students to integrate knowledge from four different technical and creative areas—design studio, grading and stormwater design, plant material, and construction documentation—to create a project that is a seamless whole, replicating the complete project process and iterative nature of a professional office setting.

The pedagogical literature has indicated the potential for an integrated project approach to address some of these concerns and to assist in the achievement of student learning outcomes (Levy 1980, Steinitz 1990). Furthermore, the project process seemed to have the potential to present and encourage student work habits and design processes that more closely mirror the expectations of professional offices. The authors have measured the degree to which this method is effective in improving student perception of knowledge, skills, and abilities. A trial study which used pre- and post-condition evaluative surveys to measure student preferences and response to the integrated project process (Rotar, Barbarash, et.al. 2014) showed promising trends; this more complete study’s results indicate a statistically significant increase in student perception of their abilities to integrate these four topics into stronger design solutions.

This paper reviews the project process and presents the results of our study of student responses to that process. Furthermore, we will reflect on the successes and challenges encountered during the project and discuss next steps in determining whether or not actual improvements in student learning outcomes are measurable.

1.1 Keywords

Integrated project approach, student perception
2 INTRODUCTION

The integration, synthesis, and application of a disparate range of knowledge areas to inform and enrich design has long been a goal of design education. In most visions of landscape architecture education, the design studio is seen as the hub of a curricular system in which knowledge gained in many disparate areas all feed the work of the central design studio course. In the studio, students are asked to integrate the knowledge and skills acquired in other courses, including the vital understanding of the technical and theoretical knowledge that makes up other aspects of curriculum, into design problems. While ideal, however, this understanding of the studio’s role is difficult to realize in standard curricular settings; often leading to the frustration and disillusion of all faculty and students.

However, the complexity of design problems requires that a broad spectrum of knowledge and skills be applied to develop a successful and creative solution. A given design problem may require knowledge of design theory, geology, geography, grading, drainage, plant materials, construction techniques, and manifold other areas. The judgment and ability of the designer to select the important knowledge areas and to properly apply the information gathered seems to be the most determining factor in the success of a design problem.

Writing in 2014, the authors noted three student attitudes that make it difficult for students to integrate knowledge areas into a design problem: first division of bodies of knowledge as silos; second student habits that prevent integration, including the attempt to develop solutions as quickly as possible due to time and other constraints; and finally the inability of students or reluctance of students to review design solutions, self-criticize, and refine the solution. The authors observation of the difficulties of integration and the necessity of knowledge integration in creating stronger deeper design solutions, led to a method to force students into integration despite the barriers provided by a traditional curricular structure. In addition to student attitudes that hinder integration of knowledge areas there are structural and administrative barriers under traditional course methodologies. Here at Purdue University, as in many institutions, course assignment and instructor of record designations coupled with faculty specialties and scheduling issues tend to lead to separation of knowledge areas from each other within their own course modules. This status quo works in direct opposition to the real-world integrated processes of landscape architectural design. (Rotar, Barbarash, Dahl, & Hildner, 2014)

2.1 Integrated Problem Structure

Beginning in fall of 2012 faculty teaching courses in the junior year at Purdue University began to collaborate in leading juniors through an encompassing iterative project. This single problem extends across two semesters and four courses - including the design studio, a course in earthworks and stormwater design, a course in planting design, and a course in construction documentation. While other coursework could benefit and enhance the integrated project experience, courses held during the junior year were selected for an integrated approach to maintain common skill and experience levels across participating students and to avoid major scheduling conflicts with non-integrated classes. Previously acquired knowledge in plant identification, materials and detailing, landscape history and theory courses along with various studio projects was expected to be part of participating students baseline knowledge at the start of the integrated experience.

The project was structured around three goals: first, to integrate the various knowledge and skills areas inherent in these four courses seamlessly throughout a single project. Second, the authors intended the project to break the typical structure of student studio projects in which the master plan or illustrative plan is seen as the end result of a design problem. This typical process includes virtually no time for reflection and revision or for technical aspects of design investigation to have any impact on the design work itself. Finally, the project’s pedagogical scaffolding was structured to be iterative in order to make clear the impact of each knowledge area on the others and on the design as a whole. (Rotar et al., 2014)

Furthermore, faculty sought to present the students with the opportunity for client interaction as part of the integrated project. For this reason each of the project sites chosen was part of a service learning project which included a real client. As we show, however this requirement also led to disparity of project type and scope that needed to be mitigated in creative ways in the objectives and outline of the project in order to provide similar experiences that met the above goals.

Two separate groups of junior-level students participated in the integrated project process. In
2012, the pilot integrated project involved the design of a small public open space in the center of an historic urban neighborhood in Lafayette, Indiana. This approximately 10 acre site is bounded by several streets including an abandoned dead-end with a moderate slope of 7 to 15% and this site seemed to offer great potential as it was neither too large nor too complex to allow students to apply these knowledge areas to its design. Students initially worked in teams to develop a program and design concept, leading to an illustrative master plan. Students then were asked to refine the initial concepts as individuals, taking the project through completion which included a revised illustrative site plan, grading plans and planting plans.

In 2013, a very different project site and potential program was used: a 100 acre site surrounding a new transmission facility for the Chrysler Corporation in Tipton, Indiana. Here students also worked in teams to develop goals, program, conceptual, and schematic designs for the entire site, leading to an illustrative master plan. Each student was then responsible for selecting a smaller study area of 5-7 acres within the site to further refine and revise. In this way the individual student site design closely replicated the size and scale of the previous year's problem, though unlike 2012, each student team member would develop and refine an individual study area rather than each team member working in individual design of the same area. However, students would be responsible for a revised illustrative plan, planting plans, and grading and stormwater plans, as in the previous year's problem.

3 LITERATURE REVIEW

3.1 Traditional Teaching Methods and Issues

Design education can be considered radically different from many traditional classroom models and programs. Traditional education methods tend to isolate knowledge into easily digestible bits that are easy for a student to memorize, and while this concept is not without its merits, students often find it difficult to connect new content with previous lessons or work being performed in concurrent courses. This is especially at issue in the design studio where core material is presented separately from a design task yet is expected to inform and be integrated into design methodologies. Traditional education methods can limit a student’s perception and process expectations, maintaining the divide between technical or scientific knowledge and creative exploration in design. This can be especially damaging to a design students capabilities when immersed in the professional world on internship or in an entry–level position after graduation. (Altomonte, Rutherford, & Wilson, 2012; Levy, 1980; Teal, 2011)

3.2 Justification for Integrated Teaching Methods

In design there can be no such thing as a skill in isolation; all skills, decisions, and choices stem from prior experience and learning and influencing one another. This extends beyond design coursework, with history, theory, and hard sciences influencing and creating a richness in design that would be missing without their inclusion. A difficulty in modern design education with its necessary emphasis on technical information—sustainable design practices, growing urban areas, and performance based design, etc. —is to address the divide between connecting technical and scientific material with creative exploration and expression.

A robust design education process is one of applied learning, where previously gained knowledge and skills are the filter through which a project is viewed and worked through. This knowledge should be supported by empirical research and case study analyses, where critique (both of self- and other works) and iterative reflection integrate and inform the final creative product. “In so doing, students should develop a deeper awareness of the subject under exploration and indeed, from early stages in projects should be able to appreciate the many interdependencies that contribute to the success of the task, and thus take an informed view of the likely outcomes of a project.” (Altomonte et al., 2012, pg. 8) This multi-level integration of knowledge and skill should encourage a depth of critical and creative thinking that would likely be missing under traditional education processes.

As the purpose of architectural education is the training of future architects and designers, a combining of theoretical “learning” with hands-on “doing” provides opportunities for more permanent concept retention and behavioral change. “Lacking flexible skills, students will find the nonlinearity, a-rationality, and ambiguity that are fundamental to both design and life confounding, overwhelming, and unnecessary. However, without such skills, they will find it nearly impossible to recognize or engage the
intricate relations and interdependencies that exist in any real world context." (Teal, 2011, pg. 37) The use of active-learning methodologies, where students are able to take ownership of their education and projects, seeing the interconnected value of the disparate courses they are required to take realized in a single project or process, often results in a more complete and robust final product. (O'Brian, Soibelman, & Elvin, 2003)

The common approach of architectural education in which experience grants expertise can only benefit from a coordinated and integrated multiple viewpoint methodology. In a non-integrated course system, students often receive a single point of view and material may therefore be presented in a limited number of ways. Integrated course methodologies can demonstrate the multitude of successful approaches and opinions to solving a design problem through the voices and expressions of a faculty body. A unified faculty, focused on a single "complete" project, foster and support the seldom spoken about student-instructor relationship, supported by Austerlitz et al's claim that the this relationship is "at least as important as other areas for understanding studio processes and pedagogy". (Austerlitz, Aravot, & Ben-Ze'ev, 2002, pg. 106) This allows for varying voices and angles of approach to cater to multiple learning styles and personality types inherent in a diverse student body.

3.3 Studio as the “Master” Course

In a multi-course integrated approach to architectural education, the design studio should serve as the catalyst or "master course" as it "...is the only environment in which all aspects of architectural ideas and skills - formal aesthetics, building technology, theory, history, and drawing - can be learned", (Levy, 1980, pg. 29) though it is important that the non-studio courses are not seen as being secondary or “lesser” by students. All learning goals, methods, and outcomes should be structured around and focused through a studio design project that forces creative endeavor to be influenced by technical skills presented in supporting courses. This material can also be presented in the studio course itself as redundancy, with studio related content discussed in the technical courses in order to keep the integrated project goal in mind throughout the student learning process.

3.4 Results/Issues in Integrated Teaching Methods

A robust set of learning outcomes should be introduced at the start of an integrated project so that each course understands their place in the larger system and each can work towards the shared set of goals. This requires a cohesive and congenial faculty willing to work with the delays and scheduling issues that can arise during the semester. Blurred boundaries between courses regarding presentation times and shared due dates can reinforce the importance of the integrated process for students while reducing the impacts of the process on a design studio’s schedule.

An integrated project allows students to use knowledge gained in parallel courses immediately in a design project. As faculty in the non-studio courses filter content through the grand vision of a shared design problem, students are more likely to perceive the overall project as “real” and “unique”, where required tasks and assignments are “practical” with students performing better and remembering material longer than the knowledge presented in isolation. (Ozimek & Ozimek, 2011) The complex relationships between skill and knowledge areas foster iterative non-linear thinking that allows a student to approach a problem from multiple angles, activating knowledge in ways traditional teaching methodologies often lack. Integrated course processes and active learning methods change student design work from creating individual isolated objects and programs to more complex and “complete” works that better simulate the realities of the design world, preparing students for the lifelong learning process necessary in professional design. (Altomonte et al., 2012; Teal, 2011)

4 METHODS

With its multi-faceted problem solving approach, this study used the design studio as the organizing class in the integrated system. A studio design project typically asks students to consider the breadth of knowledge and skills gained in related coursework and experiences. Under this integrated system, faculty actively reinforced the links between studio and concurrent technical coursework in grading, stormwater management, and planting design. Faculty were able to focus project expectations and discussion topics around the knowledge and skill level of the students at that time across all
integrated courses. The pacing of each individual skillset was timed to coincide with an analogous area in parallel courses, to effect, turning the disparate courses into a single master class.

The initial iteration of the integrated project experience in Purdue University's landscape architecture program saw students grow frustrated with inconsistent assignment goals and final product between courses (Rotar et al., 2014). After a period of reflection and refinement, the involved faculty broke the standard format of student design projects where the master plan is typically the final product by requiring an iterative series of assignments in each concurrent non–studio course after the “final” master plan design was completed. Students were then asked to revisit their design and make adjustments based on the new knowledge they acquired in supporting coursework.

This study used surveys as the primary method to determine the project’s effectiveness. Three different but similar survey instruments were employed to assess student perception of the value and product created through the integrated course methodology. In order to create a baseline for study, seniors who had taken the courses through traditional individualized methods were used as a pre–condition control group. Juniors were first presented with a project following traditional “silod-ed” knowledge areas while basic concepts of grading, stormwater, and planting design were introduced in the technical courses. Following completion of this project, a final project following an integrated methodology was completed. Students were surveyed after each of the aforementioned projects to assess their perception of the interrelationship of knowledge and skill areas under both pre-and post-integrated conditions.

The survey instruments (as seen in Tables 1 and 2) themselves were a refinement of those employed in the pilot (Rotar, Barbarash, Dahl, & Hildner, 2014) with the data gathered used to guide and shape the integrated project used in this study. Individual course knowledge areas were separated out into their own questions to better gauge the effectiveness of each course within the larger integrated system. Students were asked to assess how one course’s content as applied to the integrated project influenced the thinking and production of work related to a different course within the integrated project. In addition, they were asked to rate their perception of the value of an integrated project methodology towards project success and “completeness”. Survey responses were placed along a 5 point Likert scale and were analyzed through a one–way ANOVA with Bonferoni post–hoc tests to measure significance ($\alpha \leq .05$).
Table 1. The Junior level Pre–Integrated course project survey.

<table>
<thead>
<tr>
<th>To what extent has your knowledge of:</th>
<th>Lack of knowledge Hindered a lot</th>
<th>Lack of knowledge Hindered a little</th>
<th>Knowledge/ Lack of knowledge Neither helped nor hindered</th>
<th>Knowledge Helped a little</th>
<th>Knowledge Helped a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>earthwork &amp; drainage influenced and/or improved your studio design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>earthwork and drainage influenced and/or improved your planting design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>planting design influenced and/or improved your studio design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>planting design influenced and/or improved your earthwork &amp; drainage design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>studio design influenced and/or improved your earthwork &amp; drainage design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>studio design influenced and/or improved your planting design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How important is the relationship between design, earthwork &amp; drainage, planting, and CDo?</th>
<th>Not at all important</th>
<th>Not very important</th>
<th>Neutral</th>
<th>Slightly important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>To what extent do you believe that the integration of your Junior year coursework would result in a more &quot;complete&quot; project?</th>
<th>No benefit at all</th>
<th>Not much benefit</th>
<th>Neutral</th>
<th>Some benefit</th>
<th>Of great benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
Table 2. The Junior level Post–Integrated course project survey.

<table>
<thead>
<tr>
<th>To what extent do you believe the integrated project experience allowed you to:</th>
<th>No benefit at all</th>
<th>Not much benefit</th>
<th>Neutral</th>
<th>Some benefit</th>
<th>Of great benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>create a more “complete” project?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>become competent in the individual skills necessary to create a complete project (grading, drainage, planting, etc.)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>understand the iterative and adaptive process of design</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Better manage time due to shared deadlines and expectations</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>To what extent has your knowledge of:</th>
<th>Lack of knowledge Hindered a lot</th>
<th>Lack of knowledge Hindered a little</th>
<th>Knowledge/ Lack of knowledge Neither helped nor hindered</th>
<th>Knowledge Helped a little</th>
<th>Knowledge Helped a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>earthwork &amp; drainage influenced and/or improved your studio design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>earthwork and drainage influenced and/or improved your planting design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>planting design influenced and/or improved your studio design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>planting design influenced and/or improved your earthwork &amp; drainage design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>studio design influenced and/or improved your earthwork &amp; drainage design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>studio design influenced and/or improved your planting design?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>How important in a successful project is the relationship between design, earthwork &amp; drainage, planting, and CDs?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

5 FINDINGS

Results demonstrate a statistically significant response in the comparison between traditional and integrated course methodologies, but not for all categories (see figure 1). Notably, seniors in the control group and juniors in the post condition show a significant response with knowledge of earthwork and drainage influencing planting design. Both seniors and juniors in the pre-integrated condition demonstrated a positive influence compared with juniors in the post-integrated process between knowledge of earthwork and drainage with studio design. Perhaps most importantly, juniors also showed a realization at the importance of the relationships between the four study course areas (design studio, earthwork and drainage, planting design, and construction documentation).
6 DISCUSSION

6.1 Results

The significant results where knowledge of earthwork and drainage influenced studio design demonstrates that students perceived that they learned the values of an integrated methodology and that the two process and concept areas are intrinsically linked. The shared opinion between seniors (who have spent a full year on a managed co-operative internship before returning for their final year of academic programming) and juniors regarding issues in the pre-integrated project condition is of interest as there was no relatable correlation to the post-integrated process. In this case, students might not have received enough direction to differentiate the two methodologies; alternately, it is possible that this individual group of students was already starting from a more advanced point within this specific skill and knowledge area. Seniors’ recollection of skills may not be accurate and is influenced by their experience in their yearlong cooperative internship.

An interesting difference between the student perception of the value of this project for the two technical knowledge areas—earthworks and drainage vs. planting design-- cannot be explained by the data. The authors hypothesized that the two technical areas included in the integrated project would see similar results related to student perception of their connection to the project process and outcomes. However, students perceived a deeper connection between site design and earthwork and drainage than between site design and planting, as seen in Figure 2, despite these concepts being given equal weight and time in the integrated coursework.
The authors hypothesize that this difference may be due to student reactions to the differences in teaching styles or personalities of specific professors. However, as the planting design course used as part of the integrated study is the second of two courses required in that knowledge area in the curriculum, it is possible that the difference can be attributed to greater pre–existing understanding of the interrelationships between planting design and overall site design, which would limit the impact of the integrated process by reducing the pre and post measure to non-significant levels.

Another possibility may be at work as well: in one of the academic years in which the integrated process was employed, the planting design course was taught by an adjunct faculty. While this study cannot affirm or deny this hypothesis, it seems likely that student perception of that knowledge area was negatively impacted. The issues demonstrated with the perceived value of integrating planting design content, may have been a factor in the reduction of responses relating to total integration for juniors participating in the project process. However, the data also demonstrates an increased belief in the importance of content integration to the success of a “complete” design project (see figure 3).
6.2 Challenges Faced and Lessons Learned

Having completed both a pilot study and a full iteration of the integrated course project process, the authors are able to draw some conclusions regarding the challenges that this kind of project process presents to students and faculty, as well as strategies that may mitigate those challenges or turn challenges into positive factors. While unable to implement all of these strategies, let alone test the validity of these assumptions in improving student learning, the authors hope that this discussion will prompt further experimentation and reflection by others.

Possibly the largest challenge faced in an integrated project process is simply that the structure of university course curricula do not envision these kinds of learning experiences and as a result faculty, students, and administrators may all have different expectations for the structure and responsibilities for curriculum delivery (Rotar et al., 2014). While not insurmountable, it is clear that in order for an integrated project to be successful all faculty involved must be equally committed to the success of the project. Seeking success in the project involves considerable flexibility on the part of the faculty in regard to course schedules and due dates, as well as finding a balance between faculty expectations for student deliverables and the desired outcomes in the individual courses vs. the needs and expectations of the integrated project. In order for these expectations not to compete, faculty communication is vital. Extensive planning through a pre-scheduled series of meetings for coordinating activities, due dates, and knowledge delivery will help mitigate the difficulty faculty find being on the same page in the project process and presenting a unified program for students.

In order for the integrated process to be successful, faculty must also manage the interplay between the delivery of knowledge and skills and areas and their application into stained aspects of be integrated project. Students cannot be expected to apply their knowledge of grading and stormwater to a design solution before they have the knowledge of those technical areas and the ability to apply those
skills to a separate problem. Therefore, the scheduling of lectures in the supporting courses and project delivery and due dates in the integrated project has to be a careful collaboration among faculty members.

Finally, the authors have observed the tendency of students to prioritize input from particular faculty over others. This prioritization leads to some faculty members having an outsized voice in the design process. As a result, students’ perception of the importance of subject areas presented by some faculty might be minimized and therefore the overall goals of the integrated project not realized. In addition, less visible or more passive faculty might find themselves and their subject areas with a smaller voice in the process, possibly leading to a feeling of marginalization. A lesson that can be learned from this observation, however: it is unrealistic for four faculty to have equal impact in the studio, and perhaps a single strong mouthpiece that is able to communicate ideas well may be necessary for the project's success. Unfortunately, reliance on a single mouthpiece negates the value of one of the unintended but important discoveries of the process: that hearing multiple and disparate points of view will ask students to make judgments and apply critique in a way that parallels a professional project process with multiple clients and inputs.

Upon reflection, the authors are certain that the strongest faculty voice should be the studio professor acting as a catalyst, clarifying the overall design input, and working to ensure that other voices are heard, if not equally, than strongly in their own rights. In the iterations of the project studied, lack of a strong studio professor who acted in this way was a factor in the student perception of limited success.

7 CONCLUSIONS AND FUTURE RESEARCH

The study of integrated project process and their effect on student perceptions of knowledge integration and design outcomes has some general delimitations. Because the study is about integrating technical knowledge areas to increase their effectiveness as a foundation for design, the study does not look at several surrounding factors, including the specific order of the courses leading up to the integrated experiences, their time/ location in the curriculum at Purdue, or other similar variables. By design, the authors excluded these factors not because they do not play a role in the education objectives of a university program, but because they have little to do with this study, the specific courses and knowledge areas to be integrated, and students’ perception of their effect. In this way, the authors hope that the findings may be more generally understood, by looking holistically at student perception of integrated projects and not at specifics of curriculum and outcomes for a particular program. It is clear that the findings of this study provide an affirmation of the value of an integrated approach to strengthening student responses. However, it is also necessary to point out that the project study is testing student perception—perception of the growth of their skills in each of these areas, the impact of each of the three areas upon each other, and the value of the process in strengthening the final design product.

This study realizes that the conclusions gathered are the results of student perception of achievement and understanding, with results as yet unfiltered through the lens of a more practiced eye aware of the larger system that is professional practice. The authors do not intend that curricular changes should be made based solely on the reflections of student perception of a process or outcome. What we can gather from this exercise is fodder for investing a student body into their work on a deeper more meaningful level, with the interplay and relationships between skill and knowledge areas becoming second nature. The perceived gains inherent to an integrated project methodology may or may not result in a higher caliber of student product, but it does better simulate the depths of a “real” project, preparing students for professional positions in the future.

The results of this and previous works (Rotar, Barbarash, et. al) have demonstrated a positive shift in students’ perception of the depth and quality of their work when following integrated course methodologies. However, whether or not the integrated project process has made a measurable improvement in the actual quality of the design work has not been evaluated as a part of this study. In order to test whether integrated course procedures allow students to create deeper more “complete” work, projects need to be assessed by an independent panel of experts (professionals and non-course associated faculty) and rated in a series of key categories to weigh the value and expression of designed elements across both integrated and non-integrated projects. In many ways this professional level rubric can follow the patterns of previous student surveys with room for additional qualifying questions to measure specifics of design outcomes within the educational goals embedded within the four participating integrated courses. The authors have compiled four years of student works, three of which have projects
following both an integrated and non-integrated process, for assessment towards discovering the real world efficacy of integrated project methodologies in a cooperative academic setting.

8 REFERENCES


PROMOTING COGNITIVE PLAY BEHAVIORS THROUGH CHILDREN’S ACCESS TO NATURAL LOOSE ELEMENTS IN OUTDOOR PRESCHOOLS

ZAMANI, ZAHRA
Clemson University, Department of Architecture and Health, zzamani@clemson.edu

1 ABSTRACT
Given that natural environments play a critical role in children’s development, health, and learning, designers and educational policy makers often neglect the inclusion of natural elements in outdoor play environments. Further research is required to compare the cognitive play opportunities of outdoor play environments on a smaller scale, including natural loose, natural fixed, manufactured fixed, and manufactured loose elements. Often neglected as an essential element to be included in outdoor play, this research focused on the cognitive play value of natural loose elements for young children.

A unique outdoor preschool was selected with grounds inclusive of diverse natural and manufactured, loose and fixed elements. In 12 observation sessions, 36 four or five year olds were coded for cognitive play behaviors and the elements interacted with during play. Supplementing the research with qualitative data, 21 children were interviewed about their play experiences in the outdoor preschool. The behavior mapping indicated that almost half of children’s interactions with natural loose elements were dramatic play, such as creating ‘forts’ with sticks. The observation and interview results suggested that compared to other elements, natural loose elements supported the most opportunities for constructive, exploratory, and dramatic play that children enjoyed. The mapping of children’s interactions within the outdoor preschool illustrates the importance of including natural settings to provide natural loose props, such as sticks, dirt, sand, and logs to promote and stimulate a diverse spectrum of cognitive play.

Considering outdoor preschools as one of the most familiar playgrounds to young children, it is necessary to understand what type of experiences these environments provide for children’s development. Keeping in mind that children are the main users of these environments, we can carefully design outdoor preschools based on their interests and preferences for particular spaces or features. This research recommends landscape architects and policy makers to incorporate natural loose elements in outdoor preschool as an economical and sustainable approach that also develops children’s cognitive abilities in early stages of life.

1.1 Keywords
Natural loose elements, young children, outdoor preschool, cognitive play behaviors, diversity
2 INTRODUCTION

Play is children’s way of learning about the world through exploring and experiencing, improving their social, physical, and cognitive abilities (e.g., Burdette & Whitaker, 2005; Burghardt, 2011; Cosco, 2006; Fjortoft, 2004; Staempfli, 2009). The body of literature suggests that the complexity and diversity of natural environments provide countless discovery opportunities, enabling children to engage in diverse, creative, hands-on, and imaginative play behaviors (Blanchet-Cohen & Elliot, 2011; Gehris, Gooze, & Whitaker, 2014; Lester & Maudsley, 2007; Storlii & Hagen, 2010) that children prefer (Clark & Moss, 2005; van den Berg, Hartig, & Staats, 2007). The intended goal of natural playgrounds is to reconnect children to nature while offering various open-ended play options that stimulate creativity and imagination (Fjortoft & Sageie, 2000; Lester & Maudsley, 2007). For instance, Fjortoft and Sageie (2000) found that natural features stimulated different play types and that children love to explore and experience the challenges that natural environments provide.

In 2012, almost 53.5% of three to four years old U.S. children spent their time in preschools or structured child care programs (Snyder & Dillow, 2015). Therefore, supplementing outdoor preschools with nature provides essential opportunities for children to engage in challenging, complex, and interactive activities (Fjortoft & Sageie, 2000; Moore & Wong, 1997; Titman, 1994). Design policies for everyday urban spaces, such as preschools, can improve the quality of built environments by concentrating on ‘biophilia sensitive designs’ that promote a sense of emotional attachment towards nature (Louv, 2005; Maller & Townsend, 2012; Wells & Evans, 2003), as well as learning opportunities (Fjortoft & Sageie, 2000; Moore & Wong, 1997). Nevertheless, designers and educational policy makers often neglect the importance of incorporating natural features into the design of outdoor preschool environments to enhance children’s learning.

The departure point of this study is the concept of cognitive development that focuses on children’s neurological and psychological development in terms of information processing, conceptual resources, language acquisition, or other areas of brain development (Farmer-Dougan & Kazuba, 1999; Flavell, 1992). Literature has shifted to tracing children’s cognitive development through play behavior observation assessments (Farmer-Dougan & Kazuba, 1999). Rubin (2001) classifies cognitive play behaviors into:

1) Functional. Involves simple or repetitive motor behavior, such as jumping, climbing, etc.
2) Constructive. This behavior is recognized when children manipulate and shape an already familiar material with a direct goal in mind.
3) Exploratory. Identified when children examine the qualities of objects to gather visual data about physical features.
4) Dramatic. This behavior occurs when children play the role of someone, engage in a pretend activity with an object or someone, or assign life to an inanimate object.
5) Games with rules. Identified when children employ a sense of competence with peers while creating regulations for games.

The environmental assessment of cognitive play behavior opportunities in outdoor preschools provides insight and expands knowledge into particular natural elements that are more supportive for children’s cognitive development.

2.1 Research purpose

To promote and encourage the implementation of biophilic sensitive design policies, research is required to understand how children perceive, enjoy, and play with natural elements. Prior studies have explored how the physical elements in the environment stimulate play (e.g. Fjortoft & Sageie, 2000; Fjortoft, 2004; Sandsseter, 2009). Previous research have also listened to children’s views and preferences with regard to the outdoors (e.g. Jansson, 2015; Malone & Tranter, 2003; Norodahl & Einarsdottir, 2015; Waller, 2006). However, little research has been done exploring the cognitive play opportunities of natural loose elements within outdoor preschools. Segregating the physical environment into a smaller scale, elements are classified into (Cosco, 2006; Zamani, 2012):

1) Natural loose. These natural features are flexible, manipulative, and portable, such as flowers, sand, dirt, or leaves.
2) Natural fixed. These natural components are permanently located in space, such as shrubs, trees, or large rocks.
3) Manufactured loose. These artificial elements are transportable, and sometimes malleable, such as dolls, balls, tricycles, or shovels.

4) Manufactured fixed. They are fabricated physical features that are steady, enduring, and rigid, such as benches, play structures, or swings.

Understanding children's perspectives as every-day users of outdoor preschool playgrounds is an approach to implement children's participation and promote child-friendly environments (Björkld & Nordström, 2012; Clark & Moss, 2001). The present study adds to previous research focusing on the cognitive play behaviors children enjoy and the natural loose elements they prefer in their outdoor preschool.

3  RESEARCH METHODS

3.1  Site selection

Consulting with experts in the field of nature-play, twenty existing outdoor learning environments in North Carolina were evaluated for their diversity in behavior settings. Natural Learning Initiative (NLI) designed or transformed these sites into outdoor learning environments that focus on children's development and contact with nature. Outdoor preschools were compared based on the availability of natural or manufactured elements. The study aimed for a site that had plenty and comparatively balanced types of elements, with children's direct access. While many outdoor preschools included mixed and manufactured settings, natural settings were rarely found. The evaluation with experts revealed an exceptional outdoor preschool environment with three natural (0.11 acres), mixed (0.48 acres) and manufactured (0.4 acres) playgrounds. As displayed in Figure 1, each playground had diverse settings and distinctive manufactured and natural loose and fixed elements. Children were taken to each playground on an alternating daily basis and they engaged in free play.

Figure 1. Manufactured, Mixed, and Natural Playgrounds and diverse settings. Diagram by author.
3.2 Participants

Data collection involved behavior mapping from children during outdoor free play and interviews with children. A total of 36 four-to-five year olds (15 female and 21 male) took part in the behavior mapping, and 22 of these children (13 female and 11 male) participated in interviews.

3.3 Measures and procedures

Behavior mapping was employed as a quantitative approach for recording children's behavior (See Moore & Cosco, 2010). Children were observed for seven days, in 12 observation sessions, and during recess hours (that began at 11:30 a.m. and 4:15 p.m. and continued for 45 minutes). The behavior mapping protocol involved dividing each playground into multiple observation zones, with the observer positioned in a pre-defined place for easy scanning. Cognitive play behaviors, elements types, and location of the children were documented on a paper map. Rubin's (2001) Play Observation Scale provided the basis for coding children's cognitive play behaviors.

After each observation zone was scanned, the observer relocated to the next observation zone. Each child within the observation zone was observed for 10 seconds and recorded for 20 seconds. An audio device with a pre-recorded 30-second interval assured the reliability of the time sampling sequence. Children's were not interrupted unless the researcher was confused of the behavior type (See Pack & Michael, 1995). In these instances, the child was approached and asked about what they were playing. This interruption was immediate and coding was continued after relocating to the predefined point of observation. For data analysis purposes, behavior mapping records were inserted into the Geographical Information Science (GIS) program. After, the results were imported into the SPSS program for conducting descriptive and contingency table analysis.

The interviews were conducted during preschool hours inside the school building. Responses were recorded with a digital audio recorder. Children's interviews followed photo preference and drawing sessions as starting points in which children were asked to select or draw their favorite outdoor preschool spaces. Subsequently, children were asked to explain the reasons why they preferred the selected areas and the activities supported in these settings. Later, children's interview responses were transcribed and coded based on cognitive play behavior preferences and associated elements. For the purpose of this study, only the referred natural loose elements are reported.

4 RESULTS

4.1 Behavior mapping results

Overall, 6801 data points were recorded after importing the data from the coded children during play into the GIS (Figure 2). Figure 2 highlights the transferable and lightweight quality of natural loose elements that supported constructive and dramatic play in other natural settings. For instance, children enjoyed collecting and holding sticks from around trees and chasing peers across the hill.
he behavior mapping findings suggest that most natural loose elements were not supportive of functional play. Noticeably, 29% of observed play behaviors with logs were functional play, as a consequence of their hard and strong balancing surfaces that supported challenging behaviors. The results indicate that loose elements that were shapeable, light-weighted, and moveable supported many constructive play opportunities. For example, 26.8% of interactions with sand and 35.7% of interactions with flowers were constructive play. The existence of natural features that supported ecosystems and creatures inspired children’s curiosity and exploratory play. For instance, 81.6% of children’s interaction with the existing logs and trees that cultivated worms, bugs, or ants were exploratory play. The behavior mapping results suggest the majority of natural loose elements were supportive for dramatic play opportunities, such as mulch (72.1% of all play involving mulch was dramatic), flowers (64.3%), leaves (63.6%), sand (59.8%), sticks (54.3%), or logs (51.6%).

Arranging the elements into categories (Table 1) within the range of observed cognitive play behaviors; natural loose elements were mostly supportive for dramatic play (49.7%). Further, comparing the distribution of cognitive play opportunities within different elements, children were most likely to engage in constructive (59.4%), exploratory (45.9%), and dramatic play (38.2%) when interacting with natural loose elements. After manufactured loose elements, natural loose elements provided the most opportunities for games with rules (21.7%), compared to the fixed elements.
Table 1. The distribution of observed cognitive play behaviors in different category of elements

<table>
<thead>
<tr>
<th>Category of Elements</th>
<th>Cognitive Play Behaviors</th>
<th>Functional</th>
<th>Constructive</th>
<th>Exploratory</th>
<th>Dramatic</th>
<th>Games with rules</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufactured Fixed</td>
<td>% within Elements</td>
<td>37.3</td>
<td>3.9</td>
<td>7.6</td>
<td>37.1</td>
<td>5.2</td>
<td>8.9</td>
</tr>
<tr>
<td></td>
<td>% within Cognitive</td>
<td>15.1</td>
<td>7.7</td>
<td>11.0</td>
<td>15.1</td>
<td>9.2</td>
<td>14.6</td>
</tr>
<tr>
<td>Manufactured Loose</td>
<td>% within Elements</td>
<td>37.4</td>
<td>7.6</td>
<td>6.1</td>
<td>36.6</td>
<td>8.9</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>% within Cognitive</td>
<td>27.1</td>
<td>26.4</td>
<td>15.2</td>
<td>26.7</td>
<td>29.0</td>
<td>9.5</td>
</tr>
<tr>
<td>Natural Fixed</td>
<td>% within Elements</td>
<td>34.7</td>
<td>3.9</td>
<td>20.9</td>
<td>29.6</td>
<td>8.9</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>% within Cognitive</td>
<td>11.5</td>
<td>6.2</td>
<td>23.8</td>
<td>9.7</td>
<td>13.8</td>
<td>2.7</td>
</tr>
<tr>
<td>Natural Loose</td>
<td>% within Elements</td>
<td>8.8</td>
<td>16.1</td>
<td>17.4</td>
<td>49.7</td>
<td>6.3</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>% within Cognitive</td>
<td>6.8</td>
<td>59.4</td>
<td>45.9</td>
<td>38.2</td>
<td>21.7</td>
<td>5.2</td>
</tr>
<tr>
<td>No Elements</td>
<td>% within Elements</td>
<td>53.8</td>
<td>0</td>
<td>1.6</td>
<td>12.7</td>
<td>8.2</td>
<td>23.8</td>
</tr>
<tr>
<td></td>
<td>% within Cognitive</td>
<td>39.0</td>
<td>0.3</td>
<td>4.1</td>
<td>10.3</td>
<td>26.3</td>
<td>68.0</td>
</tr>
</tbody>
</table>

4.2 Results from children’s interviews

The interview responses were transcribed and organized using handwritten notes and Microsoft Word. Data was classified and coded to create an understanding of children’s cognitive play and learning experiences associated with natural loose elements (Table 2). Children expressed that the existence of creatures inspired their sense of wonder and exploratory play. Based on children’s memories, these creatures were discovered in natural settings. Children described the dramatic and constructive play opportunities that sand offered through its soft and shapeable quality. Children were excited about the challenging opportunities that logs offered, such as jumping or balancing. They also described how the available sticks and mulch promote their self-initiated games. Children commented on the soft surface of the grass or leaves and mentioned how these elements promoted their constructive and dramatic play.
Table 2. Examples of children’s interview responses about their play experience with natural loose elements

| Creatures | 1- | I like playing in the rock area when there is water and when I have boots on. We find worms and we put them in the water and that means that dig and die or live. If they let them be there for a long time, they would die. We just filled up water, then we brought all of them on the sidewalk, and then we put them on the sidewalk to see if the worms are alive. If they wiggle a bit they are alive. |
|          | 2- | Sometimes we scoop the water in it. But yesterday it rained and when we went outside and there was a lot of water. So we scooped them in to the bucket and put worms in it. But I didn’t touch it because I don’t like touching the worms. Then we dumped them out so we could see if they would die. |
|          | 3- | I like to feel [touch] the trees. The bugs fell down and we pretended they spread. |

| Sand      | 1- | I like to build castles in the sand. |
|          | 2- | I love to dig in the sand box. Sometimes I make a sand castle with wet sands. |
|          | 3- | I like jumping in the sand. |
|          | 4- | I throw the sand around. We make a big mountain, with lava coming out or make sand castles. |
|          | 5- | I just mix stuff and pretend to make cakes and sometimes pretend to make food. |
|          | 6- | I just dig and dig in the sand until I get to the bottom. |
|          | 7- | I like the sand pit. I play with my friends and build whatever we want. I like digging in the sand. |
|          | 8- | I like to play “sand wolves” and “sand snow”, and “sand sisters”. What I like about is because you get to do whatever you want. I pretend soft snails. We pretend to be soft and we have to live in soft otherwise we will die. |
|          | 9- | My friends and I collect sand and pretend it is pixy dust; some type of sprinkles that you think it is sprinkles that you use to make cake or cup cake. |
|          | 10- | I like to play in the sandbox and make cakes, sand pies, and pancakes. |

| Logs      | 1- | We trip over the logs |
|          | 2- | I like to jump on to the swing from the logs and swing off of it and do a back flip. |

| Stick     | 1- | Sometimes we play with sticks and pretend on the stage. |
|          | 2- | I like to pick up sticks and play with them. I throw them and sometimes I scrape shells with them. We pretend fire with sticks. |

| Mulch     | 1- | We play mulch fight. You throw mulch at others and try not to get mulch on their eyes. |
|          | 2- | I like to play “catch the mulch”. It’s where you get a certain amount of mulch and see who has got the most. |
|          | 3- | We throw mulch and drop it down the slide, and by the staircase [of the structure]. We like to play with the mulch. We fall on the mulch sometimes, but even it is softer than the grass. |

| Leaves and grass | 1- | I grasp the grass. |
|                 | 2- | We put straws in trees, so the trees become “strawee”, so the straw will be all over the trees. If you put the most straw on the tree you win! |
|                 | 3- | Sometimes we roll on the grass, the grass is so soft. Sometimes we dig in the grass, and sometimes we pull the grass so we can make ‘stew’ |
|                 | 4- | We just dig and build castle and we just put the grass over the castle. |

Classifying children’s preferred elements into categories (number of codes=144), the interview findings suggest that respectively, children preferred natural loose (40%), manufactured loose (29%), manufactured fixed (28%), no elements (27%), and natural fixed (20%) elements (Children could have preferred several elements in one responses). Comparing the within ranges of preferred cognitive play provided by natural loose elements (N=40), children mostly desired engaging in dramatic play opportunities (n=18, 45%) with elements such as sand, sticks, or leaves. Across categories of elements, children noted they were more likely to engage in constructive (N=17, n=6, 35.3%) exploratory (N=9, n=5,
55.6%), and dramatic play (N=49, n=18, 36.7%) behaviors when playing with natural loose elements. Children also mentioned how they employ sticks or mulch in their games (n=4, 10% of mentioned instances). Combining the findings from the behavior mapping and interviews, the results highlight the importance of natural loose elements for stimulating diverse spectrum of cognitive play behaviors that children enjoy.

5 DISCUSSION

This study aimed to expand knowledge on how natural loose elements in outdoor preschools contribute to children’s cognitive play behaviors. Nicholson (1971) describes “the theory of loose parts” as a means of recognizing how children can interact and use open-ended play materials and manipulative elements in playgrounds. Nicholson asserts the inclusion of loose parts in the environment offers many play chances and stimulates creativity that is unlikely found in settings with fixed elements. The findings line up with “the theory of loose parts” and prior research (Czalczynska-Podolska, 2014; Jansson, 2015; Norodahl & Einarsdottir, 2015; Malone & Tranter, 2003; Maxwell, Mitchell, & Evans, 2008; Woolley & Lowe, 2012; Zamani & Moore, 2013), suggesting that the availability of loose elements amplify chances of constructive, exploratory, dramatic play, and games.

The observation showed that natural settings in different playgrounds provided various loose elements such as dirt, sand, sticks, or logs. These elements stimulated children to shape their surroundings and develop their creative, dramatic, and constructive abilities, as suggested by previous studies (Moore & Wong, 1997; Fjortoft & Sageie, 2000; Tai, Haque, McLellan, & Knight, 2006; Zamani & Moore, 2013). Consistent with prior studies (Fjortoft & Sageie, 2000; Jansson, 2015; Maxwell et al., 2008), children preferred loose or modifiable elements and noted that the abundant natural loose elements inspired their constructive and dramatic play. In agreement with previous research (Gehris et al., 2015; Norodahl & Einarsdottir, 2015; O’Brien & Murray, 2007; Ridgers, Knowles, & Sayers, 2012), children enjoyed collecting sticks and leaves to shape hiding and child-scaled spaces in the natural playground. Recent literature is concerned about children’s opportunities to explore their surroundings (Louv, 2005; Moore & Tranter, 2003). Creatures, ecosystems, water, sand, dirt, and trees in the natural settings fascinated children and inspired their exploratory play, which is consistent with previous literature (Fjortoft & Sageie, 2000; Lester & Maudsley, 2007; Norodahl & Einarsdottir, 2015; O’Brien & Murray, 2007; Ridgers et al., 2012; Titman, 1994). These exploratory experiences stimulated children’s scientific curiosity to create realistic theories about the world (Waite, 2010). Natural features provided positive outcomes on children’s knowledge about nature, supported hands-on learning experiences, and promoted children’s curiosity and sense of wonder (Fjortoft & Sageie, 2000; Gehris et al., 2015; O’Brien & Murray, 2007; Ridgers et al., 2012; Waite, 2010).

Moore and Wong (1997) have pointed out that small animals and creatures support exploratory and learning behavior in children, in addition to enhancing the attractiveness of the outdoor learning environment for them. Consistent with previous research (Norodahl & Einarsdottir, 2015; Titman, 1994; Waller, 2006) children were enthusiastic to interact with creatures and expressed a sense of surprise and complexity towards the natural phenomena. For instance, stones, trees, or dirt created natural settings that children were curious to explore for worms, bugs, or ants (Figure 3).

Figure 3. Children were curious about creatures around the natural environment. Photo by the author.
Loose elements, such as sand or dirt, inspired children’s dramatic play behavior, as documented in other studies (e.g., Moore & Cosco, 2010). In accord with previous views (Jansson, 2015; Moore & Wong, 1997; Woolley & Lowe, 2012), children mentioned sand as one of their most favored elements in the outdoor preschool. They were observed playing in sand areas for long periods of time, engaging in dramatic and constructive play. Sand or dirt offered shapeable, loose, and light quality elements that were transferable with hands or containers. Children mentioned how they shape imaginary objects, such as “castles”, “poison”, “soup”, “food”, or “magic powder” with sand or dirt. Congruent with prior studies (Fjortoft & Sageie, 2000; Jansson, 2015; Moore & Wong, 1997; Sandseter, 2009), incorporating natural features, such as logs, provided essential challenging, complex, and interactive opportunities that positively inspired children’s learning through flexibility and mischievousness (Sandseter, 2009; Waters & Begley, 2007) (Figure 4).

![Figure 4](image1.png)

**Figure 4.** Children collected logs and sticks to create “tents”, “castles”, or “prisons”. Photo by the author.

The findings from this study indicate children’s preferences for making ‘their own places’ or ‘houses’ with natural loose elements. These findings are in harmony with prior studies showing the significance of enclosed, self-created spaces for children (Fjortoft, 2004; Jansson, 2015; Malone & Tranter, 2003; Norodahl & Einarsdottir, 2015). Further, children collected small tree logs, leaves, and sticks in the natural playground to build imaginary “houses”, “forts”, “camp fire”, or “prisons” (Figure 5), or engage in games with the sticks as “swords”.

![Figure 5](image2.png)

**Figure 5.** Children imagined creating fire with the sticks. Photo by the author.

Children enjoyed mixing and relocating these elements for dramatic play and game with rules. For example, similar to prior literature (e.g., Fjortoft & Sageie, 2000; Moore & Wong, 1997; Tai et al., 2006),
leaves and flowers inspired children’s constructive, explorative, and dramatic play opportunities. Children preferred collecting, mixing, and forming leaves and flowers to create 'soup' or 'food'. In summary, the findings from this study accentuate the value of natural loose elements for motivating children's cognitive play behaviors.

6 CONCLUSION

This study adds to the current knowledge about children's views on the outdoor preschool environment, listening to their preferences and experiences during free play. Complementing the theory of loose elements, this study displays the cognitive play value of natural loose elements for diverse spectrum of cognitive play, including constructive, exploratory, dramatic, and game with rules. Children enjoyed collecting, shaping, and creating new objects with the accessible and available natural loose elements that promoted their imagination. The existing animals and creatures in natural settings inspired children's curiosity and exploratory play that is rarely offered in contemporary playgrounds.

The present study has been limited, particularly concerning the number of participants. Future research might explore children's behavior and preferences from different ages, genders, and socio-economic status. Another limitation was concluding based on observing a single outdoor preschool. Future studies interested on the role of built environment and children's development are suggested to explore how diverse elements in different outdoor preschools contribute to children's cognitive play opportunities. The research informs landscape architects, policy makers, and teachers on the value of natural loose elements for diverse cognitive play stimulation in outdoor preschools. Finally, all indications are that including natural loose elements is a prerequisite for children’s learning and an effective impact on children's cognitive play behaviors.

6.1 Endnotes

1 For more information visit: www.naturallearning.org

7 REFERENCE


DESIGN IMPLEMENTATION

Edited by Bo Yang
VEGETATION IN DRYLAND BIORETTENTION SYSTEMS

COFFMAN, REID
College of Architecture and Environmental Design, Kent State University, rcoffma4@kent.edu

GRAVES, DARREN
College of Architecture, University of Oklahoma

VOGEL, JASON
Biosystems and Agricultural Engineering, Oklahoma State University

BROWN, GLENN
Biosystems and Agricultural Engineering, Oklahoma State University

1 ABSTRACT
Suburban development in dry-land locations requires stormwater controls that are both functional and visually acceptable thus requiring an understanding of establishment and growth of drought-tolerant vegetation that matches dry soil and climatic conditions. Profiled here is a case study of four projects, constructed from 2007-2014 under drought conditions, deploying native and non-native drought tolerant species planted under different aesthetic themes in four settings: residential green space, residential street ROW, residential lot, and civic gardens. The systems use sand and pervious engineered growing media to allow for stormwater infiltration and underdrains to de-water in non-percolating sub-soils. Described here are the proposed vegetative selections and landscape design intentions. Results of a field inventory showed good survival and health in Ilex vomitoria (Yaupon Holly), Acer ginnala (Amur Maple), Perovskia atriplicifolia (Russian Sage), Hemerocallis spp. (Daylilies), Artemisia ‘Powis Castle’ (Wormwood), Salvia greggi (Autumn Sage), and Schizachyrium scoparium (Little Bluestem). The mesic-hydric adaptive growers of Itea virginica (Virginia Sweetspire), and Juncus effusus (Rush) had limited survival and poor health. And in a comparative sub-set study using in-field Normalized Differential Vegetation Index (NDVI) recordings, street right of way bioretention systems (0.48) were more productive than traditional tree lawns (0.38). Recommended are two plant palette leads for consideration.

1.1 Keywords
Rain garden, vegetation, dryland, bioretention, green infrastructure, plants
2 INTRODUCTION

We live in an increasingly urbanized world and cities in dryland locations experiencing growth in population require climatically responsive forms of contemporary stormwater infrastructure. Although, arid or semi-arid cities may experience less annual rainfall than more temperate locations, plains locations can experience high intensity storm events coupled with long periods of drought. This pattern of extreme weather requires ‘green’ infrastructure and its vegetation to be matched to local climate and growing conditions. The aesthetics and management practices of green infrastructure must also be in line with the context of the civic stormwater infrastructure.

The process of urbanization appropriates natural resources for human uses and alters the physical and biogeochemical environment of local, and often distant, natural systems (Rees and Wackernagel 1992). To counteract these impacts, green infrastructure (GI), a network of landscape elements that mimic natural systems with vegetation, soils, and natural processes, is being proposed as a form of quasi-contextual infrastructure to accommodate urbanization (Bolund and Hunhammer 1999; Benedict and McMahon 2006). GI comes in a variety of forms (green space, holding ponds, rain gardens, green roofs, etc.) The main objective of GI design has been to avoid stormwater transport directly to sewer systems and water bodies to prevent flooding and downstream water quality degradation. GI has been popularized through the multidisciplinary approaches of Low Impact Development (LID) (LID 2014), and has found its way into the regulatory sphere of stormwater control measures (USEPA 2014). For this reason it is important to explain and attempt to use cross-disciplinary terminology when discussing a GI approach.

Late twentieth century green space communities and conservation sub-division developments using ecological planning approaches contributed to the success of an alternative way of managing urban water resources through the processes of infiltration and evapotranspiration (McHarg 1971, Girling, C. and Kellet 2002, Yang et al 2010). The term ‘green infrastructure’ would come later as rebranding of this approach (Benedict and McMahon 2002). More recently, in the effort to optimize these stormwater approaches from an edaphic perspective on smaller scales the study and conceptualization of ‘bioretention’ was advanced (Hsieh and Davis 2005). Bioretention systems are stormwater mitigation measures that use low impact approaches to reduce discharge and improve runoff water quality (Hunt et al 2015). The term bioretention system includes rain gardens, which may have intended aesthetic purposes; or biofiltration systems which are implemented for particular pollutant material removal. The term ‘bioretention cell’ is used when referring to a single contained part of the system.

In dryland regions stormwater has been managed through bioretention systems to slow and retain runoff, while capturing pollutants and creating specific aesthetics in residential communities (Wenk and Gregg 1998). The aesthetics and functionality are created by unique and particular soil and plant selections that can thrive in inundation and drought. The matching of vegetation type to hydro-periods and individual species to soil moisture conditions is critical to the success of dryland bioretention system (Li, et al. 2011 and Houdeshel et al. 2015). As studies on bioretention systems have focused mainly on understanding and optimizing soils, chemistry and hydrology, while the literature on plants has supported the design profession with publications of plant lists. Previous publications address plant selection by vegetative type; trees, shrubs, etc. (Dunnett and Clay 2007) individual traits (Fairfax county 2007) and aesthetic characteristics of formality (Missouri Botanical Gardens 2015). Common to all publications is the matching of vegetation with the expected soil hydrology and regional climate. This paper aims to present the observations of vegetative survival and health in applied dry land projects and offer recommendations towards lead plant palettes for future bioretention systems.

3 PROJECTS SITES

Four bioretention projects in five locations have commenced in the Oklahoma south central plains since 2007 (Figure 1). The projects occur in residential, civic, institutional and commercial land uses in three Oklahoma watersheds provide examples of a dryland approach to rain garden design. Trailwoods Greenstreet, (Norman, OK), Bioretention Cells (Grove, OK) Carrington Lakes (Norman, OK) and Deerfield Estates (Oklahoma City, OK) utilize highly porous growing media with sub-drains where dry-adapted rain garden vegetation is used to improve stormwater quality while providing a range of garden aesthetics. Across the projects, 43 individual gardens have been planted in bioretention systems.
The South Central plains region experiences extreme weather conditions with long hot and dry periods. Droughts are frequent and coupled with both high and low temperatures. Rainfall has high spatial, volumetric and intensity variation. Convection thunderstorms, common in the region, can drop 100 year rain event in a small basin and no rainfall in the adjacent basin. Thunderstorms are commonly followed by long periods without rainfall. These extreme conditions create difficulties for vegetative establishment and consistent visual appearance making the region acceptable for studying dryland landscape installations.

Figure 1. Map showing project locations in Norman, OK (Carrington Lakes), Oklahoma City (Deerfield Estates), Stillwater, OK and Grove, OK.

3.1 Grove and Stillwater

Ten bioretention cells have been constructed in a variety of land use settings in Grove and Stillwater, Oklahoma (Figure 2). Cells range in size from 19 m3 to 435 m3 (25 to 569 yd3), and embrace residential, commercial, and public sites. The project as part of an ongoing study to demonstrate the pollutant removal effectiveness of bioretention technology of cells amended with fly ash (Chavez et al., 2013). Of the ten cells, two are residential properties, six are public or municipal properties, and two are commercial properties. They were design in 2005-06 and constructed in 2007. All the Grove cells and one of the two Stillwater cells possessed organically amended topsoil at the surface with 30 to 36 inches of Dougherty sand mixed with 2.5% fly ash (for phosphorus retention) with subdrains overlaying parent clay soils. The other Stillwater cell is similar but without the fly ash mixed into the media. All the cells in Grove and Stillwater are covered with approximately 1 inch of hardwood mulch.

Figure 2. The Grove project has 8 planted bioretention cells. Aesthetic maintenance ranges a highly maintained civic site (left) a self-organized commercial site (middle) and intensively maintained residential site (right).

3.2 Carrington Lakes

The bioretention project at Carrington Lakes was to integrate into the site development plan to create 11 rain gardens as mid-stream interceptors that are phased in with each residential neighborhood section. Currently the community has installed 8 rain gardens and one biofiltration system. All the rain gardens are located in the publically accessible green space, cleansing 5 acre basins delivering surface flow runoff to constructed lakes and ponds. The bioretention catch first flush events form the development
prior to water entering the pond. Aesthetically, the gardens offer flowering perennials and shrubs to a verdant pastoral style landscape and are managed by the community homeowners association. Located in Northwest Norman, Oklahoma in the Little River basin of the Lake Thunderbird watershed, the community is a non-gated single family residential neighborhood covering 173 acres with 27 acres of designated public open space, including 9 acres of lakes and 2 miles of pedestrian trails (Figure 3). The cells in Carrington Lakes contain media of 70% lightweight expanded clay, 20% Dougherty sand, and 10% amended organic existing clay soils with sub-drains overlaying parent clay soils.

Figure 3. Carrington Lakes has 7 rain gardens in the greenspace and public areas. Left to right entry monument, greenspace, pond, rain garden.

3.3 Trailwoods

Trailwoods residential community is located in the northern section of Norman, Oklahoma in the Little River basin of the Lake Thunderbird watershed. The design and monitoring of the project are funded by an EPA Grant provided through the Oklahoma Conservation Commission. The construction was funded through a private sector partner, Ideal Homes. The project goals are to help clean the stormwater runoff within the watershed that supplies the City of Norman’s drinking water. The rain garden is designed to clean stormwater through the use of plant material and specialized engineered soils. The project is designed streetscape within the public right-of-way of the neighborhood street (Figure 4). The streetscape is intended to mitigate surface water flows and nutrient loads. Trailwoods Greenstreet was created by offering public-private rain gardens at the street edge to improve water quality and enhance community. The Master Plan was completed in the Winter of 2010, construction of the homes began in March of 2011, and the last home was finished in July of 2013. Monitoring equipment was installed in the Spring of 2013 and was completed and became operational in October of 2013. The cells in Trailwoods contain media of 70% lightweight expanded clay, 20% Dougherty sand, and 10% amended organic existing clay soils with sub-drains overlaying parent clay soils.

Figure 4. Trailwoods has 17 street side rain gardens. Left to right early Summer display of Autumn Sage, dryland plants, and homeowners participating in stewardship.

3.4 Deerfield Estates

Deerfield Estates is located in Oklahoma City, Oklahoma in the Hogg creek basin of the Little River basin and has a collection of five residential bioretention cells designed in different thematic concepts of “Strong Frames”, “Forest Brook”, and “Green Swing”. The gardens are placed within homeowners’
property lines that also correct issues within each site (Figure 5). All the gardens educate the homeowners and their neighbors of the use of native plant material for Oklahoma that not only requires little maintenance, but also beautification of their outdoor space. The bioretention cells, also known as rain gardens, have many attributes; such as: a storage location, physical filter, chemical reactor, and a biological degradation system for stormwater and wastewater. This project serves to reduce non-point source pollution urban runoff, phosphorus and sediment applications that may be applied by homeowners. Construction began in the Summer of 2013 and finished in the Spring of 2014. Maintenance and construction corrections were continued throughout the summer; as well as working with homeowners through stewardship maintenance/practices. The cells at Deerfield Estates contain sorted sand media overlaying sandy, well-drained soils. Only one of the cells at Deerfield estates has an underdrain, because of a relatively shallow water table at that site. All the cells at Deerfield Estates are covered with approximately 1 inch of hardwood mulch.

Figure 5. Deerfield Estates three rain gardens and two bioretention systems.

4 VEGETATION

4.1 Conceptualization

The cells were conceptualization by different design teams influencing the selection of vegetation. A common goal was achieving establishment with drought tolerant species in highly porous soils, and stewardship of the vegetation relied on creating gardens that served additional purposes. In Grove and Stillwater imported sand was the primary substrate; in Trailwoods and Carrington Lakes expanded clay was used and in Deerfield Estates sand from the project sites was used.

Within vegetation selection, concepts were developed through visualization studies that addressed each site’s context. The stakeholder’s input were taken; including property owners and owner’s representatives for new construction. Conceptual imagery was combined with a materials palette that included vegetation and substrates to aid in plant survival and meet owners aesthetic and maintenance expectations (Figure 6). Plant typologies were selected based on each site’s developing design intent. For example, entry and gateway palettes were developed for residences at Deerfield Estates. The individual species possessed aesthetic traits to contrive the setting, while having high likelihood of establishing and surviving in the edaphic and climatic conditions. These conceptuals were used to gain feedback from stakeholders and the design team. The revised design proposals entered schematics, or in some projects went directly into construction drawings.

Another commonality of the projects was that plant selection targeted nursery available species in the South Central plains. They were a mix of exotic horticultural varieties and natives. A few genera common to all projects were Hemerocallis spp., Ilex spp., Pennisetum spp. and Betula spp. Distinction of vegetation was more common in the projects and individuals cells and gardens.

4.2 Implementation and Establishment

The gardens were installed by various contractors with standard horticulture installation practices. Necessary site work was performed and substrate was prepared or installed. The installation of vegetation
occurred primarily through plugs, pots, and container plants. The majority of trees were balled and burlapped. Installation of plants occurred throughout the year with a concentration in the summer months. Sites were established under varying irrigation regimes. Trailwoods and residential gardens in Grove and Deerfield Estate received more irrigation. At Carrington Lakes routine irrigation was used provide to certain gardens, while others received little to no irrigation.

Figure 6. Imagery of the conceptualization process: Bioretention cells and rain gardens were conceptualized with substrates and vegetation in palettes that met various contextual issues to aid establishment and ownership stewardship. These gardens took on landscape themes such as thresholds, gateways, landscape follies, foci, and edges.
5 METHODS

The recording of vegetation included site observation, field inventory, photographic recordings, and Normalized Difference Vegetation Index (NDVI). Duration and frequency varied based on time of installation and age of project. Site observation included random field visitation during the growing periods. Young (>2 years), establishing projects received more frequent visitation than older, established projects. In the Grove, Stillwater and Trailwoods sites vegetation community composition was recorded as a percent cover of the cell or garden through census field measurement of each garden. Photographic records of species and gardens were used to assess the health quality. Health was determined by plant form, leaf color, and canopy density in five categories based on the characteristics of a model species: Very good, Good, Present, Struggling, and Not present were used to qualify the level of health. Survival was compared to quantity when installed when quantities were known. When quantities were unknown field inspection recorded individual plants of the species when missing from massing and rows. This was indicated as high (>85%), medium (84-50%), and low (<50%). These were used for all types of vegetation.

To explain vegetative performance Normalized Difference Vegetation Index (NDVI) was recorded in 2014 in Trailwoods bioretention cells. NDVI is calculated from the visible and near-infrared light reflected by vegetation as a measure of Photosynthetically Active Radiation (PAR), biomass and ecosystem productivity. NDVI at the plant level is linked to plant health (Guo et. al 2008) at the landscape and watershed scales have been linked to stream health (Griffith et. al 2002) and in green roofs used for plant establishment in water deficit conditions (Nektarios et. al 2013). NDVI was used to examine the productivity of the vegetation in the bioretention cells as single point- in-time measurement late in the growing season and compare to the ground plain in conventional tree lawns. A handheld NDVI meter (GreenseekerTM) took one recording per 50 m2. The measurements were used for the comparison of cell to one another and non-garden sites in the control basin. The comparative analysis used a matched pair T-test on 56 pairs to determine significant difference in mean values at the 0.05 level.

Climate was warmer with less than normal precipitation throughout the period of bioretention cell establishment. Climate data was taken from Will Rodger’s Airport for all sites, Oklahoma City, Oklahoma (NOAA). Between 2007-2014 Central and Eastern Oklahoma experienced three years of normal temperature and precipitation and four years of drought and extreme high and low temperature. In 2010-2011 the sites experienced extremely dry conditions including record potential evapotranspiration during the growing seasons and record high air temperatures (NOAA 2015). In 2011, Oklahoma City recorded the hottest days on record (113o F) and most consecutive days over 110o and 105o F (NOAA 2012).

6 PERFORMANCE

In the Grove, Stillwater and Trailwoods sites vegetation community composition was recorded as a percent cover of the cell or garden. Presented in Figure 7 are some observed trends. In highly maintained sites employing weed control the plant community remained similar to the original plant palette and species failing to establish could be identified. These cells were dominated by trees or shrub masses that expressed the aesthetic design intent of the setting. For example the Grand Lake Association bioretention cell was maintained with weed control to facilitate a “clean” ground plane. Deceased plants were not replaced leaving a larger percentage of bare soil or mulch. These changes also allowed for an aesthetic dominance of Pine and Birch in the view. On the other hand when maintenance was removed the plant community shifted towards greater coverages of volunteer species. These species were native and exotic volunteers. At Elm Creek Plaza site Johnson Grass increased to cover the ground plane while Ambrosia spp. (Ragweed) emerged as a native weed. The site contained Amur maple, Loblolly Pine and Shrubby Cinquefoil from the original palette.

The rain gardens possessed a higher mean NDVI (0.48) when compared to the lawn (0.38), $t(55) = 3.38$, p<.001 using JMP software (Figure 8). The higher values signify greater quantities of plant biomass in the gardens and correlate to nutrient and water capture in plants. Deerfield Estates was assessed upon installation and future recordings are planned. A comparative analysis across projects may be possible.

Plants that were observed across the majority of projects included Ilex vomitoria (Yaupon Holly), Acer ginnala (Amur Maple), Perovskia atriplicifolia (Russian Sage), Hemerocallis spp. (Daylilies), and Artemisia ‘Powis Castle’ (Wormwood). Natives that show presence and good health in several locations include Salvia greggi (Autumn Sage), and Schizachyrium scoparium (Little Bluestem). Species of native
primrose Calyophus drummondianus var. berlandieri (Texas Primrose) and native cultivars Echinacea ButterflyTM Julia (Coneflower) were used rarely but have shown isolated success.

**Figure 7.** Grove Ok: Two bioretention cells experience different plant community composition over 5 year period. Grand Lake Association (left) was intensively maintained with weekly weeding program while Elm Creek Plaza (right) was allowed to self-organize.

Species that failed to establish were more mesic-hydric growers including *Itea virginica* (Virginia Sweetspire), and *Juncus effusus* (Rush). Rush survived at Carrington near the inlet, but never flourished. Junipers appear to have good potential, but are showing mixed results. *Juniperus sabina* ‘Broadmore’ (Broadmore Juniper) and *J. procumbens* ‘Nana’ and *J. conferta* ‘Blue Pacific’ (Blue Pacific Juniper) all have excellent groupings, but each species has individuals that have died. Smaller trees that established well are *Chilopsis linearis* (Desert Willow) and *Acer ginnala* (Amur Maple). Shade trees have shown less consistent development across sites. *Platanus* cultivars ‘Bloodgood’ and ‘Exclamation™’ (Planetree) and *Betula nigra* ‘Heritage’ (River birch) have advanced in most gardens *Ulmus parvifolia* Allee cv. ‘Emer II’ has established well. *Pinus taeda* (Loblolly pine) has established in most gardens but has struggled to recover from ice storm damage.
Table 1. Plant species data for all project sites.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Media</th>
<th>Year</th>
<th>Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer ginnala</td>
<td>Amur Maple</td>
<td>E</td>
<td>5+</td>
<td>VG</td>
</tr>
<tr>
<td>Artemisia ‘Powis Castle’</td>
<td></td>
<td>E</td>
<td>5+</td>
<td>VG</td>
</tr>
<tr>
<td>Betula nigra</td>
<td>Riverbirch</td>
<td>S/E</td>
<td>5+</td>
<td>F</td>
</tr>
<tr>
<td>Buxus sinica var. insularis ‘Wintergreen’</td>
<td>Wintergreen Boxwood</td>
<td>S/E</td>
<td>5+</td>
<td>G</td>
</tr>
<tr>
<td>Calyphus drummondianus var. berlandieri</td>
<td>Texas Primrose</td>
<td>S</td>
<td>2</td>
<td>G</td>
</tr>
<tr>
<td>Cercis canadensis</td>
<td>Common Redbud</td>
<td>S/E</td>
<td>5+</td>
<td>G</td>
</tr>
<tr>
<td>Chilopsis linearis</td>
<td>Desert Willow</td>
<td>E</td>
<td>2</td>
<td>VG</td>
</tr>
<tr>
<td>Echinacea fulgida</td>
<td>Orange coneflower</td>
<td>E</td>
<td>2</td>
<td>G</td>
</tr>
<tr>
<td>Euonymus japonicas ‘Aureomarginata’</td>
<td>Golden Euonymus</td>
<td>S</td>
<td>5+</td>
<td>G</td>
</tr>
<tr>
<td>Hemerocallis ‘Stella de Oro’</td>
<td>Stella Daylily</td>
<td>S/E</td>
<td>5+</td>
<td>VG</td>
</tr>
<tr>
<td>Ilex spp.</td>
<td>American Holly</td>
<td>S</td>
<td>5+</td>
<td>G</td>
</tr>
<tr>
<td>Ilex vomitoria</td>
<td>Yaupon Holly</td>
<td>S/E</td>
<td>5+</td>
<td>VG</td>
</tr>
<tr>
<td>Itea virginica</td>
<td>Virginia Sweetspire</td>
<td>S</td>
<td>5+</td>
<td>N</td>
</tr>
<tr>
<td>Juncus effusus</td>
<td>Rush</td>
<td>S/E</td>
<td>5+</td>
<td>S/N</td>
</tr>
<tr>
<td>Juniperus conferta ‘Blue Pacific’</td>
<td>Blue Pacific Juniper</td>
<td>E</td>
<td>2</td>
<td>F</td>
</tr>
<tr>
<td>Juniperus procumbens ‘Nana’</td>
<td>Dwarf garden Juniper</td>
<td>S/E</td>
<td>5+</td>
<td>G</td>
</tr>
<tr>
<td>Juniperus sabina ‘Broadmore’</td>
<td>Broadmore Juniper</td>
<td>E</td>
<td>2</td>
<td>G</td>
</tr>
<tr>
<td>Liriope muscari</td>
<td>Big Blue Liriope</td>
<td>E</td>
<td>5+</td>
<td>VG</td>
</tr>
<tr>
<td>Liriope spicata</td>
<td>Lilyturf</td>
<td>E</td>
<td>2</td>
<td>VG</td>
</tr>
<tr>
<td>Lobelia siphilitica</td>
<td>Great Blue Lobelia</td>
<td>S</td>
<td>5+</td>
<td>F</td>
</tr>
<tr>
<td>Miscanthus sinensis</td>
<td>Maiden Hair Grass</td>
<td>S/E</td>
<td>5+</td>
<td>G</td>
</tr>
<tr>
<td>Oenothera berlandieri</td>
<td>Mexican Primrose</td>
<td>E</td>
<td>2</td>
<td>F</td>
</tr>
<tr>
<td>Oenothera speciosa</td>
<td>Evening Primrose</td>
<td>E</td>
<td>2</td>
<td>F</td>
</tr>
<tr>
<td>Pennisetum alopecuroides</td>
<td>Dwarf Fountain Grass</td>
<td>S/E</td>
<td>5+</td>
<td>G/F</td>
</tr>
<tr>
<td>Perovskia atriplicifolia</td>
<td>Russian Sage</td>
<td>S/E</td>
<td>5+</td>
<td>VG</td>
</tr>
<tr>
<td>Pinus taeda</td>
<td>Loblopy pine</td>
<td>S/E</td>
<td>5+</td>
<td>VG</td>
</tr>
<tr>
<td>Platanus ‘Bloodgood’</td>
<td>Planetree Bloodgood</td>
<td>E</td>
<td>2</td>
<td>VG</td>
</tr>
<tr>
<td>Platanus ‘ExclamationTM’</td>
<td>Planteer</td>
<td>S/E</td>
<td>2</td>
<td>VG</td>
</tr>
<tr>
<td>Rosa ‘Knock out’</td>
<td>Knock out Rose</td>
<td>S/E</td>
<td>5+</td>
<td>VG</td>
</tr>
<tr>
<td>Salvia gregii</td>
<td>Autumn Sage</td>
<td>S/E</td>
<td>2</td>
<td>VG</td>
</tr>
<tr>
<td>Schizachyrium scoparium</td>
<td>Little Bluestem</td>
<td>E</td>
<td>2</td>
<td>G</td>
</tr>
<tr>
<td>Sedum acre ‘Arabicus’</td>
<td>Stonecrop Sedum</td>
<td>E</td>
<td>2</td>
<td>S</td>
</tr>
<tr>
<td>Ulmus parvifolia Allee cv. ‘Emer II’</td>
<td>Allee Elm</td>
<td>E</td>
<td>2</td>
<td>G</td>
</tr>
<tr>
<td>Verbena canadensis ‘Homestead Purple’</td>
<td>Garden Verbena</td>
<td>E</td>
<td>2</td>
<td>S</td>
</tr>
</tbody>
</table>

1 S = Sand, E = Expanded clay; 2 VG = Very good, G = Good, F = Fair, S = Struggling, N = Not present; 3 H = high (>85%), M = medium (84-50%), and L= low (<50%).
7 RECOMMENDED PLANT PALETTE OPTIONS

From the observations of performing species in Table 1, we offer two options for the combination of lead species for future dryland investigation and trials. Some of these pairings were observed in particular sites, yet individual species are suggested to provide a practicality (conventional trade palette) or thematic (lumina palette) (Figure 9 and 10). Both palettes possess the expression of the dry-windy environments of the south plains through tones of foliage, exfoliating bark, and flower size, shape, and color. The conventional includes more temperate color and texture aesthetics, while the lumina palette includes more arid texture and color aesthetics. This higher intensity light and resilience to environment phenomena can be used as defining themes in plant palette development.

Figure 9. A suggested ‘conventional trade palette’ where *Hemerocallis* spp. (Daylilies) (Left), and *Rosa* ‘Knock out’ (Knock out Rose) (Right) are used as leading organizers in texture, color, and seasonality. *Schizachyrium scoparium* (Little Bluestem) (Center left) offers and fine textural contrast with native seasonality in winter color while *Platanus* spp. (Planetree) (Center right) offers a exfoliating bark, open canopy, white light quality and dappled shade.

Figure 10. A suggested ‘lumina palette’ where *Perovskia atriplicifolia* (Russian Sage) (Left), *Artemisia* ‘Powis Castle’ (Wormwood) (Right). *Schizachyrium scoparium* (Little Bluestem) (Left center) provide a garden structure made of highly tinted foliage which is contrasts with the shaded tones of *Ilex vomitoria* (Yaupon Holly) (Center), and seasonal expressions like *Calyophus drummondianus* var. *berlandieri* (Texas Primrose) (Right center).

8 DISCUSSION

All projects have been monitored for their influence on stormwater runoff water quality. Deerfield Estates, Grove and Trailwoods are assessing runoff quantity. Because vegetation assists with nutrient retention (Lucas and Greenway, 2008) while providing important aesthetic and biological associations
conditions without irrigation with only reduced foliage and bloom. Native full foliage, and respectable bloom. It was observed to persist after the first season during severe climatic exhibited an unexpected growth and health in several locations. Like the performance when nutrients are added. proper maintenance practices. homeowners at Deerfield Estates throughout the year of 2014 to answer questions and demonstrate trade-offs in water quality goals. If Deitz et al (2004) are correct then long standing behaviors (and practices) using and the practice of using garden and lawn fertilization for plant establishment could be undermining water bioretention cells. In a few isolated cases, fertilization was observed in the rain gardens. The prevalence with the homeowners to discuss any questions and concerns with the maintenance of the gardens and other plant material concerns within the property. One workshop was held in January of 2014, May of 2014, and a final workshop in September of 2014. One-on-one workshops were often held with the homeowners at Deerfield Estates throughout the year of 2014 to answer questions and demonstrate proper maintenance practices.

In some projects, warm season fertilization was observed in the lawn areas adjacent to the bioretention cells. In a few isolated cases, fertilization was observed in the rain gardens. The prevalence and the practice of using garden and lawn fertilization for plant establishment could be undermining water quality goals. If Deitz et al (2004) are correct then long standing behaviors (and practices) using conventional practices to establish and maintain healthy vegetation may create trade-offs in water quality performance when nutrients are added. The selections of vegetation, by the various designers and constructors of the project showed a relative reliance on local nursery supply. Few selections were experimental species or varieties; instead the proposed designs were, in large part, examining the adaption of currently available materials. In mesocosom studies, Houdeshel et al. (2015) examined one shared species Schizachyrium scoparium (Little Bluestem) and an Artemisia species in upland conditions that showed net-export of NO3. While the wetland treatment in their study performed better as nitrogen sink, they suggest increasing plant density in the upland setting for improve biogeochemistry, which may be influenced by the soil microbial community. However, their discussion was limited on plant diversity, productivity, growth and species health. Although only used in only the more recent project sites in our study, S. scoparium established quickly and individual plants exhibited high shoot growth in the first two seasons.

In the breadth and duration of this study, additional species were installed in projects and sites, but episodic record keeping prevented a comprehensive cataloging of all failed species. Therefore, the species listed here tended toward the clear survivors and a few species that repeatedly failed across several projects and sites. Of the most successful, Ilex vomitoria (Yaupon Holly) a native to Oklahoma, grows in both sandy as well as clay soils, but has shown to do well with enhanced good rooting conditions (Thetford et al 2015). Even though I. vomitoria tends to be successful in local soil conditions, the 36” depth of porous retention media may have offered a fitting rooting environment. It was used as an evergreen, as well as, a shrub for screening and massing across sites in sand and expanded clay mixes. Acer ginnala (Amur Maple) was not used often, but survived in nearly every recorded application and appeared in very good health when used. In two cases, it was one of the few plants that survived under neglect maintenance, when other species failed. Perovskia atriplicifolia (Russian Sage) and Artemisia ‘Powis Castle’ (Wormwood) are both well-known drought tolerant selections. P. atriplicifolia showed consistent and long duration bloom and dramatic establishment. In one project site, in which maintenance was provide by the research team during establishment, P. atriplicifolia new shoot growth was selectively removed from in areas where it was encroaching other species masses. These same plants experienced canopy growth into the street and sidewalk requiring tip pruning at the request of city officials. Hemerocallis spp. (Daylilies), including different forms of H. ‘Stella de Oro’, exhibited dependable survival, full foliage, and respectable bloom. It was observed to persist after the first season during severe climatic conditions without irrigation with only reduced foliage and bloom. Native Salvia greggi (Autumn Sage) exhibited an unexpected growth and health in several locations. Like the P. atriplicifolia its plant mass filled out to the size of a small shrub in which canopies grew across curbs providing every indication of strong native performer that offers long season blooms and massing.
The species lacking survival also tended towards nursery available species that were recommended in rain garden lists or adapted to wet settings, Houdeshel et al. (2015) illustrates that wetlands plants can be used in desert bioretention when hydric water regimes can be created thus providing an environment where species, such as *Juncus effusus* can establish and survive. Because the bioretention systems were designed with highly porous materials the failure of *J.effusus* and *Itea virginica* was likely due to poorly matched hydric regimes of the gardens, that were further stressed under the period of drought. Using *Juncus* spp., *Itea* spp. or similar hydrophilic vegetation requires the design of more intentional inundation periods that was not planned for in the projects and sites in this study.

The use of NDVI proved informative. Although, limited by its one-time data capture in this study, it provided insight into how plants contribute to the performance of urban bioretention systems. Kovachich et al. (2011) used NDVI to determine water regime impacts in green roofs planted with dry adapted plants, showing it has potential in urban green infrastructure applications and may offer designers, researchers and maintenance personnel quick feedback on the performance of the vegetation. We found it ways to use and the model to be dependable, transportable and helpful in observing and communicating the conditions of the sites.

Although limited to issues in the visual spectrum, NDVI provided a quantitative indicator of plant growth, health, and ecosystem performance. We found small, but marginal differences in the flowers, grasses and small shrubs of the bioretention gardens when compared to the turf grass lawn. While both systems require pruning and maintenance, creating an exportation of biomass, the resident biomass in the rain garden was higher. Because suburban bioretention is replacing turf grass areas the bioretention vegetation is creating net ecosystem function for the neighborhood, when compared to lawns. These measurements may have other localized interpretations when managing watershed nutrient budgets. Currently, NDVI is used to diagnose and prescribe nutrient applications in crops (Guo et. al 2008), and it is possible that future further examination could be linked to nutrient budgeting in bioretention, providing quicker and affordable ways to evaluate nutrient biogeochemistry in green infrastructure. Affordable handheld models are now market available (Govaerts and Verhulst 2015).

The sampling population of 56 matched pairs provides a limited “point-in-time” indication of vegetative health and performance. Because NDVI is a spectral range measurement it is sensitive to soil effects. In this study the site-based measurements could have been influenced by the soil surface color of the two treatments: rain garden (topsoil/expanded clay) and tree lawn (local oxide clays). However, using hand held devices does control for other NDVI limitations: cloud, atmospheric and spectral effects. Commonly, satellite NDVI is recommended to be coupled with site-based sampling, such as LAI, CO₂ flux or biomass to provide improved validity in productivity measurements (Gamon et al. 1995). The reason to employ site-based recordings is to overcome the inaccuracy of omitting non-photosynthetic biomass (woody material), known as canopy structural effects. Fortunately, the garden possessed large percentages of herbaceous material and only young woody plants. Another advantage of hand held NDVI is that the bioretention gardens are like agricultural and horticultural settings, in which they a have more uniform conditions than natural ecosystems and offer an alternative when representative destructive sampling is unrealistic. Box et al. (1988) explain NDVI’s positive correlation with NPP and GPP and it has been shown to indicate in ornamental plant health (leaf nitrogen) (Dunn et al. 2015¹; Dunn et al. 2015²). These advantages are improving popularity of hand held NDVI (Verhulst et al. 2011; Dunn et al. 2015).

Although, biomass and soil nutrient sampling would provide additional ground truthing it would also require additional collection, assessment and analysis by trained professionals. Assessing the NVDI of plant palettes would provide a group level assessment that could be comparative across projects. We recommend, future studies exam the relationships between NDVI and site-based measurements of biomass, LAI, CO₂ flux and other ecosystem function indicators to aid in the understanding of how vegetation contributes to bioretention systems performance.

9 CONCLUSIONS

In a multi-project study that was spatial distributed in the State of Oklahoma, we observed dry adaptive vegetation establishing and surviving within dryland bioretention systems created by decadal drought conditions. A field inventory showed high rates of survival and health in seven species during a dry climatic period: *Ilex vomitoria* (Yaupon Holly), *Acer ginnala* (Amur Maple), *Perovskia atriplicifolia* (Russian Sage), *Hemerocallis spp.* (Daylilies), *Artemisia ‘Powis Castle’* (Wormwood), *Salvia greggi*
(Autumn Sage), and Schizachyrium scoparium (Little Bluestem). While mesic-hydric adaptive growers of Itea virginica (Virginia Sweetspire), and Juncus effusus (Rush) had limited survival and poor health.

In a comparative sub-study, a street right-of-way bioretention system (0.48) was more productive than traditional tree lawn landscape (0.38) as recorded with in-field Normalized Differential Vegetation Index (NDVI) recordings t(55) = 3.38, p< .001). This is positive indication for the future use of NDVI as an affordable and non-destructive measurement of vegetative contribution to bioretention performance.

From these findings dry adaptive plants have can be considered for bioretention systems. Two small plant palettes provide lead options for building vegetative combinations that can establish in dry climates. These findings and methods can assist designers and researchers in Oklahoma, the Great Plains and settings that experience dryland conditions.

10 ACKNOWLEDGEMENTS

We would like to acknowledge the US EPA Region 6 and Oklahoma Conservation Commission for financial support of Grove, Stillwater, Trailwoods and Deerfield Estates projects, and Ideal Homes for financial and resource support for Trailwoods and Carrington Lakes projects.

11 REFERENCES


25. NOAA 2012 Record heat index http://www.srh.noaa.gov/oun/?n=climate-okc-heatwave

26. Thetford, M., Miller, D. L., Atwood, L. W., & Ballard, B. O. (2015). Microsite and rooting depth are more important than water-holding gel for establishment of restoration plantings of Ilex vomitoria on barrier islands in the Gulf of Mexico. *Native Plants Journal*, 16(2), 77-86.


HISTORY AND THEORY

Edited by Elizabeth Brabec
THE FORCE OF THINGS: LANDSCAPE DESIGN AND THE PANAMA CANAL

MILLIGAN, BRETT
University at California-Davis, bmilligan@ucdavis.edu

HOLMES, ROB
University of Florida, rob.holmes@ufl.edu

DAVIS, BRIAN
Cornell University, Ithaca, NY, brd63@cornell.edu

1 ABSTRACT

Ports and shipping canals are landscapes of utmost importance—geopolitically, economically, logistically, and ecologically. They are continually evolving landscapes, distributed globally and culturally significant. Despite this, the discipline of landscape architecture does not have a history of deep engagement with this landscape type. The Panama Canal offers an instructive example. This paper provides a historical and theoretical account of the construction of the Panama Canal—including locks, channels, displaced populations, the urbanized Canal Zone, and the instrumentalized watershed—as a landscape. Using Frederick Law Olmsted’s and Daniel French’s 1913 Report to the Fine Arts Commission as a starting point, and drawing from historical accounts, technical literature and contemporary theory, our analysis places cultural and natural forces on inseparable and equal footing. From this historical and theoretical investigation, this paper traces one pervasive characteristic of these maritime infrastructures, “feedback”. We argue that feedback both demonstrates the importance of direct engagement with maritime infrastructures by landscape architects and can be deployed as a conceptual tool to facilitate such engagement.

1.1 Keywords
Panama Canal, landscape infrastructure, large technical systems, Frederick Law Olmsted, Jr., ports, canals
INTRODUCTION

On October 22, 2006, the citizens of Panama approved the Panama Canal Expansion (Lacy, 2006), an infrastructural mega-project that is doubling the capacity of the Canal, the world’s most central and second most heavily trafficked (Kaluza 2010), trailing only the Suez. All along the coasts of North and South America ports are working to complete their own expansions – deeper channels and longer berths, larger shipping cranes and new container yards – with the goal of being able to receive the ultra-large ships that will begin transiting the Canal in 2016.

In recent decades there has been much interest in the topic of landscape infrastructure. This can be seen in influential contemporary work such as that of Pierre Belanger (2009, 2013), Alan Berger (2009), Sonja Duempelmann (2010) or Kristina Hill (Stevens, et al, 2014), as well as earlier writings by Michael Hough (1995), Gary Strang (1996), and Rob Thayer (1994), among many others [1]. As this trajectory takes shape in the field of landscape architecture, it can be understood in part as a response to the effects of now-rapidly changing climatic, ecological and economic conditions (Waldheim and Berger 2008). But it is also a response to the conceptual and material limitations of many of the roads, ports, electrical grids, levees and hydroelectric dams from an earlier generation of infrastructure, as well as the unintended consequences resulting from their construction, operation, and deterioration (Bélanger 2013).

As some landscape architects respond to contemporary conditions by turning toward infrastructure, the study of ports and shipping canals should emerge as an object of interest. These are places of globally significant impact—geopolitically, economically, logistically, and ecologically. As an infrastructural interface between land and water, they materialize processes of labor and flows of capital, dynamics of sedimentation and hydrology, and powerfully bind economic policy and technology with an industrial legacy of toxicity and environmental change. Landscape architects should be a part of the discourse around these maritime infrastructures, both learning from and contributing to them. But, in order to do so, we will need to grapple with both our own disciplinary history and the range of forces that shape ports and canals.

In this paper we attempt to begin that process by excavating a historical link between the discipline and a prominent infrastructural maritime landscape, the Panama Canal. We then mesh this with examination of certain periods of the history of the Panama Canal, contemporary theory, and landscape architectural practice to explore a conceptual tool – “feedback” – that landscape architecture can use to engage with these very large and expanding landscapes. Drawing on complex systems theory, we use feedback to describe nonlinear landscape change, where outputs become inputs, leading to processes of rapid aggregation, which in turn leads to qualitative changes of state.

THE CANAL REPORT

One of the important contributions of theoretical and historical projects that have dealt with landscape architecture, urbanism and infrastructure has been to identify earlier practices and theories in those fields that did similar work, albeit in a different form and using a different vocabulary. Contemporary revisionist histories by Anne Whiston Spirn (Spirn 1996), Elizabeth Meyer (Meyer 1997), and others have allowed for a critical reexamination of the work of Cleveland, Eliot, MacKaye, and Olmsted. In particular, such histories have examined the way some of their major public projects functioned as public infrastructural systems (Walheim 2006, 39). These excavations have aided in the recovery and development of conceptual tools that are proving important to contemporary efforts to rethink and reconstruct infrastructure as landscape.

The work of Frederick Law Olmsted, Jr. in Panama offers a similar starting point that is specific to the maritime infrastructures this paper is concerned with. As part of the 1912 Panama Canal Act, the Fine Arts Commission was to produce a report for the President of the United States “regarding the artistic character of the structures of the canal” (United States 1913, 5). As Vice Chairman of this commission Olmsted, Jr. went down to see the works of the Canal, along with the chairman and sculptor Daniel French, and to make recommendations as to its aesthetic qualities and any modifications that should be undertaken on the Canal works before it was completed. Their report was submitted July 26th of the following year, and ran in the New York Times that October (French 1913). In it Olmsted and French interpret their charge to report on the artistic character of canal structures to extend far beyond ornamentation and beautification. Indeed, they dispense with that role at the start, beginning with the succinct judgment that anticipated the more well-known ideas put forth by Le Corbusier nearly two decades later (Corbusier 1931): “the canal itself and all the structures connected with it impress one with a
sense of their having been built with a view strictly to their utility... like the Pyramids or some imposing object in natural scenery, [it] is impressive from its scale and simplicity and directness” (French 1913) [Figure 1]. This effect is similar to that identified by historian David Nye as the geometrical form of the technological sublime, which he described as “static and [appearing] to dominate nature through elegant design and sheer bulk.” Citing the engineer John Roebling, Nye noted that structures of this type were intended to have “very graceful, simple but at the same time substantial appearance[s]... and [were] intended to be unique and striking in [their] effect and quite in keeping with the surrounding scenery.” (Nye 1994, 77-78).

Figure 1. Bird’s eye view of Gatun Locks, Panama Canal, ca. 1913; note the sublime aesthetic quality of the locks themselves. Photo from the Library of Congress. No restrictions on publication that falls under fair use.

In addition to describing the existing monumental infrastructures in a way that offered a fully-formed modern aesthetic vision, the work of Olmsted, Jr. and French showed a genuine concern with the functioning of the ports and the canal, and the integration of the new infrastructures and concomitant urban development into the existing and projected regional landscape (United States 1913, 8). After a general analysis, they proceed to make recommendations for specific landscapes or projects such as the layout and future development to the port of Cristobal, and the town of Colon:

Cristobal is being completely enclosed with wharves upon which it is planned to erect continuous sheds, entirely cutting off the view of the town from the water. It will make the town more agreeable to live in and will enhance the appearance from the bay if the space now open at Dock 15, between the end of the present shed of Dock 11 and the southeast end of Dock 16, can be kept permanently open and free from sheds. The desirability of this is undoubted if it is found to be practicable.” (United States 1913, 9).

In this quote Olmsted and French acknowledge the importance of economic and engineering directives while asserting that attention should be paid to living conditions and visual connections across the landscape. Their recommendations reveal an interest in establishing reciprocal relationships between the land and the sea, the port town and the harbor, often through visual connections.

Throughout the document, integrating the landscapes of labor and recreation in rational and aesthetically pleasing ways is a primary objective, leading to some surprising conclusions. Regarding the design and future use of four small islands just off the Pacific coast, and the infrastructural network of causeways and dikes connecting them to the mainland [Figure 2] they write:

“These islands are connected with each other and with the mainland by dikes or causeways... it has been proposed to plant [the causeway road] with trees throughout its entire length. If the trees were planted near enough together to shade the road effectively they would completely shut out from the ships entering or leaving the canal the view of the city, which at present is very attractive... and they would tend to make the shore continuous with the island, and thus destroy the effect of its being an island. We therefore doubt the wisdom of such tree planting. It may be possible to plant groups of trees, presumably palms, near the ends of the causeway without impairing its effect... This should be carefully considered.” (United States 1913, 11).

While now serving as little more than a historical footnote, this document suggests the question of what could have happened if this report by Frederick Law Olmsted, Jr. and Daniel French had been the start of a long-term engagement with ports, canals, and other maritime infrastructure in the profession of
landscape architecture; a beginning instead of an aberration? The following sections of this paper trace a
series of incidents in the history of the same landscapes that Olmsted Jr. engaged, in an effort to
understand how those landscapes have developed and what leverage landscape architecture might find
within them.

Figure 2. “Two Women, Standing on hill, overlooking Pacific entrance to the Panama Canal, Balboa,
Panama” ca. 1916. Photo from the Library of Congress.

4 THE FORCE OF THINGS

‘Always “the force of things” had driven men to build at Panama... it had been the Spanish gold trail to
begin with, then the American railroad, then the de Lesseps canal. At times men had thought otherwise
and intended to build elsewhere, “but the force of things drives them to Panama and it will again.”

Bunau Varilla, 1900 (McCullough 1977, 283)

In the early 20th century the French military engineer Bunau-Varilla asserted that the strategic
geography of the Isthmus of Panama possessed agency, as if the place itself had conjured large-scale
undertakings since the start of global maritime commerce in the 16th century (Acemoglu, et al 2005). The
thin separation between oceans – less than fifty miles at the Canal site – has proven irresistible across
five centuries of global commerce. The terrain of the Isthmus has been modified by a succession of
infrastructural projects to serve as a conduit for goods and materials, and those infrastructures have
continually aggregated in size and scale as the global network of flows that they both serve and prompt
also grows. This type of relationship, where cause serves as effect and vice versa, is commonly described
as a feedback loop.

One of the contentions of this paper is that feedback is a useful concept for landscape architects
who seek to engage maritime infrastructures, since this characteristic can consistently be observed within
these landscapes, at the full range of scales at which they operate and materially manifest. In order to demonstrate this, we present three examples of feedback related to the Panama Canal, in ascending chronology and scale. The first example is material, and concerns the excavation of the original American canal route. The second example is territorial and occurs primarily between the original excavation and the current Expansion Project. Finally, the third example concerns the networked logistical effects of the Expansion at a hemispheric scale.

4.1 The Culebra Cut

The highest and most difficult portion of the original Canal project was known as the Culebra Cut. This ran through the saddle between two mountains on the Continental Divide. There the Divide is not the hard, stable basalts and schists of the lower elevations, but is a plate of soft shales, sandy limestone and calcareous sandstones over top of a basalt core. These softer stones were heaved and smashed together by plate subduction and volcanic activity beginning during the Miocene Era 20 million years ago. Consequently, that particular section demanded the greatest amount of excavation through the least stable geology at the highest elevation.

The volume of excavation initially required at the Culebra Cut was astronomical, a feat of earth-moving that required entirely new tools and techniques on a massive scale. In 1905 a newly designed ninety-five ton steam shovel built by the Bucyrus Company of Milwaukee began working in the Cut, a machine three times the size of the excavators used by the French in the same location. The techniques devised included an extremely careful choreography of drilling and blasting compacted rock, excavating spoils with the massive steam shovels, and loading them onto waiting dirt trains where they were then carted off to one of sixty engineered dump sites. On any given day during peak excavation, one hundred and sixty trains were hauling sixty thousand cubic yards of excavated dirt out of the Cut along seventy-six miles of track organized on seven levels. This track was constantly being removed and relocated to new excavating positions by teams of workers as the shovels worked their way through the blasted rock. By 1907, seventy-seven of the Bucyrus machines were among the shovels working to excavate over 96,000,000 cubic yards from the Continental Divide (McCullough 1977, 546-547).

Despite the sophisticated choreography of excavation and railroad technology employed in this task, the difficult geology of the Culebra Cut continually presented unexpected surprises. Because the soft surficial material of the Divide rested on a core of hard basalt, it was highly prone to sliding downhill when saturated. During the French effort it had been this Cut that had halted all progress. The technological historian David McCullough's description offers a useful insight:

> More immediate and much more discouraging were the slides in the cut through Culebra, which grew steadily worse the further the excavation progressed. (165)
> And later:
> This meant that the volume of excavation, the total cube, was being compounded steadily and enormously. The deeper the Cut was dug the worse the slides were, and so the more the slopes had to be carved back. The more digging done, the more digging there was to do. It was a work of Sisyphus on a scale such as engineers had never before faced. (168)

The most notorious of all of the landslides was known as the Cucaracha [Figure 3], characterized by Major Gallaird (for whom the Cut was originally named) as something much closer to a glacier than terra firma- always moving, slowly and with great force, and occasionally letting go of massive quantities of material (McCullough 1977, 550). By the end of the initial project more than 25,000,000 cubic yards slid into the Cut, taking lives, destroying equipment, and delaying the opening of the Canal by a year.

McCullough's realization that "the more digging done, the more digging there was to do" recalls the concept of feedback. Fundamental to this concept, which originates in thermodynamics, is the idea that causation is not linear but rather is a complex relation whereby effects reflect back on original causes and so can either work to counteract causal effects, maintaining a steady state, or can amplify deviations from the original conditions (Maruyama 1963). While originally useful in studying everything from radar and thermostats to bombs and the accumulation of capital, this concept is also useful for understanding aggregating effects in infrastructural landscapes. So in the case of the Culebra Cut, excavating fifty cubic yards of earth did not result in less material to be removed. Quite the opposite: an even greater volume came cascading downhill to replenish the excavated material.
The work of people such as Magoroh Maruyama and Ilya Prigogine led to a new understanding of material behavior, wherein non-linear systems (systems being a conceptual tool or construct to implicate an assembly of interacting things) are characterized by either negative feedback – the tendency to maintain a steady state – or positive feedback – the tendency to deviate from initial conditions (Maruyama 1968). Contemporary landscape architectural theory has explored the application of thermodynamic concepts to landscapes (Stemke 2011; Raxworthy 2014). However, the specific concept that a landscape is a non-linear assemblage containing mutual causal relations – feedback – has remained largely underexplored or taken for granted. The thermodynamic and cybernetic systems that Maruyama and Prigogine studied were understood to be of two different types: those that exhibited positive feedback or those defined by negative feedback. However, in the case of the Isthmus and the Culebra Cut – indeed, any real landscape – what is actually at work is multiple levels of both kinds of feedback, positive and negative within a single entity- the landscape of the Panama Canal. The result is a wildly unpredictable situation operating simultaneously at multiple scales and that tends to maintain a stable, steady state, until it doesn’t. And then after a time it does again.

Figure 3. The Famous Cucaracha slide, Panama Canal, ca. 1910-1914. Photo from the Library of Congress.

4.2 Water Resource Management as Feedback
Infrastructures are socio-technical systems. They are conceived of, built, maintained, and fail according to the practices and exertions of diverse communities of actors through time (Hughes 1997, 51-82). In the case of the Panamanian Canal, engineers, governmental organizations, corporate entities, local coalitions, neighborhood groups, and other communities have all played roles in constructing, maintaining, derailing, and radically altering its infrastructural landscapes over time. The infrastructure of the Panama Canal grew multiple times between initial construction and the current, well-documented Expansion Project. Often, these aggregations occurred in ways that were more subtle than the heroic steel and concrete works encountered by Olmsted, or the earthmoving that proved so difficult in the Culebra Cut. In contrast to the typical notion of infrastructure as “hardware”, these subtler expansions occurred in the realms of forestry, land management regimens and the leveraging of international treaties.
One realm in which we can observe these softer infrastructural expansions is in the provision of water for the canal, from the time it was built to the present.

The decision to build a locked canal rather than an open sea-level canal was a pivotal decision, as it established a constant need for freshwater to operate the canal’s locks. At the time of construction, each passage through the canal required approximately 50 million gallons. To increase water supply, the Chagres River was dammed in 1911 to create the enormous Gatun Lake (Carse 2012, 547). Within a decade, demand was exceeding supply and another dam was required to create Alhajuela Lake [Figure 4]. Though these two reservoirs were physically enabled by the construction of “hardware” (the dams), they were also dependent on a soft infrastructure, a treaty between the United States and Panama that enabled the American government to build the reservoirs despite the presence (and forced relocation) of many people who were living on the forested hills along the Chagres.

In the 1970s, strategies for securing increasing water supply for the canal shifted fully away from the construction of new physical infrastructure to the revision of the soft protocols governing land use within the canal’s watershed. Under the guidance and coercion of emerging forestry and watershed management expertise imported from the US, the Panamanian government reversed its policies supporting the colonization and use of the region’s forests for rastrojo agriculture, a rotational form of agriculture (often called slash and burn), a practice it has encouraged for economic growth, to one of forest conservation. To US foresters, rastrojo agriculture was detrimental to the canal’s water supply, since it reduced forest cover and potentially increased rates of runoff. Accordingly campesino farmers were asked to cease rastrojo practices, and in many cases, converted to wage labor guardianship of the canal’s surrounding forests (Carse 2012).

Thus, as a function of water infrastructure (provisioning), the canal’s territory expanded from its initial linear route to an expansive watershed, creating massive water bodies, forests and social upheaval in the process [2]. Each new phase of water infrastructure saw the whole aggregate.

**Figure 4.** Natural-color image of Lago Alajuela, a main reservoir for the Panama Canal, created to deal with the increased ship traffic of the Panama Canal in 1931. Today heavy rains in the Canal watershed can erode soils delivering large sediment loads to the lake. Satellite photo from NASA. Public domain.

**4.3 Hemispheric Feedback**

This characteristic of feedback is not only evident in the history of the Canal, but also in geographically expansive form in the contemporary Expansion Project. For that project, new locks are being constructed at both the Atlantic and Pacific end of the canal. Large-scale dredging of the shipping
channel through the Isthmus is underway in order to accommodate the larger ships necessitated by the New Panamax specifications, which will allow ships of nearly triple the original capacity to pass through its locks. It is estimated that around 150 million cubic meters of earth are being moved during the project (Alfaro 2012), a number that is fully half the excavation required by the original Canal project. This effort is requiring the mobilization of an impressive array of tools, technical expertise, and political decisions not only to cut and move the earth, and to construct the new locks, but also flotillas of support vessels, pipes and tractors and barges disposing of or stockpiling excavations, all while the original Canal structures continue operations. Such an intense concentration of construction machinery, organizational intent, and financial muscle has not operated within the canal landscape since the completion of the original excavations (ACP 2006).

But the transformations are not limited to Panama. Long before the first cubic meter of the Isthmus was excavated – and with the first New Panamax transit still years away – speculations and grand prognostications on exactly how these logistical reconfigurations would affect the global choreography of contemporary material shipments proliferated, gaining momentum with each completed milestone of construction (IWR 2012). This speculative feedback is causing an engineering shockwave to expand outward from the expanded canal, manifesting as upgrades and expansion for the complex network of waterways, ports, inspection stations, railroads, switching yards, highways, warehouses, and distribution centers hosting the global flow and movement of materials shipped through the canal. Importantly, this distributed network of new infrastructures is not waiting to be built after the expansion is complete. Rather, construction in Panama and construction across the Americas is occurring in parallel. As a result, the network and the canal are caught in an aggregating feedback circuit, where the construction of the canal puts pressure on ports to upgrade and the port expansion puts pressure on the canal to expand.

4.4  Bifurcations

Each of these examples – earthmoving and sliding rock in the Culebra Cut, the territorial aggregation of watersheds to supply water to the canal, and the contemporary Expansion project with its engineering shockwave – not only demonstrates the presence of feedback effects in the landscapes of a maritime infrastructure, but also illustrate moments of critical transformation and transition for those landscapes. At these moments, the maritime infrastructure’s landscapes has been radically reshaped as the accumulated pressures of feedbacks are released in a much shorter span of time than it typically took for those pressures to mount.

In his attempt to offer a materialist history of human settlement, Manuel DeLanda develops the concept of “bifurcation”, which offers one definition by which these key moments within a feedback cycle can be described. Borrowed from thermodynamics and mathematics, bifurcations describe the critical points when nonlinear systems – the kind of systems that are characterized by the feedback effects that Maruyama and Prigogine identified – switch from one stable state to another. At these points, “minor fluctuations may play a crucial role in deciding the outcome”, producing much greater systemic consequences than the scale of the fluctuation itself would seem to predict (DeLanda 1997, 1). This seems quite similar to what we see in the three examples presented here. For instance, in the current case of the Expansion Project, the expansion itself has been prompted by the gradual buildup of pressure from changes that arise from network effects, from the gradual accumulation of minor fluctuations – a gradual increase in global shipping volumes, the erosion of the canal’s competitive advantages – not the sudden decisions of any single actor.

Deploying this concept in relation to infrastructural landscapes suggests that identifying potential bifurcations, via scenario planning or other speculative means, and precipitating or staging certain influential minor fluctuations might offer the possibility of exerting leveraged agency in a complex network that is changing over time [3]. This is particularly valuable in the case of landscapes (or networks of landscapes) so large that direct reconfiguration into a desirable new state is financially and/or materially implausible [4]. The networks of maritime infrastructures entangled with contemporary global commerce are precisely such a set of landscapes.
5 CONCLUSION

Early in this paper, we offered a question prompted by examination of an early case of landscape architecture’s involvement in the design and function of the Panama Canal through the collaborative work of Frederick Law Olmsted, Jr.: how might ports and shipping canals, and landscape architecture itself, be different today if Olmsted’s involvement had been the start of an ongoing engagement with landscapes of maritime infrastructure? The characteristic of feedback suggests two important responses to this question.

One is that this question is not a mere counterfactual: as ports and canals have continually aggregated, expanded, and grown in the years that have passed since Olmsted, Jr.’s report, their significance and impact on contemporary society has also grown (Waldheim and Berger 2008). Today, maritime infrastructures are both cause and effect for a wide array of transformations that are of clear interest to the discipline of landscape architecture, such as the making of new land through the placement of material dredged from their navigation channels, the displacement of significant ecological communities in their construction and operation, and the economic, cultural, and aesthetic roles of working waterfronts as components of urban fabrics. Landscape architects who hope to actively direct or stage these effects, rather than merely responding or mitigating them, will need to directly engage the infrastructures implicated in them.

To pursue such efforts an expansion of current representational practices, technical skills and disciplinary concepts is needed. Feedback not only indicates the importance of engaging maritime infrastructures, but also provides one real mechanism currently operating within these global networks of ports and canals by which landscape architects and other interested disciplines might leverage substantial change. The three examples we have provided all show how substantial landscape change occurred as the result of positive (aggregating) feedback cycles. Landscape architects who are able to understand the feedback mechanisms at work in an infrastructural network and then stage the introduction of additional forces into that network may be able to induce desired bifurcations.

For instance, one might imagine a landscape architect engaged with the Panama Canal Expansion who redirects the placement of the enormous quantities dredged material excavated from ‘disposal sites’ to the active construction of new ecological reserves and recreational zones by building islands at the urbanized ends of the canal. In that hypothetical case, the shift would be accurately characterized as a “minor fluctuation”: intentionally building with dredged material rather than disposing of it as a waste according to current practice (Chin, Rivera, and Pinilla 2006, 14-25). But the potential transformation might be enormous, as the canal could become not only logistically efficient, but also ecologically and recreationally performative.

Yet feedback is only one conceptual tool. Fully answering the question we have posed about both the potential expansion of the discipline of landscape architecture and the possible transformation of maritime infrastructures will require a larger and longer investigative process. Given the importance and widespread prominence of canal and port expansion projects and the complex landscapes they are part of, and are generating, this work should be taken up as a theoretical, technical and representational project, one that builds on and help strengthen related work in landscape architecture and related fields. This paper has aimed to show how fecund that project can be.

5 Endnotes
1. It is impossible here to list all of the notable work occurring in this vein just within the field of landscape architecture. The specific projects referred to here include ongoing projects of research practice such as Bélanger’s and Mazereeuw’s work at Op-Sys, Berger’s work at P-Rex, and Kristina Hill’s work on the SeaCity2100 research network. Published works include Strang (1996), Duempelmann (2010), Thayer (1993), and Hough (1995).
2. This topic is discussed more extensively in Davis, Holmes and Milligan (2015).
3. Alan Berger’s design work, best collected in Systemic Design Can Change the World, offers a well-articulated version of this approach.
4. Casey Lance Brown and Rob Holmes’ "Landscape Switching" offers a set of case studies in other large-scale landscapes characterized by the tendency to bifurcate.
6 REFERENCES


ARBORETUM ON THE NATIONAL MALL:  
A STUDY OF TREE LABELING

HEAVERS, NATHAN  
Virginia Tech, Landscape Architecture, United States, heavers@vt.edu

1 ABSTRACT  
This paper examines the labeling of trees on the National Mall, specifically at the United States Botanic Garden, Smithsonian Gardens, the United States Department of Agriculture, and the U.S. Capitol Grounds, and questions how these individual tree collections might together better form an arboretum at the center of the nation’s capital. The notion of an arboretum in the heart of Washington is not new: George Washington initiated it with his 1796 proposal to plant trees from all thirteen states in the nation’s new capital (Wulf, 2011); the Columbian Institute for the Promotion of Arts and Sciences, the forerunner of the U.S. Botanic Garden, started planting trees in 1816 (Fallen, 2007); Andrew Jackson Downing’s designs, implemented in the 1850s, created a “museum of trees and shrubs” for the enjoyment and education of people (Ottesen, 2011); and Frederick Law Olmsted reshaped and planted Capitol Hill, labeling the trees in the manner of an arboretum (Choukas-Bradley, 2008). While some of these 19th century efforts were greatly altered through the work of the McMillan Commission in the early 20th century, over the past several decades, the activity of collecting and labeling a great variety of trees for the education of the public has increased (Ottesen, 2011). Through archival research and a contemporary field survey of tree labeling, this paper documents the history of arboreta on the National Mall and presents the present day systems of labeling from garden to garden. It suggests that tree labels across the National Mall might be better coordinated between collections and concludes that the history of tree planting on the National Mall could be one educational part of this long-standing, but under recognized, arboretum.

1.1 Keywords  
Arboretum, botanical garden, tree labeling, plant identification, plant collection
2 INTRODUCTION

Botanical gardens and arboretums are closely related design schemes; the former suggests a specialized collection of plants of all types, while the latter indicates a collection focused on trees and shrubs. The history of botanical gardens and arboretums is quite interesting and extensive; for a recent account of this history one might turn to John Dixon Hunt’s (2012): The Botanical Garden, the Arboretum and the Cabinet of Curiosities in A World of Gardens. Contemporary scholars and institutions generally identify four main agendas for such plant collections: research, education, recreation, and conservation (Heyd, 2006). These aptly describe the multi-pronged missions of many of the institutions and their gardens currently on the National Mall in Washington, DC.

This paper begins with a history of the National Mall, describing how it has been designed as an arboretum. The method for this part of the study is archival research, consulting primary and secondary documents including written descriptions and drawings. One of the key features of most arboretums, past and present, is tree labeling, for the purposes of education as well as research and conservation (Wyman, 1947), and so then the author asks: How are the trees on the National Mall labeled today and how might the tree collection, as a whole, be interpreted more systematically for the education of visitors? To address this question a field study is presented which documents through photographs the range of label types and their content across the National Mall. The study of labeling is not un-trod territory; a master’s thesis by Burston (1980) is a very useful work on visitor orientation in botanical gardens and arboretums, pointing out that “signs and tree labeling” (p. 17) are one of several devices designers and horticulturists use to engage and educate visitors. While there are other factors, which orient a visitor in gardens, this paper focuses on tree labeling to get a better sense of which collections on the National Mall have an explicit educational purpose and might contribute to re-thinking this national tree collection.

2.1 The Study Area

The National Mall in this paper is the great public parkland along the two principal axes of the City of Washington between the Capitol and Arlington Cemetery, running east to west, and Lafayette Park and the Jefferson Memorial, traveling north to south. The study is confined to that portion of the National Mall between the Capitol and the Washington Monument. This portion and the part to the north of the Washington Monument are the original ground laid out in L’Enfant’s 1791 plan of the city.

The National Mall has taken over two hundred years to emerge from the initial and influential prompt of L’Enfant’s plan. Central to the plan, since its inception, but not drawn by L’Enfant, is the idea of a national botanical garden, which George Washington first proposed to collect trees from all the states for propagation and redistribution to farmers; much as he and other founding fathers did on their own private properties (Wulf, 2011). In many ways this botanical mission has always had a presence on the National Mall, especially in the form of collections of trees, one of the great symbols of America’s natural bounty. In the years since the nation’s founding, several horticultural enterprises have taken place on the grounds of the National Mall (Savage, 2009), an extensive history of which is beyond the scope of this paper. But most of the designed gardens and landscapes that comprise the National Mall today have had their origins in earlier efforts.

3 A HISTORY OF THE ARBORETUM ON THE NATIONAL MALL

The question of how to incorporate a botanical garden into the first plan of the City of Washington was little resolved at George Washington’s death in 1799; however, construction on the Capitol and the White House had begun within a systematic, if largely absent plan of streets, squares, public buildings and monuments. Sitting on high ground, these two buildings marked important points on the two principal axes of the city, which sloped gently down to the Potomac River’s banks, intersecting at a marshy point that L’Enfant saw fit for an equestrian statue of Washington, about 400 feet from the center point of today’s Washington Monument, which rests on more solid ground. At that time, the land of the National Mall was farmland and forest, far from the vision of a botanical garden to seed the nation with plants.

It was in 1816 that the idea of a botanic garden began to take shape through the efforts of the Columbian Institute for the Promotion of Arts and Sciences to “collect, cultivate, and distribute the various vegetable productions of this and other countries” (Fallen, 2007, p. 15). Then in 1820, president James Monroe signed over 5 acres at the foot of the Capitol, on its west side, for a botanical garden, a project which initially failed, perhaps due to the extremely swampy ground at that location. The goal of a botanical
garden on the Mall was taken up again in 1842, when the Wilkes Expedition returned with 50,000 natural specimens and about 500 live plants that needed a home. With this collection and congressional backing, the botanic garden had a fresh start; a conservatory was built, finished in 1856 (U.S. Botanic Garden, 2015), more or less on the line between the unfinished capitol dome and the stump of the Washington Monument, also begun in 1842, but stalled at that time, only to be opened in 1888. L’Enfant’s drawing for this stretch of relatively level ground running from Capitol Hill to the Potomac showed a great thoroughfare, but in 1851, when Andrew Jackson Downing, the preeminent landscape designer in America at that time, was asked to draw up a plan for the National Mall; he ignored L’Enfant’s treatment of the ground in favor of trees (See Figure 1). Rather than a great highway, he imagined a great landscape garden, “a public museum of living trees and shrubs” (Ottenson, 2011, p. 14), reaching from the slopes of Capitol Hill down to the banks of the Potomac at a “Monument Park”, in the manner then fashionable in England and championed by John Claudius Loudon, the creator of Derby Arboretum, a systematically planted collection of diverse sorts of trees in a public park (Hunt, 2012). In Downing’s drawing, his arboretum covers the ground from the Capitol to Washington Monument, and then turns north, reaching around the White House to the President’s Park, now Lafayette Square. This desire to systematically replant, what had been forest, was pasture, and was shortly to be used as a Civil War encampment, was carried out in part after the war, according to Downing’s plans, particularly in the spaces around the White House and near the newly built Smithsonian Castle. But Downing’s death in 1852, left the National Mall of his era without its horticultural rudder, jurisdictionally and in terms of design, though the seed of an arboretum approach had been planted.

Figure 1. Nathaniel Michler’s Copy of Downing’s 1851 Plan for the National Mall (1867). Public domain image from http://www.archives.gov.

After the Civil War, a great effort was put toward tree plantings on the streets of Washington, under governor Alexander “Boss” Shepherd; so much so that it became known as the “City of Trees” (Choukas-Bradley, 2008, p.5). And in 1872, Frederick Law Olmsted was hired to rework the grounds of the Capitol, to which he added great marble terraces on three sides and agreed with Congress that the many trees he planted ought to have labels in the manner of an arboretum (Olmsted, 1882, p.9). Then in the final decades of the 19th century, what was described earlier in this paper, as the National Mall in full, was created with the filling of the tidal flats along the Potomac, extending both principal axes of L’Enfant’s design into the river, gaining much new ground. This new thrust to the nation’s center made misfits out of Downing’s arboretum, the Botanic Garden, and a railroad terminus on the stretch between the
Washington Monument and the Capitol. The McMillian Commission Report of 1901, in part the work of Frederick Law Olmsted Jr., proposed to: move the botanic garden; cut many of its trees; devise a way to remove the railroad from the premises; and ignore Downing’s plans in favor of L’Enfant’s. The design team interpreted L’Enfant’s plan quite freely, substituting for the concept of a great thoroughfare, a broad swath of turf lined with rows of graceful elms. Despite all this clearing, the McMillan Plan’s emphasis on establishing museums and federal office buildings along the Mall, (See Figure 2), has made up for these horticultural losses because many of the museums have since created new tree collections on their grounds.

Figure 2. Building Plan along the National Mall from the McMillan Commission Report (1901). Public domain image from http://www.nationalmall.net/resource/mcmillan.html.

But also, today, there are some very distinct remnants of historic landscapes that predate the McMillan Plan that are arboretum-like, and complement the newer tree colonies in the museums’ gardens and landscapes. To the east, around the Capitol, grows Olmsted Sr.’s arboretum. To the north, at Lafayette Park, once the President’s Park, and around the White House, there is another collection of trees that have the quality of an arboretum. Many trees in Lafayette Park are still labeled, and in 1932, the park was known for having the greatest diversity of trees for a square of its size, anywhere in the city (Colville & Freeman, 1932). Of course, the United States Botanic Garden, which has been in its current home since the 1930s, has had incredible staying power, and grew, yet again, in 2005, with the National Garden. But perhaps most significant of all, to the extension and re-invention of an arboretum concept on the National Mall, has been the rise of Smithsonian Gardens, established in 1972 to care for the gardens and grounds of the Smithsonian museums (Ottesen, 2011). Within the highly individualized plots, around each particular Smithsonian Museum collection, have sprouted up an array of plantings, a collection of collections, all with various kinds of trees, and often labeled. Even the United States Department of Agriculture (USDA), not a Smithsonian Institution, has in its fifteen-year plan, to re-imagine its landscape as an outdoor agricultural museum (Acosta, 2014, p. 6). So, in over 200 years, the National Mall has been swept over several times, with successive waves of planning and design, but one aspect that seems to persist is the labeling of trees of this unofficial arboretum.

This notion reaches across the Potomac River to Arlington Cemetery’s tree collection, up the piedmont hills to the National Cathedral, and around the home of the nation’s president, an area not so
easily accessible to the public today. There are other great collections, such as the flowering cherries and the less known crabapples that are also consistent with the typical plantings of arborets. However, this paper is focused on the stretch between the Capitol and the Washington Monument, where in the 20th century, after Downing’s arboretum and the US Botanic Garden were rolled back, a century of re-stitching the edges of this uniform tapestry, has produced a new arboretum, anchored by the historic Capitol Hill arboretum at the end.

4 TREE LABELING ON A WALK AROUND THE NATIONAL MALL

The study area of the paper is a circuit, about 2.5 mile in length, but involving much meandering along the margins of the National Mall, to take in the more intricate paths of the individual gardens along its perimeter. On this walk, one encounters a dozen Smithsonian Gardens, the U.S. Botanic Garden, Capitol Hill, and the USDA Headquarters (See Figure 3). An outlier, Lafayette Square, was also visited. The author set out to record the types of tree labeling found, and how the gardens are presented on signs to visitors, to see how this loop works as an arboretum, at least from the perspective of educating visitors through labeling.

According to Burston (1980, p. 17), there are a number of factors involved in the orientation of visitors to public gardens and arboreta, which include the visitor center, movement (routes), signs and labeling, plant collection groupings, and publications (maps, guide books, interpretive leaflets). In this study, the focus is on signs and labeling of trees, though other factors are touched upon. The author used standard institutionally provided maps as a guide and read the content available online through each institution’s website to extend his experience of the walk. In addition, a couple of popular guides, including City of Trees (Choukas-Bradley, 2008) and A Guide to Smithsonian Gardens (Ottesen, 2011), proved quite useful for orientation and additional background for the sites visited.

Figure 3. Map of the Study Area, including Museums, Gardens and Grounds (2015) Diagram by the author.

A key attribute of the gardens along the National Mall is the name each garden is given; this is usually called out on a large signpost, as tall as an average person. Then within each garden are often
sub-collections, galleries of plants, sometimes grouped according to plant types, as was typical in 19th century and earlier systematic botanic gardens and arboretums (Hunt, 2012). In other instances, the named gardens are organized and labeled in different ways, as in representative ecosystems or habitats, an organizational scheme of 20th century origins, paralleling the development of ecological science, giving new form to collections in arboretums around the world. Looking over the full list of gardens and sub-gardens on this loop, there are many spaces with distinct purposes, often with labeled plants, including trees. Typically, there is a description of each of these sub-gardens or sub-collections on a firmly planted signpost, usually more modest in size than that which announces the whole garden. Finally, entering the collections of these “living museums” (Ottesen, 2011), as most purport to be, there are often individual plant and tree labels and sometimes slightly larger labels that describe people/plant relationships or important ecological interactions. These are, perhaps, the most interesting and specific horticultural labels in the gardens, going beyond the names of plants and describing the garden in terms of some detail of a plant’s life history or its use by humans or other creatures. In addition, there are labels in the gardens that are more socially and culturally oriented, using trees as memorial markers, whether in bronze or paper, also an important aspect of some arboretums, which are common in cemeteries, for example.

Beginning a tour on the east side of the U.S. Capitol Building, one might encounter the only easily found contemporary reference to the grounds as an arboretum, on the one sign devoted to the “United States Capitol Grounds” throughout 58 acres. Here is described Olmsted Sr.’s contributions to the designed landscape, which, online, is limited to a description of his design for the Capitol Terrace and Summerhouse, saying outright that his work on the grounds was primarily a matter of the architectural “hardscape” (U.S. Capitol, 2015). While that is perhaps the most lasting visible feature of his design, the tree plantings (several hundred types), though not all of his era, are an equally significant aspect of the design, their placement between the spokes of the great radial streets that extend from the center of the city, structuring views to and from the nation’s Capitol. In terms of the labels on these trees, there are primarily two types: those that call out Latin and common names of the trees only and tree tags that double as memorial plaques. These memorial trees are themselves grouped: to the north are those for senators and to the south are found trees dedicated to representatives. This memorial function of many of the trees on the grounds seems to be one of the key ways to keep up the collection, as many of the young trees on the grounds have such labels affixed to them, with corresponding dates of planting. Wrapping around the Capitol Grounds, on a looping path, brings one to the south and west corner of the hill, at a lower elevation, where it meets the grounds of the U.S. Botanic Garden.

The U.S. Botanic Garden contains a large glass conservatory at its center with a band of display gardens around it, Bartholdi Park across Constitution Avenue to the south, and the National Garden to the west. With sago palms and other accessions dating from the return of the Wilkes Expedition, the Conservatory collections are grouped according to climates within its many rooms. However, it’s the outdoor spaces, which are the focus of this study, where many labeled trees are rooted in the ground, especially in the National Garden, opened in 2006. Of the five principal parts of the National Garden; the Rose Garden, the Butterfly Garden, the First Ladies Water Garden, the Lawn Terrace, and the Regional Garden; each introduced with a permanent waist-high sign or vertical banner; the Regional Garden is by far the most novel for this setting because it is designed as an ecosystem representing the flora of the Mid-Atlantic coastal plain east of Washington and the piedmont to the west. It also happens to lie on the former path of Tiber Creek, which once coursed below Capitol Hill, so this garden has many of the qualities of the regional woodlands and meadows that once occupied this land, including a water channel with characteristic wetland plants, as well as pines accustomed to wildfires that offer an example of locally rare pinelands. There is more evident signage and labeling in the Regional Garden, than any other on the Mall (See Figure 4), and it is most like what a visitor finds at similar institutions devoted to trees, such as the National Arboretum or the Arnold Arboretum in Boston, one of the nation’s oldest devoted specifically to the collection and study of trees and shrubs. Unlike the Capitol grounds, where most of the labels are attached to the trees at six feet above the ground, sometimes higher, the U.S. Botanic Garden labels are all in the ground, even the tree labels, and come in several types and sizes. There are the standard zinc or aluminum accession labels, inconspicuously placed, but ever so important, carrying the tree’s vital botanical records; the typical metal horticultural labels in black with white lettering, with Latin and common names, the plant’s family name, and the region where it is found; ankle high signposts corresponding to a guided audio walk, available online or by phone, rarely with QR codes for more information; occasional 8”x11” signs highlighting rare or endangered species conserved in the garden; larger banners describing
important ecological processes, such as wildfire; and finally, brochures available in mailboxes placed at intersections about the garden. All this gives the visitor plenty to absorb, while walking in the gardens, and much of the same information is simultaneously online for a virtual visit before or after a live trip. The U.S. Botanic Garden even makes available a searchable database, BG-Base, with software developed by the Royal Botanic Garden, Edinburgh, for visitors to search the plants growing in the garden. Unfortunately, the mapping codes the horticulturists use and which show up in database query responses are not revealed anywhere for an online or live visitor. Save more detailed information that could be made available online about its plant collections, the USBG meets what a visitor to any well-funded arboretum might expect in the 2010s.

![Figure 4. Typical Labeling and Signs at the US Botanic Garden (2015). Photos by the author.](image)

Moving west, along the south side of the National Mall is a series of gardens under the care of Smithsonian Gardens and associated with the nearest museums including: National Museum of the American Indian (Native Landscape), National Air and Space Museum (Walled Terraces), Hirshhorn Museum (Hirshhorn Sculpture Garden), Arts and Industries Building (Mary Livingston Ripley Garden), Smithsonian Castle (Enid A. Haupt Garden and Katharine Dulin Folger Rose Garden), National Museum of African Art (Enid A. Haupt Garden), Arthur M. Sackler Gallery (Enid A. Haupt Garden), and Freer Gallery of Art (Enid A. Haupt Garden). Although Smithsonian Gardens curates and maintains all the gardens in parentheses, as well as more to be discussed on the north side of the National Mall, there is variation in the labeling found between the sites. At the National Museum of the American Indian the landscape is a re-creation of wetlands and woodlands, such as existed in the area before European colonization, when it was still Tiber Creek. Here, a very few large plaques point out key tree species of this region that the Native Americans used, giving details of their properties. The Walled Terrace gardens and sculpture gardens of the next two museum have no tree labels, except for several “Wishing Trees” in the Hirshhorn Sculpture Garden, where visitors hang notes on a tree’s branches, a rare act of public curation in this highly controlled landscape. The Mary Ripley Livingston Garden is an example of a garden arranged primarily for aesthetic and educational purposes; with nearly all its plants labeled, using the horticultural standby of black metal with white letters, it offers the visitor pleasing combinations of a wide variety of ornamental trees and shrubs, from around the temperate world. The Victorian fascination with
collection, be it roses, as in the labeled Folger Rose Garden, or marginally hardy exotic plants from distant lands, is displayed in the warm micro-climate on the south side of the Smithsonian Castle, named for its benefactor, Enid A. Haupt. Here, a few trees, like the curious Monkey Puzzle (Araucaria araucana), from the mountain slopes of Chile, are labeled with a chest height moveable sign, set out at the edge of the walk, near where the tree is planted against the castle wall to keep it warm. This garden is home to some of the rare and admired trees collected in Victorian times, striving to give the visitor an appreciation for that era’s fascination with plant varieties of all sorts, as was once displayed on the Castle’s north side in Downing’s arboretum.

The last in this line of institutional buildings is the extensive USDA complex, the north lawn of which is under the care of the National Park Service, along with the great central space of the National Mall, west to the Potomac. The USDA has an eclectic collection of trees, especially on its north side, with walks that connect visitors to them and their bronze plaques in concrete in the ground at their bases, identifying their significance. In particular, a vigorous bur oak, dedicated to Martin Luther King, grows here, as do two American Chestnuts, a famed tree that succumbed to Chestnut Blight in the early 20th century, only surviving in the wild in stunted forms. Many of the trees on this north lawn appear to have been once part of a guided walk, each massive plaque has a number associated with it, but no guide is available. The People’s Garden project on the NE corner of the USDA building has ousted this forgotten tree walk. As a nationwide initiative to promote sustainable community gardening, with some 1900 subscribing gardens, the People’s Garden of the People’s Department—Lincoln’s name for the USDA—has diverted the focus of this mini-arboretum.

Crossing the Mall to the north side, one arrives at the National Museum of American History (Victory Garden and Heirloom Garden), National Museum of Natural History (Bird Habitat and Butterfly Habitat Gardens), and National Gallery of Art (National Gallery of Art Sculpture Garden). Back on the turf of Smithsonian Gardens, these gardens are programmed to match the missions of the museums they surround. While the Victory Garden and Heirloom Garden have few labeled trees and a different plant palette than typical of an arboretum, it is worth noting a recently planted example of Franklin’s tree, extinct in the wild, and saved because of the collection of John Bartram, who in the 18th century, set up a nursery/arboretum in Philadelphia, one of the first of its kind in America. The habitat gardens of the Natural History museum work well as a tour of native trees too. Labeled in the standard horticultural manner, though often with clear acrylic stands, making the tags appear to float, the gardens aim to demonstrate the importance of plants to the lives of animals and vice versa. Some of these plant/insect or plant/bird relationships are spelled out in detail on larger signs. On the standard horticultural stock labels of the Bird Habitat Exhibit, where each plant’s origin is usually shown on the labels, a note of how each bird species uses the plant is included. On the north side of the Natural History Museum, within the drop-off island off Constitution Avenue, is a cluster of ancient trees, living fossils, from the Carboniferous Period, including the Ginkgo or Maidenhair tree (Ginkgo biloba). Travelling eastward, the last of the truly varied tree plantings is the National Gallery of Art’s Sculpture Garden, with around 30 distinct species of trees, but with only a handful labeled. Even further east, the main buildings of the National Galleries are increasingly austere, label-less landscapes, except for the inconspicuous circular aluminum tags arborists tack on to keep track of trees for maintenance, a technology, which is fading as accurate global positioning software makes it easy to attach geo-spatial data to a tree without ever touching its trunk. So with this hint of a brave new world of labeling and marking trees in mind, we loop back to the Capitol Hill, the oldest and perhaps most traditional of the labeled areas visited to go on and consider what the future might hold for this intricate necklace of plantings which rings the eastern arm of the National Mall.

5 RE-INTERPRETING THE NATIONAL MALL AS AN ARBORETUM

Of the 15 or so gardens described above, 10 have their trees labeled, making the spaces look and work like micro-arboretums: but what about the National Mall as a whole? Most use some version of the standard horticultural black metal labels with bright white lettering, either fixed to the tree’s trunk or on a short stand, 1 to 2 feet off the ground. These labels usually contain some combination of a plant’s Latin name, common name, family, and place of origin. The exceptions to this rule are at the National Museum of the American Indian’s Woodland, which has a handful of large labels, telling the stories of each tree’s use and lore, and naming it in one or more Native American languages. There are, as mentioned, other types of tree labels across these landscapes, including memorial plaques, ranging from small engraved
labels on tree trunks, not much bigger than a standard horticultural label, to heavy bronze plaques atop concrete pedestals. Lastly, there are the ephemeral types of marking that visitor’s tend to leave, such as white paper tags at the Hirshhorn Sculpture Garden (See Figure 5).

Figure 5. Tree labels with combined memorial, habitat, and other cultural functions (2015) Photos by the author.

Labels seem to be a useful indicator of each garden’s intent to educate the public about plants—at least in a tree’s name and place of origin—or, in other cases to mark trees as memorials. But, as was suggested earlier, naming trees is just one function of an arboretum. Does the tree labeling on the National Mall create a grand arboretum in the sense that Downing’s plan suggests, a designed forest in the center of the city? Perhaps not, but it does exposes visitors to a wonderful diversity of labeled trees, from near and far, and provides a sense of each tree’s importance, at least in terms of the related mission of the museum it is paired with. The National Mall is also useful for learning a bit about American history through memorial trees. But it is the larger labels and the signs in each garden that tend to get at what seems to be most significant conceptually for thinking about the National Mall as an arboretum. That is, such labels begin to connect the each tree’s names with historical and cultural concepts or ecological processes, for instance, to foster connections between people and trees, and to extend possible readings of the content in each garden. But are the many gardens linked together or related in their line up around the National Mall?

Each of the gardens along the National Mall has a theme, which is underscored and described through a large sign with one to several paragraphs of text. Most of the themes are closely tied to the missions of the adjacent museums and federal buildings. Taken as a whole, the gardens of the National Mall are very much like a cabinet of curiosities—albeit with both historical and contemporary concerns, from Victorian parterre gardens to 21st century rain gardens. The line-up of gardens is not accidental, but has more to do with the interior missions of the museums than the exterior ordering of tree planting: the Native Landscape of the National Museum of the American Indian is adjacent to the ornamental Wall Terraces of the Air and Space Museum, for example. The themes of gardens on the National Mall, as their signs point out, include: tree walks, ecological habitat gardens, ornamental display gardens, sculpture gardens, rose gardens, agricultural, community, and home gardens, heirloom gardens and cultural gardens. Whether focused on a particular history, culture, ecology, or ornamental display, each garden has a distinct collection of trees, for a particular theme, and its signs speaking mostly to it. In other words,
it is possible to find many messages on the signs around the National Mall, but the order of it all follows the museums, rather than the trees being brought into focus with their many relationships in the garden, across the Mall, and throughout the region. What might be done with tree labeling and garden signs to make the National Mall function more clearly as an arboretum, without distracting too much from its many other functions? How might it be possible for visitors to learn about the forest and its trees? In the third century of the National Mall, with a growing range of devices and applications readily available to convey information to visitors, projects like Other Order (Rueb & Del Tredici, 2014), a collaboration between Teri Rueb and Peter Del Tredici, exploring emergent ecology through sound walks at the Arnold Arboretum, might be a way to lighten the label count and increase the richness of geo-spatially available educational experiences for visitors. For several years, the Smithsonian has been collaborating with Columbia University on LeafSnap, an app for tree identification, using face recognition software to name trees, a type of technology which may eventually take physical labels out of the running.

6 CONCLUSION

With these and many other types of applications on the horizon, it seems that there will be many choices to be made about how to interpret the trees of the National Mall. Perhaps the three primary types of labels found along the National Mall in this study: tree name tags, memorial plaques to people and events, and larger signs, which discuss much broader issues than are easy to perceive or understand directly through our senses, may be clues to how to structure future interpretation. Stories about the role of trees in cultural memory, ecology, and design of the National Mall, could be embedded in the BG-Base database at the U.S. Botanic Garden, making more of this primarily technical tool, for keeping track of specific accessions in the collection. The Smithsonian Garden Archives, which currently crowd-sources information on gardens from around the country, could gather data closer to home with regard to its trees and peoples’ experiences of them. It seems that each of the gardens on the National Mall has interesting and relevant histories, some bound up in the vaults of our National Archives, others being written in their branches as trees grow or fall in super-storms. How might we begin to layer together the histories of each of the gardens and trees that grow in their significance? Certainly it can happen through the use of digital media, but to what end and from whose perspective? In a way, the diversity of voices now speaking through the museum exhibits indoors is beautifully juxtaposed with a hushed outdoor counterpart, the trees waiting to be discovered.

Figure 6. The National Garden at the U.S. Botanic Garden looking toward U.S. Capitol (2015) Photo by the author.

Standing in the National Garden, opened in 2006, it’s possible to reflect on the history of its landscape, learn about its ecology, and delight in the beauty of both the living collection and the design of the nation’s Capitol and the garden’s conservatory (See Figure 6). This garden began in the thoughts of
the founding fathers, but was not realized in this way for over two hundred years, until after the completion of the great dome of the Capitol, which now rises above Olmsted’s arboretum. At the heart of the Regional Garden, are its trees and herbaceous plants, with labels up to wazoo. This garden, sitting serendipitously at the regional fall line, an ideal spot to bring together an incredible variety of plants from the coastal plain to the east and the piedmont to the west, along a constructed watercourse, where Tiber Creek used to flow off Capitol Hill, is abundant with signs of life—and tree labels. But most of all, it has the potential to makes one think beyond where he or she stands, physically and temporally. It can and does challenge one to think systemically about watersheds and forests in miniature and panorama. However, most of the signs at the U.S. Botanic Garden speak purely of this garden’s mission, its plants, its trees, not its current relationship to Olmsted’s arboretum on Capitol Hill, or the Native Landscape and wetland across the great asphalt expanse of Third Street, at the National Museum of the American Indian. The Native Landscape, like the Regional Garden, is a re-creation of native woodland and waterway; also young, it has grown incredibly in its first ten years, sending the message that ecology and culture might support each other, just as the author is suggesting the gardens and landscapes of the National Mall might have a greater agenda. Of course, it might be a more memorable experience for a visitor to venture out of the National Garden, cross Third Street and make the independent discovery that Tiber Creek has re-surfaced twice on the National Mall. But since, there are many pieces to this great historical, cultural, and ecological design puzzle of the National Mall, perhaps it is time to begin to rethink and re-imagine the labels attached to it, without losing sight of their historical intent of existing markers.

7 REFERENCES

MATERIAL FAILURE AND ENTROPY IN THE SALTON SINK

HOLMES, ROB  
University of Florida, rob.holmes@ufl.edu

HOLTZMAN, JUSTINE  
Louisiana State University, jholzm1@lsu.edu

1 ABSTRACT

The Salton Sea is a saline lake and the largest inland body of water in southern California, formed by a geologic depression below sea level at the bottom of an isolated basin similarly titled the Salton Sink. Once an outlet for the Colorado River to the Gulf of California, the depression was isolated over time through the deposition of sediments. The current volume of the Salton Sea originated in the first decade of the 20th century with the failure of infrastructures built to redirect the Colorado River for irrigation. The Salton Sea now functions both as an agricultural infrastructure, albeit one increasingly degraded by nutrients and contaminants present in the agricultural run-off irrigating the Imperial and Coachella Valleys, and as an ecological resource. This paper argues that the example of the Salton Sea demonstrates the capacity of material failure and entropy to generate novel landscape conditions that have properties which are valued.

The theoretical work of this paper ties together three distinct but related strands of contemporary theory impacting the field of landscape architecture: emergence and indeterminacy, new materialist thinking in philosophy, and discourse related to the concept of the Anthropocene. Theoretical arguments that engage these strands and a selective environmental history of the Salton Sea work together to advance our case for the generative capacity of failure and entropy. This case develops concepts for understanding how failure and entropy operate, applying a discourse that, within landscape architectural theory, has primarily focused on ecological phenomena and discrete sites to the behavior of geological, hydrological, sedimentary, and infrastructural assemblages at very large scales. Ultimately, the paper argues that there will be an important role for landscape architectural design that understands how to operate within the context of very large scale landscapes experiencing failure and entropy.

1.1 Keywords

Salton sink, Salton Sea, Colorado River, indeterminacy, emergence, fecundity
2  INTRODUCTION

The contemporary landscape history of the Salton Sink (Figure 01) is punctuated by a moment of failure which initiated a period of entropy. Together, these landscape processes have generated novel landscapes in the Sink at very large scales.

Figure 1. The shore of the Salton Sea & the Salton Sea in context. Photos: author

The contention of this paper is that this example, the history of the Salton Sink, can be understood by considering it in light of a series of related discourses — new materialism in philosophy, the nascent concept of the Anthropocene, and new positions emerging from contact between landscape architecture and contemporary ecological thought — and, in turn, that these discourses can be extended in new directions by considering them in light of the history of the Salton Sink. In order to bring this landscape into dialogue with that body of theory, this paper provides an overview of the state of the discourses it engages, an abbreviated environmental history of the Salton Sink, and a series of lessons related to understanding the operation of failure and entropy as landscape processes at very large scales. Given the significance of those discourses for contemporary landscape architectural theory and practice, this work ultimately speaks to the value that might be obtained through the engagement of landscape architecture with these processes and the landscapes that they make.

Before beginning to speak about the Sink itself, though, it will be valuable to carefully define two key terms for this paper — failure and entropy — and to explain, briefly, why this study is significant to landscape architectural theory.

2.1  Failure and Entropy

Failure and entropy are clearly linked, both conceptually and in the history of the Salton Sink. Both relate to disintegration, breakdown, and disorder, carrying negative connotations. Both would appear initially to be hostile to design, insofar as design intends to make, structure, and order. Yet, recent scientific discourse has altered understandings of these phenomena, suggesting that processes of growth and decay may be better understood as interwoven and interdependent, rather than mutually exclusive or necessarily opposed (Cook 2000, 125-126). Moreover, in both cases we are using these terms to describe critical processes operating within very large scale landscapes.

For the purposes of this paper, distinctions between failure and entropy begin with timespan: we speak specifically of moments of failure and periods of entropy, even though there are slow failures and fast entropies that might be discussed under other circumstances. It is important to note that we are not
concerned with all kinds of failures, but rather with a very specific set of failures: failures of the material structures or properties of landscapes. The breaching of a dam is this kind of failure; so is a landslide, or the saturation of a soil with toxins following an industrial accident.

This focus on failure as a physical process shares characteristics with two concepts which are significant to contemporary ecology; one, disturbance, has had significant impact on landscape architectural theory, while another, bifurcation, has not yet. Disturbance has largely been of interest to landscape architects for its potential to indeterminately generate new landscapes, primarily through shifts in plant assemblages. While this paper shares interest in the generation of novel landscapes through phenomena that appear to increase disorder, it attempts to move away from exclusive focus on biological systems, which we believe obscures similar behaviors in other kinds of landscape assemblages — infrastructural, geological, or chemical, for instance.

By contrast, despite its significance in complex systems theory, bifurcation has infiltrated landscape architectural discourse in a much more marginal manner. It is nonetheless more closely related to the way in which we are discussing failure here, because, in addition to emphasizing suddenness, catastrophe, and the generation of novelty, bifurcation attends to generative behaviors within any assemblage describable by complex systems theory, not just biological systems. (This differing connotation is partly a matter of origin: the scientific concept of disturbance originates with the study of ecosystems, while bifurcation originates with the work of a chemist, Ilya Prigogine, on thermodynamics.)

Bifurcation refers to a moment of transition, describing the states of systems as wholes: "...ecosystems may flip into a new state relatively suddenly. Such flips [are] properly called bifurcations." (Lister 2007, 43) "Non-equilibrium potential theory implies that ecological systems which can exhibit complex dynamics or multiple outcomes will typically not have leading indicators of regime shifts... drastic changes can appear in nature without warning" (Hastings and Wysham 2010, 471). We are using failure in a similar temporal sense — also a moment — but a narrower spatial sense, describing the point of catastrophe. Spatially, our use of failure is more similar to disturbance, as the spatial scope of both is initially restricted to the extent of the phenomena that is failing or disturbing. (The infranatural dam collapse that formed the Salton Sea is both a failure and a disturbance, and the Sink as a whole experienced sudden bifurcation.) Similarly, bifurcation and disturbance are not somewhat different terms for the same phenomena; rather, disturbance is a precipitating cause for change in the described system, while bifurcation refers to the fact of that change. It is very possible for a disturbance (or a failure) to be the precipitating cause of a bifurcation. (The Sink experienced bifurcation because of that failure.)

Like failure, entropy is a broad term, having expanded from its scientific origins as a specialized descriptor used as a measure of energy in the field of thermodynamics to refer more widely to states of loss, decay, and increasing disorder, “a turning towards” chaos. We are using entropy in this latter fashion, as a descriptor for the kinds of processes operating in leaky landscapes, landscapes which are decaying following some moment of failure.

### 2.2 Significance

At this point, it seems appropriate to ask: why should landscape architects be concerned with these two particular concepts of failure and entropy? What is their significance to the theory and practice of our discipline?

One answer is that we believe these concepts, considered in light of this example of the Salton Sink, shed new light on important on-going conversations within landscape architecture, particularly conversations that have begun by considering what landscape architecture might learn from ecology. We focus below on discussions of the importance of landscape processes to landscape architecture that draw on indeterminacy and emergence, concepts which are tightly linked to landscape architecture’s investigation of the shift in ecology toward a “nonequilibrium paradigm” (Hill 2005, 132).

The significance of these conversations goes to the core of landscape architecture’s historic and on-going responsibility for configuring physical interfaces between human cultures and our environments. These interfaces require alteration in light of contemporary recognition that environments are dynamic, characterized more often by flux than stability. Historical paradigms for urbanization were founded on the assumption of environmental stability, and have often failed when confronted by landscape dynamism. This flux is now being accelerated by planetary-scale human impacts, exacerbating and intensifying the mismatch between static, inflexible forms of urbanization and the landscapes they are embedded in.
The landscape architecture required by these conditions will be facile with indeterminacy, which leads to a second answer: the development of this facility opens new territory for the discipline. Specifically, we see opportunities for landscape architecture to operate alongside other disciplines engaged in a range of ecological restoration practices, particularly in anthropogenic wildernesses that emerge from "operational landscapes" (Brenner 2013, 20). Discourses of new materialism and the Anthropocene, summarized below, shed significant light on how landscape architecture might behave in these landscapes.

More generally, both failure and entropy share an important potential, which is the capacity to generate new landscapes and new characteristics within existing landscapes. Together, those propensities may be summarized as the generation of novelty. Landscape architecture is concerned, in large part, with making landscapes; and this role requires the ability to generate novelty, as defined above in terms of both new landscapes and new characteristics within landscapes. (Of course, novelty-as-newness is in particular demand when historical paradigms are failing, as mentioned above.) Thus, landscape architecture is properly concerned with understanding the various processes by which novelty is generated.

3 A BRIEF SUMMARY OF RELEVANT DISCOURSES

There is significant precedent for this stance on novelty, failure, and entropy. We ground our discussion in three distinct discourses: indeterminacy and emergence in landscape architecture, new materialism in philosophy, and the Anthropocene, a new epoch defined by human geologic agency.

3.1 Indeterminacy and Emergence in Landscape Architecture

The first of these is a set of on-going conversations within landscape architecture concerning the significance of new scientific paradigms, particularly but not exclusively in ecology, for landscape design. These new scientific paradigms are broadly related to one another, but engaged in varying measures by different theorists. The paradigms include complexity (emerging first from studies in thermodynamics as complex systems theory, but heavily applied to ecological phenomena through systems ecology), emergence (often described as a characteristic of complex systems), indeterminacy, and nonlinearity. These discussions also have non-scientific impetuses, gaining momentum from parallel developments in philosophy, particularly Continental philosophy as it has been adapted and understood by architects.

Towards the latter half of the 1990s, general interest in the design potential of engagement with natural processes took this specific turn toward insights from complex systems theory, propelled by things like the 1996 Landscape Urbanism conference at the University of Illinois-Chicago, the writings of James Corner (“Ecology and Landscape as Agents of Creativity” in the 1997 book Ecological Design and Planning, the 1999 book Recovering Landscape, edited by Corner), and the Environmentalism in Landscape Architecture symposium at Dumbarton Oaks (reflected in the book of the same name, published in 2000). Reflection on built and speculative works, such as the Tschumi and OMA schemes for Parc de la Villette, also played a significant role in this turn. While much of this interest was associated explicitly with “landscape urbanism”, significant components of it were not, such as Environmentalism in Landscape Architecture and the slightly later Ecology and Design: Frameworks for Learning. Where landscape urbanism took many cues from Continental philosophy via architecture — Waldheim was trained and originally teaching as an architect; architects Stan Allen, Alex Wall, and Mohsen Mostafavi wrote key texts in early landscape urbanist discourse — these other components were generally more closely associated with sciences, particularly ecology. Kristina Hill, who co-edited Ecology and Design in addition to contributing significant essays to Shifting Sites and CASE: Downsview Park, was trained as both an ecologist and a designer; Robert Cook, who wrote “Do Landscapes Learn?” for Environmentalism in Landscape Architecture, is a plant population biologist.

Both of these strands are linked by their interest in reconsidering design operations in light of ecological theories of balance, stability, and climax giving way to theories of dynamism, change, and flux. Our interest in this paper is focused in particular on a few recent texts that have reflected on this discourse, critiqued it, and extended it, paying particular attention to their treatment of emergence and indeterminacy. These texts are Rod Barnett’s Emergence in Landscape Architecture (2013), Julian Raxworthy’s dissertation “Novelty in the Entropic Landscape”, and Projective Ecologies, a volume edited by Nina-Marie Lister and Chris Reed that looks both backward on the history of this discourse and forward to its future.
“Novelty in the Entropic Landscape” centers around the question of how entropic processes generate novelty in landscape, defining novelty as “emergent newness” (Raxworthy 2013, 31). Sharing the theme of emergence, Emergence in Landscape Architecture is also concerned with how processes generate new landscapes, notably pointing to the concept of bifurcation as an appropriate concept for understanding the “switch[ing] of a physical system such as a landscape from one state to another” (Barnett 2013, 44). Earlier, James Corner’s essay “Ecology and Landscape as Agents of Creativity” (reprinted in Projective Ecologies) asserted the importance of developing “an alternative kind of landscape architecture” of “the design of ‘processes’, ‘strategies’, ‘agencies’, and ‘scaffoldings’ — catalytic frameworks”, in which “calculated conventions about how people live and relate to land, nature, and place are challenged” (Corner 1997/2014, 58-59). Each of these texts asserts that the creative orchestration of novelty is central to the role of landscape architecture, not only as it copes with performative questions related to landscape dynamism, but also as it serves as cultural imagination for societies developing new awareness of their roles as a planetary change agents (Corner 1997/2014, 56). As we trace the history of the Salton Sink, three particular ways in which emergent novelty might be valued will emerge, adding specificity to this assertion.

Beyond this shared agreement on the value of novelty for landscape architecture, a pair of critiques, one by Raxworthy and one by Barnett, are worth noting. Raxworthy develops an extended critique of what he terms “the process discourse”, in which he includes figures such as Corner, Waldheim, and other landscape urbanists, linked by their shared interest in deploying processes as agents of design. Focusing in particular on how the “process discourse” has reflected on the Parc de la Villette competition, Raxworthy argues that this discourse has often mistakenly conflated representations and representational strategies (“layering”, “algorithms”) with the dynamic reality of actual landscapes, leading to design operations that “produce simulations [of dynamic landscapes] that nonetheless become static themselves when built, because they do not produce novelty” (Raxworthy 69). In response, he proposes that landscape architecture return to and learn from gardening, “combin[ing] the use of ‘tendencies’ in the design stage with an ‘ongoing feedback’ relationship with the developing landscape” (Raxworthy 188). In the sections that follow, we ask the question: how might a response to this tendency to simulate rather than engage novelty be different if the response is developed through reflection on very large scale landscapes, rather than gardens?

Barnett offers a different critique, noting that “emergence in landscape architecture has been too closely tied to ecology”, ignoring other domains that “emergence theory might enrich”: “includ[ing] the historical, the cultural, the political” (Barnett 1-2). This critique is explicitly less central to Emergence in Landscape Architecture than Raxworthy’s critique is to his dissertation, but it is central to this essay. As with Raxworthy, we ask a question instigated by Barnett: where might novelty emerge from assemblages which are not biotic — and thus overlooked by emphasis on ecology — but which are material and nonhuman?

In North America, the greatest impact of the ideas of indeterminacy and emergence within landscape architecture has been geographically concentrated in a broad northern swathe of the United States and Canada, sweeping west from the heavily urbanized coastal Northeast to the Rust Belt on and near the Great Lakes. Seminal projects such as Fresh Kills and Downsview Park were sited in this swathe; the schools of landscape architecture that have advanced it, including Penn, Harvard, and Toronto, are situated within it; and the speculative design research, such Stalking Detroit, that has propelled the discourse has been focused in it. Extending Jane Amidon’s arguments in “Big Nature”, we postulate that this may be no coincidence, but actually a result of the co-incidence of the seemingly tabula rasa conditions of post-industrial sites and shrinking cities with a design philosophy that may be more aimed at generating novelty in controlled conditions than in operating within unruly landscapes that already exhibit failure, entropy, and novelty (Amidon 2010). Such landscapes — the Salton Sink is one — call for additional concepts.

3.2 New Materialism

In parallel to these discussions within landscape architecture, there has been a significant shift in many fields including philosophy, political ecology, history, art, towards a new appreciation of the agency of materials, underwritten by the metaphysics of “new materialism”. This shift has been relatively unappreciated by landscape architecture, yet has the potential to infuse the discipline with a new vibrancy,
emphasizing not only vegetation as an agent of growth, but also the generative capacity of many other natural and subnatural actors: schists, salts, dams, lichen, molds, power lines, beetles, and so on.

New materialism emphasizes the agency of all things, objects, and forms of matter. In *Vibrant Matter*, Jane Bennett describes this agency as a “vitality”, “the capacity of things—edibles, commodities, storms, metals—not only to impede or block the will and designs of humans but also to act as quasi agents or forces with trajectories, propensities, or tendencies of their own” (Bennett 2010, viii). Emergence might be understood as one of the primary ways in which abiotic assemblages express this vitality.

Bennett, like new materialism generally, employs an ontologically flat approach to both human and nonhuman entities, in which “materiality is a rubric that tends to horizontalize the relations between humans, biota and abiotas” (Bennett 2010, 112). This has significant politic al consequences; Bennett suggests, for instance, that “the figure of an intrinsically inanimate matter may be one of the impediments to the emergence of more ecological and more materially sustainable modes of production and consumption” (Bennett 2010, ix). Thus new materialism offers a broader philosophical framework from which we might begin to understand the *significance* of the question posed above regarding novelty and abiotic phenomena, particularly as landscape architects struggle with planetary-scale impacts of human activity.

### 3.3 The Anthropocene

There is much recent energy surrounding the notion — initially proposed in geology — of the Anthropocene, a new geologic age defined by the capacity of humans to behave as geologic change agents. Geologic change in the Anthropocene is intensely accelerated by human activity, and Anthropocene events are characterized by their speed relative to natural analogs. Triggering developments in a broad array of seemingly-unrelated disciplines, including arts, sciences, and the design disciplines, this notion of geologic agency has brought to the forefront both the scale of human agency and the degree to which human outcomes are linked to planetary forces, on scales which are geologic in both time and space.

There is also an ecological aspect to the Anthropocene. If most of the terrestrial biosphere has been shaped by anthropogenic influences, existing descriptions of “biomes” oversimplify human impacts and do not account for the complexity of interrelated ecological conditions that arise from human land use patterns (Ellis & Ramankutty 2008, 449). Using the neologism “anthromes”, environmental scientist Erle Ellis has identified an alternative category, defined as “mosaic landscapes composed of agriculture, settlements, and infrastructure in which remnant, recovering, and more lightly used novel ecosystems are embedded” (Ellis 2014, 176).

These anthromes and their affiliated novel ecosystems are, like biomes, characterized by landscape-scale processes of emergence and indeterminacy, but the failures and entropic processes found in them are differentiated by their hybrid quality, as they are triggered and sustained by mixtures of human and nonhuman inputs. These synthetic ecologies are prompting radical new forms of experimentation in practices of ecological preservation, conservation, and restoration, such as assisted migration, the design of novel ecosystems, and rewilding — landscape practices which are necessitated by Anthropocene conditions (Marris 2011). While these practices are outside the scope of most traditional landscape architectural practice, new paradigms of complexity imply the blurring of the standard disciplinary distinctions through the disappearance of discrete site boundaries and the consideration of multiple scales of influence (Hill 2005, 150-152).

Emma Marris’s *Rambunctious Garden* is an accessible but informed account of some of these practices. Like many of the landscape architects under discussion here, Marris critiques binary conceptions of nature and culture. She offers an expanded view of nature which is more inclusive of managed, disturbed, or novel ecologies, and which shifts away from the use of ‘baselines’ as a primary goal for landscape practices. Instead, she suggests that a more achievable and beneficial goal for ecological management practices would be to establish and define characteristics to assess ecological fitness that are specific to local conditions and site-specific histories in landscapes. For example, a disturbed landscape colonized by non-native species might nonetheless exhibit high biodiversity, and therefore be valued (Marris 2011). The Salton Sea is one such landscape.
4 THE SALTON SINK

How did the Salton Sea come to be so heavily influenced by anthropogenic factors? What is the history of failure, entropy, and novelty in the Sink that it lies within? Answering these questions requires an environmental history that shifts across radically different temporal and spatial scales, recognizing that forces as disparate as geology and infrastructure have combined, over time, to form current conditions.

4.1 Cahuilla

The Salton Sink is a deep topographic depression in Southern California, east of San Diego and close to the Mexico-United States border. Several million years ago, it was the outlet of the Colorado River (Figure 2). During a pluvial period in the Pleistocene, the depression slowly became isolated through the deposition of vast quantities of sediments, forming a low, flat ridge that produced two potential trajectories for the Colorado River: one eastern, into the Gulf of California, and one western, into the Sink. The river oscillated between the two; when it swung west, it filled the Sink with freshwater, forming a freshwater precursor to the Salton Sea, Lake Cahuilla. This lake existed and disappeared multiple times over the millenium (roughly, 700-1750) preceding the arrival of Europeans and Americans in the vicinity. When those explorers and settlers arrived, they found the Sink in a dry period, a vast desert filled with salt deposits. Observing floods from the Colorado into the basin in 1891, they realized it might be possible to irrigate the sink by gravity using water from the river. By 1900, “California promoter and engineer” George Chaffey and engineer Charles Rockwood incorporated the California Development Company (CDC), which “ran a diversion canal from bedrock near Pilot Knob, a mile into the United States, through Mexico, and into the channel of the Alamo River” (McGuire 2003, 384). In 1901, “within eight months of its construction, the CDC’s irrigation project spawned two towns and by the end of 1904, two thousand settlers were farming the desert—now productive land” (Reisner 123).

4.2 Infranatural Disaster

The current Salton Sea (Figure 2) owes its existence to an infrastructural failure of geologic proportion. After a couple years of low flow from 1902-1903, the CDC made the “hazardous move... to cut
into the bank of the river” to create the “Mexican Cut” and channel the water “down a short quick descent” into the Alamo Channel, an old delta channel (Crane 1914, 217). Disastrously, though, the volume of flow in the Colorado oscillated upward in following years. In 1905, the newly engineered Mexican Cut was overwhelmed. The Alamo River became the main path of the Colorado River, diverting the Colorado’s entire flow into the Salton Sink — as in the bygone era of Lake Cahuilla. “During the Great Flood onlookers described a raging torrent of huge waterfalls—as high as twenty, forty, even eighty feet high and 1,000 feet wide were recorded as the river gushed unrestrained.” (deBuys and Myers 2001, 112). During the nine months of flooding, the volume of sediments deposited into the Salton Sink were equivalent to 4 times the amount of material moved for the Panama Canal (deBuys and Meyers 2001, 114).

In 1906 while the breach was still open, an account by Edmund Mitchell in the *North American Review* described the “surprise” of the emergence of a “new geologic feature” termed the “Salton Sea”. The account begins with a footnote outlining the failed attempts to close the breach, which despaired at the “remote” possibility of “regaining control” (Mitchell 1906, 224). Even at this early stage in the emergence of the Sea, Mitchell identifies qualities that identify humans as geologic agents: the speed of change, the unfathomable scale of that change, and the similarity of this failure to “catastrophes” such as “earthquakes” or “volcanic eruption”. Mitchell recognized that “we are witnessing a reversion to an order of things that had a prior existence in some remote period of the earth’s history” (Mitchell 1906, 225).

Following multiple failed attempts to close the breach, on February 10th, 1907, a headgate was installed at original canal intake on the US-Mexico border at Pilot Knob. Closing the breach required “a workforce of nearly 2,000 men recruited from six local tribes, area settlers and Mexican laborers” and the help of the Southern Pacific Railroad to relocate “the equivalent of more than 3,000 railroad cars of timber, rock, gravel, and clay” (Boyle 2002).

### 4.3 Fecundity

The Salton Sink entered into a period of fecund growth following this failure. Agriculture, urbanization, and ecology all flourish on varying temporal spans, and were supported by or contributing to emergent novelty within the Sink. After the breach, investigations were undertaken by various disciplines to understand the physical characteristics, geology, systems, species, and abnormalities. Without a consistent flow of water, the level of the water slowly dropped from -195 ft below sea level to -250 ft, increasing in salinity as the water evaporated. In 1935, with the completion of the Hoover Dam and increased control over flows in the Colorado, the sea’s water level began to rise again, reaching -240 ft by 1948. With this new stable source of water, agricultural lands expanded, particularly after World War II land reclamation (Carpelan 1958, 375-376). This period of infrastructure-building offered stability for agriculture in the Imperial, Coachella and Mexicali Valleys (Figure 3).
The Salton Sink entered into a period of fecund growth following this failure. Agriculture, urbanization, and ecology all flourish on varying temporal spans, and were supported by or contributing to emergent novelty within the Sink. After the breach, investigations were undertaken by various disciplines to understand the physical characteristics, geology, systems, species, and abnormalities. Without a consistent flow of water, the level of the water slowly dropped from -195 ft below sea level to -250 ft, increasing in salinity as the water evaporated. In 1935, with the completion of the Hoover Dam and increased control over flows in the Colorado, the sea’s water level began to rise again, reaching -240 ft by 1948. With this new stable source of water, agricultural lands expanded, particularly after World War II land reclamation (Carpelan 1958, 375-376). This period of infrastructure-building offered stability for agriculture in the Imperial, Coachella and Mexicali Valleys (Figure 3).

Today, the Imperial Valley is allotted “20 percent of the Colorado River’s water” for a productive return that includes, among other things, roughly “80 percent of the nation’s winter crops” (Than 2014). The Salton Sea plays a vital infrastructural role in supporting this agricultural irrigation system as a catchment basin for agricultural run-off, which carries an array of contaminants that cannot be permitted to build up in agricultural soils, most importantly salt. Through subsurface tile drainage systems, the Imperial County Farm Bureau estimates the equivalent of 5,200 trucks of salt per year is deposited into the Salton Sea instead of leaching into the soil.
4.4 Entropy and Novelty

Consequently, the Salton Sea now functions both as a hybrid agricultural-ecological system (Figure 4), collecting nutrients and contaminants while also functioning as a vital component of various ecosystems, including the Pacific Flyway. These two functions have entered a peculiarly tense relationship, which illustrates well the capacity of entropy to both generate novelty and threaten the landscapes it generates.

Because the sea has no outlet, dissolved materials that enter the sea tend to build up to extreme concentrations. An early account of high dissolved oxygen levels, algal blooms, anoxia, and fish kills was associated with concentrations of ammonia, nitrate, and phosphate. A field note from July of 1958 reads: “Fish ‘kill’ general throughout the north end of the Sea. A few dead Biardiella floating at surface about a mile offshore from Fish Springs. Many dead on beaches” (Carpelan 1958, 380).

Although the concentrations of ammonia, nitrate, and phosphate were correlated to irrigation practices and agricultural runoff, the sea was considered, “highly productive and there seems to be an effective use and re-use of the nutrients that enter” (Carpelan 1958, 384). The algal blooms were mildly described as “conspicuous at times” (Carpelan 1958, 385). These conditions have only intensified over time, to the degree that the Sea is regularly described as being in crisis.

This state of crisis has led to an enormous ‘ecological restoration’ effort. These efforts recognize the sea as an important ecological landscape for maintaining infrastructural functions while providing habitat and protecting species. Estimates suggest that its current trajectory of decline could cost $29 billion and $70 billion in reduced ecological services over the next 30 years (Cohen 2014). In addition to ethical decisions surrounding the future of emergent novel ecosystems within the sink, the selection of maintenance protocols is further complicated by this economic calculus.

In order to establish future trajectories to mitigate negative ecological and economic impacts, there are several scales of ecological demands to consider. At the scale of the sink, there are recurring issues of fish kills and avian disease tied to agricultural runoff from the Imperial Valley. Ecological restoration
proposals for nutrient removal include diked wetlands at the mouth of inflow channels. The sea as a marine habitat is threatened by over-salinization and nutrient pollution. Restoration proposals include pumping alternatives that would replace the saltier water of the sink with ocean water; solar evaporation ponds; and enhanced evaporation systems, a mechanized and aggressive form of salt removal by evaporation.

At the related scale of the nearby Colorado River Delta, conflicting agendas for appropriate restoration strategies stem from ecology boundaries being obscured by differing international policies for environmental policy, water management, and monitoring requirements. Restoration groups and agencies have recognized the benefits of reconnecting the Colorado River to its delta, to re-establish estuarine conditions benefitting ecological functions above and below the international boundary. However, for the Salton Sea, which depends on maintaining the current diversion of flows, this option poses serious risks. Thus not only entropy itself, but also management imperatives that interact with it at multiple scales have this dual capacity to both generate novelty and accelerate entropic processes.

5 LESSONS

We see three significant lessons emerging from this study of the Salton Sink in relationship to the discourses outlined in the second section: indeterminacy and emergence must be applied beyond ecology alone, scalar differences are central to understanding the operation of these processes, and the ways that novelty is utilized in the Sink help us understand why landscape architecture should value emergent novelty.

All three lessons relate directly to the third discourse we discussed concerning indeterminacy and emergence. Two of these lessons concern the scope of the application of the concepts discussed above, critiquing it. The first lesson’s critique is informed by the discourse of new materialism, while the second lesson’s critique is informed by the scalar concerns of the Anthropocene discourse. In contrast, the third lesson offers specific ways in which novel landscapes emerging from failure and entropy have been valued in the past and — significantly for landscape architecture — might be valued in the future, adding specificity to the general assertion that this discourse of indeterminacy and emergence is valuable.

5.1 Beyond Ecology

First, the history of the Sink shows that indeterminacy and emergence can and should be applied to understanding not only how landscape architecture might operate with regard to ecology, but also to other aspects of landscapes, particularly the infrastructural, geological, and chemical. Most discussion of indeterminacy and emergence within landscape architecture has focused on drawing from examples in ecology and, in turn, on landscape architectural methods which might cultivate indeterminacy and emergence within ecological systems. (To a lesser extent, though particularly where landscape architecture has drawn from architecture, there has also been a concern for social and programmatic indeterminacy and emergence (Berrizbeitia 2007, 177.) For instance, Corner’s critique of ecology as source material for landscape architecture in “Ecology and Landscape as Agents of Creativity” focuses primarily on ‘radical ecologies’, which serve primarily to suggest the inadequacies of “conservation” and “ecological restoration” as inspirations for landscape praxis, inadequacies which are defined in terms of the absence of cultural imagination (Corner 1997/2014, 47-60). While it mentions “philosophical critiques of anthropocentrism [and] biocentrism”, it does not explore the potential implications of those critiques for considering non-biological landscape assemblages on equal footing with biological landscape assemblages (Corner 1997/2014, 52). Later, Corner quotes Henry Bergson’s contention that “the role of life is to inject some indetermination into matter”, with Corner elaborating that “Bergson speaks of the infinite creativity of biological and imaginative life” (Corner 1997/2014, 59). This is wrong; it does no violence to the vibrancy of life to admit the vibrancy of all matter.

Beginning with ecology imposes a filter on the consideration of landscape, a filter that distorts and obscures other potential organizations, agents, and values beyond the behaviors of organisms. In the Sink, echoing new materialism, we see how vibrant and alive other forms of matter are: a dam collapsing, a sea evaporating, tiles draining.
5.2 Scalar Difference

Second, we contend that scalar differences are significant to novelty as it emerges indeterminately from failure and entropy. Raxworthy and Barnett both largely develop their insights in relationship to relatively small-scale landscapes: gardens, groves, parks, plazas, and so on. The Salton Sink, by contrast, is a very large scale landscape. The operations of these processes certainly have similarities at small and large scales, but there are differences, and these differences are important to both the development of adequate theory and the potential role of landscape architectural design.

Some of these differences relate to sheer volume of matter. While both a garden and a basin share the characteristic of being intentionally productive, the volume of matter produced by the application of nutrients and water to the soils of the Imperial Valley is exponentially greater than the volume of matter produced by watering a grove of fruit trees in a garden. The novelty which emerges from processes of failure and entropy at very large scales is radically more productive than novelty at smaller scales. This is true as a material of volume, but also in other ways. For instance, biodiversity is not tied linearly to size, because some species require very large ranges, and thus, when measuring plots of increasingly large scale, biodiversity increases more rapidly than mere area itself does. Moreover, fecundity at the scale of Sink necessarily produces great volumes of waste, in the form of agricultural wastewater contaminated with excess nutrients and chemical-laden runoff. This waste is too great in volume to be feasibly exported, and so the Sea is now managed in part as a landscape machine for the disposal of these wastes.

These two differences point to a broader, more fundamental difference: at relatively small scales, issues are relatively easily resolved through recourse to external resources. For instance, if the soil of a garden is contaminated, it can be removed wholesale, trucked off-site, and replaced by new, soil. At very large scales, such as within the Sink, interventions must depend more wholly on the manipulation of processes within the landscape in question and existing interactions with outside systems. Very large landscapes cannot be reconstructed in totality. If the soil of the Sink is contaminated, it can be remediated by restructuring waste flows so that they no longer bring contaminants into the soil, waiting as background processes such as microbial metabolism break down contaminants, and perhaps accelerating microbial metabolism through various artificial triggers (temperature, nutrients, etc.). But it will not be removed wholesale; the sheer volume of material makes that impractical.

As a result of these differences, attitudes and practices for management are different in large landscapes than in small landscapes, such as the gardens that are the focus of Raxworthy’s dissertation. Lister makes this point in the context of discussion of “large parks”: “‘Large-ness’ is a singularly important criterion that demands a different approach to design, planning, management, and maintenance—one that explicitly provides the capacity for resilience in the face of long-term adaptation to change, and thus for ecological, cultural, and economic viability.” (Lister 2007, 35)

“Adaptation to change” becomes even more significant in landscapes of very large temporal and spatial scale that are affected by failure and entropy, like the Sink. In these landscapes, the “short-term disturbance and long-term, cyclic… change” that Lister describes as characteristic of park-sized landscapes is readily apparent and on-going (Lister 2007, 43). Indeterminacy and emergence do not need to be instigated; they exist by default (Figure 11). At very large scales, the role of the landscape designer may often be less to directly orchestrate novelty and more to react to failure, to channel entropy, and to identify specific emergent potentials that ought to be encouraged or discouraged. It is particularly important for designers to engage processes at this scale given the increasingly large (geologic) scales that humans are making landscapes at.
5.3 Valuing Novelty

The third lesson returns to a question raised near the beginning of this essay: why is the novelty that emerges from failure and entropy significant? The case of the Salton Sink describes three specific ways in which that current landscape, emerging as it has from failure and entropy, is valued. These ways, in turn, suggest important categories of value which might be looked to by landscape architects designing for and with failure and entropy. Each of these ways might be understood in terms of utilization. The Sink is utilized for agricultural production. It teems with sheep and catfish, with fields of kleingrass (Panicum coloratum) and alfalfa, with rows of beets and carrots. This role has resulted in the infrastructuralization of the Sea itself, the assimilation of artificial nature as infrastructure, as the Sea absorbs irrigation drainage contaminated by salts, fertilizers, animal wastes, and agricultural chemicals. As ecosystems, environments, infrastructures, and urbanization grow increasingly entangled, the design and construction of such landscape machines is an urgent task for landscape architecture to participate in (Roncken, Stremke & Paulissen 2011).

The Sink is utilized by subcultures — bikers, “snowbirds”, skateboarders, outsider art like “Salvation Mountain”, and so on — which find space in the relative dereliction of the sink. This is one of the differentiating aspects of growth that emerges from entropy: it has the potential to be characterized by creative fecundity rather than more utilitarian economic vitality, and so it leaves space for practices, populations, and phenomena that are marginalized in areas of greater order. This fecundity may be ecological. This ecological fecundity is often performative, in that the ecologies that utilize disvalued landscapes undergoing entropic change often perform significant roles in both human and environmental systems (Del Tredici 2014). At the same time, it has the potential to be culturally and aesthetically significant, to “evoke ‘wonder and enchantment’” (Gandy 2013, 7). It may also be the fecundity of “terrain vague”, space defined by “the absence of use, of activity” and a corresponding (or resultant) “sense of freedom, of expectancy”: “void… as absence, and yet also as promise, as encounter, as the space of the possible” (De Sola Morales 1995).

It is often asserted that there is a potential conflict between design (which requires intent and organization) and the flourishing of subcultures (which thrive on neglect and disengagement) (De Sola Morales 1995). Learning to design with entropic processes offers one promising avenue to circumvent this potential contradiction, where design might prepare substrates for subcultural futures. The Sink is utilized as a wilderness, even though its most visited and used wild place — the Sea — is anthropogenic in origin. Displaced from other potential stopping points, such as California’s Central Valley,
by agricultural development, migratory birds come to the shores of the Sea in vast numbers, making the Sea "one of the most heavily used bird habitats in the country" (Than 2014). Features like these birds, the ancient rock formations surrounding the sea (on some of which the high-water mark of ancient Lake Cahuilla is still visible), and the desert itself fit immediately with one of the four primary characteristics of wilderness described in the Wilderness Act of 1964: "contain[ing] ecological, geological, or other features of scientific, educational, scenic, or historical value". The people drawn to the Sink by these features often engage in the human uses that also form another of those characteristics, "outstanding opportunities for solitude or a primitive and unconfined type of recreation". The Sink certainly meets the scalar requirements of the Act ("at least five thousand acres"). The only characteristic that it does not meet is being "untrammeled by man", or "generally appear[ing] to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable" — but this characteristic may very well be obsolete in the face of Anthropocene conditions.

Each of these values, these modes of use, relate to contemporary goals and values within landscape architecture: the design of landscape machines, productive landscapes, and landscape infrastructures; designing for and with informal and spontaneous (sub)cultural practices; and designing new American wildnesses. When combined with movement beyond ecology and consideration of the significance of scalar difference, they point forward toward potential engagement between landscape architecture and the novel landscapes that emerge from entropy and failure at very large scales. This engagement has the potential not only to advance the body of landscape architectural theory concerned with indeterminacy and emergence, but also to illuminate avenues for landscape architecture to practically and productively participate in the design of large-scale landscapes shaped by human action, including restoration efforts like the one now underway in the Salton Sink.

5.4 Endnotes

1. For instance, Kristina Hill's essay "Shifting Sites" (in Site Matters) and Robert Cook's essay "Do Landscape Learn?" (in Environmentalism in Landscape Architecture) both discuss disturbance in some detail. Generally, landscape architecture has tended to be interested in an ontologically flat approach to disturbance, which recognizes that ecosystems do not distinguish between disturbances of anthropogenic and non-anthropogenic origin.

2. Nina-Marie Lister and Rod Barnett, both of whose work is discussed in more detail later in this text, are exceptions to this general inattention. Lister discusses bifurcation in "Ecological Design or Designer Ecologies?" (Large Parks), while Barnett discusses the concept in some detail in Emergence in Landscape Architecture.

3. The design potential of bifurcation is discussed in some detail in Casey Lance Brown and Rob Holmes's article "Landscape Switching", found in Kerb 22. The formation of the Salton Sea fits their definition of a "switch": "switching landscapes progressively accelerate in temporal units and narrow in geographic scope along three defined tracks: switches, glitches, and twitches. Switches are serious, infrastructural-scale plans or disasters. They reach into the largest, geologic-scale events and armatures humanity has constructed."

4. The Ancient Greek word that entropy descends from literally meant "a turning towards".

5. See, for example, Waldheim's discussion of Parc de la Villette in "Landscape as Urbanism", in The Landscape Urbanism Reader.

6. Projective Ecologies brings together these two strands both in the backgrounds of the co-authors and in the content of the book itself.

7. The term "subnature" originates with David Gissen.

8. While this is true as a description of the overall propensities of this discourse, there are certainly exceptions, in both theory and practice, ranging from Sanford Kwinter's discussion of wildness in...

9. In contrast to Corner, Raxworthy is explicit in allowing this vibrancy: "Inorganic materials are subject to environmental processes and undergo significant changes that result in important chemical and physical changes, at both the architectural form and the mineral level... while growth provides a model for change processes, I co-opt this sense of process to discuss inorganic materials too" (Raxworthy 2013, 29-31). He goes on to use specific examples of soil and erosive processes which demonstrate the agency of abiotic matter. However, this broadened lens on indeterminacy and emergence is not central to Raxworthy’s project in his dissertation. It deserves to be addressed more directly, in more detail, and at other scales.

10. Ashley Carse treats this concept — the assimilation of nature as infrastructure — at length in “Nature as Infrastructure: Making and managing the Panama Canal Watershed”.

6 REFERENCES

ROBERTO BURLE MARX AND THE CONSERVATION
OF THE BRAZILIAN FOREST

SEAVITT NORDENSON, CATHERINE
The City College of New York, Spitzer School of Architecture, Program in Landscape Architecture,
cseavitt@seavitt.com

1 ABSTRACT
In 1951, the Brazilian architect Lúcio Costa published an essay entitled "Testimony of a Carioca
Architect: Concrete, Sun, and Vegetation," adapted from his letter to Gustavo Capanema, the cultural
minister, in support of establishing the Ministério da Educação e Saúde building of 1937-1942 as an
historical and cultural landmark of Brazilian modernism. Here, Costa identifies the significant contribution
of landscape architect Roberto Burle Marx in the development of Brazilian modernist architecture. While
Burle Marx’s landscape projects are well known, by the late 1960s he had attained an effective, though
ethically controversial, political platform from which to promote a robust strategy for the conservation of
the Brazilian landscape, specifically the forest. Appointed by the military dictatorship as a Counselor to the
Brazilian Conselho Federal de Cultura, he delivered seventeen depositions, many addressing the impacts
of deforestation and development in Brazil. These position pieces, published in the Council’s journal
Cultura, are translated and analysed here for the first time since their initial publication. Like Costa’s
initiatives to protect cultural landmarks within the built environment, Burle Marx sought to protect natural
landscapes throughout Brazil, many of which had provided both inspiration and plant materials for his
garden designs. For Burle Marx, the ecological conservation of the forest was a national cultural project, a
position that still resonates with environmentalists today. The “culture” of the forest and the diversity of
Brazilian flora, like the legacy of modernist buildings, was to be understood as an aspect of Brazilian
national heritage, deserving both definition and protection.

1.1 Keywords
Roberto Burle Marx, Lúcio Costa, Brazil, culture, deforestation, conservation
2 CONCRETE, SUN, AND VEGETATION

“One may see gardens indoors and outdoors, on the ground floor and on roofs, and houses planned so that each room has the extension of a private garden… It all can be summarized as a creative harmony between the buildings of man and the world in which he constructs them.” (Costa, 1956, p. 137.)

Lucio Costa (1902-1998) made this observation of the integral relationship between the Brazilian landscape and the modernist language of Brazilian architecture in his 1951 essay entitled "Testimony of a Carioca Architect: Concrete, Sun, and Vegetation," which appeared in the February 1956 issue of The Atlantic. The essay, adapted from his letter to Gustavo Capanema, the cultural minister at the time, was written to support of the establishment of the Ministério da Educação e Saúde building, designed and built from 1937-1942 by Costa and his team of architects, as an historical and cultural landmark—indeed, as a national monument—of Brazilian modernism. After describing the inventive use of concrete developed by Brazilian structural engineers, Costa adds two additional elements essential to this unique synthesis of brasilidade: climate and plant material, with "nature itself invited to be part of the plan." (Costa, 1956, p. 138.) Interestingly, Costa here identifies the significant contribution of landscape architect Roberto Burle Marx (1909-1994) in the development of Brazilian modernist architecture; indeed, Costa had initiated the career of Burle Marx in 1928 with the commission of a roof garden in Rio de Janeiro with his partner, the architect Gregori Warchovchik. Burle Marx’s later roof terrace gardens and plaza design for the Ministério da Educação e Saúde are masterfully integrated into the Corbusian principles evident in the building’s form and development. (See Figure 1.)

![Figure 1](https://example.com/figure1.jpg)

Figure 1. Roberto Burle Marx, Plaza of the Ministério da Educação e Saúde, Rio de Janeiro (1937-1942). Image courtesy of the Arquivo Geral da Cidade do Rio de Janeiro.

Arguably Latin America’s finest modernist landscape architect, Burle Marx’s gardens and parks are well known, as is his insistence on the use of native Brazilian plants. Less known, however, is his establishment of an effective political platform from which to develop a robust strategy for the protection and conservation of the Brazilian landscape, specifically the forest. As an appointed Counselor to the Brazilian Conselho Federal de Cultura (Federal Council of Culture), he described the extent of deforestation and development witnessed throughout his travels in Brazil during his forty years of professional life. Like Costa’s earlier initiatives to protect cultural landmarks within the built environment, Burle Marx now sought to protect the natural landscapes throughout Brazil that had provided both inspiration and plant materials for his garden designs. This paper examines several of the seventeen consular depositions of Roberto Burle Marx made during his appointment from 1966 to 1973 to the Conselho Federal de Cultura, developing the argument supporting his successful rhetoric through a close reading of these texts. Particular attention is given to the consular statements in which Burle Marx addresses what he considered the important cultural heritage of the Brazilian landscape, its forests, and its flora. For Burle Marx, the ecological conservation of the forest was a national cultural project, a position that still resonates with environmentalists today. His appointment to the cultural council by the military
dictatorship is ethically troubling; however, his use of this political platform to defend and conserve the environment is quite extraordinary.

3 CONSELHO FEDERAL DE CULTURA

The Brazilian Conselho Federal de Cultura (Federal Council of Culture) was created by governmental decree in November 1966, two years after the 1964 military coup initiated a right-wing dictatorship in Brazil that would last twenty-one years. Appointed directly by the President of the Republic, Humberto de Alencar Castello Branco, the twenty-four counselors had dissimilar allegiances and motivations, but they all shared an interest in the national projection of Brazilian culture. Roberto Burle Marx was an appointed counselor, serving alongside other well-known members, including sociologist Gilberto Freyre and novelists Rachel de Queiroz and Guimarães Rosa. Many other culturally significant Brazilians spent this period abroad in political exile; freedom of speech and political opposition were often suppressed; and civilian protests toward government-imposed censorship occurred. (See Figure 2.)

This conflux of culture and politics, specifically a nationalist cultural policy implemented by a military dictatorship, is particularly fascinating as the continuation of a decades-long search for brasilidade, or "Brazilianess," and the national construction of a uniquely Brazilian culture.

![Figure 2. Passeata dos cem mil (March of 100,000), Rio de Janeiro (1968). Public domain image.](image)

After the military coup, the ambitious and fast-paced publically-commissioned landscape projects that had occupied Burle Marx for thirty years rapidly disappeared. Burle Marx appears to re-focus his talents toward the future of conservation, reflecting on the ecological diversity he had always championed to the reality of the extraction of Brazil's natural resources and the impacts of industrial development as it began to sprawl into the countryside. With his appointment to the Conselho Federal de Cultura in 1966, the military dictatorship provided Burle Marx with a highly effective new forum for the continuation what is arguably a cultural project—this one constructed through rhetoric and words.

In the seven years of his service, spanning from 1966 to 1973, Roberto Burle Marx wrote a total of seventeen testimonies for the Conselho Federal de Cultura, and read these at the Council's plenary sessions. The session proceedings, published by the Brazilian Ministry of Culture's journal Cultura, were forwarded to the President of the Brazilian Republic. There were a number of presidents during this period: Humberto de Alencar Castelo Branco (1964-1967), who created and appointed the Conselho; Artur da Costa e Silva (1967-1969); the two-month military junta of Augusto Rademaker, Aurélio de Lira, and Márcio Melo (September-October 1969); and Emílio Garrastazu Médici (1969-1974).

Burle Marx’s consular statements of this period, often arguing for the protection of Brazilian landscapes from development and neglect, were as influential in the construction of Brazilian culture as his earlier public park projects. These depositions have not been reprinted since their initial date of publication in Cultura, but are of significant importance to the oeuvre of Burle Marx. In one of his earliest depositions, he writes: "Unfortunately, it seems that a concern for public parks and for the natural
landscape itself is lacking in our country. Even those with a limited capacity of observation would perceive, without too much effort, the offenses committed on our natural landscapes.” (Burle Marx, Estátuas em Jardins, 1968, p. 25.)

4 VIAGENS DE COLETA

Burle Marx’s interest in conservation and preservation began early in his career, and was enhanced while exploring the various geographic regions of Brazil, particularly those the interior state of Minas Gerais, with some of the most important botanists of his time, including Henrique Lahmeyer de Mello Barreto (1892-1962), botanist and director of the Zoological Garden of Rio de Janeiro, and Emígydio de Mello Filho (1914-2002), director of the botany department of the National Museum of Brazil (Rizzo, 2010). Often his excursions were viagens de coletas—like the nineteenth century European naturalists Karl Friedrich Philipp Von Martius and Étienne Geoffroy Sainte-Hilaire who had catalogued Brazil’s rich flora, these coletas were missions to collect native plants that Burle Marx could propagate in his garden designs. But Burle Marx collected live plants, intended for use in his garden designs, not specimens to be pressed into books. (See Figure 3.)

Figure 3. Excursion by Severo Gomes, Rino Levi, Roberto Burle Marx, and Procópio Ferreira de Camargo to the Serra de Parati, Minas Gerais (1952). Public domain image, courtesy of Abilio Guerra.

“Once again I call for the protection of our natural and urban landscape. We must demonstrate that we are worthy of this rich flora that nature has bequeathed to us.”

(Burle Marx, Preservação de Condições Paisagísticas, 1970, p.35.)

To support this developing nursery, in 1949 Burle Marx purchased the former plantation Sítio Santo Antônio da Bica in Barra de Guaratiba, a village at the westernmost extent of Rio de Janeiro. This 150-acre site, a former banana plantation carved out of Atlantic coastal rainforest, consists of a collection of over 3500 species of live plants, many of which were gathered by Burle Marx himself. Some were previously unclassified species he discovered during his coletas, and these bear his scientific name, burle-marxii. At the Sítio, rainforest species were planted in an area he called the sombral, an area shaded from the sun with fabric canopies in order to keep the plants moist. (See Figure 4.)
Burle Marx developed a pedagogical approach to the design of public parks and urban arborization that would allow every citizen to gain a greater cultural understanding of Brazil's own ecological heritage. In 1985, Burle Marx donated the Sítio Santo Antônio da Bica to the Brazilian government, which renamed it Sítio Roberto Burle Marx. It is now protected by the Instituto do Patrimônio Histórico e Artístico Nacional, the same governing body which protects the Ministério da Educação e Saúde building.

5 SEVENTEEN TESTIMONIES OF A BRAZILIAN LANDSCAPE ARCHITECT

“And today, when I embark on excursions in search of botanical material that I might use in the creation of my gardens, I note with sorrow the discouraging fact that no matter where one goes, destruction [of nature] is being felt. It is a misfortune that seems incurable, a misfortune that one accepts melancholically, as if there were no possibility of changing this. If we continue to accept that which we see happening, soon little will remain of this Brazilian flora that is considered to be one of the richest in the world.” (Burle Marx, Paisagismo Brasileiro, 1967, p.16.)

Burle Marx’s position and primary ambition as counselor was clearly stated: to prevent the deforestation, personally observed over the course of his forty-year career, which had led to the extinction of hardwood species and an increase in erosion and mudslides. (See Figure 5.) He notes the observable change in the climate—the increase in torrential rains—that deforestation seems to have provoked. For Burle Marx, the definition of national culture needed to include and protect the Brazilian forest and its diversity of flora. And that “culture” needed to be understood as part of the Brazilian national heritage, deserving of both definition and protection (Burle Marx, Sugestões para Preservação dos Parques Nacionais, 1967; Burle Marx, Defêsa das Reservas Naturais, 1969).
5.1  **In Defense of the Tree**

In his first testimony to the Conselho, Paisagismo Brasileiro (Brazilian Landscapes), delivered in July 1967, Burle Marx evokes the specter of extinction through the example of the jacarandá-da-bahia, commonly known as Brazilian Rosewood (*Dalbergia nigra* Vell.), a hardwood species that was highly exploited during the colonial period and exported to Europe, extracted from forests throughout southeastern Brazil’s Atlantic Rainforest from southern Bahia to Minas Gerais and Rio de Janeiro. Few trees remain today. Brazilian rosewood is a beautiful hardwood with a rose-like scent, valued both as sound wood for musical instruments and as lumber for furniture construction. Burle Marx also mentions the Cedro, or cedar (*Cedrella fissilis*), valued for its timber but also becoming extinct. In March of 1969, Burle Marx delivered another testimony with similar themes entitled Política Florestal e Destruição das Florestas (Forest Politics and the Destruction of Woodlands), listing the following native species that were also being devastated by economic exploitation: the Pinheiro da Bocaina (*Podocarpus lambertii*); the Quebracho (*Schinopsis lorentzii*), highly sought after for its tannins for use in leather tanning; the Pau-rosa (*Aniba roseaodora*), a source of rosewood oil; and the Mogno, or big-leaf mahogany (*Swietenia macrophylla*). The exploitation of Brazilian mahogany, an extremely rare hardwood from the region of Goiás, was as controversial in the late 1960s as it is today.

Burle Marx connects the exploitation and loss of these hardwood native tree species to a much larger system, the climate. “All of these species are practically extinct, and this extinction causes a biotic imbalance, causing as a result a poor distribution of rain. This is the principal reason for torrential precipitation, provoking flooding and high waters, obstructing the river beds, and depleting the soil of its nutritive layer, its topsoil, for the cultivation of plants.” (Burle Marx, Paisagismo Brasileiro, 1967, p. 96.) Burle Marx recommends that the government create special protected areas for the preservation of these rapidly-depleted forested areas, in order to conserve them for the future.

5.2  **In Defense of the City**

Writing about cultural heritage sites, particularly those in the baroque colonial cities of the State of Minas Gerais, Burle Marx speaks of another kind of deforestation: those trees lost through the destruction associated with the development of urban cultural sites. In his January 1969 testimony entitled Paisagem Sacrifcada (Landscape Destruction), Burle Marx describes the removal of century-old trees at the Church of the Carmo in Ouro Preto as an “act of vandalism.” (Burle Marx, Paisagem Sacrifcada, 1969, p. 51.) In May 1968 he spoke of a similar cultural deforestation. “In Goiás Velho, they have transformed a plaza with large-canopied trees into an army of lampposts with mercury bulbs. In addition, benches have generously been donated by commercial firms, and each firm certifies its gift through the placement of gigantic letters painted on the seats and backs of these benches.” (Burle Marx, Parques, Jardins, e Praças Públicas, 1968, p. 15.)

Burle Marx also argues vehemently for the protection of the Jardim Botânico in Rio de Janeiro, its footprint squeezed by the encroaching development and “mutilation” occurring from the city around it.
several of his speeches to the Council’s plenary sessions, he insists on the immediate protection and preservation of the Jardim Botânico as a cultural heritage site (Burle Marx, Jardim Botânico e Hôrto Florestal, 1969). This botanical garden, founded by Dom João VI of Portugal in 1808, was opened to the public in 1822. Best known for its magnificent allée of more than one hundred royal palms, *Roystonea regia*, and giant water lilies, *Victoria amazonica*, it houses more than 6500 species of Brazilian and exotic tropical flora.

Burle Marx often insists upon the need for federal laws that would prohibit what he considered the irreverent alteration of historic monuments. This protection would include their contextual and cultural landscapes (Burle Marx, Paisagem Sacrificada, 1969).

### 5.3 In Defense of the Region

Burle Marx’s most ambitious conservation ideas, however, address the protection of regional ecologal sites at a massive scale through the establishment of new national parks and biological reserves for specific regions in Brazil. Yet any construction of a compelling argument for the protection of national territories and autochthonous plant material was of course a cultural argument.

Brazil’s national park system was initiated in 1937 by Getúlio Vargas with the creation of Itatiaia National Park, protecting the Atlantic rainforest on the border between the states of Rio de Janeiro, São Paulo, and Minas Gerais, followed by two more parks in 1939, the Serra dos Órgãos in the state of Rio de Janeiro and the Foz de Iguaçu National Park in Paraná. The program then ceased for twenty years, between the dates of 1939 and 1959, but the system has since grown to sixty-seven national parks. Burle Marx’s 1971 testimony Conservation Florestal (Forest Conservation) included his suggestion to establish national parks at the Serra do Cipó, Minas Gerais, and the Chapada Diamantina, Bahia, both regions with unique ecologies. (See Figure 6.) And in fact these two areas were eventually designated National Parks in 1984 and 1985, respectively.

![Figure 6. Composite tree at the Serra do Cipó, from Mary Agnes Chase’s *Field Work in Brazil* (1901). Image courtesy of the Smithsonian Institution.](Image courtesy of the Smithsonian Institution.)

Paisagismo Brasileiro (Brazilian Landscapes), Burle Marx’s first testimony as Counselor delivered in 1967, was followed by his comprehensive list of ten suggestions to preserve this national patrimony, including the establishment of more national parks and public parks, the proper reforestation of devastated landscapes, and the protection of vulnerable ecosystems. He connected these strategies to the greater notion of cultural stewardship, along with a sense of urgency to act quickly and with resolve.
6 CONSERVATION OF THE CULTURAL LANDSCAPE

Burle Marx is an important figure in the long period of the national search for 
brasiliade. The cultural construct he developed during the period of his appointment to the Federal Conselho de Cultura 
was perhaps as important and influential to his construction of Brazilian culture as his earlier public park projects.

Despite the troubling ethical dimension of Burle Marx’s acceptance of an appointment from the 
military regime, his consular statements of this period reflect his crusade to protect and conserve the the 
Brazilian landscapes that had always been his inspiration, and that he feared might be destroyed without 
a robust system of protection.

7 REFERENCES

NOTE: All translations from the Portuguese are by the author.


   Forest Nursery). Cultura: Conselho Federal de Cultura, 3(26). Ministério da Educação e Cultura, 
   Rio de Janeiro.


   Janeiro.

   Cultura, Rio de Janeiro.

    Cultura, Rio de Janeiro.

    Atlantic, February 1956, 137-139.

    Editore.
COUNTRY CEMETERIES AND CHURCHYARDS: ENDURING CULTURAL LANDSCAPES IN APPALACHIA

ORR, ELISABETH
West Virginia University, Morgantown, WV Elisabeth.Orr@mail.wvu.edu

1 ABSTRACT
The American cemetery is an enduring landscape, both culturally and historically. Americans have created distinct burial rituals and landscapes for the dead that reveal much about the complexity of our evolving culture. Central Appalachia and West Virginia have had little coverage in the literature on cultural landscapes, and scholars have written even less about Appalachian cemeteries and churchyards. West Virginian country cemeteries are snapshots of rural Appalachian life from centuries past that are still visible and often still used. Study of these landscapes increases our understanding of the region’s settlement history and reveals clues about life in isolated, mountainous coalfields and farmlands.

Through the review and analysis of photographs, maps, and on-site investigations of churchyards in the Reno District of Preston County, WV, this paper argues that cultural change happens more slowly in West Virginia than it does in other parts of the U.S., and cemeteries, or churchyards, in this area exemplify this notion. In some cases, the cemeteries predate the churches that are located nearby, and the context in which congregations originally sited and built these places is largely unchanged today. Though these churchyard landscapes reveal cultural information through usual venues — such as site orientation, grave marker styles, and names of those interred — their locations, orientation to the road, surrounding landscape context, relationship to a church (if any), and nearly continual use for over 150 years are equally important factors.

1.1 Keywords
Cemeteries, churchyards, Appalachia, West Virginia, vernacular cultural landscapes
2 INTRODUCTION

The general history and evolution of the American cemetery is well-documented (Baugher & Veit, 2014; Brown, 1994; Eggener, 2010; Farrell, 1980; Greene, 2008; Jackson & Vergara, 1989; Meyer, 1989; Sloane, 1991; Yalom, 2008). From frontier graves to modern day memorial parks, Americans have created distinct burial rituals and landscapes for the dead that reveal much about the complexity of our evolving culture. The American cemetery is an enduring landscape of permanence, both culturally and historically. It is a window into family genealogy, regional history, and cultural values over time.

In Central Appalachia, country cemeteries, or churchyards, and their surrounding landscape contexts are snapshots of rural Appalachian life from centuries past that are still visible now. In Preston County, West Virginia, some cemeteries pre-date the churches that congregations eventually built nearby. ‘Churchyard,’ typically defined as "the yard or ground adjoining a church, often used as graveyard," may not be technically accurate in all cases referenced in this study ("churchyard," n.d.; Eggener, 2010, p. 38). However, the term seems appropriate when describing the layered landscapes that this study seeks to illuminate, which often include churches, picnic structures, and cemeteries. This study uses both ‘churchyard’ and ‘cemetery’ to describe the Central Appalachian burial landscapes mentioned above (Sloane, 1991, pp. 17 – 20).

Rural West Virginian churchyards in the Reno District of Preston County are particularly interesting cultural landscapes because the larger site context remains unchanged today, some 150 years later. These landscapes reflect the region’s settlement history and reveal clues about life in isolated mountainous coalfields and farmlands. They provide cultural information through the usual venues—such as gravemarkers, the names of individuals interred and building materials—but the cemeteries’ locations, orientation to roads, surrounding landscape contexts, and nearly continuous use are equally important factors. Crissman (1994) noted that cultural change and societal transformation has happened more slowly in Appalachia. Churchyards in Preston County, WV, where many of my pioneer ancestors are buried, exemplify this notion (pp. 10 – 11).

3 THE CEMETERY AS AMERICAN CULTURAL LANDSCAPE

Historians, art historians, cultural geographers, archaeologists, and others have studied the American cemetery. Scholars have often focused on gravemarkers and tombstones—their religiosity, textuality, forms, and ornament—as relatively complex reflections of the cultural and ethnic heritage of the deceased, or those that are left behind (Brown, 1994; Farrell, 1980, pp. 115-140; Jackson & Vergara, 1989; Meyer, 1993). One example, J. G. Brown’s (1994) book Soul in the Stone sets out to illustrate “the partnership between human expression and the institution known as at the cemetery” through a series of photographic essays of tombstones, particularly those of different ethnic groups, religions, and time periods (p.1). Other books and articles also take this catalog-like approach (Eggener, 2010; Farrell, 1980; Greene, 2008; Jackson & Vergara, 1989; Meyer, 1989; Sloane, 1991; Yalom, 2008).

Some researchers have linked the layout of the cemetery—the layout of graves and plots themselves—to the layout of contemporary cities and towns, or some larger cultural philosophy (Francaviglia, 1971; Voller, 1991). Francaviglia (1971) argued that cemeteries are “miniaturizations and idealizations of larger American settlement patterns” and analyzed cemeteries for both their gravemarker styles as well as their land use patterns, therefore emphasizing both “architectural and spatial elements” (p. 501). In this case, Francaviglia used the word “spatial” to refer to the area within the cemetery. He defined the cemetery as a cultural landscape “having definable visual characteristics based on individual forms, such as tombstones, trees, and fences, and on the placement of those forms in a particular spatial arrangement” (Francaviglia, 1971, p. 502).

Still other scholars have strived to provide explanations, whether practical, cultural, or historical, of a single cemetery such as Mount Auburn in Massachusetts, or of a specific region or period in American history, as in Hannon’s (1989) essay on Central Pennsylvania cemeteries (p. 237-257). Another example is Sloane’s (1991) general historic overview of the evolution of death and cemeteries in American history. J.B. Jackson (1967-68/1997) wrote about the transformation of the American cemetery from a “monument into environment,” elucidating the transformation of American cultural ideals over time (p. 170).

Given these varying approaches, it is important to recall why the cemetery is so valuable a tool in cultural landscape analysis. In concluding his 1989 essay, which uses the cemetery landscape to
reconstruct aspects of a region’s cultural history, Hannon (1989) succinctly describes the value of the cemetery in cultural landscape studies:

The value of the cemetery as a cultural landscape lies in the fact that it is considered sacred or, at least, semi-sacred by the general public. Therefore, the cemetery, though it certainly reflects change, has been resistant to many of the alterations or destructive characteristics of other parts of the built environment. In that light, one can observe a preserved microcosmic representation of the region’s history and characteristics in its cemeteries and gain important insights from which both specific information and informed inferences can be drawn (p. 256).

Rural churchyards and cemeteries (not rural in the sense of the 19th century picturesque style, but rural as in an outlying agrarian area) in remote corners of West Virginia are significant when studying the state’s cultural landscapes for all of these reasons and more. Scholars accept that mountainous regions of the world are generally more isolated and slow to change, and West Virginia is no exception to this (Crissman, 1994, p. 11; Rehder, 2004, p. 301). Rice (1985) says this about West Virginia: “Her confining mountains and lack of broadly unifying river systems discouraged easy communication in early times and fostered a high degree of particularism among her people” (p. 57). This isolation in combination with cultural and contextual information leads to a more informed understanding of churchyards and cemeteries in Appalachian areas.

4 PRESTON COUNTY, WV: AN APPALACHIAN CULTURAL LANDSCAPE SNAPSHOT

4.1 Why Preston County?

The subjects of this investigation are churchyards and cemeteries in West Virginia, with a focus on the Reno District of Preston County, WV. I chose this area because at least one of these is the resting place of my distant relatives and pioneer ancestors, Mt. Zion Cemetery. My great grandmother, Susan Bolyard Summers (1882 – 1984), who I knew as a child, is buried there. She was one of thirteen children raised in a tiny rural community called Marquess (pronounced, according to my grandmother who was born there, like “Marcus”) in the Reno District, tucked into the southwestern corner of Preston County.

Figure 1. Map of West Virginia; gray area is Preston County (2015). Created from USGS data (2003).
4.2 Preston County History, Geography, and Economy

Preston County, WV (Figure 1) is located in the northeastern corner of the state, excluding the eastern panhandle. It is roughly rectangular and borders Pennsylvania to the north along the Mason-Dixon Line, and Maryland to the east; Monongalia, Taylor, Barbour, and Tucker counties create its western and southern boundaries. The county is 651.4 square miles and has eight magisterial districts: Grant, Kingwood, Lyon, Pleasant, Portland, Reno, Union, and Valley (Figure 2). Geographically, the Cheat River divides the county from north to south (Morton & Cole, 1914, p. 14; Sisler, 2013, para. 2).

![Figure 2. Map of Preston County, WV, not to scale. The Reno District is shaded (2015). Map created from USGS data (2003).](image)

The history of settlement in Preston County dates to the late 1700s. Prior to this time, movement west across the Alleghenies was difficult and dangerous (West Virginia Division of Culture and History [WVDCH], n.d., Early Settlement section). Besides the foreboding topography of the V-shaped valleys inscribed into the Allegheny Plateau, pioneers faced hostile Native American tribes, disease, and uncertainty regarding their land rights (WVDCH, n.d., Early Settlement section). Although travel was challenging, settlement began in earnest in northern West Virginia after the French, Native American, and British claims on the land leading to the Ohio Valley were negated in the 1780s (WVDCH, n.d., Early Settlement section). State records indicate that once the government removed these hurdles, settlement expanded quickly (WVDCH, n.d., Early Settlement section). In 1790, 56,000 people populated present-day West Virginia. By 1810, there were 105,000 inhabitants and by the eve of the Civil War, there were 377,000 inhabitants (WVDCH, n.d., Revolutionary War section).

In 1818, the Virginia assembly divided Monongalia County into two parts thus creating Preston County, named for the James Patton Preston then governor of Virginia (Sisler, 2013, para. 1; Wiley, 1882, p. 53). Wiley (1882) noted, “the citizens of Preston now felt themselves relieved of the necessity of long journeys to reach the county seat" in Morgantown, WV (p. 57). The population of Preston County at that time was 3,000; in 2012 it was estimated at 33,832 (Sisler, 2013, para. 2; Wiley, 1882, p. 56).

Morton & Cole (1914) begin their explanation of the county’s physical geography by saying that “there is a great diversity of surface” (p. 17). Those familiar with Appalachian terrain will understand that this is an understatement. As defined by Lee, Chang & Hill (1976), less than 1% of land in Preston County has a slope less than 2.5% (considered to be flat) (p. 14). More than 45% of the county’s land slopes at 20% or greater (Lee, Chang, & Hill, 1976, p. 14). Put another way, Morton and Cole (1914) describe Preston County’s geography as such:

Here the surface is studded with massive hills, each touching its neighbor save for an occasional ribbon-like fringe of creek bottom. Deep valleys and abrupt slopes are everywhere seen in
Preston, yet limited... smooth areas are not governed by the matter of altitude, many of the hills and ridges being broad-topped (p. 17).

Given that the geography of the area was decidedly different from eastern Virginia, it follows that the interests of its people were different as well. In 1861, during the Civil War, Prestonians overwhelmingly rejected Virginia’s proposal of secession from the Union (Wiley, 1882, p. 154). The formation of the new state of West Virginia would be final within two years in 1863 (Wiley, 1882, p. 178).

Early residents of Preston County benefitted from West Virginia's natural abundance from forests and rivers including wild game, fowl, fish, and numerous nuts and berries (Rice & Brown, 1993, p. 57). My great grandmother said that chestnuts, for example, were an important part of her family’s diet (J. Orr, personal communication, 2001). Even though forest products were readily available, most families cleared land for farming corn initially, and then later moved on to buckwheat (Rice & Brown, 1993, p. 59). While it was difficult to haul highly perishable goods such as these by packhorse and flatboats to eastern markets, it was considerably easier to move products made from farm and forest produce, such as whiskey, brandy, cider, ginseng, furs, and hides. Farmers also raised hogs, sheep, and cattle (Rice & Brown, 1993, p. 59). Due to the rough terrain and the scarcity of sophisticated farming implements, the average farmer in West Virginia before the Civil War cleared and farmed only twenty-five acres (WVDCH, n.d., Rural Life section). While farming at this scale did not generally make use of slave labor, it required the contribution of every family member, including women and children (WVDCH, n.d., Rural Life section). My great-grandmother recalled working alongside her brothers in the fields when she was a teenager and young adult (Preston County Historical Society, 1979, p. 392).

The difficulty in moving farm goods to market was considerable, and moving people was challenging as well. In 1838, however, the government completed the much-anticipated Northwestern Turnpike, which spanned from Winchester, VA to Parkersburg, WV, marking the current route of U.S. Highway 50 (Cox, 2005, p. 23; WVDCH, n.d., Rural Life section). This road goes directly through the Reno District. Its popularity encouraged growth along the route and provided the area’s best links to eastern markets in Maryland and to western markets via the Ohio River (Preston County Historical Society, 1979, p. 9). In 1853, the Baltimore and Ohio (B & O) Railroad reached Wheeling, WV, also slicing through Preston County (Preston County Historical Society, 1979, p. 11; Callahan, 1913, p. 106). After the Civil War and secession from Virginia, the B & O railroad provided West Virginians with the needed transportation infrastructure to support their burgeoning timber and mining economies (Cox, 2005, p. 29).

Even with this industrial growth, the quality of rural life in West Virginia during the 1800s remained essentially agrarian. Rice & Brown (1993) explain that the values of West Virginians “sprang in part from the emphasis of country churches upon righteous living, the role of the common school in undergirding morality and character, and the necessity of maintaining standing with lifelong neighbors by conforming to prevailing customs and norms” (p. 176).

4.3 Preston County Culture and Religion

The isolation of the hills and valleys encouraged people to seek religious affiliation whenever possible, for social, business, and religious reasons (Crissman, 1994, p. 108). In the Preston County Historical Society’s (1979) history of the area, numerous long-time residents recall a deep sense of piety in their forebears. Virginia’s Anglican, or Protestant Episcopal Church, was ill suited to life on the West Virginia frontier, which required a more flexible approach (Rice & Brown, 1993, p. 64; WVDCH, n.d., Religion section). In the last decades of the 1700s, the Great Awakening swept through the area with Methodists and Baptists leading the charge (Rice & Brown, 1993, p. 63). Frontier families went to whatever church or revival meeting set up closest to home, and would switch from one denomination to the next depending on which minister was in town (J. Orr, personal communication, 2001.) Church officials often roved from one rural area to the next, always on the move (Rice & Brown, 1993, p. 64; WVDCH, n.d., Religion section). Even so, religion acted as a social glue holding isolated and disparate family groups together (Rice & Brown, 1993, p. 67).

Early settlers in Appalachian had strong familial bonds, and the deceased were usually buried with their closest family members in family cemeteries. Family cemeteries were, therefore, the first kind of burial grounds in this region (Crissman, 1994, pp. 106 – 109). Crissman (1994) noted, however, that once religious congregations built churches in remote Appalachian areas, many established cemeteries as well
(p. 108). Congregation members formed strong, family-like bonds, and the transition to a church and community-based cemetery was logical. Given the steeply sloped physiography of the area, it is possible that not all families in an area had land suitable for burial.

Data from the Geographic Names Information System (GNIS), developed by the U.S. Geological Survey (USGS) in cooperation with the U.S. Board on Geographic Names (BGN), indicates that West Virginia has 3,643 cemeteries and 3,861 churches (USGS, 2013). According to the same data, Preston County is home to 42 cemeteries and 121 churches, which suggests that there is one cemetery per approximately 18 square miles. Based on my own observations, after years of visiting the area, I believe that the number of cemeteries in Preston County is significantly higher. The difficult terrain makes field verification both difficult and necessary. For this study, I have focused my attention on the southwestern corner of the county, the Reno District, where my family has its deepest roots.

5 THE RENO DISTRICT, PRESTON COUNTY, WV: CHURCHYARDS & CEMETERIES

5.1 Overview

From observation, field visits, and study of aerial photography, I have identified 19 cemeteries in the Reno District alone (Figure 3) (Pictometry International, 2010-2012). The district is 100 square miles, bounded on the north by the Lyon and Kingwood districts, on the east by the Cheat River, on the south by Tucker and Barbour counties, and on the west by Taylor County. At its widest point from west to east, the district measures approximately 12 miles. From north to south, it measures about 9 miles (Morton & Cole, 1913, p.32). The population in Reno was once more than any other district in the County, but even so, the population of the county as a whole was just 3,000 in 1818 rising to nearly 12,000 by 1850 (Historical Census Browser, 2004; Sisler, 2013, para. 2). In short, it is not a large area by geography or population, yet it is home to many cemeteries and many more churches – more than would be expected in comparison to other similarly populated areas of the U.S.

![Figure 3](image_url)

**Figure 3.** Map of the Reno District showing cemetery locations and Rt. 50 (USGS, 2003; USGS, 2013)

Necrogeographic research at the national level confirms this conclusion. Zelinsky (1994) analyzed the USGS’s Geographic Names Information System (GNIS) to plot “the number and relative incidence of these quite special parcels of land across the national space” (p. 31). While acknowledging the data’s shortcomings, especially its incompleteness with regard to “unnamed” cemeteries, Zelinsky (1994) mapped 99,625 items by state and then by county (pp. 32-34). Excluding the District of Columbia, West Virginia had 10.2 cemeteries per 100 square miles ranking seventh among U.S. states in 1992 (Zelinsky,
Furthermore, Zelinsky identified that several Central Appalachian – West Virginia, Virginia and Kentucky – states have elevated numbers of cemeteries per 100 square miles, which he described as a "striking phenomena . . . that was scarcely anticipated and overwhelms all the other details" (p. 34).

My examination of the data collated by Zelinsky confirms that it is incomplete, particularly in northeastern West Virginia, when compared with USGS data from 2013 mentioned above (USGS, 2013; Zelinsky, 1994, p. 34). Even though the data that Zelinsky (1994) analyzed dates from 1992, and was incomplete, it makes a strong and enduring point: West Virginia, though small in stature and population, is home to more cemeteries than most American states (p. 33-34). My research suggests that Preston County is a microcosm of this phenomenon, but the sheer number of landscapes requiring study is beyond the scope of this study.

The Reno District of Preston County, at approximately 100 square miles, could provide a more compact sample area for study, but even focusing only on cemeteries in Reno would mean analyzing 19 separate sites, and would exceed the space available for this study. Further examination of this topic at the district, county, state, and regional level is clearly warranted. However, to begin, I have chosen to highlight three cemeteries that exemplify several shared characteristics – a typology – that appears to be unique to the region.

5.2 A Reno District Churchyard Typology: Mt. Zion, Evansville, and Mt. Israel

Initially I devised my theses for this study based on my knowledge of Mt. Zion Cemetery and the adjacent Mt. Zion United Methodist Church, located in Marquess, a tiny hamlet in the southeastern part of the Reno District. Many of my relatives, including my great grandmother, are buried there. After expanding my research, it became clear that Mt. Zion exemplifies a typology that repeats at several other nearby sites. Though several churchyards in Reno fit the typology described below, I will use three of similar age to illustrate my findings: Mt. Zion United Methodist Church and Mt. Zion Cemetery; Evansville United Methodist Church and Evansville Cemetery; and Mt. Israel United Methodist Church and Mt. Israel Cemetery (these are current church and cemetery names).

Records indicate that the Mt. Zion Methodist Episcopal Church (historic name) may have formed as early as 1815, although the congregation erected the existing church building in 1873 (Cox, 2005; p. 188; Preston County Historical Society, 1979, p. 21). Traveling preachers held church meetings on this site or nearby throughout the first half of the 19th century (Wiley, 1882, p. 518). Cox (2005) has noted that "many early churches were formed in meeting houses or homes" (p. 188). Alterations to the 1873 structure have been made over time (Figure 4).

![Figure 4. Mount Zion United Methodist Church (2014). Photo by the author.](image-url)
Local residents established Mt. Zion Cemetery (Figure 5), which is located behind the current church building, in 1848 (Cox, 2005, p. 188). There are currently approximately 825 people interred there, and the cemetery continues to be used (Pierce, 2014). Evidence from western Pennsylvania suggests that, out of necessity, country folks sometimes built their burial grounds before church buildings as may have happened at Mt. Zion (Hannon, 1989, p. 243). In any case, both church and cemetery, together with other landscape and architectural features, are now integral parts of the churchyard at Mt. Zion.

**Figure 5.** Mount Zion United Methodist Church and Cemetery (2001). Photo by the author.

**Figure 6.** Aerial Photo of Mt. Zion with 5’ Contour Lines (Pictometry International, 2010-12; USGS, 2003). Site diagram created by the author.
Mt. Zion sits on a hilltop above Sandy Creek (Figures 6 and 7). The hilltop locale is in keeping with other findings on cemeteries in this country and abroad (Greene, 2008, p. 66). The custom may have been adopted from French, Native American, or English burial practices (Hannon, 1989, p. 243). Hannon (1989) suggests that the hilltop site is a “visible instance of our perception that a higher elevation is closer to heaven,” but also is often “the least viable land economically—especially in a period when farming was the mainstay” (p. 245). In addition, since the Reno District is home to numerous streams that wind through its deep valleys, locating a churchyard on higher ground would have been a practical choice to avoid flooding (Cox, 2005, p. 188).

Upon arriving at Mt. Zion, visitors get the sense that they are standing “on top of the world.” My mother has always used this phrase when describing Mt. Zion (S. McLaughlin, personal communication, 2001). The elevation of the site slopes up from 1570’ at the road to 1610’ at the top of the cemetery; it feels significantly higher than the surrounding countryside, and for the most part, it is (USGS, 2003). Deep valleys fall away to the north and south of the site, and several conical hilltops surround the area. Few trees surround the cemetery itself, which heightens the sense of being elevated.

Mt. Zion Church sits back from, but faces, Sinclair Colebank Road (County Route 74). In a land where curves and bends predominate in the landscape, the cemetery plots are in orderly rows, oriented east-west, which appear to line up with the back of the church. Since we know that the cemetery predates the existing church building, we can say that those who constructed the church aligned that newer building with the rows of cemetery plots, rather than the other way around. Rehder (2004) notes that graves are set in this direction so that “when the rapture comes, as in the second coming of Christ, those who are buried in this position will face east upon rising, ready to be gathered up and taken to heaven” (1994, p. 241). There is a large grassy area between the church and the road – an ideal spot for parking whether for a horse, carriage, or car.

The siting of the church on the road promotes a sense of grand arrival. On one side of the road is a large picnic shelter (Figure 7), and on the other is another large open space with the church and cemetery beyond. The road has followed the same path for as long as anyone can remember, with the overall site for the church enclosing both sides. My grandfather remembers having picnics with my grandmother there nearly 70 years ago (J. Orr, personal communication, 2001). If the road had been realigned at some point, and the adjacent land been used for different purposes, it would be difficult to surmise that the church grounds were constructed in this cohesive way.
The landscape surrounding the churchyard consists of beautiful rolling farmlands and forested hillsides. The view when standing in the cemetery is uninterrupted, for the most part, by anything other than agrarian and forest landscapes. It is arguable that the impacts of modern structures, increased densities, and changing land uses are less visible here than at other American cultural and historic sites. The immediate context is aesthetically pristine and close to its original form. Even the low chain-link fence seems to disappear against the picturesque views beyond.

Perhaps most important is that the church and cemetery are not lifeless historic sites. Local folks use them today in the same ways that their ancestors prescribed decades ago. New burials occur here every year, services are held regularly, and reunions and community events are hosted in the picnic structure. The outhouse just downhill from the church is still in use. While its cultural landscape context remains largely unchanged, it is powerful to note that the churchyard’s function and social meaning are also intact.

An example of this modern day relevance, the caretakers of the cemetery established the Mt. Zion Cemetery Association in 1945. This group manages the ongoing maintenance of the site and keeps detailed records of the cemetery’s history. The association has erected an information kiosk, which includes a weatherproof, enclosed cabinet where cemetery information is available to the public (Figure 9).

---

**Figure 8.** The picnic pavilion at Mt. Zion (2014). Photo by the author.

**Figure 9.** Mt. Zion Cemetery Information Kiosk/Cabinet (2009). Photo by the author.
To summarize, Mt. Zion is located at the top of a ridge; the graves are located on a hillside behind the church and face east-west; there is picnic structure and lawn for community gatherings; a cemetery association protects and manages the site and its history. With these characteristics, Mt. Zion exemplifies a typology that repeats at other nearby churchyards.

Construction was completed on the Evansville Methodist Episcopal Church (Figure 10), located about five miles northwest of Mt. Zion, in 1855 (Cox, 2005, p. 146). The residents of Evansville established a cemetery in 1833 (Figure 10) (Cox, 2005, p. 146; P. Clarkson, personal communication, 2015). Similar to the situation described at Mt. Zion, the congregation probably met at other nearby locations prior to constructing the current church building, but the need for a burial area likely happened earlier. Though the history of the Evansville Methodist Church and cemetery require further research, the landscape typology demonstrated by the Evansville churchyard is reminiscent of Mt. Zion (Cox, 2005, p. 146; P. Clarkson, personal communication, 2015).

Figure 10. Evansville United Methodist Church (2014). Photo by the author.

Figure 11. Evansville Cemetery (photo by E. Orr, 2014)
Evansville United Methodist Church, as it is now called, is located on Route 50 in Evansville. The site sits 30’ higher than Rt. 50, and slopes from 1380’ in elevation at the church to 1455’ at the highest point of the cemetery (Figures 12 and 13) (USGS, 2003). It sits at the end of a long driveway that winds up a curving hillside; a grove of trees protects the site form the traffic below. As at Mt. Zion, the cemetery, with 637 graves, climbs the relatively steep hillside behind the small, white church. The view from the top of the cemetery is breathtaking, with panoramic views across the valley to neighboring ridges. The picnic pavilion is located just east of the church entrance, facing a lawn area. The cemetery association erected
an information kiosk with an enclosed cabinet, similar to the one at Mt. Zion. A roof covers it and protects it from the elements (Figures 14 and 15).

![Image of information kiosk](image1.jpg)  ![Image of information kiosk](image2.jpg)

**Figures 14 and 15.** Evansville Cemetery’s information kiosk and cabinet (2014). Photos by the author.

In contrast to Mt. Zion, the cemetery is not fenced. In addition, the gravesites do not align with the typical east-west orientation. In this case, the graves are located on a relatively steep slope, and their alignment corresponds more closely with the topography of the land itself. The church was sited in a similar way that aligns with the gravesites that predate it, and to the existing landform. If the church and gravesites had been built to orient exactly east-west as at Mt. Zion, the builders would have faced significant grading and earth-moving challenges during construction and when digging graves. The choice for this layout, in harmony with the landscape context, appears to have been both a practical and aesthetically pleasing one. The Evansville churchyard sits comfortably, elegantly, on land of imposing topography.

The similarities continue at Mount Israel United Methodist Church and Cemetery, located on Marquess Israel Road approximately five miles east of Evansville. It too is an example of the churchyard typology seen at Mt. Zion and Evansville. The exact date of the establishment of this congregation is unknown, but the group erected a wood frame church on the current site in 1853 (Figure 16) (Cox, 2005, p. 241). In 1920, the congregation replaced the old church with the building that is now there (Cox, 2005, p. 241). The Mount Israel Cemetery Association is still very active in maintaining the site, holding regular meetings, and enforcing cemetery rules as seen on the materials and signage posted at the cemetery, but additional research on this history of the association is required. Nevertheless, 1160 people are interred there and records indicate that the cemetery is popular and growing (Figure 17) (Cox, 2005, p. 241). The association added land to the existing cemetery as recently at 1987 (Cox, 2005, p. 241).
Mt. Israel, like Mt. Zion and Evansville, sits on a relatively high ridge (USGS, 2003). The church occupies the lowest area of the site at 1675’ in elevation and the cemetery slopes up behind the building rising to 1735’ (Figure 18 and 19) (USGS, 2003). The site includes a church that is oriented east-west, a picnic structure, a fenced cemetery, an information kiosk, and a relatively new Fellowship Hall that was built in the 1990s (Figure 20). The gravesites also align mostly east-west, although the somewhat rolling topography challenges the rows to be strictly linear. In contrast with Mt. Zion and Evansville, the church at
Mt. Israel is directly adjacent to the road. There is a small, fenced lawn area at the entrance to the building, and a parking area in front. The black metal fence is more ornamental than the chain link at Mt. Zion, and there is a flagpole on site.

**Figure 18.** Mount Israel aerial photograph showing 5’ contours (Pictometry International, 2010-12; USGS, 2003). Site diagram by the author.

**Figure 19.** Site section (USGS 2003) and typological diagram of Mt. Israel. Graphic created by the author.
The church buildings at all three locations have similarities as well. Although I have not conducted a detailed survey of the structures, observers can see that all three have white clapboard siding, a rectangular shape, a single story, and gabled roofs. Aerial photography shows that each of the churches has a footprint of approximately 2,000 square feet (Pictometry International, 2010-2012).

6 CONCLUSION

The resemblance of these three churchyards is not likely coincidental. Established within decades of each other in the 19th century, Mt. Zion, Evansville, and Mt. Israel exemplify a churchyard typology that may be unique to the Appalachian region, or to West Virginia, or possibly to Preston County alone. Further exploration, study, and analysis will be necessary to confirm these observations.

Regardless, this typology is part of larger cultural landscape. The history of Preston County’s settlement through the Civil War illuminates the cultural context of these places. Mt. Zion, Evansville, and Mt. Israel are located on cathedral-like hilltops, commanding views of the surrounding countryside. The similarities in their overall site plans, including the relationships of the landscape and architectural elements, and their continuing functions as living and working churchyards, speak to the richness of these places. The analysis of a churchyard’s contextual heritage is especially powerful when considering similar sites in other areas of West Virginia and Appalachia.

The residents of the Reno District exhibit a strong sense of connection to their history with active church congregations and cemetery associations. Their continual care and commitment to these places spans nearly two centuries. In this way, Prestonians demonstrate a true pride of place, a connection between the dead and the living. Worpole (2003) has explained that “landscapes of the dead are always, simultaneously, landscapes of the living” and that this is what “gives the burial site its salience and emotional power” (p.21). The power of these churchyards as vernacular cultural landscapes remains largely unchanged over time, nestled into the hidden hills and valleys of the rural West Virginia countryside, and protected by the slow pace of change and strong sense of place in Central Appalachia.

The importance of studying cultural landscapes in Appalachia for landscape architects and other scholars goes beyond improving our understanding of regional history and settlement patterns, though those things are important. Jackson (1980) has pointed out that “we can only start to understand the contemporary landscape by knowing what we have rejected and what we have retained” (p. 119). In West Virginia, we have retained a great deal with great purpose. Historic vernacular cultural landscapes allow us to observe the contrast between these traditional landscapes and contemporary ones and to learn from that experience as designers and planners (Jackson, 980, p. 120).
7 REFERENCES


LANDSCAPE PLANNING
AND ECOLOGY

Edited by Galen Newman & Charlene LeBleu
THE STATE OF HERITAGE TREE PROGRAMS IN THE ROCKY MOUNTAIN/INTERIOR PLAIN PROVINCE

BRITTON, JENNIFER  
Montana State University, Bozeman, MT, jennifer.britton@montana.edu

BOYD, ELISA K.  
Montana State University, Bozeman, MT

HOCH, WILLIAM A.  
Montana State University, Bozeman, MT, bhoch@montana.edu

1 ABSTRACT

Heritage tree programs serve communities by recognizing and protecting significant trees. Despite the benefits of these programs, little research has investigated contributing factors in heritage tree planning policy. Through analysis of descriptive data generated from a survey questionnaire sent to professionals and those in elected or appointed services that might directly inform heritage tree policy, this research measured the regulatory environment in the Rocky Mountain/Interior Plain Province region of Montana, Colorado, New Mexico, and Wyoming, and sought to establish a regional “current state” baseline in designating significant trees. Only 7% of respondents answered that their local government has a heritage tree program, while half of the respondents indicated they were unaware of the possible benefits of such programs. Heritage tree programs were only found in cities having a staff arborist/forester and a college or university. Within professions, support for heritage tree programs was highest among arborists and lowest among landscape architects/designers, and was consistently higher for programs on streets/parks than for those on private property. These findings suggest that although a majority of those surveyed support Heritage Tree policy implementation, efforts to increase awareness, promote advocacy, and administer incentives in public sector services could well determine the success or failure of a Heritage Tree program.

1.1 Keywords  
Arboriculture, urban forestry, urban planning, historic preservation, heritage tree
INTRODUCTION

Trees serve many purposes in the urban environment. They contribute to ecological quality by improving soil, creating wildlife habitat (Trowbridge and Bassuk, 2004), mitigating stormwater and wind; they also provide climate control (Girling and Kellett, 2005), reduce pollution (Nowak et al., 2006), and in the United States alone total urban tree carbon storage is estimated as 643 million tonnes (Nowak et al., 2013). Trees also promote human health (Donovan et al., 2013; Seamans, 2013), decrease crime (Donovan and Prestemon, 2012) and increase real estate values (Anderson and Cordell, 1988; Jones, Davis, and Bradford, 2013; Neely, 1988). In total urban forests in the United States, which have been aptly referred to as our green infrastructure, are worth an estimated $2.4 trillion (Nowak et al., 2002). Trees also play a role in our social and natural connectivity (Rogers, 2001; Lawrence, 2006). Historically, people have planted and maintained trees from a desire for aesthetic pleasure and beauty in fashioning gardens, to create visions of paradise, to exhort power and control over private and public urban space, and to establish cultural and national identity (Rogers, 2001). Trees create a meaningful site (Girling and Kellett, 2005; Jim, 2004a) and have a dynamic, significant role in the human condition (Kaplan, Kaplan, and Ryan, 1998; Spirn, 1998); and whether we connect by observing their seasonal rhythms, standing in their shade, or using them as informal gathering spaces (Watson, Plattus, and Shibley, 2003), trees embody an essence of place.

As a result of increased social awareness towards the value of trees (Grado, Measells, and Grebner, 2013; Seamans, 2013), heritage and champion tree programs have emerged in an effort to protect and preserve unique individuals or groups of trees on public and private land. While champion tree programs often qualify tree protection based on size, heritage tree designation and programs include a broader list of qualifying features including botanical, ecological, aesthetic, cultural and/or historical significance. Similar to landscape and tree protection ordinance legislation that intends to establish standards to promote environmental quality and natural resources (Abbey, 1998), heritage tree preservation policy typically identifies, promotes, maintains and protects designated significant trees on both public and private land. Program policy can range from non-binding recognition such as a published record, to legal protection regulated under state or city law with resulting monetary fines and/or mitigation measures if the tree is harmed or removed without public hearing and city commission approval.

Despite growing interest to protect important trees in the United States and the larger world community (Jim, 2004b), little information is available regarding the current state of local government planning policies and public sector opinions regarding heritage tree program implementation, and even less research has investigated specific regional preservation (Thaiutsa, et al. 2008). This study, with its origins in developing a heritage tree planning policy to designate, protect and preserve significant trees for Bozeman, Montana, measured the state of heritage tree policy in an area whose landscape persona is often one of “bare pasture with a splendid view of shear space in all directions” (Lippard, 1997, p. 41). In such environments, heritage trees often arise like a ‘wolf tree’ whose canopy stands as an unique relic attesting to its age and ability to survive a sea of change, in essence becoming urban sign posts of our history and culture. This study sought to summarize the current state of heritage tree programs in the Rocky Mountains and Interior Plain Province through two primary goals: first, to measure awareness and attitudes of those in Montana and similar geological regions whose professional or service work directly informs heritage tree public policy; and second to provide insight on possible incentives and advocacy measures for regional heritage tree preservation.

METHODS

3.1 Study Area

The study area was delineated based on the geologic provinces delineated by the United States Geological Survey that comprise Montana’s landscape (USGS, 2004). This composite region (Figure 1) consisted of states with both Rocky Mountains and Interior Plain Province and included Montana, Colorado, New Mexico and Wyoming for a total of 470,560 mi² (Bureau, 2014). Although climates in the study region vary considerably in both USDA hardiness, zones 3a to 9a (USDA, 2012), and total urban tree canopy cover with a range between 6.4% in Montana, 5.5% in Colorado’s, 1.2% in New Mexico, and less than 1% in Wyoming (Dwyer, 2000), these states share many similar challenging growing conditions affecting tree growth, longevity, and the likelihood of a city having significant trees.
region soils are often alkaline and annual precipitation is relatively low, with between 12.9 to 15.9 inches annually (CDNR, 2013; NMSCU, 2013), and all four states rank in the top 12 for average wind speed (Energy, 2013).

Figure 1. Study Region Map: Montana, Colorado, New Mexico, and Wyoming

The population demographic profile of the study region varies. In terms of political affiliation, New Mexico is a "solid" Democrat political party affiliation at 49.9%/36.1% (Democrat/Republican), as is Colorado with 48.8%/38.2%. Montana is categorized as a "competitive" state at 44.5%/40.5% while Wyoming is a "solid" Republican at 36.6%/49.9% (Gallup, 2009). Population density also ranges per state, with three out of four states ranking with lowest population density in the United States: Colorado is 37th with a population density of 47.62 per square mile, New Mexico is 45th with 16.35, Montana is 48th with 6.65, and Wyoming is 49th with 5.49. Median household incomes from 2010-2012 ranged from a high in Colorado of $60,180, $56,004 in Wyoming, New Mexico at $44,605, and Montana the lowest at $43,226 (Bureau, 2012b). Homeownership rates also varied between states with Wyoming the highest at 70.3%, 68.9% in New Mexico, and 68.5% in Montana, with Colorado lowest at 65.9% (Bureau, 2014).

3.2 Data Collection Strategy

This study generated descriptive data from a survey questionnaire (Levy and Lemeshow, 1991). To create the sample, cities of Montana, Wyoming, Colorado, and New Mexico were listed according to population size and divided into three population categories: > 80,000, 80,000 to 20,000, and < 20,000 (Brinkhoff, 2011; Bureau, 2012a). The parameters of these three categories were chosen both to achieve a relatively even distribution across the population range and to align with sizable gaps existing within the overall rank of populations. The "large city" tier established the base-line with a total of 17 in the >80,000 population category. Subsequently, within the two additional categories 17 cities were randomly selected for the "mid" and "small" cities. This sample provided for a total of 51 cities (n=51). The city sample distribution per state included nine cities from Montana, 26 from Colorado, 11 from New Mexico, and five from Wyoming (Table 1). Although this study’s sample is low, it is in-line with similar studies in the United States and Europe (Kuhns, 1998; Schmied, 2003) and also mirrors the low population density characteristic of the study area.
Table 1. States and cities surveyed in the Rocky Mountain/Interior Plain Province

<table>
<thead>
<tr>
<th>Montana:</th>
<th>Colorado:</th>
<th>Colorado:</th>
<th>New Mexico:</th>
<th>Wyoming:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billings</td>
<td>Alamosa</td>
<td>Evans</td>
<td>Albuquerque</td>
<td>Casper</td>
</tr>
<tr>
<td>Bozeman</td>
<td>Aurora</td>
<td>Federal Heights</td>
<td>Artesia</td>
<td>Cody</td>
</tr>
<tr>
<td>Great Falls</td>
<td>Arvada</td>
<td>Fort Collins</td>
<td>Belen</td>
<td>Kemmerer</td>
</tr>
<tr>
<td>Kalispell</td>
<td>Boulder</td>
<td>Fountain</td>
<td>Carlsbad</td>
<td>Laramie</td>
</tr>
<tr>
<td>Libby</td>
<td>Broomfield</td>
<td>Greeley</td>
<td>Clovis</td>
<td>Rock Springs</td>
</tr>
<tr>
<td>Missoula</td>
<td>Burlington</td>
<td>Lafayette</td>
<td>Deming</td>
<td></td>
</tr>
<tr>
<td>Plentywood</td>
<td>Castle Rock</td>
<td>Lakewood</td>
<td>Gallup</td>
<td></td>
</tr>
<tr>
<td>Polson</td>
<td>Centennial</td>
<td>Longmont</td>
<td>Las Cruces</td>
<td></td>
</tr>
<tr>
<td>White Sulphur</td>
<td>Cherry Hills Village</td>
<td>Loveland</td>
<td>Portales</td>
<td></td>
</tr>
<tr>
<td>Springs</td>
<td>Colorado Springs</td>
<td>Parker</td>
<td>Rio Rancho</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Commerce City</td>
<td>Pueblo</td>
<td>Roswell</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dacono</td>
<td>Thornton</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Denver</td>
<td>Westminster</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total: 9       Total: 26       Total: 11       Total: 5

To further stratify the sample, additional subgroups created comprised of individuals in the city and university public sector who through professional and/or service work might influence heritage tree policy and planning. Professions included: architect/architectural designer, arborist/forester, landscape architect/designer, planner, city council member/mayor, advisory board member, and an optional “other” category to allow for flexibility in job titles with similar and relevant responsibilities. Each local government office and higher education facility was then called to request contact information for appropriate personnel resulting in a 168 total surveys sent.

3.3 Survey Design

The survey questionnaire was designed to investigate four possible contributing factors influencing heritage tree policy implementation: awareness and attitude towards heritage trees programs, and potential incentive and advocacy measures. For example, the survey asked respondents if they were aware that heritage tree programs allow a community to identify, protect, maintain and promote protection of significant trees, if they would support a heritage tree program in their community, if so under what conditions, and if their local government has a current means to promote heritage tree program policy.

Questions were in one of five closed-end formats: multiple choice; agree/disagree; rank order; yes/no descriptive; and questions along a continuum of one to five to indicate a positive to negative rating. A final open-ended question provided the opportunity for further comment (Tables 2 through 5). Skip-logic questions allowed for additional data collection dependent on response, therefore the survey length varied from 22 to 27 total questions. An initial trial was performed to validate the question comprehension and process standards (Levy and Lemeshow, 1991). Each participant was emailed an orientation paragraph and SurveyMonkey URL link. The survey was administered from February 12, 2013 through April 2, 2013.
Table 2. Awareness questions

Q3: Does your community have a tree ordinance that requires the local government to review and/or issue a permit for removals?
Q4: Are you aware that a heritage tree program allows a community to identify, protect, maintain and promote awareness of significant trees
Q5: Does your community have a heritage tree program
Q6: My community's heritage tree program allows nomination in...
Q7: How successful is the heritage tree program? 
(On scale of 1 to 5, 1 indicating very successful and 5 indicating not successful at all.
Q8: What incentives does your local government provide for your Heritage Tree Program? Choose all which apply. I don't know; Property tax reduction/abatement; Landmark designation; Signage/certificate; Reduction in Planning, Design Review and Building Permit Application Fees; Payment of Public Hearing Notice Cost for development; Setback flexibility for development; Local government responsible for maintenance; Other (please specify) 
Q9: Did your community ever have a heritage tree program?
Q10: Why is there no longer a heritage tree program?
Q14a: Does your community have an elected... (city council)
Q14b: Does your community have an elected... (mayor)
Q15a: Does your local government staff have a/an...(forester/arborist)
Q15b: Does your local government staff have a/an...(historic preservation officer)
Q16: Is there a tree advisory board in your community?
Q17a: Does your local government provide... (guidelines for street tree selection?)
Q17b: Does your local government provide... (a voucher or cost share program for buying trees?)
Q18: Is your local government responsible for street/park tree maintenance?
Q19: Is there a college or university in your community?
Q20: Does the college/university have a forestry, horticulture, or landscape architecture/design program?
Q22: I am an active member in my local professional organization.
Q23: My community has calculated/mapped our canopy/tree inventory.

Table 3. Attitude questions

11a: Would you support a heritage tree program for...(streets and parks)
Q1b: Would you support a heritage tree program for...(private property)
Q13: If you were to initiate a heritage tree program, how would you prioritize the following: (1 indicating most important and 3 least important) Establish guidelines for nominating trees; Determine maintenance protocols; Facilitate public education about the value of trees.
Q24: Check all that reflect your beliefs about trees. Trees are aesthetically pleasing; Trees are replaceable, thus I can use them as I see fit; Trees provide wildlife habitat and are integral to ecological systems; Tree planting/removal on streets/parks should be regulated by government; Trees enhance property values; Trees create a unique sense of place; Trees are a liability and require too much maintenance.
Q25: How important to you is public open space such as parks/trail systems? (1 indicating very important, 5 indicating less important)
Q26: How sensitive are people in your community towards private property rights? (1 indicating very sensitive, 5 indicating less sensitive)
Table 4. Incentive questions
Q12: Under what conditions or with which incentives would you be interested in a heritage tree program? Choose all which apply: I don't need an incentive; Property tax reduction/abatement; Landmark designation; Signage/certificate; Reduction in Planning, Design Review and Building Permit Application Fees; Payment of Public Hearing Notice Cost for development; Setback flexibility for development; Local government responsible for maintenance; Other (please specify)
Q17a: Does your local government provide... (guidelines for street tree selection)
Q17b: Does your local government provide... (a voucher or cost share program for buying trees)
Q18: Is your local government responsible for street/park tree maintenance

Table 5. Advocacy questions
Q15a: Does your local government staff have a/an... (forester/arborist)
Q15b: Does your local government staff have a/an... (historic preservation officer)
Q16: Is there a tree advisory board in your community?
Q20: Does the college/university have a forestry, horticulture, or landscape architecture/design program?
Q22: I am an active member in my local professional organization.

3.4 Data Analysis
Data compilation and analysis was exported from the survey instrument as a summary of responses for each question with additional cross-tabulation between questions. Correlation analysis was performed using Fisher's Exact probability test to determine a two-sided p-value. The measure of associations between answers was determined using a Cramer’s V coefficient. All analyses were performed with SAS for Windows v. 9.2 using an experiment-wise error rate of α= 0.05.

4 RESULTS
The 62.7% city response rate obtained in this survey is within the range found by other surveys investigating urban forestry, e.g. 58.2% in Utah (Kuhns, Lee, and Reiter, 2005) and 71% in the Pennsylvania (Elmendorf et al., 2003). By state, the total survey response rate was 88.8% for Montana, 53.9% for Colorado, 72.7% for New Mexico and 100% for Wyoming. A total of 75 individuals responded and results showed that 34 respondents were city council member/mayor, followed by 15 planners, 12 arborist/forester, four were advisory board member, three were landscape architect/designer, and seven respondents specified “other,” which included relevant professional positions such as a manager for landscaping & grounds, two maintenance worker in grounds department, two arborist supervisors, and a facilities director. Our variation in N per city and profession can be attributed to differences in municipality size and staffing numbers, which resulted in certain categories having a low N.

4.1 Awareness
Although 36.1% of respondents answered their local government has a tree ordinance requiring review and/or permit issuance for tree removals, and 64.2% indicated having guidelines for street tree selection, only 7% of respondents answered that their municipality has a heritage tree program. Of these respondents, 40% were from cities in the largest population, 40% from midsize cities, and 20% from small cities. All respondents who indicated having a heritage tree program also indicated having a college or university and a city staff arborist/forester. Our study found a positive correlation between local governments staffed with an arborist/forester and tree protection ordinances, active tree advisory boards, and available tree incentive programs. In addition all respondents in cities with an arborist/forester also indicated the “value belief” that trees aid property valuation, offer habitat, are integral to ecological systems, and create a unique sense of place.

Still, the overall characterization of awareness towards heritage tree programs was low. 35.2% of respondents indicated they were unaware if their community had a program and half of the respondents were unsure of the benefits of heritage tree programs, including 73% of planners, 52.9% of city council/mayor, and 25% of arborist.
4.2 Attitude
Among questions gauging attitude, participants showed a high support of heritage tree program implementation, with a significant correlation between tree programs for streets/parks and cities that staffed a forester/arborist. In addition, respondents in cities with universities/colleges had a higher support rate for heritage tree programs for street/parks, 97.9 %, vs. 76.9%. There was also a significant correlation between cities with a college or university and a preference for tree regulation administered through local government.

Of the surveyed professions, 100% of arborists indicated they would support a heritage tree program on streets and park, with similar support from city council mayors (93.5%), planners answered with less support (80.0%) and landscape architects/designers were lower still at 66.7%. Across all professions, respondents showed less support for heritage tree programs on private property: arborists (88.9%), landscape architects/designers (50%), city council (39.3%), and planners showed the lowest support level at 14.3%. A majority of respondents (81.5%) also indicated they viewed their cities’ populace as highly sensitive to private property rights and preferred directing heritage tree programs towards streets/parks.

Within the qualitative questions, a majority of respondents answered they considered trees to be beneficial rather than a nuisance and indicated they viewed trees as aesthetically pleasing, creating a unique sense of place, and integral to ecological systems and wildlife habitat. Only a small percent of respondents (16.9%) viewed trees as replaceable and 3.1% of respondents view trees as a liability requiring too much maintenance. In terms of establishing a heritage tree program, responses indicated the most important priority would be to 1) establish guidelines for nominating trees (49.2%), 2) facilitate public education about the value of trees (38.1%), and 3) determine maintenance protocols (12.7%).

4.3 Incentive
Although 75% of respondents indicated not knowing what tree incentive programs are provided by their local government, 44.1% answered that incentives were not needed. Of those who showed interest in incentives, 39% indicated interest in landmark designation, 32.2% setback flexibility for development, 30.5% signage/certificate, 22% property tax reduction/abatement, 20.3% reduction in planning design review and building permit review fees, and 20.3% local government responsible for maintenance. A majority of respondents (88.1%) indicated their local government is currently responsible for street/park tree maintenance and in one significant positive correlation, cities that currently have tree protection ordinances also typically provide a tree cost share or voucher program, indicating that municipalities at present provide tree-related incentives to promote government policy and planning.

4.4 Advocacy
In measuring which individuals might be in a position to advocate a heritage tree program, 56% percent of respondents indicated their city staffs an/a arborist/forester, 37.9% staff a historic preservation officer, and 44.8% indicated they have a tree advisory board in their community. No city had a heritage tree program without a staffed arborist/forester and results further indicated cities with a staffed arborist/forester have a greater likelihood of having a calculated/mapped canopy (66.7%), guidelines for street tree selection (86%), and are somewhat more likely to have a tree advisory board (54.1%) but not necessarily a voucher incentive program (50%). Furthermore there was a positive correlation between communities with tree advisory boards and the calculation or mapping of tree inventory, utilization of vouchers or cost share for buying trees, and established policy for street tree selection. This suggests that tree advisory boards provide a valuable service which could benefit heritage tree planning. Although the majority of respondents indicated high activity in their local professional organizations, this study found no significant correlation between activity in professional organization and implementation of heritage tree programs.

5 DISCUSSION
This study’s results clearly demonstrate a need for improved clarification and information dissemination about heritage tree program benefits and planning in government agency. Across professions there was a general lack of awareness towards the benefits of heritage tree programs.
Although the study did find a relationship between participant activity in professional organizations and an increased awareness of the benefits of a heritage tree program, heightened professional activity did not translate into practical implementation of heritage tree programs. Thus, while 100% of arborist/foresters are participatory in their professional organizations and 75% indicated awareness of heritage tree program benefits, 92.9% indicated not having a heritage tree program. This breakdown between activity level in professional organization and awareness of heritage tree program benefits was even more pronounced in the other surveyed professions. For example 72.7% of planners responded they are participatory in their professional organization but only 26.7% indicated awareness of heritage tree program benefits. This could be symptomatic of specialization, but also suggests that professional organization venues are not a current method for promoting heritage tree awareness and advocacy. However, since municipalities staffed with an arborist/forester indicated having a higher likelihood of general tree protection ordinances (62%) the results may suggest that cities with an arborist/forester have an increased capacity and ability to implement a heritage tree program. A majority of respondents (80.3%) indicated there was a college/university in their town and 47.2% indicated their institution had forestry or landscape architecture/design program, yet only 14.7% of these respondents indicated having a heritage tree program. However, there was a high correlation between respondents who indicated having a college/university and a positive, receptive attitude toward implementing heritage tree policy.

Despite low general awareness, our study showed a positive attitude toward heritage tree program implementation with a majority of participants answering they would support such program with very little incentive. These results did show variable support levels towards heritage tree programs between professional and appointed/elected groups within a government body, suggesting a conflict between city staff and elected officials. For example, a large majority of arborists/foresters supported implementing heritage tree programs on private property, while city councils/mayors responded with less support and city planners showed the least amount of support. This illustrates possible conflict in policy implementation between city staff. Also since a large majority of surveyed cities elect their city council (98.5%) and mayor (89.2%), this could indicate disconnect between public opinion and public agencies, which previous studies have shown is common (Dwyer et al., 1992; Heynen, Perkins, and Roy, 2006; Kielbaso, 2008; Jones et al., 2013).

It is also possible that local populations may not support legislation they view as restricting freedom. As municipalities grow and development pressure conflicts with preservation, elected officials may be less inclined to continue their support of a heritage tree program if they believe their constituents place high value on property ownership rights. Our study showed a large majority of city councils/mayors (60.6%) view their constituents as highly sensitive to private property rights, suggesting that an elected politician’s perception of public values could influence heritage tree policy implementation and effectiveness. However, respondents did indicate interest in mitigation incentives such as flexibility on property set-backs and reduced property taxes, which may prove effective measures to assuage concern over heritage tree programs involving private property. Although the influence of socio-demographics towards urban forestry management programs have shown mixed results in other studies (Moskell and Allred, 2013; Zhang et al., 2007), our study’s demographic trended more toward a Democrat/Competitive partisan view, which may suggest a higher likelihood of comfort with government regulation (Jones et al., 2013). In addition, only a small percent of respondents viewed trees as replaceable or as a liability requiring too much maintenance, and a majority viewed public open spaces such as parks/trail systems as very important, suggesting a prevailing attitude of support towards green space, which could prove a beneficial underlying ideological belief in protecting significant trees.

5.1 Action Plan: Practical Implications for Heritage Tree Program Implementation

Since a small number of cities surveyed have established legislative tools that attempt to regulate tree plantings and/or natural resource protection (Abbey, 1998), cities identified in the study area may need to create stand-alone policy specific to heritage trees. This approach could be similar to Ontario, Canada’s legislative tools that function through a variety of zoning by-laws, easements, and government acquisition (Ontario Heritage Tree, 2011). Likewise, although local government participation is necessary to build program awareness, administer incentives, and support advocacy, cities may choose to collaborate with advocates in allied industries and professions such as nurseries, tree care businesses, university extension services, state forestry agencies (Kuhns et al., 2005), and local and state historic preservation officers. One respondent commented that their city has a historic protection program, but the
designation was for buildings rather than for trees. Yet broadly defined, heritage trees are after all historic assets, and a collaborative effort between city departments could help with resource and asset management.

As costs associated with the identification, conservation and maintenance of heritage trees may prove to be the biggest limiter, especially in rural areas with low median incomes, communities need to determine if municipalities have the financial resources to fulfill ordinance requirements (Ontario Heritage Tree, 2011). As this will vary by location, effective policy may need to include measures such as cost-sharing grants from government agencies and trained volunteers in a significant role to mitigate expenses. As one respondent wrote, they would not support an “unfunded mandate,” suggesting socio-economics plays a strong role in determining policy feasibility. So although respondents indicated maintenance protocols as the least important priority to establish a program, similar to other studies (Swiecki, 2001).our results show expense management in heritage tree conservation is best addressed from the start.

In terms of educating professionals and the general public, arborists/foresters and tree advisory boards may play the most critical role in building awareness, shaping attitudes, advocating and incentivizing heritage tree programs. Not only did this study’s impetus originate at the request of the City of Bozeman’s Tree Advisory Board, but our results suggest that together arborist/foresters and tree advisory board may be the most effective resource in providing service for new tree-related policies. Similarly, advocacy from citizen grassroots efforts and private and non-profit coalitions can serve as outreach partners offering seminars, conferences, school curricula, tours, special events or fieldtrip can help to fill the gaps in service left by government budget limitations (Jones et al., 2013; LeRoux, 2007; Seamans, 2013). For instance, American Forests, the oldest national nonprofit conservation organization in the United States, offers a Tree Protection Toolkit for grassroots activism that provides steps for overburdened city personnel to empower communities in shouldering some responsibility (American Forests, 2013).

For a heritage tree program to have gravitas, effective planning needs to begin with survey and research to identify significant trees, followed by nomination with established parameters for evaluation, listing, and recording (Schuster et al., 1997; Ontario Heritage Tree, 2011). This process and the resulting documentation can then act as a planning trigger for incentives and/or regulation. To then determine the best policy approach, a front-end discussion between policy-makers and the general public may prove critical in addressing ideological and fiscal concerns. As one survey respondent commented, “trees preserved under this type of preservation program can and will be viewed as limiters to development,” and depending upon receptivity, cities may need to create their own adaptive management of incentives (non-prescriptive) and legal (prescriptive) approaches.

To incentivize programs that foster receptivity and mitigate potential conflict, preservation policies typically utilize strategic planning to determine an appropriate reward/penalty approach. This study showed respondents were receptive to soft reward incentives such as landmark designation, and more aggressive monetary incentives such as development setback flexibility or property tax reduction/abatement. Respondent receptivity to positive reinforcement illustrates municipalities are amenable to using incentives as a tool in promoting tree preservation. Penalty incentives are typically of a regulatory nature with review from the city arborist, tree advisory boards or at times full design review boards. These include a wide range of enforcement tactics within heritage tree programs such as the City of Portland, Oregon where explicit code finds it “unlawful for any person, without a prior written permit from the Forester, to remove, destroy, cut, prune, break, or injure any Heritage Tree, to injure, misuse or remove any device set for the protection of any Heritage Tree, or to cause or authorize or procure any person to do so” (City of Portland, 2004). While our study did not investigate opinions regarding penalty effectiveness, a majority of survey participants responded they would prefer government oversight of a heritage tree program, which may indicate openness to a more stringent regulatory environment. This result also aligns with that of Moskell and Allred (2013) who found residents often view tree care a government responsibility.

In light of this study’s findings, municipalities pursuing heritage tree policy might ask themselves the following feasibility questions: 1) Do we have the service of a city arborist/forester or is there a tree advisory board that can help identify and advocate for significant trees? 2) Are there tree guidelines or protection ordinances already in place? 3) Do we have other departments or organizations which might pool resources? 4) Can we build contacts with a college or university, interested professionals, and/or non-profit organizations that may help facilitate public education about the value of trees through positive
advocacy? 5) Can professional societies play a stronger role in educating the community about the benefits of heritage tree programs? These questions are not a comprehensive list, but they do represent overall patterns that emerged when this study attempted to identify awareness levels, prevailing attitudes, incentives and advocacy measures. They may serve as guidance in planning for heritage tree program implementation.

6 CONCLUSIONS

From measuring the state of heritage tree programs, this study suggests protection of heritage trees has significant support and that heritage tree programs in Rocky Mountain/Interior Plain Province are both possible and timely. Yet, implementing effective heritage tree policy that balances the static character of preservation and nature’s dynamics does make protecting significant trees one of the most intriguing and difficult types of preservation (Tyler, 2000). As a result, drafting protection policy may mean reaching beyond typical strategies. If government is to respond to escalating urban environmental problems by including heritage tree protection in sustainable ecosystem-based management and stewardship (Konijnendijk, 2003), not only do communities need support from those whose professional or service work directly informs heritage tree policy, but equally important is public sector awareness, advocacy, and incentive management.

7 REFERENCES


Grado, S.C., Marcus M.K., and Donald L. Grebner. (2013). Revisiting the status, needs, and knowledge levels of Mississippi’s governmental entities relative to urban forestry. Arboriculture & Urban Forestry, 39(4), 149-156.


EFFECTS OF LAND USE CHANGE IN URBANIZING COASTAL ECOSYSTEMS

LEBLEU, CHARLENE
Auburn University, Auburn, AL leblecm@auburn.edu

1 ABSTRACT

Population growth and development present a daunting challenge to land use planners and designers, particularly in coastal communities where urbanization dramatically impacts water quality, habitat, other natural resources, and the delicate balance of sensitive environments. This study investigates the effect of changing land use and land cover (LULC) on water quality, and suggests changes in development policy to mitigate impacts. The Fish River watershed, located in Baldwin County, Alabama, USA, is used as a case study to examine both spatial and temporal domains. This watershed is of critical importance to the health of Weeks Bay, a designated Outstanding National Resource Estuary located at the watershed outlet. Water quality data and the Soil Water Assessment Tool (SWAT) are used to understand the LULC dynamics. Spatial comparisons between sub-watersheds showed that sites with large increases in urbanized land uses had substantially higher Total Suspended Solids (TSS). Nitrate trends over time showed a general decrease, while Total Phosphorus (TP) increased significantly. This may have very important implications as analysis at the spatial domain showed that urbanization increases Nitrogen (N) loadings, therefore posing an increased threat of eutrophication. Land development policy was examined and Low Impact Development (LID) Best Management Practices (BMPs) were identified to mitigate TSS, TP, and N within urban catchments. Policy changes that have resulted due to this research include new development policy that supports reduced impervious surfaces, conservation of natural resources, natural drainage courses, and minimization of clearing and grading.

1.1 Keywords
Land use, water quality, development, policy
2 INTRODUCTION

Land use and land cover are watershed health indicators that are strongly tied to water quality. Urbanization and intense agriculture practices can be detrimental to water quality and watershed health due to runoff from impervious surfaces, leaking septic systems and fertilizer leaching from agricultural crops, golf courses and residential lawns. Population growth and development present a daunting challenge to land use planners, particularly in coastal communities where urbanization dramatically impacts water quality, habitat, other natural resources, and the delicate balance of sensitive environments. Coastal areas are highly desirable for human settlement and are almost three times as densely populated as the global average, with 1.2 billion people living within 100 km of the shoreline (Small and Nicholls 2003).

Nitrogen (N) and Phosphorus (P) are the two most important nutrients to track in coastal watersheds because excessive nutrient loading in coastal systems can result in algal blooms, lowering dissolved oxygen levels and ultimately causing eutrophication and decreased productivity. The Gulf of Mexico Dead Zone is an example of such nutrient loading from the Mississippi River. Assessing current N and P conditions and changing land use and land cover (LULC) trends over time is critical to future planning and development especially in sensitive coastal watersheds. Watershed modeling is a tool that can be used to assess the effect of changes in the LULC on water quality by programing the model with past and current data. Water quality models are good for predicting future water quality conditions and can inform future planning and development, however post validation of the model is not common due to lack of readily available current nutrient data.

This study investigates the effect of changing LULC on water quality in a coastal watershed, and suggests changes in development and conservation policy to mitigate impacts. The Fish River watershed, located in Baldwin County, Alabama (AL), USA, is used as a case study to examine both spatial and temporal domains (Figure 1). This watershed is of critical importance to the health of Weeks Bay, a designated outstanding national resource estuary located at the watershed outlet. Fish River contributes 75% of the freshwater source to Weeks Bay. There is no direct discharge from point watershed. Threats of increasing population, urban development (impervious surfaces) and LULC change from agriculture to sod farming, golf courses, and large subdivisions, has put this sensitive watershed at risk (Kalin et al. 2009). The objectives of this study are: 1) To explore temporal trends in water quality using N, P, Total Suspended Solids (TSS), and compare 1994 to 1998 LULC with LULC data with data collected from 2008 to 2010; 2) To determine spatial linkages between LULC and water quality at the sub-watershed scale; 3) To test whether the Soil Water Assessment Tool (SWAT) model can be used to predict effect of LULC changes on water quality within the watershed; and 4) To use results to suggest Best Management Practices (BMPs) for policy and design to mitigate water quantity, water quality and land use problems at the sub-watershed level.

3 LITERATURE REVIEW

LULC change has a history of being strongly tied to water quality (Trimble et al, 1987; Gash et al, 1996; DeMoraes et. al, 2006; Bruijnzeel, 2004; Bosch et al., 2007; Kalin et al. 2009). Urban developments have also been shown to increase heavy metals (Callender and Rice 2000), bacteria loadings (Gregory and Frick 2000, Schoonover et al. 2005), and stream temperatures (Brooker 1981, Krause et al. 2004). These studies indicate the necessity of critically evaluating the potential consequences of future development plans. Several researchers have also presented evidence that a 10 percent increase in impervious surface area could result in stream degradation (Schueler 1995, Booth and Jackson 1997, Bledsoe and Watson 2001). High proportions of impervious surface can lead to increased nutrient and sediment loading into streams (Harden 1992, Arnold and Gibbons 1996, Nelson and Booth 2002).

Water quality data was collected from the United States Geological Survey (USGS) Baldwin County permanent sampling sites from 1990 to date. The Geological Survey of Alabama (GSA, 2003) collected water quality data from the Fish River and Magnolia River between 1994 and 1998. GSA analyzed grab samples for Nitrates (NO3), Total Phosphorus (TP), Total Suspended Solids (TSS), ammonia and ammonium (NH3 plus NH4) and other chemical analysis.
Figure 1. Location of the Fish River watershed with 1992 LULC distribution. Locations of precipitation and temperature gauges shown (Harsh Vardhan Singh).

Site locations were located throughout Fish River watershed and the adjacent Magnolia River watershed. Results showed that water quality is closely linked to physiographic and LULC characteristics. Prakash Basnyat (Basnyat, 1998) sampled the Fish River watershed from 1995 to 1996. NO$_3$ and TSS data were collected biweekly by grab sample. Basnyat was the first to observe that forested areas within the watershed acted as NO$_3$ sinks. He concluded that residential urban areas were responsible for majority of NO$_3$ and that agriculture areas were secondary contributors. Andrew Morrison (Morrison, 2011) conducted water quality sampling from 2008 to 2010. There was no specific sampling interval rather both grab and automatic sampling techniques were taken during stormflow and baseflow events. His data is used for model calibration in this study including post validation. Predictions by the model for 2008 and 2009 were compared with observed data.

The research of planning policy in Baldwin County shows a very traditional policy style including zoning, and large street subdivision regulations that promote infrastructure and impervious surfaces (Baldwin County, Alabama, 1996). No watershed information is given. Baldwin County is under the jurisdiction of water policy at the federal, state, county, and municipal levels. There are no watershed authorities. Urban land use policy is mandated at the county and municipal levels with municipalities have...
their own planning commissions. Small rural towns are under the jurisdiction of county planning commissions. All development must adhere to State of Alabama erosion and sediment control laws but due to tight economic conditions there are few enforcement officials. Land use and zoning policy show no incentives to promote sustainability. In 2010, Baldwin County initiated a new Comprehensive Plan (Baldwin County, Alabama, 2010) which promotes a more sustainable development but this plan does not support planning and development ordinances tied to designing BMPs to correspond to water quality analysis. An example of a BMP that removes pollutants is a rain garden or bioretention cell. LeBleu et al (2007) found significant removal of particulate phosphorus and total phosphorus elements were found under both conventional and internal water storage (IWS) rain garden types. Hydrologic effects measured included reduced outflow of hydrograph peaks and reduced total outflow volumes that would in turn reduce outflow pollutant load to receiving waters.

A model policy review revealed several examples of planning and development regulations in the United States support the selection of BMPs for development using water quality analysis and modeling. Permeable paving is often mentioned as such a BMP. A study conducted by Dougherty et al (2011) showed a 20 percent to 85 percent reduction in contaminants in leachate from rainwater and stormwater through pervious concrete compared to runoff from adjacent impervious concrete. The following model policies were selected for examination due to their BMP and water quality support: 1) The Cape Cod Commission, Cape Cod, Massachusetts (1999, 2000); 2) Model Stream Buffer Ordinance (Wenger and Fowler, 2000) and 3) Jordan Cove Urban Watershed Project in Waterford, Connecticut USA (Jordan Cove Urban Watershed Project, 2009).

4 METHODS

4.1 Water Sampling

Water quality and flow data were collected from October 2008 to March 2010 from ten sample sampling locations by Andrew Morrison, Auburn University Graduate Student. Each site had its own pressure transducer, and sampling visits were timed to capture both baseflow and stormflow events. Baseflow was measured during each site visit using a digital flow meter. Sampling consisted of grab samples and automated sampling. Grab samples were collected from all sites during each visit. Four sites were equipped with an automated water sampler that sampled up to 24 times over the duration of a storm to capture samples at the rising and falling of the storm event. Samples were analyzed separately and results combined to form one Event Mean Concentration (EMC). Samples were analyzed for NO3, TP, TSS and NH3 plus NH4 by an outside lab in accordance to Standard Methods for the Examination of Water and Wastewater (1998).

4.2 SWAT Modeling

LULC data was collected from previous studies dating from 1990 to date. A SWAT analysis model was calibrated using 1992 LULC as a reference. The model was calibrated with water quality data from Basnyat and GSA to predict the following: 1) Flow from 1990 to 1998; 2) Sediment (TSS) for 1994 to 1998; and 3) Nutrients (NO3) and Organic Phosphorus (Org P) for 1994 to 1998. The model results were compared to the actual data collected by previous researchers. Post Validation of SWAT was used to predict water quality from October 2008 to January 2010 using 2008 LULC. Instantaneous observed data was converted into continuous monthly data using USGS's LOADEST software. Predictions by the model for 2008 and 2009 were compared with observed data.

4.3 Planning Policy

Current planning and design policy was investigated in Baldwin County, Alabama and three municipalities within the Fish River watershed: Daphne, AL (site 4), Fairhope, AL (site 4), and Foley, AL (site 6). Comprehensive Plans were reviewed with particular emphasis on zoning, Overlay Zoning, and Landscape Ordinance (Baldwin County, 1996). Policy was found to be basic and adequate with no emphasis on planning or designing for water quality. Developers and designers tend to choose BMPs that are traditional and typical, that is, BMPs they are familiar with. The majority of the stormwater and erosion laws in Alabama are mandated by the U.S. Environmental Protection Agency and enforced by state and local authorities (State of Alabama Soil and Water Conservation Committee, 2009). Enforcement is at the
local level. County and municipalities agree that there is not enough manpower to consistently enforce the laws.

5 REFERENCES

5.1 Nitrate Trends

Nitrate trends over time showed a general decrease (Figure 2). Concentrations of NO₃ varied from site to site with the highest average and median concentrations at sites 7, B20, and 70 (USGS). These sites also discharged the highest amount of daily flow compared with other sites. NO₃ concentrations remained well below the minimum drinking water standards for human safety. Median concentration ranged between 0.3 to 1.2 mg per liter.

![Figure 2. Nitrate (NH₃⁻) trends over time showed a general decrease (Kalin et al. 2009).](image)

5.2 Ammonia and Ammonium Trends

The average and median concentrations for NH₃ plus NH₄ remained relatively low for all sites (less than 0.1 mg per liter). High concentrations did occur at site 7 and 6. Both these samples were collected during separate storm events. Other samples during the same storms showed highly variable concentrations of NH₃ and NH₄. It was observed that conditions during storm events can be highly variable with occasional pockets of high concentrations within the water column.

5.3 Total Suspended Solids Trends

Spatial comparisons between sub-watersheds showed that sites with large increases in urbanized land uses have substantially higher TSS (Figure 3). However, concentrations of TSS were relatively low for most of our sites, with the exception of site 4. Median concentrations at site 4 equaled 66 to 122 mg per liter respectively with other sites typically less than 15 mg per liter. Site 4 sub-watershed has highest urbanized area of all sites (36 percent).
TSS loading results show mostly decreasing trends with the exception of site 4 which has a significant increase in load over time due to urbanization (Kalin et al. 2009).

5.4 Total Phosphorus Trends

Total Phosphorus (TP) increased significantly (Figure 4). Concentrations of TP were found to be relatively similar throughout the watershed and were typically higher than nitrate levels. Median concentrations ranged between 0.5 to 1.0 mg per liter for all sites. Highest TP values were found at sites 10 and 5A. Maximum concentrations of over 3 mg per liter were found at site 5A and are likely due to high amounts of agricultural land upstream.

Figure 4. Total Phosphorus (TP) increased significantly (Kalin et al. 2009).
5.5 Land Use/ Land Cover Change from 1992 to 2008

Landscape analysis revealed significant urbanization between 1992 and 2008 (Figure 5). Water quality data and LULC data from Basnyat (Basnyat, 1998) and GSA (GSA, 2003) were used to calibrate the SWAT model for: 1) Flow Calibration verses Flow Validation; 2) Sediment calibration verses Sediment validation; 3) Nitrate calibration verses Nitrate validation; and 4) Organic P calibration verses Organic P validation. Post-Validation of the SWAT model from 2008 to 2009 was performed by calibrating parameters using 1992 LULC and transferring it to the model with 2008 LULC. Instantaneous observed data was converted into continuous monthly data using United States Geological Survey LOADEST software (USGS, 2011). Water quality data collected from October 2008 to January 2010 was compared with model simulations.

![Figure 5. Land use change 1992 to 2008 (Kalin et al. 2009).](image)

5.6 Planning Workshop

A planning and development workshop was held to educate Baldwin County planners, engineers and other professionals and government officials on the benefits of using water quality analysis and SWAT watershed modeling in long-range planning initiatives within the Fish River Watershed. The workshop also showed how SWAT could be used to inform Low Impact Development (LID) as a development method to increase water quality. The workshop was held in September 2010 in Fairhope, Alabama. Thirty Landscape Architects, Planners, Arborists, Civil Engineers, and Forest Hydrologists attended.

The transdisciplinary workshop included presentations on: 1) the state of the Fish River Watershed, water quality data and SWATS watershed modeling; 2) an overview on model planning policy (The Cape Cod Commission) and 3) LID model policy and design, and economic benefits of protecting trees during development (Model Stream Buffer Ordinance and Jordan Cove Urban Watershed Project in Waterford, Connecticut USA). A hands-on LID planning and design charrette followed. The charrette focused on a site in Baldwin County and emphasized the current ordinance constraints of using LID techniques in Baldwin County and the need for policy change. Design time was also used to show how LID Best Management Practices, especially permeable paving, might offer improvement to specific water...
quality problems. Examples of model policies that support LID and the selection of design BMPs based on water quality analysis at the site scale were discussed.

Survey results from the workshop and charrette concluded that the event was a success. Thirty percent of the attending group was from the Fish River Watershed area including Baldwin County Planners, City of Daphne Planners (site 6), City of Foley Planners (site 4) and City of Fairhope Planners (site 4). Several comments identified how important it was to not only learn about the watershed modeling information, but also learn how to communicate the information to developers and stakeholders.

6 MODEL PLANNING POLICY REVIEW

6.1 The Cape Cod Commission, Cape Cod, Massachusetts (1999, 2000)

The purpose of the Cape Cod Commission is to protect ground water and surface water; identify allowable uses in sensitive areas, comply with and compliment state and federal regulations; and protect sensitive resources. Strategies that have made this a model plan include: use regulations; performance standards; overlay districts; and LID subdivision design with Best Management Practices. Use restrictions cited within the document include: certain industrial uses; transportation infrastructure (airports, bus stations, etc.); outlets for floor drains; removal of native soil; activities that withdraw large volumes of water; disposal of waste and construction material, and some special use restrictions including large subdivisions with large impervious surface build outs.

6.2 Model Stream Buffer Ordinance (Wenger and Fowler, 2000)

The Model Stream Buffer Ordinance was written with the intent to reduce erosion and sediment; trap and remove P, N, and other contaminants; and protect wildlife habitat. The ordinance supports vegetative buffers along streams, rivers and other water bodies that reduce stream side erosion and support wildlife habitat. The width, extent and density of buffer are determined by the adjacent land use. Buffers along streams adjacent to residential properties are less dense than those along commercial properties. Each land use also list a set of prohibited activities such as fencing out cattle in agricultural use. Tools that give regulatory protection include overlay zones, freestanding ordinances, and floodplain ordinances. Non-regulatory protection includes transferable development rights, density transfers, conservation easements and acquisition. Clear communication of restrictions is vital to the success of ordinance.


The Jordan Cove community project in the Glen Brook subdivision of Storrs, CT is funded in part by the Connecticut Department of Environmental Protection (CT DEP) under the United States Environmental Protection Agency (US EPA) Section 319 Clean Water Act grant program. This model subdivision supports a ten year monitoring project that is a paired watershed study with part of the Glen Brook subdivision being developed using a traditional lot style and typical construction practices, while the other part was developed using a LID approach. BMP design practices included shared pervious driveways and a reduced width access road. The permeable driveways and roads in this unique subdivision contribute to the watershed’s water quality objectives by reducing nitrogen, bacteria and phosphorus export from the site, maintaining the predevelopment peak runoff rate and volume, and maintaining predevelopment suspended sediment loads.

7 DISCUSSION

This study supports the hypothesis that LULC is linked to water quality. Linkages were determined using multi-linear regressions between LULC and water quality data. Concentrations of NO3 for baseflow periods showed significant positive relationship to moderate density and high density residential areas. Forest areas continue to act as a nitrate sink as previously reported by Basnyat, 1998. Concentrations of NH3 plus NH4 were positively linked to pasture and grassland areas during stormflow. Results for TSS stormflow showed positive relationships for agriculture, pasture and grassland, forest, and high density residential areas. Baseflow TP results showed a positive relationship between agriculture and moderate
density residential areas and a negative relationship to forested wetlands. Stormflow TP concentrations showed positive relationships to agriculture, pasture and grassland, forest, and high density landscapes.

The SWAT model performed well for water quality during calibration validation (1994 to 1998) and prediction periods (2008 to 2009) at most sampling sites. Model performance was best for flow and weakest for NO3. Model simulations systematically underestimated TSS loadings at various sites during extreme events.

8 CONCLUSION

Automated sampling over time during storm events can provide a better water quality snapshot than occasional grab samples. However, automated sampling does produce an increased cost and workload. Changes in urban LULC have dramatically increased since 1995 and urbanization can be linked to increases in TSS and NO3 particularly due to the loss of grasslands and wetlands. Sub-watersheds with mixed LULCs require use of multilinear regression analysis to determine interactions. Flow was not statistically different between study periods for most sites. Nitrate loads typically decreased between study periods. The load of TP increased dramatically between study periods. A shift in the N to P relationship over time is thought to have come from the introduction of peanuts as a new crop to the watershed. Nitrate concentrations are highest in watershed with a large percentage of agriculture and urban LULC. Forest areas continue to act as a nitrate sinks, but development is encroaching on this natural resource. Concentrations of TP were typically higher than nitrate levels at most sites, and the highest concentrations of TP found in sub-watersheds with high agricultural land use. Also, the seasonality of water quality and flow can play an important role in selection and awareness of BMPs sizing and can help mitigate and reduce runoff during large storms in urban areas.

The SWAT model performed poorer with the 1992 LULC data in simulation water quality than with 2009 as expected. These findings underline the importance of using the most accurate and up to date LULC data in modeling. This study raises the credibility of the SWAT model as a dependable watershed tool for predicting the changes in water quantity and quality due to LULC changes. Water quality monitoring and modeling are effective tools to inform policy and design in sensitive watersheds. Modeling can be used as a support and validation tool for future watershed scenarios.

Support is need for land use and development policy change especially in sensitive coastal watersheds. Planners, designers and government officials participating in this study have begun to embrace model planning policies that support the selection of BMPs that correlate with water quality analysis resulting in new ordinances that support the use of BMP’s that addresses the needed pollutant removal efficiencies. Civic leaders, developers, engineers, planners, and architects, all need to be educated about water quality analysis, BMP pollutant removal properties, and the use of SWAT as a watershed planning tool.

8.1 Further Study

The results from this modeling study will be used to develope a template of design scenarios to be used as examples on how to use the SWAT model results to implement water quality senesitive design in the Fish River watershed.

9 ACKNOWLEDGEMENTS

I would like to thank Mississippi-Alabama Sea Grant Consortium, Ocean Springs, Mississippi, USA and the National Oceanic and Atmospheric Administration, Washington, DC, USA for funding this study. I would like to acknowledge Auburn University study partners Dr. Latif Kalin, Hydrologist, Andrew Morrison, and Harsh Varhan Singh, Graduate Students, School of Forestry and Wildlife Sciences.

10 REFERENCES

STRUCTURES OF COASTAL RESILIENCE: DESIGN STRATEGIES FOR STORM RISK REDUCTION AT JAMAICA BAY, NEW YORK

SEAVITT NORDENSON, CATHERINE
The City College of New York, Spitzer School of Architecture, Program in Landscape Architecture, cseavitt@seavitt.com

1 ABSTRACT
This proposal for enhancing coastal resiliency at Jamaica Bay, New York consists of strategic design recommendations for the Rockaway Peninsula, the central marsh islands, and Back Bay communities. These recommendations, developed in a progressive academic research laboratory with the support of USACE, embrace the vast scale of Jamaica Bay as an asset for exploring USACE’s new focus on developing nature-based features as viable coastal storm risk reduction techniques. The Jamaica Bay resiliency plan includes three strategies developed through field research and modeling, both physical and digital. The first strategy addresses water quality and the reduction of back-bay flooding via a series of over wash plains, tidal inlets, and flushing tunnels at the Rockaway Peninsula and Floyd Bennett Field. The second strategy develops enhanced verges at Robert Moses’ Belt Parkway and elevates of coastal edges at vulnerable back-bay communities, managing flood risk with a layered system of marsh terraces, berms, and sunken attenuation forests. The third strategy develops novel techniques of bay nourishment and marsh island restoration through maximizing the efficacy of minimal quantities of dredged material. This “island motor / atoll terrace” would align with local cycles of maintenance dredging. Dredged material from maintenance dredging may be beneficially reused to nourish the Rockaways’ coastal beaches, enhance the bay’s marsh islands, and create living shorelines at the back-bay perimeter. A resilient marsh ecosystem provides coastal storm risk management services to adjacent communities through wind and wave attenuation, delivering maximum immediate benefits for both vulnerable communities and the disappearing salt marsh islands.

1.1 Keywords
Coastal resiliency, salt marsh islands, dredged material, sediment capture, nature-based features
2 THE STATE OF THE BAY

Since Hurricane Sandy’s landfall along the Atlantic seaboard in October 2013, the word “resilience” has loomed large as coastal communities and government agencies assess their preparedness for the potential of future storm events and the uncertain certainties of climate change and sea level rise (Schultz et al, 2012). Former New York City Mayor Michael Bloomberg was quick to organize the Special Initiative for Risk and Reconstruction (SIRR), with a dedicated team producing a 445-page report and recommendations within during the summer of 2013. At a national level, the United States Army Corps of Engineers, defenders of the nation’s navigable waterways and coastlines, was tasked by Congress in January 2013 to prepare a Comprehensive Study of the eastern seaboard affected by Sandy, a close scrutiny of the possible future of the post-Sandy coastal landscape from Virginia to Maine. This $19.5 million study, led by the North Atlantic Division of USACE and titled the North Atlantic Coast Comprehensive Study (NACCS), was delivered to Congress in January 2015, and review and comment by interested parties on the massive report is ongoing (USACE, 2015).

Structures of Coastal Resilience (SCR) was conceived as a progressive multi-university academic research paradigm, working in parallel with USACE’s Comprehensive Study schedule. This eighteen-month multi-university collaborative study, fully funded by the Rockefeller Foundation, provides a focused look at designing for resilience at four coastal embayment sites along the East Coast within the Corps’ greater study area. The four sites and four university teams, each lead by a landscape architect or architect, are Narragansett Bay, Rhode Island, Harvard University; Jamaica Bay, New York, City College of New York; Atlantic City, New Jersey, Princeton University; and Norfolk, Virginia, University of Pennsylvania. Though the work of SCR is not officially part of USACE’s study, these projects have been reviewed, advised, and informed by continuing discussions with both members of the North Atlantic Division and those in the regional district offices. This direct contact with the Corps has reframed the designers’ resiliency thinking, pushing the limits of comfortable and known niches. The ambition is that these academic studies, and the design thinking they have engendered, might indeed have some impact on the Army Corps as well.

The Comprehensive Study addresses storm risk reduction strategies and promotes resilient communities along the coast, while considering future climate change and sea level rise scenarios (Figure 1). Perhaps most interestingly, given USACE’s traditional reliance on engineered hard structures for coastal...
engineering, the study examines the integration of what USACE has termed natural and nature-based features (NNBF) into their lexicon of risk reduction measures—a radical paradigm shift (Bridges, 2013; USACE, 2013). NNBFs include such features as dunes, oyster and coral reefs, barrier islands, maritime forests, and wetlands (Nature Conservancy, 2013). Often the benefits and performance of these features increase with scale. And that is perhaps the most invaluable quality of Jamaica Bay, New York, the study site of the City College of New York university research team, led by landscape architect Catherine Seavitt Nordenson, with research associates Kjirsten Alexander, Danae Alessi, and Eli Sands.

The Rockaway peninsula and the back bay communities of Jamaica Bay were massively impacted by Hurricane Sandy's surge and extensive flooding. The bay has been environmentally challenged since its early days as New York City’s dumping ground (Moses, 1938; NYCDEP, 2007; NYCDEP, 2012). Since the 1970s, the reduction of the marsh island footprints within the bay has severely increased, likely due to the combined anthropogenic impacts of poor water quality, nutrification, erosion, and sediment starvation (Hartig, 2002). Yet, given its vast scale, Jamaica Bay has the potential to be recast as an impactful ecological, infrastructural, and community asset, becoming an anchor of the region’s resiliency. And for the Army Corps, it provides an incredible design opportunity for exploring the performance of nature-based features, particularly salt marshes, maritime forests, and dunes. Jamaica Bay is a dynamic ecological entity, an estuarine embayment in a post-glacial outwash plain, a sandy, shifting terrain geologically capable of functioning resiliently during and after disturbance events. The City College of New York’s adaptive resiliency design proposals for Jamaica Bay seek to enhance that capability.

3 EXPERIMENTAL RESEARCH STUDIO

The SCR Jamaica Bay Team is not an academic studio, but an experimental research studio within the academic setting at City College of New York. This grant-funded research studio reflects a distinct shift in the discipline. Recently, several landscape architecture educators and practitioners have argued that the range of the discipline is expanding, and evolving. And several expect that landscape architecture’s range of inquiry in the earth, ocean, and atmospheric sciences is approaching (or perhaps has already become) a STEM / STEAM discipline. In some ways, this Jamaica Bay research studio, and the SCR project in general, may represent another phase shift toward a new model of a research-driven, laboratory-based academy, with work led by principal investigators in the discipline of landscape architecture.

Inspired by interaction with the Army Corps and research into their historic methodologies during a visit to Vicksburg, Mississippi, the Jamaica Bay research studio is modeled as a contemporary version of the Waterways Experiment Station (WES), established by USACE in 1930 in response to the Great Mississippi Flood of 1927. A 673-acre complex in Vicksburg, Mississippi, WES is the Army Corps’ hydraulics research laboratory facility and the site of the Engineer Research and Development Center (ERDC) headquarters. WES built large-scale hydraulic physical models of the Mississippi River, Chesapeake Bay, and the New York Harbor in order to test flood control structures and the effects of longshore drift. While ERDC still works with hydraulic physical models, their research has substantially shifted to digital modeling. Yet the think-tank atmosphere of experimentation is still present, and ERDC’s affiliated engineers and scientists are actively involved with the study of natural and nature-based features that figure prominently in the Comprehensive Study.

At the City College Jamaica Bay lab, a large number of physical models have been produced, from the scale of the watershed to the detailed marsh platform, resulting in a deep understanding of the morphology of the bay. Five of these are water tank models, constructed to test the dynamic conditions of water flow, residence time, overwash, sediment transfer, and surge (Figure 2). The hydrodynamic effects produced are somewhat coarse, but the precision of the Jamaica Bay topobathy model through which the water flows allows for the iterative study of design scenarios with subtle physical transformations. These water tank models are topographic contour models cast in glycerin, a forgiving material which allows for quick transformations and manipulations to the topography during the flow experiments. The empirical results of the water tank experimental studies, captured in video, have provided integral feedback to the design.

In the digital realm, a highly refined digital elevation model (DEM) of the topobathy of Jamaica Bay has been built, seamlessly merging topographic (land) and bathymetric (water depth) data. This continuous surface is integral to the conceptual understanding of terrain as a gradient surface, a
transformable basin containing the dynamic medium of water. The DEM is used in both its existing condition and with proposed design modifications to create comparative analyses of the efficacy of the design proposals using digital hydrodynamic modeling tools such as the SLOSH (Sea, Lake and Overland Surges from Hurricanes) model, SLAMM (Sea Level Affecting Marshes Model), and the wind fetch raster generator WAVES2012, an ArcGIS toolbox plug-in.

![Figure 2. CNC-milled topobathy model of Jamaica Bay with watertank flow and residence time test. Image courtesy of SCR Jamaica Bay Team](image)

But getting out of the lab in order to ground-truth in the field is critical. Broad Channel, Queens, is an unexpected community on a marsh island in the middle of the bay. Like Jorge Luis Borges’ fabled one-to-one map of the kingdom, Jamaica Bay itself is a full-scale research lab. Friendships have been forged with local environmentalists in Broad Channel. The EcoWatchers (Dan Mundy, Jr. and Dan Mundy, Sr.) have been an incredible source of knowledge, particularly regarding marsh island restoration. Don Riepe, the Jamaica Bay Guardian and director of the American Littoral Society’s Northeast Chapter, has provided support and access to over thirty years of his photographic archive of Jamaica Bay imagery. Current observation and the mapping of both low and high tide lines in the marshes have been critical for locating the proposed placement of elevated terraces for sediment traps. Data collection and ground-truthing is done in tall rubber boots, Trimble in hand, Avenza tracking on NOAA’s chart 12350 enabled on iPhones. Tide charts are critical. The research team walks to islands during extreme low tides. Visits are timed with the incoming tides to access the back bay inlets in Don Riepe’s boat, with mean tides for quad copter overflights, and with unnaturally high tides for surveying flooded streetscapes in Howard Beach.

Another resource developed as part of the work in the research studio is the Pamphlet Library, consisting of sixteen topical pamphlets and three reference manuals, which are compiled as a structured repository for accumulated data. Inspirations include by the “semiotext(e)” model of carefully curated translations of French philosophy for an American pocket, and the low-tech hand-printed-and-folded “cordel” literature and poetry of the northeastern Brazilian troubadours, self-published pamphlets hung from a cord with clothespins and sold in town squares.

Each pamphlet is a both a reference and a tool. Some compile aerial imagery, some are photographic field notebooks, some contain collections of coastal infrastructural inventions. Most address in some way the complex cultural, ecological, and infrastructural systems at this complex embayment. (Black, 1981). As a set, the pamphlets comprise the thoughts and research that influenced and informed the team’s resiliency strategies and designs for Jamaica Bay. They are also intended to be a resource for others, and may lead to future research directions.

“Experimental Marsh Island Restoration at Jamaica Bay” was the first pamphlet, evolving from a need to understand the techniques, processes, locations, and lessons learned from USACE New York
District’s innovative and unprecedented island restorations at the bay. Another pamphlet, “The Air above Jamaica Bay” explores the conflicts between the marsh restoration initiative and FAA-controlled airspace, given that high marsh provides a fantastic breeding habitat for birds that can potentially take down an aircraft. The Port Authority of New York and New Jersey’s bird depredation techniques are examined and quantified—the FAA’s most-wanted. “The Bottom of Jamaica Bay” showcases bathymetric scans and video stills of benthic habitat, providing a fascinating look at those otherwise unseen species floating in the water column and crawling around on the bottom.

4 ADAPTIVE DESIGN STRATEGIES FOR JAMAICA BAY

The SCR Jamaica Bay team has identified a holistic set of strategic design recommendations supporting coastal resiliency at Jamaica Bay, inclusive of the Rockaway Peninsula, the central marsh islands, and the tributary inlets at the ay’s interior perimeter. The project seeks to address social, environmental, and infrastructural vulnerability, with the goal of enhancing the overall resiliency of Jamaica Bay. These proposals reflect a set of ideas emerging from USACE that attempt to merge its more recent environmental restoration projects with traditional flood protection and erosion control practices. (USACE, 2013). The Army Corps is a large bureaucratic ocean liner of an organization, but the Comprehensive Study is the beginning of a paradigm shift. For USACE, it’s not about flood control any more, nor is it flood protection. It’s about the management of risk. The new terminology at the Army Corps is coastal storm risk management (CSRM). And now ecosystems are included in this thinking—ERDC produced a post-Sandy study arguing that salt marsh island restoration projects at Jamaica Bay effectively reduced wind fetch, and thereby the potential for erosive undermining of the Cross Bay Boulevard North Channel Bridge, a critical infrastructural evacuation route for Broad Channel and the Rockaway Peninsula (Burks-Copes, 2013).

The Jamaica Bay-wide resiliency master plan includes three strategies, merging novel techniques of ecosystem restoration with layered nature-based features (Figure 3). First, the improvement of water quality and the reduction of residence time and back-bay flooding via a series of overwash plains, tidal inlets, and flushing tunnels at the Rockaway Peninsula and Floyd Bennett Field. Second, the strategic verge enhancement of the Belt Parkway and elevation of coastal edges at vulnerable back-bay communities to manage flood risk via a layered system of marsh terraces, berms, and sunken attenuation forests. Third, the development of novel strategies of bay nourishment and salt marsh island restoration.

Figure 3. The “island motor” concept uses natural processes to capture sediment through the use of an “atoll terrace” perimeter ridge at the marsh islands. Images courtesy of SCR Jamaica Bay Team
through maximizing the effects of the strategic placement of minimal quantities of dredged material. This feature, dubbed the "island motor / atoll terrace," would align with local cycles of maintenance dredging.

4.1 Flow and Circulation

An important consideration in the design strategy is the improvement of both water quality and hydrologic flow throughout Jamaica Bay. Reducing residence time, particularly in the easternmost reaches of the Bay, will support ecological and benthic health as well as ensure the success of restoration projects within the bay. Improving flushing through the introduction of tidal inlets, overwash plains, and flushing tunnels may also reduce impacts from surge by providing additional outlets for the retreat of floodwaters. In addition, reintroducing sediment sources from the ocean to the bay will support the nourishment and accretion of the wetland marsh islands.

At Edgemere, near the eastern end of the Rockaway Peninsula, with its relatively dense building footprint, both below-grade flushing tunnels and above-grade flow paths are included to improve bay-to-ocean circulation as well as provide a controlled trajectory for periodic floodwaters. At the western end of the Rockaway Peninsula, near Jacob Riis Park and Fort Tilden, there is much more open space. Here, tidal inlets and overwash plains are proposed as very shallow topographic modifications allowing for sediment delivery from ocean to bay. Low earthen berms limit the extents of the overwash plains and serve to protect the adjacent communities to the east (Figure 4).

Figure 4. Design proposal for a tidal inlet and overwash plain at Jacob Riis Park at the western edge of the Rockaway Peninsula. Images courtesy of SCR Jamaica Bay Team

4.2 Verge Enhancement

Strategic gradient enhancement through the elevation of coastal edges at the vulnerable back-bay communities of Jamaica Bay is addressed through a layered system of marsh terraces, earthen berms, and attenuation forests, defined in sum as “verge enhancement.” The project also seeks to connect elevated earthen berms with existing high ground and the linear infrastructure of the Belt Parkway, recasting the verges of this transportation network as a continuous elevated buffer from Mill Creek to Canarsie and Howard Beach. These enhanced verges are foregrounded by low marsh, high marsh, and
upland planting zones, providing additional mitigation of wave energy as well as public space at the waterfront. Densely planted sunken maritime forests are established behind the berm.

Howard Beach is a very low-lying back bay community that was extensively flooded during Sandy, and even experiences street flooding during high tidal cycles. Here, a continuous connection is created from existing high ground at the southwest to the launching of the Belt Parkway’s bridge over Spring Creek. A continuous elevated verge is created from the Spring Creek bridge at the west to the Bergen Basin and Lefferts Boulevard at the east. By providing closure structures below the Belt Parkway at Spring Creek and near the mouths of Shellbank and Hawthorne Basins at 165th Avenue, this continuous enhanced verge has the capacity to provide the entire community with the equivalent protection of FEMA’s current 100-year base-flood elevation plus two feet of “freeboard” (Figure 5).

Figure 5. Design proposal for Howard Beach at Spring Creek, Shellbank Basin, and Hawthorne Creek, establishing a continuous earthen berm tying into high ground at the verges of the Belt Parkway. Images courtesy of SCR Jamaica Bay Team

4.3 Atoll Terrace / Island Motor

Salt marsh loss at Jamaica Bay is a paradigmatic example of environmental vulnerability, particularly given future sea level rise. A resilient marsh ecosystem provides coastal storm risk management services to adjacent communities through wind fetch reduction and wave attenuation. After assessing the methods and results of the innovative marsh island restorations at Jamaica Bay undertaken in partnership with the National Park Service, USACE, and local environmental NGOs, the project proposes novel strategies of bay nourishment and salt marsh island restoration through an “island motor,” maximizing the effects of the strategic placement of minimal quantities of dredged material as a perimeter “atoll terrace.” This elevated marsh terrace, formed specifically to reduce wave energy and encourage sediment deposition, provides an ideal slope for the upward migration of low marsh grass (Spartina alterniflora) and allows the natural processes of current-driven sediment capture and deposition to nourish the marsh, thus allowing it to accrete upward with sea level rise. Atoll terraces are arrayed at the perimeter of the marsh island footprints, positioned to best capture sediment given predominant current speeds, tidal flows, and sedimentary transport. The construction of the atoll terraces would be aligned with the availability of local dredged material and sequenced to provide maximum immediate benefits for the most vulnerable communities and marsh islands (Figure 6).
The “atoll terraces,” formed specifically to reduce wave energy and encourage sediment deposition, provide an ideal slope for the establishment and upward migration of low marsh grasses. Image courtesy of SCR Jamaica Bay Team

The atoll terraces, formed specifically to reduce wave energy and turbidity as well as encourage sediment deposition, will provide both an ideal slope for the establishment and upward migration of low marsh grasses (*Spartina alterniflora*) as well as conditions for achieving the water clarity and light penetration required for the successful establishment of submerged aquatic vegetation (*Zostera marina*). The team is also examining resilient plant selections for the marsh islands given climate change, such as SAVs that tolerate warmer waters and low marsh / high marsh species that are adaptive to wetter and warmer climates. Ensuring the future success (and indeed, the continued existence) of the salt marsh islands at Jamaica Bay requires the strategic use of dredged material resources, the improvement of water quality at the Bay, and a robust palette of plant material.

5 AN ADAPTABLE FRAMEWORK FOR JAMAICA BAY

The three proposed design strategies for coastal resilience at Jamaica Bay, developed through iterative research using physical and digital modeling as well as field investigations, are conceived as complementary and developed as an adaptable framework. Each of the three elements combines with the others, creating an enhanced, and resilient, Jamaica Bay, capable of responding to future sea level rise and storm risks over time while supporting the continued co-existence of nature and culture at the bay (Figure 7).
Figure 7. Resiliency Plan for Jamaica Bay, New York. Image courtesy of SCR Jamaica Bay Team

6 REFERENCES


PEOPLE-ENVIRONMENT RELATIONSHIPS

Edited by Karen Baptist and Deni Ruggeri
WHEN THE WELL RUNS DRY

COLWEL, ERIN
University of Oklahoma, erincowan.colwell@gmail.com

COFFMAN, REID
Kent State University, rcoffma4@kent.edu

RYAN, RICHARD
University of Oklahoma, ryan@ou.edu

1 ABSTRACT
While new rainwater harvesting (RWH) products and systems are evolving beyond the simplistic rain barrel, the reasons for their implementation and adoption remain less defined. With hopes of better understanding these influences, a study was initiated to examine the relationship between RWH system incorporation in new projects and owners’ reasons for inclusion.

Projects under construction or previously built that include above or below ground water capture and storage systems were targeted in Oklahoma, Texas and New Mexico due to typical arid climates between eight and forty-eight inches of annual rainfall. Factors influencing integration of RWH were determined from literature review and included in an online cross-sectional survey. Project owners were invited to complete a five level Likert scale to be used to rank the strength of influence of these factors: initial cost, perceived return on investment, government dollar incentives, geographical factors, product availability, available design and installation expertise, aesthetics, maintenance, education, social reluctance, legislation and regulations, marketing, storm water management, LEED and environmental concern.

The results show that rainwater harvesting practitioners believe that implementation is due to an environmental ethic, rather than economic incentive or environmental regulation. Further discussed is the strength of influence for any type of building project (office buildings, schools) and building feature (rainwater harvesting, LEED credit categories). This study contributes to a greater understanding of the influences associated with water conservation through integration of rainwater harvesting and reuses systems in new building construction projects.

1.1 Keywords
Rainwater harvesting (RWH), LEED, water conservation, water reuse
2 INTRODUCTION

Water could be viewed as the new oil. It is a natural resource and while once plentiful, it has become the focus of tension and competition as demand continues to increase. Benjamin Franklin said “When the well runs dry, we will know the worth of water.” While we haven’t run dry yet, many would agree that we are wasting, contaminating, and mismanaging our water resources. Like oil, a defining resource of the twentieth century, for most of human history, water has been a crucial resource. In coming years it will reassume its natural dominion placing water on high as the defining resource of the twenty-first century (Pru’d Homme 2011). While cities continue to grow, ground water is increasingly threatened, even depleted, and reservoirs are built for municipal water supply. In order to adapt we must acknowledge this reality, and unlike oil, the good news is water is renewable by means of reuse practices.

With population growth and urban sprawl surging, commercial property owners are turning towards on-site rainwater harvesting or RWH, the practice of capturing and reusing site rainfall, as a form of environmentalism and security for an increasingly limited resource. Understanding why these management decisions are made is critical to the sustainable future of the earth’s water supply. While humans may pollute, overuse, and waste it, we cannot destroy the water sources. The challenge for humanity here is to focus on management and education. Using RWH systems may contribute to environmental awareness and education (Winterbottom 2002).

Recognition of this challenge is the major motivation for this research that uses quantitative data to measure the strength of influences on owners to integrate rainwater catchment systems into new construction projects. The importance of the findings lies in how they can be further used to adjust current sustainable construction practices. Initial research began with determining influences and defining through interviews and literature review. Using a survey, influences are weighted by frequency of selection by participants in order to establish means. These means determine the strongest influencing factors such as initial costs or product availability.

Despite available research, the answer to what the strongest influences are on project owners to install RWH systems has seemingly yet to be determined. Based on previous work however, there is evidence of factors that influence inclusion. David Crawford of Rainwater Management Solutions and expert in the field of RWH has defined several roadblocks that he feels effects adoption of RWH systems. He found that RWH is new to many clients, designers, and contractors, therefore resulting in high bids due to unfamiliarity. Crawford also theorizes that consistency in design would result in simplifying installation and therefore result in utilization of such systems by more builders and developers in new projects. He also explains there are regulatory hurdles, such as multiple agencies involved in the regulation of rainwater. Crawford lists the following agencies as being involved in regulation: EPA, Department of Health, Department of Conservation and Recreation, State Water Control Board, Department of Environmental Quality, local plumbing inspectors, and the USDA. “The big picture here is that RWH is still new to a lot of people, builders and developers. Consistently designing, installing, and selling systems that actually work is the best thing we can do to remove the roadblocks. Bad systems will just validate people’s fears.” (Crawford, 2011).

Billy Kniffen of Texas A&M University, an Education and Development Specialist with the American Rainwater Catchment Systems Association, has produced much RWH research over the last decade. Through his studies he formulated the following factors that currently affect adoption of rainwater harvesting system installation and use (Kniffen, 2011).

Crisis - Defined as the fear of a lack of water i.e. drought in arid regions.
Fear - A fear of aquifer drainage, contamination, and salinization of water affects population, growth and economic conditions. This is one of the most significant factors affecting adoption.
Catastrophic Events - Events like floods and earthquakes causing the public to become more interested in water control methodology.
Education – Better educating the public and decision makers.
Leaders Paving the Way - The “early adopters” as Kniffen labels them, are those whose efforts, passions, and driving knowledge pave the road to RWH becoming a way of life leading others to follow suit.
Right Products - RWH tools that are effective, low maintenance, and accessible.
Peer Pressure - Kniffen refers to this as a “keeping up with the Joneses” scenario where a failure to participate will end in losing ground and a failure to act can leave constructors permanently disadvantaged as other companies trudge forward with a sustainable mindset.

Do Our Part - At the heart of the matter lies a healthy planet. This can be as simplistic as the fact that people hold a legitimate concern for the environment and the ecosystem in which it lies. Influenced by the internal need to participate in the game of resource reuse, this element may be one of the most simplistic influences, however research shows it to be increasing.

The importance of the study findings lies in the knowledge gained about the motivating factors effecting RWH system adoption. The study concludes by proposing further research based on the relationships discovered with the sample population and influential factors.

3 THE STUDY AND METHODOLOGY

The guiding assumption of the study is that perceived return on investment would have the strongest influence on owners to RWH systems in new construction projects. In The Wealth of Nations, Adam Smith describes what he labels the “diamond-water paradox.” Smith points out that while water is essential for survival, diamonds, which have merely aesthetic value, commence and interestingly and quite substantially higher market value. Galeleo Galilei supports Smith’s theory hundreds of years prior when he said “it is scarcity and plenty that makes the vulgar take things to be precious or worthless; they call a diamond very beautiful because it is pure like water, and they would not exchange one for ten barrels of water.”

Current research shows to support both views concerning water and monetary correlation as well as propose how costs of RWH can affect installation of such systems. In Arlington County, Virginia, a cost-benefit analysis at commercial facilities considered the feasibility of meeting water demands in modern commercial buildings using rainwater harvested on site as well as the economic viability of the harvested water versus municipal water supplies. The study determined that regardless of whether municipal water is readily available, private developers are most apt to incorporate these systems into commercial development designs if the benefits justify the costs (Hicks, 2008).

3.1 Intent and Significance

Water conservation practices have become a major issue of concern for U.S. communities in recent years. Particularly in the study’s focus region, Oklahoma passed House Bill 3135 that made $35,000 available for the implementation of water conservation projects. This ‘Dust Bowl’ state remains acutely aware of the need for water reserve and reuse based on historical misfortunes. After a visit from storms in May 1935, the St. Petersburg Times reported that the Nation’s Dust Bowl has become a rain barrel, even though some areas only received less than an inch. This article described the region as powder dry as the welcomed drops patterned steadily and became music to the ears of residents and life itself, as crops and pastures suffered alongside. Rain barrels were used in this era to account for such difficult times the nation was enduring. It was out of obvious solution to severe necessity. While there are new technologies, products, and systems emerging derived from the simplistic rain barrels used many years ago, these systems and methods are taking time for unrelenting adoption in spite of what history forewarns us.

The problem is that the influences associated with the implementation of such systems are neither determined nor defined to even begin to address actual system integration into projects. The majority of research reviewed for purpose of this study was nested under significance of system optimization and performance. One study examined, by the Texas Water Development Board in January 2011, focused testing and analysis on the effects of roofing materials on water quality. Another study, prompted by severe drought, was conducted by a computer-simulated model in order to evaluate the use of RWH systems in the Southeast region of the U.S. Three cisterns in North Carolina were used where the model simulated system performances of 2,081 larger rain barrels and cisterns in order to use historical data and anticipated usage. The results showed the RWH systems to be underutilized.

The intent of this study is to explore the relationship that exists between rainwater harvesting systems, and influences on project owners to integrate them when building new structures. This research was designed to create awareness of the influences associated with water conservation through integration of rainwater reuse systems in new construction projects. The strength of influence will be
determined for factors affecting adoption and implementation of rainwater harvesting systems in new building projects in order to explore the relationships that exist.

3.2 Limitations
The parameters of this research include owners of construction projects currently under construction or previously built and still fully operating, that include above or below ground water capture and storage systems in a region with annual rainfall between 8 and 48 inches per year. Given those limitations, the states of Oklahoma, Texas, and New Mexico were selected due to the statistical similarities such as typical arid climate and range of annual rainfall. There are roughly 3 different ranges: Low (8”-16” or below), Medium (16”-32”), and High (32”-48”) (National Oceanic and Atmospheric Administration, 2011).

3.3 Methodology
In an effort to delineate between the influences and their individual strengths, an online survey was chosen for data collection. It was considered to be the most appropriate method for this particular study, because it was a true way of obtaining information directly from the selected population. The design consists of an online cross-sectional survey of project owners who installed RWH systems in their buildings or projects under construction or recently constructed.

A 5-Level Likert scale is used in order for the participants to rank the influences of each factor identified. Inferences were developed by research and literature review. When responding to a specific item, respondents specify their level of agreement or disagreement using the scale. Weakest, Low, Medium, High, and Strongest influence ratings indicate the strength of influence for each survey question based on the owners’ decision to include of a RWH system in a new construction project.

3.4 Data Collection
Projects were initially targeted based on known inclusion of rainwater harvesting, project type, the owner, and cost. After contact was made and an appropriate responsible party identified, each owner was sent a link to an approximate 30 minute maximum online one-time non-experimental quantitative data collection survey through www.surveymonkey.com. Notification of the survey link was delivered via email to each targeted participant.

3.5 Survey Questions
The survey consisted of two parts with the first part to qualify the participants and the second identified influences for inclusion of RWH systems in the project as factors. Qualified respondents were to rank the level of perceived strength of influence on a scale of 1 to 5; 1 being the weakest and 5 being the strongest. The following instructions were given to respondents for question 5a through 5o to rate the Influences in their decision to include the RWH system in their project. The categorical areas included:

1. Initial Cost - Cost of products and installation.
2. Perceived Return on Investment - Current knowledge of financial loss/gain.
3. Government Dollar Incentives - Grant monies or tax reliefs.
5. Product Availability - Proper and effective manufactured products, techniques and systems to meet intended need.
6. Available Design and Installation Expertise - Inconsistency in design creating a lack of standard procedure or higher costs for labor at installation.
7. Aesthetics - Visibility aspects of cisterns, catchment systems, or retention ponds.
8. Maintenance - Need of maintenance or availability of parts and customer service or discrepancies for who facilitates maintenance after installation.
10. Social Reluctance - Reluctance to accept change by the public, laborers or municipalities.
11. Legislation & Regulations - Codes & standards, local officials and water authorities.
12. **Marketing** - Tool for gaining eco-conscious praise/recognition or incentive for owners to follow “green” trend.


14. **LEED** - RWH used for Water Efficiency credit.

15. **Environmental Concern** - Legitimate concern for environment and need for sustainable building practices.

### 3.6 Study Sample

Twenty projects were discovered in the sample area through various public or trade resources such as U.S. Green Building Council case studies. Eleven projects were targeted from New Mexico, Oklahoma and Texas that qualified based on project type, owner, cost and completion date between 2005 and 2010. Of those eleven, eight participants allowed direct communication with the owner or owner’s representative to obtain further information and agreed to complete the survey. These projects are listed in Table 1.

**Table 1. Demographic and Basic Project Information**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Name/Location</th>
<th>Project completed</th>
<th>LEED Certified</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Sandia Prep School Field House Addition Project</td>
<td>2005-2010</td>
<td>NO</td>
<td>Cistern $125/ Total construction $4.5 million</td>
</tr>
<tr>
<td>4</td>
<td>Marc Heitz Chevrolet -</td>
<td>2005-2010</td>
<td>NO</td>
<td>$22,000</td>
</tr>
<tr>
<td>6</td>
<td>Bishops Building,</td>
<td>2005-2010</td>
<td>Yes, Gold</td>
<td>$20+ million</td>
</tr>
<tr>
<td>7</td>
<td>Agriculture Resources Center, OSU-OKC campus</td>
<td>2005-2010</td>
<td>NO</td>
<td>Donated - approx value $60000</td>
</tr>
<tr>
<td>8</td>
<td>Jefferson Elementary</td>
<td>2005-2010</td>
<td>NO</td>
<td>$7,000</td>
</tr>
<tr>
<td>9</td>
<td>Skyline Elementary, Shangri La Botanical Gardens and Nature Center</td>
<td>2005-2010</td>
<td>NO</td>
<td>$10,000</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>2005-2010</td>
<td>Yes, Platinum</td>
<td>$90 million</td>
</tr>
<tr>
<td>11</td>
<td>Denton Fire Station #7</td>
<td>2005-2010</td>
<td>Yes, Gold</td>
<td>$3.2 million</td>
</tr>
</tbody>
</table>

### 4 DATA AND ANALYSIS

As part of the analysis a mean score is calculated for each response to determine the strongest degree of influence that explains how the factors rank against each other. The mean scores are the calculated average across all eight participants for each of the factors tested. The averages give a rank order to the influences. For example, environmental concern had the most ‘highest influence’ numbers. The higher the number on the ranked means (averages) reflects a stronger influence. The lower the number, 1.87 Government Dollar Incentives for example, means the least amount of participants responding to that factor as a strong influence. Table 2 lists the mean responses to the factors using the following measurement indicators: 5- Strongest Influence; 4- High Influence; 3- Medium Influence; 2- Low Influence, 1- Weakest Influence.

Environmental Concern weighted the strongest influence among participants with the highest mean score of 4.38. See Figure 1. Government Dollar Incentives proved to be the weakest influence, with an average of 1.87 indicating grant monies or tax reliefs ranked low on determining an owners’ decision to install rainwater harvesting systems. According to the mean scores reported in the study it appears owners of projects hold a concern for the environment and see a need for sustainable building practices more than any of the other factors effecting influence on their decision to integrate the systems. Marketing, calculated at 4.25 ranked just below Environmental Concern. It’s worth noting that other factors pertaining to the environment such as LEED, a sustainable building ranking system based on
weighted credits by the Leadership in Energy and Environmental Design, and Geographic Factors were ranked considerably lower at 2.38 and 2.25 respectively.

Table 2  Mean scores of participant responses across all influential factors

<table>
<thead>
<tr>
<th>Influencing Factors</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Concern</td>
<td>4.38</td>
</tr>
<tr>
<td>Marketing</td>
<td>4.25</td>
</tr>
<tr>
<td>Education</td>
<td>4.13</td>
</tr>
<tr>
<td>Stormwater Management</td>
<td>3.25</td>
</tr>
<tr>
<td>Product Availability</td>
<td>2.75</td>
</tr>
<tr>
<td>Available Designs &amp; Installation Expertise</td>
<td>2.5</td>
</tr>
<tr>
<td>Maintenance</td>
<td>2.5</td>
</tr>
<tr>
<td>Social Reluctance</td>
<td>2.5</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>2.38</td>
</tr>
<tr>
<td>LEED</td>
<td>2.38</td>
</tr>
<tr>
<td>Geographical Factors</td>
<td>2.25</td>
</tr>
<tr>
<td>Initial Cost</td>
<td>1.88</td>
</tr>
<tr>
<td>Perceived Return on Investment</td>
<td>1.88</td>
</tr>
<tr>
<td>Legislation &amp; Regulation</td>
<td>1.88</td>
</tr>
<tr>
<td>Government Dollar Incentives</td>
<td>1.87</td>
</tr>
</tbody>
</table>

Figure 1. Mean scores of participant responses across all influential factors
Education with a 4.13 average is placed below Marketing indicating still a high level of influence on project owners. Stormwater management with an average response of 3.25 was a medium influence. Product Availability, Available Designs and Installation Expertise, Maintenance, and Social Reluctance had an average means of 2.50 indicating moderate influence.

Initial Cost, Perceived Return on Investment, Legislation and Regulation and Government Dollar Incentive all had similar averages at around 1.88. These factors had the least influence on respondents’ decision to integrate. Among these considerably lower influential factors, Perceived Return on Investment disproved the study hypothesis and the average of 1.88 is also quite a low in comparison to the other included influences.

4.1 Study Sample
Table 3 illustrates the frequency and percentages of participants’ responses to each influential factor. The data displayed represents how participants viewed each factor separately.

<table>
<thead>
<tr>
<th></th>
<th>Weakest Influence</th>
<th>Low Influence</th>
<th>Medium Influence</th>
<th>High Influence</th>
<th>Strongest Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
</tr>
<tr>
<td>Initial Cost</td>
<td>2</td>
<td>25.0%</td>
<td>5</td>
<td>62.5%</td>
<td>1</td>
</tr>
<tr>
<td>Perceived Return on Investment</td>
<td>2</td>
<td>25.0%</td>
<td>5</td>
<td>62.5%</td>
<td>1</td>
</tr>
<tr>
<td>Govt. Dollar Incentives</td>
<td>6</td>
<td>75.0%</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Geographical Factors</td>
<td>3</td>
<td>37.5%</td>
<td>2</td>
<td>25.0%</td>
<td>2</td>
</tr>
<tr>
<td>Product Availability</td>
<td>1</td>
<td>12.5%</td>
<td>3</td>
<td>37.5%</td>
<td>2</td>
</tr>
<tr>
<td>Available Designs &amp; Installation Expertise</td>
<td>1</td>
<td>12.5%</td>
<td>3</td>
<td>37.5%</td>
<td>3</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>3</td>
<td>37.5%</td>
<td>2</td>
<td>25.0%</td>
<td>1</td>
</tr>
<tr>
<td>Maintenance</td>
<td>0</td>
<td>0.0%</td>
<td>4</td>
<td>50.0%</td>
<td>4</td>
</tr>
<tr>
<td>Education</td>
<td>3</td>
<td>37.5%</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
</tr>
<tr>
<td>Social Reluctance</td>
<td>2</td>
<td>25.0%</td>
<td>3</td>
<td>37.5%</td>
<td>1</td>
</tr>
<tr>
<td>Legislation and Regulations</td>
<td>3</td>
<td>37.5%</td>
<td>3</td>
<td>37.5%</td>
<td>2</td>
</tr>
<tr>
<td>Marketing</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
<td>0.0%</td>
<td>2</td>
</tr>
<tr>
<td>Stormwater Mgmt</td>
<td>1</td>
<td>12.5%</td>
<td>2</td>
<td>25.0%</td>
<td>2</td>
</tr>
<tr>
<td>LEED</td>
<td>3</td>
<td>37.5%</td>
<td>2</td>
<td>25.0%</td>
<td>0</td>
</tr>
<tr>
<td>Environmental Concern</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
<td>0.0%</td>
<td>2</td>
</tr>
</tbody>
</table>

**Initial cost** - Cost of products and installation. 62% of participants felt that the initial cost of installing RWH systems along with the cost of all of the different components, equipment, and necessary products was a relatively low influence. One participant reported that initial cost was a medium influence on their decision. Two participants believed that initial cost had little to no influence on their decision and ranked initial cost as the weakest influence.

**Perceived return on investment** – Current knowledge of financial loss/gain. Contrary to the proposed hypothesis of this study, the majority or 62.5% of participants ranked perceived return as 2 – (low influence) on a scale of 1 to 5 where 5 was the highest influence. Two participants claimed that the consideration of financial loss or gain in fact had the weakest influence in their decision. While no
participants responded to perceived return having a strong or high influence, one participant believed it to be an evenly weighted influential factor and selected 3-medium influence.

**Government dollar incentives** - Grant monies or tax reliefs. 75% of respondents believe government dollar incentives to be the weakest influence during project design decision-making regarding RWH system integration. Two respondents selected high and strongest on the scale indicating that tax relief or grant money incentives were very influential. Whether these projects took the incentive monies or reliefs was not asked of participants. However, it could be interpreted due to two respondents believing it to be on the opposite end of the scale as a high or strongest that they were able to take advantage of such incentives.

**Geographical factors** - Drought, flooding, or earthquakes. The frequency of respondents of the survey seemed to be more evenly distributed regarding geographical factors influencing participants. One participant responded as it having the strongest influence. Two participants each felt that geographical factors had medium or low influence. The remaining three participants agreed that geographical factors had the weakest influence.

**Product availability** – Proper and effective manufactured products, techniques, and systems to meet the intended need of the project. One participant ranked product availability as the strongest influence and one the weakest influence. Remaining respondents ranked influences in between. 37.5% perceived product availability to be a low influence.

**Available designs & installation expertise** – Inconsistency across designs that in turn creates a lack of standard procedure or even higher costs for labor at the time of installation. One respondent believed expertise to be the weakest influence and contradictorily one chose it to be a high level of influence on decision-making. Three respondents ranked expertise as a low influence and three felt it was a medium influence.

**Aesthetics** – Visibility aspects of the cisterns, catchment systems, or retention ponds on project sites. 57% of respondents felt that aesthetics was the weakest or low influence. Two respondents, on the opposite end of the scale, ranked aesthetics high and the strongest influence.

**Maintenance** – Need of maintenance or availability of parts and customer service or discrepancies for who facilitates maintenance after installation. Results for maintenance showed interesting percentage of participant responses. 100% of respondents felt that maintenance was a low or medium influence for RWH integration in the project. Half responded to low and the other responded to medium which shows an equal split, but nevertheless an overall low to medium overall outcome.

**Education** – Informed public and key decision makers. The issue that RWH is still new to a lot of people leading to misunderstandings and misconceptions that create roadblocks. Half of the respondents felt that education had strongest level of influence. One respondent scored it as a high influence however the remaining three respondents ranked education as the weakest. The frequency here shows results that are spread throughout the entire ranking scale. Respondents agreed that an educated public or decision makers strongly effect their decision to integrate RWH into their projects, or they don’t feel as if it has much of an influence, if any on their decision making. This could possibly be related to location of the respondents and could be further explored in future research.

**Social reluctance** – The reluctance to accept change by the public, laborers or municipalities. While at least one participant responded to each of the five in the rankings, three ranked social reluctance as a low influence. One participant marked it as the strongest influence.

**Legislation & regulation** – Referring to the codes and standards, local officials and water authorities involvement and regulations. The idea that too many agencies are involved and/or standards are thought to be scattered and tend to vary from state to state and city to city (no standard set). All participants ranked regulatory standards as a medium or less influence.

**Marketing** – Marketing used as a tool for gaining eco-conscious praise, recognition, or incentive for owners to follow the green trend. Half of the respondents agreed that marketing played a role when deciding to integrate RWH systems in their projects and ranked it as the highest influence amongst other factors. Marketing also averaged the second highest influence. The remaining participant responses were split as the table above shows 25% ranking it as medium influence and the other 25% as high influence. No survey respondents perceived marketing anything lower than medium, therefore attesting that using RWH system integration in projects as a tool for show is an incentive.

**Stormwater management** – The benefits of runoff management. Three respondents ranked the influence of beneficial runoff management as the strongest influence. One respondent ranked storm
water management as the weakest influence and the remaining responses were split between low and medium.

**LEED** – The use of rainwater harvesting system employment in project scope for Water Efficiency credit gain. Three participants found LEED to be the weakest influence; three also found it to be a high influence. A quarter of the respondents however ranked credit achievement as a low influence and either did not pursue LEED certification or did not find it influential in determining credits in pursuit.

**Environmental concern** – Holding a legitimate concern for the environment and seeing a need for sustainable building practices. Environmental Concern had the highest overall frequency of respondents for a single factor, but those 62% of respondents also ranked it as the strongest influence on the owner’s decision to integrate the RWH system. No participants considered environmental concern less than a medium influence.

### 4.2 Discussion

Decision makers of RWH tend to be influenced more by the aspiration to support the environment rather than the proper economic incentives and return on investment. The responses provided by the sample pool of property owners and project managers did not support the position of Crawford (2011), Kniffen (2011) and the findings of Hicks (2008). Instead, the project managers perceived environmental concern as the most influential factor. It was grouped with marketing and education (score > 4.0) as primary factors influencing adoption of RWH. Furthermore, according to the mean score results, all economic factors (scores < 2.0) ranked as the lowest four of all influential factors. According to the results, owners hold a more legitimate concern for the environment over issues related to economics all other influential factors in relation to RWH.

This raises question to the relationship with the geographical limitations of the arid climate. Are buildings located in arid climates, such as those included in this study, more likely to include RWH systems in their building projects because of legitimate care for the environment or simply a fear of drought? With a mean score of 4.38 Environmental Concern was ranked the strongest influencing factor and the biggest influence which supports the assumption that participants in the studied region have a vested interest in the environment. Geographical factors such as the fear of drought, flooding or earthquakes had a mean score of 2.25, ranking it as a lesser influence.

These findings encourage the idea of rainwater reuse on site. Echols and Pennypacker (2012) show how stormwater is “artfully” displayed across goals of education, recreation, safety, public relations, and aesthetic richness. By deploying a rainwater harvesting system as a designed landscape the site can engage ecological goals as well (Meng, 2009). When clients are influenced by environmental concerns they may be more apt to use RWH solutions that achieve multiple goals.

Marketing closely followed Perceived Return on Investment as half of the respondents ranked marketing as a 4- high influence. With Marketing defined as a tool for gaining the eco-conscious consumers and seeking a label of being green, one could see a closeness to return on investment if translated as a tool for owners to gain profits. However, results show only a 0.13 mean difference between marketing and environmental concern with both holding a high influence on owners to include RWH systems in their projects. If marketing aspects of RWH are interpreted as owners simply desiring to be a part of the green trend and hold desirable eco-conscious attributes, it is related to concern for sustainable building practices.

With interest in the environment ranking higher as an influence one might assume LEED certification would closely follow. Following this assumption it is worth noting LEED credit achievement actually had a mean score of 2.38, placing it somewhere between medium and low influence and seven factors below marketing. This result appears contradictory as owners often proudly display a project’s LEED certification for recognition and use it as a marketing tool when the project is intended for owner occupancy. Rarely has a project been LEED certified where certification is not displayed in some way and by definition LEED, “Leadership in Energy and Environmental Design” (USGBC, 2012) it could be assumed that a tool for using LEED as signification of leadership would be advantageous. To further understand how this information might affect sustainable construction, the data was scrutinized more closely to investigate LEED certified projects and respondents’ feedback on the remaining influences in a LEED Cross Examination found in section 4.3.
Speaking to the limited data set applied in this study, it has been mentioned that the 40% response rate could be improved for future study purposes. However it is notable that half of all surveys receive a 26% response rate and the average is 32.42% according to Michael Braun Hamilton, an online survey analyst. Therefore, while the sample size could be improved it still holds validity in the findings due to recorded averages. Another interesting query uncovered is whether or not the sample size had any relevance towards the geographical location of the projects studied. The three factors ranked on the strongest to highest end of the scale (Environmental Concern, Marketing, and Education) could be interpreted as emotional or social influences. The bottom three, (Perceived Return on Investment, Legislation & Regulation, and Government Dollar Incentives) on the other hand, are more rational influences. Geographical location of the sample utilized may be able to explain the results if looked at in future research. Furthermore, what exactly tips the scale from emotional to rational given the factors that lie in between? All of these issues could also be examined in order to advance additional findings.

4.3 LEED Cross Examination

Of the eight projects included, three were LEED certified. Of those two were Gold Certified. One project was Platinum Certified, ranking the highest on a scale of Certified, Silver, Gold and Platinum. Of the three LEED certified respondents, two were commercial buildings and one was municipal. Using these three respondents’ data, a LEED certification cross tabulation was created for each survey factor ranking question.

Two of the three LEED project respondents replied with a 5 - strongest influence that environmental concern had on their decision to integrate RWH systems. One respondent regarded LEED credit achievement as a medium influence. The LEED certified respondents did not rate LEED credit achievement as strongly and ranked it as a 4 - high influence. Based on this comparison it can be assumed that LEED certified project respondents’ influences concur with the previously theorized assumption that they do in fact hold a legitimate concern for the environment.

As discussed previously LEED certification and marketing appear to be related. One respondent did feel that using RWH for Marketing was highly influential and gave it a score of 4. The remaining two respondents in the cross-examination of Marketing, felt it was of medium influence. Given those results, it is then noticeable that of those LEED certified project respondents, all felt little to no influence perceiving return on investment. Furthermore, all three respondents were in agreement that the incentive of tax breaks or funding aid from the government had the weakest influence upon their decision for RWH in their projects. This supports the assumption that dollar relationships were of little importance. Results in Table 3 show four out of eight projects that were not LEED certified, marketing held the strongest influence. These respondents also ranked marketing higher than those LEED certified project respondents. Recognizing the limited data set, marketing a project as eco-friendly by use of RWH is supported whether a project is LEED certified or not. Owners appear to possess high environmental values as well as a perceived need for sustainable building.

It is also worth noting that this study holds structural value in that it could be employed for further research, particularly aimed at LEED features. If replicated, the methodology could be used to discover strength of influence for each individual LEED credit category and pique interest for further examination in this arena.

5 CONCLUSION

Evaluation of the study data means, frequencies, relationships, and cross tabulations revealed the following conclusions. This study proposed a hypothesis stating that perceived return on investment has the strongest influence on owners to integrate rainwater harvesting systems in new construction projects. This was disproved according to responses to the survey. The findings extracted from the limited data set strongly indicate that the decision to install RWH systems in building projects is influenced by many factors. The strength of influence associated with perceived return on investment was weakest to low according to mean scores of all respondents.

With a mean score of 4.38, Environmental Concern was ranked the strongest influencing factor in relation to the other included factors. It can be concluded based on the findings that environmental concern is the biggest influence on owners to integrate RWH systems included in building projects indicating a vested interest in the environment and sustainable building practices.
Marketing was the second strongest ranked influencing factor among study respondents. It can be concluded that respondents recognized the value of the green trend and were highly influenced by the use of marketing as a tool to gain eco-conscious praise and recognition.

Perceived return on investment had minimal influence on LEED certified and school related projects. Respondents felt that environmental concern was the strongest influence. Again, gain of eco-conscious recognition is assumed.

The authors feel that this study methodology can be replicated focusing on other U.S. climate regions, specific project types, and specific sustainable features within a building rating system to further explore the use of RWH systems.

6 REFERENCES

YOUNG CHILDREN’S COGNITIVE PLAY
PREFERENCES FOR NATURAL, MIXED, OR MANUFACTURED SETTINGS IN OUTDOOR PRESCHOOL

ZAMANI, ZAHR
Clemson University, Department of Architecture and Health, zzamani@clemson.edu

1 ABSTRACT
Emphasizing the value of hearing children’s voices, this study combined drawings, photo preferences, and interviews to understand the perspectives and experiences of four- to five-year-old children. Children were enrolled in a preschool with diverse manufactured, mixed, and natural settings. After identifying and illustrating their preferred spaces, children were asked about their favorite play spaces, kinds of play they enjoy, and the reasons for drawing or selecting certain photos. The data was coded for different settings (natural, mixed, manufactured) and cognitive play behaviors (functional, constructive, exploratory, dramatic, and games with rules). Children mainly preferred settings that offered challenging, diverse experiences, and learning opportunities, such as the trees, sand, or hill. They enjoyed height alterations, hideouts, complexity, adaptability, and changeable qualities in mixed settings that were composed of natural and manufactured features. Children emphasized how mixed settings provide opportunities for functional, constructive, dramatic, and games with rules play behaviors. In addition, children expressed their interest for exploring creatures and natural cycles in natural settings. Natural loose parts expanded the ranges of cognitive play in mixed and natural settings. The findings suggest landscape architects incorporate natural and mixed settings for encouraging a diverse spectrum of cognitive play, as well as exciting hands-on learning opportunities for young children.

1.1 Keywords
Behavior settings, outdoor preschool, challenging play, young children, cognitive play
2 INTRODUCTION

Play promotes children's physical abilities and stimulates them to practice communication, thus contributing to their physical, social, and cognitive development (e.g., Burdette, & Whitaker, 2005; Piaget 2007; Pellegrini 2009). Enhancing children's play behavior requires certain interactions and experiences that are provided through complex and diverse environmental qualities (Little & Sweller, 2015; Storli & Hagen, 2010). Research indicates that outdoor natural environments provide flexible and diverse learning and play opportunities (Storli & Hagen, 2010; Fjortoft & Sageie 2000; Fjortoft, 2004; Moore & Cosco, 2007) that promote children's creativity, discovery, and motivation to play (Thomas & Harding, 2011; Waters & Maynard, 2010). Sensory experiences in natural environments support children's hands-on learning (such as, touching, smelling, hearing), risk-taking, and self-managed behaviors (Fjortoft & Sageie, 2000; Magraw, 2011; Sandseter, 2009; Thomas & Harding, 2011).

Tracing children's development through play behavior observation assessments (Farmer-Dougan & Kazuba, 1999), some forms of play have been termed as "cognitive play" that is associated with children's neurological and psychological development in terms of information processing, conceptual resources, language acquisition, or other areas of brain development (Farmer-Dougan & Kazuba, 1999; Flavell, 1992). Rubin (2001) classifies cognitive play behaviors into:

1) **Functional**. Involves simple or repetitive motor behavior, such as jumping, climbing, etc.
2) **Constructive**. This behavior is recognized when children manipulate and shape an already familiar material with a direct goal in mind.
3) **Exploratory**. Identified when children examine the qualities of objects to gather visual data about physical features.
4) **Dramatic**. This behavior occurs when children play the role of someone, engage in a pretend activity with an object or someone, or assign life to an inanimate object.
5) **Games with rules**. Identified when children employ a sense of competence with peers while creating regulations for games.

The characteristics of outdoor preschools may provide varying degrees of cognitive play opportunities. The concept of behavior settings provides a theoretical base for measuring behavioral connections between designed physical settings and cognitive play behaviors. Barker (1976) identified behavior setting as subspaces with distinguishable spatial and temporal boundaries that predict behavioral opportunities. Cosco (2006) classifies behavior settings into:

1) **Natural**: These settings primarily compromise of vegetation, trees, gardens, and wild play spaces defined by plants. 2) **Mixed**: These settings encompass a balanced proportion of natural and manufactured environments (pathway, sand-climber, etc.). 3) **Manufactured**: These settings mostly include fixed and human-built elements (play equipment, shade structures, etc.).

In 2012, almost 53.5% of three to four years old U.S. children spent their time in preschools or structured childcare programs (Snyder & Dillow, 2015). Nevertheless, inadequate attention is given to the cognitive play opportunities in outdoor childcare centers. Further, it is essential for research on children's environments to regard children as individuals with a right to express opinions (Clark & Statham, 2005). Therefore, the aim of this study is to identify the preferences of young children for cognitive play behaviors and settings in an outdoor preschool environment. Identification of these settings and attributed cognitive play behavior opportunities could be included in the design and provision of future preschool outdoor play areas.

3 SITE SELECTION

Consulting with experts in the field of nature-play, twenty existing outdoor learning environments in North Carolina were evaluated for their diversity in behavior settings. Outdoor preschools were compared based on the availability of natural, mixed, and manufactured settings. The study aimed for a site that had plenty and comparatively balanced types of settings. The evaluation found many outdoor preschools with mixed and manufactured settings, yet without any natural settings. Consulting with experts in the field revealed an exceptional outdoor preschool environment in a suburban area of Durham, North Carolina. The site consisted of three natural (0.11 acres), mixed (0.48 acres) and manufactured (0.4 acres) playgrounds (Figure 1).
4 DATA GATHERING

Data gathering combined photo preference (N=22, 13 female and 11 male), drawings (N=24, 13 female and 9 male), and interviews (N= 21, 13 female and 8 male) to understand children's perspectives about their experiences in the outdoor preschool. The photo preference and drawing methods were employed to sharpen children's memory and communication skills. Reviewing twenty-two pictures, children were asked to select three of their favorite areas in the outdoor preschool. Afterwards, they were interviewed about the reasons for selecting each of the photos and the type of play they usually engage in the associated settings.
Once children had selected their favorite photos, they were asked if they wanted to draw their favorite play places within the outdoor preschool. Subsequently, children were asked about what each illustrated feature represents and their favorite play in the associated setting. In the meanwhile notes were documented on the drawing. The open-ended interviews immediately followed the photo preference and drawings sessions, using the previous methods as starting points to sharpen children’s memories. If the child was willing to continue participating in the data collection, they were asked to further describe their experiences and interesting memories during outdoor play.

5 ANALYSIS AND RESULTS

5.1 Photo Preferences

Children were energetic and engaged when asked to choose the photos of their favorite play spaces. Data analysis involved coding choices based on preferred cognitive play behaviors and behavior settings associated with each photo (Table 1).

Table 1. Example of children’s coded explanation during photo preference.

<table>
<thead>
<tr>
<th>Behavior Setting</th>
<th>Explanation</th>
<th>Cognitive Play Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Patches</td>
<td>1- I play animals in the tire</td>
<td>1- Dramatic</td>
</tr>
<tr>
<td>2- Trees</td>
<td>2- We play dinosaurs in the back woods.</td>
<td>2- Dramatic</td>
</tr>
<tr>
<td>3- Structure</td>
<td>3- We play ‘people’ on the top of the structure, and princess over there.</td>
<td>3- Dramatic</td>
</tr>
</tbody>
</table>

Specifically, children mostly chose the green tube, swings, play structure, and trees as settings they primarily enjoyed playing within. The findings suggest children’s preferences for mixed settings (58%, n=43, total number of codes, N=74), and then manufactured settings (28%). They mentioned functional (41%, n=31, N=75) and dramatic play (40%, n=30, N=74) as the most preferred cognitive play in settings.

The crosstab analysis indicated children’s preference for natural settings that provided opportunities for dramatic (41.7%, n=12) and games with rules (25%, n=3) play. Mixed settings were favored for functional (41.9%, n=18) and dramatic play opportunities (39.5%, n=17). Children predominately appreciated manufactured settings for their functional (52.4%, n=11) and dramatic play opportunities (38.1%, n=8).

5.2 Interviews

Drawings and photos served as starting points for interviews. Instances of children’s accounts, coded behavior settings, and cognitive play behaviors are displayed in Table 2.

Table 2. Examples of drawing codes and categories.

<table>
<thead>
<tr>
<th>Children’s Explanation</th>
<th>Behavior Settings</th>
<th>Cognitive Play Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- Ball: I like to kick balls and run around the pathway, and pretend games such as ‘Star wars’ or ‘princesses’.</td>
<td>1- Pathway</td>
<td>1- Functional, dramatic</td>
</tr>
<tr>
<td>2- Grass: I like playing princess. We pretend to have a fancy dress.</td>
<td>2- Green patches</td>
<td>2- Dramatic</td>
</tr>
</tbody>
</table>

The crosstab analyses of interviews suggest that children preferred mixed (40%, n=58, N=144) and natural settings (38%, n=55, N=144), as well as, dramatic (34%, N=144) and functional play (33%, N=144). Natural settings were favored for functional (38%, n=21) and dramatic play (22%, n=12); mixed settings for their dramatic play (50%, n=29); and manufactured settings for their functional (32.3%, n=10), and dramatic
play (25.8%, n=8) experiences. Comparing the three settings, natural settings were the most favored for functional (44.7%), exploratory (77.8%), and games with rules (50%) opportunities. Children preferred mixed settings for their constructive (47.1%) and dramatic play (59.2%) opportunities, when compared to natural and manufactured settings. The next level of analysis for interviews involved synthesizing the data that included connecting the categories into themes to account for the most important perceptions that captured the main findings (Table 3). This analysis mostly aimed to identify important meanings and experiences in children’s accounts.

**Table3.** Examples of themes collected from the interviews.

<table>
<thead>
<tr>
<th>1. Children enjoyed fast movement and functional play opportunities in mixed and manufactured settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I like the scooters because I like riding on them. Because they go super-fast!</td>
</tr>
<tr>
<td>2. I like running down the hill.</td>
</tr>
<tr>
<td>3. Rope swing; on the bike playground. You stand on the bucket and you swing. I like that because it’s so fun on it and I like to dance on it.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Children enjoyed challenging experiences that inspired dramatic play.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I run down this hill and there is a big tire, I pretend to be an animal in the tire.</td>
</tr>
<tr>
<td>2. I hide in the sand structure and we play “snowy wolves” where we hide.</td>
</tr>
<tr>
<td>3. We go inside the house and I pretend to the ‘Iron man”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Natural and mixed settings inspired exploratory play</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I like the trail in back woods: I play running to find a baby cheetah.</td>
</tr>
<tr>
<td>2. I like playing in the rock area when there is water and when I have boots on. We find worms and we put them in the water and that means dig and die or live.</td>
</tr>
<tr>
<td>3. We scooped the bucket and put worms in it. But I didn’t touch it because I don’t like touching the worms. Then we dumped them out so we could see if they would die.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Natural settings promoted dramatic and game with rules combined with challenge.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. You have to look for the caves in the back woods; there is just one cave that is really a house.</td>
</tr>
<tr>
<td>2. I like to run in the woods and play “Ninja Turtles”.</td>
</tr>
<tr>
<td>3. We usually play in one of the wood houses [stick piles] and you think you are a “kiddy” and you live in the house.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Children enjoyed playing with loose materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. We make a big mountain, with lava coming out or make sand castles.</td>
</tr>
<tr>
<td>2. I just mix stuff and pretend to make cakes and sometimes pretend to make food.</td>
</tr>
<tr>
<td>3. My friends and I collect sand and pretend it is pixy dust.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Natural environments inspired different senses.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I like to feel [touch] the trees.</td>
</tr>
<tr>
<td>2. I love to take the bark off the trees. Because sometimes we use the bark to make something.</td>
</tr>
</tbody>
</table>

**5.3 Drawings**

Most children were capable of illustrating their favorite play settings (Figure 2). The drawing analysis included grouping the documented codes that had emerged during data collection to behavior setting and cognitive play categories. The findings suggest that children were mostly interested to play in the sand, pathway, woods, and swings settings. In general, children mostly depicted mixed (41%, n= 59 N=145) and manufactured (34%, N, n= 49, =145) settings as their favorite.
6 DISCUSSION

Little research has examined children’s declared and drawn opinions of an enjoyable experience within behavior settings. Given the potential impact of outdoor preschools in supporting or enhancing children’s cognitive development, this is a critical gap to explore. Adding to the body of knowledge about learning and children’s accounts, the following sub-section examines children’s cognitive play experience in natural, mixed, and manufactured play settings in their outdoor preschool.

6.1 Natural settings and cognitive play behavior opportunities

Access to natural settings developed children’s imaginations and transformative learning about the world (Fjortoft & Sageie, 2000; Lester & Maudsley, 2007; More & Wong, 1997; Tai, Haque, McLellan, & Knight, 2006; Thomas & Harding, 2011). Consistent with prior studies (Norodahl & Einarsdottir, 2015; Waters & Maynard, 2010), the findings demonstrate that the alternating and diversity of natural settings presented complex and exciting interactions. The available natural loose elements, such as barks, seeds, or leaves, offered flexible and unique play props for diverse cognitive play opportunities, as mentioned in prior studies (Bilton, 2010; McClintic & Petty, 2015; Wilson, 2008). Consistent with prior findings (Tranter & Malone, 2004; Waters & Maynard, 2010; Waters et al., 2010; Zamani & Moore, 2013), children expressed enthusiasm and eagerness for experiencing, learning, and watching natural transitions and cycles. The following discusses children’s experiences in natural settings.

1) Hill: Large areas of grass and hills offer opportunities for gross motor skill, such as rolling, running down, or sliding (Fjortoft and Sageie, 2000; Mc Clintic & Petty, 2015; Woolley & Lowe, 2012). Consistent with previous studies (McClintic & Petty, 2015; Jansson, 2015; Ozdemir & Yilmaz, 2008), children enjoyed chasing and group play opportunities on the wide-open grassy hill, such as “tag” or “Frisbee”. The topographic variations of the hill inspired dramatic play and games with rules that has also been found in previous studies (Fjortoft and Sageie, 2000; Fjortoft, 2004; Norodahl & Einarsdottir, 2015).

2) Camp: This behavior setting consisted of tree logs and trunks arranged in a circle for gathering purposes. Consistent with prior studies (Bilton, 2010; Magraw, 2011; Wilson, 2008), children created imaginative representations with natural loose props in this setting, such as “fire,” “poison,” or “food.” They occasionally balanced on the rocks or logs, demonstrating functional play behavior.

3) Stone-lined River: The stone-lined river setting was covered with rocks and dirt and included three small bridges. Children enjoyed walking on the bridges, as well as balancing, running, or jumping on the rocks. Combining rocks, dirt, mud (after rain), and vegetation in this setting stimulated children’s
explorative and imaginative play. Consistent with previous literature (Fjortoft & Sageie, 2000; Lester & Maudsley, 2007; Norodahl & Einarsdottir, 2015; Ridgers et al., 2012), children expressed their fascination about natural ecosystems, cycles, and creatures in this natural setting. Current findings are consistent with recent evidence suggesting the uneven and sloping surface of the rocks to be stimulating children's functional, and game with rules behavior (Little & Sweller, 2015; Sandseter, 2009).

4) Stick pile: Children enjoyed collecting sticks and logs and stacking them, indicative of their constructive play behavior. Teachers sometimes helped children in their construction. Consistent with previous studies (Norodahl & Einarsdottr, 2015; Tranter & Malone, 2004), children enjoyed the ‘to-be continued’ activity of building a “fort” or a “house” over the course of several days that developed their environmental learning and sense of place. This spontaneously created space allowed children to hide from adult supervision and imagine being in a “prison,” “haunted house,” or their “home”, consistent with prior studies (Norodahl & Einarsdottir, 2015; Tail et al., 2006).

5) Trail: Along the trail setting, children enjoyed running, chasing each other, and jumping over the logs. The trail inspired functional play opportunities as a result of its flat surface (Fjortoft & Sageie, 2000; Little & Sweller, 2015). While the trail also provided exploratory play opportunities, children occasionally explored plants, tree barks, and creatures. The trees around the trail also stimulated children to engage in dramatic play behaviors, such as “cheetahs” or “dinosaurs.” Consistent with prior studies (Little & Sweller, 2015; Sandseter, 2009), the existing tree trunks, logs, trees, and trail provided challenging opportunities that children incorporated into their games.

6) Trees: The loosely designed natural tree settings and habitats offered outdoor classrooms that motivated children to learn through play, enhance their imagination and curiosity, as mentioned in previous studies (Bilton, 2010; Wilson, 2008; McClintic & Petty, 2015). The trees provided dramatic and game with rules opportunities by providing loose props, including sticks, leaves, or fruits (Gehris, Gooze, & Whitaker, 2015; Jansson, 2015; Norodahl & Einarsdottir, 2015). As mentioned in previous studies (Fjortoft, 2004; Kernan, 2007; Norodahl & Einarsdottir, 2015; Waller, 2006), the existing trees created ecosystems that supported the existence of creatures and animals for children’s exploratory play. Children preferred challenging and functional play opportunities in natural settings, such as “jumping over the logs,” “moving the rocks,” “balance over the rocks”, or “swinging with the ropes”, as reported in prior studies (Little & Sweller, 2015; Sandseter, 2009; Fjortoft & Sageie, 2000).

6.2 Mixed settings and cognitive play behavior opportunities

Mixed settings provided flat areas, diverse height levels, slopes, secluded spaces, challenging play structures, and loose elements that triggered a diverse spectrum of cognitive play behaviors that children enjoyed. Children preferred the complex, challenging, and diverse aspects of mixed settings as they offered more play options (Little & Sweller, 2015; Norodahl & Einarsdottir, 2015). Children expressed interest for collecting accessible manufactured loose and natural loose elements in mixed settings and incorporating them into their games or dramatic play, as documented in previous studies (Fjortoft & Sageie, 2000; Jansson, 2015; Maxwell et al., 2008). The following explores children’s experiences in the main mixed settings.

1) Pathway: In line with prior studies (Little & Sweller, 2015; Moore & Cosco, 2007; Sandseter, 2009), children enjoyed the functional play (such as cycling or running), along with the challenging and fast movement opportunities, provided by the hard and smooth surface of pathways. The pathways also offered chasing and running opportunities that children incorporated into their games.

2) Ropes: Little & Sweller (2015) recognize rope swings as play resources that provide moderate to vigorous physical activity opportunities. Consistent with the previous studies (Fjortoft & Sageie, 2000; Little & Sweller, 2015; Sandseter, 2009), children described their preference for ropes tied to trees as they challenged themselves to balance, climb, jump, and swing, promoting functional and game play. Fjortoft and Sageie (2000) found that children enjoyed climbing ropes and looking over the adjacent space.

3) Tube: The existing tube in the natural playground provided a play setting where children enjoyed climbing, disappearing, hiding, and excluding themselves from peers or teachers. These characteristics have been associated with risk taking and challenging opportunities that children enjoy (Little & Sweller, 2015; Sandseter, 2009; Tai et al., 2006). In addition to the hiding and climbing opportunities, the existing natural loose props at the perimeter of the tube inspired children’s imagination and creativity, as suggested...
by previous studies (e.g., Gehris et al., 2015; Norodahl & Einarsdottir, 2015). For example, children mentioned how they enjoy playing “Star Wars,” “cheetahs,” or “dinosaurs” inside or around the tube.

4) **Play Houses:** Similar to prior studies or design suggestions (Norodahl & Einarsdottir, 2015), children most enjoyed the playhouses for their dramatic play opportunities. The availability of loose props in these settings inspired dramatic play behaviors, such as “houses,” “forts,” or “ice-cream shop” that has also been recognized in prior studies (Fjortoft, 2004; Jansson, 2015; McGinnis, 2002; Norodahl & Einarsdottir, 2015; Woolley & Lowe, 2012). The hiding and secluded qualities of playhouses inspired risk taking and games with rules behaviors, as suggested by prior studies (Little & Sweller, 2015; Norodahl & Einarsdottir, 2015).

5) **Tires in the Green Patches:** As mentioned in previous findings (e.g. Norodahl & Einarsdottir, 2015; Little & Sweller, 2015), children enjoyed the enclosed and child-scaled spaces of the tires where they imagined being “warriors,” or “cats” or the tire to be a “home,” or a “ship”. Sometimes, children transferred loose elements into the tire and prepared “food”. Children also preferred to balance, walk, or jump from tires, as suggested by previous studies (Little & Sweller, 2015).

6) **Sand:** Consistent with recent review of evidence (McClintic & Petty, 2015; Woolley & Lowe, 2012), the shapeable, adaptable, and soft characteristics of sand inspired children’s dramatic and constructive play. Children mentioned their enjoyment for combining sand with other loose elements to create symbolic representations, such as “ships,” “boats,” or “fish”. Similar to previous research (Little & Sweller, 2015; Woolley & Lowe, 2012), children expressed interest for challenging and functional play opportunities, such as climbing, jumping, or swinging, provided by the climber or pots in sand settings. The climber also provided refuge or hiding opportunities that inspired children’s dramatic play behaviors, as found by previous studies (Little & Sweller, 2015; Sandseter, 2009; Tai et al., 2006).

### 6.3 Manufactured settings and cognitive play behavior opportunities

The results from this study indicate children’s preference for manufactured settings for their challenging behaviors and functional play opportunities, as mentioned by previous literature (Little & Sweller, 2015; Sandseter, 2009). While dramatic play was more prevalent in other settings, manufactured setting coupled with the accessible loose elements inspired dramatic play. The following explores children’s experiences in manufactured settings.

1) **Tables:** Consistent with previous literature (Ozdemir & Yilmaz, 2008; Woolley and Lowe 2012), tables and seating settings were important spaces to stimulate imaginative play behavior. Children described their preference for employing the available loose elements (Jansson, 2015; Kernan, 2007; Norodahl & Einarsdottir, 2015), such as sand, mulch, or buckets to engage in dramatic play, such as “house”, “making ice cream”, or making food.

2) **Swing:** The swing settings offered children enjoyable opportunities to experience heights, as well as the sensation of speed, as found in previous studies (Sandseter, 2009; Little & Sweller, 2015; Woolley & Lowe, 2012). As described by children, swinging supported risky and functional play that supported moderate-vigorous physical activity levels, such as swinging, balancing, or jumping.

3) **Rockers:** The rocking equipment inspired challenging, fast movement functional play (Little & Sweller, 2015; Sandseter, 20009), such as rocking, swinging, and balancing. Emphasizing on the value of loose material in manufactured settings (Gehris et al., 2015; Jansson, 2015; Norodahl & Einarsdottir, 2015), children also mentioned how they enjoyed combining the ground-cover mulch for their dramatic play activities, such as making “food”, “poison”, or “magic dust”.

4) **Play structure:** In agreement with prior studies (McClintic & Petty, 2015; Little & Sweller, 2015; Zamani & Moore, 2013) the play structure setting mostly offered functional play opportunities, such as balancing, climbing, or jumping. As suggested by other literature (Kernan, 2007; Little & Sweller, 2015; Sandseter, 20009), the different height levels and secluded spaces of the play structure offered challenging opportunities for hiding and pretending. The available loose elements, such as mulch or dirt, encouraged children’s dramatic play, which is consistent with previous studies (Gehris et al., 2015; Norodahl & Einarsdottir, 2015; O’Brien & Murray, 2007; Ridgers, Knowles, & Sayers, 2012).

5) **Platform:** Children preferred platform settings surrounded by trees that provided different visual exposures and flat surfaces for dramatic play, which is similar to design suggestions (Little & Sweller, 2015; Tai et al., 2006; Sandseter, 2009). Children described how they imagined platforms to represent “ships” or
“performance stages”. Furthermore, platforms encouraged children to sit, gather, and discuss their game strategies, as well as engage in constructive play for “building” or “mixing” play props.

7 CONCLUSION

The current study addressed the gaps in the literature by sampling young children and examining their preferences and perceptions of outdoor behavior settings that promoted their cognitive play behaviors. Children enjoyed settings that offered challenging movements, overview of their surroundings, privacy, and topographical variation. The diverse and changing quality of nature inspired a wide spectrum of cognitive play and enhanced children’s imagination, games, and understanding about natural phenomenon. Further, shapeable, movable, and changeable qualities of loose elements in different settings inspired higher levels of cognitive play. Possible topics for design implication revealed in the case study analysis included:

a) Enhancing the complexity and diversity of the outdoor preschool environment by including different play options through natural, mixed, and manufactured settings.

b) Provide loose elements to inspire children’s building, imaginative and self-initiated games.

c) Including wide, topographic, open natural and mixed settings for children’s games with rules behavior.

d) Providing challenging, yet safe, opportunities for children through features that offer climbing, hiding, and fast-movement opportunities.

The present study has been limited, particularly concerning the number of participants. Future research might want to study children’s behavior and preferences from different ages, genders, and socio-economic status. Another limitation was concluding based on observing a single outdoor preschool in a suburban area. More studies are needed to compare diverse settings in different outdoor preschools within urban, suburban, or rural areas and children’s cognitive play opportunities. Future longitudinal research is also suggested to children’s different preferences and interactions over longer time spans and seasonal variations.

8 REFERENCES


RESEARCH AND METHODS

Edited by Byoung-Suk Kweon
UNDERSTANDING HOW STUDENTS APPROACH DESIGN:  
A QUALITATIVE INQUIRY

KLEIN, CHARLES H.  
Texas Tech University, Charles.klein@ttu.edu

1 ABSTRACT

It may be difficult for some design professors to realize that not all students approach design in the same manner that they had, perhaps for decades. The students may favor other, perfectly valid approaches and it would be helpful for the professor to understand how and why students favor one approach over another.

Three primary research questions guided this inquiry; 1) How do students describe how they approach design? 2) What approaches do they prefer and why? 3) How can faculty help them to become more comfortable and confident designers?

Since design is a complex and multifaceted task a qualitative research methodology was used which allowed for the exploration of the research questions from multiple directions. This research followed the phenomenological paradigm that “describes the meaning of the lived experiences for several individuals about a concept or the phenomenon.” (Cresswewil 1998, 51). Kevin Lynch’s seven approaches to design (Lynch 1971) were used as a theoretical foundation. Interviews were recorded and later transcribed. A stylized coding form was developed to guide the qualitative inquiry. Member checks were also used to validate the findings.

Results indicated that students tend to use several approaches and that they varied with the circumstances. The research also discovered that students who tended to favor a single approach were often frustrated and confused. Consequently, it is important for professors to understand that students will often use multiple, perfectly valid approaches when solving a design problem.

1.1 Keywords

Design, Qualitative, Interviews, Studio

The authors are solely responsible for the content of this technical presentation. The technical presentation does not necessarily reflect the official position of the Council of Educators in Landscape Architecture (CELA), and its printing and distribution does not constitute an endorsement of views which may be expressed. Technical presentations are not subject to the formal peer review process by CELA Track Chair System; therefore, they are not to be presented as peer-reviewed publications. Citation of this work should state that it is from a CELA conference paper. EXAMPLE: Author's Last Name, Initials. 2014. Title of Presentation. CELA Paper No. 14-xxxx. Baltimore, Maryland: CELA. For information about securing permission to reprint or reproduce a technical presentation, please contact CELA at dsolco@uta.edu or 817-272-2321.
2 INTRODUCTION

“Does that usually work” I ask? He’s a third year student in a master planning design studio and he is sitting on his stool, staring at his drawing. “What” he responds? “If you stare at it long enough, does anything magically appear?” I ask again. It is my sarcastic wit; an attempt to keep the studio atmosphere fun and light hearted, as well as some good natured teasing to prod the student into action; any action rather than staring.

That was years ago and I’ve long since realized that my sarcasm was not always appreciated; so I’ve tried to keep it check and use it sparingly. More importantly, I now understand why a student stares at his drawing rather than using the same techniques I had always found useful, or any number of others that are available. Not only is he still learning how to approach a design, but contemplation can be a legitimate means to solving a design problem. As good as I am as a teacher, I can’t read his mind.

As I was starting my teaching career, I found it curious that students wanted to base their design on something like the university’s logo or the state symbol. This is often called a representational approach (Motloch, 2001) where the design is supposed to represent something else, but in a different media, place or size. Some years later I attended a conference where Penn State landscape architecture professor Elisa Pennypacker (2007), presented research she and a colleague had done on how students learn to design. She explained that when they researched how professionals approached design and found that the professionals tend to draw from a store house of experiences; either previous projects of their own or projects they were familiar with. They used the analogy of a tool box and choosing from it the appropriate implement for different situations. Using the tool box analogy is what Lynch (1971) would call employing a case study approach. It was then that I realized that the students who used the university logo were simply drawing from their mostly empty tool box that had very few experiences available to them.

In all, Lynch (1971) describes seven specific approaches to design as well as several techniques. They remain timeless and tend to encompass those approaches and techniques described by other authors and researchers using different terminology. Consequently, Lynch (1971) served as a theoretical or organizational basis for this study.

Ever since I came to the teaching profession with more than 20 years in the professional consulting world I have been interested in understanding how students learn to design and how we teach them. I have also come to realize that well-developed design abilities is one of the most important factors affecting their future employment, entry level income, and positioning for success in a professional design firm. Qualitative research methodology is ideally suited to making sense of complex situations with multiple variables, such as the design process. It is also particularly suited to answering questions such as “what” and “why” by gathering a wealth of information that provides more in depth and insightful data rather than responses to a specific hypothesis (Lindlor and Taylor 2002) (Cresswell 1998) (Gall, Gall and Borg 2007).

Qualitative research is also known as constructivist research, and suggests that individuals construct knowledge within a cultural context. Consequently, qualitative research typically takes place in the natural setting of the phenomenon under study. It relies on a large volume of data that can provide “thick descriptions” of experiences and perceptions as opposed to numerical or quantifiable data. The volume of the data collected helps overcome situations where a significant sample size is not available. The researcher becomes the data collection instrument and can often be a participant, to some extent, in the phenomenon under study. (Creswell, 1998; Gall, Gall, & Borg, 2007; Giles & Eyler, 1994). Reporting qualitative research studies do not always follow the traditional, scientific format and in fact can vary considerably within the field. (Cresswell, 1998). For example, while some may find the first person narrative distracting, it is often used in qualitative research and emphasizes the nature of this form if inquiry where the researcher is also a participant (Denzin & Lincoln, 2005) (Glesne, 2011).

In addition, this study sought to better understand how, as a professor of landscape architecture, I can help students to become more comfortable, capable and creative designers. It was a phenomenological study conducted in the landscape architecture studio at a large Southwestern university using participant observation and interviews over the course of one semester. Transcriptions of the interviews served as the primary data set and were analyzed using qualitative methodology to identify recurring themes as well as significant unique or isolated insights.
3 RESEARCH QUESTIONS

The three primary research questions that guided this inquiry were:
1. How do students in the landscape architecture curriculum describe how they learn to design?
2. What approaches to design do they prefer and why?
3. How can we, as faculty, help them to become more comfortable and confident as designers of the landscape?

As stated earlier, it is important to understand that when using the term “design” I am referring to the point at which a student is preparing to develop the physical form of the proposed site improvements or changes. A second clarification is that there are two processes taking place at the point where design commences; ideation and implementation. Ideation refers to developing design schemes and concepts whereas implementation involves the process of manipulating those schemes to work in the context of their current project. Finally, it is important to emphasize the distinction between an approach and a technique. A design approach is the theoretical foundation upon which the student chooses to begin solving the problem at hand. A technique involves the actual physical or mechanical means by which the student either ideates or implements the design approach.

4 LITERATURE REVIEW

Design in any profession is a process that in order to be proficient, requires “whole brain thinking” that includes the ability to observe, visualize, generate ideas, conceptualize principles and analyze alternatives (Maraviglia & Kvashny, 2005, p. 73). It requires the mental powers of the left brain and the right brain, the two primary physical aspects of the brain where researchers believe specific functions take place (Maraviglia & Kvashny, 2005). The ability to be both creative and analytical requires critical thinking skills that are the ultimate educational goals and the focus of much research (Halpern, 1998).

As a design profession, landscape architecture began just in the U.S. just before the end of the 19th century. Frederick Law Olmsted, considered the Father of Landscape Architecture recognized that as designers of the land we have the ability to address the quality of life in our cities and rural landscapes through the thoughtful design of our parks, towns and college campuses.

Throughout the 20th century, the profession has embraced environmental, ecological and social foundations for design with the expressed goal of creating a better, more livable built environment. As the profession evolved, so did the theoretical basis for design processes and the educational programs that taught them (Motloch, 2001). Scholars recognized that teaching designers to address the needs of the public required effective means of teaching the design process in order to better prepare professionals for their role in society.

For landscape architecture students, many publications focus on the design process that includes, as phases: an inventory of existing site conditions; analysis of their implications; program development; a statement of goals and objectives; and case study research of similar design problems and solutions. The process continues with the synthesis of the physical form of a design solution using techniques such as: ideal functional diagrams; site-specific functional diagrams; concept plans and other methods of design synthesis (Rutledge, 1971). Most reference materials also offer techniques for implementation of the design process. For example techniques for generating ideas such as brainstorming and questioning techniques are a popular and important aspect of design synthesis (Maraviglia & Kvashny, 2005).

It is important to understand that this study was primarily interested in the point at which, in the design process, design solutions begin to be synthesized and applied to a specific site. It can happen at almost any point in the design process but most often occurs soon after information about the site and the proposed users has been collected and analyzed and the designer starts to apply a physical form to the site plan. Consequently, for the purposes of this study, the term “design” will refer to the synthesis of a solution and not necessarily the process. Additionally, there is a distinction between a design approach and a design technique. An approach is a method upon which the designer bases his analytical and creative thinking about potential design solutions. Techniques are those exercises or tools that are used to implement the approach. For example, a designer may base his design for a residential subdivision on patterns that are traditional to the context of his project. That is the approach. To implement that approach, he or she may use techniques such probing, which involves a series of trial and error sketch plans followed by critical evaluation of the alternatives, to adapt the typical form to the new site.
There are many references available that describe various design approaches, processes and techniques. The inventory and analysis process is the main focus of LaGro (2003) and the reference used in many design process curricula. Others focus on the form of landscapes (Dee, 2001) or the interactions between people and the built landscape (Laurie, 1986) (Rutledge, 1971). In Design with Nature, McHarg (1992) emphasizes the natural process of the environment as an essential resource in almost every landscape architecture program. Perhaps the most comprehensive resource for understanding approaches to design is Site Planning (Lynch, 1971). His description of the seven principle approaches to design encompasses those found in most other references. The design process and various techniques are also provided. The seven approaches form the theoretical basis of this research and are described as follows:

4.1 Adaptation
Uses adaptations of solutions used in other circumstances. Usually involves heavy reliance on case studies of similar design issues or sites. An example might be a designer who uses a familiar gridded street system but turned at a 45 degree angle.

4.2 Modular Division
Involves breaking down the problem into parts to be solved independently (disaggregation) to be brought together later and reevaluated (re-aggregation). It could involve physical parts of a site or aspects of the design problem for the entire site. An example would be dividing a large site into smaller tracts or solving pedestrian circulation for the entire site to be combined later with vehicular circulation.

4.3 Optimizing
The designer develops a series of ideal solutions that focus on the various, specific purposes, than seeks to reconcile those idealized solutions. It is usually externally focused on the concept rather than the users. Solving for a specific purposes such as circulation, privacy, shade, enhancing a picturesque view or creating a sense of place are examples.

4.4 Essential Function
The designer focuses on the most important function and solves for that function in the most ideal fashion. All other functions are subordinate and may be compromised in support of the primary function. Examples would include designing a farmer’s market to make the function of buying the most important issue. Others might be the function of a university as education as in the case of Thomas Jefferson’s Plan for the University of Virginia.

4.5 Problem Solving
Suggested solutions rise directly out of the situation; difficulties, conflicts potentials, rather than starting with the ideal concept and adapting it to a situation. Correctly defining the problem is essential. This is the typical design approach taught in many schools and is preceded by the processes of inventory, analysis, goals, and programming, that is intended to point logically to the problem to be solved.

4.6 Exploring Means
This approach involves free-thinking, open mindedness, drawing from abstract concepts, geometry or other inspirations. The designer must eventually reconcile the abstractions to truly develop a design solution. This approach can use a strong sense of geometry, basing a design on a painting, music or other abstraction such as the use of a word or phrase as inspiration such as “diminishing rhythm.”

4.7 Drawing on Consequences
Asking what could happen with various design solutions, either in a virtual sense or in reality as in a trial or test run of an actual built environment. Building a prototype solution, such as a Traditional Neighborhood Development (TND) in a city where one had never been implemented is an example.
5 METHODS

One of the most popular forms of qualitative research is the grounded theory method, which uses the research to “generate or discover and theory.” (Cresswell, 1998, p. 56) However, this study had already identified several theories upon which to base the research. Consequently it is a phenomenological study that “describes the meaning of the lived experiences for several individuals about a concept or the phenomenon.” (Cresswell, 1998, p. 51)

The methods utilized to gather data for this investigation included both participant observation and interviews of landscape architecture students during the spring semester of 2011. There were 27 students registered for my Site Construction and Development class, which dealt with advanced site grading issues such as storm drainage, roadway alignments and storm water management. Six of the students were in the graduate level first professional degree program and enrolled in a class taught in tandem with 21 undergraduate students. The graduate students included two females and four males. One of each gender was from China while the others were from the United States. They were all in their mid-twenties and in the second semester of the three-year, first professional degree graduate program.

The undergraduate students included 6 females and 15 males, all U.S. born and in the late teens to early twenties. They were all in the third year of a five-year, first professional degree program, with the exception of two fourth year students who had fallen behind in this sequence of courses. There was also a fourth year student who volunteered to serve as a teaching assistant in order to keep in practice with the course curriculum.

All of the students met for an 8:00 am lecture followed by separate studios for the graduate and undergraduate students. This diverse group of students held similar positions within the curriculum and provided a range of similar and differential approaches.

5.1 Participant Observation

The use of participant observation allows the researcher to place him/herself in the research and thereby gain access to a wealth of information that might not be available as an uninvolved observer. It allows the researcher’s actions to become a part of the data that is gathered and analyzed (Lindlof & Taylor, 2002). However, I was not a complete participant since I was not actually participating in the design process. Rather I was assisting and guiding the students in the implementation of that process. Yet it was a natural role and unobtrusive in the sense that I belonged in that situation and my presence or interaction did not necessarily adversely affect or bias my observations.

The participant observations took place in the respective design studios, usually on the first day that a new project was assigned. The graduate studio was located in an older building in a small but comfortable room with plenty of room for the students’ drawing tables, storage lockers and two computer workstations. The room faced south with large windows so there was plenty of early morning sunshine entering the room which made for a positive and warm atmosphere. The Undergraduates met an hour later in the historic agricultural pavilion, which was a large, approximately 6,000 square foot space that was very open with plenty of room for drawing tables and storage lockers. It is the third oldest building on campus and has brick floors, indoor plants and vaulted ceilings with overhead windows that also allowed for a good amount of early morning sun. Both studio spaces are very open and created an atmosphere that tended to be very supportive of creative and interactive learning that defines a design studio.

Participant observation involved approximately three hours of studio observations on the first day that a new project was assigned. During the course of the semester, I observed five separate projects resulting in approximately 15 hours of participant observation. Traditionally, in our program students will work at their drawing tables in their respective studios using hand drafting and drawing techniques. I visited with the students individually at their desks to gauge their progress and provide assistance when needed. This process was commonly referred to as “desk crits” and was an important part of the one-on-one design studio environment. The desk crits offered the opportunity to observe first-hand the students’ initial design approach. During the studio I took field notes after I visited each student at their drawing tables. Some of the field notes were then compiled into more complete journals soon after class so as to not limit my time with the students. Students were not identified by name in my field notes or journal. Since the process of compiling field notes into a completed journal was incomplete, they were not available for a comprehensive analysis using traditional qualitative coding methods. However, they were available to triangulate information gathered during the interview phase of the study.
5.2 Interviews

Students were interviewed in order to gain more on-depth, reflective information about how they approached design, what approaches they prefer, and what approach they prefer in particular situations (aesthetic design vs. technical design). All students in the class were invited to participate and informed of the reason for the interviews. They were assured that their identity would remain confidential and that they were free to withdraw from participation at any time. Additionally, they were informed that their grades would not be affected by their decision to participate or not. The invitation was offered on two occasions at the start of lecture and a sign-up sheet was distributed with twelve, pre-determined time slots outside scheduled classroom or studio times. The students were told that the sign-up procedure was first come, first served which reinforced the notion that their participation was completely voluntary.

A total of nine interviews were conducted using a semi-structured approach that followed an interview guide (see Appendix A) but allowed for the discovery of information to emerge from the discussion (Goodall, 2008). The interview guide also allowed for the free flow of ideas and follow-up questioning, while maintaining a focus that avoided wondering off on interesting, but unproductive tangents. The interviews were conducting in a collaborative, interactive stance, which fit well with the design studio environment as well as the Department’s and my own teaching philosophy. Additionally, the stance helped students feel more comfortable and fit my personality and a rapport based on mutual respect that I feel I have with my students.

The interview guide consisted of a few demographic questions designed to establish some background as to the students previous design experience and whether or not they had transferred into the landscape architecture program. These questions also helped the students relax before asking questions that were more pertinent to the study. A subsequent set of questions regarded design and were indirect in nature. The interview questions were designed to glean from the students a description of how they approached design without asking directly which approach they preferred. This allowed the students to provide their own description which allowed for more extensive responses and far richer information. It also avoided any confusion over different interpretations of the terms being used.

The students were asked what they liked most about being a designer, what the most difficult part was, what was their most challenging project and how did they work through it, what they do when they get stuck on a project, and how they might handle a technical problem differently than a more creative one. Generally, these questions were designed to reveal the students’ motivations, the approaches they preferred and some of the techniques they used. They were also asked to describe the characteristics they would incorporate into the design of the best, and worst, studio professor in order to provide additional insight into both what I could do to improve as an instructor as well as what motivates or frustrates them as students of the design profession.

Two additional interviews were conducted using the informant approach. One was with the volunteer teaching assistant (TA) mentioned earlier and the other was with a colleague who was the instructor for the two preliminary design principles and process classes that the undergraduates had their previous two semesters. These two interviews took place after the student interviews were concluded and the questions were variations of the same questions asked of the students. In some cases, new insight was gained while in others, the informant interviews confirmed information that was learned during the student interviews. The interviews, along with my own observations, provides the triangulation that qualitative researchers use to establish trustworthiness (Glesne, 2011).

The student and informant interviews lasted between 27 and 45 minutes each and were recorded with the permission of the interviewees. The student recordings were transcribed as close to verbatim as possible, using Express Scribe software. Transcribing eight of the nine interviews personally (one was transcribed by a secretary) took approximately six hours. In total, the nine interviews resulted in 56 pages of text. Although transcribing the interviews personally was unpleasant, difficult and time consuming, it did result in a much better understanding of the dialog and helped tremendously with the analysis. In fact, the one interview that was transcribed by a secretary needed to be replayed while coding the transcript.

6 VERIFICATION

In qualitative research, the term verification is used in place of the quantitative term validity. There are many procedures that can be incorporated to insure that results are trustworthy and authentic (Cresswewill, 1998). In this study verification was accomplished through the use of triangulation whereby
the data were collected from several sources; interviews with students, interviews with a TA and a colleague, participant observation, and the incorporation of member checks, which involves reviewing the data and conclusions with the original participants (Cresswell, 1998). In this case preliminary results were emailed to all of the individuals that had been interviewed. They were asked to review the findings and implications and comment on whether or not they were realistic, were any corrections needed, and did they agree with the information presented. Three of the original participants responded and, in general, all agreed that the data presented was accurate and that the implications were realistic.

7 ANALYSIS
In order to make sense of the data collected, codes were created based on Lynch’s (1971) seven approaches, and traditional design implementation techniques. Individual transcripts were reviewed and design approaches color coded on both the transcript and the rubric. The rubrics were then evaluated to identify prevalent themes, relationships among the various categories, and anomalies that provided additional insight. A copy of the rubric can be found in Appendix B

8 FINDINGS
After the coding system was established and the review completed, I was able to identify recurring themes among the transcripts and rubrics. Once the patterns were identified I looked for relationships between the various aspects of the study. For example, I looked to see if there were any consistencies among those students who used a particular design approach to see if they also favored a corresponding set of techniques. The analysis revealed the following five findings that I felt were significant:

1. Most of the time, students used two or more design approaches in combination.
2. Two approaches; Adaptation and Drawing on Consequences, were relegated to technique status as opposed to an approach
3. There does not appear to be any obvious relationship between specific design approaches and the techniques used to implement them.
4. There does not appear to be any obvious relationship between a students’ stated difficulty with ideation or implementation and an approach or technique.

8.1 Discussion and Examples

8.1.1 Most of the time, students used two or more approaches in combination.
In almost all cases, students described using a combination of two or more approaches, usually in combination or simultaneously. In other words, their descriptions often included elements from two or more approaches, such that there was no clear cut division between the approaches nor was there a clear cut preference for a single approach.

There were four primary combinations of approaches including: Problem Solving and Optimizing; Optimizing and Modular Division; Essential Function and Problem Solving; and Exploring Means and Modular Division. Consequently, Problem Solving, Modular Division and Optimizing appeared to be the most often used approaches.

Modular Division was often cited when discussing a project that was larger in scale or a more involved technical problem, such as the large Traditional Neighborhood Development (TND) assignment as described by one student “A perfect example is the TND you just saw me working on. I have it split up into four quadrants.” (TBone).

The use of Problem Solving and Optimizing by the students would appear to be the result of the emphasis by the department on those aspects of the design process that tend to lead the students toward defining the problem and identifying ideal theoretical solutions. An example is how one student described how he separated pedestrian and vehicular traffic using classic, problem solving terminology: “Yea, uh I had done the non-site specific functional [diagram] and I thought the best way for any space or any size of space to connect them [pedestrians] without crossing the street is to just stick the street on the outside.” (Rick)

Students tended to describe using Available Means and Essential Function the least. I am not sure why Essential Function was not described more since the program emphasizes the use of functional
diagrams. There did not appear to be any revealing dialog among the student interviews nor did either of the interviews with the TA or colleague indicate a reason. However, my discussion with the colleague who teaches the formative design classes (principles and process) indicated that the students have a very difficult time switching between the analytical and creative, left and right brain functions. My own observations in the classroom tend to confirm this phenomenon.

There is one very interesting insight concerning design approaches and the apparent combination of approaches that involves two students who were leaving the program. In both cases they were very capable students who put forth considerable effort, but struggled with the design curriculum and had second thoughts about landscape architecture as a career choice. One student did not appear to have any clear focus on an approach to design while the other seemed to be focused solely on a single approach. The first simply used probing as a technique while the other tried to find the most ideal solution every time. Consequently, this fortuitous, although unfortunate situation seems to underscore the importance of having a variety of approaches available rather than depending solely on one approach.

8.1.2 Two approaches; Adaptation and Drawing on Consequences, were relegated to technique status as opposed to an approach

Virtually no one described using either Adaptation or Drawing on Consequences as an approach to design. The students did describe techniques that have similarities with the concepts of these two approaches. For example, many students employed adaptation as a way to break through a mental or creative block by conducting research in the form of books, magazines, or the internet, including Google Earth. The rational for this phenomenon, I believe, stemmed for the students’ motivation for becoming designers. While observing students in the studio and in discussions with students in other classes they tend to equate creativity with originality. They are reluctant to even look at other solutions because they feel that ideas and possible solutions need to come from within in some sort of spontaneous, esoteric process. At times they have even described basing their design on another project as plagiarism, even when that project was built and a part of the existing public realm. During the interviews, one student described being in a rut, in just her third year of classes.

"More or less, I mean we do a lot of projects sometimes. I feel like I coming up with the same ideas but I don’t want to do the same thing twice. I guess that’s pretty hard for me to go out and find new things that inspire me to do something different than what I’ve already done cause it would be easy to be like oh I’ve already done this I could just use this same design and I could just put it on here, I mean some people do that…..Yea it’s easy to get in a rut.” (Bee)

Both the TA and colleague, when interviewed, agreed that sentiments like these were not uncommon and a result from the students’ desire to be creative and the feeling that re-invention or adaptation is not creative enough.

With regard to Drawing on Consequences as an approach, it is understandable that students would not be able to utilize this approach. They have neither the time nor the resources to build mockups and gauge users’ reactions. However, when students described self-reflection as a technique, they were essentially anticipating what the consequences of their preliminary design solution might be. Similarly, the availability of digital imaging makes it possible to explore potential consequences in a virtual world utilizing focus groups. Other projects might also base a design upon survey research, such as a recent thesis where the student based his recommendations for a bikeway system at a small southern university on a survey of students, faculty and staff. Clearly, though, for Drawing on Consequences to be used as an approach or the foundation upon which a design is synthesized, it would most likely need to be part of the assignment.

There does not appear to be any obvious relationship between Approaches to Design and the Techniques used to implement the approach.

For me, one of the most surprising findings is that there was no clear relationship between a students preferred approach, or approaches and the techniques used to implement that approach. I would have predicted that the approach and the technique would go hand in hand, but that was clearly not the case.

"I like try to pull ideas from like anywhere I can get them. I actually have a bunch of friends who are in art school and I’ll get on my face book and they post all of their paintings on
This student clearly preferred using Available Means as an approach. She also said that she got her colors from the music and described both the art and the music as having a certain flow and feel. In her case, the approach seemed to match her techniques since they were very free thinking and open minded. However, another student who was very rigid in his use of the Problem Solving approach also utilized abstracting techniques such meditation and described design in terms of elegance and simplicity. Many students also described various forms of probing which includes testing and evaluating many different solutions and subsequent variations of those solutions, while adopting any number of design approaches.

8.1.3 There does not appear to be any obvious relationship between a students’ stated difficulty with Ideation vs. Implementation and an Approach or Technique.

This was another aspect of the study that was somewhat of a surprise. When asked if they had more difficulty coming up with ideas as opposed to implementing those ideas, the responses were evenly divided. More importantly, there was never any hesitation what so ever by any of the students as to which was the most difficult for them. One student said "Ideas come down like rain; it’s just a matter of getting all the acidic stuff like pollutants out of the rain and distilling it." (Rick). However, another said that coming up with ideas was like breaking through a dam and that once the dam was broken, the ideas came through and the subsequent implementation of those ideas on the site was the easy part. These analogies are two of the more eloquent examples of what was a clear preference for all of the students. However, while they both expressed difficulty with either ideation or implementation, they both also described a preference for the Problem Solving Approach in other parts of the interviews. Another student indicated a clear preference for the Problem Solving Approach when he said “I am more of the problem statement kind of a guy, because the most elegant solution comes from the most elegant question.” (Muddy). However, he was very creative when he explained “Yea, think of it like poetry, a poem that, if it’s well written it says a whole lot in not very many lines and its very choice words. That’s what I mean about elegant.” (Muddy) These examples indicate that there is not necessarily an inherent connection between the approaches that students take to design and the techniques they employ to implement those approaches.

The value of qualitative methodology was also revealed when one considers the notion that, in a quantitative study, the tendency might have been to determine which approach or approaches were favored the most. The researcher/instructor might then want to focus his or her teaching on those approaches, and only those approaches. This study, however implies that all approaches can be valid depending upon the circumstances, and not just those that are the most popular, or the most comfortable for the instructor. Otherwise, the female student who uses music might not have been able to find her colors.

9 FUTURE RESEARCH

This qualitative study revealed a wealth of information on a broad range of issues. Since the profession of landscape architecture is highly vested in the quality of the built and natural environments, it is entirely appropriate to utilize qualitative research as a means to understand and improve the education of future professionals in the field. The current standard for student/teacher ratios promulgated by the Landscape Architecture Accreditation Board (LAAB) is 15:1 in the design studio. At this ratio, it would be difficult although not impossible, to continue a similar interview protocol coupled with a more practiced participant observation effort. However, an adaptation of the process using a focus group or qualitative survey may be more feasible and just as useful. Implementing participant observation as a regular part of the classroom would also be helpful as both a formative and summative form of evaluation of me and my students’ efforts.

In summary, the findings of this research are revealing to the point that it would be beneficial to continue with it and develop a longitudinal qualitative study of the ways in which landscape architecture students approach design.
10 REFERENCES

ANATURE DISCOURSES:
META-PARADIGMS IN LANDSCAPE ARCHITECTURE

PERRON, P. RICHARD, PhD
University of Manitoba, Winnipeg, Manitoba, Canada

1 ABSTRACT

Landscape architecture is about finding new ways to understand and to deal with the complex problems in everyday environments, problems that often result from human actions, needs and desires. Integral Ecology provides us with ways to look at problems of landscape architecture differently, more broadly and systematically and may possibly influence our own approaches towards integrated design theory. Integral ecology questions what we mean by nature, recognizing that we are not always talking about the same thing when we talk about nature.

Integral ecology is a metatheoretical approach to theories of nature. It is about thinking about how we think about nature (ontological in the sense of what constitutes knowledge about nature, epistemological in the sense of uncovering our relationship to specific kinds of knowledge, and methodological in terms of how we go about using different forms of knowledge). Its goal is to unite, coordinate, and mutually enrich knowledge generated from different disciplines and approaches. In their seminal text on integral ecology, Esbjörn-Hargens and Zimmerman have identified over 200 different perspectives on the natural world. These perspectives, range from deeply established disciplinary approaches to very spiritual approaches to the nature of being. Integral ecology is a framework that seeks to “sort through these many approaches and connect them in pragmatic a way that honors their unique insights on their own terms.” In this project the studio serves as the setting for sorting through perspectives on nature, by considering what it means to connect them in pragmatic ways for landscape architecture, by considering how perspectives may be operationalized in modeling, mapping and developed into design intentions. Investigations involve using three selected perspectives on nature as part of the directed design inquiry.

1.1 Keywords

Landscape ecology, studio, perspectives on nature
2 INTRODUCTION
In 2014, students of landscape architecture at the University of Manitoba worked on a studio that turned to Integral Ecology and specifically the book Integral Ecology: Uniting Multiple Perspectives on the Natural World by Sean Esbjörn-Hargens and Michael E. Zimmerman, as a strategy for understanding the range of thinking that might influence landscape architecture thinking. Integral Ecology is described as “the mixed methods (i.e., qualitative and quantitative) study of the subjective and objective aspects of organisms in relationship to their intersubjective and interobjective environments at multiple levels of depth and complexity.” Landscape architects already use many of these perspectives for deriving meaning about the world. Integral Ecology provides a prism for uncovering the range of ‘ways of thinking’ about nature.

3 A RESEARCH BASED STUDIO
In the studio 15 students were interested in how different perspectives on nature begin to influence design approach and design thinking. The studio was seen as the vehicle for research and follows from the approach to research method described in Rigour and Complexity in Educational Research: Conceptualizing the Bricolage by Kincheloe and Berry. “In this process bricoleurs act upon the concept that theory is not an explanation of the world – it is more an explanation of our relation to the world.” More specifically the studio would be used to uncover how perspectives on nature begin to work within meaning-making processes that influence design. The studio was conducted in three stages. Each stage is summarized below along with examples of work and observations regarding outcomes of each stage of the investigation.

3.1 Sorting through and connecting perspectives on nature
The studio is the final studio in a Masters of Landscape Architecture degree. Fifteen students took part in the studio. The students were first asked to choose three of the perspectives on nature, to research and describe each perspective. The topics or perspectives would be based upon the student’s own landscape architecture research interests and were developed as written essays. From a research perspective, would students converge on specific perspectives on nature?

In the second part of this phase of the studio students were asked to visualize (through 3D fabricated modeling) the integration of the three perspectives that they had chosen.

3.1.1 Observations
A much wider range of topics were chosen than was originally anticipated by the instructor. The topics are listed below where each point represents a student’s choices. Rather than a convergence on specific topics there was almost no overlap in the topics chosen.

- Political Ecology/Socialist Ecology/Architectural Phenomenology
- Terrapsychology/Catastrophe Theory/Humanistic Geography
- Reconciliation Ecology/Biophilia/Ecological Hermeneutics
- Sustainable Architecture/Bioregionalism/Industrial Ecology
- Agroecology/Restoration Ecology/Horticultural Therapy
- Environmental Ethics/Permaculture/Animal Rights
- Yoga Ecology/Sensory Ecology/Divine Gardening
- Urban Ecology/Place Studies/Design Ecology
- Acoustic Ecology/Ecological Psychology/Architectural Phenomenology
- Invasion Ecology/Environmental Aesthetics/Cultural Landscape Studies
- Biomimicry/Music Ecology/Clinical Ecology
- Spiritual Ecology/Deep Ecology/Sacred Geography
- Ecological Hermeneutics/Ecological Modernization/Animism
- Goetheian Science/Plant Neurobiology/Eco-linguistics
- Chaotic Ecology/Ecosemiotics/Ecological Phenomenology

The modeling of the integration of perspectives brought about a number of realizations specific to the students’ understanding and emphasis. Topics were often grouped around related interests, where specific ideas would dominate the form. The models began to reveal how different areas of knowledge would easily lend themselves to modeling, while other areas could only be represented through metaphor.
or with respect to specifics of the area of knowledge.

Figure 1. 3d Print Model by Frank Choi: environmental ethics/animal rights/permaculture. Metaphorical representation of integrated living systems.

Figure 2. Model by Carmela Bul-Lalayao: terrapsychology/human geography/catastrophe theory. Discs relate to a wide range of cultural archetypes, whereas model form and deliberate lack of stability influenced by catastrophe theory.

3.2 How perspectives may be operationalized through mapping

Students were asked to “find” a site for the investigation of design inquiry that would include and allow for design investigations working from the three perspectives on nature. The sites were to be of a large scale, consistent with projects that may be considered “landscape urbanism” projects, and students were asked to consider the notion of liminal spaces, i.e., spaces that are often contested or neglected. Much of the work in the second phase began with geographic information systems (GIS) analysis and
then considered in terms of actor network theory. What actors are operating on the site, how do they assemble, how do they interact? How do the perspectives on nature bring agency to the design thinking? This analysis was compiled into using a range of “eidetic imaging” techniques.

3.2.1 Observations

The introduction of actor-network theory into the project allowed students to consider a wide range of “actors” within the landscape. Whereas design projects often begin by privileging the agencies of human actors in articulating design problems, actor network theory places an equal emphasis on non-human, living and non-living, actors. This may be about the agencies of other species, of different forms of matter, and even the agencies of techniques (i.e., mapping, modeling, simulating…), or in the case of the studio, the agencies of the selected perspectives on nature. In this way the perspectives on nature were used to set limits or parameters on the design discussion. So for example, a perspective such as plant neurobiology might privilege the agencies of plants, i.e., plant behavior and responses to material and phenomena; whereas spiritual ecology may be focused upon developing individual understanding from systems of traditional knowledge rooted in place. In each case the site mapping and site selection would be based upon careful considerations of agencies that emerge from the selected perspectives. What clearly emerges in this phase of the work is that one’s perspective on nature can serve to limit the scope of the problem (breadth of the investigation) in exchange for increasing the focused complexity of the problem (depth of the investigation). As one begins to integrate the perspectives, combining actors of different types and allowing for the intermingling of different agencies, there arises the potential for greater confusion, and greater creativity. For some students this would be overwhelming, causing them to privilege one perspective over another, while others understood this as an opportunity for greater experimentation with the meanings derived from intersecting priorities.

Figure 3. Cinematics study Kaleigh Lysenko: plant neurobiology, ecolinguistics, delicate empiricism (Goethean Science). The use of cinemetric drawing attempts to approach the moment between perception and action.
Figure 4. Word map and edited text by Kari Zahariuk: Ecological phenomenology, chaos theory, ecosemiotics. Series of ecosemiotic mapping studies.

Figure 5. Collage by Stephanie Kirkland: invasion ecology/environmental aesthetics/cultural landscape studies. Increasing complexity with intersecting interests. Understanding the spread of purple loosestrife as cultural phenomena, and the result of an aesthetic preference.
3.3 How perspectives may be operationalized as design intentions.

In the final stage of the studio students were asked to “operationalize” the perspectives on nature and develop design ideas for the “sites” that emerged in phase two. This meant the development of design intentions that were influenced by the perspectives, students were encouraged to, where possible, use all three perspectives in an integrated fashion. Where appropriate the design intentions would begin at a large/regional scale, and then move into meso (middle) scale design proposal. Detailed design development was not a requirement of the studio. Design solutions were strongly influenced by the perspectives, with a large range of integrated approaches to the design processes.

3.3.1 Observations

The final projects could be characterized into three types. The greatest tendency was for the work to be dominated by a singular Perspective on Nature. Perspectives were abandoned in the final design for a variety of reasons, including questions of scale (the macro/meso scale may not be the best fit for certain types of investigation), enfoldment (some practices are more relevant and comprehensive and accessible than others), and difficulties with enactment (certain perspectives lend themselves to design practices that have already been acquired by the designer).

Figure 6. Rendering and edited text by Kaleigh Lysenko: plant neurobiology, ecolinguistics, delicate empiricism. The final project would focus upon delicate empiricism (Goethean Science). The effect of distance inspired a gesture in the landscape that could be seen from far away.

The second type of projects were developed in ways that included all three perspectives, yet the resulting designs consisted of parts making up the whole, where the perspectives were evident in the solution but not necessarily integrated. In these cases the perspectives often co-exist on the site often for didactic reasons (complementary but separate). In other cases the perspectives might appear as devices in form generation rather than serving a clear purpose in and of themselves (ex. ideograms of cultural archetypes as pattern generators on site).
Figure 7. CAD/Photoshop collage and edited text by Nathan MacLoed. Agroecology is represented in the agricultural cycle contained on the site. Agricultural plots are proposed on the remnant concrete pads that were foundations for demolished livestock barns.

Figure 8. Rendering and edited text by Evan Gomez: urban ecology, design ecology, place studies. The design includes the integration of green corridors within existing urban neighbourhood.

In the third type of project the three perspectives were actively integrated. Only a few of the fifteen students were successful in integrating the three perspectives. (Although integration of the perspectives was desirable on the part of the instructor, it was not a requirement.) The flexibility in using perspectives was useful to begin to understand when and why designers take the paths that they do. In the third type of project the perspectives were usually kept “in play” because of their differences in emphasis and the relational meaning that emerged through their integration.
4 FINAL OBSERVATIONS

Integral Ecology provides a framework for landscape architects to develop an expanded view of nature and to critically examine their role as designers. The use of landscape ecology in a studio setting provides students with a broad palette through which they can develop their own design ideas. The meta-theoretical approach to design provides means for participants to uncover individual biases and begin to understand the role that landscape architects may take in multi-disciplinary design and planning studies. The use of meta-theory allows the participant a way to contextualize current practices, and situate them within a broader academic realm. The difficulty arises in that many of the perspectives on nature include complex academic discourses, deep spiritual practices, or contemporary world-views that may be difficult to access within a studio setting. The application of Integral Ecology in a studio setting may result in cursory overviews of the perspectives and lead to work based upon limited understanding of the different fields of knowledge. Integral Ecology provides a window into different ways of seeing nature and how our different relations to nature can influence the ways that we construct meaning.

Figure 3. Model by Gesa Gaertner: ecological psychology/architectural phenomenology/acoustic ecology. Sound room, with narrative of affordances inscribed on a recycled door.

5 REFERENCES


MAPPING SEA LEVEL RISE AND STORM INUNDATION
BY 3DI HYDRODYNAMIC MODEL IN THE SAN FRANCISCO BAY AREA
AND ITS IMPLICATIONS FOR FUTURE PLANNING AND DESIGN

JU, YANG
University of California, Berkeley, CA 94706, yangju90@berkeley.edu

RADKE, JOHN
University of California Berkeley, CA ratt@berkeley.edu

1 ABSTRACT
In the San Francisco Bay Area (the Bay Area), one of the greatest concerns of global climate change
is inundation from sea level rise (SLR) associated with extreme storms. The projected 1.41 m SLR will
inundate many of Bay Area’s low-lying coastal areas, including populated development and ecologically
important tidal marshes. Therefore, it’s critical to map the inundation and then develop subsequent
strategies to adapt to and mitigate the impact. Differing from previous static models, we used the 3Di
hydrodynamic model to simulate a near 100-year storm associated with different levels of SLR at a 50-meter
spatial resolution, in order to capture the dynamics of semi-diurnal tides in the Bay. The model produces a
time-series with a 1-hour interval simulated inundation with both extent and depth outputs. Based on the
outputs, we find there is a significant increase in inundated areas with rising sea level, especially for
development and wetlands. Immediate planning and design actions are required in those areas to avoid
potential long term consequences. We also recommend using the time-series result to visualize the
inundation process and the integration of our research framework into GeoDesign to give planers the ability
to test different adaptation proposals.

1.1 Keywords
Sea level rise, inundation, mapping, 3Di hydrodynamic model
INTRODUCTION

Global climate change induced Sea Level Rise (SLR) has already affected coastal areas around the world by inundating coastal land, salt water intrusion, increased erosion, the decline of coastal wetlands, etc. (Nicholls & Cazenave, 2010; Titus et al., 1991). In the San Francisco Bay Area (the Bay Area), the mean sea level is projected to rise 1.41 m by the year 2100 (Cayan et al., 2009; Cloern et al., 2011), which may cause major impacts on the Bay Area’s population, economy, environment, and development. Heberger et al. estimated that a 100-year flood event, coupled with 1.4 m SLR increment, could put 270,000 people at risk (given 2012’s population), and cause $62 billion (in year 2000 dollars) to replace the properties at risk (Heberger, Cooley, Moore, & Herrera, 2012). Biging et al. (Bijing, Radke, & Lee, 2012) predicted that SLR would cause much of the Bay Area’s transportation infrastructure to fail and impact regional accessibility as well as population mobility patterns.

In order to develop adaptation strategies for SLR in planning and design, it is critical to explicitly predict the spatial extents of the future inundation in coastal areas. Many researchers have added inundation to the existing research framework. For example, in land use planning, Berry and BenDor (2015) added a simulated SLR inundation layer to development suitability analysis of New York City. In transportation planning, Demirel, Kompil, and Nemry (2015) combined SLR and storm surge inundation with Europe road network to identify the road network vulnerability. In habitat conservation, Zhu et al. (2015) used a Sea Level Affecting Marsh Model (SLAMM), species habitat models, and conservation prioritization (Zonation) to prioritize conservation based on ecological services and land cost. In public participation, Wadey et al. (2015) conducted a participatory visualization exercise in Yarmouth, UK, to simulate the SLR scenarios of interest, and to engage multiple stakeholders. Wadey et al. also recommended that such approach should be widely adopted in communities and act as an important part of coastal flood management. To promote environmental justice in climate change adaptation, researchers also used simulated inundation and populations’ socioeconomic characteristics to identify the most vulnerable populations (Nutters, 2012; Martinich, Neumann, Ludwig, & Jantarasami, 2013; Bickers, 2014).

Equilibrium models and dynamic models are the two main categories of models to simulate and map SLR inundation and storm surge (Gallien, Schubert, & Sanders, 2011). Equilibrium models are static and model one stage of inundation, such as inundation by Mean Higher High Water (MHHW), while dynamic models are able to simulate entire inundation processes over a specified period of time. Equilibrium models can process higher spatial resolution (<20 m) data (Poulter & Halpin, 2008; Gesch, 2009; Marcy et al., 2011; Biging et al., 2012), but they fail to show temporal details. In contrast, dynamic models simulate with time-series data, but at a cost of lowering spatial resolution (>50 m) (Knowles, 2010; Dahm, Hsu, Lien, Chang, & Prinsen, 2014; Wang, Loftis, Liu, Forrest, & Zhang, 2014). A comparison between equilibrium and dynamic inundation models can be found in Table 1.

Table 1. Comparison between equilibrium models and dynamic models.

<table>
<thead>
<tr>
<th>Category</th>
<th>Input</th>
<th>advantage</th>
<th>disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>equilibrium</td>
<td>water level data; digital ground surface data</td>
<td>higher spatial resolution</td>
<td>lower temporal resolution</td>
</tr>
<tr>
<td>dynamic models</td>
<td></td>
<td>higher temporal resolution</td>
<td>lower spatial resolution</td>
</tr>
</tbody>
</table>

In the Bay Area, several equilibrium models have been applied to simulate potential inundated area due to SLR and storm surge. Even though equilibrium models are able to model at a high spatial resolution, they fail to represent the dynamics of real tides and storm events, especially in the Bay Area that is characterized by daily semi-diurnal tides, where there are two uneven heights of high tide and low tide. Dynamic models are particularly appropriate for the Bay Area as they simulate all stages in the tidal cycle and the movement of tides in a storm event. Knowles (2010) conducted a recent dynamic modeling in the Bay Area, which combined a dynamic model and an equilibrium model. Knowles first used a TRIM-2D dynamic model to create a water surface with 200 m horizontal elevation, and then used an equilibrium approach where he compared the water surface elevation and ground surface model from a Lidar generated Digital Elevation Model (DEM) to identify the inundated area (Knowles, 2010). However, the water surface might be inaccurate as it was simulated at 200 m resolution and some smaller water pathways (<200 m) might be diminished and the results were thus inaccurate. To better understand the dynamics of inundation...
and to more accurately simulate its impact, a more advanced dynamic model modeling at a higher resolution should be implemented.

With such concerns, we applied a new hydrodynamic model, 3Di (Stelling, 2012), to better model SLR, storm surge and inundation at a 50 m resolution for the Bay Area. We seek to answer the following questions: (1) Where will the spatial extents of future inundation lie in the Bay Area? (2) How will specific land cover types be impacted (e.g. development and wetlands)? In addition to answering these questions, our study also produced time-series visualization for simulated inundation to assist planners and designers, and to contribute to public awareness about SLR and storm surge.

3 DATA AND METHODS

3.1 Method Overview
We used the 3Di model (Stelling, 2012) to simulate a near 100-year storm associated with different SLR scenarios to map the inundated area in the Bay Area. The input includes a 50-m resolution digital surface model and time-series water level data. The output is a time-series, 1-hour interval simulated inundation, providing extent and water depth. Based on the time-series output of the model, we then calculated the average inundation depth for each grid cell, reclassified the average inundation depth into 5 classes to identify the inundation severity, and compared how the inundated area changed with rising sea levels. Finally, we overlaid the inundation layer with the land cover layer from Nation Land Cover Dataset 2011 (NLCD 2011) and identified the inundation for each land cover. In this process, we only considered storm surge and SLR, and we didn’t incorporate other factors such as shoreline erosion, subsidence, and sedimentation, which might further exacerbate the impact.

3.2 3Di Model
The 3Di hydrodynamic model (Stelling, 2012) dynamically simulates the movement of tides through a digital ground surface. We consider two benefits of this model: (1) compared to equilibrium models, this model provides an additional dimension of time and illustrates the inundation process; (2) the model uses a spatial quadtree approach to hierarchically decomposing the study area (Cormode, Procopiuc, Srivastava, Shen, & Yu, 2012), draws smaller grid cells for areas requiring more detail, and draws larger grid cells for areas where surface homogeneity dominates (Dahm et al., 2014). With this approach, 3Di is able to process larger and higher resolution datasets and at a faster computational speed compared to models using even grid cells. In this study, the quadtree approach decomposes the study area into 120,810 grid cells, with the minimum grid cell size of 50 by 50 meters.

To initialize the model: (1) we input the digital surface model to 3Di and as Figure 1 illustrates, the model conducted a quadtree spatial decomposition for the surface model; (2) we defined the initial boundary for simulated waves. As seen in Figure 2, an initial boundary was set west of the Golden Gate Bridge and the water level data from Point Reyes tidal gauge station was used to populate the water level for this boundary. The water level input is a 6-min interval, time-series water level record from Feb 5 to Feb 7, 1998. The model simulated virtual tides from the initial boundary throughout the entire study area based on this input. We assumed the simulated 3-day period should allow the peak tide go through the entire study area. A longer time period wasn’t simulated as it required excessive computing time. In addition, we assigned observation stations at existing San Francisco, Alameda, and Port Chicago NOAA tidal gauge station locations, to record the simulated water levels. These help us calibrate and validate the accuracy of the simulation by comparing measured and simulated water levels. We set the model to create inundation extent and depth every hour and record simulated water levels every 15 minutes.
Figure 1. Quadtree decomposition of the study area, where the 3Di model draw finer grids for area with more elevation changes and coarser grids for area with less elevation changes or above certain elevation.

Figure 2. Initial boundary and tidal guages used for model initialization and validation.
3.3 **Digital Surface Model**

Our digital surface model was obtained from Radke et al. (2014), which included both the digital elevation model and bathymetry model for the entire Bay Area. The spatial resolution of that dataset was originally 1 meter. However, considering computational constraints of the 3Di hydrodynamic model, we resampled the dataset to 50-meter resolution. Although we understand lowering the resolution may increase the inaccuracy of the results, 50-meter was assumed as the finest resolution to simulate. The potential issue with a coarse resolution such as 50-meter is inaccuracy of the results. When aggregating the model from finer resolution to coarser resolution, a coarser (i.e. 50 meters) grid cell takes either the mean, median, maximum, or minimum value of all the finer (i.e. 1 meter) grid cells within the coarser grid cell as its aggregated elevation value. The coarser surface thus might elevate or lower the actual elevation, resulting in water pathways diminishing or emerging and underestimation or overestimation of the results. Alternatives to using a coarse resolution are included in the discussion section.

3.4 **Water Level Data**

To estimate the worst-case scenario, we simulated a near 100-year storm associated with different levels of SLR. Being a dynamic model, 3Di requires a time-series water level input. We selected a historic storm event with peak water level close to a predicted 100-year storm as the input. As shown in Table 2, at San Francisco NOAA tidal gauge, the peak water level of a 100-year storm is estimated as 2.64 meters (Zervas, 2013). Recent historic data reveals, two storms in 1983 exceeded this estimation and a third highest storm in 1998 produced a measurable peak water level of 2.587 meters. We used this latter 1998 storm event in this study, as it has a more complete gauge station data log.

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Date</th>
<th>Estimated 100-year storm (m)</th>
<th>Peak Water Level (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Francisco</td>
<td>01/27/1983</td>
<td>2.64</td>
<td>2.707</td>
</tr>
<tr>
<td></td>
<td>12/03/1983</td>
<td></td>
<td>2.674</td>
</tr>
<tr>
<td></td>
<td>02/06/1998</td>
<td></td>
<td>2.587</td>
</tr>
</tbody>
</table>

Table 2 Peak water level of estimated and historic extreme storms at San Francisco NOAA tidal gauge (Zervas, 2013).

For SLR scenarios, there have been several projections about the global mean sea level rise, that range from 0.30 m to 1.80 m by the year 2100 (Bindoff et al., 2007; Nicholls & Cazenave, 2010; Bromirski, Cayan, Graham, Tyree, & Flick, 2012; Church et al., 2013). In addition, SLR is not uniform around the world due to non-uniform ocean warming and salinity variations (Nicholls & Cazenave, 2010). For the Bay Area, Cayan et al. and Colern et al. estimated that SLR would be about 1.41 m by the year 2100 (Cayan et al., 2009; Cloern et al., 2011). We used 1.41 m as the SLR projection by year 2100 for this study. We also estimated intermediate 0.5 m and 1.0 m SLR scenarios to show the impact over time. In addition, 0 m SLR scenario was modeled to understand the baseline condition. For an X meter SLR scenario, we simply added the X meter SLR to the 1998 storm water level to represent the 100-year storm in that SLR scenario.

4 **RESULTS**

4.1 **Comparison between Measured and Simulated Water Level**

Before we output the results of a simulation, we first compared the measured and simulated water levels at San Francisco, Alameda, and Port Chicago tidal gauge stations, to insure the model was providing an accurate simulation. We used the coefficient of determination (R2) between the measured and simulated water level as an accuracy indicator. A higher R2 indicates the simulated water level is closer to the measured water level, and the model as configured is providing a better simulation.

As shown in Figure 3, the model provides a fairly accurate simulation for the tides in the Bay Area, with the lowest R2 of 0.7803 at Port Chicago. There is a distance decay of simulation accuracy from San Francisco (R2: 0.9515) – Alameda (R2: 0.8822) – Port Chicago (R2: 0.7803), which is likely the result of
only using tidal data from the Golden Gate and ignoring discharge from the Sacramento-San Joaquin Delta. Delta discharge is likely to elevate the water level, especially during low tides, which explains why the simulated low tides are lower than the measured low tides at Port Chicago.

![Water level comparison graphs](image)

**Figure 3.** Measured and simulated water level comparison, with time series (left) and statistical measures (right).

### 4.2 Overview of Inundated Areas

Sea level rise and extreme storm surge will cause major impacts in the Bay Area. Figure 4 illustrates that without SLR, 365.41 km² of the study area is inundated by a near 100 year storm surge. With a 0.5 m SLR, the inundated area increases to 547.74 km² and with a 1.0 m SLR, the inundated area increases to 674.24 km². Finally, with 1.41 m SLR, the inundated area increases to 756.19 km², which is about twice that with no SLR. Most inundation happens in San Pablo Bay and Suisun Bay, which are mostly tidal marsh. Other heavily impacted areas include Foster City and Redwood City in San Mateo County,
Treasure Island, the City of Alameda, San Francisco International Airport and the Oakland Airport. (Figure 4).

The impacts of rising sea levels not only include larger inundation extents, but also include greater inundation depth. We calculate and report the average inundation depth for each grid cell and identify the inundation severity by classifying the average inundation depth (Table 3). When sea level rises, there is a significant increase for area receiving deep inundation. Areas with an average depth greater than 2.0 meters increase from 2.48 km² in 0 m SLR scenario, to 155.71 km² in 1.41 m SLR scenario, predicting an increase of 6278.63%.

Table 3. Summary table of inundated area (km²) in different SLR scenarios.

<table>
<thead>
<tr>
<th>Depth Interval</th>
<th>0 m SLR</th>
<th>0.5 m SLR</th>
<th>1.0 m SLR</th>
<th>1.41 m SLR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.5 m</td>
<td>219.94</td>
<td>254.90</td>
<td>214.08</td>
<td>188.62</td>
</tr>
<tr>
<td>0.5-1.0 m</td>
<td>111.43</td>
<td>100.13</td>
<td>175.68</td>
<td>187.83</td>
</tr>
<tr>
<td>1.0-1.5 m</td>
<td>24.39</td>
<td>127.07</td>
<td>89.95</td>
<td>117.74</td>
</tr>
<tr>
<td>1.5-2.0 m</td>
<td>7.16</td>
<td>47.83</td>
<td>104.64</td>
<td>106.29</td>
</tr>
<tr>
<td>&gt;2.0 m</td>
<td>2.48</td>
<td>17.81</td>
<td>89.90</td>
<td>155.71</td>
</tr>
<tr>
<td>Sum</td>
<td>365.41</td>
<td>547.74</td>
<td>674.24</td>
<td>756.19</td>
</tr>
</tbody>
</table>

4.3 Inundation in Development and Wetlands

For planning and design, we particularly focus on developed regions and wetlands, as they are the two most impacted land cover in the Bay Area. By overlaying simulated inundation with land cover from NLCD 2011, we produce a summary in Table 4 for different SLR scenarios.

Table 4. Summary table of inundated area (km²) in development and wetlands in different SLR scenarios.

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>0 m SLR</th>
<th>0.5 m SLR</th>
<th>1.0 m SLR</th>
<th>1.41 m SLR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed, Open Space</td>
<td>10.24</td>
<td>19.13</td>
<td>25.76</td>
<td>31.67</td>
</tr>
<tr>
<td>Developed, Low Intensity</td>
<td>16.08</td>
<td>29.29</td>
<td>43.25</td>
<td>53.74</td>
</tr>
<tr>
<td>Developed, Medium Intensity</td>
<td>21.97</td>
<td>40.01</td>
<td>63.75</td>
<td>87.92</td>
</tr>
<tr>
<td>Developed, High Intensity</td>
<td>5.98</td>
<td>14.69</td>
<td>26.23</td>
<td>45.14</td>
</tr>
<tr>
<td>Wetlands</td>
<td>229.54</td>
<td>314.63</td>
<td>361.05</td>
<td>370.29</td>
</tr>
</tbody>
</table>

From Table 4 wetlands are the most seriously impacted land cover. Most of these impacted wetlands are tidal marshes that are frequently exposed to water but not permanently inundated (Philip Williams & Associates, Ltd. & Faber, 2004). Tidal marshes are identified by certain tidal datum and Parker et al. (1989) assume they extend from mean low water (MLW) to mean high water spring (MHWS). The datum will rise with SLR, leading to permanent submergence (Craft et al., 2009) and original tidal marshes will become open water. These tidal marshes will migrate to the adjacent higher-elevation regions and it is necessary to map and prevent future development in those regions. Heberger et al. (2012) estimates it requires approximately 93 square miles to accommodate tidal marshes to survive 1.4 m SLR, and 38% of these potential accommodation areas are not currently suitable as they are already developed with buildings, roads, and pavement.
Figure 4. Inundated area due to the near 100-year storm associated with 0, 0.5, 1.0, 1.41 m SLR and its intersections with different types of land cover and land use.

From Table 4 wetlands are the most seriously impacted land cover. Most of these impacted wetlands are tidal marshes that are frequently exposed to water but not permanently inundated (Philip Williams & Associates, Ltd. & Faber, 2004). Tidal marshes are identified by certain tidal datum and Parker et al. (1989) assume they extend from mean low water (MLW) to mean high water spring (MHWS). The datum will rise with SLR, leading to permanent submergence (Craft et al., 2009) and original tidal marshes will become open water. These tidal marshes will migrate to the adjacent higher-elevation regions and it is necessary to map and prevent future development in those regions. Heberger et al. (2012) estimates it requires approximately 93 square miles to accommodate tidal marshes to survive 1.4 m SLR, and 38% of these potential accommodation areas are not currently suitable as they are already developed with buildings, roads, and pavement. Since Bay Area being a rapidly growing part of the country, creating and preserving accommodation areas can be very difficult. We recommend four approaches to preserve and restore tidal
marsh: (1) of the occupied 38% of these areas, planning and design should focus on a long-term strategy to create more open space for migrated tidal marsh; (2) for the remaining 62% of these areas, mitigation efforts should be implemented to promote suitable development that can coexist with tidal marsh; (3) for existing tidal marshes, they can be elevated by using material from dredged channels to sustain themselves with SLR (Titus & Anderson, 2009); (4) living shorelines should replace armored shorelines. Living shorelines are consisted of tidal marsh, which can absorb floods, slow erosion and provide ecosystem services (Tam, 2009). Those living shorelines can also compensate for the lost tidal marsh.

4.4 Inundation by Time Sequence

It is important to show the dynamics of inundation to help planners, designers and decision makers understand when and how frequently a piece of land will be inundated so that they might better develop subsequent mitigation strategies. These dynamic representations will also aid the public discourse to initiate public awareness of the impacts of SLR and storm surge. We used the heavily inundated Foster City and Redwood City as an example to show the inundation extent and depth every 2 hours for the 1.41 SLR scenario. Figure 5 shows a large portion of Foster City will be inundated in the first 8 hours. After Hour 8, there will be an accumulation of water over the inundated areas, leading to deeper inundation and further damage.

![Figure 5](image)

**Figure 5** Time-series inundation of the 100-year storm associated with 1.41 m SLR in Foster City and Redwood City.

5 DISCUSSION

5.1 Applications in Planning and Designing

This study provides a dynamic inundation dataset to understand the impact of SLR and storm surge. As we suggest in Section 3.4 planners and designers can use the results of our model to: (1) overlay the simulated inundation to understand how SLR and storm surge affects various land use, facilities, vegetation, and habitat; (2) use the time-series outputs to map the dynamics of inundation, adding an additional dimension of time to the analysis; (3) use the time-series outputs to raise public awareness about SLR and global climate change by dynamically illustrating the process rather than displaying a static map of the impact of their own households and neighborhoods. With higher resolution simulation for an area of interest, a 3D visualization can also be created to further enhance the visual communications; (4) incorporate this study's framework with GeoDesign. GeoDesign is "a design and planning method which tightly couples the creation of a design proposal with impact simulations informed by geographic context" (Flaxman, 2010,
In a GeoDesign approach, the 3Di model can simulate inundation when different adaptation planning and design proposals are adopted. For example, planners and designers can simulate inundation after a levee is constructed, and conduct an evaluation based on the results to determine the optimal solution.

5.2 Limitations

There are several limitations to this study: (1) although the modeling spatial resolution is 4 times greater than previous dynamic models, it is still relatively low and with a 50-meter resolution we miss many landscape details, such as narrow water pathways (<50 meters) and buildings. These objects will influence the water flow to a certain degree and result in different inundation results. The spatial modeling resolution remains an issue in 3Di as we can only process approximately 125,000 grid cells at one time; (2) we consider only SLR and storm surge in this study and do not consider other important variables such as shoreline erosion, sedimentation and rainfall that could also influence the inundation process; (3) we simplify the hydrology in the Bay Area, as we only consider waves coming from the Golden Gate and disregard discharge from Sacramento and San Joaquin Rivers that likely elevates the water level in the North Bay. These limitations mainly result from the state of current hydrodynamic models and will likely be eliminated as more robust models are developed.

5.3 Recommendations

The limitations discussed in Section 4.2 are unlikely to be solved at the present time. However, two recommendations can be made for future research: (1) the simulations can be run at different spatial resolutions to determine the sensitivity of resolution on results and specify an optimal resolution for simulation; (2) large regional studies such as this can be modeled at high resolution by tiling the analysis on a watershed-by-watershed basis.

6 CONCLUSIONS

In this study, we use the 3Di hydrodynamic model to simulate SLR and storm surge inundation for the Bay Area in order to examine how the inundation is spatially distributed and how developed and wetlands regions are affected. Our results show that most inundation occurs in the tidal marshes of San Pablo Bay and Suisun Bay. Several developed coastal regions are also heavily impacted, including Foster City, Redwood City, and Treasure Island. For impacted developed areas we suggest that immediate action be taken to mitigate against significant inundation due to rising sea levels. For wetlands, we recommend planners, designers and policy makers focus on the adjacent higher-elevation areas in order to allow space for the migration of future wetlands, as well as transforming armored shorelines into living shorelines. We also recommend integrating this research framework with GeoDesign to test and visualize adaptation proposals, and using the time-series result to enhance the public discussion. Although the modeling approach introduced here has limitations, it is an effective approach to understanding the impact of Sea Level Rise and storm inundation.

7 REFERENCES

Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.


IMPROVING COMMUNITY WALKABILITY THROUGH UNIVERSITY OUTREACH, TECHNOLOGY AND CROWDSOURCING

SEEGER, CHRISTOPHER J.
Iowa State University, Ames Iowa cjseeger@iastate.edu

1 ABSTRACT

Improving community walkability requires an understanding of existing infrastructure and user perception and behavior, as well as expertise in physical design. Because local leaders often lack access to this type of information, a University Extension Outreach program for small communities was developed that reframes expert assessment as a community-learning experience using digital technology, user perceptions, facilitated evaluation, and infrastructure data collection.

The methods implemented identified user perceptions of assets, barriers, and opportunities for improving walkability (and bikeability) and documented how walkers and cyclists interact with the environment. Using local experience as a foundation for participatory planning, these methods allowed residents to make meaningful discovery about community infrastructure, while the hard evidence generated in the facilitated infrastructure assessments reinforced decisions about the investment of scarce funds.

This crowdsourcing method is beneficial beyond the raw data. For instance, inviting citizens and civic leaders to experience infrastructure conditions firsthand through assessing the community's transportation network and discussing issues they discovered strengthens the local walkability coalition.

This paper presents the methodology employed in more than 50 Iowa communities to collect user perceptions, evaluate the current infrastructure, and present that information in a format appropriate for both local leaders and the general public. Through this participatory research process, local leaders were able to make informed decisions regarding changes necessary to improve walkability (and bikeability) in their community.

1.1 Keywords

Walkability, crowdsourcing, outreach, participatory research, and technology
2 INTRODUCTION
The correlation between the decrease in physical activity and the increase in the number of children (and adults) who are overweight or obese over the past decade is well documented (Heelan, Combs, Abbey, Burger, & Bartee, 2013; Frank, Andresen & Schmid, 2004; French, Story & Jeffrey, 2001). Currently, one in three children in America is overweight or obese. The state of Iowa is no exception to this trend, with 28.3% of children ages 10–17 overweight or obese (NSCH 2011). In 2010, the Iowa Department of Public Health and Iowa State University (ISU) Extension and Outreach worked together to address the childhood obesity problem by creating the Iowans Walking Assessment Logistics Kit (I-WALK).
I-WALK is a participatory program and relies on local knowledge of the day-to-day transportation issues. The program is innovative in its use of both crowdsourcing and geospatial technologies. This paper documents the main program elements and identifies benefits generated from the participatory process conducted at 57 locations across the state of Iowa (Figure 1). The primary goal of the program is to develop a sustainable participatory model that not only aids in the building of community coalitions but also provides a process in which those coalitions can continuously update, visualize, evaluate, and implement local Safe Routes to School (SRTS) plans.
Recognizing the importance of promoting healthy behaviors for all Iowans and that older residents face issues similar to youth, the I-WALK program expanded in 2013 to include transportation issues impacting older Iowans. Health data from 2014 rank Iowa as 16th highest for adult obesity. Today, nearly 31% of Iowa’s adult population is obese—a more than 19% increase since 1990 (State of Obesity, 2015).

Figure 1. I-WALK has been successfully conducted as 13 adult and 44 SRTS projects across Iowa.

3 METHODOLOGY
Both the youth and older-adult I-WALK programs utilize f-VGI to collect several of the data sets necessary for the coalition and planners to visualize and identify potential infrastructure improvements. Two main components—the first of which is a geospatial survey to collect user statistics and perceptions—provide this information. Following the survey, the second component—a mapping workshop—allows volunteers to use GPS-enabled smartphones to map pedestrian infrastructure throughout the community. These two components include five key participatory elements as part of the program methodology: 1) perceived behavioral issues, 2) inventory of routes walked, 3) identification of improvement opportunities, 4) infrastructure mapping, and 5) visualization of route and infrastructure data.

3.1 Geospatial User and Perception Survey
A geospatial survey that allows the responses to be geographically analyzed was developed to better understand the use and perceptions of residents. Both web-based and print versions of the survey were available to participants. The surveys incorporated a variety of questions from instruments such as the
National SRTS walkability audit and the Peds – Pedestrian Environment Data Scan, among others. Questions were reformatted to work in a system that has been geospatially enabled and designed for presentation using responsive web interfaces.

Youth and their parents took the I-WALK for Schools survey together, thus allowing them to discuss options for walking to school. The survey asked respondents to identify where they live and to respond to several questions regarding their perception of the walkability of their neighborhood. The questions included an assessment of the neighborhood sidewalks, issues related to speeding or driver behavior, and other concerns the individual had about walking to various destinations. Additional information from the survey indicates with whom respondents walk most of the time, the number of days per week participants walk or bike, and opinions on whether their community encourages walking and biking. Also, youth were asked if they would be interested in taking part in sponsored walking programs such as a walking school bus.

Survey respondents were asked to identify the routes they use or would consider using by drawing on paper or via web-map interface. Youth were asked to draw the routes they walk or bike to school. Surveys developed for older adults asked respondents to identify the community locations to which they currently walk or bike and to draw the routes they walk or bike most frequently, as well as the locations to which they wish they could walk or bike. Once entered, the data were processed in a GIS model to create a weighted map identifying the routes. Only routes identified by more than three respondents were printed on the map to maintain individual privacy (Figure 2). In addition to user routes, participants pinned the locations of intersections they perceive as dangerous as well as other barriers that make walking or biking difficult. These responses and comments were categorized and displayed as data layers on a series of maps provided to the community in a final report.

![Figure 2](image-url)

Figure 2. The most frequently used routes to and from school and a map identifying the locations of barriers perceived by parents and youth to impact routes to school provide valuable insight to planners.

3.2 Infrastructure GPS Mapping Workshops

Utilizing an f-VGI approach, university and local public health program leaders facilitated a one-day mapping workshop for community volunteers. The pool of volunteers taking part in the workshop
consisted of members of the local coalition and other residents who may have learned about the workshop though news outlets or social media. Typically 12–24 volunteered took part in the workshop.

Volunteers had the option of using their own smartphone or one of the 12 iPhones that are part of the I-WALK toolkit. In a 45-minute orientation during the workshop, facilitators explained the types of features the volunteers would map and trained them to use the customized mobile mapping. Following the training, volunteers were paired together and assigned locations to assess. Assessments were conducted at each intersection and midblock. Additional data for random features were also assessed. After completing their assigned area, volunteers returned to the workshop and the data were uploaded to an online mapping system and displayed on an overview map indicating which parts of the community had been assessed.

The software utilized in the mapping workshops was initially built upon the ESRI ArcGIS iOS framework but has since been ported to the Fulcrum mapping system (Figure 3). Questions were tailored to the type of environment the user is documenting (e.g., intersection or midblock). Participants evaluated the location by first identifying the type of feature they were evaluating (sidewalk, intersection, or other) and then responded to a series of questions by simply tapping the correct response. The assessment form utilized responsive question branching that modifies form questions based on initial responses. For example, if the user indicated that there are no sidewalks, the questions involving the sidewalk condition and width were omitted from the form. After entering the pertinent information, users identified the site on the map by either placing a marker at their current location using assisted visual map placement (AVMP) or via the phone’s GPS. Additional barriers to pedestrian and cyclist movement such as vegetation growing into the walkway, excessive truck traffic, or cars blocking sidewalks were also mapped using the GIS app.

![Figure 3. Fulcrum mapping app customized to document infrastructure.](image)

4 RESULTS

The I-WALK program has been successful for public and private schools in both urban and rural settings, as well as for programs focused on community walkability for older residents. To date, more than 350 Iowans have taken part in forming local coalitions. While 450 community volunteers (including residents and students) have collected more than 1,000 photos during the infrastructure assessment workshops. More than 2,100 parent/child surveys with more than 2,500 mapped locations of perceived barriers/opportunities and 850 identified routes to school have also been submitted.

While the collected data continue to include some error that varies from community to community, sample analysis indicates better than 92% accuracy without conducting a secondary review in most established areas. An initial analysis of each data item collected by volunteers in one community identified that approximately 88% of the infrastructure items inventoried were located, assessed, and entered
correctly. The remaining 12% were identified as having some sort of error, incomplete data, or simply missing.

- 4%: The locations the research team had expected the volunteers to document were skipped. Most of these locations were in areas with no sidewalks or in areas currently being developed. To remedy the issue the instructions on where and what to evaluate were improved.
- 5%: The attribute value for the particular location was omitted. In many cases this was a result of a question dealing with lighting or street parking. The interface to record the information was improved to allow the user to select an unsure option via a more easily accessible button selector.
- 3%: Miscoding an attribute likely do to the user pressing the incorrect button. Switching to the FulcrumMaps app helped to alleviate this issue by making it easier for the volunteer to correct the error while in the field as opposed to adding an additional correct point or trying to remember to correct it later with assistance from the research team.

Collected data were analyzed in a GIS to help community leaders identify gaps in the existing network as well as locations where citizens perceive there to be safety issues such as speeding traffic, reduced visibility, or inadequate sidewalks. Responses have also been used to identify the locations of barriers along what would otherwise be a satisfactory route. Locations where there might be an opportunity for improvement were also identified. Collectively, this information helped communities prioritize areas to improve and write grant proposals that contain up-to-date details of the current infrastructure needs.

Pre- and post-surveys of volunteers found that as residents examine their community and collect data through the participatory process, they experience and witness the limitations of the non-motorized transportation options. Community coalitions are made stronger as residents who might not have responded to a general request to join a “community walkability committee” are now more willing to participate in future discussions and take leadership roles in the development of the local coalition.

The data collected from both the survey and infrastructure mapping were analyzed and consolidated into a report for each participating community. Web-mapping interfaces were designed to allow coalition members to explore, query, and overlay the collected data. Several of the participating communities have used these data to help secure funding to implement infrastructure improvements, create walking programs, and generate better understanding by officials of the need for improved pedestrian systems.

5 CONCLUSIONS

Equipping the public with discipline-specific knowledge and extending the methods of landscape architecture into decision making empowers residents to communicate with powerful outsiders, such as district transportation planners and county engineers, about community needs and desires for specific types of change. The data generated also support grant writing to secure external funds to build infrastructure, another essential need for small communities that wish to make transportation improvements. Community-based participatory research and the facilitated-VGI approach to collecting data have generated increased citizen buy in to the project while providing the base data to start to visualize this information. Future steps for communities involve the continuous updating of this information as identified in I-WALK’s core mission. Tools to assist with this process are currently being implemented into several of the participating I-WALK communities to allow them to visualize the improvements as they are made.

6 REFERENCES


SERVICE LEARNING AND COMMUNITY ENGAGEMENT

Edited by Paula Horrigan
TOGETHER WE DESIGN: LANDSCAPE ARCHITECTS OFFER THEIR 
BEST TECHNIQUES FOR TRANSACTIVE FORM-MAKING

de la PENA, DAVID  
University of California, Davis, CA dsdelapena@ucdavis.edu

HESTER, RANDY  
University of California, Berkeley, CA rthester@frontier.com

HOU, JEFF  
University of Washington, jhou@uw.edu

JONES ALLEN, DIANE  
DesignJones LLC diane@designjonesllc.com

LAWSON, LAURA  
Rutgers, the State University of New Jersey ljlawson@rutgers.edu

1 ABSTRACT

In spite of increasing demand for participatory design within democratic cultures, the most effective transactive methods remain elusive. Which are most useful to address contemporary issues? CELA activist scholars have recently articulated contexts in which their techniques are successful; there is now a critical mass of such work, but it has infrequently been brought together in a forum for critical discussion. This paper modestly initiates that discussion, bringing together five participatory designers who teach and practice community design to share the techniques they consider most effective in achieving truly collaborative form-making with people. Each presents the one technique he or she thinks best enables the designer and community to work together to actually design landscapes. The focus is methods for decision-making and shared form-making as opposed to preliminary activities like listening and program generation. Attention is paid to the transaction—the give and take between designer and community—regarding precise design layout, spatial configuration and experiential qualities. The five techniques include “Design Buffet: Work with what the participants have”; “Kitchen Table Work Session”; “El Carrito: Go where the people are”; “Make It Real: communication and empathy through building small”; and “Drawing-out-the-sacred, upside-down.” We describe the techniques with instructions for implementation, case stories and reflections, concluding with tentative insights, a few lessons for improvement and how others can contribute to create a collective techniques catalogue. A long-term objective is to publish a catalogue of best transactive design techniques for landscape architects. Such a publication would significantly advance this field and serve society.

1.1 Keywords

Participatory design, participatory techniques, transactive design, landscape architecture, community design
2 CONTEXT

As democratic cultures have increasingly expected citizens to participate in decisions about the design of their cities, community designers have borrowed participatory techniques from other fields and created ones appropriate to landscape design. But, which are most useful and in what contexts? Which are best-suited to address contemporary issues? This paper begins the search for answers.

Books on participatory techniques are outdated or more related to planning than to the detailed design of landscape architecture (Hester,1990; Sanoff, 2000). Although many of the techniques most often used today were developed during the Civil Rights Era and are still appropriate, some are not (Linn 1968, 2007; Alinsky, 1971). Classic techniques have been iterated to the point of incomprehensibility. Some are sadly neglected (Friedmann, 1973; Halprin, 1969; Davidoff, 1965; Iacofano, 2001). Some have been replaced by fresh ones springing from new insurgencies as well as cross cultural, regional and global movements (Hou, 2010; Liu, 2005; Palermo, 2000; Angotti et al 2011; Sandeckock, 1998; Irazabal, 2008). Some of these remain too vague for others to replicate. Most emphasize programming and conflict avoidance, skimping on collective creativity and form-making (Zoh, 2012). Until recently rigorous participatory techniques were buried in inspiring grass roots stories (Hester, 1999). Young activist scholars have begun to articulate their techniques: there is a wealth of old and new techniques that need evaluation and collective advancement.

This paper initiates those actions by bringing together six participatory designers who teach and practice community design today to share the single technique each considers most effective for transactive form-making with people. Transactive design- a process of give and take between community and designer through which each learns and teaches the other and they actually design the landscape together- is concerned with both how the designer “designs” with community members and how community members "design" with the designated professional designer (Friedmann,1973; Sanoff 2000). We chose techniques we think most effective in that regard.

The objectives of this paper are to share what we learned in this effort. We wanted to 1) create a simple four-part framework of describe, instruct, illustrate and reflect; 2) test that framework for presenting, comparing, evaluating and disseminating techniques; and 3) pose questions for improvement. The main body of the paper presents the five techniques using our preset format.

Each of the five authors describes his or her technique with step by step instructions of how it is prepared and carried out. We intend the instructions to be precise enough for others to use the technique. A case story accompanies each technique, followed by a self-reflection regarding the strengths and weaknesses, contexts in which it is more and less useful, how it has evolved over time, and what each panelist uniquely learns from this technique. After we present the five techniques, we offer preliminary evaluations of the four-part framework, insights from trying to communicate a technique clearly and concisely, questions to be answered and next steps in developing a catalogue of techniques.

3 METHOD

For several years the organizing author, Randy Hester, discussed with others at CELA the need to create a catalogue of participatory design techniques most useful today, especially techniques that shape landscape design decisions. Observing the numerous presentations of new techniques, he asked those involved in the Service-learning and Community Engagement Track to submit what they considered their best method—old or new—for collaborative form-making. Many expressed interest; five submitted a brief description of the techniques included here. Each wrote 1000 word descriptions of his or her technique as a test example, using the four-part framework of describe, instruct, illustrate and reflect that the organizing author had developed. Each technique was written independently by each author, in their own words without any attempt to standardize descriptions beyond the four-part framework. This resulted in significantly different aspects of emphasis and divergent descriptions of each technique. After drafts were written, we used a Delphi Probe to give each other comments and ask questions to improve clarity and utility, and to determine next actions. After four rounds of back-and-forth discussions we tried to generalize our conclusions about the format. We did not try to write as a single author. We did consider how to modify the four-part framework and how to invite others to add their best techniques.
4 TEST CASE TECHNIQUES

The major part of this paper consists of the five test case techniques that were submitted to the organizing author. Each follows the four-part format: Description, Instructions, Case Story and Self-reflection.

5 DESIGN BUFFET: WORKING WITH WHAT PARTICIPANTS HAVE
Contributor: Jeff Hou

5.1 Description
Despite benevolently intentions, participatory design can be an alienating experience for community members, particularly in immigrant communities where language and culture present challenges for communication and engagement (Hou, 2013). This is worse when professional designers are unaware of social nuances that impact the efficacy of a participatory process. How can designers overcome these challenges in practice? How can they develop techniques that bridge the cultural divide and enable multicultural participants to engage effectively in transactive design?

A decade of work with city officials, local professionals and University of Washington Department of Landscape Architecture faculty and students in Seattle’s International District taught me that a community designer could overcome such barriers by uncovering, recognizing, and working with what is familiar to people and the assets that already reside in the community (Hou, 2011). These include the skills and knowledge that community members currently possess, the existing organizations and social groups to partner with, and activities that are already occurring in the community that might serve as venues for participation. Rather than seeing the community members as lacking skills to participate, using what the participants already have can enable them to work with experts as equals.

5.2 Instructions
After a community invites the University or, more recently, me directly, a first step is to identify partners: organizations and individuals that have a deep understanding of the issues in the community with networks for further outreach to identify assets in the community. Initially I relied heavily on the few community gatekeepers whom I trusted to identify appropriate partners. After working in this neighborhood for ten years, I know most of the potential partners and can immediately identify the best ones for a particular issue.

Community engagement involves truly interacting with community members, not just giving them their legal right to participate. Rather than inviting community members to a public meeting, removing them from their “comfort zone,” inviting ourselves as designers to the activities already taking place in the community is a more empathetic and effective approach. Once we have identified a setting to engage the community, we then work with the nature of that event, activity, or venue to determine the appropriate format and techniques for engagement relative to the nature of the projects we were asked to work on by the community. Precisely how this is done is critical. During the participatory process, unforeseen outcomes can occur that may require the design team to improvise further on the spot. Without following a strictly prescribed format, the unforeseen interactions can yield unexpected results.

5.3 Case Story
International Children’s Park in Seattle’s Chinatown International District was built in 1980. In 2006, I was approached by a neighborhood organization to improve the park, facing issues of safety, disrepair, and lack of use. First, I found out more about the park from the individuals with intimate knowledge of the site: nearby residents, members of organizations nearby, the manager of a Community Center and staff of a daycare center who brought children to the park daily. Their knowledge provided the basis for the participatory design process. For example, safety was the top concern; children often came to the park with adults; and young and older adults also used the park. It was necessary to involve users of different ages.

Finding an appropriate venue to engage the diverse users was the next task. Community partners told us about a weekly social hour that took place in the Community Center each Friday afternoon. Elderly residents from the neighborhood came to meet friends, watch videos, and play Ping-Pong. We inquired whether it would be appropriate for us to “borrow” their social hour to get their input on improving the park, along with high school students from a youth organization. They accepted.
The next challenge was for us to develop a format to engage the participants. To involve high school students, we wanted the workshop to be interactive, distinct from passive and all too often alienating public meetings. With the goal of capacity-building in mind, we wanted them to gain new skills from the workshop. We also wanted to build on abilities they already had in order to more effectively engage them as participants. We knew from previous exchanges that people in the neighborhood all enjoyed a buffet meal. There is an inside joke among Chinese immigrants about the central import of eating to their culture. With that in mind, we began to design our workshop around the notion of a buffet, resulting in a game called “design buffet.”

Because the design game proceeded like a buffet, it required little explanation. As soon as it was announced that the workshop would be like a buffet, the audience immediately queued up. With a plate (site model) in hands (Figure 1), the participants selected park design elements (cut-outs) from aluminum trays on what looked like a buffet table. The trays had bilingual labels to ensure people understood what the elements were. Each person was to generate a design to share with others. We assigned high school students to sit around tables with the elderly so that the students could help the elders, sparking interactions between the different age groups. Each person explained his or her design to others around the table.

Features and elements emerging directly from the Design Buffet transaction were subsequently incorporated into plans for the park’s renovation, which was completed in 2012. The park now includes a spacious gateway entry and a common area for people of all ages to gather, elements that most residents had included in their Design Buffet proposals. One element in most Design Buffet proposals, fencing the entire park, was eliminated, replaced by the open entry and newly cleared sight lines that increased visibility. During the workshop, people were most concerned about safety, which prompted their fencing proposals. But improved accessibility, features appealing to more users and increased use made fencing unnecessary. There are now more eyes in and on the park, and residents and visitors more actively use the park since the renovation.

![Figure 1. Workshop participants selected their chosen park elements on the “buffet” line. Photo by co-author Hou](image)

### 5.4 Reflection

During the design workshop for the International Children’s Park, it was surprising how quickly and smoothly the participants were able to go through the exercise without much difficulty. The Design Buffet had a sense of novelty yet familiarity that alleviated the discomfort typically experienced in community
meetings. Informal conversations at the tables also reinforced the workshop as an extension of everyday activities.

Ownership emerged from physically and mentally generating a design. Some weeks later students presented design alternatives based on what they learned from the “buffet” designs, the participants actively inquired about design features in degrees that I had not expected. The “buffet” made details of design familiar and actionable. The intergenerational workshop enabled everyone to appreciate the needs of diverse users beyond just children. Furthermore, it helped all participants understand that by increasing the diversity of park users, the park’s safety also increased.

6 KITCHEN TABLE WORK SESSION
Contributor: Diane Allen Jones

6.1 Description
The Kitchen Table Work Session is a participatory research and design strategy developed by our firm, DesignJones, LLC. It has been crafted to build new or strengthen existing interactive networks and practices, specifically providing venues that go beyond the public meeting and stakeholder interview processes. Using this technique, the designer seeks group information, perspectives and visions that directly speak to the desires and concerns of those living in and/or directly impacted by any design proposed for the area.

Transactive form-making begins with building trust and transparency through clear and open communication strategies with groups that have historically and recently experienced unfulfilled promises in spite of diligent participation in city planning hearings regarding disasters or economic loss in their community. Such groups suffer a general feeling of a lack of representation. Thus, designers can expect a great deal of skepticism, reservation and even resistance to participating in the design process, particularly if the approach is not deemed fair and inclusive. On the other hand, there are groups who see an inclusionary process as the perfect opportunity to finally share an extensive amount of information that would potentially derail the timing or even broadness of a public meeting. In short, designers have to conceive workshop strategies that move beyond the typical. Experience using the inclusionary Kitchen Table Work Session technique has made us acutely aware of its value and appeal, over formal approaches like institutionalized meetings and public hearings, to certain cultures and environments. It significantly improves communication and participation by bringing designers and community members together to do research and exchange knowledge and ideas leading to and influencing form-making and the work at hand. The Kitchen Table Work Session provides the design team with on the ground detailed data, ideas and beliefs guiding the expectations of people whose lives and neighborhoods will be directly impacted by the outcomes of the proposed development.

6.2 Instructions
The Kitchen Table Work Session provides a face-to-face dialogue among friends and neighbors with a trained community facilitator/landscape architect in the most local of settings. The setting may be a kitchen table, a stoop, beauty salon or even a bar or restaurant. Once it is determined whose home or establishment will host the work session, that person can invite friends, neighbors and other community members they know. This allows for an ease and openness to express ideas. Someone should inconspicuously take notes. The designer or residents may draw ideas on paper or a map. Over time participant tools have increased to include laptops, iPads, iPhones, large flat screen monitors or even the host resident’s television for displaying up to the moment information, digital images and drawings. We observe that in the familiar setting among close friends and neighbors, even those with computer phobias feel free to ask questions about alien technology, and many soon engage its use. Individuals not only see their ideas expressed in an expedient fashion, but just as important, the processes of inquiry and discovery are demystified in a familiar personal surrounding. This also allows for easy capture of the information. Access to the Internet provides many of the tools needed to guarantee a high level of interactive exchange related to city information and best practices for design and implementation. We often have a central body of expertise available remotely for the kitchen table participants.
6.3 Case Story

DesignJones, LLC saw a positive increase in participation among New Orleans’ Lower Ninth Ward residents around a proposed warehouse district development. We held several Kitchen Table Work Sessions in the homes of Holy Cross residents (Figure 2) enabling dialogue and education about the potential site. The main focus was to determine if the Holy Cross/Lower Ninth Ward neighborhood could use the Warehouse Waterfront District as a site for sustainable food security, economic development and cultural livability. Through the Kitchen Table Workshops we got a clear understanding of the type of development residents really wanted. Mixed use would serve their needs. Most importantly, we were able to galvanize opposition for the proposed zoning change, from Mixed Use to Industrial, which would have constrained development by limiting it to industrial and port-related uses. After several Workshops where a thorough understanding of zoning issues was gained, residents came out to the Planning Commission, and won a victory. The existing zoning remains. As one result, a local organization, The Backyard Gardeners’ Network, is developing a plan for a community-serving park on land that the rezoning would not have allowed.

![Figure 2. Gathering around the kitchen table. Photo by co-author Jones Allen.](image)

6.4 Reflection

There are challenges with this technique. One difficulty is to guarantee consistent messaging aligned with objectives of the project. The leader must keep the informal chat focused so that adequate time is spent determining how the community desires the project manifested. Another difficulty is that demand for the Kitchen Table Work Sessions will grow as word of the opportunity to participate in meaningful and personalized dialogue spreads. We propose several ways to address both problems. First, implement a Centralized Information Exchange Center (CIEC) available during every Kitchen Table Work Session to serve as a reverse webinar approach to communication through the group facilitator whenever a Kitchen Session is held. In a central location a panel of representatives from the project team would constitute a think tank to offer answers to inquiries from localized discussions. The panel need not agree yet offer insight that keeps groups engaged and learning from different perspectives, serving as a catalyst for greater understanding of the endeavor. Second, advertise the exchange widely and maintain a strict, standardized schedule for both the Kitchen Sessions and CIEC. Standardizing time allows numerous groups to
simultaneously access the CIEC from different venues. Hold all of these sessions one or two days each week throughout the project.

The Kitchen Table Work Session provides the designer the essential deep understanding of a community’s needs and desires. It develops greater community interaction and clarity of goals. Unlike techniques that occur in larger forums, the Kitchen Table Work Session in an intimate setting allows freedom to express one’s ideas, and to learn, question, and exchange without the judgment or influence of a larger audience. Community members gain confidence to participate in a larger group, armed with knowledge and the strength of their ideas.

7 EL CARRITO: TAKING THE CHARRETTE TO THE PEOPLE
Contributor: David de la Peña

7.1 Description
Carrito is the Spanish equivalent of the French charrette, now more associated with public workshops than the carts used at the École des Beaux Arts to collect drawings to present final designs to experts. Today’s institutionalized charrette process involves experts and the public (NCI, 2015; Sanoff, 2000). Although charrettes typically take place in the communities their projects affect, participation is seldom representative. Furthermore, inviting neighbors to participate in a process tightly orchestrated by experts gives a false sense of empowerment.

The carrito is an innovation that adds another dimension to community outreach. It is simply a cart that designers take into public spaces. Instead of inviting people to a controlled charrette, the carrito engages people within their daily routines by meeting them where they are—on their way to work or lunch. It is a small movable object adaptable to local conditions—an architectural curiosity, an art piece that attracts people because it is out of the ordinary. In a location that slightly disturbs but becomes part of the community’s rhythms, on the edges of the flows of everyday life, it can be deployed on a temporary basis, or repeatedly. It allows users to display drawings or even games. It penetrates beyond the “usual suspects” that appear in most charrettes. Most importantly, it flips the tables, taking experts out of their comfort zone and opening new ways for them to understand the communities they are acting within.

7.2 Instructions
Making a carrito expresses one’s attitude to form-making, requiring some construction skills, but allowing every member of a design team to contribute. Consider the project a team-building exercise. Guidelines regarding size, materials, features, and aesthetics are not hard-and-fast rules but a starting point.

The size of the carrito should reflect its objectives, the scale of spaces it must command, and the ability to transport it easily: a small rolling suitcase or a large trailer. The carrito has wheels; it moves without falling apart. Materials reflect the builders’ expertise, but should be lightweight, sturdy, and easily replaced like bicycle parts. Consider its kinetics: closed and open. Closed, it should occupy little space. Open, it may unfold to provide a tabletop, pin-up space, storage, signage, or shade. One of the carrito’s main purposes is aesthetic—to stand out, well designed and crafted evoking curiosity or wonder. Avoid making it too polished. An imperfect object may be more approachable to passers-by. Using recycled materials assembled in an understandable manner says that locals create public space best.

But the carrito does not create community engagement on its own—it is not a drone. The opportunities it creates—to observe behaviors, to hear local stories—require designers to spend extended periods of time in a community, rather than looking at it remotely. Take the carrito to the project site, to popular public spaces, to parking lots, wherever people are. Placement is critical: position it at the edges of pedestrian activity, where it can slightly disrupt without impeding flows. Display useful transactive props—maps, models and photos of the community. Add flyers for community events, distribute surveys, or conduct unstructured interviews. Take notes, draw, diagram, paint, smile, and listen to what the community tells you.

7.3 Case Story
For the activist group in Barcelona, Raons Públiques, the carrito expresses a commitment to empowering communities to make their own public spaces. I worked with the group as a participant observer
and continue to communicate with them as an activist scholar. The group includes environmental designers, anthropologists, sociologists and educators dissatisfied with the city’s urban planning model. Raons’ work emphasizes diagnosis and dialogue—knowing a neighborhood in order to design its spaces transactively (de la Peña, 2013).

The Raons built a prototype carrito to stand out, enliven public space and invite dialogue for a workshop in France. Raons group member Carlos explains: “the carrito has more use when you set it loose and learn from what happens. It's not just an intention of transforming. Every element when you project it into space transforms the space, but in a social way, to generate participation.” The object itself is an odd box on three wheels, sheathed in translucent ribbed plastic and painted wood flaps that transform into tabletops with the help of a hacked tripod. The carrito is used often, rolled into public squares as a temporary kiosk to distribute information, to play games about public space, to interview neighbors. At meetings and workshops its quirky design has disarming effects, attracting children and seniors alike, engaging hundreds of people in design discussions—people who would have otherwise never come to a charrette.

In 2012 the city of Barcelona announced a competition to “improve” car mobility and access to Collserola Park; most teams responded with structured parking and aerial trams. In contrast, we, the Raons, brought our carrito to the working class neighborhood targeted for “improved” access. At the bocce courts where parking was scheduled to destroy their community space, elderly users expressed nervousness about the influx of more cars. Our “carritos sessions” produced a counter-proposal that was named a winner in the city competition. The massive access project was scuttled; community space was saved.

![Figure 3. The carrito as a magnet for curious citizens. Photo by co-author de la Peña.](image-url)
7.4 Reflection

Carritos abound in many variations from food-like-carts in Medellín that make everyday spaces slightly unfamiliar, to collectives in Madrid who hack public space by teaching citizens to make urban furnishings from found objects to provoke suspension and elicitation as a performance of use (Lab 2012; Corsin Jimenez, 2013). The carrito functions at multiple levels—as an embodiment of a participatory design philosophy, an object that evokes dialogue, and a reminder that small gestures create humane public spaces. It does not replace other useful engagement tools, but the diversity of publics demands a diversity of approaches. Taking the charrette to the people is a participatory experiment with a great deal of promise.

8 MAKE IT REAL: EMPATHY AND COMMUNICATION THROUGH BUILDING SMALL

Contributor: Laura Lawson

8.1 Description

In community design, constructing a small part of the design deepens the learning, engagement, and purposefulness of the endeavor. While the intention may be to develop a long-range plan, a smaller implementable project often brings big ideas down to the literal everyday needs of the people. With limited funds, time, and experience, the building project must be simple, yet it encapsulates the intention of the larger project, grounding it in what is possible now. The small project is often, but not always, the first step in accomplishing a grander vision or attacking a bigger issue. In some cases, what seems to require visionary design is actually solved with a small intervention. This technique creates a direct opportunity to work side-by-side with community. It moves the conversation away from the drawing, where the designer is expert, toward problem solving that engages a broader range of skills. When completed, the basic utility of a path or sign, removes distinctions between designer and user. Everyone enjoys the new feature and discusses next steps.

Although appropriate for designers generally, this technique is particularly relevant in the community engagement studio (Lawson, 2014). Attracted by studios providing “real world” experience and opportunities to learn professional skills, students initially think they are simply providing technical assistance to a needy community (Lawson et al; 2011). While these goals are appropriate, they reduce the process to a business transaction. Knowledge moves in one direction, missing mutual learning opportunities (Angotti et al 2011; Vidal et al, 2002). Community engaged building allows students to learn about socio-economic and cultural contexts different from their own upbringing (O’Grady, 1998). It also assures community partners that time spent in planning is worth it. In grassroots projects in low-income communities with limited resources, it is essential to identify doable improvements that move the project forward within the community’s means. Larger overall plans take considerable resources and time, often years, to develop and be realized. In contrast, doable small built projects improve daily life, sustain commitment and interest, keep spirits up and help advance greater realization of the project across extended timeframes.

8.2 Instructions

Unlike other techniques within the design process, a Building Small project grows from desires, opportunism, and ability. As a technique it runs parallel to a long-term project and is not intended as a “design-build” model of engagement. As the larger project unfolds, identify smaller elements that seem to have a quick and positive impact for residents. The project may arise through comments by residents about a problem or a vision or the designer may imagine a small intervention creating a new opportunity. Acting on this idea often is spur-of-the-moment requiring opportunistic planning for its design and implementation. The Building Small project should be able to be designed and built quickly by inexperienced students and residents with minimal funding or red tape that might stall the enthusiasm. The challenge is to coordinate a series of workdays so the materials, tools, and labor are all available to efficiently build the project. Prepare for chaos and stress. Make building fun, social, and eventful. Invite local media to raise public awareness of the effort.


8.3  Case Story

In 2004, the University of Illinois began a multi-year park project with the 41st Street Neighborhood Coalition as part of the East St. Louis Action Research Project. We met with residents to discuss goals for the project, conduct fieldwork, and develop design alternatives. Realizing the project was daunting to this small community group, we slowed the process to discuss questions of phasing and maintenance. The following year the group developed a modest interim design that included key priorities to deter illegal dumping from vehicles, develop a walking path for residents to exercise, and develop a sign to convey ownership. Two residents, impatient to address illegal dumping, collected donated plants to obstruct access to the site. This inspired a linear garden where weeding a bed prompted participants to talk about the neighborhood; resident Willie Beard told students why she chose to stay in East St. Louis and work so hard on this project. Students were inspired. Residents were ready to take action, no matter how small. One day residents and our team redesigned the walking path, on site, redirecting it to avoid the cost of having to clear a soggy wooded area. We got small grants and in-kind contributions and with the community constructed a gravel path. Residents named the site Pullman Porter Park, in honor of the Pullman porters who’d served for decades on the adjoining railroad line. They decided to create a commemorative sign to which students responded by conceiving a series of design options. The design favorite, picked by the residents, was a vibrant sign depicting the Pullman porter history. Working together, residents and students posted it at the park’s entry. With the park’s full realization much further in the future, the Building Small project had provided residents with a garden, walkway, and sign and moved them one step closer to their goals.

Figure 4. Students dividing donated plants and weeding during a workday at Pullman Porter Park. Photo by co-author Lawson

8.4  Reflection

We encounter several questions about Building Small interventions. A simple gravel path or sign may be considered overly mundane for the academic design studio review so it is important to document the process and demonstrate how the small connects to the big or larger design project underway. Some practicing professionals question whether the learning outcomes – multicultural competency, maintenance, and a sign – are too far removed from appropriate professional training for landscape architecture. But
building is legitimate. It pushes students from thinking of design as a drawing exercise into considerations of siting, materials, construction, use and sustainable maintenance. This is the core of landscape architecture.

9 DRAWING-OUT-THE-SACRED, UPSIDE-DOWN
Contributor: Randy Hester

9.1 Description
Drawing-Out-the-Sacred, Upside-Down is a form-seeking technique encouraging back and forth communication about values and spatial qualities. It leads to explicit decisions about landscape design, made jointly by users and designer through face-to-face transactions. Drawing-upside-down has practical and symbolic implications. Literally, it communicates ideas pictorially to collaborators (instead of to the designer herself), inviting them to correct the spatial dimensions or qualities, enabling them to take the drawing materials from the designer to draw their own alternatives. This generates an exchange of genuine transactive creativity. Because I don’t draw well upside-down, the upside-up-drawing is not professionally intimidating, making it easier for laypeople to design themselves. The drawing says, “We are the designer, engaged in mutual form-making.” This establishes the basis for spatially-precise, value-laden critical exchange. If the process has already legitimized sacred landscapes, fears about marginality and improbable visionary dreams can be spatially articulated (Hester, 1985). The designer is no longer a singular expert or mere facilitator but is free to elaborate, teach and counter-argue graphically; a graphic debate is seldom as mean-spirited as an oratorical one. Previously unimagined ideas take form as design that touches the heart both because community members are drawing their own precise ideas and because their ideas are grounded in valued places that are sacred to them.

9.2 Instructions
Clear objectives and pre-meeting preparation are key. The landscape architect must distinguish this event from placating institutionalized techniques that satisfy the law but are seldom transactive. The setting should be comfortable, open to everyone in the community, with a large table, preferably round, drawing materials spread about. I provide well-worn sketchbooks, a variety of layperson-friendly pens and pencils, food and drink.

A community leader should introduce the goal of the meeting in context of previous decisions; newcomers need introductions and elaborated context. Work might begin with “Ok, at our last session, places for picnics was a top priority, so tonight we need to design exactly what these picnic areas should be.” Ms. Lopez interrupts, “The parking’s got to be closer to the tables.” In response, I upside-down-draw what I think she says. “No, no, not so close.” I hand her the sketchbook, but her neighbor takes it, drawing an alternative. We are off to a good start.

9.3 Case Story
When the Master Plan for Parque Natural in Los Angeles was approved, sub-committees formed to resolve contested details. Ms. Lopez had successfully argued that a zocalo and paseo were essential as the soul of Parque Natural (Sorvig, 2002). Now she focused on culturally inclusive details. She only wanted “Mexican” picnicking. One upside-down-drawing I did of picnic tables spread out for privacy drew gentle laughter from the group. Ms. Chavez corrected me, “No, Randy. Put all those tables together. My whole family, all 50 of us, is coming for that picnic.” She didn’t want to draw at first, but she produced an elegant plan-axonometric of tables, coolers, grills, ovens, extra chairs and tables “all brought from home.” I asked about trash cans. Mr. Chavez drew trash cans. Then he moved trees around, “to hang the piñata.” Recalling a park nearby, I upside-down-drew picnic tables adjacent to a flat grassy area and added old men kicking soccer with children. Applause. After back-and-forth drawing the group settled on a revision, largely reflected in the park today.

When we turned our attention to designs for the peripheral fencing (Figure 5), I upside-down-drew an egret gate arising from Aztec ground, a cultural landscape theme previously approved; a man who seldom spoke grabbed my sketchbook, exclaiming in Spanish. I didn’t understand. He redrew the egrets, telling everyone that my design was impossible to fabricate in metal. When I countered with more graceful lines,
he nodded. Soon we had a culturally sacred design to be produced locally (He is a metal fabricator). English and Spanish had been replaced by the language of pictures—a common language we all spoke and that allowed us to shape culture in precise spatial terms.

Figure 5. Drawing upside down invited residents to take the sketchbook and make corrections in detailed design, first for the *zocalo* where they removed a water feature to create a space big enough for weddings and then in designing gates and fences with nature elements using metal they knew how to fabricate. Photos by co-author Hester.

9.4 Reflection

The first question is almost always, “How do you get people to draw/design with you?” People will draw with you if certain conditions are met. Does the designer really want my input? Does she care about what I know, what is sacred to me, my culture and our life-patterns? Will my drawing be okay? Will the design be better if I draw with the designer? Drawing-upside-down satisfies the first conditions. I use upside-down-drawing throughout our practice’s (Community Development by Design) community design process. That process begins with 1) listening, 2) goal-setting, and 3) citizen-involved inventory; the results of which, 4) introduce the larger community to itself, 5) get a gestalt, 6) draw activity settings; which create a design language of shared knowledge and expressions of sacredness between users and landscape architect; that enables 7) archetypes and idiosyncrasies to inspire form within 8) a realistic framework of potentials and constraints; whereby 9) a spectrum of plans is developed and 10) evaluated, 11) responsibility transferred for construction and 12) post-construction evaluation (Hester, 1984). If you start drawing upside-down for one-on-one listening, each step in the progression builds a stronger working relationship and a common pictorial language of landscape architecture, place values and vernacular culture. After months of working together with sketches, almost everyone will draw as needed to communicate, enabling people to freely offer ideas, argue with the expert and expect the expert to argue back, all with pictures. The technique creates a language older than words, overcomes language barriers and provides marginal, less vocal participants a “voice.”

A drawback is that the technique works best in a group of less than 20 people. This can be resolved by working in small groups, then reporting to each other via a modified nominal group process. This requires several upside-down-drawers. Often participants are interested in different aspects of the plan and divide into small groups. Budget for repetition. Drawing upside-down taxes the designer who must learn to draw to communicate instead of impress, then facilitate, engage the reluctant, evaluate,
criticize, elaborate, interject site and budget realities, call up precedents, imagine additional choices and design, all at once. To do all of these simultaneously takes a lot of practice or a partner to share tasks.

10 WHAT WE LEARNED

We conclude that the four-part framework is an easy and effective way to present cases. Such a small sample cannot reveal trends, but speculation was irresistible. We had difficulty isolating a single technique from an overall process, writing more about preceding events or guiding principles and less about the technique precisely. This may be because any one technique is only a part of an entire process, can be used in various stages of participation or has not been adequately articulated by us. Can we better focus? Can we be more explicit in instruction? Can we offer more precise design outcomes related to transactions?

In some cases old methods are being reinvented; in others new approaches are created to cope with changing publics, environmental issues, cultural conflicts, forms of civic life, participation law, media and ways the publics want to participate. There is focused effort to maximize the combined benefits of face-to-face collaboration and new technology that allows remote fact-finding, data mining, simulation and instantaneous opinion polling. The invisible complexity of climate change and anonymous new immigrants seem to be areas of particular innovation. Other test techniques innovate around long-standing issues of inclusion, environmental justice and degree of difficulty facing marginalized communities. Regulated public-institutional participation makes civic engagement less creative, less just and less visionary but more profitable, paradoxical and troubling. Frustration with institutionalized participation is a motivating force for many new techniques. Emerging methods attempt to mend, mitigate, supplement, confront or replace public hearings and bureaucratized workshops and charrettes that often serve to placate rather than create. Can a catalogue of techniques help address these issues?

11 REFERENCES


SUSTAINABILITY

Edited by Mintai Kim
IS CHANGE NEEDED? WHY DO THE UNITED NATION’S SUSTAINABLE DEVELOPMENT GOALS SOUND SO FAMILIAR?

SOSA, LAUREN STUBBS
University of Florida, Gainesville, FL lstubbs436@ufl.edu

1 ABSTRACT
At this moment, there are more than a billion (1,000,000,000) adults, infants and children across the globe living in impoverished conditions. Two and a half billion (2,500,000,000) human beings live in environments that lack basic sanitation. Each day, more than 22,000 children die because they fail to overcome the challenges of living in poverty. In 2014, the United Nations (UN) identified seventeen Sustainable Development Goals (SDGs) with corresponding indicators as a means of uniting efforts to address global development issues. These SDGs seem overwhelmingly applicable to the profession of landscape architecture, yet landscape architects are not often identified as members of the international community of experts and professionals addressing concerns of poverty and standards of living. This paper presents survey-based research that asks landscape architecture practitioners and scholars to identify both their level of involvement with projects that address the SDG indicators and their opinions on the relevance of the indicators to the practice and theory of landscape architecture. The results indicate that while most of the SDGs are identical to many of the goals that guide the discipline of landscape architecture, few landscape architects classify their work as specifically directed towards alleviating poverty or improving the standard of living for poor communities across the globe. While there is a strong commitment to the wellbeing of the physical environment within landscape architecture practice, there is a clear opportunity for the profession to advance and refine its interactions with the socio-ecological components of development, especially as it applies to the world’s marginalized communities.

1.1 Keywords
International development, Sustainable Development Goals
INTRODUCTION

A vast number of people around the globe live in poor and unjust situations. Recently the United Nations established seventeen Sustainable Development Goals (SDGs) to alleviate the most pressing matters in international development. Many of these goals deal with the concerns of human habitat, terrestrial and marine ecosystems, resilient infrastructure, water management and the like. Such topics are directly applicable to the discipline of landscape architecture, yet professional involvement in international development projects is not readily noticeable. The literature suggests that while there are many opportunities for landscape architecture to flourish in the developing world (Taylor, 2011), the profession of landscape architecture mostly caters to developed contexts (Brown & Kjer, 2007). It also suggests that despite a rhetoric that values social aspects of the landscape, the profession does not realize these ideals through practice (Brown & Jennings, 2003; Thompson, 2002).

This research seeks to better understand the specific topical overlap between the professions of landscape architecture and international development by asking landscape architects to identify their involvement with and their opinions on the relevancy of the project types outlined by the SDGs. The research is designed to establish a starting point from which to further engage landscape architecture’s influence and involvement with the most pressing issues of global inequity.

A PROBLEM OF GLOBAL PROPORTIONS

The sheer magnitude of people who suffer impoverished conditions is overwhelming. But poverty is not just an issue of being economically poor; lack of access to natural resources, food, health care, education, and clean environments can maintain and create poverty. The United Nations (UN) (unwater.org) reports that 783 million people do not have access to clean water; 2.5 billion people do not have adequate sanitation; and anywhere from 6 to 8 million people die annually from water-related disasters. About 805 million people (or 1 in 9 people) on earth do not have enough food; poor nutrition causes over 3 million child deaths each year (wfp.org). Pressure is increasing on an already strained food and water supply due to population growth and climate change. Pollution and environmental degradation is rapidly increasing.

Certainly poverty exists within the developed world, but it is predominantly encountered by the people in less developed countries who constitute the “bottom billion” (Collier, 2007).

The challenges are daunting but the goal of this research is to encourage landscape architects to confront the problems of sustainable development within the developing world, specifically because the topics are relevant.

Development Organizations

The overwhelming challenges presented in the developing world are being addressed by a number of governmental, not-for-profit, and private organizations. Some of the most prominent members of the international development community include the UN and its subsidiaries (especially the United Nations Development Program), World Bank, Peace Corps, International Monetary Fund, Red Cross, USAID, Amnesty International, Habitat for Humanity, among almost innumerable others. There are also many professional organizations “without borders” that provide the infrastructure for volunteer doctors, engineers, and architects to provide services in international and impoverished settings, one of the most commonly known is “Doctors Without Borders” (Médecins Sans Frontières).

Organizations and entities such as these operate under the broad professional and academic category of “international development,” a practice that emerged after the Second World War to address poverty and encourage progress in previously colonized countries. International development ranges from policy-making to on-the-ground project implementation. Although it lacks a clear definition, international development is often associated with humanitarian aid, disaster relief, and human rights. Organizations and practitioners in international development have embodied different approaches, intentions, evaluations and standards; depending on the scenario each has been met with varying degrees of successes and failures.

In an effort to launch a united front to address global issues, the UN established the SDG campaign to categorize the goals of international development and assign specific indicators and measurable targets in achieving the goals throughout the UN member states.
3.2 Where are the Landscape Architects?

Within the UN’s SDG list there are a number of specific and familiar connections to landscape architecture: “maintain sustainable cities and human settlements,” “ensure access to water and sanitation,” “conserve and sustainably use marine resources,” “protect and restore terrestrial ecosystems,” and “halt biodiversity loss.” These are all areas in which landscape architecture is well established. However, upon closer examination, nearly every component of the Sustainable Development Goals potentially involves issues of landscape and land planning. Poverty is linked to economic vitality, which is directly affected by location and function of industry, job sources and tourism. Hunger issues rely greatly on agriculture, efficiency of rural land use and urban-rural linkages. Issues of health, disease, and education often involve matters of access to resources and infrastructure. These concerns of industry, agriculture, infrastructure, resource use and access are all topics that landscape architects either directly or indirectly affect. These are all systems that interact with the landscape.

Although the similarities of project types is noticeable, landscape architecture’s role in these kinds of international development projects is not immediately visible. This is not to say the profession is entirely uninvolved: the International Federation for Landscape Architects (IFLA) is specifically geared towards encouraging students and professionals to address issues of climate change, sustainable communities, water, housing and the prevention of hunger (iflaonline.org). Landscape Architects Without Borders is not yet a full-fledged organization, but there seems to be general interest within the landscape architecture community and support from IFLA. Landscape Architecture for Humanity (laforhumanity.org) currently serves as a networking hub with the hopes of inspiring and helping to launch humanitarian projects led by landscape architects. Additionally, James Taylor (2011) recently highlighted the role of landscape architects on the ground in developing countries, specifically with regard to projects based on alleviating the issues inherent to informal settlements.

In order to unite landscape architecture’s relevant experience with the issues regularly confronted by international development it would be helpful to better understand the degree and nature of the overlap between landscape architecture and what the United Nations sees as the most pressing issues in international development.

The research presented in this paper is focusing specifically on the standards and goals presented by the UN, namely the Sustainable Development Goals. Although the SDGs are being used here as the definitive list of topics in international development the author does not necessarily endorse the language or approach of the UN’s development goals, or even goal-driven development per se. However, with 193 member-states the UN is expansive and their list of goals and indicators is exhaustive. Thus, for now the SDGs serve as a reliable and general starting point to the discussion on the key issues within international development.

4 SUSTAINABILITY & DEVELOPMENT

“Sustainable development” is in a large sense what landscape architects do. However, there are some important elements to highlight regarding how landscape architects conceptualize both “sustainability” and “development.”

4.1 Sustainability

Overwhelmingly, landscape architecture’s sustainability efforts focus the physical environment. Some of the most innovative projects incorporate green infrastructure, restoration, brownfield redevelopment, bioswales, eco-corridors, and the like. Bioregionalist, Robert Thayer (2004), convincingly argues that bioregions, or “life places,” provide the best structure for sustainable production and consumption activities; he connects local landscapes to “physical, technological and economic variables” (p. 13) in a globalizing world. Similarly, Windhager et al (2010) suggest that ecosystems serve as the best basis for sustainable design decisions. At the community scale, Francis’ (2002) case study of Village Homes highlights that sustainable community design embodies virtues such as energy-efficient houses, edible landscapes, community open space and water conservation.

When considering the problems in the developing world, the concern is that the majority of landscape architecture projects—even those that embrace sustainability—take place in a “first world” context and cater to “the needs of the commercial sector, the professional class and the most affluent in society” (Brown & Kjer, 2007). While the discussions presented in this paper are focused on the role of
landscape architecture in developing contexts it is critical not to undermine the importance of sustainability within developed (or “first world”) contexts: often in the developing world it is the lack of sustainable practices in the developed world that trickle down some of the most negative effects, most notably with regard to issues of consumption and pollution.

4.2 Development

Within international development there is much contention involved in defining what development should or should not be, who it should benefit, and how it should be implemented (Sumner & Tribe, 2008). The idea of “development” has some specific connotations within landscape architecture. As a concept it is not as rigorously debated as it is in international development, but there is a sense of “development” being separate from “nature.” Landscape architects have been concerned with mitigating the battle between “unspoiled landscape” and development (McNally, 2011), and have been part of the discussion of development goals being separate from preservationist goals (Machemer, 2006). This is consistent with landscape architecture’s strong stewardship ethic and manner in which sustainability is discussed, specifically in protecting the physical, natural environment. Devotion to our natural resources will hopefully continue, but in moving forward it is exciting to consider how solutions to both development and sustainability issues might move past the dichotomies of developed/not developed, and man/nature to focus on the complex and dynamic systems of landscape which incorporate the interaction of environmental, cultural, and societal aspects.

This seems to be an area where landscape architecture would thrive in elaborating on or redefining its concept of development. In a particularly inspirational vein, Amartya Sen’s (Sen, 2011) notion of development is both a means and an end to “freedom.” Not just freedom in the political sense, but freedom as a capacity to make choices about life and livelihood. Here the notion of development is integrated as social and economic change, both of which have direct ties to the landscape. Sumner and Tribe (2008) highlight McGregor’s definition of development as “what a person has, what a person can do with what they have, and how they think about what they have and what they can do (p.25).”

5 SOCIAL & ENVIRONMENTAL

Landscape architecture often expresses an emphasis on environmental concerns, but according some studies, social values may not be translated into practice as well as we think. Dedication to the physical realm is clear, but if the complex issues of the developing world are to be addressed, there will need to be a holistic socio-environmental front.

It is interesting to note that despite a general ideology that promotes a strong relationship among aesthetic, ecological and social components, the social aspects are neither explicitly developed in terms of theoretical approach nor are they realized in practice. In Reference to Crewe & Forsyth’s study, Brown & Jennings (2003) note that “less than ten percent of the projects were classified as plural design (with its orientation towards equality, justice, and empowerment). While there are efforts made to address such issues by a number of individuals, there is a serious lack of explicit discussion of equity and justice in society, or recognition of power, oppression and privilege within communities in which landscape architects work” (Brown & Jennings, 2003, p. 100). Similarly, Thompson’s research found that while there seems to be a consistent desire to meet the “greatest good for the greatest number” within professional discourse, landscape architects seldom engage the discourse of social change (which, for Thompson, manifests as involvement in politics). In his study, “only 2 of the 26 interviewees could be said to have translated their professional concerns into political engagement” (Thompson, 2002, p. 89).

In the past decade there have been discussions that recognize both the trend toward and the need for a richer discussion of the social within landscape architecture, both professionally and academically. This is a promising development, and perhaps a means of holistically structuring the profession’s approach to landscape. Matthew & Selman (2006) advocate “action through landscape” rather than “action for landscape” and suggest that cultural landscapes must be thought of as “socio-ecological systems” (where approaches to social, economic and biophysical components are not isolated, but synthesized). Some authors suggest situating landscape architecture within broader socio-political processes. Kolodney & Kallus (2008) offer a practical approach in navigating social issues in contested urban landscapes by means of looking at landscape through the political lens. They suggest that we view landscape design as a technique (or a set of techniques) rather than a product of aesthetic inspiration” (p. 175). Brown and Kjer
(2007) outline an approach of “critical awareness” regarding issues that marginalized communities face. Whether the term is “socio-political,” “social processes,” or “socio-ecological,” these authors are calling for a direct involvement of social concerns within the design decision-making process.

The apparent trend towards social engagement in landscape architecture holds an exciting potential for the profession to connect with the kinds of societal concerns outlined by the SDG’s, yet despite a general call for social sustainability as a professional value or goal, these discussions appear to be in the minority. We are thus confronted with a paradox: landscape architecture is a firmly anthropocentric discipline (Thompson, 1998), yet when it comes to social issues (even those that seem to lie at the very heart of society’s connection to landscape), there is an apparent disconnect between the “idealism of theory” and the “realities of practice.”

6 METHODS

This research seeks to better understand the contemporary viewpoints of academic and professional landscape architects, specifically regarding their current involvement in both social and environmental issues as they apply to international development, as well as their opinions on the relevance of SDG indicators to landscape architecture practice.

The online survey of involvement and relevance questions was constructed using Qualtrics and indicators were pulled directly from the list of the UN’s SDGs. All decisions regarding what indicators to include and how to modify them were at the discretion of the author. The goal was to include any indicators that had the potential to be relevant to the discipline as well as modify the wording of the indicators to make the survey easier for the participants to take. In some cases the indicators seemed specifically geared towards professions other than landscape architecture, for example: creating market structures, or forming peaceful political negotiations, and were excluded from the survey. Some indicators were modified slightly; for example, several questions were made less verbose to make answering the question easier for the participant. Also, references to percentages (i.e. “conserve 10% of terrestrial ecosystems”) were removed because target numbers are irrelevant to the discussion of whether or not landscape architects are involved in a project type.

Both professional and academic landscape architects were solicited. LinkedIn posts of the survey on ASLA groups served as the means for soliciting professionals. Department chairs of academic institutions listed on the CELA website were contacted with a request to distribute the survey to students and faculty in landscape architecture.

The survey collected 186 responses. While this number of participants is acceptable for a pilot study, future research would need to solicit more responses in order to be statistically significant and representative of the profession as a whole. It should also be noted that the majority of the participants identified themselves as students of landscape architecture (26% undergraduate and 21% undergraduate). While the high number of student responses does skew the results to the extent that we cannot say the data represent the profession as a whole, the data could give valuable insights on the basis of being largely representative of student opinions and experiences. For example, it could open discussions on curriculum development or insight into how future landscape architecture practitioners and academics may expand the scope of the profession. The remaining participants identified as 27% professional landscape architects, 20% academics, and 5% “other.” Comparing responses between the different groups of participants would be an interesting “next step” in this research but it exceeds the bounds of this paper.

The survey asked participants to indicate their level of involvement with projects as outlined by the SDG indicators on a scale of: never, sometimes, often, very often. If they were involved, participants indicated whether the project occurred in a “first” or “third” world country. The participants were also asked to indicate the degree of relevance the indicator had to landscape architecture on a scale of: not at all, kind of relevant, mostly relevant, or directly relevant. For both the involvement and the relevance questions, responses were divided between positive and negative responses, for example: responses in “often” and “very often” counted towards a “positive” response while “never” and “sometimes” counted as “negative.” Indicators were compared based on percentages of positive responses. This method of coding responses is not an ideal way to quantify the survey data and future research should incorporate a new survey design that will allow for a more sophisticated statistical analysis.

The SDGs incorporate indicators that target both environmental and social concerns. If landscape architecture has responded to the call to reconcile social concerns with practice it is anticipated that the
survey will reflect a high number of positive responses on SDG indicators that incorporate social responsibility. However, based on recent literature regarding the lack of landscape architecture’s involvement in the developing world, it is anticipated that while landscape architects may indicate involvement in projects that accommodate the social good, those projects will not be located in the so-called “third world.”

7 RESULTS & DISCUSSION

The goal of this research was to get a general sense of landscape architects’ involvement with and opinions of international development projects as outlined by the SDGs. One of the best ways to highlight this is by looking at the extremes. Taking the highest and lowest scores (based on percentages of responses) for both levels of involvement and levels of relevance yields some interesting comparisons between the goals, as is outlined in the following tables.

7.1 Goals with Response Rates

The highest scoring SDGs regarding “involvement” are (in order) sustainable consumption and production; sustainable use of terrestrial ecosystems; reducing inequality within and among countries; building resilient infrastructure and sustainable industrialization; and ensuring sustainable water and sanitation (see Table 1).

The indicators for the goal of “sustainable consumption and production” focus on management of resources, reducing waste, strengthening sustainable technologies. The highest scoring indicator within this goal was on increasing awareness and access to information on sustainable technologies and lifestyles in harmony with nature. Not surprisingly, the indicators for “terrestrial ecosystems” were all relatively high (halting deforestation, protecting biodiversity, ensuring conservation, etc.) with the exception of the indicator “halting desertification.” Similarly, “water and sanitation” indicators were all high except “trans-boundary water management cooperation.” Perhaps this is indicative of a problematic political system that has yet to figure out how to coordinate responsibilities with shared watersheds and upstream-downstream relationships. The “reducing inequality” goal scored high due to indicators on participation. “Sustainable industrialization” indicators focused on “infrastructure,” and could be widely interpreted as applicable.
Table 1  Highest scoring SDGs for “Involvement.”

<table>
<thead>
<tr>
<th>SDG Category</th>
<th>Positive Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTIVE PATTERNS</strong></td>
<td>46.8%</td>
</tr>
<tr>
<td>• Achieve sustainable management and efficient use of natural resources</td>
<td></td>
</tr>
<tr>
<td>• Reduce waste generation through prevention, reduction, recycling, and reuse</td>
<td></td>
</tr>
<tr>
<td>• Ensure that people have the relevant information and awareness for sustainable development and lifestyles in harmony with nature</td>
<td></td>
</tr>
<tr>
<td>• Support developing countries to move towards more sustainable patterns of consumption and production</td>
<td></td>
</tr>
<tr>
<td><strong>2 PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS</strong></td>
<td>43.7%</td>
</tr>
<tr>
<td>• Ensure conservation and sustainable use of terrestrial and inland freshwater ecosystems</td>
<td></td>
</tr>
<tr>
<td>• Promote sustainable management of all types of forests, halt deforestation, restore degraded forests, and increase afforestation and reforestation</td>
<td></td>
</tr>
<tr>
<td>• Combat desertification, and restore degraded land and soil</td>
<td></td>
</tr>
<tr>
<td>• Reduce degradation of natural habitat, halt the loss of biodiversity and protect threatened and endangered species</td>
<td></td>
</tr>
<tr>
<td>• Introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems</td>
<td></td>
</tr>
<tr>
<td>• Integrate ecosystems and biodiversity values into national and local planning, development processes and poverty reduction strategies</td>
<td></td>
</tr>
<tr>
<td><strong>3 REDUCE INEQUALITY WITHIN AND AMONG COUNTRIES</strong></td>
<td>42.4%</td>
</tr>
<tr>
<td>• Empower and promote the social, economic and political inclusion of all irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status</td>
<td></td>
</tr>
<tr>
<td><strong>4 BUILD RESILIENT INFRASTRUCTURE, PROMOTE INCLUSIVE AND SUSTAINABLE INDUSTRIALIZATION AND FOSTER INNOVATION</strong></td>
<td>40.0%</td>
</tr>
<tr>
<td>• Develop infrastructure to support economic development and human well-being</td>
<td></td>
</tr>
<tr>
<td>• Upgrade infrastructure and retrofit industries to make them sustainable, with increased resource use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes</td>
<td></td>
</tr>
<tr>
<td><strong>5 ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL</strong></td>
<td>37.2%</td>
</tr>
<tr>
<td>• Provide access to clean drinking water and access to safe sanitation and sewage systems</td>
<td></td>
</tr>
<tr>
<td>• Improve water quality by reducing pollution and toxic materials and improving wastewater management</td>
<td></td>
</tr>
<tr>
<td>• Improve water-use efficiency and reuse</td>
<td></td>
</tr>
<tr>
<td>• Implement trans-boundary water management cooperation</td>
<td></td>
</tr>
<tr>
<td>• Improve water quality by reducing pollution and toxic materials and improving wastewater management</td>
<td></td>
</tr>
<tr>
<td>• Protect and restore water-related ecosystems</td>
<td></td>
</tr>
</tbody>
</table>
The highest scoring SDGs regarding “relevance” were sustainable use of marine resources; sustainable consumption and production; sustainable use of terrestrial ecosystems; sustainable cities and human settlements; and ensuring sustainable water and sanitation (see Table 2). Three of these are shared with the list from the highest scores for relevance—it was expected that goals that are seen as relevant are also goals identified in the work done by landscape architects. It was surprising that “marine resources” made it at the very top of the relevance list as it also scored as one of the lowest for involvement (see Table 3). Not surprisingly, however, was that all the indicators for the goal on “sustainable cities and human settlements” scored very high as they covered upgrading slums, affordable housing, transportation, participation, safeguarding cultural heritage, public and green spaces, and urban-rural links—all of which are concerns familiar to the discipline of landscape architecture.

**Table 2 Highest scoring SDGs for “Relevance”**

<table>
<thead>
<tr>
<th>SDG Category</th>
<th>Positive Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 CONSERVE AND SUSTAINABLY USE THE OCEANS, SEAS AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT</td>
<td>96.1%</td>
</tr>
<tr>
<td>• Reduce marine pollution of all kinds, particularly from land-based activities</td>
<td></td>
</tr>
<tr>
<td>• Sustainably manage, restore and protect marine and coastal ecosystems</td>
<td></td>
</tr>
<tr>
<td>• Conserve coastal and marine areas</td>
<td></td>
</tr>
<tr>
<td>2 ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTIVE PATTERNS</td>
<td>96.0%</td>
</tr>
<tr>
<td>• Achieve sustainable management and efficient use of natural resources</td>
<td></td>
</tr>
<tr>
<td>• Reduce waste generation through prevention, reduction, recycling, and reuse</td>
<td></td>
</tr>
<tr>
<td>• Ensure that people have the relevant information and awareness for sustainable development and lifestyles in harmony with nature</td>
<td></td>
</tr>
<tr>
<td>• Support developing countries to move towards more sustainable patterns of consumption and production</td>
<td></td>
</tr>
<tr>
<td>3 PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS</td>
<td>94.9%</td>
</tr>
<tr>
<td>• Ensure conservation and sustainable use of terrestrial and inland freshwater ecosystems</td>
<td></td>
</tr>
<tr>
<td>• Promote sustainable management of all types of forests, halt deforestation, restore degraded forests, and increase afforestation and reforestation</td>
<td></td>
</tr>
<tr>
<td>• Combat desertification, and restore degraded land and soil</td>
<td></td>
</tr>
<tr>
<td>• Reduce degradation of natural habitat, halt the loss of biodiversity and protect threatened and endangered species</td>
<td></td>
</tr>
<tr>
<td>• Introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems</td>
<td></td>
</tr>
<tr>
<td>• Integrate ecosystems and biodiversity values into national and local planning, development processes and poverty reduction strategies</td>
<td></td>
</tr>
</tbody>
</table>
4 MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE  92.4%
   • Ensure access to adequate and affordable housing
   • Upgrade slums
   • Provide access to safe, affordable, accessible and sustainable transport
   • Enhance inclusive and sustainable urbanization and capacities for participatory, integrated and sustainable human settlement planning and management
   • Protect and safeguard the world’s cultural and natural heritage
   • Provide access to safe, inclusive and accessible, green and public spaces, particularly for women and children, older persons and persons with disabilities
   • Support positive economic, social and environmental links between urban, peri-urban and rural areas

5 ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL  88.6%
   • Provide access to clean drinking water and access to safe sanitation and sewage systems
   • Improve water quality by reducing pollution and toxic materials and improving wastewater management
   • Improve water-use efficiency and reuse
   • Implement trans-boundary water management cooperation
   • Improve water quality by reducing pollution and toxic materials and improving wastewater management
   • Protect and restore water-related ecosystems

7.2 Goals with Low Response Rates
   The lowest scoring SDGs regarding “involvement” were on gender equality; sustainable use of marine resources; ending hunger; ending poverty; and climate change (see Table 6-3). Gender in the landscape is an underrepresented area of study and it is not surprising that is scored the lowest in both involvement and relevance. Surmising the reason for this would exceed the bounds of this paper, but there is a clear opportunity for further research in this area as whenever people are concerned, gender is a factor. Ending hunger and poverty often rank as the most critical of goals within development, and these two areas in particular need to be further fleshed out in their practical applications within the landscape architecture. The indicators on climate change were not expected to have low involvement responses. Further research is needed in understanding landscape architecture’s involvement in climate change.

Table 3 Lowest Scoring SDGs for “Involvement”

<table>
<thead>
<tr>
<th>SDG Category</th>
<th>Positive Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS</td>
<td>13.0%</td>
</tr>
<tr>
<td>• With regard to design and policies for development projects, actively promote gender equality and the empowerment of all women and girls at all levels</td>
<td></td>
</tr>
<tr>
<td>2 CONSERVE AND SUSTAINABLY USE THE OCEANS, SEAS AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT</td>
<td>14.0%</td>
</tr>
<tr>
<td>• Reduce marine pollution of all kinds, particularly from land-based activities</td>
<td></td>
</tr>
<tr>
<td>• Sustainably manage, restore and protect marine and coastal ecosystems</td>
<td></td>
</tr>
<tr>
<td>• Conserve coastal and marine areas</td>
<td></td>
</tr>
</tbody>
</table>
3 END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION, AND PROMOTE SUSTAINABLE AGRICULTURE 16.7%
- Increase productivity of small-scale food producers by securing equal access to resources, services, and knowledge
- Implement resilient agricultural practices that help maintain ecosystems, adapt to environmental disasters and improve land quality
- Maintain genetic diversity of seeds, plants, animals; ensure access to genetic resources and knowledge

4 END POVERTY IN ALL ITS FORMS EVERYWHERE 18.3%
- Ensure equal rights to natural resources and control over land
- Build resilience of the poor exposed to climate-related, social and environmental disasters
- Create pro-poor and gender-sensitive development strategies

5 TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS 20.8%
- Strengthen resilience and adaptive capacity to climate induced hazards in all countries
- Integrate climate change adaptation and mitigation strategies into development plans and poverty reduction strategies
- Improve education and awareness on mitigating climate change

The lowest scoring SDGs regarding “relevance” were gender equality; ending hunger; ensuring healthy lives; ensuring equity of education; and ending poverty (see Table 4).
The discussions for relevance of gender equality and ending hunger and poverty directly relate to the discussions of these goals and their level of involvement; these areas and their relationship to landscape need to be explored in greater depth.

It is also interesting to note that while the goal to end hunger scored low for relevance, there seems to be much discussion on food systems, rural landscapes and an emphasis on community gardens within the profession. Similarly, it was expected that healthy lives would score higher for relevance given the discussions on walkable communities and pollution mitigation. None of these categories are seen as irrelevant by the participants—even with the lowest score there were still nearly 60% of respondents who thought gender equality was relevant to the profession, but that is significantly different from the 96% who indicated that conserving ocean resources was relevant.

Table 4 Lowest Scoring SDGs for “Relevance”

<table>
<thead>
<tr>
<th>SDG Category</th>
<th>Positive Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS 59.5%</td>
<td></td>
</tr>
<tr>
<td>• With regard to design and policies for development projects, actively promote gender equality and the empowerment of all women and girls at all levels</td>
<td></td>
</tr>
<tr>
<td>2 END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION, AND PROMOTE SUSTAINABLE AGRICULTURE 68.7%</td>
<td></td>
</tr>
<tr>
<td>• Increase productivity of small-scale food producers by securing equal access to resources, services, and knowledge</td>
<td></td>
</tr>
<tr>
<td>• Implement resilient agricultural practices that help maintain ecosystems, adapt to environmental disasters and improve land quality</td>
<td></td>
</tr>
<tr>
<td>• Maintain genetic diversity of seeds, plants, animals; ensure access to genetic resources and knowledge</td>
<td></td>
</tr>
</tbody>
</table>
3 ENSURE HEALTHY LIVES AND PROMOTE WELL-BEING FOR ALL AT ALL AGES 73.9%
   • Prevent epidemics of tropical and water-borne diseases
   • Reduce deaths and injuries from road traffic accidents
   • Reduce health-related issues from hazardous chemicals and air, water, and soil pollution

4 ENSURE INCLUSIVE AND EQUITABLE QUALITY EDUCATION AND PROMOTE LIFE-LONG LEARNING OPPORTUNITIES FOR ALL 74.0%
   • Ensure that learners acquire knowledge and skills needed to promote sustainable development including human rights, promotion of culture of peace and global citizenship, and appreciation of cultural diversity
   • Build and upgrade education facilities that are safe and inclusive

5 END POVERTY IN ALL ITS FORMS EVERYWHERE 75.0%
   • Ensure equal rights to natural resources and control over land
   • Build resilience of the poor exposed to climate-related, social and environmental disasters
   • Create pro-poor and gender-sensitive development strategies

7.3 Basic Needs and Developing Places

The overall trends between the 3 common highest scoring and 3 common lowest scoring goals divide themselves between "sustainability, terrestrial ecosystems and water management" on the high-scoring end, and "gender equality, ending hunger, and ending poverty" on the low-scoring end. The indicators for the respective groups suggests that while there is a trend for landscape architects to better identify with physical rather than social landscape issues, it is not clear-cut and it is not exemplified in all cases. (see Table 5).

Table 5 Shared SDGs for Both Relevance and Involvement Categories

<table>
<thead>
<tr>
<th>High Scoring</th>
<th>Low Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTIVE PATTERNS</td>
<td>ACHIEVE GENDER EQUALITY AND EMPOWER ALL WOMEN AND GIRLS</td>
</tr>
<tr>
<td>PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS</td>
<td>END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION, AND PROMOTE SUSTAINABLE AGRICULTURE</td>
</tr>
<tr>
<td>ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL</td>
<td>END POVERTY IN ALL ITS FORMS EVERYWHERE</td>
</tr>
</tbody>
</table>

Of particular interest is that the lowest categories for relevance are some of the most basic, primal needs for human existence and rank among the top concerns in international development. Poverty is one of the most important and most commonly addressed issues in international development, food and health are inaccessible by a vast amount of the global population, and sensitivity to gender issues is vital in every development issue where people are concerned. These are basic human rights and physiological needs.
Certainly the other components of physiological needs would include water issues and human habitat—both of which did rank high in relevance to landscape architecture. Is there a way that gender, hunger and poverty issues can be addressed by landscape architecture with the same explicit dedication to sustainability, protection of terrestrial systems, and water management? How would those sustainable practices and applications function in developing contexts?

8 CONCLUSION

There is a considerable opportunity for landscape architects to develop appropriate theory and application towards advancing both social and environmental conditions in the developing world, especially in light of the vast number of people who are afflicted by place-based societal issues such as inadequate natural and built environment habitats, limited or lack of access to basic human needs such as shelter or clean water, and lack of power to affect change or make decisions that would improve quality of life for a community. Because so much of the global development problems concern water, agriculture, habitat, natural resources, and landscape, it seems that landscape architects would have much to contribute. If it is true that landscape architecture is a profession that promotes social and environmental well-being, then the SDGs have identified specific areas of both environmental and societal concerns that could complement theoretical and practical approaches within the profession of landscape architecture as well as vice versa. This is especially true for projects that might address basic life requirements for people who simply do not have them.

9 REFERENCES


URBAN DESIGN

Edited by Madis Pihlak
INVESTIGATING COMMERCIAL PEDESTRIAN SPACES
BASED ON FORM-BASED CODES

CHEN, DAN
Department of Landscape Architecture, Shanghai Jiao Tong University, China, danchen.gator@sjtu.edu.cn

ZHANG, BO
Department of Landscape Architecture, Oklahoma State University, zhangboarch@gmail.com

CHE, SHENGQUAN
Department of Landscape Architecture, Shanghai Jiao Tong University, chsq@sjtu.edu.cn

1 ABSTRACT
Recently, form-based codes have become widely used in North America, with rapid increasing adoptions by different communities since 2003. Considering its popularity, it is essential to know the working mechanism and applicability of a form-based code. In this study, we use eight key elements selected from general form-based code to investigate commercial pedestrian spaces at Yorkville in Toronto, Canada. These eight parameters are: 1) continuity of building façade, 2) distance between buildings and sidewalks, 3) ratio of building height to the width of a street, 4) parking arrangements, 5) open spaces, 6) welcome entrances, 7) attractive windows, and 8) street plantings, which is concluded from the official website of form-based code. Specifically, we use these eight parameters to investigate and analyze the degree of matching between the elements used in Yorkville pedestrian spaces and those required by the general form-based code. In addition, a user-generated photography based analysis is employed to identify the characteristics that attract visitors. By searching photos posted by visitors on Flickr representing positive street experience (3,000 photos), we observe and analyze the elements perceived in those pedestrian streets. The results of this study characterize the features of popular pedestrian spaces that match those in the general form-based code. In addition, we identify the elements that are required by the form-based code but are not evident in the photo pool, and the elements suggested by visitor’s photos but are not mentioned in the form-based code. These mismatches also suggest several possible improvements over the current form-based code.

1.1 Keywords
Form-base code, pedestrian spaces, design elements
2 INTRODUCTION

2.1 Form-based codes

A form-based code is a regulation generated through controlling physical form of buildings and spaces to foster predictable urban forms, which is different from a traditional zoning plan. Conventional zoning plan separates various zoning based on land use, which brings many problems to the urban development of past half-century (Sitkowski, 2006). It divides lands and communities into zones of apartments, large houses, small house, education, offices and industry. To move among these areas, people have to drive, causing problems to modern cities including urban sprawl, population clustered by income, unfriendly transportations to pedestrians, and the disappearance of social gathering places, as discussed in the book “The Death and Life of Great American Cities” by Jane Jacobs (1961).

Separating incompatible land uses is reasonable, such as industrial areas and residential areas, while many land uses are compatible, effectively mixed land use bring benefits to communities. Form based codes encourages a mix of land use, and is what New Urbanism promotes. Conventional zoning regulates density use, floor area ratio, setbacks, parking requirements, maximum building heights, etc. In another way, form-based codes regulate street and building types, build to lines, number of floors, and percentage of built site frontage (Parolek et al. 2008). Form-based codes consider the development regulation from a new perspective. They help to build safe neighborhoods, communities and streets which are friendly to pedestrian, and preserve community history and environment.

A form-based code consists of a regulation plan, that mainly includes public standards building standards, and administration. A regulating plan is a map of the regulated area locating the areas where different form standards apply. Public standards regulate elements in the public area, such as sidewalk, travel lanes, on-street parking, street trees and furniture, etc (Parolek et al. 2008). An effective public standard creates comfortable and useful spaces for many activities, including walking, bicycling, driving, public transit, and relaxing. They ensure that the public space works for everyone, rather than just for transportation. Building standard control configurations, and function of buildings, include distances from buildings to sidewalks, the minimum window area of a building, ratios of buildings’ height to the width of the streets, accessibility of front entrances, and building’s parking. Lastly, the administration ensures the application and review process (Parolek et al. 2008).

In addition, a form-based code may include the following aspects: architectural standards controlling the materials and qualities of building facades; landscaping standards controlling landscape design; signage standard controlling sizes, materials, illumination and location of signage; and environment resource standards controlling issues like storm water drainage, tree protection, low impact development, etc (Parolek et al. 2008).

Recently, more and more communities have adopted form-based codes in North America, especially since 2011, showing the wide application of form based codes. However, form-based codes have their inherently flaws, such as incompleteness and expensiveness. For instance, form-based code is not as easy to understand as it mentioned. In addition, a code that is conceptual easy does not mean it is easy to implement. To simplify form-based codes, only those standards that are necessary should be established. Despite its flaws, form-based codes are predictable, well-illustrated, mixed use oriented, and address regional and local scale.

In this study, we use eight main characters of form-based codes to study Yorkville area (Parolek et al. 2008). The eight parameters are: 1) continuity of building façade, 2) distance between buildings and sidewalks, 3) ratio of building height to the width of a street, 4) parking arrangements, 5) open spaces, 6) welcome entrances, 7) attractive windows, and 8) street plantings, concluded from “Form Based Codes: a guide for planners, urban designers, municipalities, and developers” by Parolek et al. (2008). To indicate the application value of form-based codes, we study Yorkville that is a historical and successful commercial area, discuss how important element of form-based codes are applied in Yorkville, and is there any other element that a successful place may have. This paper aims to prove the value of key characteristics from form-based codes and investigate the essential characteristics of a popular mixed land use (commercial and residential).
2.2 Yorkville in Toronto

The village of Yorkville was founded in 1830 as a residential suburb. The Victorian-style residential architectures and the pedestrian friendly neighborhood survive until today. With the opening of many high end businesses, Yorkville was becoming a top grade commercial area in City of Toronto in 1980s (Figure 1).

In this article, we study the southwest part of Yorkville, with a north boundary of Scollard St and an east boundary of Yong St. The total area is around 2,000,000 square feet. Most streets in Yorkville consist of two lanes for general traffic, and they are highly walkable and encourage pedestrian experience.

Figure 1. The map of Yorkville and boundary of the study area (Edited from Google map2014)

Today, Yorkville is an upscale shopping and residential district in Toronto, Canada, including the Holt Renfrew store on Bloor Street, Luxury hotels such as Four Seasons, Canada's largest museum and the fifth largest in North America, the Royal Ontario Museum, and Toronto's most expensive, etc. Since it is a successful model for a popular neighborhood, this study selects the southwest part of Yorkville to study the essential elements that consist of this commercial-residential mixed used area.

2.3 Yorkville Park

In 1993, the land Yorkville Park was built on was used as a parking lot. Local residences insist that they needed a park here as early as 1950s, which encourage the built of this park. The objectives of this park are: “to reflect and extend the Victorian scale and character of the original village; to provide ecological opportunities and display of native plant species and communities; to provide a variety of spatial and sensory experiences; and to link the park to existing pedestrian walkways and adjacent areas.

To achieve these objectives the park was divided into ten different gardens with distinct spaces, reflecting landscapes of Canada - pine grove, prairie, marsh, orchard, rock outcropping and so on. The ten gardens are arranged in the layout style of the nineteenth century row houses, extending the character of this Victorian style. The Village of Yorkville Park becomes a local landmark since its completion in 1994, though its size is small.

3 METHODOLOGY

In this study, we use the eight key elements previously stated to investigate commercial pedestrian spaces at Yorkville in Toronto, Canada. Specifically, we use these eight parameters to investigate and analyze the degree of matching between the elements used in Yorkville pedestrian spaces and those required by the general form-based code.

Besides the study of the eight parameters, a user-generated photography-based analysis is employed to identify the characteristics that attract visitors. This method is sourced from photo elicitation which is based on the simple idea of inserting a photograph into a research interview (Harper, 2002). Stepchenkova & Zhan (2010) applied the user-generated photography to compare the projected and
perceived tourism destination. To study visitors’ experience, photos are more effective than words alone. This study adapts the user-generate photography method to study the essential elements from form-based codes and Yorkville neighborhood.

Flickr is one of the best website for photo management, and attracts a large number of users all around the world. After searching “Yorkville, Toronto”, all photos under this theme are shown, and we choose the top 3,000 photos on December 07, 2014. By searching photos posted by visitors on Flickr representing positive street experience, we are able to observe and analyze the elements perceived in those pedestrian streets. For each photo, all elements shown in the photo are recorded, and the numbers are counted to get percentages. For example, for each element, we computed the number of times that this element appears in the total of 3000 photos.

The results of this study characterize the features of popular pedestrian spaces that match those in the general form-based code. In addition, we identify the elements that are required by the form-based code but are not evident in the photo pool, and the elements suggested by visitor’s photos but are not mentioned in the form-based code. These mismatches also suggest several possible improvements over the current form-based codes. In general, all parameters keep the characters derived from the overall historic and aesthetic values of buildings, streets and open spaces together.

4 RESULTS
4.1 Application of eight parameters presented in Yorkville

4.1.1 Continuity of building facade

The architectures in Yorkville are well preserved with consistent house forms reflecting the unique mix of Victorian Toronto life. Among almost 200 properties in Yorkville, more than 65% were built before 1900, and there are 39 properties were built even earlier. These buildings have a coherent sense of scale, material, and rhythm (Yorkville-Hazelton Area Heritage Conservation District Plan, 2002).

The buildings have a mixture of 19th century housing types, built close together and sharing a similar experience with the street (Figure 2). These human-scaled commercial/industrial properties are built of wood, stucco, and brick. Building facades are unified with building style, color, or material. There are consistent floor heights from 2 to 3 stories throughout, with steep pitched gables, foundations, porches, front steps and window openings that vary from street to street and by their scale. The form, rhythm, proportions and texture of steep pitched gables support the heritage character of the individual building and the whole area. Porches, porticos, and exterior stairs are integral to the principal elevation and have a similar proportion and an open appearance to traditional porches in the District. Brick is the predominant material in this District.

Figure 2. Boutiques in Yorkville (Photo by Author)
4.1.2 Distance between buildings and sidewalks (streets)

The consistent relationship between a house (front door) to the sidewalk and the street lies on the distances between buildings and sidewalks, and these spaces are taken advantages to be used as planting areas, plazas, steps, and seating areas. These diverse spaces provide various opportunities for visitors. The planting areas improve and beauty the environment, and the plazas and seating areas create places for gathering, talking and relaxing. Figure 3 shows a typical place in Yorkville where there are gathering spaces between buildings and sidewalks. For instance, the Yorkville Ave, with an 80’ building-face-to-building-face width has an approximate 20’ to 30’ relationship between front doors and sidewalks on both sides of the street which are wide in the district. Several internal streets have 50’-60’ building-face-to-building-face distances and approximately 12’ to 24’ relationship between front doors and the sidewalk. In general, these spaces benefit the pedestrian environment and help build a walking friendly neighborhood.

4.1.3 Ratio of building to height to width of a street

We use W to represent the width of a street, and H to represent the height of the building along that street. If W/H<1, the space is enclosed, long and narrow, providing a driving force of moving forward. If W/H=1, there is a balance between width and height, and there is no obvious feeling of enclosed or open. In this situation, it is better to adding plants or art installations along the street (Figure 3). If W/H>1, the enclosed feeling decreases, with a sense of open. If W/H>4, the space loses the relationship between two sides of a street. Previous studies (Yoshinobu, 2002, etc.) show that people prefer enclosed spaces without any sense of oppression from buildings; therefore, a favorite ratio of W/H is between 1 and 2.

Compared to modern streets, streets of old time have smaller ratios of W/H, and create intimate feelings. It is the function that determines the scale of streets. The street spaces for automobile are absolutely different from those for pedestrians. As a modern city, wide streets are required for City of Toronto considering the large traffic flow. Though Bloor Street is 20meters wide, its ratio of W/H is still smaller than 1 because of the high-rise along Bloor Street.

The ratio of building height to the width of a street varies in the study area. The buildings are generally located between 12’ and 30’ from the street. In general, the ratio is high, and greater than 1:1. There are many pedestrian streets with a width of only 2 to 3 meters. This human-scale street interprets the intimate lifestyle in the old time to visitors.

Figure 3. Different street scales in Yorkville(Photo by Author)
4.1.4 Parking arrangements

There is a large parking building in the study area, and the first floor is used for commercial. Besides the parking building, on street parking is encouraged (Figure 4). Parking is allocated primarily to the street with few cars between building face and the street. Comparing to other ways of parking, on street parking is convenient and economic. In Yorkville, where luxury cars are more likely to appear, on street parking becomes an attraction. In addition, street parking helps reduce the traffic flow and create a street that friendly to pedestrians.

![Image of parking arrangements]

Figure 4. Parking arrangements (Photo by Author)

4.1.5 Open spaces

As mentioned before, the Yorkville Park is arranged in the layout pattern of the nineteenth century row houses to express the Victorian style of collecting landscapes of Ontario. The park is a bridge between the old neighborhood to the left and the high rises of Toronto’s urban redevelopment to the right and beyond. In addition, the divided park creates diversity experiences and extends the spatial depth, therefore, increase the perceived size of this one acre park.

It has been found that open spaces provide social, health, economic, and environmental advantages to cities (Woolley, 2003; Waits, 2008; Garvin & Brands, 2011). With the Village of Yorkville Park being fifteen years old, it is clear that these benefits have been reached. This place, which used to be a parking lot, has been transformed to an attractive oasis providing year-round interest for relaxing, dating, tourism, etc. The park now serves as a popular meeting place for residents, business owners and tourists.

Here we discuss several points proposed by the project statement of Village of Yorkville Park from the website of 2012 ASLA Professional Awards, which are transparent “rain curtain”, steel arbor, granite outcrop, and some seating opportunities.

**Transparent Rain Curtain:** The transparent “rain curtain” fountain provides an experience of raining, as well as creates white noise during the warm seasons and become ices in the winter seasons (Figure 5). In addition, the “rain curtain” separates the park into two parts, where the granite outcrop part is busier and another part that is more quite. This transparent “rain curtain” works as a screen which appears in the traditional Chinese indoor design and it frames views.

**Steel Arbor:** The galvanized steel arbor aligns with an adjacent mid-block passageway, connecting the park to Bloor Street (Figure 5) and mixing the park into the entire layout of Yorkville area. The material and color of the steel arbor is same to the rain curtain, with a sense of sculpture. The arbor has become a popular sitting place for talking and reading. The pavement under the steel arbor breaks the stiffness of straight lines, and the passageway keeps the human-scale experience.
Granite outcrop: A reconstructed native Muskoka granite outcrop creates the dominating terrain feature of the park, and provides visitors a high perspective to observe the whole area (Figure 6). This place provides a vantage place with high-rise as its background, and it is the most popular and busiest space in the park. Many activities happen here, including meet, talk, eat, and relax. People observe surroundings and they are observed.

Seating opportunities: Seating opportunities are everywhere throughout the Yorkville Park, including movable cafe tables and chairs, built-in seats at the arbor, stone slabs with suitable height (Figure 6), the granite outcrop, as well as seat concrete rings in the area of Pine grove. These seating opportunities are design to be well involved into the landscape. Visitors have many choices to use the diverse spaces created in this park.

4.1.6 Welcome entrances
Doors located on the principal elevations are an important expression of the character and architectural style of the building in study area and they are the linkage between public and private realms.
To attract visitors, the store entrances in Yorkville usually are carefully designed with novel forms and detail decorations. Front doors must face the street, with clear sight lines to the sidewalk (Figure 7). Most of the entrances have awning to be a transaction between interior and exterior. The style and material of these entrances represent the building culture of Yorkville. In addition, glass entrance is used quite often, which connect interior and exterior and create rich hierarchies.

4.1.7 Attractive windows

Windows are essential to the overall architectural character of the building, and attractive windows is definitely a remarkably feature in Yorkville (Figure 7). The window proportions in the District are generally vertical and rectangular. Windows and other openings in the visible elevation of the additions repeat the proportions, location and rhythm of windows in the existing building. Large glass windows with a superb collection of beautiful goods connect interior and exterior, and attract visitors to stop and shop. During the night, bright and colorful windows light up the whole area and form a flourishing and safe commercial area.

![Figure 7. Welcome entrance and attractive windows (Photo by Author)](image)

4.1.8 Street plantings

Views created by the canopy of street trees, boulevards and sidewalks are essential to the experience of the district. There are various types of street plantings, including alee-trees, shade trees, flowerbeds and tubs, and climbing trees. Most streets are lined with mature deciduous trees that creating an intimate street shed and enclosure spaces that is losing on the other streets in the district. Besides mature trees, sidewalks are complimented by small, intensely planted front yard gardens, and other planting boxes and containers. Most trees are native in the area which includes Freeman Maple Autumn Blaze, Red Oak and White Ash. Planting beds and grass treatment along the boulevards are maintained well, with proper drainage system.

4.2 Photo elicitation

A total of 3,000 photos from the Flickr were used in this study. The frequency of each parameter is shown in Table 1. The attractive windows are the primary parameter that is photographed by most people, followed by street plantings, open spaces, welcome entrances, continuity of building facade, ratio of building height to the width of a street, and distance between buildings and sidewalks. Nearly half of the photos (49.7%) are related to attractive windows, indicating its essential influence to visitors’ experience. Street planting is the second most important parameter from the photo elicitation, showing that visitors directly experience them and that they are fundamental to the district. The next important parameter is open space.
which becomes a landmark in Yorkville. In addition, entrances are also noticed by visitors, reflecting the successful design.

Table 1. The frequency percentage of eight parameters showed in the photo elicitation study

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuity of building façade</td>
<td>8.3%</td>
</tr>
<tr>
<td>Distance between buildings and sidewalks</td>
<td>6.5%</td>
</tr>
<tr>
<td>Ratio of building height to the width of a street</td>
<td>7.2%</td>
</tr>
<tr>
<td>Parking arrangements</td>
<td>5.8%</td>
</tr>
<tr>
<td>Open space</td>
<td>27.3%</td>
</tr>
<tr>
<td>Welcome entrances</td>
<td>20.7%</td>
</tr>
<tr>
<td>Attractive windows</td>
<td>49.7%</td>
</tr>
<tr>
<td>Street plantings</td>
<td>29.5%</td>
</tr>
</tbody>
</table>

In addition, there are other elements that often appear in photos, see Table 2. This table shows that activity is captured more often than other elements, followed by night scene, art installations, residential property, and so on. The popular activities reflected from photos are Icefest, Holiday Magic, automobile exhibitions, World Pride, and other local events. The reasons that Yorkville attracts so many activities are 1) Yorkville Park provides various spaces serving different types of activities; 2) Yorkville is one of Canada’s most fashionable shopping districts; 3) historical and cultural background (by the 1960’s Yorkville was the heart of one of Toronto’s finest and most creative arts communities, and is known as the Canadian capital of the hippie movement). In addition, the night scene is another key element that attracts visitors. Art installations represent art, culture, and aesthetic, which is essential to a livable commercial district, especially a historical commercial district. Residential properties retain and extend the Victoria-style of this area, forming the character of this district.

Table 2. The frequency percentage of other elements showed in the photo elicitation study

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art installations (sculptures, clock, drawings)</td>
<td>8.1%</td>
</tr>
<tr>
<td>Activities</td>
<td>17.6%</td>
</tr>
<tr>
<td>Night scene</td>
<td>12.0%</td>
</tr>
<tr>
<td>Residential property</td>
<td>8.1%</td>
</tr>
<tr>
<td>People</td>
<td>7.0%</td>
</tr>
<tr>
<td>Architecture (Museum, church, fire station)</td>
<td>3.6%</td>
</tr>
<tr>
<td>Landscape Furniture(fountains, advertisement, light)</td>
<td>5.2%</td>
</tr>
<tr>
<td>Diverse Pavement</td>
<td>1.7%</td>
</tr>
<tr>
<td>Others(Interior, food, Motorcycle)</td>
<td>8.0%</td>
</tr>
</tbody>
</table>

5 DISCUSSION & CONCLUSIONS

In general, all eight parameters play important role in attracting and impressing visitors. The most influential parameters are open spaces, welcome entrances, attractive windows, and street plantings. The Yorkville Park, as the major open space in the study area, reflects the scale and context of the neighborhood, incorporates the native ecology of the surrounding region, and make connections with the circulation of local streets and a system of midblock passageways, therefore, creating a sense of place for local people and an attractive place for visitors. Yorkville Park celebrates the history of Yorkville and reflects the diversity of the Canadian landscape. The attractive windows are the soul of the commercial district, without which this area would be a backwater. The glass windows combine the old building style with modern material and fashion, and project the cultural inheritance. More important, they pass the information that comprises the sense of the place, as well as the welcome entrance.

Entrances are important elements on the principal elevation and should address the street and be clearly visible. Style and type of doors reflect the character and the architectural style of the building. The
scale of humanity of entrance invites people, and contributes to the popularity of Yorkville. Finally, various types of street plantings provide shades, green, sense of nature, and colorful views to visitors, which is absolutely one of the most important elements to attract visitors in a shopping district.

In addition, continuity of building façade, distance between buildings and sidewalks, ratio of building height to the width of a street, and parking arrangements are essential for creating a friendly space and neighborhood, though they do not happen as frequently as the other four parameters. The continuity of building façade assures the quality of the overall architecture, and keeps visitors' visual perception in a stable mode, which is essential for creating a sense of continuous space and a sense of place. The similar architectural style and overall proportions of the residential buildings balance and complement one another. Distance between buildings and sidewalks takes advantage of small spaces to provide more choices and activity opportunities to visitors, which makes the spaces more diverse and friendly to pedestrians. The high ratio of building height to the width of a street creates various scale of pedestrian streets, from human scale paths to automobile streets, making Yorkville thriving. Two types of parking arrangements meet the requirements, and form this area making Yorkville a car exhibition show district.

Moreover, some other elements attract the camera; activities and night scenes highly occur in the photo elicitation. The reason for highly noticed activities and night scenes lies in the spaces that designers created, which include the parameters that help create this kind of place. Therefore, we believe that the high frequency of activities and night scenes is an underlying reflection of the application of the above eight main parameters.

In summary, parameters from form-based codes contribute to the visitors' experience in the study area. Open spaces, welcome entrances, attractive windows, and street plantings are the most influential elements for visitors' experience in Yorkville. While continuity of building façade, distance between buildings and sidewalks, ratio of building height to the width of a street, and parking arrangements are elements that form the space, their frequency of showing in the photos are not high. Besides these eight parameters, activities and night scene are also essential, which also indicate the importance of spatial layout and the main parameters from form-based codes. Therefore, this paper suggests that form-based codes should consider adding regulations on forming open spaces for activities, and regulating light design for night scenes.

6 REFERENCES


SUSTAINABLE URBAN DESIGN STRATEGIES FOR HISTORICAL URBAN LANDSCAPES: CASE STUDY OF IZNIK CITY (TURKEY)

CENGIZ, CANAN
Bartin University, Department of Landscape Architecture, Turkey  canankapuci@yahoo.com

CENGIZ, BULENT
Bartin University, Department of Landscape Architecture, Turkey  bulent_cengiz@yahoo.com

1 ABSTRACT

Historical cities are the cultural sites which carry the traces of the features of the former civilizations including social and economic structure, life philosophy, architectural style, mind of settlement and aesthetic sensitivity. In choosing a land for these cities; geographical location, social events and natural structures were determinant factors and different urban planning models have been emerged. In this paper, Iznik City (Bursa, Turkey) which is very significant center for religion tourism is investigated in terms of urban design of its historical structure. Iznik is in UNESCO World Heritage Tentative List since 2014. In this study, reflections of different civilizations hosting the city throughout the history and effects of changing social structure to the development of the city were studied. Hellenistic, Roman, Byzantine, Seljukian and Ottoman periods specific to military, political, cultural, religious, and economic development hosted by Iznik City has been demonstrated. The development of the city is discussed in the historical and spatial development process as urban landscape characters. In this context, the stages of the study consist of (i) historical and spatial development process of Iznik City, (ii) natural (topography, Iznik Lake, soil, geology and seismicity, climate) and social (religious factors, economy, social events, the art of tile-making) factors that affect historical urban landscape of Iznik, (iii) historical urban landscape features of Iznik, city plan, city walls and gates, current historical structures in the city as well as the Iznik Lake and the olive orchards that provide unity with the historical structure (iv) within this framework design strategies related with preservation-revitalization and tourism were developed towards the sustainability of urban cultural heritage. In this context, to evaluate the integrated planning and design work in urban scale relation with the pedestrian work with each other and the environment as well as the protection of urban structures and places in one building scale is important. Concurrently, as complemented historical pattern elements, Iznik Lake and olive groves are important outcomes of the study on handling within the entire historical urban landscape and on the evaluation within design strategies. Moreover, Iznik has a highly significant potential in terms of cultural tourism as a capital, a city of trade routes, a center of science and culture in addition to being a religious center in terms of religious tourism for Christians.

1.1 Keywords

Historical urban landscape, urban design, Iznik city, urban sustainability
2 INTRODUCTION

Anatolian lands that have been selected as settlement areas since the Prehistoric Ages until today have rich historical and cultural data. The reflection of the rich historical structure of our country to the current cultural values increases spatial attractiveness (Kapuci, 2004). Historical structures and areas that have to be preserved with their cultural, social, economic, archeological and aesthetic values increase the perceptibility of cities by transferring the emotions, thoughts, social life and accumulations of the period they were built in to our day (Velioglu et al., 1993). Historical cities that have been able to reach our day as elements that reflect the style of living of a society make up the historical landscape. By hosting various civilizations shaped over time with the cultures and traditions of societies, these spaces have created environments in which the generations of our day and especially of the future can live in (Yazgan et al., 2000). Geographical location, social events and natural structures have been determinant in the selection of the locations of historical cities and various different urban planning models have emerged. These urban forms that differ with respect to the goals for which societies use nature and their ways of life have reached our day with their historical landscape identities by developing into the cultural landscape of our day. In this sense, historical cities include spatial arrangements in which the defects in urban planning works that are experienced in the cities of our day do not exist.

Cities are the expressions of the cultural, social and economic structures of people in space. The urban spaces created by societies in different stages have completed their formations through a historical process with reference to a center determined by natural, economic or military strategic factors. Cities can be classified in two categories based on their reasons of development; first category includes cities that have been established in history for political, military and economic reasons and that have developed primarily with the effects of these priorities thus emerging slowly over time. Whereas the other category includes cities that have been established with the request of the leader of a society or a government. The difference between these two models is that the first is created slowly over time in accordance with the time and conditions of a small congregation; whereas the second is actualized in accordance with a predetermined plan. The cities that are included in the first group are settlement areas that have developed naturally. Whereas the second is included in the class of cities that have urbanized later (Karaca, 1999). Even though the cities that are included in the natural city group have a formation process dating back to antiquity, they have been established as a result of a plan. The logic of spatial organization in the establishment of cities constitutes the foundations of the concept of urban identity. The stages of the establishment of a city in which elements that define the city come together have developed under the effect of certain strategies and factors. The formation of cities depends on geographical, topographic, climatic and physical qualities as well as social, cultural and economic factors. The locations and plans of cities differ significantly since these factors are quite different in comparison with each other (Karaca, 1999). In this regard, social and natural elements have been determinant in the formation of historical cities that comprise the historical memory of societies, ensure their cultural continuity and function as bridges between the past and the future. Social factors that affect urban settlement: are military, religious and economic factors. Whereas natural factors that affect urban settlement are; climate conditions, topographic structure, proximity to sources of water and soil properties.

3 MATERIAL & METHOD

3.1 Material

The town of Iznik that has been selected as the study area is a town under the governorship of the city of Bursa located in the Marmara Region of Turkey that is located to the easts of the lake known by the same name (Figure 1). Iznik has been established around the intersection of the N40-21 40-37 longitude and E29-30 29-57 longitude. (Bodur, 2000). Total population of 43 287 (TUIK 2014).

Served as a capital city to Seljukian, Byzantine and Ottoman states respectively, Iznik bears exceptional testimony to early examples of cultural, architectural and artistic accomplishment of these cultures. It hosted the most important examples of early church in the history of Christianity. The earliest examples of mosque, madrasa and soup kitchen belonging to the Ottoman Period were all constructed in Iznik. It is also a place of co-existence displaying unique synthesis of cultural, architectural and artistic creations of Byzantine and Ottoman cultures, evidence of which can be found in the form, design, material and artistic features of the buildings which were built in the transition period from the Byzantine to the Ottoman Empire.
In the meantime, the study area is included in the UNESCO World Heritage Temporary List as of 15.04.2014 and meets the II. III., V. and VI. criteria.

### Figure 1. Geographical location of the study area (modified from Kapuci 2004).

#### 3.2 Method

The study consists of four stages:

(i) The historical and spatial development process of Iznik: The importance of the civilizations it has hosted throughout history and the reflections of the changing social structure on the space have been examined in terms of urban development. Iznik reflects the characteristics of the Hellenistic period with its Hippodamos City plan. It completed its urbanization process during the Roman period. Iznik developed in terms of religion, politics, culture, military and economy during the Byzantine period and became a religious center. Iznik was the first capital city of the Turks in Anatolia during the Seljuq period. Whereas it had an important place in the world history of culture during the Ottoman period thanks to the art of tile making and thus reflected this to all the art works of the period.

(ii) Factors affecting the historical urban landscape of Iznik: Natural (topography, soil, geology and seismicity, climate, Iznik Lake) and social (religious, economy, social events, Iznik tile) factors.

(iii) Iznik Urban Landscape Features: City plan, walls and gates, current historical structures in the city as well as the Iznik Lake and the olive groves that provide unity with the historical structure have been handled.
(iv) Within this framework, design strategies related with preservation-revitalization and tourism were developed towards the sustainability of urban cultural heritage.

4 HISTORIAL & SPATIAL DEVELOPMENT PROCESS OF IZNIK

Iznik or known in history as Nikaia is built on a fertile plain to the east of the Iznik Lake within the borders of the city of Bursa surrounded by mountains. It is known that the city was founded in 316 BC by Antigonus who was one of the generals of the Macedonian Emperor Alexander and traces of settlement on the city grounds date back to the prehistoric ages. It became one of the most important Hellenistic cities of Anatolia during the Bithynia empire period, was transformed into a magnificent city during the Roman period and became a religious center during the Roman period when it hosted two Ecumenic Consuls (325 and 787) after which it gained an important place in the world cultural history during the Ottoman Period as a tile manufacturing center. The city walls with a total length of about 4,970 meters have four monumental gates and many towers and have carried the traces of the civilizations and cultures that have been dominant in the area for about two thousand years to our day and age. (http://www.kulturvarliklari.gov.tr/TR,93767/Iznik-bursa-2014.html).

The city of Iznik that is positioned with various militaristic, political, religious, social and cultural effects that has been able to preserve the rich texture it has is one of the most important historical centers of our country. The interaction between the urban texture that has been structured with physical, architectural and aesthetic elements in different period with the dynamic social life has an important place in the urban development of the city (Anonymous, 2000a).

Iznik is an important historical city reflecting the militaristic, political, social and cultural ways of life during the Hellenistic, Roman, Byzantine and Ottoman periods which has underwent intense developmental activities throughout its urban development process (Anonymous 2000a). This historical structure is of great importance as one of the fundamental factors for the shaping of the current settlement texture. The civilizations that the city has hosted throughout its rich development history have been quite effective. Iznik has underwent various periods such as the Hellenistic Age (Age of the Greeks), Roman Age, Byzantine Age, Seljuq Period, Byzantine Period, Ottoman Period. The city of Iznik has been known throughout history as: “Antigonea”, ”Antigonia”, ”Nikaia Eist Nemalar”, ”Nicèa”, ”Nikea”, ”Nicaea” (Şen, 1998),”İz-i Nicea” due to the variety of the civilizations it has hosted throughout history (Yalduz, 1999).

Hellenistic Period (Greek Era): The city was founded during the Hellenistic Period. The most distinctive feature of this era is the city plan. This plan system known as “Hippodamos” was developed and popularized by the famous Miletian architect Hippodamos and in it the city founded on a flat area is surrounded by walls in the shape of a rectangle and it has four gates. The two perpendicular main streets direct one towards the temple – the Hagia Sophia Church in Iznik – and ends with these four gates. (http://whc.unesco.org/en/tentativelists/5900/; Nuhoğlu, 1995). The city plan that carries Hellenistic features is preserved today as well. There is no trace of the walls dating back to the Hellenistic Period which encircled the city.

Roman Period: The city became one of the most important centers of Anatolia during the Roman Empire Period and it was named as the Metropolis. Iznik was famous during this period with dyeing, silk production and the rose festivals organized in the name of the elderly (Yalduz, 1999). The Roman Period was effective in Iznik with significant structures (Akkaya, 1994; Bodur, 2000). The complete urbanization of Iznik took place during the Roman Period. Hence, most of the historical structures of today date back to this era. The city was located on an important trade rout during this period (Bodur, 2000). The most important structures of the Roman period that have reached our age: Ancient Roman Theater, Obelisk, Gymnasium, City Walls, İstanbul Gate, Yenişehir Gate, Lake Gate, Lefke Gate, Great Ceremony Area.

Byzantine Period: The Byzantine period manifested itself in the city with strategic properties. Iznik developed in religion, politics, cultural and economic areas during both the Roman and the Byzantine Periods and was transformed into a strong military base with strong fortifications (Karginer et al., 1963). It was in 325 AD that the first Christian Council known as the Council of Nicaea was held in Iznik with the participation of more than hundreds of bishops who came from different parts of the empire. In 787, the Seventh Ecumenical Council was took place in Nicaea in order to handle the iconoclastic controversy regarding the use of icons. The location for this council was the Hagia Sophia church. (http://whc.unesco.org/en/tentativelists/5900/) The fact that two consuls important for the world of Christianity gathered in Iznik increased the importance of the city in the world of Christianity (Şen, 1998).
The city became a city of caravans during the Byzantine Period because the roads leading to the sacred cities passed through Iznik (Nuhoğlu, 1995). Significant public improvement works were carried out in the city during this period; monasteries, churches and aqueducts were built (Eyice, 1988). All of the churches were demolished during the 1065 earthquake and the walls and towers were damaged (Yalduz, 1993).

Seljukian Period: The city went under the Seljukian rule during 1075 and was named as “Izniķ”. It was the capital city of the Seljukian Empire. Thus, it became the first capital of the Turks in Anatolia.

Byzantine Period: The city was the capital city of the Byzantine Empire in 1097. Iznik was the center of culture and arts during this period (Eyice, 1988; Erton, 1995; Şen, 1998). Iznik became a significant city with regard to politics and culture as a result of the construction of imperial and civic buildings such as the palace of the Patriarch, hospitals, charity institutions, and churches. Reinforcement works were carried out on the city walls using many towers. (http://whc.unesco.org/en/tentativelists/5900/). Hagia Sophia Church and Baptistry (Böcekayazması) are among the structures that have reached our age and that are still preserving their importance. In addition, excavation works are ongoing at the Koimesis Church, Hagios Tryphon Church and the Ayatrifon Church.

Ottoman Empire Period: The city that became the capital city twice was once the capital city of the Ottoman Empire as well. It was during the Ottoman Empire period that cultural structures were started to be built more rapidly. The Ottoman period had a special impact on the city of Iznik with its unique settlement style as well as the interest shown to the monuments preceding them. The largest church of the city, the Hagia Sophia Church was transformed into a mosque during the Ottoman Period (Öztuna, 1994; Şen’den, 1998). Tile making was one of the most important economical incomes of the city during this period. Iznik gained a world-wide renown for the second time during the Ottoman Empire as the centre for ceramic tile production which is one of the most beautiful and enduring types of Turkish-Islamic art. Iznik became famous during the 16th and 17th centuries for its beautiful tiles which decorate mosques and palaces throughout the Ottoman Empire (http://whc.unesco.org/en/tentativelists/5900/). Many inns, Turkish baths, mosques and madrasahs were built all over the city by Turkish craftsmen. This is closely related with the settlement of the Muslim public. The structures that have reached our day include; the Green Mosque, Nülufer Hatun Imaret (Soup Kitchen), Hacı Özbek Mosque, Şeyh Kudbettin Mosque, Mahmut Çelebi Mosque, Süleyman Paşa Madrasah, Murat the 1st Turkish Bath and Murat the 2nd Turkish Bath.

Republic Period: The city entered a development process based on urban tourism beginning in 1965 as its geographical location, historical values and natural structure were discovered. Development Plans as well as Reconstruction Plans for development were prepared during the development of the Republic Period (Anonymous, 2000b).

5 THE FACTORS AFFECTING THE HISTORICAL URBAN LANDSCAPE OF IZNIK

According to Akdoğan (1975), landscape forms that have emerged as a result of the various goals that humans use nature for and that differ with respect to these differences make up the cultural landscape, inform us about the relationship between human-nature from the past to the present. These urban forms that differ with respect to the goals that societies use nature for as well as their forms of living have reached our day by developing and changing over time.

5.1 Natural Factors

Topography: Land structure that is important for the character of settlement differs with respect to the reasons for settlement. Whereas hills and elevated areas or flat lands are preferred for cities that are built for militaristic purposes, flat plains are preferred for cities in which agricultural cultivation is important. The town of Iznik is located on a flat plain that is encircled by mountains. The city has been established during the Hellenistic Period. It is observed that Iznik has a Hippodamos plan as was the case during the 4th century for all Hellenistic cities (such as Ephesos, and Miletos). This plan that is also known as the grid plan has been developed and popularized by the famous Milesian architect Hippodamos. This system has been preserved for centuries and has been carried over to our day. According to this plan system, the city was established over a flat area, and is surrounded with rectangular walls. It has four gates. This plan was executed as a result of the problems that colonizing groups faced after they reached their destination regarding the best and easiest means to divide the land into plots. This rectangular plan has minimized all such problems. The city which resembles a fortress city has such features since it was established by giving primary importance to security. The urban structure for settlements which has been established for
defensive purposes, is in accordance with the topographic structure. The relationship between topography and existence of water is very important. The city is located on a flat plain surrounded by mountains and presents an image that is quite convenient for protection thanks to the effect of the lake that acts as a natural border to the west of the city. This has made the city easier to defend throughout history. Whereas the hill located to the northeast of the flat city has been used as the acropolis area of Iznik (Nuhoğlu, 1995). Another facility provided by the topography at Iznik is the transportation system. This topographic structure has enabled the application of the grid plan. This grid plan has enabled the spreading of the city in three different directions. The city plan that carries Hellenistic features has been preserved until today. The city walls are still effective elements that characterize the city and give it its identity.

**Iznik Lake:** Sources of water that encircle the city as natural borders are important as natural richness due to their importance as well as their positive effects on the climate and security. Iznik Lake covers the majority of the northwestern lands, and has played an important role during the establishment of the city. In terms of area, it is the sixth largest lake in our country and the largest in the Marmara Region with an area of 312 km² and it has provided a natural security border for militaristic reasons. The lake has also been effective in the selection of the settlement area and urban development for the city due to the possibilities it can provide the locals as well as the fertile lands around it and its aquacultural resources (Gulez et al., 2005).

**Soil Properties:** The city has suitable conditions for the public to earn their living off the land thanks to its convenient climate conditions. It’s high suitability for agriculture is due to being located on a fertile plain as well as its abundant vegetation. In addition, the city attracts attention today with its olives and vineyards as well as its special climate and fertile agricultural lands.

**Geology and Seismicity:** Iznik Lake and Plain was formed as a result of a collapse that took place during the geological eras. The collapse took place on a fault line that passed the Plain and the southern border of the Iznik Lake and continued all the way to the bay at the southern border of Orhangazi and Gemlik Plain (Anonymous, 1974). The city itself consists of the alluvial lake and river deposits dating back to the Quaternary Period that have accumulated at the collapse basin formed by the southern branch of the Northern Anatolia Fault Line (Anonymous, 2000b). Iznik has a special status geologically and is located on the southern branch of the Northeast Anatolia Fault Line. It was determined that Iznik has features that increase the current earthquake intensity due to the surface properties consisting of loose clay, silt, gravel and sand (www.Iznikdefteri.com). It was determined during the surface etudes carried out that the surface has a high risk of liquefaction since the dominant unit within the limits of Iznik Municipality borders is sand and sandy material and also it has high ground water levels (Anonymous, 2000b). Iznik is located on a 1st Degree Earthquake Region belt and it has a negative structure in terms of suitability for settlement due to its geological and hydrogeological properties as well as surface liquefaction and ground subsidence movements.

**Climate:** The distance of the town from the sea, and the fact that it is located in a hollow region surrounded by mountains that are parallel to the coast determine the climate of the region, gives the city a climatic advantage. Iznik has a mild climate where the Mediterranean climate effects are observed, as well as the regional Marmara climate. The fact that Iznik is surrounded by mountains in the north is one of the most important factors resulting in the fact that its temperature does not drop too low. This has positive effects on the agricultural and life quality in the city.

### 5.2 Social Factors

**Religion:** The location and intensity of the sacred structures which are the expression of religious beliefs on the space give us ideas about the periods they were built in and the civilizations they served. The main streets continue onwards to the temple – Ayasofya Church in Iznik – and they intersect to form a cross (Nuhoğlu, 1995). These two important arteries that constitute the basis of transportation in the city while connecting the gates in the north-south and east-west directions are still important even today.

**Economy:** One of the factors that is important for the location of the city in addition to defensive measures is the means of livelihood of the public and the existence of rich natural resources. The fact that the city is close to important trade and caravan routes is important among the economic factors that have been important for the selection of the location for the city. Sea trade was carried out via the Gemlik Strait-Iznik Lake-Sakarya River-Black Sea without passing through the Istanbul Bosphorus. The fact that Iznik is located on this trade axis shows its strategic importance (Bodur, 2000).
Social Events: The city has been home to an important event; when Christianity was recognized as a free religion during the reign of Constantinus the 1st. More than 318 leading religious figures came together for a meeting known as the 1st Ecumenical Council on May 20, 325 A.D. to discuss religious issues. The Iznik council was a turning point for the world of Christianity. One of the four Bibles accepted by the Christian world today originated here (Yalduz, 1999). Iznik has been a significant center of settlement thanks to its location on the trade route in addition to its strategic location. The city also hosted many caravans during the times when Christianity was accepted since all roads to holy cities passed through Iznik (Nuhoğlu, 1995). Large building works were carried out in the city during the Byzantine Period thus resulting in the building of monasteries, churches and aqueducts (Eyice, 1988).

The Art of Tile Making: The origins of ceramic art can be dated back to the Neolithic Site of Çatalhöyük and it reached its perfection during the 16th century in Iznik. Glazed technique was discovered by the Assyrians even though the first known ceramic production dates back to 3rd century BC China and it was developed throughout Central Asia and Anatolia thus reaching maturity in Iznik. Iznik ceramics have often been depicted with floral motifs such as tulip, hyacinth, pomegranate and carnation and mostly blue, turquoise, green and red in colour. These fine works of art are still being manufactured in Iznik (http://whc.unesco.org/en/tentativelists/5900/). The art of tile making was one of the most important income sources for Iznik during the Ottoman Empire period. The final years of the Byzantine Period and the first years of the Ottoman reign are accepted as the starting point of Iznik tile making (Şen, 1998). The city became a center that manufactures and ships many tiles and ceramic items all over the country and even to foreign countries during the 16th century thanks to the spreading of workshops and kilns all over this city thus strengthening the economy. Iznik tiles have been used to decorate many of the architectural structures built during that time and thus have become a decorative element symbolizing the city. Attempts were carried out to maintain the city as an important tile production centre. Thus, Iznik Tiles Atelier and the Tile and Ceramic Research Center were opened in 1996. It is now possible to produce Iznik tiles with the same quality as of those of the 16th century. (http://whc.unesco.org/en/tentativelists/5900/)

Natural and cultural factors that affect Iznik’s historical urban landscape in different periods are given in Table 1.

Table 1. Factors that affect the urban landscape of Iznik according to different periods.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Sub-Factors</th>
<th>Hellenistic Period</th>
<th>Roman Period</th>
<th>Byzantine Period</th>
<th>Ottoman Period</th>
<th>Republic Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Factors</td>
<td>Topography</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iznik Lake</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil properties</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Geology and Seismicity</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Climate</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Factors</td>
<td>Religious factors</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Economy</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social events</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The art of tile-making</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tourism</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6 IZNIK URBAN LANDSCAPE FEATURES

Iznik contains all the key attributes that convey its outstanding universal value, testifying to the urban texture and its relationship with the lake and surrounding rural areas. Situated in a fertile valley nearby the lake with the same name, Iznik is a small historic town still enclosed within its ancient walls surrounded by a beautiful landscape. The historic urban layout of the town is still visible with its grid settlement plan remained since the Hellenistic Period and monumental structures from the Roman, Byzantine and Ottoman periods. The city walls which 4970 m in length, which was built in the late Roman period, then expanded and strengthened during the Byzantine and Ottoman period, is one of the distinctive features of the city. It
surrounds settlements creating an irregular polygon with four monumental and several small gates. The walls were also fortified by more than a hundred towers some of which have inscriptions. In addition, columns and other architectural fragments from the ruins of more ancient edifices have been inserted into the city walls (http://whc.unesco.org/en/tentativelists/5900/).

Within the scope of Iznik urban landscape features; the city plan that makes up the main city features was handled together with the wall gates and the walls located where the two central axes that intersect on the plan end. Afterwards, the current historical monuments and structures in the city were handled together with the olive groves which make up another cultural attribute of the city thus putting forth the historical urban landscape of Iznik.

6.1 City Plan

It is observed that the city has a Hippodamos plan. This plan also known as the grid plan was developed and popularized by the famous Miletian architect Hippodamos. The main features of this system was preserved for centuries and has reached our day. According to this plan system, the city founded on a flat area is surrounded by walls and has four gates. The main streets lead towards the temple – Hagia Sophia Church in Iznik – and intersect each other thus forming a cross (Nuhoğlu, 1995). The Hellenistic culture, walls and Iznik Lake have an important effect on the formation of the city plan. The completeness of the city is represented by the fact that it exists today in unchanged form. Iznik is still enclosed within its ancient walls and the city still retains its grid urban plan, the two streets north/south and east/west oriented cross the town meeting at a right angle (http://whc.unesco.org/en/tentativelists/5900/). The place where the two main streets intersect is used as the city center just like in the ancient days. Hagia Sophia is one of the focuses of today’s city center, whereas the other is the Government House.

6.2 City Walls

The city walls have different construction phases dating back to the seventh, tenth and twelfth centuries the evidence of which can be found in different material and building techniques. http://whc.unesco.org/en/tentativelists/5900/). The walls that give the city of Iznik the attribute of a "Walled City" were first built during the Hellenistic age in the shape of an equilateral quadrilateral with a length of 2.893 m; however they could not stand erect until today (Kargıner et al., 1963). Today’s city walls of Iznik date back to the Late Roman Period and constitute the second most important wall feature in Turkey after Istanbul Land Walls. Just like the Istanbul walls, Iznik walls also have a secondary wall in front in addition to a defensive ditch. The walls that surround the city and constitute the Archeological Protection Site border have a length of 4.970 m and a height of 10-13 m (Kargıner et al., 1963). This puts forth that Iznik was smaller during the first period than it is now. Today’s walls of Iznik that date back to the Late Roman Period carry with them the architectural properties of all ages. They are the second most important walls after the Istanbul Land Walls. There are four main walls that enable entrance to Iznik which are Istanbul Gate, Yenişehir Gate, Lefke Gate and Lake Gate and there are also secondary gates that can only be used by pedestrians. A significant portion of the fortifications preserve features of their original form, design, materials and are used in harmony with the local terrain and their surroundings http://whc.unesco.org/en/tentativelists/5900/).

6.3 Gates

There are four main gates that enable entrance to Iznik which are İstanbul Gate, Yenişehir Gate, Lefke Gate and Lake Gate and there are also secondary gates that can only be used by pedestrians.

Istanbul Gate: According to Nuhoğlu, (1995); it is the largest and the most important gate that is located to the north of the city. It was built during the reign of Hadrianus between 117-138 AC (Kapuci, 2004). It consists of three uniaxial and concentric separate gates and was built for defensive purposes (Bodur, 2000; Kapuci, 2004). There is an oval courtyard between the inner and outer gates. The first gate when coming in from the outer part dates back to the Byzantine Period. There is one bastion on two sides. The second gate is in the shape of a victory Arch. Whereas the third gate has been badly damaged (Oktay, 1969; Kapuci, 2004).

Yenişehir Gate: According to Kargıner et al.(1963) and Sen (1998), it was built during the reign of Cladius the 2nd between 258-270 AC. It is a gate that has been subject to enemy attacks the most and that has been damaged the most (Kapuci, 2004). According to Oktay (1969), it consists of three consecutive
gates. There are two bastions in the shape of a semi-circle to the right and left of the first and second date located under the outer wall which were built in XIII. Century (Kapuci, 2004). It is located to the south of the city. It is a gate from where one can enter the city when coming in from the Yenişehir District and the coastal path direction (Kapuci, 2004).

**Lake Gate:** According to Kargıner et al. (1963) and Bodur (2000), it is the gate that opens up to the lake which is located to the west of the city. It was built during the reign of Cladius the 2nd. It functioned as a wharf. The facilities that supplied water to the ditches surrounding the walls were located here. Today, only their remains can be seen (Kapuci, 2004).

**Lefke Gate:** According to Bodur (2000), it was built in II. Century during the reign of Hadrianus. It was built as three concentric gates to the east of the city (Kapuci, 2004). According to Sen (1998), there are two frieze sections made of marble which are thought to be established during the Laskaris Period. One of the frieze parts depicts the bringing of war booty by the losing party, whereas the other one depicts the Roman militia in their military outfits (Kapuci, 2004). According to Oktay (1969), the second gate has been built in the shape of a victory Arch (Kapuci, 2004).

Hagia Sophia (Ayasofya) Church, Ancient Roman Theater, Green Mosque and Süleyman Paşa Madrasah are among the monumental buildings that best reflect the characteristic of the city during that period.

### 6.4 Hagia Sophia

Hagia Sophia was the location where The Seventh Ecumenical Council was organized in the church constructed by the Emperor Justinian over the ruins of the former church dating back to the 4th century. The church was rebuilt as a basilica with three naves after it was demolished following an earthquake in the 11th century. The church is still located at the point where the roads leading to the four main gates in the district centre meet. (http://whc.unesco.org/en/tentativelists/5900/). It is a basilica type large church built on the foundations of the Gymnasium located on the path where the roads leading to the four gates of the city meet (Eyice, 1988; Şen, 1998). The Hagia Sophia Church has been repaired and renovated many times due to the earthquakes and fires and has been architecturally transformed until our day (Anonymous, 1996). The 7th Ecumenic Council of 787 AC was organized here as well as the 8th Council which took place here in 2000 and which was important for the Christian world. Over time, the frequency of concrete buildings increased and thus the Hagia Sophia Museum which was quite derelict at the time amidst the ever increasing number of concrete buildings, it was removed in 1995-1996 within the scope of the project applied by the Ministry of Culture. The church was surrounded with a green landscape arrangement after which the City Center became a spot of attraction in the city center.

### 6.5 Ancient Roman Theater

The theater was built at during 2nd century AC by the Roman Emperor Trianus between 98-117 AC and has been built on a flat area at the Seljukian Neighborhood Saraybahçe Location about 400 m east of the Lake at the southwestern section of the city (Nuhoğlu, 1995; Sen, 1998; Bodur, 2000). The theater is the most important archeological site that still stands erect in Northwest Anatolia and has rare features such as the Antalya Side Theater. Large block stones were used during its construction forming a theater that is 85 m long and 55 m wide. It covers an area of 7332 m2 and was built by a group of 15000 people. It appears that the ancient theatre was converted into a mass graveyard in the 13th century. During the Ottoman period, there were also ceramic kilns within the ancient theatre. Its stones were used as construction materials especially in the restoration of the city walls during the Byzantine and Ottoman period (http://whc.unesco.org/en/tentativelists/5900/). Excavation work is ongoing today at the ancient theater and it is among the most important archeological values of the city.

### 6.6 Green Mosque

Green Mosque is one of the most important cultural assets that has become a symbol of Iznik and it gets its name from its minaret made up of turquoise tiles and glazed brickwork (Kapuci, 2004). It was built during 1378 and 1392 by Architect Hacı Musa following the order by Çandarlı Halil Hayrettin Pasha. It is the first example among the Ottoman mosques in which a rectangular floor plan with a central dome was used (Anonymous, 1996; Yalduz, 1999). The body was covered with tiles in different tones of green and blue with a mosaic technique (Eyice, 1988). It was the first structure in which tile work was used at the time and is
one of the strongest mosques that is still used today following the earthquake damage in 1967 (Sen, 1998).
Around the Green Mosque is in use after it has been enriched by walkways and seating areas.

6.7 Suleyman Pasha Madrasah

The madrasah is located at the Mahmut Çelebi District and was ordered to be built in 1332 by Suleyman Pasha, the son of Orhan Gazi. It is one of the madrasah buildings that make Iznik a center of culture. It is the oldest Ottoman Madrasah known also as the first university of the Ottoman Empire. It has thirteen cells, one classroom and nineteen domes covering them and it is also one of the first examples of madrasah buildings with a courtyard. It has an open courtyard and "U" type plan (Karginer et al., 1963). It was restored in 2000. It is now used in the service of tourism as a Market for Tile Makers in order to revive the traditional tile making craft of Iznik (Kapuci, 2004).

The periods and character features of monumental buildings in Iznik are summarized in Table 2.

Table 2. Periods and characteristics of the monumental buildings in Iznik.

<table>
<thead>
<tr>
<th>Period</th>
<th>Building</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hellenistic</td>
<td>Walls</td>
<td>The walls the surround the city and form the borders of the Archeological Protection Site have a length of 4.970 m and a height of 10-13 m (Karginer et al., 1963). The city walls have different construction phases dating back to the seventh, tenth and twelfth centuries, evidences of which can be found in different material and building techniques. <a href="http://whc.unesco.org/en/tentativelists/5900/">http://whc.unesco.org/en/tentativelists/5900/</a>).</td>
</tr>
<tr>
<td>Roman</td>
<td>Istanbul Gate</td>
<td>The largest and most important gate of the city located to the north. It was built during the reign of Hadrianus between 117-138 AC (Nuhoğlu, 1995; Kapuci, 2004). It consists of three uniaxial and concentric separate gates and was built for defensive purposes (Bodur, 2000; Kapuci, 2004).</td>
</tr>
<tr>
<td></td>
<td>Yenişehir Gate</td>
<td>According to Karginer et al. (1963), it was built between 258-270 AC. (Kapuci, 2004). It is the South Gate of the city. According to Oktay (1969), it consists of three consecutive gates (Kapuci, 2004).</td>
</tr>
<tr>
<td></td>
<td>Lake Gate</td>
<td>According to Karginer et al. (1963) and Bodur (2000), it is the gate that opens up to the lake which is located to the west of the city. The facilities that supplied water to the ditches surrounding the walls were located here (Kapuci, 2004).</td>
</tr>
<tr>
<td></td>
<td>Lefke Gate</td>
<td>According to Bodur (2000), it was built in II. Century during the reign of Hadrianus. It was built as three concentric gates to the east of the city (Kapuci, 2004).</td>
</tr>
<tr>
<td>Roman</td>
<td>Roman Theater</td>
<td>The theater was built at during 2nd century AC by the Roman Emperor Trianus between 98-117 AC and has been built on a flat area (Nuhoğlu, 1995). The theater is the most important archeological site that still stands erect in Northwest Anatolia and has rare features such as the Antalya Side Theater. Large block stones were used during its construction forming a theater that is 85 m long and 55 m wide. It covers an area of 7.332 km² and was built by a group of 15,000 people.</td>
</tr>
<tr>
<td>Great Ceremony Area</td>
<td>Great Ceremony Area</td>
<td>It is a large area for great ceremonies during the Roman Period. Afterwards, Hadji Hamza Mosque was built in this area during the Ottoman Era. Municipality building was built during the 1930’s in place of the demolished mosque (Eyice, 1988). This area and the gathering place in front of the Municipality Building still has a function similar to its function in history.</td>
</tr>
<tr>
<td><strong>Saint Neophytos Basilica</strong></td>
<td>By a very recent discovery of the remains of an ancient basilica about 20 meters from shore in Lake Iznik, the basilica is considered to have been built in memory of Saint Neophytos, who was killed during the reign of emperor Diocletianus mentioned in the written sources. It is also estimated that the basilica collapsed during an earthquake that occurred in the region in 740 (<a href="http://whc.unesco.org/en/tentativelists/5900/">http://whc.unesco.org/en/tentativelists/5900/</a>).</td>
<td></td>
</tr>
<tr>
<td><strong>Hagia Sophia Church</strong></td>
<td>H. Sophia Church is one of the most important pieces of Christian architecture and it was built in 4th century AC (Oktay, 1969). It is a basilica type large church built where the roads leading to the four gates of the city intersect (Eyice, 1988). The church is a three nave basilica with a rectangular plan in the east-west direction (UNESCO). The 7th Ecumenic Council of 787 AC was organized here as well as the 8th Council which took place here in 2000 and which was important for the Christian world. Hagia Sophia Church was transformed into a mosque after Orhan Gazi captured Iznik in 1331 and it was the first mosque in the city.</td>
<td></td>
</tr>
<tr>
<td><strong>Baptistery</strong></td>
<td>Böcek Ayasması (Baptistery) is a round structure with a water spring at the center of a quadrangular fountain, is also erected as part of the Hyakinthos Monastery (<a href="http://whc.unesco.org/en/tentativelists/5900/">http://whc.unesco.org/en/tentativelists/5900/</a>). According to Gönenc (1993); there is an entrance to the west of the domed structure with a circular plan that is shaped as “L” which can be reached by going down 11 steps. There is a baptistery pool of 1 m depth surrounded by square shaped marbles at the center of this underground location as well as four naves placed asymmetrically on the walls. The Baptistery was originally a location which was used for rituals during the 1870’s and it was used as a source of holy water by the Greeks who continued to visit the location until 1921 (Kapuci, 2004). It is the best preserved Byzantine structure. It can be visited under the control of the Museum Directorate.</td>
<td></td>
</tr>
<tr>
<td><strong>Green Mosque</strong></td>
<td>It was built during 1378 and 1392. It is the first example among the Ottoman mosques in which a rectangular floor plan with a central dome was used (Anonymous, 1996; Yalduz, 1999). The body was covered with tiles in different tones of green and blue with a mosaic technique (Eyice, 1988). It was the first structure in which tile work was used at the time and is one of the strongest mosques that is still used today (Sen, 1998).</td>
<td></td>
</tr>
<tr>
<td><strong>Süleyman Pasha Madrasah</strong></td>
<td>Built in 1332. It is one of the madrasahs that make Iznik a center of culture. It is also one of the first examples of madrasah buildings with a courtyard. It has an open courtyard and “U” type plan (Karginer et al., 1963).</td>
<td></td>
</tr>
<tr>
<td><strong>Nilüfer Hatun Public Soup House (Imaret)</strong></td>
<td>According to Sen, (1998); the plan of the structure located across the Green Mosque and which was built in 1388 is in the shape of a reverse “T”. There are porticos in the front and a central dome in the middle. There is a lantern on the central dome (Kapuci, 2004). It has rich and colored stone-brick engraving. The structure continued to function as a public soup house until the end of the 19th century and was used as a storehouse from that time until the 1960’s. Today, it is a very valuable and important structure that has been transformed into a museum (Kapuci, 2004).</td>
<td></td>
</tr>
<tr>
<td><strong>Hacı Özbek Mosque</strong></td>
<td>According to Şen, (1998); it was built in 1332. It is the oldest Ottoman Mosque with an inscription. It has a single dome. The mosque that is covered with a single dome of 8 m diameter has a square plan (Kapuci, 2004). It is the first Ottoman mosque built in Iznik. It is used as a mosque today.</td>
<td></td>
</tr>
</tbody>
</table>
6.8 Iznik Lake, Natural Structure of the City and Olive Groves

Iznik Lake which completes the historical texture along with the natural landscape properties of the city strengthen the perceptibility of the history and cultural texture of the city. Iznik Lake also contributes to the skyline of the city as well as its identity thus completing the historical urban landscape in terms of aesthetics. Iznik Lake is among the significant landscape values of the city and the remains of the Ancient Niceae City are submerged in the lake waters. In addition to the richness of the historical richness of the city, olive groves strengthen the identity of the city by making Iznik a city of agriculture as well.

7 URBAN DESIGN STRATEGIES

The city of Iznik is an important cultural heritage within the scope of its history and the values it hosts. The historical, archeological, natural, landscape and urban landscape properties of the city of Iznik have been evaluated as elements that complete the historical urban texture of the city. The historical urban texture of Iznik is still used today. The effects of the Iznik historical urban landscape which is still actively used today on the socio-economic structure as a result of tourism and cultural interactions continues to have significant effects even today. Within this scope, it is important to determine the current problems of the city and to develop urban design strategies to solve these problems.
- The Iznik city walls that have a Roman Period structure, have reached our day with various repairs and additions that were made during the Early Byzantine period and in the 13th century. It should be preferred to leave the city walls as they are after a protective restoration study (Kuban, 1994). Care should be exercised to ensure that the interventions to the city walls will be at a minimum so that the interventions carried out will not damage the gates or the towers and especially not affect the architectural properties of the four gates. The vibrations that are caused by the use of the roads passing near the walls by heavy vehicles lead to rock slides and damages. The exhaust gases that are caused by the intensive traffic around the walls and the other historical structures in the city have negative effects on the surfaces of these structures. Hence, green banded areas should be created along the city walls both inside and outside and traffic intensity near the city walls should be minimized. Pedestrianizing should be carried out at suitable locations all vehicle roads passing through the city walls or other historical structures and green buffer zones should be established to minimize the damages caused by traffic.

- Since a comprehensive and integrative preservation plan is not applied for the protection of historical areas, many historical, cultural and natural heritages are used insensibly as part of the changing economic conditions of our day and are left to rot without being taken into any kind of planning scope. Many historical values in Iznik have not been able to reach our day due to irregular structuring, lack of maintenance, wear and tear over time as well as lack of care and importance. The historical buildings in the city have been excluded outside the development plan of the city and thus integration has not been established with the historical structure. Some of the significant buildings inside the city have become dead spaces in the planned areas. To evaluate the integrated planning and design work in urban scale relation with the pedestrianization work with each other and the environment as well as the protection of urban structures and places in one building scale is important. Roads between the structures should be pedestrianized to be protected from damages caused by traffic, and common usage areas should be established by relating the exterior spaces of buildings.

- The olive groves that are among the most important urban identity elements which comprise the majority of the agricultural landscape patches of Iznik faces to urbanization pressures. This causes the loss of agricultural areas especially outside the walls. Allowing structuring on agricultural lands outside the city walls have negative impacts on the economy of the city of Iznik which is solely based on agriculture. The discharge to the Iznik Lake of agricultural chemical substances in addition to the wastes of the surrounding villages due to the pressure of urbanization have negative effects on the lake ecosystem as well as the landscape. In addition to the usage of the areas outside the Iznik city walls which continue to urban develop, its natural structure should also be considered as part of the design/planning strategies. During the development of the city along the coast, works should be carried out to ensure the continuity of the natural balance around the Iznik Lake and its environs and relevant precautions should be taken. The olive groves which are among the important urban identity elements of the city are among the areas that should be considered as “agricultural protection areas” in order to ensure the sustainability of the agricultural landscape character of the city. Natural and cultural properties of the Iznik should be considered in conjunction with the historical texture.

- Irregular structuring within the city surrounded by historical city walls has negative effects on the historical integrity of the environment. Buildings with monumental value in the city have started to disappear due to the irregular and multi-storey structuring in the city thus leading to difficulties with regard to perception. Traditional structures and structural properties are not observed within the urban texture of Iznik. Structures inside the city are not in accordance with themselves or with their environment. The structures in the city of Iznik differ from each other in terms of color, material used and heights. This visual pollution weakens the emphasis of the historical structures on the city skyline. Restorations and façade improvements should be carried out in order to enhance the historical texture of the existing structures while also enriching their visual appearance. Structural details should be taken into account in order to ensure urban integrity.

- Telephone wires, poles, television antennae, bulletin boards that are discordant both among themselves and with their environment obscure vision and thus result in visual pollution by making perception more and more difficult. In addition, the fact that there are no signposts for historical structures as well as signposts that direct people towards these structures is one of the most important shortcomings of the city. Advertisements and bulletin boards that hinder perception as well as directing-introductory boards, commercial signposts should be renewed in accordance with designs that are suited to the scale and material of the historical surrounding. Introductory boards should be set up at the entrance of historical
structures to inform visitors. The city should be enriched using suitable urban furniture in accordance with the needs of contemporary life and these should be selected to be in accordance with the properties of the surrounding area. Novel solutions that are suited to the cultural identity of this city should be developed while selecting the urban furniture to be used.

- The increase in the sidewalk and road levels has resulted in the fact that the entrance of historical structures remain under the elevation of these roads thus causing both aesthetic and functional disorder. The determination of streetscape standards suited to the historical urban texture and their inclusion to the application process is important for the sustainability of the urban cultural heritage.

- Iznik is among the rare cities that has carried the architectural properties of the four different periods it has hosted to our age as well as being the capital city during all these four periods. Iznik has a highly significant potential in terms of cultural tourism as a capital, a city of trade routes, a center of science and culture in addition to being a religious center. Iznik has a rich historical texture in terms of cultural tourism and is an important center in terms of belief tourism thanks to structures that are sacred for Christians. The historical values should definitely be preserved and sustained so that the tourism potential of the city can be fully used thus contributing to the city and country economy. In this regard, tourism should be accepted as the sole method of development for the city and the remains and monuments should be handled as economic values which create potential for first degree tourism and thus they should be evaluated within the principle of preserve-develop-sustain.

- The city of Iznik is included in the UNESCO Temporary World Heritage List and it will be a significant center of attraction when it is added to the main list. Thus, a management plan should be developed that is based on ecological balance in addition to the sustainability of the cultural heritage of the city.

The city of Iznik currently resembles an open air museum and the sustainability of the historical landscape properties of the city should be ensured with a holistic approach together with the landscape plans/designs.

8 CONCLUSIONS

Iznik is one of the exemplary cities that has succeeded in preserving its specific city model despite various damages in its historical structure. The city of Iznik is established over an area that is well suited for settlement with its fertile soil structure, rich natural resources, and climate conditions. As a fortress city that has set up a natural security border thanks to the Iznik Lake. In addition to the current use of these properties that date back to the historical periods that the city went through, and their effects in terms of tourism and nature-culture are ongoing, Iznik is also an important center for belief tourism with historical structures sacred for the Christians such as the Ayasofya Church and Baptistry. Indeed, Iznik still retains its spiritual value for the Christian believers (http://whc.unesco.org/en/tentativelists/5900/). Iznik is an open air museum with its natural and historical richness and continues to attract the attention of tourists with its structure well suited to treks and water sports as well as its biological diversity, handcrafts and tiles. Different from traditional tourism areas, the city and its environs has areas that have potential for activities such as trekking, mountaineering, biking, paragliding and grass skiing. However, when the planning decisions are considered in terms of style, damages occur in the authentic texture due to the erroneous structuring conditions (increase of the number of floors, changes in structural order etc.) thus destroying the historical street perspectives. There is an obligation for a dynamic planning system due to the requirement to relate the urban preservation area conditions with the environs of registered structures (Ergen et al., 1994). The traditional structure and textural properties can be destroyed during the interaction of urban preservation sites with urban development. This brings with it deteriorations due to failure of the integration of the urban preservation area with the developing city due to the fact that they are not planned separately and due to the pressure of income value (Ergen et al., 1994). The character of the settlement should also be considered as part of the whole for historical cities in addition to the monumental structures (Akdoğan, 1975).

The only way for societies to be able to receive and share information about their pasts is through historical urban textures that put forth the cultures of the past. According to the natural and social data, the reasons for why the city of Iznik is preferred for as a settlement in the past and today will have guiding effects for the projections that will enable it to develop even further. The planning, design and management of the urban texture of the city of Iznik is important within the scope of the preservation and development of its historical urban texture, arrangement as livable environments and tourism.
What makes Iznik different from such properties is the existence of combination of political, cultural, religious and artistic features. Iznik which is a peaceful historic town located on the lake with outstanding natural beauty, having spiritual values with important archaeological and historical finds (http://whc.unesco.org/en/tentativelists/5900/)

9 REFERENCES


BIO-CENTERS: ECOLOGICAL SANITATION AND RENEWABLE ENERGY HARVESTING IN INFORMAL SETTLMENTS

GODSHALK, ANDREA
Washington University, Saint Louis, MO agodshalk@wustl.edu

ZENCEY, ERIC
Gund Institute for Ecological Economics, University of Vermont, Burlington, VT Eric.Zencey@uvm.edu

1 ABSTRACT
Lack of adequate sanitation affects approximately one-sixth of the global population, causing major environmental and public health problems (UNDESA, 2013). Many of those affected live in informal settlements where traditional sanitation systems are not feasible (Shouten & Mathenge, 2010). This case study investigates a new type of structure, called a “bio-center,” developed by Umande Trust, which provides ecological sanitation (Umande, 2013). Situated as a hybrid between a productive landscape and an architectural topology, bio-centers provide a paradigmatic example of ways in which landscape architecture can redefine the problematics it addresses and the criteria under which solutions are judged, thereby allowing the discipline to increase its contribution to the monumental challenges facing informal settlements. A variety of case study methods were utilized including site visits, site analysis, interviews, and archival material analysis (Francis, 2001). This case study provides a unique example of an ecological sanitation model that embodies an integrated view of social-ecological systems and offers crucial lessons for sustainable infrastructure design. This research finds that by layering multiple community-service and income-generating functions into a shared facility, bio-centers become anchor-buildings or nodes within communities, with the potential to facilitate positive social and ecological change. The bio-center model addresses the most acute problems informal settlements face, and the benefits land squarely amid the overlapping economic, social, ecological, and energy challenges present in such settlements.

1.1 Keywords
Ecological Sanitation, Informal Urbanism, Ecological Economics
INTRODUCTION

The major demographic story of the twentieth century was the increasing urbanization of an ever-increasing human population. Between 1900 and 2000, the population grew from 1.65 billion to over 6 billion (United Nations Population Division, 1999). With much of the growth happening in impoverished, unplanned, haphazardly built informal settlements that lack running water and other elements of basic civic infrastructure. Currently around 2.5 billion people live without access to adequate sanitation facilities (UNDESA, 2013). In Kenya, about 80% of hospital attendance is from preventable disease, and half of those visits are related to illnesses connected to contaminated water, poor sanitation and deficient hygiene (Munala, 2012).

The solution that is common in OECD countries—private, intra-domiciliary facilities making liberal use of inexpensive running water—is not likely to be implemented for residents of informal settlements. The reasons are several. Installation of private toilets would incur an expense that the population simply can’t support; landlords who rent housing in informal settlements prefer to use space for tenants, not sanitary facilities; clean running water is scarce in such communities; nor is there now, or is there likely ever to be in the future, the physical infrastructure—the sewer pipes and waste treatment plants—to which private in-home sanitary facilities must connect. Because of the many and varied roadblocks that stand in the way of bringing traditional sanitation infrastructure to informal settlements, Shouten and Mathenge (2010) conclude that “communal sanitation facilities, when well-constructed and maintained, may be the only technically and economically feasible sanitation option for low income, high density slums” (p. 816). The challenge of designing such facilities is best met with systems thinking shaped by the principles of sustainability.

The term “sustainability” has been applied to such a wide variety of phenomena that some commentators propose that it no longer means anything and should be avoided. (King, 2013) We disagree, and propose a useful definition: a system is sustainable if it does not undercut its own preconditions for existence (Zencey, 2012). By this criterion pit latrines and other problematic modes of disposal of human waste are not sustainable—and their lack of sustainability is what makes them problematic.

For its part, systems thinking encourages us to look behind and beneath event to discern causal dynamics emerging from systems—“an interconnected set of elements that is coherently organized in a way that achieves something” (Meadows, 2008). If the system is mechanical, the system is designed to achieve a function; if the system includes humans, its aims to achieve a purpose. Systems thinking focuses on stocks and flows and how both either are or aren’t shaped by feedback loops. A stock of humans (for instance) produces a flow of excreta, which can accumulate as a stock, which becomes a biohazard if it isn’t treated or digested by biological systems.

One solution to the problem of sustainable waste disposal is a public facility called a bio-center. Developed by Umande Trust, these structures layer multiple community uses into an environmentally sound sanitation facility. In addition to providing public toilets and washrooms, bio-centers safely process excreta on site though an anaerobic process in an underground dome, which yields two valuable by-products: biogas biogas (which can be used for cooking) and bio-slurry fertilizer. Piloted in 2007, by 2014 there were 84 bio-centers in Nairobi and neighboring Kisumu. Each serves between 350 and 1000 people a day (Whitehead, 2014).

In addition to providing urgently needed sanitation facilities, bio-centers also offer to their communities an exemplary instance of a sustainable, multi-modal business. Each facility offers space that can be rented for business incubation or civic or church functions, and also provides an inexpensive renewable energy resource. Often the biogas generated is used on-site by a community kitchen, restaurant or other function in the building itself, eliminating the need for transport with its associated investment and operational expenses (Umande, 2013). Several bio-centers have successfully connected adjacent pit latrines to their anaerobic digesters, thereby accomplishing several positive outcomes: increased biogas production, conversion of those latrines to an eco-sanitation model and enrolment of their owners as allies rather than competitors (J. Omotto, personal communication, July 15, 2014).

Methodology

This research is informed by Mark Francis’s (2001) definition of a case study as a “well-documented and systematic examination of the process, decision making and outcomes of a project that is undertaken for the purpose of informing future practice, policy, theory and/or education” (p 16). The case is viewed as a paradigmatic example of ecological sanitation. Flyvbjerg (2006) defined the purpose of a paradigmatic case study as “to develop a metaphor or establish a school for the domain that
the case concerns” (p. 307). The case study data-gathering activities took place from September 2013 through November 2015, and field research was conducted in Nairobi in July 2014. A variety of case study methods were utilized including site visits, site analysis, interviews, and archival material analysis (Francis, 2001).

This case study provides a unique example of an ecological sanitation model that embodies an integrated view of social-ecological systems and offers crucial lessons for sustainable infrastructure design. This article examines how by layering multiple community-service and income-generating functions into a shared ecological sanitation facility, bio-centers become anchor-buildings or nodes within communities, with a specific focus on the potential of bio-centers to facilitate positive social and ecological change.

We took note of the methodology of several case studies when assessing bio-centers. The Katukiza (Selection, 2010) case study of sustainable sanitation facilities in Bwaise III in Kampala, Uganda took into account social acceptance, technological and physical applicability, economic and institutional aspects, human and environmental health, ability to replicate and scale up, water availability, accessibility of exhauntion trucks and, recovery of nutrients and energy. Munala's (2012) survey of sanitation facilities in informal settlements revealed acceptability of sanitation technology to be dependent on availability, security at night, economic aspects, and physical capability of the users. Maintenance with regards to cleanliness is also an important consideration. Financial, technological, and participatory issues were taken into account in Schouten et al. case study of facilities in Kibera (2010).

3 CONTEXT: PRECARIOUS GEOGRAPHIES

3.1 Physio-politically Precarious

Informal settlements are often built illegally in precarious geographies, on ground not effectively administered (and often abandoned and ignored) by civic authority. Steep slopes, residues of dangerous industries, vulnerability to flooding, and past experience as an earthquake zone or landfill often make up the backdrop and ground planes of informal settlements. The challenge of basic sanitation is magnified by these geographic circumstances. Then too, informal settlements develop haphazardly and densely with no thought, space or investment given to the development of sewer networks and other elements of urban infrastructure, including simple passageway (Munala, 2012). The major capital investment needed to develop a traditionally conceived sewage infrastructure is a significant obstacle to providing informal settlements with such centralized systems. Further, to provide such infrastructure at public expense would be a step toward formal recognition and legitimation of these informal settlements—a step that governments are reluctant to take, since they are disinclined to favor marginalized squatters over owners-of-record and in any event are not keen to annex territory with a high need for civic services and a low ability to contribute to tax revenues. Even so, civic administrations near informal settlements often recognize an ecological reality: everything is connected to everything else—meaning, specifically, water pollution will migrate and pathogens do not respect politically drawn boundaries. Many informal settlements therefore occupy a legal grey space in which governments provide some support for improvement of sanitation without formally recognizing the community or its needs. This arrangement bars large-scale, comprehensive infrastructural solutions to the settlements’ sanitation needs.

When informal settlements are built on land that is vulnerable to flooding or in direct aquatic communication with wetlands, the consequences of poor sanitation—and the cost of traditional methods of improving it—are magnified. This is the case in Kampala, Uganda, where Bwaise III, an informal settlement, is built on a former wetland. A study of the Lubigi wetland into which the settlement now drains found that seasonal flooding makes the contamination of drinking water from leaking pit latrines “highly likely” if not inevitable (Katukiza et al., 2010). There was of course no clean-slate design of the settlement’s sanitation system, and the de facto system that evolved did so in violation of fundamental precepts of good sanitation practice. Excreta is disposed of in unlined pits that also collect greywater and stormwater; the pits easily overflow and readily contaminate groundwater even when they don’t. Pit latrines, elevated to achieve a semblance of dryness, empty fecal sludge into the adjacent storm water drains during rains and when they are excavated. To empty a pit latrine residents often make a hole through its fecal sludge chamber—a cheaper alternative to full-scale excavation of the pit—compromising the chamber’s integrity and function. Many residents make use of what are colourfully called “flying” toilets: they relieve themselves in plastic bags, which are then left on the ground, where the plastic is vulnerable to mechanical damage and to photo
While the bags effectively isolate fecal matter from the larger ecosystem, the isolation is only temporary; their use delays but doesn’t forestall the health issues that stem from open-air defecation. Not surprisingly, residents of Bwaise III are routinely exposed to and become infected by pathogens from human feces. Studies have indicated that most of the spring water sources in the peri-urban areas of Kampala are contaminated with pathogens of fecal origin attributed to these and other poor sanitation practices (Katukiza et al., 2010). The situation is similar in the informal settlements in the capital of Uganda’s neighbor, Kenya. Taking its name from the Maasai, who lived there before the British came in 1899 to pin a train depot roughly halfway between the Kenyan seaport of Mombasa and the border of landlocked Uganda, Nairobi is named for the water that flows through it: Enkare Nyrobi means “cold water.” Four rivers run through the city on roughly parallel courses as they make their way from their rise in the highlands in the northwest to the Indian Ocean in the southeast. Historically they have provided water for the residents—and have also served as sewage transport systems. Both uses, always contradictory, were exponentially strained by population growth over the last century as the human population of Nairobi increased from a mere 11,500 in 1906 to 3,375,000 in 2014. More than half of that growth came in the city’s informal settlements, many of which are on the banks of the Nairobi River. As a recent appraisal of water quality in the area noted, “The four rivers still flow through Nairobi but, because of a century-long pollution, many people mistake them for an open sewerage system” (Weru, 2012).

A positive feedback loop aggravates the problem: human habitation is drawn to the rivers for their water-source and sewage-transport services, and this development destroys riparian flora that provide what little natural filtration services the rivers enjoy, increasing the burden of pollutants the rivers must then carry, further compromising riparian flora and diminishing public health. In places the rivers are scarcely recognizable as waterways. They have become a health and safety hazard to the increasing number of marginalized residents whose only space in the city is pressed against their edges (Makworo and Mireri, 2009).

In the mid-twentieth century, traditional approaches to water management in Nairobi brought landscape-altering infrastructure but didn’t inoculate the rivers against the damage brought by a steadily increasing human presence. Constructed in 1953 to provide potable water to 15 million people (about a third of the present-day population of Kenya), an earthen dam at the edge of the city impounded a shallow lake (greatest depth of just 9.1 feet) that locals call Nairobi Dam after the structure that created it. The Nairobi River flowed into the lake; the Ngongo River exited it through a spillway. As recently as twenty years ago Nairobi Dam was a tourist draw, offering sailing and fishing close to the business center of a major African capital. But the lake is gone. The impoundment area has been filled with sediment and human fecal waste transported by the river. The resulting nutrient-rich artificial wetland is choked with water hyacinth, effectively eliminating any and all recreational use of the water (Obiero, 2013). This sedimentation is the result of Kibera, the largest informal settlement on the African continent, which sits immediately upslope of the dam. Kibera without adequate sanitation for residents cannot support a mutually healthy, ecologically sustainable relationship with the Nairobi River or the lake.

3.2 Conceptually Precarious

Effective solutions to the water-and-sanitation crisis must be multi-scalar, adaptive, and address multiple overlapping systems simultaneously. As Mostafavi (2010) explains “the city, for all its importance, can no longer be thought of as a physical artifact; instead, we must be aware of the dynamic relationships, both visible and invisible, that exist among the various domains of a larger terrain of urban as well as rural ecologies” (p. 29). And Steffen et al. (2011), reporting Walker et al. (2009): “it is no longer useful to concentrate on environmental challenges and variables individually, but the challenge lies in the intertwining of multi-scale challenges across sectors (e.g., environment, demographics, pandemics, political unrest)” (Steffen et al., 2011). These realizations point up the qualities successful design solutions will have and the conditions under which they will emerge. These include the consistent application of whole-systems thinking to design problems; an appreciation that the relevant whole system is humans-and-landscape; an understanding that landscapes house natural processes that have to be accommodated because they can only rarely be defeated, and that in any event defeat of natural systems and processes would diminish their ability to supply valued ecosystem services; and a concurrent appreciation that effective solutions of the city’s “cross sector” challenges will reach across disciplinary boundaries toward desired outcomes in several sectors at once.
3.3 Socially and Economically Precarious

Solving the sanitation problems of informal settlements is made more difficult by the socio-economic dynamics that characterize such settlements and their economies. Transience, compounded by the lack of property ownership by residents, makes it difficult to establish a collective investment in maintaining sanitation facilities (Katukiza et al. “Selection”, 2007). Lack of sanitation is just one item on a list of civic, economic, and physical ills the population endures: poverty, hunger, unemployment, high crime rates, poor health, little to no access to education. Each of these challenges makes dealing with any of the others more difficult. And each is exacerbated by population growth (Munala, 2012).

An effective sanitation system provides a public good, meaning a significant amount of the benefit that comes from use of the system is not captured by individual users who pay for system services but accrues to non-payers. In the case of sanitation systems, the non-paying beneficiary is the public at large. Public health as a positive externality is the main reason that in urban areas sewer services are usually provided at public expense. As Daly and Farley caution, public goods cannot be produced and distributed efficiently or in optimum quantity through market dynamics (Daly and Farley, p. 177-80). Nevertheless, in many informal settlements access to communal latrine-based fee systems is baseless. The landlords who own the toilets are usually responsible for their maintenance and operation. While in many cases moderate investment could reduce the adverse health and environmental impacts of the toilets (as, for instance, through lining of pit latrines and more frequent emptying of their contents), the profit motive discourages investment that offers no return. Absent regulation to set minimum standards, landlords have an incentive to reduce standards to the lowest level the market will bear and to continue to impose the negative externality of fecal contamination of the environment and the resulting disease on the public at large. Public authority is ill equipped and resistant to establishing regulatory administration. Nor are the tenants themselves in a position to pay for, support, or otherwise effect the necessary changes. Those whose incomes improve move out, becoming renters somewhere else (and occasionally becoming landlords of the inferior habitation they leave behind). (Katukiza et al., “Selection”, 2010). The frequently shifting population of informal settlements, the unwillingness of public authority to include these settlements in their jurisdiction and the failure of market dynamics to provide the quality of public goods these settlements need are the major impediments to improved sanitation. Within the market-based, landlord-fee model, the problem looks insurmountable. Successful intervention through the selection and deployment of an effective, ecologically sound sanitation technology may need to be rooted in an alternative, i.e. collective, ownership model.

3.4 The Precarious Present

In informal settlements, significant amounts of human excreta are deposited in unlined pit latrines. These are usually elevated in areas with a high water table so that deposition is made directly into water. “The numbers of bacteria and viruses in the soil are normally reduced to insignificant levels within a metre of effluent movement if aerobic conditions and unsaturated flow exist,” but “saturated or nearly saturated flow in coarse textured or highly structured soils…can…result in rapid transmission of bacteria and viruses for considerable distances” says one authoritative analysis of septic leachate constraints. (Epp, 1984) Saturation of a latrine’s working soils can easily come about through overuse, and overuse is common. In Bwaise III, the user load was found to be between 1:30 to 1:70. The recommendation by the Uganda Ministry of Health is 1:20. In the informal settlements of Nairobi -- Kibera, Obunga and Bandani -- about 68% of households rely on shared facilities with a high loading factor (average of 71 people per facility) (Munala, 2012). In Uganda’s Bwaise III, studies found that 15% of the population uses a public pit latrine and 75% uses shared toilet facilities. Only 10% of the population has access to private, non-shared sanitation facilities (Katukiza et al., “Selection”, 2010).

High usage increases the needed frequency of latrine emptying if the latrines are to remain effective in isolating waste from the environment. As noted, though, landlords have little incentive to provide this service. While it is possible for families near a latrine to pay for emptying it, this kind of organized community response is challenging given the circumstances of residents (Katukiza et al., “Selection” 2010). As a result pit latrines are often abandoned when full because emptying them is expensive and narrow pathways make vehicular exhaustion difficult (Schouten et al., 2010). Mulana found that 75 % of the surveyed pit latrines were abandoned rather than emptied for reuse. Wastes from the remaining 25 % were exhausted from the pits and disposed of offsite by exhasser trucks, incurring expense that is passed on to users. Abandoned
pit latrines remain a contamination risk to water bodies and drinking water. This open loop system doesn’t capture and recover nutrients and is a “great economical as well as ecological loss”, (Mulana, 2012).

In addition to pit latrines, flying toilets and open defecation are common in informal settlements. Small market shares are held by other approaches and technologies, including ventilated improved pit latrines (VIP), biogas toilet/latrines, compost pit latrines, lined ventilated improved pit latrines, pit latrines with urine diversion, and urine diversion dry toilets (UDDT). Pour-flush toilets, a variant on the standard toilet with fixed links for water in and sewage out, are used by a few higher income earners in informal settlements (Katukiza et. al., “Selection”, 2010).

Biogas facilities do not require as frequent exhaustion as pit latrines. But if small biogas systems are to be successful, knowledgeable networks capable of maintenance must be developed, (Bond, 2011). Since the 1970s the development and use of small biogas systems have spread mostly in rural areas and are usually used with animal faeces for gas production. Since then the number of biogas systems in India and China have grown to 4 and 27 million respectively (Bond). In other countries the technology didn’t proliferate as extensively and in some cases up to 50% of the plants are non-functional because of a lack of maintenance.

Predictably, open defecation and “flying” toilets score the lowest on surveys of residents’ preferred methods of dealing with human waste (Munala, 2012). And while pit latrines are the most common type of sanitation facility in informal settlements, as a method of waste disposal they ranked second to last in the survey Katukiza et al. did of residents of Bwaise III. Katukiza et al. conclude, “…this implies that communities are aware of the environmental pollution caused by existing unimproved excreta disposal facilities but have no options due to lack of funds and complexity of the slum settings” (“Selection”, 2010, p.60).

Many sanitation interventions by NGO’s have failed because of a lack of stakeholder participation at various stages in the project. Some facilities failed because they followed models that succeeded in other areas with different, more favorable conditions: non-collapsing soils with a low water table, or appropriate legal status and ownership. “Sanitation facilities were constructed without considering sanitation as a system that comprises of collection, storage, treatment and safe disposal/reuse” This failure to think systemically caused failures in the operation and maintenance of facilities, resulting in dissatisfaction in users and environmental pollution from untreated waste, (Katukiza et. al., “Selection”, 2010). Past failed interventions can be expected to diminish enthusiasm for fresh innovations—a diminishment that is, however, moderated by the severity of the sanitation crisis that these communities face. Because of that severity the communities remain open to innovative intervention.

4  THE BIO-CENTER INNOVATION

4.1  Design Fundamentals
Umande Trust, a rights based organization, developed the bio-center eco-sanitation facility model in 2007. Bio-centers layer multiple community uses into a sanitation facility. Piloted in Gitwekera village of Kibera informal settlement in 2007, there are now 84 bio-centers in Nairobi and Kisumu. Bio-centers are permanent multi-layered structures, built of locally sourced concrete, stone and brick, that use underground anaerobic digesters to process excreta on-site, producing two valuable by-products of immediate use or sale to the population near the facility: biogas for cooking and bio-slurry compost for agricultural production therefore the resource and energy efficiency and returns are high.

Bio-centers provide a sustainable business model with a variety of Income Generating Activities (IGAs) “to ensure the sustainability of the facilities and a wider socially transformative effect”, (Umande, 2014). In each bio-center there are about twelve toilet stalls available to the public for about five Kenyan shillings. On the second, and sometimes third, floors spaces are to rent for businesses, banks, churches, community groups, office to hire, restaurants, and internet cafes. During the World Cup several bio-centers had success renting the space for people to watch the games. Community stoves utilizing harvested biogas can be used to cook or boil water for 10 Kenyan shillings for the duration of the cooking time. Since 2012 Umande Trust has partnered with Kopo Kopo to provide a “web based application that allows bio-centers to accept and track transactions made through mobile money (MPesa).” This partnership further supports the micro and small businesses being developed.
The construction of bio-centers is overseen by Umande Trust, which guides a community group or collective through the process of building, financing and managing the facility each new bio-center. The bio-centers are then managed by community groups, which own the centers. After the construction of a bio-center, the management groups operate bio-centers independently, but remain connected to Umande Trust through a collective upgrading fund and sharing of best practices. In this way all the bio-centers benefit from continuous improvement. For example Katwekera, the first bio-center ever built, was designed for a capacity of 400 people a day. Currently 800 people a day use it. So Umande Trust added three additional overflow domes and a baffle filter to increase the capacity of the bio-center. Around 60% of the profits generated by bio-centers goes to the management and/or operation group, 30% to operational costs, and 10% go to a collective fund for the upgrading and maintenance of all the Bio-centers.

In 2007 Athi Water Service Board provided some initial investment for 20 bio-centers. These bio-centers, financed by AWSB, were assessed to gather best practices from the highest achieving centers in 2013. AWSB’s report looked at 20 bio-centers in three settlements Kibera, Mukuru, and Korogocho. (Umande, 2013)

4.2 The Bio-center as a Manifestation of Systems Thinking

Sustainable systems can be conceptualized as being formed of loops and arrows. The loops describe both material movement and information flows. Because matter can neither be created nor destroyed, the movement of material in a system has to be circular. If it isn’t, the system will perpetually accumulate matter in one portion of the system and perpetually source that matter from another. But perpetual accumulation and perpetual extraction of matter is impossible on a finite planet. The circular information loops are feedback loops—closed systems in which information about the effect of a process is used to regulate the process. Absence of feedback (or absence of timely feedback) can lead to system collapse. For instance, it remains to be seen whether human civilization can respond rapidly enough to the relatively sudden feedback we’ve been given—feedback that emerged gradually over the past twenty years—that now that we are several centuries into the Fossil Fuel Era we have deposited more CO2 into the atmosphere than it can hold without undergoing systemic change.

Arrows describe any transformation of energy, since these can operate in only one direction: energy flows from low entropy (high usefulness) to high entropy (low usefulness), never the reverse. A stream tumbles from the highlands down to the ocean, ever downward, never up. (Water does rise out of the ocean for transport to mountaintop, to fall again as rain; this hydrological cycle requires fresh input of energy in the form of solar powered evaporation.) Life colonizes the downward fall, from sunlight through herbivore, carnivore, detritivore, and so on, until all the solar energy captured by photosynthesis has been dissipated into the metabolic processes—the muscular motion and bodily heat—of successive consumers. The one-way flow of energy is relevant to the design of Bio-centers because excrement of any sizable animal contains a store of energy that is useless to the animal itself but which can be used by niche specialists. Human excrement contains such energy, and because we are a tool using species we constitute an exception: while we cannot survive by eating our own wastes (no animal can), we can harvest the unused energy in our waste and put it to work for us instead of releasing it for dissipation into microbial life in the environment. As can be seen, then, Bio-centers are instances of sustainable design because they offer closure of a material flow, mending the nutrient-food-waste-nutrient cycle, and allow us to colonize a greater part of the one-way flow of energy through our alimentary systems.

4.3 Investment, Ownership, Operational Economics

Management groups generally view expenses as a positive part of operating the facility, which leads to income and job creation. Groups from Mukuru described the income and expenses of the facilities they managed “as a tree, with the roots representing the expenses and the fruits representing the incomes, really capturing the essential nature of these items as fertilizer that is used to grow incomes” (Umande, p. 4). This perspective of the economics of bio-centers mirrors the ecological relationship of bio-centers to their place. This embeddedness and place based wealth generation marks a significant difference from other sanitation facilities which don’t integrate as deeply in the ecology or economics of the places in which they operate.

Most bio-centers display upward trends in income and decreasing or stabilization of expenses over time as management groups streamline operations and the surrounding community becomes more
familiar and accepting of the facility. Revenues and expenditures correlate across highest and lowest earning bio-centers, averaging to around 30-40% of income spent on regular operational expenses including tissue, electricity and water and the infrequent costs of exhausting the dome of bio-slurry, manual maintenance and caretaker labour, and facilities upgrading. While it varies, the average net income or profit for the AWSB bio-centers was 23,400 KSh/month or 280,800 KSh/year (Umande, 2013).

Table 1. Financial Summaries of AWSB-financed Bio-Centers (AWSB, 2013)

<table>
<thead>
<tr>
<th>Bio-Center</th>
<th>Avg Revenues</th>
<th>Avg Expenses</th>
<th>Avg Profits</th>
<th>Annualized Profit</th>
<th>Construction Cost</th>
<th>Return on Investment</th>
<th>Internal Rate of Return IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunkers</td>
<td>4,833</td>
<td>685</td>
<td>4,148</td>
<td>49,776</td>
<td>-1,520,651</td>
<td>3.3%</td>
<td>-8%</td>
</tr>
<tr>
<td>Heshima Disabled</td>
<td>14,686</td>
<td>4,534</td>
<td>10,152</td>
<td>121,824</td>
<td>-1,106,855</td>
<td>11.0%</td>
<td>11%</td>
</tr>
<tr>
<td>Kisumu Ndogo</td>
<td>22,599</td>
<td>8,373</td>
<td>14,226</td>
<td>170,712</td>
<td>-1,529,680</td>
<td>11.2%</td>
<td>11%</td>
</tr>
<tr>
<td>KYU</td>
<td>19,598</td>
<td>7,138</td>
<td>12,460</td>
<td>149,520</td>
<td>-1,478,495</td>
<td>10.1%</td>
<td>9%</td>
</tr>
<tr>
<td>LindiUsafi</td>
<td>10,168</td>
<td>5,745</td>
<td>4,423</td>
<td>53,072</td>
<td>-1,298,820</td>
<td>4.1%</td>
<td>-5%</td>
</tr>
<tr>
<td>Nyaharwa</td>
<td>24,002</td>
<td>9,202</td>
<td>14,800</td>
<td>177,600</td>
<td>-2,310,767</td>
<td>7.7%</td>
<td>4%</td>
</tr>
<tr>
<td>Tegemeo</td>
<td>39,808</td>
<td>13,348</td>
<td>26,460</td>
<td>317,520</td>
<td>-1,515,218</td>
<td>21.0%</td>
<td>24%</td>
</tr>
<tr>
<td>UwezoMpya</td>
<td>21,793</td>
<td>8,298</td>
<td>13,495</td>
<td>161,940</td>
<td>-1,330,822</td>
<td>12.2%</td>
<td>13%</td>
</tr>
<tr>
<td><strong>Average (unweighted)</strong></td>
<td><strong>19,686</strong></td>
<td><strong>7,165</strong></td>
<td><strong>12,520</strong></td>
<td><strong>150,246</strong></td>
<td><strong>-1,511,414</strong></td>
<td><strong>10%</strong></td>
<td><strong>7%</strong></td>
</tr>
</tbody>
</table>

Of the AWSB bio-centers surveyed, all have attained somewhat positive cash flow on a monthly basis making profits off the initial investment, though the extent of profit varies by bio-center. The rate of Return on Investment ranges from 3.3% for Bunkers bio-center to 21% for Tegemeo bio-center. (Umande, 2013) Even those centers with the lowest RoI can successfully pay back initial construction costs (in some cases taking up to 30 years). Given this the construction of bio-centers can be considered viable investments independent of the benefits of improved sanitation and health, renewable energy production, and infrastructural development.

The primary source of bio-center income is the toilets, constituting an average (unweighted) of 52.2% of sales of the twenty centers surveyed, which had complete records. The second largest source of income is water contributing an average of 26.9% of income, showers 9.4%, rent/hall usage 8.1%, sale of biogas and other various incomes make up the remainder. The most profitable service offered is rental of space for gatherings and businesses as there are little to no operational costs. (Umande 2013) This revenue demonstrates and supports the bio-center as a community anchor or node for other, often wealth generating, community building activities. Of the AWSB bio-centers surveyed the average gross income was 21,400 KSh/month (700 KSh/day) or roughly $235 USD/month ($7.7 USD/day).

4.4 Placement, Use & Autonomous Infrastructure Development

The daily usage of Bio-center services, (toilet, shower, stove, gathering space) varies widely in relation to placement and availability of other sanitation options. Korogocho settlement, which had the lowest average weekly users, has a generally higher level of existing sanitation coverage. LungaLunga Bio-center, with the largest weekly average served 3830 users largely because of its adjacency to a busy market area (AWSB, 2013). Considering placement of Bio-centers in relation to circulation of commerce is advantageous to ensure the economic sustainability of centers, which enables and proliferates the ecological services they provide (Table 2).
Table 2. Average Weekly Users of Bio-Center Services (AWSB, 2013)

<table>
<thead>
<tr>
<th>Bio-center Area</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>All AWSB Bio-centers</td>
<td>1370</td>
</tr>
<tr>
<td>Bunkers</td>
<td>203</td>
</tr>
<tr>
<td>LungaLunga</td>
<td>3,830</td>
</tr>
<tr>
<td>Residential</td>
<td>1,190</td>
</tr>
<tr>
<td>Market</td>
<td>2,210</td>
</tr>
<tr>
<td>Mukuru</td>
<td>1,950</td>
</tr>
<tr>
<td>Kibera</td>
<td>890</td>
</tr>
<tr>
<td>Korogocho</td>
<td>840</td>
</tr>
</tbody>
</table>

Several bio-centers have begun piping biogas to surrounding houses for a monthly fee, generating a new income stream and extending the autonomous renewable energy infrastructure anchored by the bio-center. Kawekera bio-center provided biogas to five households for a monthly fee starting in 2014 (Figure 1). LindiUsafi bio-center connected 3 pit latrines to the digester. This provided an additional 4,000 KSh of income per month for the center (Umande, 2013).

Figure 1. Expanded Bio-center renewable energy and sanitation infrastructure (Andrea Godshalk, 2015)

These three toilets, which serve 60 families, extend the reach of the sanitation infrastructure provided by the LindiUsafi bio-center without significant investment, create an additional income stream and convert an existing latrines to an eco-sanitation model without competing with the owners of those latrines. In this case the depth of the pit won’t limit the timeframe of operation, since the dome that collects the waste is being emptied of the compost regularly. This means that the life expectancy of these buildings is only limited viability of the construction material (Munala, 2012). As bio-centers expand their capacity to network biogas connections to surrounding households for fees, revenues will increase along with the establishment of renewable energy infrastructure services to their communities.

There are several other models of ecological sanitation—though they lack the scope and reach of Bio-centers as a sustainability-purposed whole-systems design. The two main examples currently being utilized in Kenya are Peepoo bags and Sanergy’s Free Life Toilets.

The company Peepoople launched the Peepoo bag in 2010 to address immediate needs for sanitation (Peepoople, 2015). The Peepoo, an ecological iteration of the flying toilet, is a single use bag treated with enzymes to biodegrade feces into fertilizer when buried. It disintegrates into carbon dioxide, water and biomass. While this is an improvement on the “flying toilet”, the business model creates
dependency for the bags, which are produced in Germany. Peepoo bags address needs for immediate sanitation, but doesn’t contribute to place making.

Sanergy, founded by three MIT graduates from the Sloan MBA program, designed the “Fresh Life” toilet for the informal settlements of Nairobi, Kenya (Sanergy, 2015). Using an ecological sanitation model, which utilizes feces and urine as a resource for fertilizer, biogas and energy, Sanergy began their enterprise in 2010, and operates as a non-profit with a franchise business model that aims to build a network of local entrepreneurs who manage low-cost toilets. Waste is collected from these and processed off site at a centralized location to produce electricity and fertilizer (Likoko, 2013). As of 2014 there were 299 locally pre-fabricated Fresh Life Toilets in operation and approximately 11,000 daily users (Sanergy, 2015). Users can pay by visit, week or month, including family memberships. The Sanergy team is 90% Kenyan, 60% of them live in the communities where Free Life Toilets are installed and 50% are under 27 years old. Sanergy holds weekly 1-on-1 meetings, monthly advisory council meetings and quarterly network forums to support Fresh Life Operators (FLO). Team members are provided with contracts, medical and life insurance and pensions. FLOs are supported with training, access to financing, operational and marketing support, and daily collection of containers from individual toilets and provides clean containers to replace the full ones.

Because the sealed containers can be moved by foot truck and the toilets take up a small space they can be installed in dense areas. FLOs are to collect waste daily from the toilets they manage. In the first four years 1,426 metric tons of waste were collected. The waste is transferred offsite and processed at a centralized facility, where it is composted into biogas and fertilizer (Sanergy, 2015). There is high demand for the fertilizer from the farmers in the region, many of whom are otherwise reliant on synthetic (i.e. petroleum-based) fertilizers imported from abroad. Like Bio-centers, then, Sanergy’s Fresh Life toilets help reduce the outflow of money from Kenyan farmers to international fertilizer companies, re-localizing to some extent the agricultural economy. The energy produced is sold to the national grid. The profits from this are being reinvested to build the infrastructure, more could be done to have that energy and fertilizer going back to the communities it was harvested from and contribute to place building. Sanergy’s model is centralized and franchise toilet managers remain dependent on that centralized network. It is a strong network that provides support and training, yet it also operates to extract resources from the community. Bio-centers, in contrast, function as stand-alone, autonomous entities networked in order to trade information; resources and services are not traded between outpost and center as they are in the Sanergy model.

4.5 In Relation to Other Eco-sanitation Models

There are several other models of ecological sanitation—though they lack the scope and reach of Bio-centers as a sustainability-purposed whole-systems design. The two main examples currently being utilized in Kenya are Peepoo bags and Sanergy’s Free Life Toilets.

The company Peepoople launched the Peepoo bag in 2010 to address immediate needs for sanitation (Peepoople, 2015). The Peepoo, an ecological iteration of the flying toilet, is a single use bag treated with enzymes to biodegrade feces into fertilizer when buried. It disintegrates into carbon dioxide, water and biomass. While this is an improvement on the “flying toilet”, the business model creates dependency for the bags, which are produced in Germany. Peepoo bags address needs for immediate sanitation, but doesn’t contribute to place making.

Sanergy, founded by three MIT graduates from the Sloan MBA program, designed the “Fresh Life” toilet for the informal settlements of Nairobi, Kenya (Sanergy, 2015). Using an ecological sanitation model, which utilizes feces and urine as a resource for fertilizer, biogas and energy, Sanergy began their enterprise in 2010, and operates as a non-profit with a franchise business model that aims to build a network of local entrepreneurs who manage low-cost toilets. Waste is collected from these and processed off site at a centralized location to produce electricity and fertilizer (Likoko, 2013). As of 2014 there were 299 locally pre-fabricated Fresh Life Toilets in operation and approximately 11,000 daily users (Sanergy, 2015). Users can pay by visit, week or month, including family memberships. The Sanergy team is 90% Kenyan, 60% of them live in the communities where Free Life Toilets are installed and 50% are under 27 years old. Sanergy holds weekly 1-on-1 meetings, monthly advisory council meetings and quarterly network forums to support Fresh Life Operators (FLO). Team members are provided with contracts, medical and life insurance and pensions. FLOs are supported with training, access to financing, operational
and marketing support, and daily collection of containers from individual toilets and provides clean containers to replace the full ones.

Because the sealed containers can be moved by foot truck and the toilets take up a small space they can be installed in dense areas. FLOs are to collect waste daily from the toilets they manage. In the first four years 1,426 metric tons of waste were collected. The waste is transferred offsite and processed at a centralized facility, where it is composted into biogas and fertilizer (Sanergy, 2015). There is high demand for the fertilizer from the farmers in the region, many of whom are otherwise reliant on synthetic (i.e. petroleum-based) fertilizers imported from abroad. Like Bio-centers, then, Sanergy’s Fresh Life toilets help reduce the outflow of money from Kenyan farmers to international fertilizer companies, re-localizing to some extent the agricultural economy. The energy produced is sold to the national grid. The profits from this are being reinvested to build the infrastructure, more could be done to have that energy and fertilizer going back to the communities it was harvested from and contribute to place building.

Sanergy’s model is centralized and franchise toilet managers remain dependent on that centralized network. It is a strong network that provides support and training, yet it also operates to extract resources from the community. Bio-centers, in contrast, function as stand-alone, autonomous entities networked in order to trade information; resources and services are not traded between outpost and center as they are in the Sanergy model.

5 EXTERNALITIES OF SOCIO-ECOLOGICAL SANITATION

Bio-centers have socio-political benefits that exceed those of other eco-sanitation technologies. All sanitation technologies offer the significant externality of improved public health as a by-product of use, and both the Bio-center and the Sanergy model offer the capture of energy that would otherwise be wasted. But Bio-centers have additional positive externalities that become clearer when the following criteria are used to assess performance of the overall system:

- Involvement of stakeholders (both users and owners);
- Net flow of resources into/out of the community;
- Effect on social capital through place-making and improvement in living conditions.
- Ability to sustain the infrastructure, with skills, materials and knowledge, locally

Successful socio-ecological sanitation facilities expand waste-to-wealth strategies and community place building to maximize social and economic benefits in the communities in which they are situated, while simultaneously addressing the health and environmental damage from a lack of adequate sanitation. Eric Swyngedouw (2003) defines the aim Urban Political Ecology “to enhance the democratic content of socio-environmental construction by identifying the strategies through which a more equitable distribution of social power and a more inclusive mode of environmental production can be achieved” (p. 898).

Ecological sanitation models are able to generate wealth in the form of compost and biogas both of which can be sold. For these models to make a significant impact the wealth accumulated from the harvested resources (or unprocessed excreta) should benefit the communities from which they are gathered. In the same vein, the organizational structure of the leadership, management, and ownership of facilities should be representative of the community being served by the facilities to contribute to the long-term wealth building.

Communications technologies allow for rapid global dissemination of design innovations, yet given the history of colonial exploitation, well intentioned westerners bearing innovative solutions would do well to build partnerships that empower local ownership and management. “We own, you work” is an outmoded developmental model. “We design, you build” can be equally problematic, especially if the fundamental purpose of sanitation facilities is to allow a population to fulfill elemental needs and begin the work of recognizing and defining higher-purpose needs, such as economic self-reliance, political efficacy and political and social autonomy. A technology that meets a first-order need (like sanitation) at the expense of diminishing the ability to meet higher order needs is not a sustainable technology.
6 CONCLUSION

By layering multiple community-service and income-generating functions into a shared facility, bio-centers become anchor-buildings or nodes within communities. In addition to providing urgently needed sanitation facilities, bio-centers also offer to their communities an exemplary instance of a successful, multi-modal business. Bio-centers provide a variety of Income Generating Activities (IGAs) “to ensure the sustainability of the facilities and a wider socially transformative effect”, (Umande, 2014). Each facility offers space that can be rented for business incubation or civic or church functions, and also provides an inexpensive renewable energy resource. Often the biogas generated is used on-site in a community kitchen, restaurant, or other function in the building itself, eliminating the need for transport with its associated investment and operational expenses (Umande, 2013). Several bio-centers have successfully connected adjacent pit latrines to their anaerobic digesters, thereby accomplishing several positive outcomes: increased biogas production, conversion of those latrines to an eco-sanitation model, and enrolment of their owners as allies rather than competitors (J. Omotto, personal communication, July 15, 2014).

Of 20 bio-centers surveyed, all had attained positive cash flow on a monthly basis, making profits off the initial investment (Umande, 2013). Even those centers with the lowest RoI can successfully pay back initial construction costs (in some cases taking up to 30 years). Given this, the construction of bio-centers can be considered viable investments independent of the benefits of improved sanitation and health, renewable energy production, and infrastructural development. As bio-centers expand their capacity to network biogas connections to surrounding households, and pit latrines for fees, revenues will increase along with the establishment of renewable energy infrastructure and ecological sanitation services to their communities.

The most important lesson from the Umande Trust bio-centers is not one of technology but rather about the benefits that come from integration of humans and natural processes into a metabolic cycle. The technology shows that such metabolic integration can be generative at a local scale. Mike Davis (2006) notes that "urban theorists, beginning with Patrick Geddes, have long recognized, both environmental efficiency and public affluence require the preservation of a green matrix of intact ecosystems, open spaces and natural services: cities need an alliance with Nature in order to recycle their waste products into usable inputs for farming, gardening and energy production" (p. 134). Cities must utilize localized metabolisms to process excreta and utilize by products to uplift the dignity and wealth of those most vulnerable and disenfranchised. Developing ecological infrastructures to process human excrement and harvest resources, both biogas and compost, can make deep impacts on the wellbeing of humans and their social and ecological communities in rapidly urbanizing cities around the world. Bio-centers increase health and entrepreneurial and generate renewable resources, rather than exploiting, or damaging them.

Bio-centers, and the way they are collectively built and managed is an essential model for developing effective, multi-purpose, community-building sanitation facilities in circumstances that are among the most physically and economically challenging on the planet. But bio-centers do more than that: they shine compelling insight into effective innovative design premised on an integrated view of social-ecological systems. The development of an ecological urbanism is crucial for the long-term sustainability of the human project on Earth.

7 REFERENCES


