## Analysis 1

LEED® Point Alignment Depth Study

**Problem**

Despite the initial goal and investment for certain level of LEED® certification, it is very difficult to maintain that level and achieve each point throughout the construction process. As the construction progressed, the Columbia Heights Community Center project team identified a few points that may not be feasible for this type of project, thus placing it into the category of the buildings mentioned above. Aligning the owner's goals with corresponding LEED® points can result in a better quality building for its intended use and a more structured approach towards maintaining and obtaining the initial LEED® certification level.

**Goal**

The main goal of the proposed research would be to identify LEED® points that are associated with the owner's initial goals for the construction, function, operation, and maintenance of their building. With this knowledge, an interactive tool can be produced to identify the most achievable and functional points based on the input of the owner's goals. For example, the goal of the building being accessible to the community can be linked with the set of points that cover "Alternate Transportation".

**Methodology**

1. Literature review to become familiar with the different LEED® points.
2. Develop a list of interview questions to determine the owner's goals.
3. Identify and interview 10 different owners on 10 different LEED® Rated projects.
4. Compare the owner's goals with the LEED® points that were achieved on that project.
5. Compile the results and generate a specific set of goals. These goals, when targeted by the owner, will produce a set of potential LEED® points.
6. Assemble an interactive program that can be used for the purpose mentioned above.

**Tools**

1. U.S. Green Building Council (USGBC) website (www.usgbc.org)
2. LEED® Green Building Rating System for New Construction and Major Renovations (LEED®-NC) Version 2.1
3. Microsoft Excel

**Outcome**

As stated before, once a list of interviewing questions was assembled (refer to *Appendix C* for the *LEED® Interview Questionnaire*), research was conducted on the USGBC website for projects that varied in location, building type, and level of LEED® certification achieved. Once contacts were made and interviews were carried out, the results were tabulated and an Excel® file was generated to help identify potential LEED® points. Upon analyzing the interview answers, several goals seemed to be common among all owners. Also, when viewing the projects' LEED® points list, there were several "popular" points that were pursued by multiple projects. These common goals and popular points aided in the assembly of the Excel® spreadsheet. For more detail on project selection, common goals, common points, and Excel® spreadsheet assembly, please see the following sections with those titles.

**Project Selection**

All projects were selected upon availability of information from an online database of New Construction and Major Renovations (LEED®-NC) Version 2.1 projects. See "*Table 1 – Project Directory*" on the following page for project names, locations, sizes, and primary contacts. The projects that were selected included four LEED® Certified, three LEED® Silver, two LEED® Gold, and one LEED® Platinum certification level. On this project list were government buildings, educational facilities, mixed-use buildings, a health center, and a municipal building. Of these buildings, 3 out of 10 were to be leased.

As mentioned on the previous page, some of Columbia Heights Community Center's LEED® points were identified to be difficult to achieve. A possible cause for this was that the design thus far was not able to support the points that were set for this project, such as an "Innovation in Design" credit. This project was included in the project contact list so that it could be lined up against the results from other facilities. Even if this does not immediately solve the problem of missing LEED® points, it will provide an excellent tool to show what could have been done differently, or what other points could have been pursued.

## Table 1 - Project Directory

**LEED® NC 2.0, 2.1**

| | Project | LEED® Certification Level | Size (Sq. Ft.) | Approximate Construction Cost | Project Address | Owner |
|---|---|---|---|---|---|---|
| 1 | Columbia Heights Community Center | Silver | 47,395 | $9.8 Million | Washington, DC | DC Department of Parks and Recreation |
| 2 | Carl T. Curtis - National Park Service | Gold | 68,000 | $8.5 Million | Omaha, Nebraska | National Park Service |
| 3 | Artists for Humanity EpiCenter | Platinum | 23,500 | $4.9 Million | Boston, MA | Artists for Humanity, Inc. |
| 4 | Baca/Dlo'ay azhi Community School | Certified | 78,900 | $10.4 Million | Prewitt, NM | Bureau of Indian Affairs |
| 5 | Pennsylvania Department of Environmental Protection's Cambria Office | Gold | 36,000 | $3.2 Million | Ebensburg, PA | Department of Environmental Protection |
| 6 | Seattle Justice Center | Silver | 288,000 | $91.3 Million | Seattle, WA | City of Seattle, Facilities Services Division, ESD |
| 7 | Clackamas High School | Silver | 265,000 | $31 Million | Clackamas, OR | Clackamas School District |
| 8 | Heimbold Visual Arts Center | Certified | 60,000 | $25 Million | Bronxville, New York | Sarah Lawrence College |
| 9 | Social Security Administration Child Care Center | Silver | 31,900 | $5.1 Million | Baltimore, MD | Social Security Administration |
| 10 | Patrick H. Dollard Health Center | Certified | 28,300 | $6 Million | Harris, NY | The Center For Discovery |

**Common Goals**

By the time of the completion of the interviews, several goals were noticed to be common among most of the projects. Many of the goals depended on the occupants (and their tasks) of the building, if they owner was occupying or leasing, and what area the building was in.

Of the many existing types of building occupants, 7 out of 10 of the projects had either an office or administrative worker using their building. The main goal that was given from these owners was a healthy indoor environment for their workers. Despite that all 10 of the projects listed this as their goal, the 7 projects mentioned above made this one a top priority. In the majority of buildings, the cost of salaries far outweighs that of maintenance and construction. The productivity of the worker is important to an owner, and worker health directly impacts this. Maintaining a healthy indoor environment will prevent any negative health effects (such as "Sick Building Syndrome"), any liability, and even future maintenance. Also, research has been conducted and it was found that several million dollars are lost each year due to loss of worker productivity from a poor indoor environment[1].

Another goal that was common among the projects was lowering operation and maintenance costs. It was particularly stressed on the projects where the owner was to occupy the building. This was to be expected since the owner would be responsible for all utility and maintenance costs. The majority of the owners counted on the long term savings from these lower costs to maximize their return on investment. Even though several of the leased projects listed this as a goal, one pointed out that the utility savings would be seen from a lower rental rate.

Only 4 out of 10 owners identified themselves as being in an urban setting. This would generally mean a higher occupancy rate and a stronger need for community accessibility. Being in an urban setting greatly impacts the number of parking spaces and the methods for travel to work. Several owners expressed an interest at providing an accessible building to multiple forms of transportation.

[1] Fisk, William J. Health and Productivity Gains from Better Indoor Environments and their Relationship with Building Energy Efficiency. www.usgbc.org . March 15th, 2006.

The last goal that was popular among the owners, despite their project differences, was that of "setting an example" or "being the measuring stick" for future Green facilities. This was evident among owners who were part of an organization that had multiple projects planned for the future. This goal could be loosely tied with the fact that many organizations are now mandating that their facilities have a minimum standard of LEED® certification. Many of the projects that were contacted were either the first or second Green projects built by the organization. It was tough to align LEED® points to this goal, but one subject that was important to the owners in this category was cost. Since these owners wanted to "set an example" for their future mandated Green buildings, they wanted to make the process as economical and efficient as possible. During earlier research, a list of "Low Cost" LEED® points was found, which would benefit this type of owner. "Low Cost" LEED® points will be discussed in the next section "*Common Points*". Ultimately, the goal of a low cost LEED® building could apply for those owners who expressed these "measuring stick" goals.

The goals listed above were those that were identified most frequently by the owners. For a complete list of goals and interview responses, please see "*Table 2 – Project Comparison*" on the following page.

## Table 2 - Project Comparison

LEED® NC 2.0, 2.1

| | | Projects | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Columbia Heights Community Center | Carl T. Curtis - National Park Service | Artists for Humanity EpiCenter | Baca/Dlo'ay azhi Community School | Pennsylvania Department of Environmental Protection's Cambria Office | Seattle Justice Center | Clackamas High School | Heimbold Visual Arts Center | Social Security Administration Child Care Center | Patrick H. Dollard Health Center |
| | | Silver | Gold | Platinum | Certified | Gold | Silver | Silver | Certified | Certified | Certified |
| | Questions | | | | | | | | | | |
| 1 | Intended use of the building? | Community center, mixed recreational use, satellite officers for owner | Office use | Organization activities, afterschool / summer, art display | Elementary education | Office use - headquarters for district mines and abandoned mine wrecks | Police Dept. headquarters, Municipal courts | Educational facility, comprehensive high school | Educational use with visual arts through studios / classrooms | Child care facility for Social Security Administration, small % of community allowed | Clinic, healthcare, outpatient services, disabled, dental, occupational / physical therapy |
| 2 | Occupy or Lease? | Occupy | Lease - 20 years | Occupy | Occupy | Lease - 20 years | Intended 100% occupy, but court rooms are leased out | Occupy | Occupy | Lease | Occupy |
| 3 | Who is using the building? | D.C. Department of Parks and Recreations (owner), community members | National Park Service administration | Artist for Humanity (owner), community organizations, students | Teachers, students, councilors | Department of Environmental Protection staff (leasee) | Police administration, judges, defendants | Teachers, students, administration | Teachers, students, administration | Social Security Administration childcare staff, children | Administration, doctors / professionals |
| 4 | Types of tasks users are performing? | Sports / health related activities, theatrical, educational, administrative | Computer related activities, research, education seminars, document storage | Display gallery for rent for functions, administrative, studio design, tours | Academic, sports related activities (gymnasium), theatrical, reading (library) | Administrative, computer related, document storage | Administrative, computer related, holding cell (detainee's) awaiting trial, judicial acivities | Administrative, academic | Academic, computer related activities, sculpting, artistry | Child care, food preparation, recreation | Therapudic activities, healthcare, wheel chair access, dental work |
| 5 | What type of area is the building in? (urban, suburban, rural, residential, etc.) | Urban / Residential | Urban | Urban / industrial | Rural | Industrial park | Urban - government centers district | Suburban / residential (heavily developed) | Suburban | Suburban / mixed community | Rural |
| 6 | Is operation and maintenance cost important? | Yes | It is to the building owner so rent will be less for tenant | Yes - minimize dependence on purchased energy through heavy use of solar panels | It is required by Federal Law, but still a high priority to minimize energy costs | Yes - lower energy costs result in lower rental rates | Yes | Yes - energy management, large day light use in work spaces | Yes - need long term utility savings | Yes - SSA is given an allowance and must meet those goals | Yes |
| 7 | Was minimizing environmental impact a priority? | Yes | Yes - tenant requested it to be LEED rated | Yes - maximize renewable energy - rain water collection for irregation | Yes - building on existing school site, minimize site impact | Yes - boost local economy through local materials, redevelop brownfiel site | Yes - rebuild on existing site, minimize impact to community, reduce traffic / parking spaces | No | Yes - wanted to minimize fossil fuel consumption | Yes - build on existing lot, maintain green space | Yes - remove some existing concrete structures, irregate with rain runoff |
| 8 | Was a healthy indoor environment a priority? | Yes - high occupancy rate - children and administration will be using it - healthy place to work and play | Yes - healthy environment for workers | Yes - natural light and ventilation - better / ceaner environment for users | Yes - healthy indoor learning environment | Yes - improve worker productivity, comfortability, local sensors to monitor air quality | Yes - old building had poor air quality, local control, good filters, health of tenants | Yes - minimize HVAC runtime, use natural ventilation, induced convection, healthy air | Yes - some art supplies contain V.O.C.'s - want to maintain healthy environment by removing the pollutants | Yes - healthy environment for occupants, high visibility | Yes - occupants have compromised immune systems - health a priority |
| 9 | Is there green space on your property? | Yes - on the roof and in the park on the propoerty | Yes - use of native plants without irregation | Yes - courtyard (minimum irregation) | Yes - use of natural landscape / plants | Yes - did not remove trees, graveled parking lot for run off | Yes - green roof, plaza at street level | Yes - sports fields, use natural landscape, minimize irregation | Yes - sunk into an existing hill, greenscape on roof | Yes | No |
| 10 | When is this building used (day, night, or both)? | Day, sometimes night | Both, but mainly during standard business hours | Day, night use not common | School during day, community use at night | Day | Day, some evening | Day, some night activities (sports / theater) | Both | Day | Day |
| 11 | Are there any other reasons for obtaining LEED certification? | Improve the neighborhood while minimizing impacts to the site / community, accessibile to community | Have a positive impact on local economy (local materials), teaching tool for community to demonstrate LEED | Set an example, good marketing / advertising, helped to raise money for construction (budget), minimize impact to community through building materials reuse | Standardization of the school district, Federal order accessible to community since in rural setting | Want to be environmental leader, provide a "measuring stick" for Green failities, minimize cost / s.f. | Conserve resources (sun access), future solar collectors to be added, high visibility using daylight, provide a model for sustainability, example for community | Set an example for community, good advertising, public relations | Donation was made so that LEED could be pursued | Set example for future Silver LEED rated buildings, level of LEED a function of maintaining low square foot costs | Improve health of clients, zero combustion building (no V.O.C.'s), advertising for patients and fundraising |

**Common Points**

A list of the LEED® points achieved, or to be achieved, by each project was found on the USGBC website. This was an extremely good aid in the process of matching up LEED® points to owners' goals. Immediately, several points were seen to be achieved on at least 90% of the projects. These included *Site Selection, Optimize Energy Performance (20% New / 10% Existing), Recycled Content (Specify 5%), Local/Regional Materials (20% Harvested Local), Low Emitting Materials (Adhesives and Sealants), Low Emitting Materials (Carpet), Innovation in Design,* and *LEED® Accredited Professional.*

As mentioned in the previous section, during preliminary research and literature reviews, a list of "low cost" LEED® points was found. This list was based off of research conducted by Hernando Miranda (Soltierra LLC) that was published under the name "Achieving Low Cost LEED® Projects" in the April 2005 issue of *HPAC Engineering Magazine*. Here, he surveyed 128 projects for which LEED® points they achieved. This research yielded 26 points that were most often earned because they were "among the least expensive and/or least difficult to obtain".

When comparing this list to the project list of LEED® points, several things were noted. First, all of the LEED® points mentioned above in this section were among the 26 points on the Low Cost list, which supports Miranda's research. Second, roughly 80% of the projects incorporated these 26 points into their certification. Surprisingly, the points that were on this list that were not as common among the projects were *Thermal Comfort (Comply with ASHRAE 55-1992), Daylight and Views (Views for 90% of Spaces),* and *Construction Waste Management.* This could be due to the extra cost associated with these points. Lastly, there were two projects that were seen to deviate from this list the most: The Patrick H. Dollard Health Center (17 out of the 26) and the Baca/Dlo'ay azhi Community School (18 out of the 26). Reasons for this were not immediately clear, but these two projects had two things in common:

1. They were not projects where the organization mandated they go Green.
2. From the interview process, they seemed to have the goal of obtaining points that were functional to their building.

Looking at these reasons, it could be said that if a project must be built Green as part of a statute or organizational mandate, the best option would be to first pursue the 26 points on the "Low Cost" list.

In all, the average amount of points achieved for the ten projects was 34.6, which would obtain a Silver rating. For a list of all the projects and their LEED® points achieved, please see "*Table 3 - LEED® Point Comparison*" on the following page.

**Excel® Spreadsheet Assembly**

In order to form the Excel® spreadsheet, the goals and LEED® points were matched up using the previous tables in this section, as well as knowledge obtained from reading the LEED® Green Building Rating System for New Construction and Major Renovations (LEED®-NC) Version 2.1 Handbook, which can be found on the USGBC website under publications. The final Excel® product containing the LEED® points was a result of a modification of an existing file, created by Mike Pulaski for his Ph.D. dissertation in 2005, which allows the user to weight certain factors. In this case, it is goals for LEED®.

Based on the responses from the owners, seven prime goals were identified and inserted into the Excel® file. They include:

1. Construction Cost
2. Minimize Impact to the Community
3. Operation / Maintenance Cost
4. Health of Occupants
5. Occupant Productivity
6. Accessible to the Community
7. Minimize Negative Environmental Impacts

Each of these goals is then defined on the other sheet, with the tab marked "Definitions". Along with the definitions are the corresponding LEED® points for each goal.

Using this program is fairly simple. On the "Weights" page, one is asked to enter a series of zeros and ones in a matrix depending on which goal they value more. Upon entering this information, the spreadsheet will calculate a weights percentage that shows which goal they ultimately hold above others. With this knowledge, they are to reference the "Definitions" page and the list of LEED® points for their goals. A detailed list of directions and an example is provided on the three pages following *Table 3*.

The main caveat with this program is that it is intended to be used as a tool for determining *potential* LEED® points for a project during the early planning phases. The *actual* LEED® points that are to be pursued should ultimately be determined by the project planning team, and not solely by this tool, as there are many more LEED® points that are not mentioned within this spreadsheet.

## Table 3 - LEED® Point Comparison

| | | Projects | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | LEED™ Points Most Often Earned* | Columbia Heights Community Center | Carl T. Curtis - National Park Service | Artists for Humanity EpiCenter | Baca/Dlo'ay azhi Community School | Pennsylvania Department of Environmental Protection's Cambria Office | Seattle Justice Center | Clackamas High School | Heimbold Visual Arts Center | Social Security Administration Child Care Center | Patrick H. Dollard Health Center |
| | **LEED-NC Version 2.1 Points** | Certified | TBD | Gold | Platinum | Certified | Gold | Silver | Silver | Certified | Certified | Certified |
| | **Sustainable Sites** | | | | | | | | | | | |
| Credit 1 | **Site Selection** | X | X | X | X | X | | X | X | X | X | X |
| Credit 2 | **Development Density** | | | | X | | | X | | | | |
| Credit 3 | **Brownfield Redevelopment** | | | X | X | | | | | | | |
| Credit 4.1 | **Alternative Transportation**, Public Transportation Access | X | X | | X | | X | X | X | | X | |
| Credit 4.2 | **Alternative Transportation**, Bicycle Storage & Changing Rooms | X | X | X | X | X | X | X | | | | X |
| Credit 4.3 | **Alternative Transportation**, Alternative Fuel Vehicles | | | | | X | X | X | | | | |
| Credit 4.4 | **Alternative Transportation**, Parking Capacity and Carpooling | X | X | X | X | X | | X | | X | | X |
| Credit 5.1 | **Reduced Site Disturbance**, Protect or Restore Open Space | | X | | | X | | | | | X | X |
| Credit 5.2 | **Reduced Site Disturbance**, Development Footprint | X | X | X | | X | X | | X | | X | X |
| Credit 6.1 | **Stormwater Management**, Rate and Quantity | | | | | X | X | | | | X | X |
| Credit 6.2 | **Stormwater Management**, Treatment | | X | X | X | | | X | X | | | |
| Credit 7.1 | **Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof | X | X | X | X | X | | X | X | X | | X |
| Credit 7.2 | **Landscape & Exterior Design to Reduce Heat Islands**, Roof | | X | X | X | | X | X | | | | |
| Credit 8 | **Light Pollution Reduction** | | X | | X | | | | X | X | X | |
| | **Water Efficiency** | | | | | | | | | | | |
| Credit 1.1 | **Water Efficient Landscaping**, Reduce by 50% | X | | X | X | X | X | X | | X | X | X |
| Credit 1.2 | **Water Efficient Landscaping**, No Potable Use or No Irrigation | X | | X | X | X | X | X | | X | X | X |
| Credit 2 | **Innovative Wastewater Technologies** | | | | | | | | | | | |
| Credit 3.1 | **Water Use Reduction**, 20% Reduction | X | | X | X | X | X | | X | X | | |
| Credit 3.2 | **Water Use Reduction**, 30% Reduction | | | X | X | X | X | | | | | |
| | **Energy & Atmosphere** | | | | | | | | | | | |
| Credit 1 | **Optimize Energy Performance** 20% New / 10% Existing (2) | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX |
| | **Optimize Energy Performance** 30% New / 20% Existing (2) | | X | X | XX | | XX | XX | XX | XX | XX | |
| | **Optimize Energy Performance** 40% New / 30% Existing (2) | | | | XX | | XX | X | XX | | X | |
| | **Optimize Energy Performance** 50% New / 40% Existing (2) | | | | XX | | XX | | XX | | | |
| | **Optimize Energy Performance** 60% New / 50% Existing (2) | | | | XX | | XX | | | | | |
| Credit 2.1 | **Renewable Energy**, 5% | | | | X | | X | | | | | |
| Credit 2.2 | **Renewable Energy**, 10% | | | | X | | X | | | | | |
| Credit 2.3 | **Renewable Energy**, 20% | | | | X | | X | | | | | |
| Credit 3 | **Additional Commissioning** | | | X | X | | | X | | X | | X |
| Credit 4 | **Ozone Depletion** | | X | | X | | | | | | | |
| Credit 5 | **Measurement & Verification** | | | X | X | | | X | X | | | |
| Credit 6 | **Green Power** | | | X | X | X | X | | X | | | X |
| | **Materials & Resources** | | | | | | | | | | | |
| Credit 1.1 | **Building Reuse**, Maintain 75% of Existing Shell | | | | | | | | | | | |
| Credit 1.2 | **Building Reuse**, Maintain 100% of Shell | | | | | | | | | | | |
| Credit 1.3 | **Building Reuse**, Maintain 100% Shell & 50% Non-Shell | | | | | | | | | | | |
| Credit 2.1 | **Construction Waste Management**, Divert 50% | X | | X | X | | | X | X | X | X | X |
| Credit 2.2 | **Construction Waste Management**, Divert 75% | | | | X | | | X | X | X | X | |
| Credit 3.1 | **Resource Reuse**, Specify 5% | | | | | | X | | | | | X |
| Credit 3.2 | **Resource Reuse**, Specify 10% | | | | | | | | | | | |
| Credit 4.1 | **Recycled Content**, Specify 5% (post-consumer + ½ post-industrial) | X | X | X | X | X | X | X | X | X | X | |
| Credit 4.2 | **Recycled Content**, Specify 10% (post-consumer + ½ post-industrial) | X | X | X | X | | X | | X | X | X | |
| Credit 5.1 | **Local/Regional Materials**, 20% Manufactured Locally | X | X | X | | X | X | X | X | X | X | X |
| Credit 5.2 | **Local/Regional Materials**, of 20% Above, 50% Harvested Locally | X | X | X | | | | | X | X | X | |
| Credit 6 | **Rapidly Renewable Materials** | | | | | | X | | | | | |
| Credit 7 | **Certified Wood** | | X | X | X | | | | | X | | |
| | **Indoor Environmental Quality** | | | | | | | | | | | |
| Credit 1 | **Carbon Dioxide** ($CO_2$ ) **Monitoring** | | X | X | | | X | X | | | | |
| Credit 2 | **Ventilation Effectiveness** | | | X | | | | | | | | X |
| Credit 3.1 | **Construction IAQ Management Plan**, During Construction | X | X | X | X | X | X | X | | X | | |
| Credit 3.2 | **Construction IAQ Management Plan**, Before Occupancy | X | X | | X | X | | X | | X | X | |
| Credit 4.1 | **Low-Emitting Materials**, Adhesives & Sealants | X | X | X | X | | X | X | X | X | X | X |
| Credit 4.2 | **Low-Emitting Materials**, Paints | X | X | X | X | | X | X | | X | | X |
| Credit 4.3 | **Low-Emitting Materials**, Carpet | X | X | X | X | | X | X | X | X | X | X |
| Credit 4.4 | **Low-Emitting Materials**, Composite Wood & Agrifiber | | X | | X | | X | | | X | | X |
| Credit 5 | **Indoor Chemical & Pollutant Source Control** | X | | X | X | X | X | X | | X | X | |
| Credit 6.1 | **Controllability of Systems**, Perimeter | | | | X | | X | | | | | X |
| Credit 6.2 | **Controllability of Systems**, Non-Perimeter | | | | X | X | X | | | | | X |
| Credit 7.1 | **Thermal Comfort**, Comply with ASHRAE 55-1992 | X | | X | X | | X | | X | | X | |
| Credit 7.2 | **Thermal Comfort**, Permanent Monitoring System | | | X | | | X | X | | | X | |
| Credit 8.1 | **Daylight & Views**, Daylight 75% of Spaces | | X | X | X | | X | | X | | | |
| Credit 8.2 | **Daylight & Views**, Views for 90% of Spaces | X | X | X | X | | X | | X | | X | |
| | **Innovation & Design Process** | | | | | | | | | | | |
| Credit 1.1 | **Innovation in Design**: Provide Specific Title | | X | X | X | X | X | X | X | X | X | X |
| Credit 1.2 | **Innovation in Design**: Provide Specific Title | | | X | X | X | X | X | X | X | | X |
| Credit 1.3 | **Innovation in Design**: Provide Specific Title | | | X | X | X | | | X | | | X |
| Credit 1.4 | **Innovation in Design**: Provide Specific Title | | | X | X | X | | | X | | | |
| Credit 2 | **LEED™ Accredited Professional** | X | X | X | X | X | X | X | X | X | X | X |
| | **Total:** | 26 | 30 | 40 | 53 | 28 | 45 | 33 | 33 | 29 | 28 | 27 |

* LEED™ Points Most Often Earned obtained from:
Hernando Miranda (Soltierra LLC), "Achieving 'Low Cost' LEED Projects", *HPAC Engineering Magazine,* April 2005.

| Average Points | 34.6 |
|---|---|

| Determining Weight Factors | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Desired Performance Categories** | **Construction Cost** | **Minimize Impact to the Community** | **Operation / Maintenance Cost** | **Health of Occupants** | **Occupant Productivity** | **Accessible to the Community** | **Minimize Negative Environmental Impact** | | **Sum** | **Weight** | |
| Construction Cost | | 1 | 1 | 1 | 1 | 1 | 1 | | 6 | 28.57% | Construction Cost |
| Minimize Impact to the Community | 0 | | 0 | 0 | 0 | 0 | 0 | | 0 | 0.00% | Minimize Impact to the Community |
| Operation / Maintenance Cost | 0 | 1 | | 1 | 1 | 1 | 1 | | 5 | 23.81% | Operation / Maintenance Cost |
| Health of Occupants | 0 | 1 | 0 | | 0 | 0 | 0 | | 1 | 4.76% | Health of Occupants |
| Occupant Productivity | 0 | 1 | 0 | 1 | | 0 | 0 | | 2 | 9.52% | Occupant Productivity |
| Accessible to the Community | 0 | 1 | 0 | 1 | 1 | | 0 | | 3 | 14.29% | Accessible to the Community |
| Minimize Negative Environmental Impacts | 0 | 1 | 0 | 1 | 1 | 1 | | | 4 | 19.05% | Minimize Negative Environmental Impacts |
| | | | | | | | Total | | 21 | 100.00% | |

Instructions:

1. For each cell above the shaded cells, determine if the desired performance category in the left hand column is preferred vs. the category in the upper row.
2. If left hand column category is preferred enter "1"
3. If the upper row category is preferred enter "0"

DO NOT MODIFY SHADED CELLS

4. The inflection will appear on the lower half of the matrix
5. When the upper half of the matrix is complete the summation of each category will be calculated and appropriate weights assigned.
6. The total sum (J:10) should equal 21 and total weight (K:10) should equal 100.00%
7. Upon completion of this spreadsheet, notice which categories are most heavily weighted.
   Refer to the page marked "Definitions" for a description of each item and a list of related points that could be pursued as a result of your preferred categories.

Note: The above example places greatest weighting on "Construction Cost" and "Operation and Maintenance Cost" which is denoted by the 1's across the board for these rows.

** This spreadsheet was constructed to be used as a tool for determining potential LEED® points for a project during the early planning phases. The actual LEED® points that are to be pursued should ultimately be determined by the project planning team, and not solely by this tool, as there are many more LEED® points that are not mentioned within this spreadsheet.*

| Goal Definitions and Related LEED® Points | |
|---|---|
| **Construction Cost** | This category pertains to owners who are under a strict construction budget or who want to obtain low cost LEED® Points. The following points have been determined to be among the least expensive and/or least difficult to attain from a study conducted by Hernando Miranda (Soltierra LLC). This study can bee seen in the article "Achieving 'Low Cost' LEED® Projects", HPAC Engineering Magazine, April 2005. These points were also achieved in over 90% of the projects interviewed for this research. |
| *Related LEED® Points* | |
| | **1.) LEED® Accredited Professional** |
| | **2.) Local/Regional Materials**, 20% Manufactured Locally |
| | **3.) Low-Emitting Materials**, Carpet |
| | **4.) Recycled Content**, Specify 5% (post-consumer + ½ post-industrial) |
| | **5.) Optimize Energy Performance** 20% New / 10% Existing (2) |
| | **6.) Site Selection** |
| | **7.) Low-Emitting Materials**, Adhesives & Sealants |
| | **8.) Alternative Transportation**, Bicycle Storage & Changing Rooms |
| | |
| **Minimize Impact to the Community** | This category pertains to owners who wish to minimize their building's impact to the community. This involves such measures as maintaining the original site layout, the original building appearance (through façade re-use), and reducing the disturbance to neighboring buildings. |
| *Related LEED® Points* | |
| | **1.) Site Selection** |
| | **2.) Reduced Site Disturbance, Protect or Restore Open Space** |
| | **3.) Reduced Site Disturbance, Development Footprint** |
| | **4.) Landscape & Exterior Design to Reduce Heat Islands, Non-Roof** |
| | **5.) Landscape & Exterior Design to Reduce Heat Islands, Roof** |
| | **6.) Light Pollution Reduction** |
| | **7.) Low-Emitting Materials**, Adhesives & Sealants |
| | **8.) Building Reuse**, Maintain 75% of Existing Shell |
| | **9.) Building Reuse**, Maintain 100% of Shell |
| | **10.) Building Reuse**, Maintain 100% Shell & 50% Non-Shell |
| | |
| **Operation / Maintenance Cost** | This category is important to owners who wish to minimize operation and maintenance costs throughout the life of the building. Operation and maintenance costs account for roughly 5-10% of the building's life cycle costs. Minimizing these costs involves lower energy and water consumption as well as possessing efficient HVAC systems. Typically owners who planed on occupying the building held interest in this category. |
| *Related LEED® Points* | |
| | **1.) Water Use Reduction**, 20% Reduction |
| | **2.) Water Use Reduction**, 30% Reduction |
| | **3.) Optimize Energy Performance** 20% New / 10% Existing (2) |
| | **4.) Optimize Energy Performance** 30% New / 20% Existing (2) |
| | **5.) Optimize Energy Performance** 40% New / 30% Existing (2) |
| | **6.) Optimize Energy Performance** 50% New / 40% Existing (2) |
| | **7.) Optimize Energy Performance** 60% New / 50% Existing (2) |
| | **8.) Renewable Energy**, 5% |
| | **9.) Renewable Energy**, 10% |
| | **10.) Renewable Energy**, 20% |
| | **11.) Controllability of Systems**, Perimeter |
| | **12.) Controllability of Systems**, Non-Perimeter |
| | **13.) Thermal Comfort**, Permanent Monitoring System |
| | **14.) Landscape & Exterior Design to Reduce Heat Islands**, Roof |
| | |
| **Health of Occupants** | This category applies to owners who are concerned about the health of the occupants of the building. Typically, this involves minimizing indoor pollutants and maintaining a clean indoor air environment. Owners whose occupants included children, the elderly, and the sick would have this initial goal of a healthy indoor environment. |
| *Related LEED® Points* | |
| | **1.) Additional Commissioning** |
| | **2.) Carbon Dioxide** ($CO_2$) **Monitoring** |
| | **3.) Ventilation Effectiveness** |

| | |
|---|---|
| | |
| | **4.) Construction IAQ Management Plan**, During Construction |
| | **5.) Construction IAQ Management Plan**, Before Occupancy |
| | **6.) Low-Emitting Materials**, Adhesives & Sealants |
| | **7.) Low-Emitting Materials**, Paints |
| | **8.) Low-Emitting Materials**, Carpet |
| | **9.) Low-Emitting Materials**, Composite Wood & Agrifiber |
| | **10.) Indoor Chemical & Pollutant Source Control** |
| | **11.) Controllability of Systems**, Perimeter |
| | **12.) Controllability of Systems**, Non-Perimeter |
| | **13.) Thermal Comfort**, Comply with ASHRAE 55-1992 |
| | **14.) Thermal Comfort**, Permanent Monitoring System |
| | |
| **Occupant Productivity** | This category pertains to owners who are conscience about their personnel costs and productivity throughout the life of the building. According to a study conducted by the National Institute of Standards and Technology (NIST), personnel costs account for roughly 92% of the building's total life cycle costs. Improving occupant productivity through a comfortable indoor environment has been proven to reduce these costs. Typically owners who occupy an office or operate a business are interested in this category. |
| *Related LEED® Points* | |
| | **1.) Indoor Chemical & Pollutant Source Control** |
| | **2.) Controllability of Systems**, Perimeter |
| | **3.) Controllability of Systems**, Non-Perimeter |
| | **4.) Thermal Comfort**, Comply with ASHRAE 55-1992 |
| | **5.) Thermal Comfort**, Permanent Monitoring System |
| | **6.) Daylight & Views**, Daylight 75% of Spaces |
| | **7.) Daylight & Views**, Views for 90% of Spaces |
| | |
| **Accessible to the Community** | This category is of interest to owners who wish to have their building easily accessible from the surrounding community. Owners who expressed interest in this category built projects such as community centers, office buildings, schools, and public buildings. |
| *Related LEED® Points* | |
| | **1.) Development Density** |
| | **2.) Alternative Transportation**, Public Transportation Access |
| | **3.) Alternative Transportation**, Bicycle Storage & Changing Rooms |
| | **4.) Alternative Transportation**, Alternative Fuel Vehicles |
| | **5.) Alternative Transportation**, Parking Capacity and Carpooling |
| | |
| **Minimize Negative Environmental Impacts** | This category involves minimizing negative environmental impacts throughout the construction of a project via reduction of waste, pollution, and disturbances to the building's surroundings. Owners who frequently had this goal for their project included government buildings, park services, and environmental agencies. |
| *Related LEED® Points* | |
| | **1.) Site Selection** |
| | **2.) Brownfield Redevelopment** |
| | **3.) Reduced Site Disturbance**, Protect or Restore Open Space |
| | **4.) Reduced Site Disturbance**, Development Footprint |
| | **5.) Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof |
| | **6.) Landscape & Exterior Design to Reduce Heat Islands**, Roof |
| | **7.) Light Pollution Reduction** |
| | **8.) Green Power** |
| | **9.) Construction Waste Management**, Divert 50% |
| | **10.) Construction Waste Management**, Divert 75% |
| | **11.) Recycled Content**, Specify 5% (post-consumer + ½ post-industrial) |
| | **12.) Recycled Content**, Specify 10% (post-consumer + ½ post-industrial) |
| | **13.) Rapidly Renewable Materials** |
| | |
| | |
| | |

**Conclusions**

LEED® (Leadership in Energy and Environmental Design®) is a rating system that building owners can opt to pursue when constructing a new facility. Constructing a LEED® rated building not only minimizes the environmental impact, it has also been proven to save the owner roughly ten times the initial investment over the life of the building[2].

As mentioned before, despite the initial goal and investment for a certain level of LEED® Certification, the Columbia Heights Community Center is finding it very difficult to maintain that level and achieve each point throughout the construction process. This situation is not uncommon in the building industry. The purpose for this analysis was to combat this issue by providing a tool that could be used during the project planning phase to help identify potential LEED® points. Using this tool upfront will invoke thought and discussion, increasing the amount of planning. This tool was assembled by comparing owners' goals with the LEED® points that they achieved on their project. A total of ten projects were interviewed and analyzed. Their points were also compared to the "Most Achievable" LEED® points to see how many did and did not match. It was found that two projects deviated significantly more than the rest, which could be contributed to the facts that they were not required to go Green, and that they looked to obtain points that would serve a more functional purpose for their projects.

Overall, this was an interesting topic to research. It is a timely issue within the construction industry. It is certain that the information obtained form this analysis can help future LEED® rated projects. Unfortunately, since this tool was just built, it has not yet been tested in a real setting. In order to determine its effectiveness, it would have to be applied to several projects and then upon their completion, its success would have to be analyzed. This study would have to be carried out over a number of years. However, a study like this could ultimately improve this tool, increasing its chance for success and helping projects maintain their level of LEED®.

[2] Hernando Miranda (Soltierra LLC), "Achieving 'Low Cost' LEED Projects", *HPAC Engineering Magazine*, April 2005.