Teaching Proposal:
Landscape Architecture Foundation Landscape Performance Education Grant (LPEG), 2013-2014
Principal Investigator: Kenneth R. Brooks, FASLA, FCELA, PLA
Professor of Landscape Architecture
The Design School at Arizona State University

Principal Investigator / Instructor Reflections

Background:
This project was conducted during the spring 2014 semester at The Design School at Arizona State University. The scope of the project was to explore the teaching and learning of landscape performance as a primary learning objective within the framework of the Master of Landscape Architecture thesis studio. Within the MLA program, a thesis or an applied culminating project is a core requirement in the concluding semester of the degree program. At ASU the difference between a “Thesis” and an “Applied Culminating Project” is that process and product of a “Thesis” must following standard ASU Graduate School format and procedures typical of traditional masters theses in most disciplines in most research institutions. The “Applied Culminating Project” permits the student to engage in an independent investigation in format and process that has much more flexibility in both the process and the deliverable products. Although students have the option to choose either approach (thesis or applied project), almost all choose, or are encouraged to choose the applied project format. In our School, this generally means that most of our MLA students enroll in a semester-long research project that explores a significant design issue and plies the findings of that research through a prototype design project that illustrates the application of those research findings in a professional design setting. Most of those students will enroll in a studio course that has a single faculty instructor. Some highly-capable and motivated students will be given permission by the faculty to work on their Applied Project independently of the studio with a Landscape Architecture faculty member of their choice. Each of the students will have a principle faculty critic and all of them will present and defend their work before a jury that includes the landscape architecture faculty as well as outside reviewers.

The Design School has professional studio-based masters programs in the disciplines of architecture (MArch), industrial design (MID), interior architecture (MIA), landscape architecture (MLA), visual communications design (MVCD) and urban design (MUD). Although most of these masters programs were established relatively recently, the MArch program has operated for many years and it has successfully used the applied studio project format for a culminating project for quite some time. It makes it easier to manage our programs – both in terms of communicating degree requirements to students and accountability policies with the ASU Graduate School by using these thesis/applied project options consistently for all of these degree programs across The Design School.

Our MArch and MLA programs are each accredited by the respective accrediting agencies (NAAB and LAAB). Both the MArch and the MLA degree programs have a two-year track for students that come from a professional undergraduate degree background and a three-year track that accommodates students without professional undergraduate background in the related discipline. The MUD program is structured as a post-professional degree, requiring a student to already have advanced professional education in either architecture or landscape architecture as a prerequisite to entry into the program. The instruction in the MUD program is carried out by architecture and landscape architecture faculty members of The Design School. MArch, MLA and MUD students have several overlapping courses within their curricula. Within the MLA Applied Project Studio this past spring, there were MLA and MUD students enrolled.
Project Organization:
This LAF LPEG project was organized to use the MLA Applied Studio instructional framework to teach landscape architectural (and urban) design performance as a means of evaluation and assessment of the value and success of a design strategy. Each student enrolled in the course was assigned to select a significant critical topic of interest to base their term project on. Topics included such issues as water management, riparian habitat, park utilization, urban infill, animal conservation, therapeutic gardens, transit, and sustainable building materials and strategies. Each student did research on their topic and explored ways that they could resolve problems, enhance design benefits and contribute to a quadruple bottom line outcome as demonstrated in a prototype design project. As a prototype project, the design needs to become a role-model or exemplar for applying the design strategies in other similar situations. The students also had to evaluate their final designs with a framework that identified the performance benefits of the design relative to the primary issue being studied. The goal of the project was to optimize design on the issue of special interest, and not necessarily endeavor to optimize on all possible issues.

Another major component of this LPEG project was the creation of an integrated seminar course dedicated to the topic of “Design Performance” that formally met for an hour each week to explore and discuss issues, philosophies, history and strategies for using “Design Performance” tools and techniques in evaluating, enhancing and promoting better design. We used the terminology “Design Performance” in place of “Landscape Performance” to give a broader transdisciplinary perspective more broadly accommodating to all of the disciplines in The Design School. Obviously, if the nature of the “design” is applied to landscapes or landscape architecture, we are implying “landscape performance.”

By structuring and scheduling the Seminar within the clock hours of the Studio, we could guarantee participation of all of the studio participants in the Seminar. By making it quasi-independent, we could accommodate participation by some other students who were not a part of the Studio, but wanted to participate in the discussions and activities of the Seminar.

The official enrollment in the studio included 10 MLA students and 2 MUD students. We also had 2 MLA students who were working on “Independent Applied Projects” parallel with the studio. Although those 2 students were not required to participate in the studio, they did participate in the monthly mid-semester critiques and final presentations, just like all of the other MLA students. All 14 of these students participated in the Seminar, as did two other non-degree graduate students not enrolled in studio courses. One of those other two students is the ASU campus landscape architect who also serves in an adjunct teaching capacity with The Design School. The second non-degree graduate student is a person who’s undergraduate degree is in Architectural Studies from our School and she also has a Master of Education and she currently serves as one of the staff members coordinating student development in our College.

The activities of the seminar included reading and discussing topics of design performance based on the book Urban Design and the Bottom Line: Optimizing the Return on Perception, by Dennis Jerke, Douglas R. Porter and Terry J. Lasser and published by ULI in 2008. Another activity of the seminar was to participate in the LAF Webinar on March 20, 2014, on incorporating landscape performance research into design, presented by Allyson Mendenhall, PLA, Associate, Director of DW Legacy Design; Design Workshop; Deb Mitchell, FASLA, PLA, Senior Vice President, SmithGroupJJR; and Skip Graffam, ASLA, PLA, Partner, Director of Research, OLIN. Students discussed the nature of the quadruple bottom line as advocated by Jerke (economic, ecological, social and aesthetic – sometimes referred to by others as Planet, Profit, People and Poetics) and sought way to demonstrate quadruple-bottom-line benefits into their own projects. Samples of some of the presentation materials from the seminar are included in the Illustrative Vignettes Folder of the submitted materials. Another reference of applied professional work was the project work from Ayers Saint Gross for the City of Washington, DC for their The Sustainable DC Plan (http://sustainable.dc.gov/finalplan).

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The Studio Project Topics:
There were 14 projects, each with a different agenda of critical issues and problems to solve, developed by the students during the semester. The projects are described below. Most of the students have given me permission to use their name in crediting their work. Where I don’t have such written permission, the student author remains anonymous. The deliverables for the applied studio project for the term were a set of three documents: 1) an illustrated oral presentation (a Powerpoint/pdf file presented by the student to a jury of professional reviewers); 2) a text and image document that could be read by an interested reviewer; and 3) a poster (dimensions 2’ x 6’) promoting the project. Some selected samples of the work have been provided with these reports.

The student projects:

Carol Kegley (MLA) “Urban wetlands provide ecosystem services by re-using wastewater.” This is a proposal for an adaptive water strategy recycling wastewater through constructed urban wetlands and reusing it to generate an attractive and climate mitigating landscape for downtown Phoenix. This is one way towards conserving the fresh water supply while providing ecosystem services for people and the environment and creating a healthier downtown Phoenix.

Toby Roanhorse (MLA) “Integrating traditional knowledge with dry wetland restoration” A riparian area is ecologically rehabilitated in a manner that is culturally sensitive to a resident indigenous American Indian community using traditional ecological knowledge (TEK).

Christine Kimple (MLA) “Dust Control Management.” Due to mismanagement of land use and climate change the hazards from dust will be ever increasing. The dangers are not only here in the Arizona, but also in other places in the world. Dust Control Management doesn’t have a simple applied solution. It is a complex problem that manifests itself on multiple levels. Finding efficient ways to tackle land sources of dust and creating environments for focused investigation and research can influence our policy, knowledge and practice.

Melodii Zhu (MLA) “Promoting Utilization Rates of Urban Neighborhood Parks.” Neighborhood park is a self expression of the community. It is a strong icon linking the relationship among neighbors. Low utilization rate is a common issue happens in most of our urban parks. Even though each park is serving thousands of residents, less than 20% of them really use the park. By providing flexible functions, neighborhood parks could serve multi-generations. The benefit of the project is to encourage social interaction, enhance personal health and create internal enjoyment.

Anonymous (MUD) “Downtown East Revitalization through start-up economy.” The proposed project aims to establish a new innovation hub east of downtown which cultivates strong entrepreneurship, harness creativity, lower economic barriers, and generate productive energy with healthy, inspiring environments.

Anonymous (MUD) “Entertainment and Cultural District in Downtown Phoenix.” To build connection between the downtown phoenix and warehouse district and Southern neighborhood by incorporating entertainment, cultural and appropriate mix of other land uses and bring back the liveliness of the district which is lost in time.

Anonymous (MLA) “Connecting stormwater infrastructure to natural hydrologic system in a xeric environments.” Urban runoff outfall is used to charge a rehabilitated riparian area.
Anonymous (MLA) “Principles of therapeutic gardens and their application to a park hiking trail.” Healing gardens are fast becoming a place of refuge for urbanites from the daily grind and the stressors that accompany our fast-paced world. Gardens in urban spaces may improve the overall health and well-being of individuals and thus communities as a whole. Evidence-based design can help us rediscover increased happiness and well-being of our mind-body-spirit as a whole with the healing powers of nature.

Jesse Westad (MLA) “Green wall applications in the arid Southwest.” The rapid urbanization of the arid southwest has led to an increase in the urban heat island effect, a decrease in nature, irresponsible building practices, as well as noise and air pollution. Now that these systems are already in place how do we use nature to help mitigate these issues in the built environment? My project will focus on the applicability of green walls and how through proper usage can provide a very valuable asset to the urban dweller.

Cris Portugal (MLA) “Using art to encourage community engagement in a south Phoenix TOD development zone.” A transit-oriented development node is created in south Phoenix that enhances the cultural and artistic heritage of the community.

Starin Butler (MLA) “Exemplary Zoo Exhibit Design”. A well-designed zoo exhibit can help urban zoos fulfill their roles as wildlife conservation and education centers. By creating a zoo exhibit rubric, landscape architects and zoo officials will have the tools they need to assess, evaluate, and design exemplary zoo exhibits.

Jose Quintana (MLA) “Creating great streets that promote smart paving systems – a pedestrian mall on the ASU campus.” An exploration of the sustainability characteristics of local hardscape materials and paving systems, demonstrated in a prototype design for a pedestrian streetscape on a campus.

Anonymous (MLA) “Symbiotic school garden model.” An exploration of community gardening, environmental education, local food production within an educational system that provides vocational training, healthy living and economic opportunities to disadvantaged youth.

Anonymous (MLA) “Arizona capital mall redevelopment with augmented reality enhancements”. Upgrading an existing urban landscape to enhance the narrative, function, and economic well-being of the pedestrian environment.

Student Work Evaluation and Critique:
During the semester, students have regular desk critiques during studio production time. At regular intervals, all students make semi-formal progress presentations to a review panel made up of faculty. These faculty members included the regular landscape architecture faculty, some adjunct faculty members, several of the architecture/urban design faculty and occasionally critics from outside the university. These may have been public officials serving a “client role” for a specific project or they may have been technical or professional experts providing additional mentoring in a particular student’s project. These monthly progress reviews were scheduled and announced from the beginning of the course and were designated as open, public reviews.

Towards the end of the semester, we held a review with a couple of invited outside critics. Those critics were Ms. Astric Sykes, Associate of the firm of Mia Lehrer and Duane Blossom, FASLA, recently retired from Todd Associates. At the end of the term, our distinguished review panel included (in addition to faculty members), Dr. Mary Myers of Temple University and an LAF CSI & LPEG Fellow; Mr. Jay Hicks, ASLA of Logan-Simpson Design; and Mr. Chris Brown, FASLA of Floor Associates.
Project Assessment:
I would make the judgment that the project was a success. The students engaged critical issues of interest to the profession and developed design strategies to illustrate resolving or advancing our understanding of those issues. Their projects were conducted professionally. I expect several of the projects to be entered into ASLA design awards programs at the state and national levels. Several have already been recognized for “Design Excellence” within The Design School. I also expect for one to three papers presented in a forum such as the CELA annual conference to come out of this work.

What did we do well? The structure of the project, with both a studio component and a seminar component, provided a framework for engaging the issues both intellectually and in hands-on professional, activity-based problem-solving settings. Including people who were not regularly enrolled thesis/applied project students into the discussion enhanced the richness of the learning environment (these other people included the other members of the landscape architecture faculty – both regular and adjunct; other graduate students who were not enrolled in the studio portion; community experts or “clients”; and outstanding experience professionals serving on the juries.

I believe that the project demonstrated that the consideration of design benefits perspective or an evidence-based design approach could be incorporated as one of the important learning objectives of most intermediate or advanced courses. I our case, the studio had a very broad and flexibly wide agenda, but it would be possible to make performance benefits a component of courses with a narrower learning agenda (including courses focusing on planting design, urban design, recreation planning, infill, brownfields reclamation, sustainable landscape construction or other similar professional specialties).

How could we improve the course?
I believe that incorporating learning objectives related to design performance, evidence-based design, and research-informed design into the thesis/applied project course on a regular and permanent basis is both justified and critical to advancing the capacity of the students to bring such skills to their professional settings. Celebrating the joy of discovery and a design well-crafted will put such students in a position of providing vision and leadership to their firms/agencies, professions and their service to society and the environment.

It would be difficult to justify making the course projects longer than the semester, giving the general tightness within the curriculum, but it might help students prepare for this semester by having an orientation session early in the fall semester so that they could begin planning and exploring ideas for possible thesis/applied projects before they begin the semester.

It might also enhance their confidence and competence in developing skill and experience with various design benefit tools to create a series of demonstration projects that give them some hands-on experience with various benefit calculation tools (either early within the course or earlier throughout the curriculum).

I believe that one of the goals of a thesis/applied project should be the expectation for a systematic or structured sharing of the information in ways that encourages and facilitates peer review. To that end, creating a format for sharing project findings would enhance the exchange of information from such student projects.

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Teaching Proposal:

**Landscape Architecture Foundation Landscape Performance Education Grant, 2013-2014**

**Proposed by:**  Kenneth R. Brooks, FASLA, FCELA, PLA  
Professor of Landscape Architecture  
The Design School at Arizona State University

**Project Organization:**
The proposal is organized around the work of two integrated and interactive courses – an advanced MLA design studio and an advanced graduate studio – each of them taught within the interdisciplinary Design School that is the home of the accredited BSLA and MLA programs at ASU. The LDE 690 Studio is the final studio in the MLA core curriculum with a focus on applied project design that serves as the “thesis” project for the MLA degree. The applied project is typically a complex, systems-based design exploration focusing on a topic mutually agreeable to the student and the faculty and related to the strengths and mission of the program. The projects will require the student to integrate comprehensive design skill and experience with research methods appropriate to the project to resolve and advocate for their particular design challenge. The work is mentored by the instructor (in this case, Brooks) and juried and critiqued by the whole landscape architecture faculty. This year there will be a special emphasis on the application of principles of evidence-based design and the concepts of design performance, design value and design assessment. Past projects have addressed such topics as urban forestry (an ASLA student winner), neighborhood water recycling (another ASLA student winner), complete streets, stormwater management, solar power farms (resulting in an invited paper at a national solar conference), the psychological sense of engagement with the neighborhood correlated to residential architectural styles (resulting in an invited paper to a CELA conference), riparian habitat restoration, pedestrian streetscapes and other topics related to urban design and resource planning and management.

The Seminar course (LPH 590) will be taught as an advanced graduate elective course with the fundamental purpose of exploring the concepts of design performance evaluation and advocacy. To that end, the students, instructor and guests will research, refine and retell the story about our advances in the systematic process of articulating, evaluating and advocating quality design strategies and outcomes. We will apply the practices of case study, post-occupancy evaluation, and other research methods to demonstrate the practices of evidence-based design applied in the interests of improving and enhancing environmental, economic, social, cultural, and aesthetic contexts. The seminar will then move to explore and develop pedagogic methods, strategies and materials for educating professional design students, practitioners, design educators, public policy decision-makers, and general public about best practices for applying performance-based design and evaluating design contributions on the basis of the breadth and depth of the services or values provided by such design.

**Learning Outcomes:**

For the studio course (LDE 690), the Learning Outcomes are:

- identification and exploration of significant design topics worthy of MLA theses
- precedent and case studies relevant to the issue(s)
- research into alternative approaches for resolving the design issues
- development of evidence-based design solutions
- with assessments that illustrate performance values

For the seminar course (LPH 590), the Learning Outcomes are:

- exploration of the history and concepts of evidence-based and performance-based design
- exploration and demonstration of the application of design performance evaluation
- exploration and demonstration of the best practices in pedagogy related to development, delivery and assessment of professional course, curricula, and program content
- development of instructional materials advancing the teaching of design performance
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Learning Outcomes (continued):
Topics of discussion related to design performance will include:
  ▪ Traditional, historic and/or conventional concepts of design performance evaluation:
    Vitruvius – “firmness, commodity & delight”
    Sullivan/Wright – “form follows function”; “form and function are one”
    Precedence-based design
    AIA: “Standard of Practice”
    Pro Forma studies
    Case Study Investigations
    Health, Safety, & Welfare
    Bottom Line
  ▪ Contemporary advances to design performance evaluation:
    Life-cycle cost analysis
    Value engineering
    Return on Investment (ROI)
    Post-occupancy evaluation (POE)
    Value-added design
  ▪ Quality assessment applied to project, firm and/or design management:
    Total Quality Management (TQM)
    ISO 9000
    Six Sigma Management (6σ)
  ▪ Innovation and Experimental approaches
    Best Practices
    Triple Bottom Line
    Quadruple Bottom Line
    House of Quality
  ▪ SITES Program, Initiative and Aspirations
  ▪ Pedagogy
    Course & Curriculum development
    Educational evaluation, assessment and accountability
    Instructional materials

Structure:
The two courses are organized as complementary and interactive. All of the MLA students participating in the studio (doing applied advanced design work) will also participate in the seminar. Additional students not in the MLA thesis studio will be recruited to participate in the seminar and to potentially apply their own problem-solving experience in a parallel fashion. Graduate students from other design disciplines, from sustainability science and from education will be recruited to participate in the seminar and enrich its transdisciplinary character. Landscape architecture will serve as the primary disciplinary perspective, but the related disciplines will all focus on the nature of evidence-based and performance-based approaches to design, design evaluation and design education and advocacy.

Schedule:
The schedule will fit the University’s academic calendar in its 2014 spring term (Mid-January through early May). The studio will meet twice weekly on Wednesday and Friday afternoons (1:30-5:00) while the seminar will meet once weekly on Friday afternoons (1:30-2:30). While the use of studio time is structured with flexibility to permit informal production, critique, consultation, review and informal interaction between and among individual student designers, critics and instructors; the seminar is the formal time for
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all students, instructors and guests to engage in presentations, debates, and discussion. The general schedule will look like this:

January – establish and identify the context(s), backgrounds, challenges and opportunities
February – explore alternatives, standard and best practices, and cultivate alternatives
March – test alternatives, experiment with options and potential solution; mid-term presentation
April – design development, pedagogical materials development; design and program evaluation
May – final presentations, advocacy sharing of lesson learned

Assignments:
The principle assignments for the studio course will be to 1) explore a significant landscape architectural design issue with appropriate analysis of background, precedence, literature review, and context studies; 2) Prepare design alternatives with a developed final proposal; 3) Evaluate the design using performance assessment strategies to determine the success of the design; and 4) communicate the findings and recommendations of the design and of the performance-based evaluation in a professional peer setting.

The assignments for the seminar will be to explore the practices of design performance evaluation and to develop strategies and materials for teaching and advocating design performance assessment.

Assessment/Evaluation:
Students’ design work will be reviewed and critiqued by the instructor (Brooks); landscape architecture faculty colleagues, local design professionals, design faculty from related disciplines. Participants, critics and peer reviewers for the seminar course will come from design, sustainability, and education faculty colleagues and from practicing landscape architects and other designers. CSI Fellows, LAF staff and similar external experts will be invited as contributors, critics and peer reviewers both during the courses and at the conclusion of the courses.

On-campus critics will include faculty colleagues with backgrounds in landscape architecture, architecture, industrial design, interior architecture, visual communications design, healing & healthcare environments design, urban design, sustainability science, ecology, education and psychology.

Reading Materials and Resources:
Sustainable Sites Initiative. 2013. SITES v2 Rating System and Reference Guide. SSI.
Web-based materials from LAF Sustainable Sites Initiative website and from ASLA’s Advocacy Resources
Syllabus

The Course:

LPH 598 Topic: Design Performance (schedule line #29643). This course is a seminar exploring the concepts and applications of Design Performance, especially as applied to landscape architecture and urban design. The course is inspired by the recent work by the Landscape Architecture Foundation to advance concepts of landscape performance – the application of tools, processes and outcomes that enhance the capacity of the design to serve people and environment. (see the LAF Performance Series information at: http://www.lafoundation.org/research/landscape-performance-series/). The principle goal of the course is to explore and cultivate strategies for developing, applying and advancing the concepts of design performance.

The course will be taught for variable credit (1-3 credits) as a general elective for landscape architecture, urban design and other interested students with advanced backgrounds in design or pedagogy. Students enrolling for one credit will participate in the course through readings, discussion, and a demonstration of concepts of design performance to a case-study design project. Students enrolling for more than 1 credit will also develop a project for sharing and/or teaching an example of design performance to other design professionals.

Meeting times and location:

The class meets regularly on Fridays from 1:30-2:20pm in the seminar room in the Tempe Center Studios of The Design School.

Instructor:

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Office Hours: Wednesdays 10:00-11:00am, Thursdays 2:00-4:00pm and by appointment; drop-ins accepted on a time-available basis (if you come by and I’m not available, please leave a message so that I can get back to you). The best way to consult with me is to request an appointment during class or by email.

Textbook:

Title: “Urban Design and the Bottom Line
Authors: Dennis Jerke, Douglas R. Porter, Terry J. Lassar
Publisher: Urban Land Institute
Copyright: 2008
ISBN: 9780874209969
Student E-mail Contact Requirements:
A portion of the communication among students and instructors for this course will be conducted through the ASU Blackboard On-line website in the myASU tools and the use of the college network server. In order to facilitate the secure use of the networks, it is necessary for all of the students in the course to use their officially assigned ASU e-mail accounts for access and communication. Although students are permitted to use non-ASU email accounts for simple unofficial e-mail communication, all official communication in the course will be through the ASU e-mail accounts. E-mail messages used in the course should include the name of the sender and a subject description in the e-mail header or subject line.

University Policy on Academic Integrity:
ASU’s policies and standards related to academic integrity are provided at the website of the Office of Student Life. Students are expected to be familiar with standard practices of honesty, fairness and consideration of peers and colleagues as well as the consequences for violating those standards. Committing acts of dishonesty or unfairness or tolerating such acts by classmates will be subject to appropriate sanctions. Students are encouraged to discuss concerns or questions with the instructors to determine what is and isn’t acceptable. Some actions maybe acceptable in this class while being unacceptable in others. (For instance, we will encourage students to work on projects in this class related to project assignments in other classes, as long as they have been concurrently preapproved by the instructors of both classes. The ASU academic integrity website can be found at: http://www.asu.edu/studentaffairs/studentlife/judicial/academic_integrity.htm

Plagiarism and cheating are serious offenses and may be punished by failure on an exam, paper, exercise, or project; failure in the course; and/or expulsion from the university. Academic dishonesty and cheating also includes software piracy, since it is a form of unauthorized use of the intellectual property of others.

Late Work Policy:
Work submitted late will be reviewed and critiqued, but it will have a penalty of at least 10% per day for being late. For all work submitted through the on-line digital dropbox, the time/date stamp on that submittal shall be considered the submittal time.

Attendance, Participation and Professionalism:
Attendance and participation in the course is important to learning and will be strongly encouraged. Collaborative learning is a valuable form of learning software. When you're not able to participate, you're not able to learn from others, and they not from you. Roll may be called at various times. Roll may be called at various times. Students must participate at a rate of 90% or a grading penalty will be assessed for each 10% missed. Tardiness will be treated as one-half an absence.

Evaluation and Grading:
Points for assignments for the term will be organized as follows

50% for projects assigned
50% for participation, professionalism, attendance and contribution
Grading Scale:
Grades will be assigned according to the following scales and performance characterizations:

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<tr>
<th>Letter Points</th>
<th>Grade Earned (Approximate Percentage)</th>
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<tr>
<td></td>
<td>&quot;A&quot; grades indicate superior performance, significantly exceeds expectations and requirements</td>
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<tr>
<td>A+</td>
<td>between 98 - 100 %</td>
</tr>
<tr>
<td>A</td>
<td>between 93 - &lt; 97 %</td>
</tr>
<tr>
<td>A-</td>
<td>between 90 - &lt; 93 %</td>
</tr>
<tr>
<td></td>
<td>&quot;B&quot; grades indicate very good performance, meets professional expectations of competent performance</td>
</tr>
<tr>
<td>B+</td>
<td>between 87 - &lt; 90 %</td>
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<tr>
<td>B</td>
<td>between 83 - &lt; 87 %</td>
</tr>
<tr>
<td>B-</td>
<td>between 80 - &lt; 83 %</td>
</tr>
<tr>
<td></td>
<td>&quot;C&quot; grades indicate good performance, meets minimally acceptable professional performance standards</td>
</tr>
<tr>
<td>C+</td>
<td>between 77 - &lt; 80 %</td>
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<tr>
<td>C</td>
<td>between 70 - &lt; 77 %</td>
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<tr>
<td></td>
<td>&quot;D&quot; grades indicate poor, marginal, not professionally acceptable</td>
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<tr>
<td>D</td>
<td>between 60 - &lt; 70 %</td>
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<tr>
<td></td>
<td>&quot;E&quot; grades indicate unacceptable or irresponsible performance</td>
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<tr>
<td>E</td>
<td>less than 60%</td>
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University Policy on Incomplete Grades:
The University policy for incomplete work and incomplete grades will be followed in this course. A grade of Incomplete will only be assigned for circumstances beyond the control of the student with the student’s grades-to-date being passing or better at the time of the request. Typical circumstances indicating a need for an incomplete include personal illness, family emergency, or sustained equipment failure. Students are encouraged to communicate with the instructors as soon as possible if they have circumstances that limit their ability to perform well in the course. The process requires that the student make a request and provide information that justifies the request. The instructor and student will fill out and file a form indicating that an Incomplete grade will be assigned, outline the work to be completed and the date to be submitted.

Policy on cell phones, pagers and similar devises in class:
As a courtesy to students and speakers, it will be a class policy that all cell phones, pagers, beepers and other similar devises be turned off while class is in session. During any testing (including quizzes) all phones, pages, texting equipment and related devises must be turned off and put away. Any of these devises sitting out in plain sight during such periods are subject to confiscation because they raise a question about integrity. To protect yourself, make sure that the phone or pager is off and out of sight in a pocket, backpack, briefcase or purse.
Syllabus: Advanced Applied Project/Thesis Studio

Course(s): This syllabus serves several courses. This advanced design studio course is intended as a culminating studio for master of landscape architecture and master of urban design students. The course sections for enrollment in the course include: LDE 690 Topics: Advanced Landscape Architecture Studio IV, LDE 593 Applied Projects, and MUD 690 Advanced Urban Design Studio IV. This is the regular thesis studio that most MLA students will take. The ASU Graduate College recognizes this course as a “non-thesis, culminating experience” or project. By being a “project,” the Graduate College’s rules for format, process, and content are somewhat relaxed. The expectations of the landscape architecture faculty is that exploration and presentation protocols may be more flexible but a researchable issue is systematically and rigorously examined, evaluated and specific conclusions and recommendations are made. Design, as a process for exploring or comparing ideas may be an acceptable part of the project, but it is probably not the object of the project intent (“doing a design project” is not the goal of the thesis studio). The schedule line number for LDE 690 is 19177 and for LDE 593 is 27554.

The themed topic and focus of the course will be Design Performance. Students will develop a complex design project that addresses a significant professional issue. The project will explore and demonstrate how advanced design resolves that issue in a performative manner using evidence-based practices and performance-based metrics.

Instructor: Prof. Kenneth R. Brooks (serving as studio supervisor in consultation and collaboration with other landscape architecture and urban design faculty)
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Office Hours: Wednesdays 10:00-11:00, Thursdays 2:00-4:00 and by appointment; drop-ins are invited on a time-available basis (if you come by and I’m not available, please leave a message so that I can get back to you). The best way to consult with me is to request an appointment during class or by email.
Grading: Traditional grades will be assigned by LA faculty consensus.

Description This course is intended to give professional design students (especially MLA and MUD students) an opportunity to engage in complex design that applies a research-based approach. The course serves as a culminating experience for the MLA or MUD degree. The focus will be on both process and outcome related to a topic of significance to the discipline, of professional interest to the student and supportable by the resources of The Design School (including available faculty expertise).

Requirements: Each student will propose a researchable topic or issue. The proposal will include a description of the issue, the methodology to be used in investigating it, the lead landscape architecture faculty, the anticipated outcomes and deliverables. Each student will propose at least two faculty members as lead reviewers (including the designated thesis studio supervisor). Students may invite other faculty and other professionals serve as critics, advisors, and/or reviewers. The proposals, periodic reviews and final project presentations/defense will be conducted and adjudicated by a committee of the landscape architecture and/or urban design faculty and invited guests. Students taking the formal thesis track (LDE 599) will follow a similar process, with the addition of review and acceptance by the officially-approved supervisory committee.

Course Meetings: The thesis studio is scheduled to meet regularly on Wednesday and Friday afternoons from 1:30 - 5:55pm. Because of the independent nature of the projects, students will have flexibility in the use and management of this time for project work. Students will schedule weekly critique review sessions with the studio supervisor (Brooks) and with other faculty consultants. A monthly progress presentation will be made to a committee of faculty reviewers during the term.

Final Products: All students will prepare both a formal oral final presentation and documents that can be digitally achieved. All students are also encouraged to present their work in a venue for professional peer-review (such as an article, a conference presentation or a competition submission) in a format appropriate to the venue.
Review Dates:
(all mid-reviews in TmpCt198 Seminar Room, Final review location will be announced.)

<table>
<thead>
<tr>
<th>REVIEW</th>
<th>DATE</th>
<th>FOCUS / DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Mid-Review Fri, Jan 28</td>
<td>Project Issues, Goals, Scope, Program, Expectations – 15 minutes</td>
<td></td>
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<tr>
<td>3rd Mid-Review Fri, Apr 4</td>
<td>Design Implementation and Development – 30 minutes</td>
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</table>

TDS Public Design Reviews
   Friday, May 9   Showcase Presentation– 30 minutes

Related Course: The thesis studio, focusing on Design Performance, will be complimented by seminar on Design Performance. The seminar will explore the nature of design performance and examine strategies, systems and tools for applying and communicating issues of performance.
Estrella Mountain Regional Park
Healing Garden
Traci Arellano | Spring 2014
Therapeutic Landscapes Network defines a healing garden as, “any landscape, designed or wild, that facilitates human health and well-being.”
Estrella Mountain Regional Park Nature Center
14805 West Vineyard Avenue
Goodyear, AZ 85338
**THOUGHTS**

- Officially received approval for EMRP Sensory Garden to be my Applied Project.
- Must answer: How does this project advance Landscape Architecture as a profession?
- 20-25hrs/week; Meet with Rebecca and Denise about 1x/week.

**Deliverables**

- Daily Project logbook (printed & bound)
- Construction documents (2’x3’)
- Overall Site Plan
- Dimensioning Plan
- Preliminary Design Plan / Planting Plan
- Hardscape Plan (construction drawing & details)
- Irrigation Plan
- Lighting Plan
- Conceptual documents (2’x3’)
- Site Transects (N-S; E-W)
- Photoshop renderings
- PS hangings
- Sensory Gardens

- Level of completion depends on funding, staffing, in-kind services, etc.
- More information:
  - Session 3: 1.03.14
  - Met with EMRP park supervisor Don Harris & Ranger Amy for irrigation and ideas.
  - Met with Todd Briggs.
  - Met with Kris Floor.
  - Visit sensory gardens:
    - Banner Estrella Hospital
    - Banner Good Samaritan
    - Desert Botanical Gardens
    - Tucson Desert Museum

- Project logbook
- Midterm Boards

**PRELIMINARY TIMELINE**

<table>
<thead>
<tr>
<th>Week of</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 13 (1)</td>
<td>Semester begins</td>
</tr>
<tr>
<td>Jan 20 (2)</td>
<td>Overall Site Plan (Existing &amp; Proposed)</td>
</tr>
<tr>
<td>Feb 3 (4)</td>
<td>Preliminary Design Plan / Planting Plan</td>
</tr>
<tr>
<td>Feb 10 (5)</td>
<td>Hardscape Plan (construction drawing &amp; details)</td>
</tr>
<tr>
<td>Feb 17 (6)</td>
<td>Lighting Plan</td>
</tr>
<tr>
<td>Feb 24 (7)</td>
<td>Irrigation Plan</td>
</tr>
<tr>
<td>Mar 3 (8)</td>
<td>Site Transects (N-S; E-W) Photoshop renderings</td>
</tr>
<tr>
<td>Mar 10 (9)</td>
<td>Spring Break</td>
</tr>
<tr>
<td>Mar 17 (10)</td>
<td>Construction begins</td>
</tr>
<tr>
<td>Apr 7 (11)</td>
<td>TBD</td>
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<tr>
<td>Apr 14 (12)</td>
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<td>Apr 21 (13)</td>
<td>TBD</td>
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<tr>
<td>Apr 28 (14)</td>
<td>Last day of classes 5/02/14</td>
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<tr>
<td>May 5 (15)</td>
<td>Final graduation</td>
</tr>
<tr>
<td>May 12</td>
<td>Final graduation</td>
</tr>
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</table>

**ADDITIONAL ACTIVITIES**

- Meet with park supervisors and volunteer programs for ideas and help.
- Meet with Todd Briggs.
- Visit sensory gardens:
  - Banner Estrella Hospital
  - Banner Good Samaritan
  - Desert Botanical Gardens
  - Tucson Desert Museum
- Review Midterm Grades
• Maricopa County Parks & Recreation Department
• West Valley Arts Council
• Three Rivers Historical Society (3RHS)
- Healing garden
- Centennial trailhead
- School desert awareness
- Environmental programs
- Special events
- Picnic area
- Community volunteer site
Statement of Intent

If there is public access to visitors and staff to a healing garden in close proximity to the publically visited Nature Center at Estrella Mountain Regional Park then there will be a substantial increase in benefit to well-being of the participants by engaging human senses through natural stimuli and observation of wildlife.
SITE PANORAMA: *Future site of the healing garden*
 CONTEXT

- Estrella Mt Regional Park is 19,840 sq acres in Goodyear, AZ
- Located near the meeting of the Gila and Agua Fria rivers
- First park in county system established in 1954
- Site is directly southwest of the park’s Nature Center
Healing/sensory gardens are fast becoming a place of refuge for urbanites from the daily grind and the stressors that accompany our fast-paced world. Gardens are often green places of respite and solitude that can help to recharge our mental capacity to cope. This healing garden’s purpose will be to help re-acknowledging the healing powers of nature that have been known and used for centuries, but have gone by the wayside as western medical advances moves toward technology and pharmacology and farther from the view of treating mind-body-spirit as a whole.

GOALS
The main area of interest is the recessed area to the SW of the nature center which is already a retention area where water is directed away from the building. The garden design will...

- Be reflective of the low-land Sonoran desert species
- Create a microhabitat for birds and butterflies
- Support vegetation that is lush versus just surviving
- Have seasonal color/textural interest
- Incorporate plants that represent the native culture (edible/medicinal)

SITE FACTS
- Estrella Mt Regional Park is 19,840 sq acres in Goodyear, AZ
- Located near the meeting of the Gila and Agua Fria rivers
- First park in Maricopa County system established in 1954
- Part of a larger portfolio which is the Centennial Trail

PROJECT NARRATIVE
CENTENNIAL TRAIL PORTFOLIO: *Part of the whole*

- Part of a larger portfolio which is the Centennial Trail
- Trailhead with half-mile looped barrier-free trail
- 11 exhibit area nodes
- Community-led/grassroots project
- Official Arizona Centennial Legacy status by the Arizona Historical Advisory Commission.
**REVISED TIMELINE**

**Week of February 3, 2014**

---

**Jan 13 (1)**
- Semester begins
- Meet w/ Ken Brooks re: important dates; pin-ups
- Meet w/ Rebecca Fish-Ewan re: deliverables; requirements
- Meet w/ Denise re: important dates; deliverables; timeline

**Jan 20 (2)**
- Overall Site Plan (existing)
- Aerials from Google Earth | AutoCAD line drawing

**Jan 27 (3)**
- Dimensioning Plan (existing)
- Pin-up #1 (1/31)

**Feb 3 (4)**
- Start project logbook
- Start annotated bibliography
- Read Healing Garden articles

**Feb 10 (5)**
- Visit healing gardens in Phoenix/Scottsdale areas
  - City of Glendale’s Elsie McCarthy
  - Banner Estrella
  - Phoenix Children’s Hospital
  - Scottsdale Healthcare Thompson Peak
  - Banner Gateway
  - Mercy Gilbert

**Feb 17 (6)**
- Write up case studies (1-3)

**Feb 24 (7)**
- Preliminary (proposed) Design Plan
- Photoshop renderings
- Pin-up #2 (2/28)

**Mar 3 (8)**
- Ploting Plan

**Mar 10 (9)**
- Site Transcripts (P.0, F.W.)
- Pin-up #3 (3/28)

**Mar 17 (10)**
- Spring Break

**Mar 24 (11)**
- Irrigation (Requirements) to submit to irrigation professionals

**Mar 31 (12)**
- Fin-up #3 (4/4)

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**Additional to do’s**
- 1.03.14
  - Met w/EMRP park supervisor Don Harris & Ranger Amy for irrigation and ideas
- 1.03.14
  - Meet w/ Rebecca x1/wk
- 1.03.14
  - Meet w/ Denise x1/mo
- 1.03.14
  - Meet w/design professionals as able: Todd Briggs, Christine Floor
- 1.03.14
  - Visit other sensory gardens as able: Desert Botanical Gardens, Tucson Desert Museum
- 1.03.14
  - Visit other sensory gardens as able: Desert Botanical Gardens, Tucson Desert Museum
- 1.03.14
  - Pin-up boards
- 1.03.14
  - EMRP Meetings
“A garden at your workplace may reduce stress”
Ulrika Stigsdotter

U. Stigsdotter found there was “a significant connection between access to a garden and decrease in levels of stress at the workplace” and “gardens at workplaces play an important part in offering a more stress-free environment, irrespective of sex, age or socio-economic background.”

“Natural versus urban scenes: Some psychophysiological effects”
Roger Ulrich

R. Ulrich found that landscapes can be restorative by “reducing negative emotions, holding a person’s attention and blocking stressful thoughts.”

Therese Rivasseau Jonveaux, et al

This study states that healing gardens provide a definite reduction in behavioral disorders such as irritableness, aggression and overall improved health, nutritional status and sleep patterns for Alzheimer’s patient which is measurable in the patient’s well-being.
The Banner Estrella courtyard has very straight geometric shapes placed asymmetrically in thirds. It has a very modernist feel with the concrete planters and clean lines. The water feature, "running along the outside face of the glass curtain wall spanning the length of the garden along the north side, this feature was a well-placed and welcome transitory element, tying the interior and exterior spaces together." (Bradley, 2010)

The site has a lot of concrete. The paving, raised planters and water feature is concrete. There looks to be a portion of the linear walkway that is stabilized granite; however, the predominant material is concrete. There is elegance to the simplistic lines but it also makes the atmosphere very sterile and "sterile." The plants were aesthetically pleasing and their tight look complemented the concrete material; however, they did not evoke a "cozy" or informal feeling.
Banner Gateway Medical Center is a general medical and surgical hospital in Gilbert, AZ. It performed nearly at the level of nationally ranked U.S. News Best Hospitals in 2 adult specialties, as shown below. Banner Gateway Medical Center has 177 beds. The healing garden is located in the maternity unit and has restricted access to the patients and their families. On one end is a courtyard which is a special event/seating area which the patient rooms in the 3-story high wing can look down upon. The space is bisected with a wall-water feature that obstructs your view to the play/eating area which invites you over with sounds of water and child laughter. The area is spacious yet cozy. It has abundant shade and a state-of-the-art play equipment with cool loungers for the parents.
Dedicated to healing the whole person—mind, body and soul—Banner Good Samaritan offers an enhanced healing environment for patients and their families. There are six gardens, including the award-winning Healing Garden, provide an atmosphere for reflection and relaxation. To ensure your spiritual and emotional needs are met, interfaith hospital chaplains are available around the clock to meet with families. The healing garden is has multiple topographies and water features. It has inviting alcoves which allow visitors to have quiet conversations or sit among planters of blooming flowers and succulents and other friendly visitors. The garden also sports amazing mosaic pillars that are colorful and the tiles that are used were a community project that was created by patients with inspirational sayings and words.
The Banner MD Anderson Cancer Center Togetherness Garden is reached by entering through a narrow doorway that symbolizes hope and victory at the conclusion of treatment. The facilities were built to heal; Along the way there are wildflowers, water features and stepping stones which all carry a metaphorical message of hope for cancer patients to live a fulfilling life.
The Richard and Annette Bloch Cancer Survivors Park stretches a full block on First Street, from Willetta to McDowell. There's a nice shaded gazebo surrounded by cacti, and a colorful obelisk in the center. The highlight of the park are the bronze sculptures by artist Victor Salmones. The piece is called "Cancer. There's Hope," and it depicts eight people in various stages of fighting cancer. At the back are five figures meant to represent cancer patients and their supporters as they enter treatment. Treatment is represented by a large bronze maze, and there's a figure of a young woman working her way through the maze. There are now 24 Richard and Annette Bloch Cancer Survivors Parks throughout the United States and Canada. Cancer Survivors Parks promote survivorship and provide common sense information that will guide and support the patient through his or her cancer journey.
Elsie McCarthy Sensory Garden is one of the few sensory gardens in the Phoenix area that are owned and maintained in a non-healthcare public space. It is located in the heart of Glendale, Arizona. Funds were donated from the Elsie McCarthy estate and it is maintained by the Glendale Parks and Recreation Department. The garden was developed to stimulate the senses of sight, sound, smell and touch through the use of specific plants and trees for texture and scent, water features for sound, touch and sight and evening lighting for dramatic visuals.
Mercy Gilbert partnered with the Gila River Indian Community to construct the Healing Garden. The components of the garden were designed to work in harmony, providing the community with a place of serenity. The landscape incorporates plants with medicinal uses or qualities. Mercy Gilbert is built on the ancient tradition that love can help heal. Within that framework, the Golden Thread of Compassionate Care is used as a symbol to illustrate the balance between the science and the human spirit.
Phoenix Children’s Hospital in Phoenix, Arizona is ranked nationally in 5 pediatric specialties. Phoenix Children’s Hospital is a 425-bed children’s general facility with 13,404 admissions in the most recent year reported.

The healing garden is located on the facility’s rooftop and is restricted to the patients and their families. This creates a very secure-feeling environment. There are over-sized brightly painted flowerpots that adorn the garden and add whimsy to the area. Additionally there is a lot of funky seating and plenty of shade to encourage users to enjoy the glorious outdoors and incredible views.
<table>
<thead>
<tr>
<th>SITE</th>
<th>THOMPSON PEAK HOSPITAL</th>
<th>YEAR</th>
<th>2007</th>
<th>CITY</th>
<th>SCOTTSDALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPOLOGY</td>
<td>COURTYARD</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

The Thompson Peak healing garden was designed “to evoke feelings of well-being, provide places for serenity and rejuvenation, and impart visitors with a sense of connectedness to the natural world.” (Gensler, 2014) Made possible through community philanthropy, the garden offers shaded outdoor gathering spaces, paths, and water features. In addition to being visible from many patient rooms, the garden offers shaded outdoor seating, a water feature, and walls with drought-tolerant plantings. Hummingbird and butterfly gardens connect the hospital and draw in patients and visitors.
Recent studies have shown that regular doses of nature can be an effective tool in managing Attention Deficit Hyperactivity Disorder (ADHD). For the parents of children and adolescents suffering from ADHD, a walk in the park may be an even more important part of their daily routine.

Disorder (ADHD), a walk in the park may be an even more important part of their daily routine – particularly for those with ADHD. Studies have shown that spending time in green spaces can improve attention and reduce impulsivity.

For instance, a study conducted by the Landscape and Human Health Laboratory (LHHL) at the University of Illinois, Urbana-Champaign, found that children who spent time in green spaces showed improvements in attention and reduced impulsivity. The study, which was conducted over a period of three weeks, found that children who participated in regular nature walks showed significant improvements in attention compared to those who did not.

Dr. Taylor Faber, a researcher at the LHHL, says that their research has shown that spending time in green spaces can improve attention and reduce impulsivity. He notes that this is particularly important for children with ADHD, as they often struggle with attention and may benefit greatly from spending time in nature.

The study was conducted with the collaboration of Dr. Andrea Faber, a research scientist at the LHHL, who conducted the Digit Scan test to measure the participants' attention. The study also included a control group, which did not participate in the nature walks, to provide a comparison.

Dr. Faber and her team are currently working on extending their research to include longer-term effects of nature walks on ADHD symptoms. They are also exploring the potential benefits of using nature as a treatment for other disorders, such as depression and anxiety.

As Dr. Faber notes, "Nature provides a safe, inexpensive, and widely accessible tool for managing ADHD. We are excited about the potential of using nature as a treatment for other disorders and continue to explore the ways in which nature can improve mental health."
1. Does nature play a vital role in human health & wellbeing?

2. Do humans have a deep emotional connection with nature?

3. Do healing gardens provide nature in our urban environment?
individual human needs

- nature
- urban living
- instinctual physiological societal
instinctual = mind
physiological = body
societal = spirit
Nature plays a vital role in human health and well-being.

**BENEFITS TO MIND** (Healthy Parks, 2014)
- Cope & recover from stress
- Restore concentration
- Improve productivity
- Calming, restorative effect on children and adolescents with ADHD

**BENEFITS TO BODY** (Therese Rivasseau Jonveaux, et al)
- Recovery from illness quicker
- Fewer amount of pain medications
- Fosters recovery from mental fatigue
- Boosts immune system
- Increases life expectancy

**BENEFITS TO SPIRIT** (Maller, et al, 2005)
- Reduces depression
- Positive outlook on life
- Higher life satisfaction
- Beneficial physiological effects (i.e., increased happiness) when humans interact with animals, plants, & landscapes
1. Nature does play a vital role in human health and wellbeing!
1. Does nature play a vital role in human health & wellbeing?

2. Do humans have a deep emotional connection with nature?

3. Do healing gardens provide nature in our urban environment?
“...the innately emotional affiliation of human beings to other living organisms. Innate means hereditary and hence part of ultimate human nature.”

E. O. Wilson

Author of Biophilia, 1984
Cross-disciplinary research

1. Horticulturist, research fellow and author of *Green Nature Human Nature* in 1996 explains the evolutionary basis of people-plant relationships and human responses to the environment. “People and plants are entwined by threads that reach back to the beginning of a species”....”emotional responses to nature setting are the psychic equivalent of body knowledge.”


2. Environmental Psychologists Rachel Kaplan and Steven Kaplan study human preferences for specific landscape configurations and identified 4 qualities humans use to determine preference: Coherence, Legibility, Complexity, Mystery.


3. Robert Ulrich, Ph.D., professor of architecture and landscape architecture at Texas A&M University and a pioneer of evidence-based design, measures physiological and psychophysiological responses (heart rate, blood pressure, muscle tension & brain waves) to preferred settings. Ulrich found 6 variables in qualities of landscape preference: Focality, Complexity, Depth, Ground Texture, Deflected Vistas, Appraised Threat.

2. Humans have a deep emotional connection with nature and is attracted to all that is alive and vital.
1. Does nature play a vital role in human health & wellbeing?

2. Do humans have a deep emotional connection with nature?

3. Do healing gardens provide nature in our urban environment?
ACCESS TO NATURE
Individual’s Role with Local Community in Health & Wellbeing

INGROUP (family & friends)

OUTGROUP (neighbors, co-workers, clubs, etc)

SOCIAL INTERACTION

Access to Nature for Individual’s role in human health and well-being.

BENEFITS TO SOCIAL-SELF
(The Health and Social Benefits, 2005)
- Strengthens community ties
- Reduces crime
- Encourages volunteerism
- Promotes stewardship
- Promotes social bonds
3. Healing Gardens do provide nature in our urban environment.
<table>
<thead>
<tr>
<th>Design Principles vs Hospital Healing Gardens</th>
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</thead>
<tbody>
<tr>
<td>Simplicity</td>
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<tr>
<td>Reflects community</td>
</tr>
<tr>
<td>Clarity of layout</td>
</tr>
<tr>
<td>Opportunity for choice</td>
</tr>
<tr>
<td>Physical comfort</td>
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<tr>
<td>Movement &amp; exercise</td>
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<tr>
<td>Senses for soul</td>
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<tr>
<td>Plant interactions</td>
</tr>
<tr>
<td>Anchor points</td>
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<tr>
<td>Provides mystery</td>
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<tr>
<td>Encourage wildlife</td>
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<tr>
<td>Natural forms</td>
</tr>
<tr>
<td>Courtyard</td>
</tr>
<tr>
<td>Park</td>
</tr>
<tr>
<td>Private</td>
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</table>
PHASE DEVELOPMENT MAP

PROPOSED DEVELOPMENT

- PHASE 1: HEALING GARDEN
- PHASE 2: PICNIC AREA
- PHASE 3: CENTENNIAL TRAIL
instinctual = mind
physiological = body
societal = spirit
12 BEST DESIGN PRINCIPLES

1. Simplicity is important | **Empathize with the user’s need for clear pathways and intuitive cues.**

2. Design should be reflective of the larger community | **Holistic modeling; represent a larger feature in the landscape.**

3. Design should encourage clarity of layout and movement | **Avoid dead end paths and complex formations.**

4. Design needs to have opportunities to make choices | **Encourage interaction, offer contemplation or people watching areas.**

5. Design should provide physiological comfort and psychological security | **Create options of sun or shade, protection from breezes and others’ view.**

6. Design needs to create physical opportunities for movement and exercise | **This brings physical and emotional benefits and helps to combat depression.**

7. Design should provide pleasing senses for the soul | **Include elements of surprise, whimsy, variety in color, texture, size and massing.**

8. Use the healing power of nature through sight, smell, touch and hearing | **Increased plant-human interactions.**

9. Provide carefully defined anchor points | **Contemplative situations require a full sense of involvement with the surroundings.**

10. Design should provide mystery and urge the visitor to explore | **Garden elements should be revealed one at a time to not diminish the sense of discovery.**

11. Design should encourage wildlife | **Provide habitat and diversity of food in berries, seeds, nuts and nectars with seasons in mind.**

12. Design should work with nature and natural forms | **Avoid straight lines & planes, or excessive symmetry; Healing power of water as feminine energy.**
1. Looking southeast to southwest; Panorama outside EMRP Nature Center
2. Looking north across healing garden, toward tortoise pen
3. Looking east at EMRP Nature Center west facade
DESIGN PRINCIPLES ACHIEVED

- Clarity of layout and movement
- Opportunity to make choices
- Pleasing senses for spirit
- Healing power of nature
- Provides mystery
- Encourage wildlife
- Nature and natural forms

VIEW 1
Looking southeast to southwest; Panorama outside EMRP Nature Center
VIEW 2

DESIGN PRINCIPLES ACHIEVED

- P7 Pleasing senses for spirit
- P8 Healing power of nature
- P11 Encourage wildlife
- P12 Nature and natural forms

Looking north across healing garden, toward the tortoise pen
DESIGN PRINCIPLES ACHIEVED

- P³ Clarity of layout and movement
- P⁴ Opportunity to make choices
- P⁵ Physiological comfort and psychological security
- P⁹ Provides anchor point
- P¹¹ Encourage wildlife interactions
Looking east at EMRP Nature Center west facade
## 12 Design Principles vs EMRP Site Plan

<table>
<thead>
<tr>
<th></th>
<th>CIRCULATION</th>
<th>PLANT LIST</th>
<th>SEATING</th>
<th>SPACE</th>
<th>VIEWS</th>
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<td>REFLECTIVE OF COMMUNITY</td>
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<td>CLARITY OF LAYOUT</td>
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<td>OPPORTUNITY FOR CHOICES</td>
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<td>PHYSIOLOGICAL COMFORT</td>
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<td>OPPORTUNITY FOR EXERCISE</td>
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<td>PLEASING SENSES FOR SOUL</td>
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<tr>
<td>HEALING POWER OF NATURE</td>
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<td>DEFINED ANCHOR POINTS</td>
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<td>PROVIDE MYSTERY</td>
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<tr>
<td>ENCOURAGE WILDLIFE</td>
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<tr>
<td>NATURE &amp; NATURAL FORMS</td>
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</table>
WILDLIFE HABITAT
***
FOOD
SHELTER
CAMOUFLAGE

ECOLOGICAL
***
NATIVE SPECIES
ELEVATION
HARDINESS

ATTRACTORS
***
BLOOMS
FRAGRANCE
AESTHETICS

NATIVE PEOPLES
***
MEDICINE
MATERIAL RESOURCE
CEMERMONIAL
ESTRELLA MOUNTAIN REGIONAL PARK
Healing Garden Plant List

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Mature Size</th>
<th>Blooming Season</th>
<th>Reason for Selection</th>
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<tbody>
<tr>
<td><strong>Trees</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Acacia constricta</td>
<td>White Thorn Acacia</td>
<td>10x15</td>
<td>spring to summer</td>
<td>Attracts birds</td>
</tr>
<tr>
<td>Chilopsis linearis</td>
<td>Desert Willow</td>
<td>25x20</td>
<td>spring to fall</td>
<td>Attracts hummers</td>
</tr>
<tr>
<td>Parkinsonia florida</td>
<td>Blue Palo Verde</td>
<td>30x30</td>
<td>spring</td>
<td>Good for nesting</td>
</tr>
<tr>
<td>Prosopis pubescens</td>
<td>Screwbean Mesquite</td>
<td>15x20</td>
<td>spring to fall</td>
<td>Attracts wildlife</td>
</tr>
<tr>
<td><strong>Shrubs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calliandra eriophylla</td>
<td>Pink Fairy duster</td>
<td>3x4</td>
<td>spring to fall</td>
<td>Attracts hummers</td>
</tr>
<tr>
<td>Celtis pallida</td>
<td>Desert Hackberry</td>
<td>8x10</td>
<td>summer</td>
<td>Birds love orange berries</td>
</tr>
<tr>
<td>Encelia farinosa</td>
<td>Brittlebush</td>
<td>3x4</td>
<td>winter to spring</td>
<td>Attracts wildlife</td>
</tr>
<tr>
<td>Ericameria laricifolia</td>
<td>Turpentine Bush</td>
<td>2x3</td>
<td>late summer to fall</td>
<td>Attracts wildlife; fragrant</td>
</tr>
<tr>
<td>Justicia californica</td>
<td>Chuparosa</td>
<td>4x4</td>
<td>winter to spring</td>
<td>Attracts hummers</td>
</tr>
<tr>
<td>Larrea tridentate</td>
<td>Creosote</td>
<td>6x6</td>
<td>spring to fall</td>
<td>Attracts wildlife; fragrant</td>
</tr>
<tr>
<td>Lycium pallidum</td>
<td>Wolfberry</td>
<td>8x8</td>
<td>spring to fall</td>
<td>Attracts wildlife; fragrant</td>
</tr>
<tr>
<td>Simmondsia chinensis</td>
<td>Jojoba</td>
<td>6x6</td>
<td>spring</td>
<td>Attracts wildflower; medicinal</td>
</tr>
<tr>
<td>Tecoma stans</td>
<td>Arizona Yellow Bells</td>
<td>6x6</td>
<td>spring to fall</td>
<td>Attracts hummers &amp; butterflies</td>
</tr>
<tr>
<td><strong>Groundcover/Annuals/Perennials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baileya multiradiata</td>
<td>Desert Marigold</td>
<td>1x1</td>
<td>year-round</td>
<td>Beautiful flowers year-round</td>
</tr>
<tr>
<td>Daucus pusillus</td>
<td>Rattlesnake Weed</td>
<td>2x1</td>
<td>spring</td>
<td>Attracts wildlife, medicinal, edible</td>
</tr>
<tr>
<td>Eriogonum fasciculatum</td>
<td>Wild Buckwheat</td>
<td>1x2</td>
<td>spring</td>
<td>Attracts birds, medicinal</td>
</tr>
<tr>
<td>Lupinus arizonicus</td>
<td>Arizona Lupine</td>
<td>3x3</td>
<td>spring</td>
<td>Beautiful flowers; sun-tracking</td>
</tr>
</tbody>
</table>
ESTRELLA MOUNTAIN REGIONAL PARK
Healing Garden Plant List

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Mature Size</th>
<th>Blooming Season</th>
<th>Reason for Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cactus/Succulents/Accent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agave murpheyi</td>
<td>Murphey’s Agave</td>
<td>5x4</td>
<td>Late winter to spring</td>
<td>Edible; material resource</td>
</tr>
<tr>
<td>Asclepias subulata</td>
<td>Desert Milkweed</td>
<td>3x3</td>
<td>Spring to fall</td>
<td>Attracts butterflies</td>
</tr>
<tr>
<td>Dasylirion wheeleri</td>
<td>Desert Spoon</td>
<td>4x4</td>
<td>Summer</td>
<td>Attracts wildlife; material resource</td>
</tr>
<tr>
<td>Fouquieria splendidens</td>
<td>Ocotillo</td>
<td>24x18</td>
<td>Spring</td>
<td>Attracts hummers</td>
</tr>
<tr>
<td>Lophocereus schottii</td>
<td>Senita</td>
<td>10x10</td>
<td>Spring to summer</td>
<td>Edible fruit; material resource; spiritual</td>
</tr>
<tr>
<td>Opuntia acanthocarpa</td>
<td>Buckhorn Cholla</td>
<td>4x5</td>
<td>Spring</td>
<td>Edible fruit</td>
</tr>
<tr>
<td>Opuntia basilaris</td>
<td>Beavertail Prickly Pear</td>
<td>1x3</td>
<td>Spring</td>
<td>Beautiful flowers; edible fruit</td>
</tr>
<tr>
<td>Yucca elata</td>
<td>Soaptree Yucca</td>
<td>10x4</td>
<td>Spring to summer</td>
<td>Attracts wildlife, medicinal, edible</td>
</tr>
</tbody>
</table>

Type Note: Estrella Mountain Regional park “ris[es] gradually from approximately 900 feet above sea level to the highest point in the park of 4,512 feet.” (D. Bates) This locates the park in the **Lower Sonoran Zone** which is 0-4500’. These plants endure extreme temperatures that exceed 110°F in the summer and 25°F during the winter, as well as, precipitation of 6 inches or less annually.
PLANT PALETTE

Blue Palo Verde

Desert Willow

Screwbean Mesquite

White Thorn Acacia

Desert Marigold

Rattlesnake Weed

Wild Buckwheat

Arizona Lupine
Buckhorn Cholla

Desert Milkweed

Desert Spoon

Ocotillo

Parry's Agave

Purple Prickly Pear

Senita

Soaptree Yucca

PLANT PALETTE (cont)
TAKE-AWAYS

1. Nature IS vital to our health and wellbeing...and should be designed into our lives.

2. There are multiple BENEFITS to the mind-body-spirit of individuals that spend time in and around Healing Gardens.

3. Healing Gardens are a BEST PRACTICE for anyone that wants health & happiness.

4. Healing Gardens can be created ANYWHERE and be ANY SIZE.
“Everybody needs beauty as well as bread, places to play in and pray in, where nature may heal and give strength to body and soul.”

~John Muir~
Urban Wetlands providing ecosystem services
Site - Downtown Phoenix
The problem and context: Preserve fresh water as a resource while recycling wastewater through urban wetlands to provide ecosystem services

The direction of water management has taken throughout history has begun to show in severe drought conditions of groundwater and aquifer depletion while ocean levels rise. The established method of treating stormwater and rainwater in an urban environment has been to direct it off of surfaces and away from a city. As populations grew the water cycle became more manipulated. Dams, canals and large irrigation systems were built. Wastewater was isolated, collected and transferred outside of cities to be treated. This allowed for an immediate rise in standards of living for populations in urban environments. For centuries before and at the beginning of human civilization the natural hydrological cycle filtered, absorbed, transferred and balanced the distribution of water and waste through plants and soil to groundwater recharge which leads to river life and cycles which in turn flow to the oceans. Today the average flow of water into streams and reservoirs has been decreased by 37% (Sensitive Cities 2012). Climate and rainfall does play a role, however, the demand and use by civilizations can be managed and reduced while revealing how non-rainwater sources of water can play a role in delivering liveable, resilient and productive cities.

Rather than a costly and smelly waste treatment plant new industries, economic growth, and new technology can be used to generate new ways of collecting and using wastewater in a safe, and aesthetically pleasing construction. Through the Living Building challenge construction of wastewater treatment wetlands has already been included for on-site waste water treatment in the design of new buildings. Several buildings through the Living Building Challenge have been completed with constructed wetlands and awarded LEED platinum as well as Living Building Challenge credentials.
By 2040 the surrounding downtown areas of Phoenix will have grown 4 \times \text{current population}

These areas will have 10,000 and more people per square mile.
Drought severity measures the average length of droughts times the dryness of the droughts from 1901 - 2008.

Calculations: Drought severity is the mean of the lengths times the dryness of all droughts occurring in an area. Drought is defined as a contiguous period when soil moisture remains below the 20th percentile. Length is measured in months, and dryness is the average number of percentage points by which soil moisture drops below the 20th percentile. Drought data is re-sampled from original raster from into hydrological catchments.
Groundwater Stress

Areas where there is Ground Water Stress

Ground water stress measures the amount of groundwater withdrawal relative to its recharge rate over a given aquifer. Values above on indicate where unsustainable groundwater consumption could affect groundwater availability and ground-water dependent ecosystems.

Calculations: Groundwater footprint divided by the aquifer area. Groundwater footprint is defined as \( A \left[ \frac{C}{R-E} \right] \), where \( C \), \( R \), and \( E \) are respectively the area - averaged annual abstraction of groundwater, recharge rate, and the groundwater contribution to the environmental stream flow.

\( A \) is the areal extent of any region of interest where \( C \), \( R \), and \( E \) can be defined.
Aquifer Stress

USGS Real Time Groundwater

April 14th 2014

Low <10 Percentile - Much Below Normal
10-24 Percentile - Below Normal
25-75 Percentile - Normal
76-90 Percentile - Above Normal
Not Ranked
More than 1.8 million people live in Phoenix itself, and 22 cities surround it in the Valley of the Sun, forming the largest metropolitan landscape by area in the United States.

Each year the valley receives about Seven Inches of rainfall. Average temperatures exceed 100 degrees for three months a year, with peaks as high as 120 degrees. Global Climate change means longer sustained days of heat means more loss of water to evaporation.

Desert nights no longer cool down they way they used to, because energy from the sun is trapped in roads and buildings, a phenomenon researchers call the “urban heat island effect.”
Solar Radiance /Radiation

**Irradiance** - The amount of electromagnetic energy incident on a surface per unit time per unit area. In the past this quantity has often been referred to as "flux".
* When measuring solar irradiance (via satellite), scientists are measuring the amount of electromagnetic energy incident on a surface perpendicular to the incoming radiation at the top of the Earth's atmosphere, not the output at the solar surface.

**Solar Constant** - The solar constant is the amount of energy received at the top of the Earth's atmosphere on a surface oriented perpendicular to the Sun's rays (at the mean distance of the Earth from the Sun). The generally accepted solar constant of 1368 W/m² is a satellite measured yearly average.

**Insolation** - In general, solar radiation is received at the Earth's surface. The rate at which direct solar radiation is incident upon a unit horizontal surface at any point on or above the surface of Earth.
*I will refer to insolation as direct solar radiation at the Earth's surface.*

How radiation is expressed in an urban environment with regards to materials.

**Transmission** = Filter
**Reflection/Scattering** = Reflection or Albedo
**Absorption** = Shade
Investing in implementing an ecosystem service is securing a greener economy for the downtown not only in the ecology but in the dollars gained by venues and services that benefit from the attraction of people.

This study shows that investments in pedestrian safety and an attractive street environment brings quantifiable financial returns. Key Finding: On a seven-point pedestrian environment scale,

**Every One Point Increase In Walkability Was Associated With 5.2% Higher Retail Prices and 4.9% Higher Commercial Rents.**

Economic Value of Walkability, Victoria Transport Policy Institute, September 2009, citing a study by Accent Marketing and Research. Key Finding: This study of consumer expenditures in British towns found that customers who walk spend significantly more ($50) compared to those who drive ($40), take transit ($38), or arrive by taxi, bicycling, or other mode ($35).

“The Impact of Neighborhood Walkability on Walking Behavior” paper
Published November 2013
The paper provides strong evidence that Neighborhood walkability impacts the amount of time people walk. Those who live in a more walkable neighborhood, where the infrastructure is pedestrian-friendly, walk more than those who live in a neighborhood less conducive for walking.

People will take advantage of pedestrian-friendly environments and walk more – whatever their original predispositions were towards walking.
The First Era Of Water - Relying on Nature's Sources
Hydrological Cycle - This process shows Earth’s ability to filter itself through an air, land, and underground process
Dependence on Natural Water Cycle
Humans water needs were 'cleaned' by the Hydrological Cycle. Average life span of Human- 35 years.

The Second Era Of Water
Humans Manipulate Water Cycle
A higher standard of living is achieved through innovations in water technology such as Canals, Dams, Irrigation
Wastewater is collected and isolated
Canals strain dirty water out of tanker-less water born illness and disease
Population Living Longer
With sanitation and water-related diseases reduced population growth

Third Era Of Water
Over-Development
New industries, economic growth, and new technology add to the demand of water world-wide
Failure to Integrate
Delivery of water over long distances, open storage
Lack Of Access
1/3rd of the world’s population currently lacks access to fresh water.
Earth’s Climate Is Changing
Temperatures are rising and the need for water will too. Precipitation cycle with change as a result

Ecosystem Services from Non-rainwater supply solutions along with rainwater harvesting

To help establish a broader vision and system for a city like Phoenix to avoid committing to a growth pattern of costly augmentation of water supply and environmental damage. This proposal has the potential to improve water management and livability in the city at the same time.
Downtown Wetlands

The full use of water ecosystem services in an urban environment can shift and combine the image of water from a resource focus to a service focus. Water supplies will be stressed because of the growth in demand. Bringing water out into public spaces in a manner that demonstrates a recycled use demonstrates the importance and needs on water. It will take a coevolution of technological and mutually reinforcing institutional and sociocultural goals and values. This project looked at ecosystem services as the catalyst for the shared goals and values in society and how these ecosystem services can be delivered through constructed urban wetlands.

Lessons learned from current construction demonstration sited and already existing models allow for diversity of configuration of constructed wetlands to adapt to growth and continue even distribution of recycled wastewater.

A decentralized water system not only has landscape design and construction mitigating stormwater runoff and providing rainwater harvesting it creates re-uses for non rainwater sources such as HVAC condensate and wastewater wetlands. Wetlands are permanently waterlogged areas populated by hydrophytic plants such as reeds, They comprise a variety of sub-surface micro-habitats of differing oxygenation and redox potential. Constructed wetland systems are increasingly being employed for treatment of wastewater, sewage sludges and industrial effluents as a cost-effective, low energy and robust alternative to traditional engineered biological treatment such as the activated sludge process.

Constructed wetlands are classified according to their mode of operation as free water surface-flow, horizontal flow, vertical downflow or vertical upflow type. They have been used successfully in the treatment of domestic sewage, urban, highway and stormwater runoff, acid mine drainage, agricultural wastewater and industrial effluents (including landfill leachate). Biological oxygen demand (gases) and solids reduction occurs through microbial activity and removal of nitrogen and phosphorus through the processes of filtration, denitrification, plant uptake and absorption. This project is focused on the subsurface flow wetlands which through its construction allows for integration within a streetscape or urban space of a city.
## Design structure of a new water management system

Use of water ecosystems and integrated wetlands develops multifunctional urban spaces

<table>
<thead>
<tr>
<th>Conventional Wastewater Treatment</th>
<th>Constructed Emergent plant Wetlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single purpose to process and treat large volumes of wastewater on small parcels of land</td>
<td>Scaled to neighborhood and can be distributed throughout the watershed</td>
</tr>
<tr>
<td>Secondary benefits not considered</td>
<td>Secondary benefits in conservation of water and ecosystem services that contribute to the landscape network</td>
</tr>
<tr>
<td>Process involves application of chemicals and energy for pumping, agitating and aerating</td>
<td>Byproducts can be used to augment landscape, natural areas and contribute to species and habitat diversity.</td>
</tr>
<tr>
<td>High cost of electricity /fuel to operate waste treatment facility</td>
<td></td>
</tr>
</tbody>
</table>
Wetlands ecologies are both complex and stable and the root systems of the plants are adapted to thrive all the while submerged in water. Wetlands have continuous water flow, thus the plants are adapted to filter out nutrients very quickly. Plants do not take up the waste contaminants to their tissue the submerged root system is where nutrients are broken down so no portion of their leaves or stems contain contaminants.

Constructed Wetlands are differentiated by vegetation type and flow regime. A new function to wetlands is below ground treatment of wastewater. The benefit to this is a multifunctional green infrastructure that can be scaled to the neighborhood as well as a city block and distributed throughout the watershed.

The (HSF) horizontal subsurface flow wetland and the (VSF) vertical subsurface flow wetland are the two options for below-ground treatment stages. A hybrid of the two allows for more compactness and higher performance of treatment.
Case Study Sidwell Friends Middle School- Living Building

90% Reduced Municipal Water Use
60% Less Energy Demand
Dashboard Information Access

Biodiversity
Over 80 Native Plant Species established on the campus
Learning Life Sciences in Landscape
Case Study San Francisco Living Building

These Living Buildings clean wastewater through a living wetland system that moves from outside to inside the building.

11 Story Building

900 employees

recycles 6,000 gallons per day of wastewater

60% Reduction of municipal waste cost.
Plant Choices For and Urban Setting

Exterior wetland plants

- Eleocharis palustris
- Calex species
- Acanthus mollis
- Chondropetalum tectorum
- Juncus effusus
- Acorus gramineus
- Cyprus alternifolius

Interior wetland plants

- Rumohra adiantiformis
- Agapanthus Preacox
- Zantedeschia aethiopica
- Cyprus alternifolius
## Adopting An Adaptive Regime

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Traditional Regime</th>
<th>Adaptive Regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Boundary</td>
<td>Water supply, sewerage and flood control for economic and population growth and public health protection</td>
<td>Multiple purposes for water considered over long-term time frames including waterway health, transport, recreation/amenity, micro-climate, energy, etc.</td>
</tr>
<tr>
<td>Management Approach</td>
<td>Compartmentalization and optimization of single components of the water cycle.</td>
<td>Adaptive, integrated, sustainable management of the total water cycle (including land-use)</td>
</tr>
<tr>
<td>Expertise</td>
<td>Narrow technical and economic focussed disciplines</td>
<td>Transdisciplinary, multi-stakeholder learning across, technical design, economic, social and ecological spheres, coordination across all levels and usually with social engagement.</td>
</tr>
<tr>
<td>Service Delivery</td>
<td>Centralised, linear and predominantly technologically and economically based</td>
<td>Diverse, flexible solutions at multiple scales via a suite of approaches (technical, social, economic, ecological etc.)</td>
</tr>
<tr>
<td>Role of Public</td>
<td>Water managed by government on behalf of communities</td>
<td>Co-management of water between government, business and communities</td>
</tr>
<tr>
<td>Risk</td>
<td>Risk regulated and controlled by government</td>
<td>Risk shared and diversified via private and public instruments</td>
</tr>
</tbody>
</table>

---

### Water Cycle System

**System Boundary**

- **Traditional Regime**: Water supply, sewerage and flood control for economic and population growth and public health protection.
- **Adaptive Regime**: Multiple purposes for water considered over long-term time frames including waterway health, transport, recreation/amenity, micro-climate, energy, etc.

**Management Approach**

- **Traditional Regime**: Compartmentalization and optimization of single components of the water cycle.
- **Adaptive Regime**: Adaptive, integrated, sustainable management of the total water cycle (including land-use).

**Expertise**

- **Traditional Regime**: Narrow technical and economic focussed disciplines.
- **Adaptive Regime**: Transdisciplinary, multi-stakeholder learning across, technical design, economic, social and ecological spheres, coordination across all levels and usually with social engagement.

**Service Delivery**

- **Traditional Regime**: Centralised, linear and predominantly technologically and economically based.
- **Adaptive Regime**: Diverse, flexible solutions at multiple scales via a suite of approaches (technical, social, economic, ecological etc.).

**Role of Public**

- **Traditional Regime**: Water managed by government on behalf of communities.
- **Adaptive Regime**: Co-management of water between government, business and communities.

**Risk**

- **Traditional Regime**: Risk regulated and controlled by government.
- **Adaptive Regime**: Risk shared and diversified via private and public instruments.
Wastewater design characteristics are used to determine size and design of the treatment system components. Design mass load of chemical oxygen demand (COD) and Total Kjeldahl Nitrogen (TKN) are the primary water quality indicators or characteristics for sizing treatment components. The following table shows selected design influent concentrations that would be cleaned based on a flow rate of 5,000 gallons per day. The system is designed to provide for maximum treatment capacity in the space available in the wetland cells. If the flow of wastewater has significantly higher concentrations of the key constituents listed in the Table 1, the treatment capacity will be reduced to less than 5,000 GPD. The flow into the system can be monitored by a control system and set manually by an operator that will allow overflow to the city sewer.

**Table 1. Tidal Wetland Design Influent Wastewater Characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Concentration mg/L</th>
<th>Mass Load (b) kg/d</th>
<th>Mass Load (b) lb/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Flow, gallons per day</td>
<td>5,000</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>BOD (Biological Oxygen Demand)</td>
<td>260</td>
<td>4.92</td>
<td>10.83</td>
</tr>
<tr>
<td>COD (Chemical Oxygen Demand)</td>
<td>545</td>
<td>10.32</td>
<td>22.71</td>
</tr>
<tr>
<td>TSS (Total Suspended Solids)</td>
<td>90</td>
<td>1.7</td>
<td>3.75</td>
</tr>
<tr>
<td>Total Kjeldahl Nitrogen as N (c)</td>
<td>170</td>
<td>3.22</td>
<td>7.08</td>
</tr>
<tr>
<td>pH, standard units</td>
<td>6.5–8.5</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

(a) Wastewater pumped to the Living Machine System after primary treatment  
(b) Mass load based on stated design flow multiplied by the listed parameter concentration  
(c) Total Kjeldahl Nitrogen (organic + ammonia)
Vertical subsurface flow wetlands are continually flooded and drained to mimic incoming tides of natural estuaries.
Constructed horizontal subsurface flow wetlands are treating pre treated water from the vertical subsurface wetlands based on gravel size and temperature.
Decentralized Wastewater Stakeholder Decision Model adapted using quadruple-bottom-line approach to help users determine what is most important to the community and how decentralized wetlands can create these in urban environments through ecosystem services.
Designer as "one-man band."

The design is lead by a single learner of the discipline, who specializes and executes the design in isolation from other disciplines. Community and Stakeholders are represented. Coordination by standardization.

System wide investment (management) by one party into the whole system.

Designer as an "orchestra conductor"

Multidisciplinary where the lead designer examines from other perspective and through their own discipline how to integrate and staple together the results from the other disciplines. Stakeholders and other disciplines contribute and synthesized by single party.

System wide management of multi-disciplines within the single party, multi-closed loops systems. Pooled interdependence.

Designer as part of an "ensemble"

Interdisciplinary where there is coordination from the design concept for a unified guide to the problem solving and shared methods. Community and Stakeholders can contribute to the process.

Coordination by planning. Sequential interdependence.

Adapted from Urban Ecological Design Plate #9 -The designer as part of an ensemble. Showing progression of management and collaboration towards a method that would include the quadruple bottom line.
Transdisciplinary model and the quadruple bottom

Transdisciplinary, allows for formulation of problems into different context and learn to see in new ways. There is coordination across all levels and usually with engagement of society and stakeholders. Reciprocal interdependence
Coordination based on integrated input/output. Development based on shared values and goals and uncertainty and reorientation

- Community Input Social Equity
- Ecology Health & Society
- Economics Government Private/Public Partnership
- Aesthetics Equity & Value

Collaboration across levels
Formulate Problems new context
Variety of approach

Discussion Issues wants/needs

Designer / Planner Professional

Discipline / Field of expertise

Licensed professional in expertise/discipline

Transdisciplinary model and the quadruple bottom
Ecosystem Service Defined in the quadruple bottom line & Transdisciplinary model

<table>
<thead>
<tr>
<th>Aesthetics</th>
<th>Social Equity</th>
<th>Economic Government &amp; PPP</th>
<th>Ecology Ecosystem Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale: Human, Ecological, Local, City, Regional. Relevance, appropriateness, Proportions Color, texture, light, moisture, water, materials Habitat, productive soils</td>
<td>Education &amp; Lifestyle</td>
<td>Social Capital</td>
<td>Habitat Endangered species</td>
</tr>
<tr>
<td>Securities and Goods Arable lands, crops Drinking water, energy Natural fibers, pharmaceuticals Seafood, textiles, timber Industrial products</td>
<td>Partnerships Growth and uptake</td>
<td>Partnership Growth and uptake</td>
<td>Room Moisture Lakes Oceans</td>
</tr>
<tr>
<td>Processes / Functions Air pollution, CO2 absorption, carbon storage Disturbance regulation, drought mitigation, dust particle capture Erosion control, climate mitigation on different scales, groundwater recharge Nitrogen removal / fixation, photosynthesis, seed dispersal, self-purification Storm protection, UV protection, water purification Water recycling pollination protection</td>
<td>Accessibility Walkability</td>
<td>Increase Property Value</td>
<td>Waste Disposal</td>
</tr>
<tr>
<td>Biodiversity, food production Future genetic materials, Pollination protection</td>
<td>Climate &amp; Radiation Regulating</td>
<td>Improve living &amp; working conditions</td>
<td>Air &amp; Water Purification</td>
</tr>
</tbody>
</table>
Ecosystem services out of the quadruple bottom line

**Aesthetics**
- Recreation
- Planting pallet
- Habitat
- Provision
- Climate & Radiation
- Regulating
- Cultural
- Appealing to the Senses
- Attraction

**Social Equity**
- Education & Lifestyle
- Improve Living & Working Conditions
- Accessibility
- Walkability
- Mental Physical Health
- Civic Space

**Ecology**
- Waste Decomposition
- Air & Water Purification
- Ecosystem Services
- Habitat
- Endangered species
- Soil & Nutrient Cycling
- Rivers
- Groundwater
- Lakes
- Oceans

**Economic Government & PPP**
- Increase Property Value
- Partnerships
- Growth and savings
- Employment
- Social Capital

**Material & Energy**
- Material
- Energy

**Improve Living**
- Improve Property Value
- Access to Aesthetics
- Live in Social Equity
- Ecosystem Services
- Economic Government & PPP

**Civic Space**
- Walkability
- Mental Physical Health
- Civic Space

**Environmental**
- Climate & Radiation
- Regulating
- Cultural

**Economic**
- Employment
- Social Capital
- Partnerships
- Growth and savings

**Material & Energy**
- Material
- Energy

**Cultural**
- Aesthetics
- Appealing to the Senses
- Attraction

**Social**
- Improve Living & Working Conditions
- Accessibility
- Walkability
- Mental Physical Health

**Ecosystem**
- Waste Decomposition
- Air & Water Purification
- Ecosystem Services
- Habitat
- Endangered species
- Soil & Nutrient Cycling
- Rivers
- Groundwater
- Lakes
- Oceans

**Government**
- Economic
- Partnerships
- Growth and savings

**Equity**
- Social Equity
- Accessibility
- Walkability
- Mental Physical Health

**Education & Lifestyle**
- Education
- Lifestyle
- Improve Living & Working Conditions
- Accessibility
- Walkability
- Mental Physical Health

**Endangered species**
- Aesthetics
- Appealing to the Senses
- Attraction

**Civic**
- Civic Space
- Walkability
- Mental Physical Health

**Material**
- Material
- Energy

**Geographic**
- Climate & Radiation
- Regulating
- Cultural

**Physical**
- Physical
- Mental
- Health

**Recreation**
- Recreation
- Planting pallet
- Habitat
- Provision
- Climate & Radiation
- Regulating
- Cultural
- Appealing to the Senses
- Attraction

**Psycho-social**
- Social Equity
- Accessibility
- Walkability
- Mental Physical Health
- Civic Space

**Economic**
- Economic
- Partnerships
- Growth and savings

**Psychological**
- Social Equity
- Accessibility
- Walkability
- Mental Physical Health

**Ecosystem Services**
- Waste Decomposition
- Air & Water Purification
- Ecosystem Services
- Habitat
- Endangered species
- Soil & Nutrient Cycling
- Rivers
- Groundwater
- Lakes
- Oceans

**Social Impact**
- Improve Living & Working Conditions
- Accessibility
- Walkability
- Mental Physical Health

**Economic Impact**
- Economic
- Partnerships
- Growth and savings

**Mental Health**
- Social Equity
- Accessibility
- Walkability

**Physical Health**
- Social Equity
- Accessibility
- Walkability

**Ecosystems**
- Waste Decomposition
- Air & Water Purification
- Ecosystem Services
- Habitat
- Endangered species
- Soil & Nutrient Cycling
- Rivers
- Groundwater
- Lakes
- Oceans

**Social Capital**
- Education
- Lifestyle
- Improve Living & Working Conditions
- Accessibility
- Walkability
- Mental Physical Health

**Economic Government & PPP**
- Increase Property Value
- Partnerships
- Growth and savings
- Employment
- Social Capital

**Material & Energy**
- Material
- Energy

**Access to**
- Aesthetics
- Appealing to the Senses
- Attraction

**Climate & Radiation**
- Climate & Radiation
- Regulating
- Cultural

**Education**
- Education
- Lifestyle

**Lifestyle**
- Education
- Lifestyle

**Senses**
- Aesthetics
- Appealing to the Senses
- Attraction

**Regulating**
- Climate & Radiation
- Regulating
- Cultural

**Seismic**
- Climate & Radiation
- Regulating
- Cultural

**Economic Impact**
- Economic
- Partnerships
- Growth and savings

**Environmental**
- Climate & Radiation
- Regulating
- Cultural
Transdisciplinary, allows for formulation of problems into different context and learn to see in new ways. There is coordination across all levels and usually with engagement of society and stakeholders. Reciprocal interdependence
Coordination based on integrated input/output. Development based on shared values and goals and uncertainty and reorientation.
A healthy downtown Phoenix core is what is essential to the growth and health of the surrounding municipalities.
Wastewater Use

- **Phoenix Sky Harbor Airport**: 1,200 gallons per day
  - Peak flow greater for events

- **Desert Botanical Garden**: 5,000 gallons per day
  - Approximate based on 2,000 visitors per day

- **Phoenix Zoo**: 150,000 gallons per day
  - Approximate
  - Peak flow greater for events

- **Burton Barr Library**: Approximate
  - Approximate based on 110,820 passengers per day

- **Downtown Phoenix**: 554,094 gallons per day
  - Approximate

North
Urban Wetlands providing Ecosystem Services

The Climate of Phoenix

To Improve the quality of living in the urban city

While providing Non Rainwater and Rainwater supply solutions
For the vibrant landscapes, cooling micro-climates, walkability in the urban city

Current Issues
Drought
Stressed Groundwater Resources
Population Growth
Heat and Heat Island
Lack of aesthetics in the urban downtown
Downtown city one square mile comparison

Phoenix, Arizona

Atlanta, Georgia

Philadelphia, Pennsylvania

Los Angeles, California

0 1 mile 5 miles
Green Spaces

- ASU Phoenix Campus
- Civic Space Park
- City Hall Plazas
- Library Park
- Cityscape
- Japanese Friendship Garden
- Burton Barr Library
- Margaret T. Hance Park
- Arizona Center
- Catholic Arch Diocese
- Heritage Square
- Convention Center
- Police Headquarters
- Margaret T. Hance Park

North
Catholic Arch Diocese
This is the process of defining what are the elements of landscape design which contribute to the ecosystem services in the quadrupal bottom line and begins to look at placing an importance or priority on them base on the site specific conditions and use.

<table>
<thead>
<tr>
<th>Techniques</th>
<th>Micro Climate</th>
<th>Water Management</th>
<th>Air Quality</th>
<th>Physical Health</th>
<th>Mental Health</th>
<th>Energy Consumption</th>
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<tbody>
<tr>
<td>Trees &amp; sidewalk planting, ground cover</td>
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<td>Seat walls &amp; Raised planters Site furniture</td>
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<td>Vertical and horizontal vine systems for shade</td>
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<td>Constructed Wetland</td>
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<td>Rainwater Harvesting</td>
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<td>Pollinator Plants</td>
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<td>Pocket Park</td>
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<td>Soil health, moisture</td>
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<td>Water Feature</td>
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<td>Shade Structure</td>
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</tbody>
</table>
City Hall Plaza
Site
100 cubic foot = 748 gallons

Gallons per day:
- 20 gallons
- 40 gallons
- 748 gallons
- 748 gallons
- 5,000 gallons
- 8,200 gallons
- 140,000 approximate gallons
- 280,000 approximate gallons
First life, then spaces, then buildings
The other way around never works.

Jan Gehl
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| Project Assessment |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-------------------|-----------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Campus            | Tempe Manzanita Hall |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Project Status    | Design Development/Completion |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Date              | 11-Apr-14 |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Form              | Returns   |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |

| Academic/Economic |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Budget Maximization |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Student Growth    |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Research Growth   |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Tourism           |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Operations and Maintenance Considerations |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Innovation        |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Regenerative      |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Reuse             |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Recyclable        |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Deconstruction    |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Added Green Space |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Stormwater Management |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Proper Site Design |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Reflect Heat and Glare |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Heat Island Mitigation |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Embodied Energy   |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Life Cycle Parameters |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Public Access and Use |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Place Making Components |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Community Engagement |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Area Vitalization |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Safe for Students and Staff |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Fluidity of Interaction and Movement |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Iconic in Place   |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Timeless Qualities |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Human Scale as Needed |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Visual Amenity for the campus |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Operations and Maintenance Considerations |           |           |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |

| University        | 5  | 5  | 1  | 3  | 4  | 4  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Campus            | 5  | 5  | 5  | 5  | 4  | 4  | 5  | 4  | 3  | 3  | 4  | 3  | 5  | 4  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  |
| School/ College   | 3  | 1  | 3  | 3  | 5  | 5  | 5  | 4  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Site              | 4  | 4  | 5  | 3  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| Total             | 37 |     |     |     |     |     | 82 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 95  |